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Final Report: Turtle Creek Park

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Final Report

Turtle Creek Park

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Origins

In August of 2022, The Board of Supervisors of East Buffalo Township (EBT) purchased 78 acres, about the area of a large shopping mall, of partially developed park land from the Lewisburg Christian & Missionary Alliance Church, a local church group in Central Pennsylvania. Turtle Creek Park, named after the stream that runs through it, is located in the southernmost part of Lewisburg, Pennsylvania, on the northeastern corner of Supplee Mill Rd. and Furnace Rd.

The Church had purchased the land in 2018 with the intent of developing the land to create infrastructure that would advance the Church's mission, including new sports facilities and areas of worship; preparation for construction began immediately after the purchase in 2018 (**Appendix A2**). The Church planted rows of crops down the center of the park in attempts to both generate income during the Covid-19 pandemic, and to address the drainage issues that were present through the area in hopes that the agricultural project would help mitigate the irrigation problems that left large swaths of the property waterlogged. However, due to financial constraints, the church group put Turtle Creek Park up for public sale in 2022. This caught the attention of The Board of Supervisors of EBT (Or 'The Township'), who had intentions of acquiring portions of the land since the church group had begun development. With grants from the Charles B. Degenstein Foundation and the Department of Conservation and Natural Resources, EBT was able to purchase the entirety of Turtle Creek Park and is currently looking to revitalize the area.

The intention for the park was for the land to be restored into an open-space, passive-use park for community members. After the purchase, it was clear to The Township that the development that took place in preparation for the proposed infrastructure, including the removal of the dog park, the clearcutting of the meadows and grassland to make room for the agricultural operation, and the lack of trail maintenance, had detracted from the natural aesthetic and usability of the park. The Township wishes to bring back the dog park and make improvements to the area to facilitate this as a place of outdoor recreation, environmental education, and a spot for community within EBT. To achieve these goals, The Township is implementing a multi-year plan that is segmented into distinct phases. Over the course of this semester, they have been amid

Phase One, and they anticipate it will not be complete for a couple of years. Our project was centered around facilitating community engagement in Phase One of the restoration plan and helping the Board of EBT lay the foundation for future revitalization of Turtle Creek.

Our assigned community partner for our ENST411 project was Jim Knight, who sits on EBT's Board of Supervisors. Responsibilities for this board position include "sound fiscal management and to secure the health, safety, and welfare of township residents and guests" ("Board of Supervisors – East Buffalo Township" n.d.). Jim has a long history with the community, first coming to the area to attend Bucknell University, and then staying to work in environmental and energy related fields at Bucknell. Driving this purchase is the fact that East Buffalo Township has the largest municipal park deficit within Union County (County of Union Pennsylvania n.d.). According to The Township's estimates, the current deficit stands at 217 acres, but could increase to over 322 acres by 2040 with projected population growth (**Appendix A2**). Despite much of the township being open-space forests or agricultural land, these areas are privately owned and do not have any trail paths for residents to use (**Figure 1**).

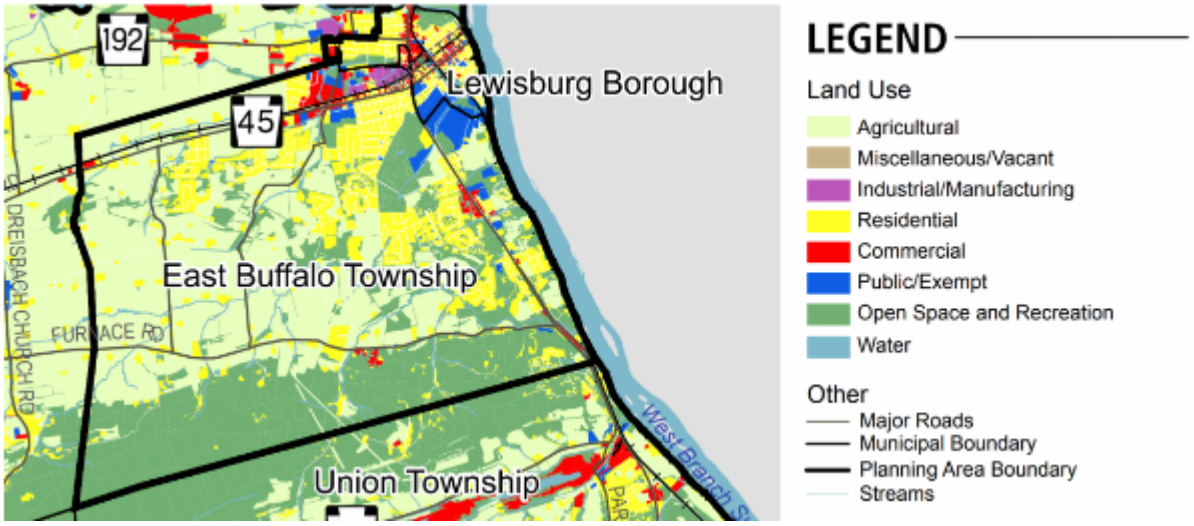

Figure 1 Land use in East Buffalo Township (Union County n.d.).

Furthermore, the dog park within Turtle Creek provided a public place for members of the community to allow themselves to socialize with their pets. However, as it was the only dog park previously within eastern Union County, its destruction removed this option for many residents. A former Eagle Scout in Lewisburg did build a new dog park using the fencing from the Turtle Creek Park in collaboration with Brookpark Pet Supply, but it is along the northern border of the township and under ownership of a privately owned company (East Buffalo Township, n.d.; Krize 2019). Thus, The Township hopes that through revitalizing the park that there will once again be an open-use, public space for residents and their pets to enjoy the outdoors (**Figure 2**). Specifically, The Township has laid out five main benefits they wish to bring to the area: 1) Provide opportunities for recreational activities and accessibility for all ages, 2) Remain available for environmental education and nature studies, 3) Space for groups like the Audubon Society, 4) Local scouting groups to use the land for camping and Eagle Scout projects, and 5) Space for homeschool student groups to use the area as a meeting space (**Appendix A2**).

Figure 2 Turtle Creek Park (Google n.d.).

Goals

Our project primarily focused on revitalizing the trail system throughout the park. With over four years of little attention, many of the trails need maintenance. Furthermore, some of the trails go through riparian wetlands and need infrastructure put in place to allow users access throughout the year. Similarly, the meadow area was used for farmland during the four years it was owned by the church. This destroyed the existing trail system and uprooted most of the grass preventing erosion and helping to irrigate water into the ground, resulting in the now present pools of mud and water after rainfall. As such, we made our primary goal of this project to identify these areas through both precision GPS mapping and field work. Along with tracking drainage issues, we had the goal of creating signage to be added by The Township. Of particular interest to our group is educational signage that can be used to engage and educate the community in the park.

In addition, we decided a goal would be the development of community engagement. This not only allows us to complete more within our timespan, but it helps foster a sense of ownership for the community. As outlined in Researching With by Gullion and Tilton (2020), Chapter 3 discussing the importance of bottom-up as opposed to top-down research, the community involvement allows us to make sure that their needs are being met while the space is being developed. Finally, by getting the community involved with the park, members will be more likely to use the space for themselves and their families, which is the primary goal of The Township. By creating this network of volunteers within the community to not only help build the park but maintain it into the future, the park will continue to sustain itself past our graduation.

Needs

As previously stated, one of the biggest needs of the community is park space. With much of the township being used as farmland or development space, there are few local, large spaces for community members to be surrounded by nature and escape the modern world. With this lack of community outdoor space, The Township then decided that the purchase of Turtle Creek Park would be a positive step towards shortening this deficit. We found through community interactions that having an outdoor community space is critical to many people that live in the area yet is a need unmet. With Turtle Creek Park being in and out of private ownership over the last two decades, the transformation of the park back into usable community space became even more critical.

It was also apparent through research and discussions with members of the community that families do not have a space in which to bring their children to experience the outdoors. As research has shown, nature is a key part of children's growth and offers an experience to promote healthy development and wellbeing (Gill, 2014). The benefits of outdoor experience also pertain to adults. We realized that this park not only offers an outdoor space for enjoyment, but also offers an escape from the bustling world we all live within and can have health benefits as well. Following that, not only does outdoor spaces provide benefits to one's physical health but it is also proven that spending time outdoors in this type of environment provides mental health benefits (Hartig et al., 2011). As such, the need for a defined park space will allow community members to engage this beautiful natural resource and utilize the health benefits such spaces provide.

With The Township, its resources, and our work as a group, we needed to lay the groundwork towards developing a place people will want to visit and explore. To do this, we needed to not only identify the regions that needed to be fixed, but work with the community to make sure our project fits within their needs. Many of these community members have lived in the area for decades and we found it critically important to collect their sentiment and ideas pertaining to the park, its past, and the future plans that are currently in action. This need for community engagement is critical for the future success of the park. Without the community

being on board with the development plans, the park will not be seen as a useful community space that fills a need.

While we will not be able to continue with the project ourselves, The Township has many resources and partners that we are confident will be able to make the necessary changes to create a sustainable, well-maintained park that can be enjoyed by all. With the park being open to the public once more, we are confident that it will quickly become a place for community development and a space for gatherings, with the ability for those who visit to enjoy the beautiful nature Turtle Creek Park has to offer.

Assets

One of the strongest assets of this project is the community itself. From 2008 to 2018, Turtle Creek was available to the public as both a dog park and open-use park land. Therefore, members of the EBT community already recognize the area as a park space for their families and are eager for the space to return to the hands of the public. During one initial conversation with a community member who has been using the space for over eight years, they had mentioned there will be no shortage of community interest to develop the area, something we found aptly true as our project progressed. As such, the interest and willingness to help with the area already existed; it just needed direction. From public meetings, Facebook support, volunteering, or plant tree saplings, we saw examples of how involved and enthusiastic the EBT township community was for the revitalization of this park space.

Furthermore, by working directly with The Township, we were fortunate to gain access to local government resources. Since public interest is highly favorable towards this project, there was a willingness to allocate funds from The Township towards our efforts. Additionally, The Township' appointed engineering firm, HRG, was available for consultation on projects such as drainage remedies to sign post locations. The Township also hired a landscape architect, Brian Auman, that is helping to organize the master plan for the park. The Township regularly hosts public meetings and work sessions to discuss community opinions about various elements and stages of the overall project.

Finally, we had the advantage of being affiliated with Bucknell University. Since the area is a popular destination for courses with outdoor labs in biology and environmental science, professors such as Prof. Matthew McTammany are extremely knowledgeable sources of information about the area's ecology and physical attributes and were readily available over the semester for consultation. Additionally, Bucknell has the physical equipment and required software licenses that has allowed us to not only create a high-quality trail map with the help of Janine Glathar, Bucknell's Digital Pedagogy & Scholarship Specialist for GIS and Spatial Thinking, but to pinpoint problem areas digitally as we walked through the park. With additional help from Professor Rich Crago in the Department of Civil and Environmental Engineering, we were able to create a high precision flow map of the area to determine areas of poor flow quality

not visible from the trail. Overall, we have been able to collect many resources and contact many useful individuals to create the maps, designs, and community engagement that will be crucial for the park's success going forward.

Turtle Creek Watershed

One of our members, Juliette Chandler, has previously completed research on Turtle Creek in the spring of 2022 (Chandler, McDougal, and Bright 2022). As part of her research, she discussed the chemical, physical, and geologic traits of Turtle Creek Park and evidence for its impairment due to agricultural pollution. However, Turtle Creek Park only covers a small proportion of the Turtle Creek Watershed (**Figure 3a)**. This watershed additionally has been undergoing conservation work through the Pennsylvania Department of Environmental Protection (DEP), as it is an impaired streamway (**Figure 3b**) (PA Department of Environmental Protection n.d.). According to the DEP, Turtle Creek is approximately 24 miles long, of which 8.8 miles were impaired, and the surrounding watershed consisted of forestland (45.6%), low intensity development (6.9%), wetland (0.3%), turf/grass (0.1%) and agriculture (47.1%) including croplands and hay/pasture. Additionally, they classified the stream as a Warm Water Fishery and Migratory Fishery (PA Department of Environmental Protection 2013).

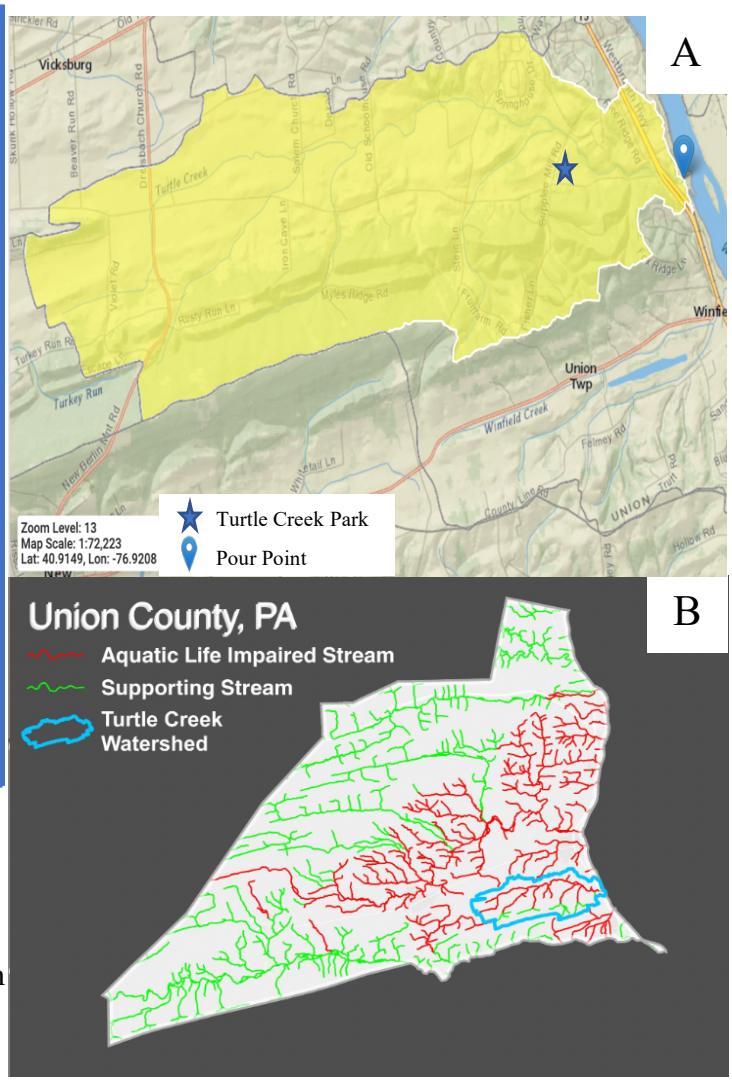

Figure 3 **a)** The Turtle Creek Watershed (USGS n.d.). **b)** Union County impaired streams (PA Department of Environmental Protection 2013).

Precision Conservation (Modified from Glathar, 2023)

The information contained in this section was adapted from an unpublished CENG421 lab in which students were tasked with using precision conservation to identify and prioritize sites needing remediation. This content has been adapted with permission from both Prof. Rich Crago and Janine Glathar.

In 2015, Bucknell faculty Rich Crago, student Elyse Pettaway and Bucknell GIS Specialists Janine Glathar and Luyang Ren collaborated with non-profit agency Chesapeake Conservancy (https://www.chesapeakeconservancy.org/) to analyze a small section of the Buffalo Creek Watershed as part of a pilot project. By combining (1) High Resolution Land Cover/Land Use Analysis, (2) Concentrated Flow Path Mapping, and (3) Normalized Difference Flow Index Mapping (NDFI) (See below for definitions), researchers are able to more accurately predict the nutrient and sediment load that is removed due to run off.

1) High Resolution Land Cover/Land Use Analysis: A combination of multiple imagery types to generate a 6-band image (layer data, see Raster Bands (n.d.) for more information) that is then analyzed to create a 1-meter land cover classification file (water, forest, shrub scrub, etc.).
2) Concentrated Flow Path mapping: By using algorithms developed by Dr. David Tarboton from Utah State University, researchers are able to generate highly accurate models of how water flows and accumulates at a micro-scale across the surface
3) Normalized Difference Flow Index (NDFI): By combining unweighted and weighted flow accumulation models, the likelihood that a pollution load from different flow path channels can be identified and ranked. See the Precision GPS Mapping section in the Methods for a more detailed breakdown of the steps to generate an NDFI.

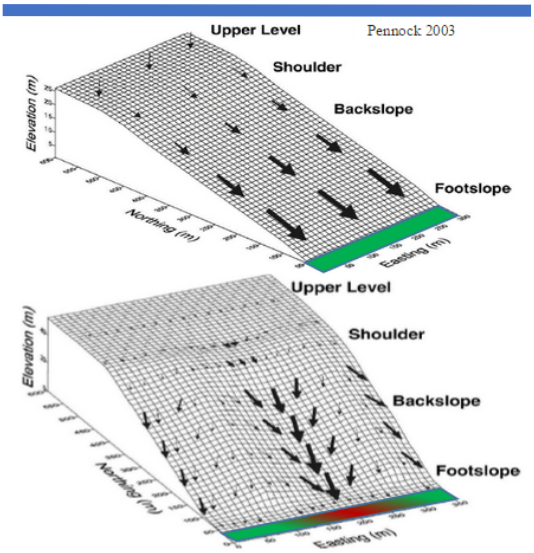

Figure 4 Schematic of surface water flow when algorithms account for land curvature (Pennock 2003).

Stormwater Drainage:

As previously mentioned, of the 12 miles of stream, the DEP estimates that approximately two-thirds are impaired (Inglis 2019). In 2013, the Northcentral Pennsylvania Conservancy (NPC), county conservation districts, non-profit organizations and local landowners began work to repair the farmlands along the stream, thus improving erosion and sedimentation within the stream. While the stream itself will be addressed by the PA Fish and Game Commission due to their expertise and equipment, the rest of the property needs significant drainage remediation.

There are three common types of patterns runoff takes before entering a stream: *(i)* dendritic, *(ii)* trellis, and *(iii)* rectangular. For dendritic drainage *(i)*, water pools into irregular branches that come from various directions at all angles, resembling tree branches (**Error! Reference source not found.**a). With trellis drainage *(ii)*, the water follows a path almost parallel to the stream and enters at a lower angle (**Error! Reference source not found.b**). Finally, rectangular drainage *(iii)* is characterized by 90° bends that do not follow the parallelism of trellis drainage (**Error! Reference source not found.c**). The example Zernitz (1932) includes of trellis drainage is a map from south of Williamsport which is approximately 25 miles north of Turtle Creek, given the proximity, we expect similar drainage in Turtle Creek. However, without

Figure 5 **a)** Dendritic drainage, northwestern part subsequent streams. of Palmyra (Va.) quadrangle. Scale 1:125,000. **b)** Trellis drainage, southern part of Williamsport (Pa.) quadrangle. Scale I: 62,500. ***c)*** Rectangular drainage, southwestern part of Elizabethtown (N.Y.) quadrangle. Scale 1:62,-5oo. (Images from: Zernitz 1932)

further testing and observations, the drainage pattern present cannot be conclusively determined.

To diagnose drainage issues, much of the literature focuses on spaces such as yards and recreational areas. Most experts attribute draining issues to grading or poor soil irrigation (Graham 2022). While The Township will require a more in-depth answer to address the drainage issues, providing a surface understanding of basic diagnostic techniques is useful to engage with experts that will be brought in. To find grade changes and potentially diagnose a grading issue, experts recommend the use of a clinometer or Abney level. Another simple method (the one we ultimately ended up employing) is to simply observe the trails during the wet months to find major problem areas that are in need of renovation (American Trails 2004).

Drainage Remedies

Experts have determined that the best approach to fixing a drainage issue is to avoid disrupting the natural flow of water. Disrupting this natural flow could disrupt the ecosystem and have negative consequences for plant and animal species who live in the area. This includes, but is not limited to: disrupted reproductive cycles, increase in invasive species, and decreased diversity (US EPA 2015). The EPA provides a simple conceptual diagram how changing various

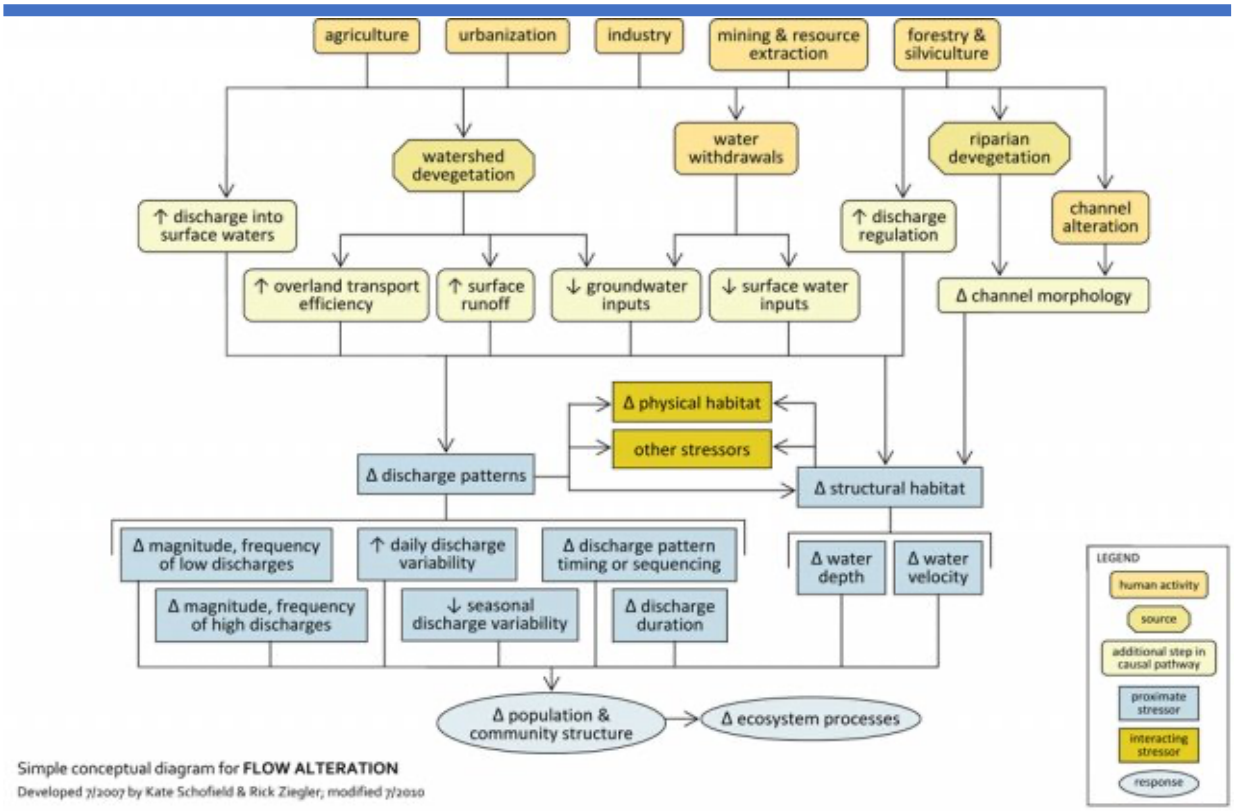

Figure 6 A simple conceptual diagram, depicting pathways from sources to biological responses, for flow alteration (US EPA 2015).

changes can lead to a change in the ecosystem (**Figure 6**). The key to trails by the water is balancing the appeal of being close to the water with the stability of the trails themselves. Being close to water makes the trail more compelling for visitors but threatens the sustainability of the trail.

To fix grading, soil can be moved around to adjust the angle that water runs off. If there is zero grade in an area, water will pool instead of running off (Schmid 2004). Another possible culprit could be soil irrigation, if the soil doesn't absorb the water, it will stagnate in pools on the surface.

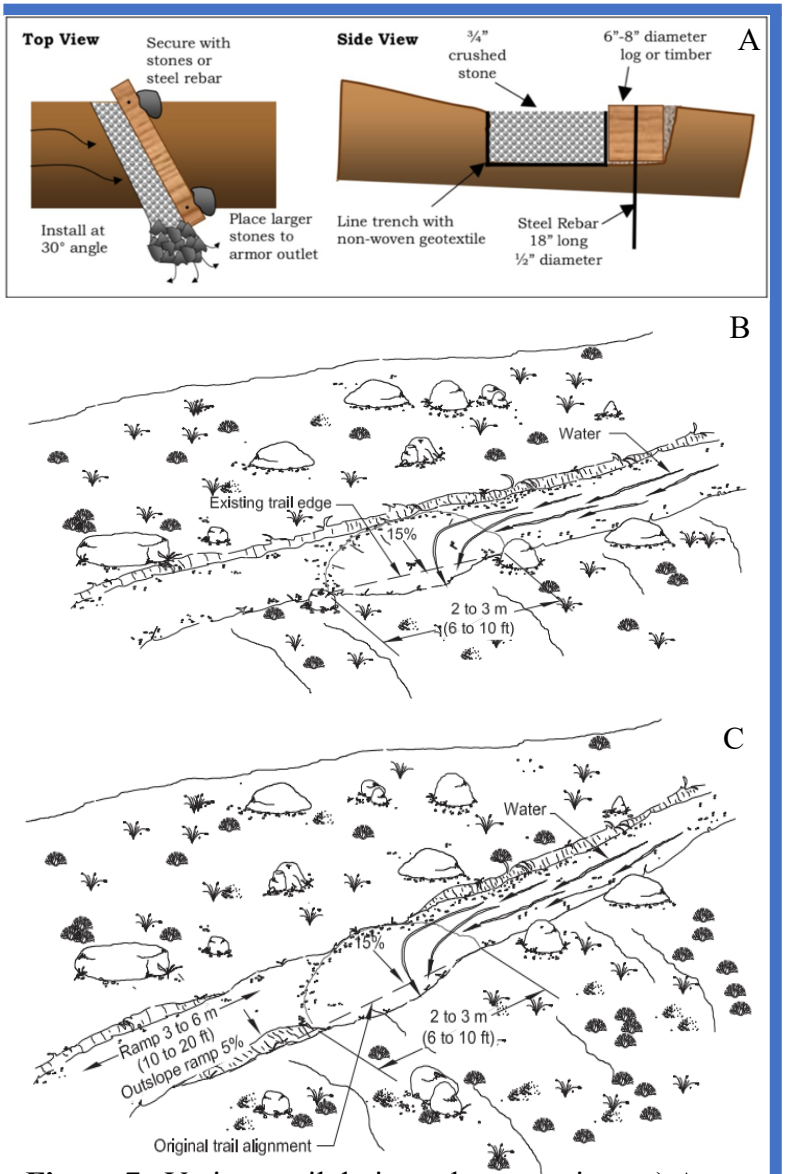

Figure 7 Various trail drainage best practices. **a)** A top and side graphic of installing a waterbar (AWWA 2019). **b)** A diagram of a knick (USDA Forest Service 2007). **c)** A rolling grade dip (USDA Forest Service 2007).

One fix experts suggest for trails with drainage issues is a water bar. This remedy is a pit of rocks that acts as a drain for the trail. To build a water bar, experts say to dig a trench and fill it with gravel or crushed stones. After this, reinforce it with a log or timber and large stones (**Figure 7a**). This method is ideal because rocks and gravel are plentiful and trees that have fallen in the area can be used as materials instead of buying supplies. This is a straightforward and easy drainage method that can be used to divert water flow and prevent accumulation of runoff on trails. The maintenance for this remedy consists of checking on the gravel or crushed rock and ensuring that it

is not eroding or becoming too compact to absorb water, which is ideal for Turtle Creek (AWWA 2019).

Another solution suggested by trail experts is to create knicks (**Figure 7b**). Knicks are out sloped drains that are shaved down in the shape of a semicircle. These drains are cut out of the trail tread to divert water away and prevent pooling (USDA Forest Service 2007). The USDA Forest also suggests a rolling grade dip for steeper areas. Essentially, this method is a knick with a ramp leading up to it (**Figure 7c**). The ramp is provided by the steeper trail and would not require extra materials to change the grading of the tread. (USDA Forest Service 2007).

Due to both the clearcutting that was done by the church and the fact that many of the streams go through riparian wetlands, water consistently pools throughout the park land. This is not only visually unappealing for users of the space, but it is also unsustainable to the health of the park as well. When topsoil is exposed to rain or wind, it is taken away from the area and can cause much ecological harm (Brown, Kallsz, and Wright 1977; Mulvihill 2021). While most research is focused towards protecting crop spaces, it is still important to reduce erosion as much as possible within any trail system. To address this, research has suggested multiple potential design factors to reduce erosion.

According to one site, stabilizing slopes, creating natural vegetation buffers, and controlling the volume and velocity of runoff, will help reduce the erosion of an area and enable the trails to be more accessible to increased populations of the community (American Trails 2004). Building off this, while the roads have proper infrastructure to drain, the development ends with a drainage pipe at a high point in the park that has no place for water to travel and exit the park (**Figure 8a**). Additionally, throughout the meadow area, there are some natural channels for waterflow, but some stagnate in the middle of the meadow, or even just short of the creek (**Figure 8b**). To address such an issue, many public spaces have found the use of bioswales to not only address stormwater drainage, but do so in a way that is visually appealing as well (Delaware Riverkeeper Network n.d.). These channels are designed to collect water and allow for perfusion into the ground while also flowing into drainage systems, such as a creek (**Figure 8c)**.

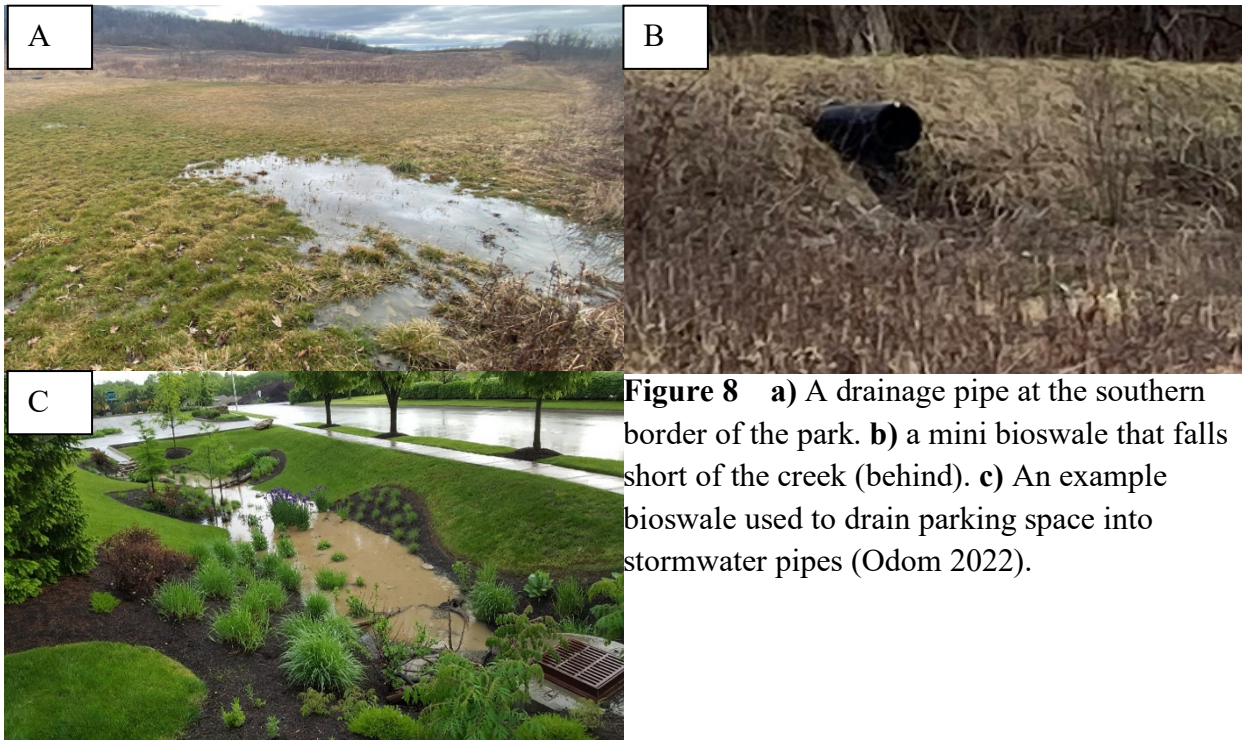

Figure 8 **a)** A drainage pipe at the southern border of the park. **b)** a mini bioswale that falls short of the creek (behind). **c)** An example bioswale used to drain parking space into stormwater pipes (Odom 2022).

Signage Practices

Risk management is a vital aspect of any park, and signage is one of the best ways to protect the park's patrons. Additionally, proper signage wording and placement is one of the most effective ways to communicate safe practices towards park goers. Researchers have found that the more exposure an individual has to persuasive messages encouraging them to maintain the integrity of the park, the more likely the individual was to not partake in activities that might damage the park (Reigner and Lawson 2009). According to international survey data collected in 2000 from the National Association for Interpretation, it was found that prescriptively worded signs (See **Table 1**) are viewed to be more effective at directing visitor behavior (P. L. Winter et al. 2000). Yet when tested in the field, Winter found that injunctive-prospective wording, or negative wording, is more effective at stopping unwanted visitor behavior (J. Winter 2008). This could be due to a variety of factors, the most compelling of which is the potential difference in how people perceive changes in their behavior depending on the wording of signs versus people's observed behavior when interacting with posted signs in the field. Bradford & McIntyre (2007) found that messages that *explain* the impacts of recreation behaviors and enable visitors

to engage introspectively, rather than only discouraging unwanted behavior, to be significantly more effective.

Table 1 Summary of four different message types and example wording.

Message Type	Wording
Injunctive-prescriptive (i.e., desired behavior, positive)	Please stay on the established paths and trails, in order to protect the sequoias and natural vegetation in this park
Injunctive-proscriptive (i.e., desired behavior, negative)	Please don't go off the established paths and trails, in order to protect the sequoias and natural vegetation in this park.
Descriptive-prescriptive (i.e., others' behavior, positive)	The vast majority of past visitors have stayed on the established paths and trails, helping to preserve the natural state of the sequoias and vegetation in this park.
Descriptive-proscriptive (i.e., others' behavior, negative)	Many past visitors have gone off the established paths and trails, changing the natural state of the sequoias and vegetation in this park.

(J. Winter 2008)

Collectively, the best method appears to be using injunctive-prospective signage that explains why visitors should follow the signage to be a great passive way to encourage sustainability within a park system. Additionally, signage is frequently used to elicit responses that benefit the ecosystem in a positive fashion. Whether that be staying on a trail or encouraging trail users to clean up after their pets, such signs benefit and help to maintain the ecosystem. For instance, Reigner and Lawson (2009) found that messages that emphasize the ecological benefits of an area to be the most effective in discouraging unwanted behavior that harms the ecosystem within a park in Hawaii.

There are multiple types of signs that can be designed to display information within a park system (**Table 2**; See **Appendix B** for visual examples as well). In addition to the tips outlined in **Table 2** there are a variety of resources offering how best to design educational signage. One of the best practices is the use of a wayside sign (National Park Servies n.d.). Here, the sign is placed on the edge of a trail or path to provide extra information about the surrounding area. The low-profile wayside displays are stand alone and are meant to complement the natural environment. The National Park Services further suggests that the attention span for a

wayside is thirty to forty-five seconds, so it is important to keep the information simple and up to twenty words. This also keeps the displays around six by twelve inches and low to the ground. Collectively, these constraints help to engage all visitors with unique aspects of the park, from unique species to ecosystem behaviors.

Table 2 A summary of different potential signage types.

Signage type	Usage and Tips
Park Maps	- Help guide highlight places of interest and enhance the curiosity of park visitors. - Useful maps include the entire park, boundaries, trails, places of interest, and the location of posting ("You are here").
Information/Bulletin Boards	- A space for public message posting. - Tool to better inform visitors about the park's facilities, events, or plans for renovation and management
Educational/Interpretive Signs	- Used to educate and engage visitors with the environment or ecosystem within the park - Typical examples highlight specific fauna, animals, or ecosystem interactions.
Directional Signs	- Placed intermittently (at trail branches for instance) to help park visitors navigate and feel secure.

(Adapted from Operations n.d.)

Reforestation:

Communities increasingly recognize the need for infrastructure that slows down, spreads out, and filters stormwater runoff (Herbohn et al. 2023). Commonly called "green infrastructure," these approaches include rain gardens, street trees, constructed wetlands, wet meadows, permeable pavement, vegetated rooftops, and streamside forests (Chesapeake Bay Foundation, 2023) (See Appendix C for visual references). These artificially created systems mimic natural ones to slow the water flowrate, allowing it to soak into the ground or evaporate into the air

rather than rushing into the waterway (**Error! Reference source not found.**). Additionally, these systems can capture pollutants, such as carbon and nitrogen, by directing it through natural filters to clean the water before entering into the ground or stream (Deletic and Wang 2019). Finally, reforestation creates green spaces for recreation that support pollinator species and other important wildlife (Chesapeake Bay Foundation, 2023).

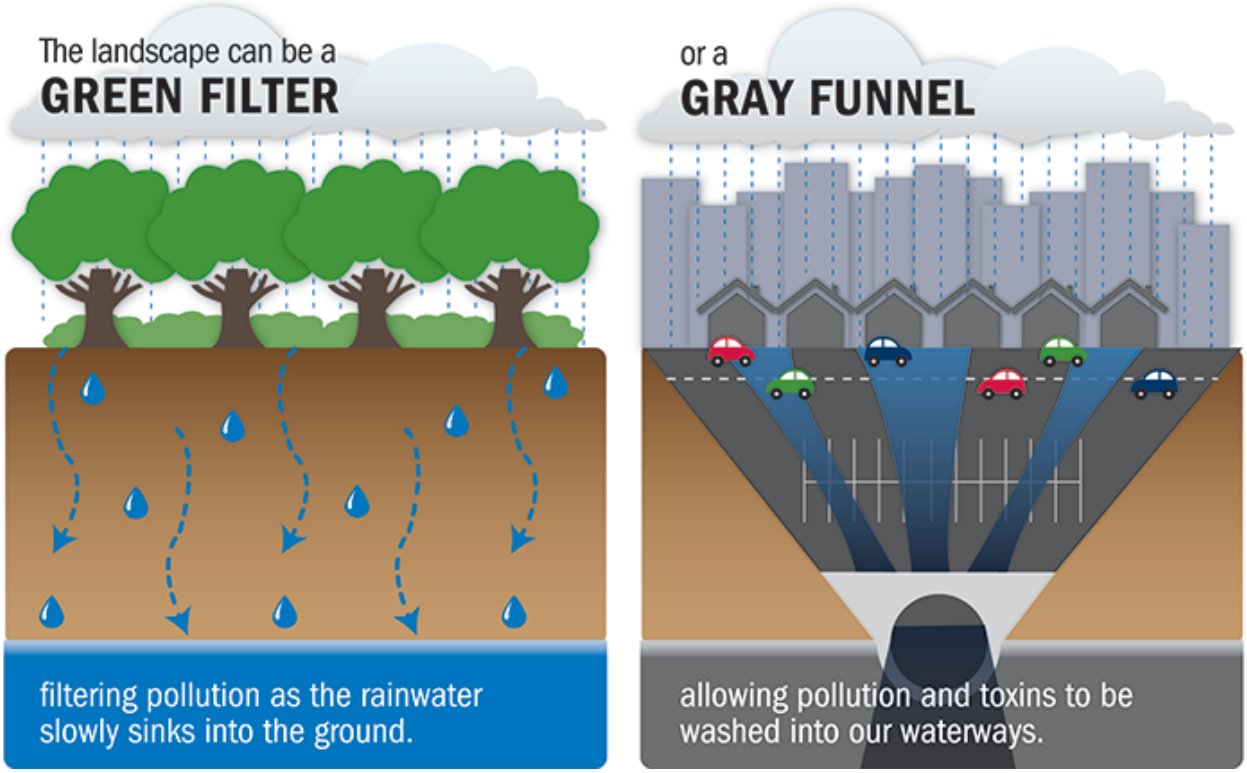

Figure 9 The importance of green filters to filter pollution before entering the waterway (The Chesapeake Bay Foundation, n.d.).

Trail Systems and Management

Since no new trails will be added to the existing system within the area, this project will not have to worry about best practices for designing new trails. Instead, this project will be focusing on how to improve the existing trails to be sustainable within the ecosystem of Turtle Creek Park. To define sustainable, we refer to the National Park Service's definition of a sustainable trail as:

1. Supporting current planned and future uses with minimal impact to the natural systems of the area
2. Causing negligible soil loss or movement while allowing naturally occurring plant systems to inhabit the area
3. Recognizing needed pruning and eventual removal of certain plants over time
4. Not adversely affecting the naturally occurring fauna
5. Accommodating existing and future uses while only allowing appropriate uses
6. Requiring little rerouting and minimal maintenance over extended periods of time

-National Park Service; Rocky Mountain Region, January 1991 (Buerkle, n.d.)

It is therefore our goal that our redesigned trail system meets, or preferably exceeds, these standards. For us, we expect these trails to be general hiking trails used by the community to support hiking, trail-biking, cross-country skiing, snowshoeing, horseback riding, and birdwatching. To accommodate such uses, project groups need to be specific in making sure that whatever measures taken within the area fit these needs of individual groups while not harming the park experience for other groups.

Community Engagement

When community dialogue is brought into the conversation, it ensures that citizens will use the land respectfully and have a recreational area that they *will* care about and respect because of the benefits it provides (Arni and Khairil 2013; Selin et al. 2020). Other sources emphasize the relationships between ecosystems and communities and how the two interact with each other. By recognizing the community as a component in the ecosystem of a conserved area, a more wholistic approach is applied to the park system. Specifically, this approach focuses on how the park will be used instead of just examining the area on a species-by-species basis, ensuring a collaborative mindset of our place in nature through the entire restoration process (Brody 2003).

As such, it is vital that community leaders take input in ways that are truly beneficial and representative of all community members, especially minority community members. When community leaders make unpopular decisions without community input, it creates a lack of trust where community members are not able to respect or trust offered resources and services fully

(Bedford, Clark, and Harrison 2002). Social capital is another dimension to be aware of when determining who within the community is being heard. Those with more social capital often have more influence when it comes to park creation and management (Hewlett and Edwards 2013). By being aware of and addressing this phenomenon, the needs of everyone in the community, not just those with more social gravitas are represented.

Additionally, governmental bodies and community leaders need to be aware of the U.S. history of privatization of parks, and how minorities have been excluded from parks for centuries (More 2005). Unfortunately, there is a tense history of discrimination within outdoor spaces. When parks were first being conceptualized, these spaces were designed by white men to appeal towards white men (Gosalvez 2020). This led to segregation in such spaces, which has left lasting effects to this day. According to Earl Hunter Jr., "A lot of Black people, particularly in the South, we were told the woods are not for you. […] My great-grandmother told us not to go into the woods because of the heinous things that happened there" (Mercer 2022). It is also vital to be aware of the rural, low-income status of many of the community members and how this might affect their ability to participate and contribute in the ways that we can as students. Researchers at UCLA discuss the damage that a lack of community participation and engagement in the creation of public parks can have on an area, especially one that is underprivileged or low-income. In their work, they also help outline ways to reach members of the community who are lower-income and are harder to reach because of working hours (Loukaitou-Sideris and Mukhija 2020). As Turtle Creek shifts from private to public, EBT and researchers should be aware of the consequences of privatization and the impacts that the park still faces from being privatized for the last couple of years.

Diversity, Equity, and Inclusion (DEI)

While having this space is vital to community health and wellbeing, it is likewise vital that the community wants to use the space. Taking from the National Recreation and Park Association (NRPA), Turtle Creek Park should work to be inclusive as well as equitable (Stokke n.d.). To do this, community members need to not only have access to what makes the park space successful (equity), but they need to *feel* that they have access to such opportunities or tools (inclusion). Together, these two results in an environment in which community members

feel they have a space within the park and improve the space through their presence. From the Township's governmental standpoint, this policy also causes the community to feel a sense of ownership over the space, which will increase their participation in maintaining it (National Recreation and Parks Association n.d.). While the NRPA does not explicitly include diversity within their reports (but is indirectly stated and discussed within the report), it is an important point to address within park systems and greater outdoor spaces.

There are a couple of methods that can be used to make park systems accessible for all members. From the NRPA article (n.d.), researchers suggest involving local community leaders and partners to be transparent and deliver on promises. More specifically to Turtle Creek, one of the best practices to enhance DEI is to improve the park's trail system to ensure trails are not only sustainable but that, at a minimum, a trail loop is physically accessible to all people (Department of Conservation and Natural Resources n.d.). While achieving full ADA compliance within the course of this project will be difficult, it is possible to make the first steps towards ensuring any future plans will work towards being as acceptable as possible within the constraints of the park.

It should be noted that while paving a trail loop, something the Township is already implementing at the entrance area of Turtle Creek Park, is one way to improve accessibility within the area, this is not always necessary. According to the Accessibility Guidebook for Outdoor Recreation and Trails (2012), an accessible surface is firm and stable. Putting this into practicality, a firm and stable surface is one in which ruts are not left by "Someone riding a bicycle with narrow tires [or] someone pushing a 3-year-old in a folding stroller with small plastic wheels" (Zeller et al. 2012) As such, Turtle Creek will be accessible to a greater percentage of the community by ensuring the grounds throughout the park are well drained and meet the above standards.[1] This and other considerations are vital for consideration when designing the Turtle Creek trail system to be inclusive for all members of the public.

[1] The Department of Conservation and Natural Resources (n.d.), "Disability Accessible Trails and Parks Guide" (2021), and US Department of Transportation: Federal Highway Administration (n.d.) all provide great resources and breakdowns that can be used for detailed accessibility standards and applications.

Conclusions

At the start of this project, we were not sure exactly which direction we wanted to take our work and so decided our best course of action was to gather information about the watershed itself through previous work from the DEP and other governmental organizations. During this time, we went through our first walk-through of the space. It was here that our focus really took its shape into working with mapping, conservation, and community engagement. With these goals in mind. we began tailoring our literature review to both broaden our understanding and to shape our methods to fit the community.

Due to the level of research previously done by Professor Crago and Janine Glathar, the literature review here was less focused towards how to best utilize ArcGIS for our goals, but to instead understand what each output file told us about the flow of water through Turtle Creek Park. This then allowed us to not only identify additional points of poor drainage and nutrient loss, but to give The Township a guide of places to avoid (areas where there is a high throughput of water) when working to improve Turtle Creek.

While we were not working to directly fix the drainage issues of Turtle Creek Park, we still elected to start looking into the various types of drainage patterns, how these can negatively impact the surrounding environment, and the best practices for remediation. By having the knowledge of what damage was caused, we knew what to look for while walking Turtle Creek Park. Additionally, this research gives The Township the necessary knowledge to make informed decisions about how to address the drainage points we identified.

Finally, the research on accessibility, community engagement, and DEI worked to help us understand both the history of outdoor spaces as a place where not all members feel comfortable interacting with for various reasons. As such, we took extra care when designing our methods to emphasize this space is designed for the community, by the community, to give a sense of belonging and identity to the area. Collectively, all of the sources used has their own unique role in either shaping our methods and providing resources that future projects can expand and integrate into their own project.

Methods

To meet the goals this project is setting out to accomplish, multiple methods were needed to gather the interests and priorities of both our community partner and the community itself. These include but are not limited to: (1) township-led community engagement, (2) student-led community engagement, (3) fieldwork, and (4) precision GPS mapping.

1) Township-Led Community Engagement

The community has demonstrated an interest in the land, and The Township has involved the community throughout this period throughout the purchase of this property. During a work session on August 22, 2022, The Township gathered the community to address any initial concerns or comments about the project before it was purchased. These meeting minutes gave us a variety of initial responses from community members that we have engaged to support or quench potential fears during the development of this project. Furthermore, The Township used SurveyMonkey to survey members of the township (advertised on the township website, ebtwp.org, and a flyer at the park) to gauge resident responses on the importance of recreation, what demographics have previously used the space, what would bring a resident into the park, etc. Finally, The Township hosted another work session on February 27th to present The Township's Phase One for improving the area surrounding the entrance of Turtle Creek Park and to gather feedback from residents about this plan. In the Results Section, we detail our notes and observations from these meetings.

2) Student-Led Community Engagement

In addition to these wide-sweeping forms of community feedback, we wanted to get community engagement directly involved with our phase of the project. The table below depicts who we contacted for support and how they aided us in the progression of our project:

Table 3 Community Partners we contacted during this project.

Contact Name and Affiliation	Reason
Dr. Matthew McTammany, Bucknell Biology Department	Field survey of the land for potential drainage issues and other concerns within the trail system
Garrett Kersetter, Local Landscape architect for Creative Plantscapes	Input on drainage issues in the park, unavailable
Janine Glather, Bucknell Digital Pedagogy and Scholarship Specialist for GIS and Spatial Thinking	ArcGIS mapping assistance
Gavin Davidson, Bucknell Geology Lab Director	Handheld GPS training
Professor Ellen Herman, Bucknell Geology Department	Obtaining GPS materials
Professor Rich Crago, Bucknell Civil Engineering Department	Drainage information and ArcGIS mapping suggestions (particularly concentrated flow maps)
Emeritus Biology Professor Abrahamson	Ecological information
David Hafer, layman forestry expert	Ecological information and species identification (particularly birds)
Jacob Bausinger, Pennsylvania Department of Conservation and Natural Resources (DCNR) forestry representative	Ecological information and species identification (particularly plants)

On April 10th we attended a township meeting to share our progress on the project, collect more contacts for ecological information for the signage and advertise for volunteer days at the park. On April 15-16 and April 22-23, The Township held a volunteering day to plant new tree seedlings and facilitate other clearing and cleanup. We created a flyer to hang up around Bucknell, send to Bucknell organizations, and hand out at the community meeting on April 10th to gather volunteers. We also created a Facebook message with an attached photo to send to the Buffalo Valley Bulletin with the assistance of Prof Andrew Stuhl in order to advertise the park to the public who might not be aware of its availability for use (Figure 10).

Figure 10 The Facebook posted by Prof. Stuhl in the Easy Buffalo Township Bulletin group.

4) **Field Work**

By taking inventory of the space and the problem areas we needed to address, an appropriate park system can be designed. To get a better understanding of this, we have met with experts to understand the basics of drainage and ecosystem management. We attempted to do some GPS mapping using the ArcGIS FieldMaps app and it was not successful, so we decided to switch to Garmin GPS devices to obtain more accurate path data. After a training session with Gavin Davidson, we went back to Turtle Creek on April 13th and collected point and vector data that was then imported into ArcGIS. With this data, we were able to not only map the problem spots that we determined from our field surveys, but to include point positions where park elements exist and where The Township should consider installing different types of signage. By mapping this data digitally, we allow future groups to understand and continue our work with ease.

4) Precision GPS Mapping

As previously mentioned, Professor Crago recommended that we attempt to undergo precision conservation mapping in the area to identify drainage points that cross the trail system but were not identified previously. In order to do so, Janine Glathar worked tirelessly to relearn the methods for this tool to create a concentrated flow map from high resolution land cover data we obtained from the Chesapeake Bay Conservancy's public website. This flow map and a surface raster of the surface type were necessary to create a NDFI layer.

$$NDFI = \frac{(Weighted\ flow\ accumulation\ -\ Unweighted\ flow\ accumlation)}{(Weighted\ flow\ accumulation\ +\ Unweighted\ flow\ accumulation)}$$

Where weighted flow accumulation is the flow of water through an area, weighted based upon the surface through which it flows (**Figure 11**) and unweighted flow accumulation.

Land Cover Classes and weights	
(0)	Open Water
(0)	Shadows on water
(2)	Forest
(3)	Shrub Scrub
(5)	Low vegetation/herbaceous
(5)	Extra veg
(5)	Shadows on low vegetation
(7)	Crops
(8)	Barren (tilled fields, open soil, baseball fields)
(9)	Buildings
(10)	Impervious (roads, lots)
(10)	Shadows on impervious

Figure 11 Example weighing index used to create a weighted flow accumulation raster.

This NDFI layer then allows us to identify underperforming landscapes (indicated by a high NDFI) that are a priority for restoration and drainage remediation that The Township can use while revitalizing sections of Turtle Creek.

Results

Community Survey on Turtle Creek Park

From January to March of 2023, HRG Engineering administered an online survey to the residents of East Buffalo Township to collect the public's opinions and desires for the future of Turtle Creek **(Appendix D)**. After HRG collected 161 participant responses, we were able to interpret and analyze the data using R Studio Software (**Figures 12a-f**) (Additional statistical analysis can be found in **Appendix E**).

The survey's results provided insightful information on how the property is currently being used -or not used- by the public, and what elements the public hopes to see at Turtle Creek in the future. The majority of the survey's correspondents do not regularly visit Turtle Creek, have only lived in East Buffalo Township for less than 10 years, and are typically families with young children (**Figures 12a-d**). Survey respondents were also asked an open-ended question about their thoughts on additional suggestions that were not listed as an option in the survey. Their suggestions included longer trails (> 1⁄2-mile loop), people-only trails (for visitors who are allergic to dogs), bicycle parking, water source for dogs, restroom facilities (Porta-Potties OK), even more shade trees and native landscaping, park signage, and picnic tables (**Figure 12e**). Furthermore, respondents were asked why they had not previously visited Turtle Creek, and a surprising statistic was that a significant majority of respondents stated that they were not aware of what existed on the property (**Figure 12f).**

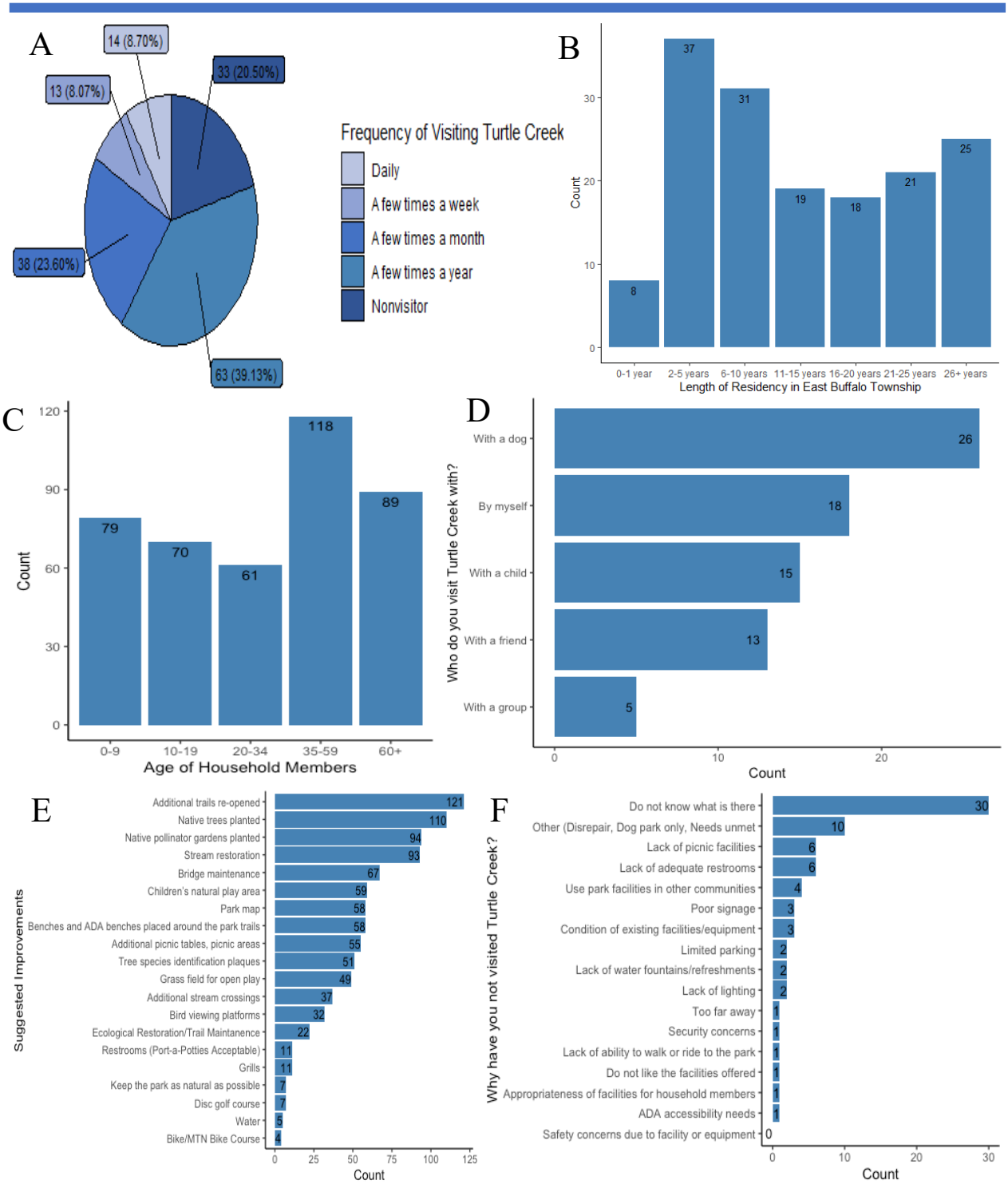

Figure 12 **a)** The frequency at which residents visit Turtle Creek. **b)** The length of residency demographics of respondents. **c)** Demographics of who respondents visit Turtle Creek with. **d)** Respondent demographics of household members that visit Turtle Creek. **e)** Improvements suggested by township residents. **f)** The reason(s) why residents do not visit Turtle Creek.

Initial Turtle Creek Walkthrough

On February 17th, 2023, our project group took our first walkthrough of Turtle Creek together with Jim and Professor McTammany for his extensive academic experience with stream ecology and aquatic biology would provide expert insight on the issue. On the grassland directly behind the parking lot, we observed that the Phase One area has been thoroughly decorated with stakes to mark out the proposed dog park, gazebo, parking-lot expansion, and ADA trail (Error! Reference source not found.**a)**. As we were already predisposed to the drainage issues present on the trail network, gauging the severity and locations of these wet spots was one of our main priorities for the visit.

As our group walked down the park's central path between the abandoned agricultural fields, Knight informed us that there used to be seven to eight feet-tall shrubs surrounding the

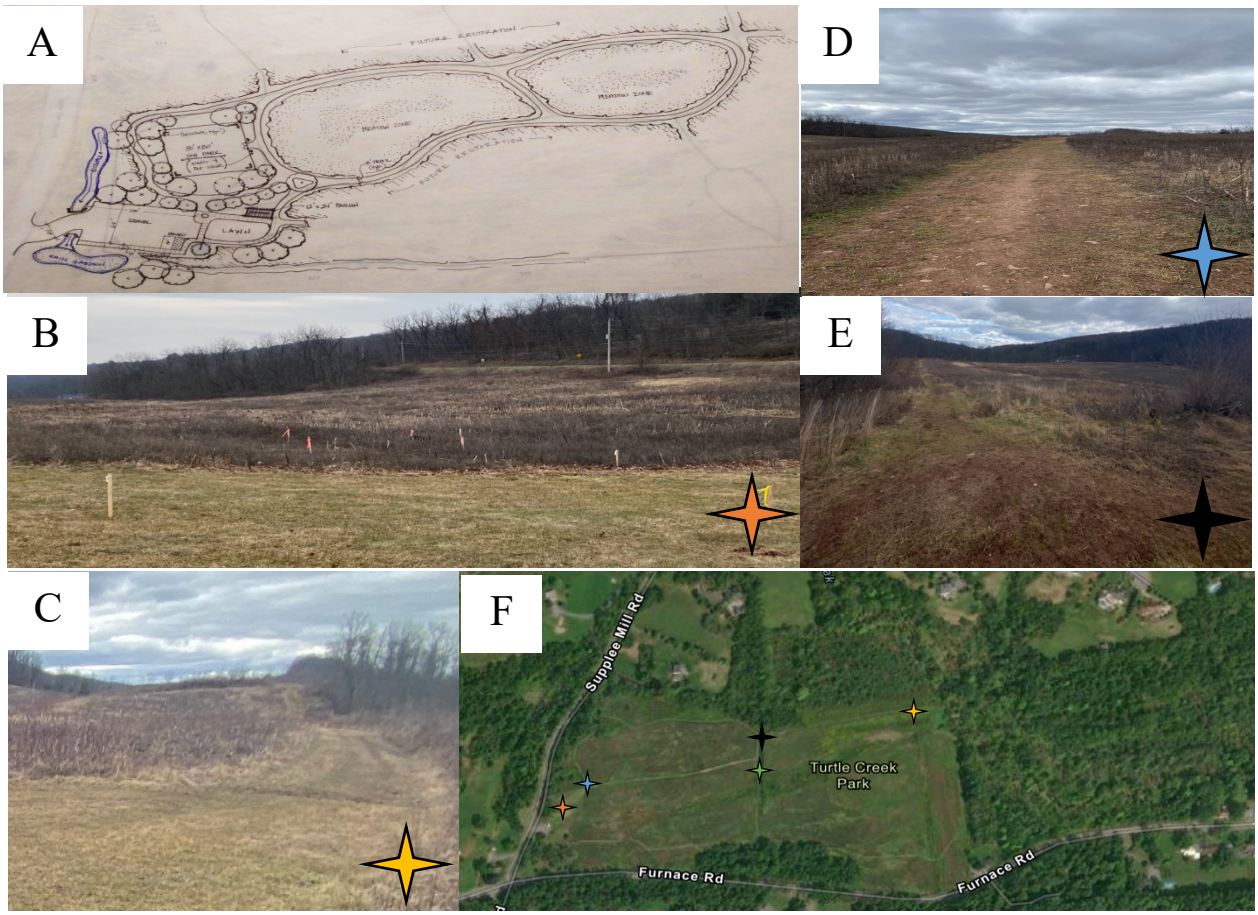

Figure 13 **a)** The initial conceptual drawing of the Phase 1 area. **b)** Stakes representing the dimensions for Phase 1 improvements. **c-e)** Various pictures of Turtle Creek that has been converted into farmland. **f)** Relevant photo locations. Since no accurate satellite data exists of the area, an image from before the partial development is used to provide locational references.

meadow paths; these were now open farm fields (Error! Reference source not found.**b-f**). He also mentioned some discussions had by EBT's Board of Supervisors on planting evergreens along the roadside of the meadow to prevent noise from the road. There is currently a well-constructed bridge built by a previous Bucknell Civil Engineering class to give access to the eastern part of the property.

As we walked through the park's riparian wetlands (**Figure 14a, blue outline),** we observed the high concentration of water pools on both the trails themselves and the surrounding grassland **(Figure 14b).** While some plastic drainage tubes, gravel, and wooden boards were

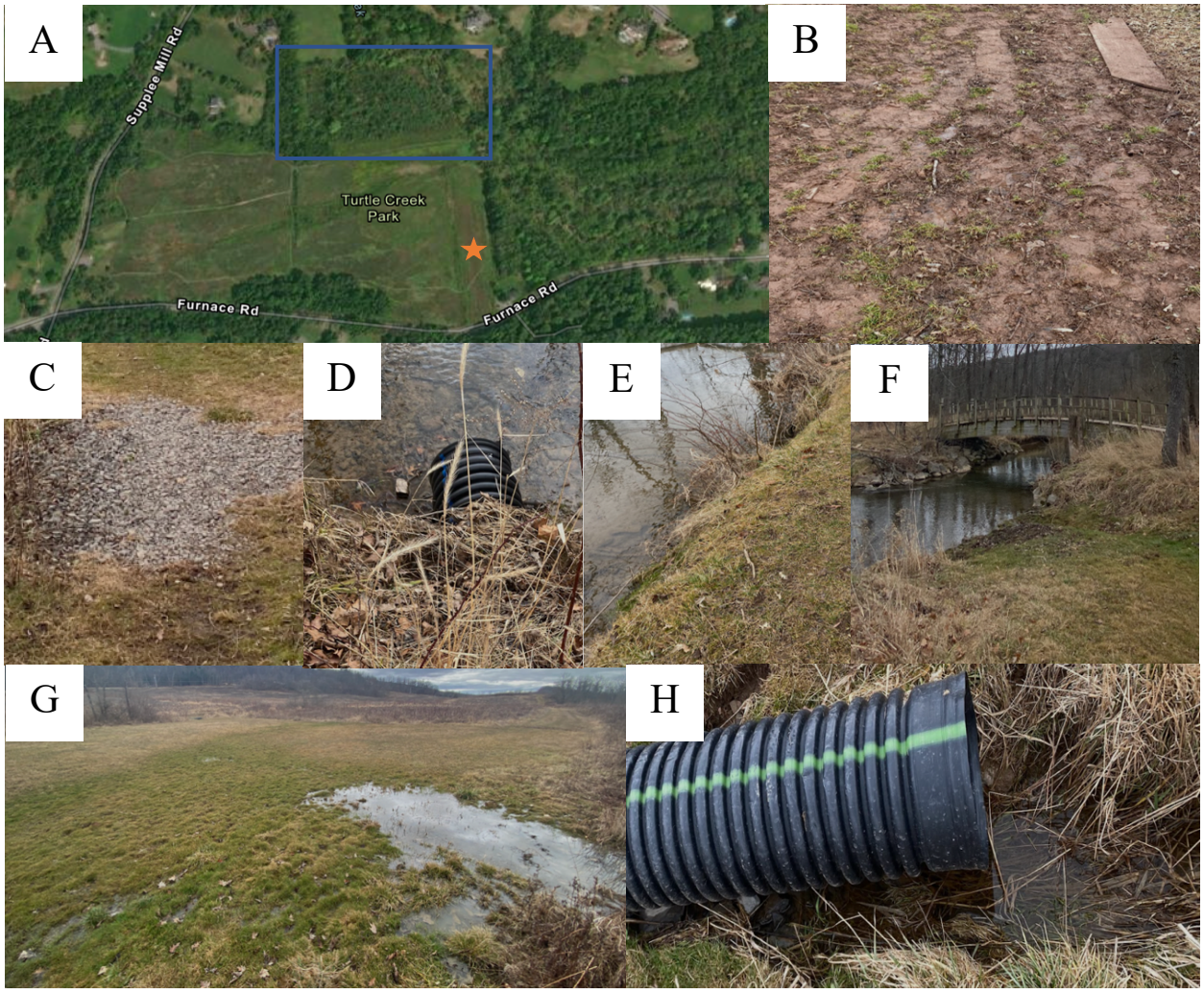

Figure 14 **a)** The forested riparian wetlands we evaluated. **b-d)** Examples of bad **(b)** and effective **(c&d)** solutions previously attempted. **e)** The trail travelling directly along the river, without any buffer between. **f-g)** The Turtle Creek Bridge and view into the meadows (orange star in **a**), note the pooling water. **h)** An example of infective drainage solutions attempted by the Church.

installed previously to provide some drainage and visitor access, they were minimally effective (**Figures 14b-d)**. The creek runs alongside some portions of the trail; while some of the riparian border remains, there are large segments where such borders are nonexistent (**Figure 14e**).

On periphery of the property there is a combination of private homes, public road, and forested area. We also observed the abundance of dead ash trees throughout the wooded area of the park, some still standing upright and others laying horizontally. We noted one of the park's deepest drainage issues was located directly before the bridge, where the grassland's topography sinks significantly (**Figure 14g**). We also noted past attempts to alleviate the drainage issue present in this area, but we observed that these were ineffective due to the water running noticeably under the pipes instead of through them. (**Figure 14h**).

In the wooded area directly behind the bridge, we noticed that the drainage issues were not as severe as those in the upper reaches of the park; after immediately crossing the bridge, the soil had rapidly dried up for the first two hundred feet (**Figure 15a, outlined in blue**). We note

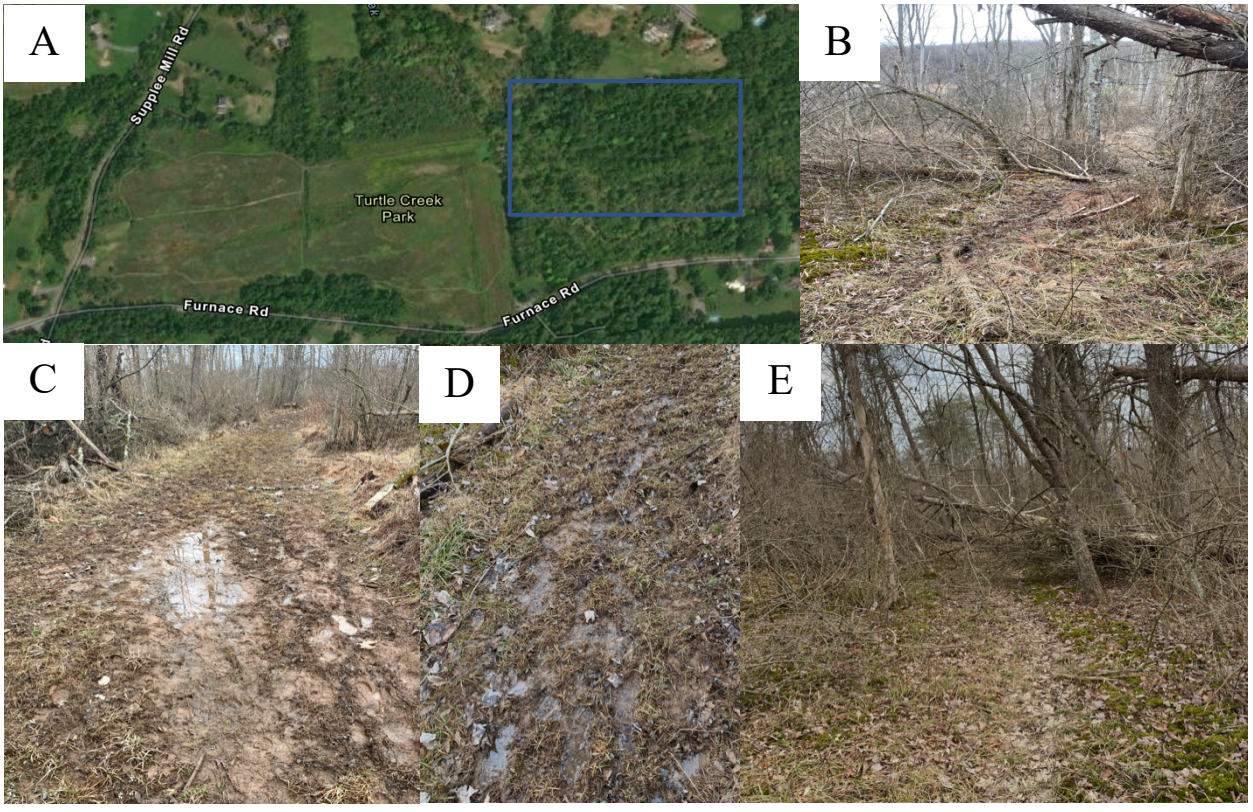

Figure 15 **a)** The second forested riparian wetlands we evaluated. **b)** The current state of the trail in this area. **c&d)** Mud and stagnant water making up most of the trail. **e)** A trail that dead-ends due to a fallen tree.

that this is largely affected by the rapid change in land type, the transition from open fields to congested vegetation and tree growth (**Figure 15b).** While there were a few swaths of trail where the puddles had been covered by bark or gravel placed there to absorb the moisture, most of the trail network's major drainage issue areas persisted throughout (**Figure 15c-d**). Knight informed us that several of the original trails were lost due to lack of maintenance, so due to overgrowth they have become dead ends (**Figure 15e**).

After walking the trails along the creek itself, we investigated the uphill section (blue outline in **Figure 16a**). While the inclined trail is mostly dirt, the trail becomes grass near the northeastern corner of the property (**Figure 16b&c**). We also noted the extensive amount of invasive shrubbery that existed in the wooded region of the park, and the air and light deprivation it was causing the surrounding vegetation. Professor McTammany and Jim both discussed how this was an ongoing issue in Central Pennsylvania's wooded parks. (**Figure 16d**).

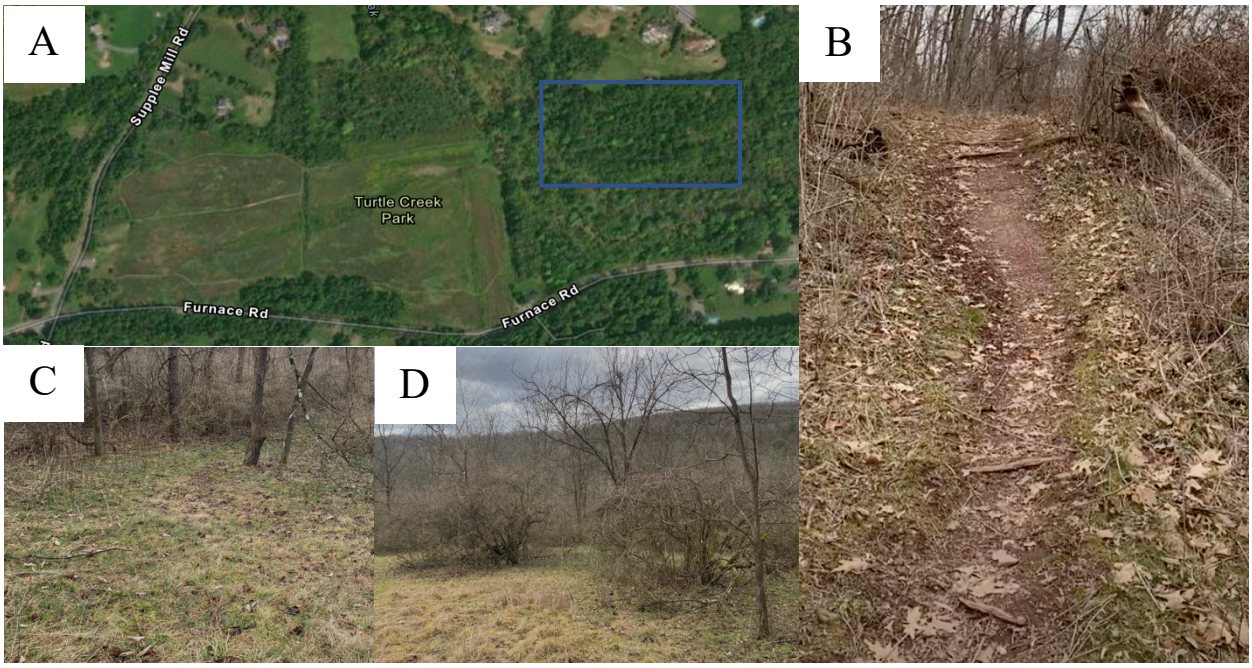

Figure 16 **a)** The uphill section of Turtle Creek Park. **b-c)** An inclined dirt path leading uphill into a grassy trail. **d)** Invasive species are found throughout the park but are highly prevalent in this area.

The final area we noted is another riparian wetland where the trail follows the creek (**Figure 17a, outlined in blue**). This region diverged from the previous riparian wetlands along the trail because of the intense erosion and damage the streambank was facing. While we did not

observe visible drainage issues in this area, the enlarged creek opening due to bank erosion made us concerned (**Figure 17b**). The trail in this third area ends at a cleared wading spot before looping back into the central meadow area (**Figure 17c**).

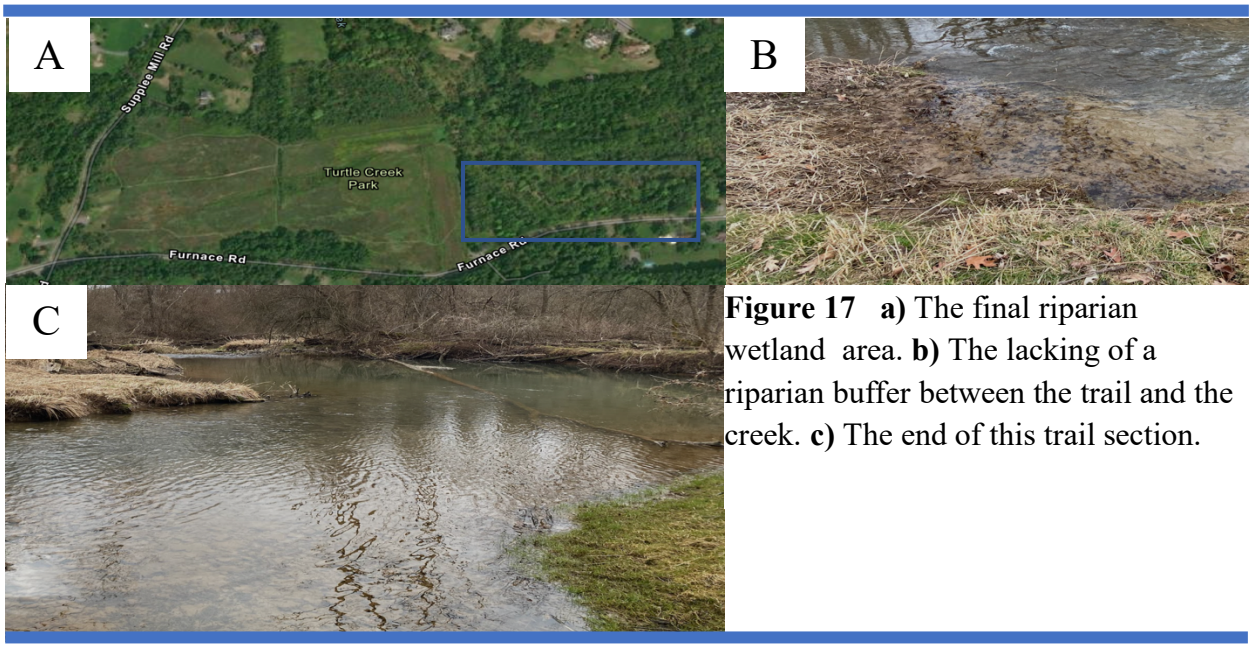

Figure 17 **a)** The final riparian wetland area. **b)** The lacking of a riparian buffer between the trail and the creek. **c)** The end of this trail section.

HRG Led Community Meeting

On February 27th, we attended the public township meeting located in the EBT municipal space, hosted by both HRG Engineering, and EBT's Board of Supervisors, or 'The Township'. The meeting was focused on community discussion about Phase One of Turtle Creek. We were invited by Jim to hear both HRG's plans for Phase One, as well as begin gathering community input. There were two visitors from the Merrill Linn Conservancy who are working to put this land into the conservancy to protect the land from being developed. The primary agenda of this meeting was for HRG to present on their progress thus far and the preliminary results from the community survey, and then to engage attendees in interactive exercises that would involve the master site plan, features, an idea wall, and more. The meeting had a final attendance of 19, not including our group or the meeting's hosts.

The PowerPoint presentation that HRG displayed began with an introduction to Turtle Creek, with some basic information on the property. Most of their presentation was dedicated to the results of the survey (which has since been updated with Auden Block's R Studio analysis in

the previous **Survey Results** section). The last portion of the PowerPoint discussed the conceptual master site plan for Phase One. They described the addition of a parking lot, including an ADA compliant space and a rain garden to remedy any drainage from the parking lot. They also described the installation of a half-mile ADA accessible trail composed of crushed granite. Phase One also includes the reintroduction of the dog park. This fenced-in dog park would be 80x100 feet with native flowering and shade trees on the perimeter. At this point one of the meeting's attendees voiced some concerns about the dog park being too small. The representative assured this person that the dog park was bigger than the last one at Turtle Creek, and that the rest of the park would remain dog friendly. The HRG representative also mentioned some other possible additions to the Phase One changes including a pavilion, a porta potty, a trashcan, and a pet waste area. There was a question about permeable paving, which was answered in that the land would need surveying to explore if such an option existed. If the land has drainage issues, it will destabilize the base and ruin the structure of the parking lot. Another community member asked about previous alterations of the land. The supervisors and representatives responded by stating that the land was largely clear cut by the church.

After the presentation on the initial plan and the initial survey results had concluded, the HRG representatives led the group in a red dot green dot exercise. People were asked to walk to different posters of the drafted plan and placed red dots near features that they didn't like and green dots by features they did like (**Figure 18**). Under green dots, people liked the ideas for the rain garden, the porta potty, the pinetum near the road, the native trees and shrubs, the meadow, and the open dog run area at the north end of the park. We observed that most of the discussions revolved around the red dots. There was a red dot near the pavilion because people felt that the gazebo was in a bad place and created a bottleneck. The second activity involved placing red and green dots on pictures of proposed shade solutions, fences and surfaces, seating, and pavilions. For shade systems the most green dots were for 3 and 6 (**Figure 19a**). For fences and surfaces the most desired option was 3 (**Figure 19b**), and for pavilions the community members liked either 1 or 4 the best (**Figure 19c**). For seating, the best option was either 1, 3, 5, or 8 (**Figure 19d)**.

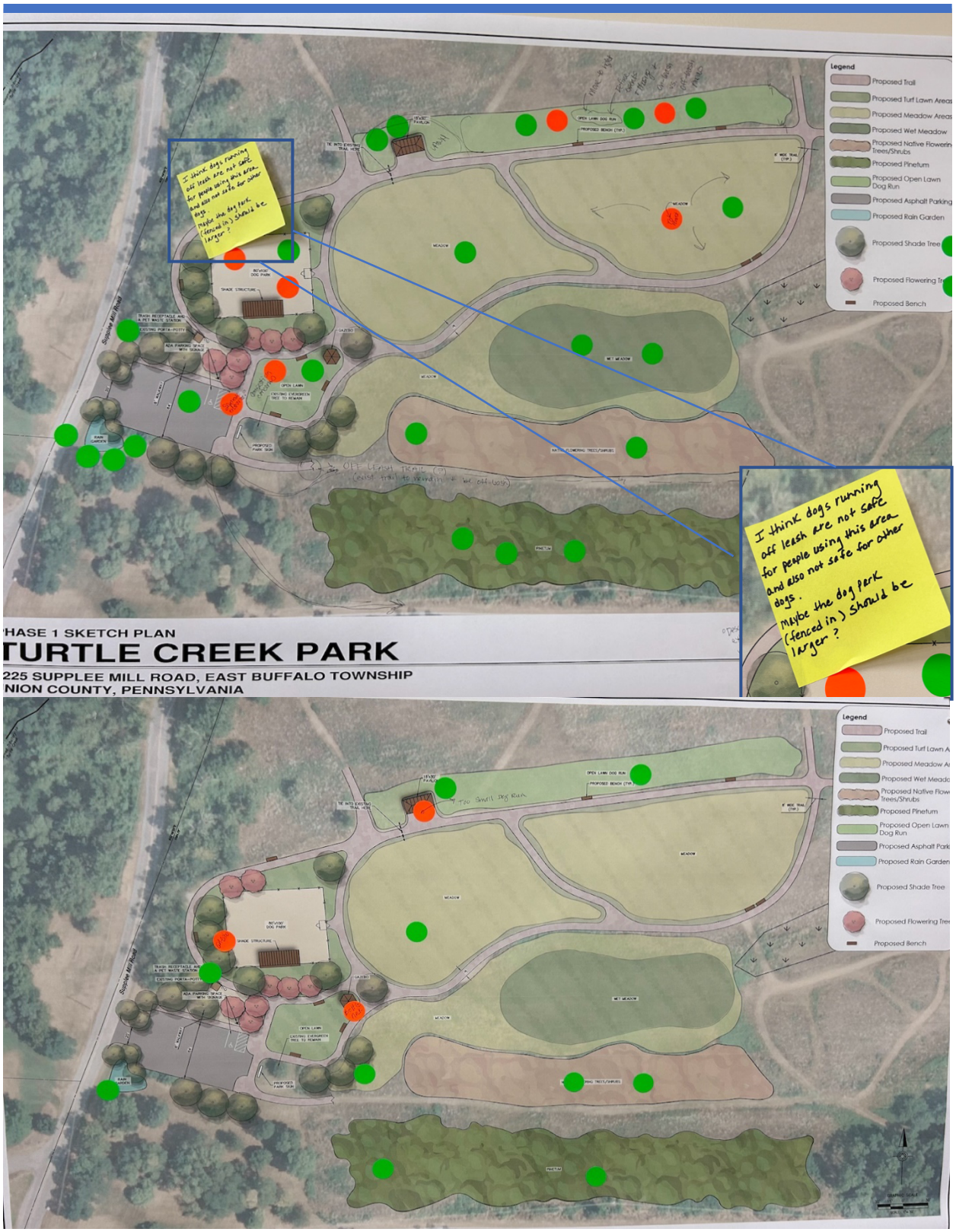

Figure 18 Results of the red dot green dot exercise on the Phase 1 sketch plan.


A
3
6
B
3
C
1
4

Figure 19 The most voted for **(a)** shade systems, **(b)** fence system, **(c)** pavilion, and **(d)** seating options.

The conversation topic that attracted the most controversy and tension was the dog run area and the dog park. Some attendees voiced that they believed it was too small, while other attendees were concerned about the safety of dogs running freely. Others were concerned about the danger that having dogs run off-leash may present to young children or those with allergies. While the discussion of whether to allow dogs to be off leash was quite extensive, the conversation closed with remarks made by both HRG and The Township on how this was a this is a preliminary plan, and most elements were still subject to change.

Additional concerns in Phase One included the plans for the central open space that was once a meadow and was now abandoned agricultural fields. One individual suggested that it could be reforested so the ADA trail could include two different landscapes, which would provide a visual transition and contrast. There was also concern raised about keeping the ADA trail and dog-friendly trails separate for safety reasons. Another concern was about maintaining the park's natural groundcover, to which the HRG representative responded that the intent is 95% pervious surfaces/softcover, with the 5% of impervious surfaces/hardcover being the ADA trail and the parking lot. The final question of the meeting was whether a full context of the park's renovation was possible to explain and present to the public, to which HRG and the board responded no; Turtle Creek's renovation will take many years and they only have the tools and data to present on Phase One.

Public Township Meeting Presentation

During our check-in meetings with Jim on March 30, he invited us to present at the upcoming town meeting on April 10th. Our goal during this presentation was to inform the public on the work we had undertaken and to ask for help in finding experts to help us in identifying and selecting species for educational signage. We were excited to accept his invitation because we knew the wealth of information and valuable input a public meeting like this could offer. We began with a brief introduction of our group and our goals, discussed our work with ArcGIS shared information about our intention to create signage, and advertised the tree planting event with the poster and QR code we developed (See later section **Tree Planting Volunteer Sessions** for more information). Towards the end of the meeting, we asked for advice on possible community members who were experts on Turtle Creek's flora and fauna. One attendee recommended that we post our inquiry in the Penn State Master Gardener's Facebook group, a large online community dedicated to answering questions on Central Pennsylvania's vegetation. After the meeting, we posted an inquiry in this group but unfortunately did not receive a response. However, Char Gray, one of the township's supervisors, recommended that we reached out to David Hafer, a local member of the Audobon Society and the Sierra Club, who grew up fishing in Turtle Creek.

Phone Call with David Hafer

On April 16th, team member Juliette spoke on the phone with local expert David Hafer. During the call, David mentioned that there was an abundance of dead Ash Trees due to the invasive Emerald Ash Borer. He also mentioned the rich biodiversity of other tree species within the park, specifically along the creek. David told Juliette that he had recently noticed yellow Trout Lilies blooming in the park, but that there are not a lot of wildflowers in comparison to other naturally wooded areas. David attributes this to the large deer population who eat seedlings. In terms of signage, David suggested that we create a sign that features the various birds that are found in and around Turtle Creek. David will be joining us for the walkthrough with the DCNR representative on Thursday April 20th.

Walkthrough with David Hafer and DCNR Forestry Representative

On April 20th, team members Will, Bethany, and Juliette traveled to Turtle Creek to meet with David Hafer, Char Gray, and Jacob Bausinger, a forestry representative from the DCNR. We were introduced to both David and Jacob through Char, who believed that their expertise was what we needed to finalize our ecology signage. We first met with Char & Jacob, then immediately afterwards met with David for a second walkthrough. This visit was incredibly beneficial in learning more about the flora and fauna living in Turtle Creek because of the deep wealth of knowledge both experts had on the local ecological community. Both experts noticed a host of invasive species including multiflora rose, autumn olive, bush honeysuckle, privet, and oriental bittersweet. In terms of native vegetation, the experts both pointed out black walnut trees, box elders, hackberry, hawthorn, silky dogwood, black cherry, and more. One of the more surprising discoveries was a live ash tree; many Ash trees on the East Coast have been infected by the Emerald Ash Bore and died, but we were happy to find a living Ash tree along the creek. Both walkthroughs took around an hour, and within the hour we as a group mainly walked along the wooded trails past the bridge.

Educational Ecology Signage

To decide which species we wanted to highlight through our educational signage, we drew from the information collected in our literature review on the park's ecology, discussions held with Matthew McTammany, Jacob Bausinger, David Hafer, and online communication held

with Emeritus Professor Warren Abrahamson. Using Canva Pro, a popular graphic design platform, we created five different signs to be implemented along the park's trails **(Appendix Fa-e).**

1) For our first sign, we chose to focus on the unique and interesting birds one may see or hear in Turtle Creek Park, mainly because of the conversation we had with David. As a member of the Audobon Society, David made clear to us how wonderful of a location Turtle Creek Park is for the bird-watching community. The four species that are displayed on the sign, the Red-Tailed Hawk, the Woodpecker, the House Wren, and the Great Blue Heron, were all species that Hafer said he had seen or heard at Turtle Creek in the past month. David also mentioned that these were four species that garnered a lot of public interest due to the bird's appealing aesthetic or loud bird call (**Appendix Fa)**.

2) We also wanted to create a sign that educated park patrons on the Eastern Bluebird (**Appendix Fb)**. This desire stemmed from information Char Gray communicated to us on a new project a local Scout troop was taking on, which is creating bird homes for bluebirds. We wanted to create a sign that would work in tandem with the bird homes, and that could be displayed directly in front of their project to help add to their efforts.

For our third and fourth signs, we decided to focus on native species. We believe that focusing on Turtle Creek's native species helps educate park patrons on the uniqueness of Central Pennsylvania's ecology, thus helping to build Turtle Creek's identity as a legitimate park with exclusive attributes.

3) We created a sign on the Hackberry Tree (**Appendix Fc)** after reflecting on our walkthrough with DCNR Rep Jacob Bausinger. When walking on the outer trail that hugs the north side of the property, Jacob pointed to two Hackberry trees that were incredibly twisted and gnarled. Jacob commented on how an average park visitor would be intrigued by the bark's unique pattern, and we agree. The Hackberry is not only one of Central Pennsylvania's native trees but is also one of the species of the samplings planted recently, so the tree will exist in the park for a long time.

4) Another sign we made is dedicated to Spicebush **(Appendix Fd),** which was inspired by our conversations with both Jacob and David. Both experts pointed out Spicebush,

commented on its rare aroma, and its ability to be used in the kitchen as an allspice substitute. As such, we wanted to create an interactive experience for park patrons where those walking by could have the option to not just read the signage, but also smell the shrub's leaves.

5) For our fifth and final sign, we chose to create a sign educating visitors on the harm invasive species offers the park's ecosystem (**Appendix Fe).** The idea behind this came from a repeated theme in conversations about how severe of an issue the invasive shrubbery is on the wooded area of Turtle Creek. Jacob, Professor McTammany, and David all commented on this ongoing problem, and Emeritus Professor Abrahamson also included a memo about it in our online communication. We believe that teaching park patrons on this harmful phenomenon is valuable because it is one of the biggest threats the park's ecological community faces, so those who enjoy the trails should be made aware. On April 25th, both Jim and Char approved of the aesthetics and information contained in five signage drafts. On April 26th, communication began between our group and Middle Creek Signs, a local sign and logo company that The Township has already contracted to create Turtle Creek's entrance sign. As we leave this project, we are handing off the implementation of the signs themselves to the Board of Supervisors.

Tree Planting Volunteer Sessions

On April 5th, Jim highlighted the need for community volunteers to plant a new shipment of native tree saplings in Turtle Creek through email correspondence. The tree saplings would all be planted in a confined nursery located in the upper reaches of the park in the old agricultural fields, and then moved to a more permanent location still within the confines of Turtle Creek once they are strong enough to stand on their own. While she was reaching out to an extensive amount of community contacts, including other Bucknell students outside of ENST411, The Township was having trouble gauging interest and getting the word out to those not involved with EBT. So, Jim & Char asked for our assistance in marketing the volunteer sessions and increasing participation. As a first step, we used Canva, a popular graphic design platform, to create a flyer advertising the different volunteer sessions **(Figure 20a)**

Once the flyer was created, we sent the PDF digitally to all of the environmental clubs and societies we knew on campus, particularly those that required service hours. This included Epsilon Eta, Alpha Lambda Delta, Bucknell Student Government's Sustainability Council, the President's Council on Sustainability, and the Environmental Club. Afterward, we printed 50 paper copies of the flyer to distribute to interested participants; we brought these copies to the public township meeting that we attended on April 10th.

While our group was unable to attend the session on Saturday, April 15th, four of us excluding Juliette were able to come in on Friday, April 14th to get a start on planting the saplings with township supervisor Char Gray and four other volunteers. To plant the trees, volunteers dug holes with shovels, planted the saplings, planted stakes, and then installed a protective covering over the saplings in an assembly line fashion. Over the next four volunteer sessions, a total of 265 trees were planted in Turtle Creek's sapling nursery (See **Appendix G** for detailed species breakdown). There were 30 different types of tree subspecies that were donated by the Union County Conservation District to be planted during these sessions. Volunteers ranged from elementary aged to adults, some fulfilling Scout badges and others just lending a helping hand (**Figure 20b**).

Figure 20 **a)** The tree planting volunteer flyer we created and published online and on Bucknell campus. **b)** Bucknell Staff member Matt Lamparter and his children helping plant trees on April 15th (Photo credits: Anna Wiest, (2023)).

Meetings with Janine Glathar

On Thursday, March 9th, Juliette and Auden held an initial introductory meeting with Janine Glathar to discuss methods for mapping Turtle Creek. Of particular importance to us was the desire to create a digital map, and potentially one that could be implemented into a physical park map. Janine explained that in addition to surveying the trail paths, ArcGIS FieldMaps would allow us to document the location of specific data we hoped to collect: Drainage, ecology species, park elements, and potential sites for trail markers. Within two days of this initial meeting, Janine created a group and a map of 2019 aerial images of Turtle Creek within ARCGIS's database. While we hoped to solely use ArcGIS FieldMaps, the low accuracy of our cellphone's GPS caused us to switch to Garmin GPS units, which had a slightly higher degree of accuracy. On March 31st, group members Will, Haley, and Bethany met with Janine, along with her colleague Gavin Davidson from the Geology Department, in the library to receive a tutorial on how to operate these Garmin GPS devices. Gavin taught us how to operate the device's different functions, such as dropping points, marking the coordinates, and starting/ending a new trail.

Trail Mapping

During multiple points of the semester, all five group members used GPS devices acquired through Bucknell's Geology Department and digitally logged Turtle Creek's trail network. We would trace the trails by holding the GPS unit in the centermost line in the path as we walked the trails. By having all five of us walk the trails multiple times, we were able to collect more reliable data on the trails' direction and line. As we recorded the trails, we also would document points that had clear drainage issues. The GPS data was then extracted and given to Janine Glathar, who imported the data into ArcGIS Pro. This point data was then vectorized to generate a new class object that was manually manipulated with aerial imagery, personal experience, and limited previous maps to be the final map of the trails in Turtle Creek (**Figure 21**).

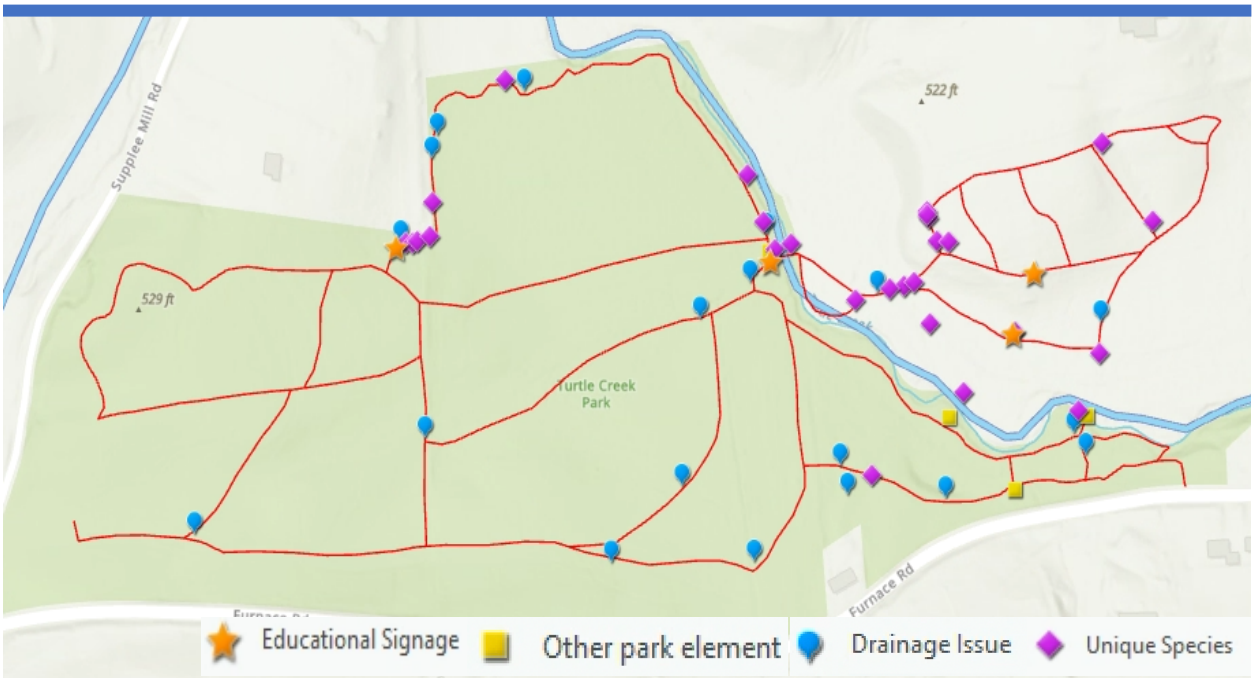

Figure 21 The map of Turtle Creek based on the trail data we collected and manually manipulated based on our experiences at the park and limited trail data previously collected.

Precision Conservation

As previously discussed, Janine was a major supporting factor in the creation of the flow accumulation flow and the NDFI raster that allows for visualization of the runoff loads through the park system. By isolating the large data pool to just the channel paths, she was able to visualize the path water takes as it moves through the park and surrounding land **(Figure 22a)**. Additionally, Janine created an NDFI map of the park area to potentially identify areas in need of conservation **(Figure 22b)**. This map was color coded so on a green to red color coding, enabling rapid identification of areas that are in good (green) or poor (red) functioning landscapes. While this analysis was done using 2019 data, the land was not altered significantly enough for us to reject the validity of these results. Of particular interest to us is the lack of green in the NDFI, indicating the park needs restoration to reduce the amount of nutrient and sediment runoff.

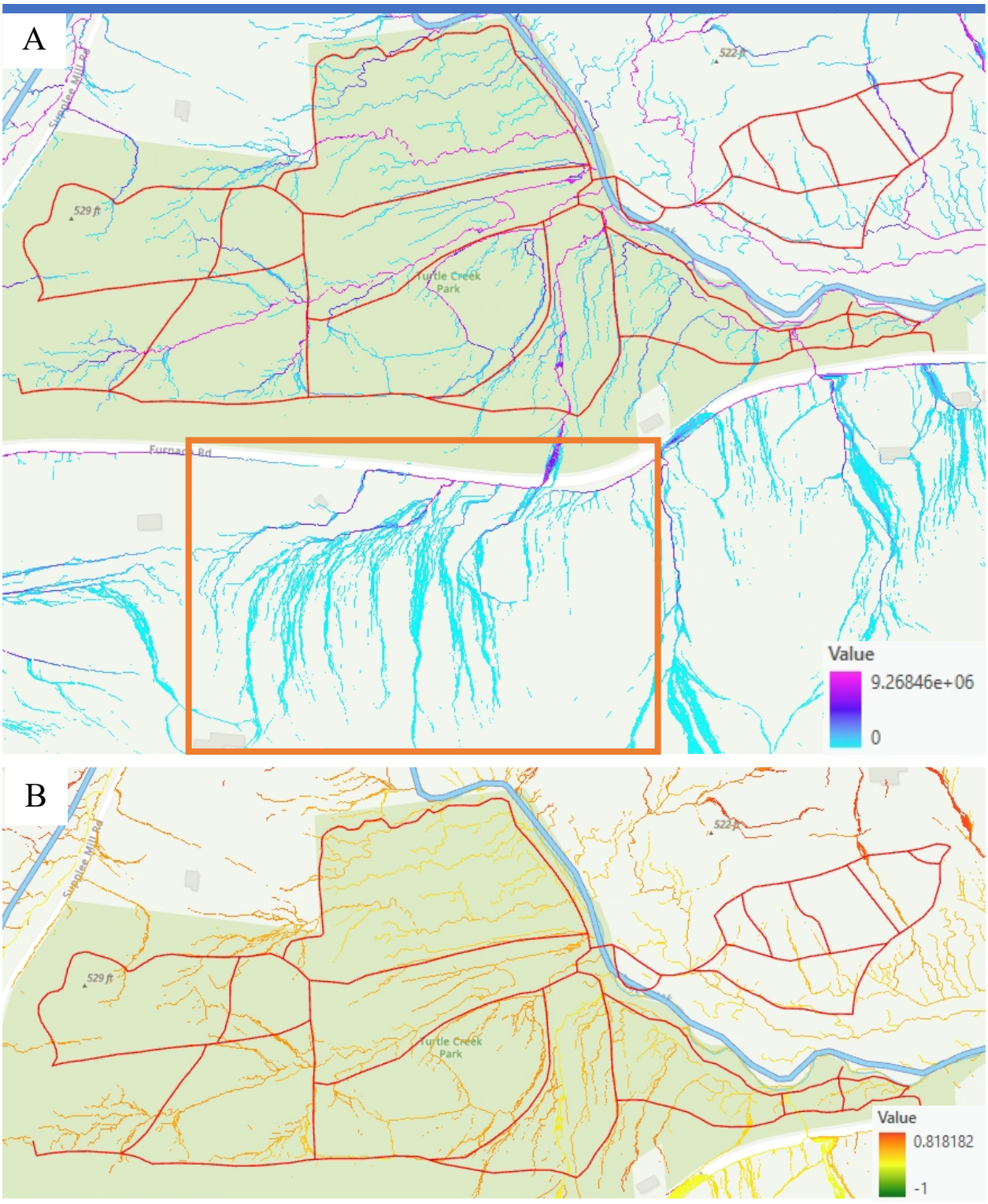

Figure 22 **a)** The weighted, channel only, Flow Accumulation raster illustrating how water flows through the area. The color scheme is organized from blue (indicating low flow throughput) to purple (indicating a high volume of water flows through the area). The orange box outlines an area in which water from outside the park boundaries is flowing through the park space. **b)** The NDFI raster of Turtle Creek. The green indicates areas with a low NDFI score, indicating high-functioning landscapes that should be conserved. Red areas represent landscapes that are underperforming and need remedial renovation.

Discussion

Through this project, we have felt fortunate to not only be able to engage with the local community, but also be able to provide physical materials such as a trail map and physical ecology signage to be enjoyed by park patrons for years to come. We hope that the digital database we have designed can be utilized by future groups and community partners to create their own sustainable projects to continue the revitalization of Turtle Creek Park. Yet, accomplishing these goals did not come without strife; through producing a trail map, educational signage, and drainage recommendations, we were faced with several unprecedented constraints and obstacles that we had to work through as a group. We hope that our work with our community partner has left Turtle Creek Park in a better place than it was before, and the work will be continued in the future.

Field Studies

Throughout this project, we spent a considerable amount of time in the field, both meeting with local community experts as well as our own work we did to map Turtle Creek Park in various capacities. While ArcGIS FieldMaps App and the Garmin GPS systems gave an above average degree of accuracy, which is bolstered by walking the same section multiple times, the point values often had to be manually manipulated to the correct position within ArcGIS FieldMaps. However, this data is still vital to The Township and gives future researchers a starting place to work from. We also used mapping to identify optimal areas in which to place the designed educational signage. Since each of these signs is closely linked to a physical space within the park, we hope this will enhance visitor curiosity and engagement, allowing them to connect with nature in unique ways. With the undertaking of this massive restoration project, our group represents just a small portion of the greater effort being put toward the park. We hope this information not only enables our community partners to make educated decisions to further improve the park, but also continue to enhance the experience it offers to its visitors.

Community Engagement

To appropriately design our plans for the park system, we met with a variety of experts at Turtle Creek to gather their own unique opinions. During and after these walkthroughs, we were able to document the different Turtle Creek connected to members of the community and the ways they felt would best improve the space. We found that community engagement in a project such as this one is critically important. We were able to work with the township towards having two successful weekends of community tree planting in April on the 15-16th and 22-23rd where with the help of community members we planted over 265 native saplings of different species that will be transplanted throughout the park when they reach a more mature size. This event brough together community members of all ages for a fun afternoon at the park and we hope similar events will continue in the future. Without the influence and help of these community members, we could not be sure our project fit the needs of the community. We found that the community had the same sentiment that we did in relation to how important the restoration of the park is. Additionally, continued engagement enables The Township to better connect with the constituents that want to be directly involved in the Turtle Creek Park restoration project. Sustained community engagement will enable the community to feel a sense of ownership over the space.

Community Survey

While it was incredibly opportune that we were able to utilize the data from The Township's community survey that had already been created and distributed, this also meant that we did not have control over the questions asked or the format of the questionnaire. As community-based researchers, we know that the way a question is phrased can impact the response that is given. The loss of autonomy over the survey altered how we were taught to perform community-based research and put us into uncharted territory. However, we were fortunate that the survey administered was well thought-out; the only question we would suggest reformatting for future surveys is the demographics ask about male and female residents, which can be interpreted as being exclusive to non-binary members of the community. Otherwise, HRG created a phenomenal method to collect quantitative data on the town's desires for the park; the survey has been an incredible resource to give our group and The Township much-needed

feedback on how to shape future projects to meet the needs of the community. This type of community engagement and research will be critically important as the next phases of the park begin.

An additional hurdle we faced with the community survey was disseminating it to as many people as possible within the EBT community. When we were first introduced to the survey by Jim Knight, the QR code displaying the survey's hyperlink was only marketed in two areas: a piece of paper stapled to a tree near the Turtle Creek's parking lot, and on the EBT website, at the bottom of the home page. We initially grew concerned because we observed that the survey was difficult to find; an average park patron would not be able to read the flyer until they were a couple inches away from the sheet, and we feared that not many people would scroll all the way to the bottom of the EBT website. While we saw that these were strong preliminary efforts, we also believed that to reach an adequate sample size of responses, social media marketing should be utilized (As supported by the results in **Appendix E1**). In response to this, we posted a blurb on the Buffalo Valley Bulletin, a Facebook group dedicated to promoting news and updates in Union County and included the QR code. The post received 39 likes and 3 comments; while we cannot count how many respondents found the survey through the post, we do believe that several community members saw the survey on Facebook that would not have seen it on the website or on the property. It will always be impossible to reach every single member in the community for an opinion on Turtle Creek's renovation, we believe that expanding the survey into social media allowed for a wider pool of participants to engage with the questionnaire.

Educational Signage

As we now hand off the digital PDFs of the educational signs to Middle Creek signs and the EBT Board of Supervisors, we reflect on how difficult it was to reach this stage, mainly because of how painstaking the process of getting in touch with lay experts in the community who could advise us on different species truly was. After being directed in circles to different members of Bucknell's faculty, we felt somewhat defeated. However, we continued to post in different Facebook pages (the Seven Mountains Audobon Group, the Penn State Master Gardener's Group, etc.), as well as asking the board and attendees at the April 10th public

meeting for assistance. While we are content with the signs we have created at the close of the semester, we would not have these drafts if we were not persistent in finding the right people that could help us. It taught us an important lesson in determination and hope; while things may have seemed futile for a couple of weeks when those we reached out do did not have the ability or resources to help as we had hoped, we would not have created the signs themselves if we had not kept trying to reach various communities.

We also learned a great deal about the importance of lay experts throughout this experience; after we found individuals that met our needs, a couple of meetings cut down on the potential hours of research we would have had to complete to reach the same conclusions. These experts have dedicated their lives to their respective fields, and their willingness to share their knowledge greatly helped our project. This portion of the project would not have been possible without local expertise and shows how integral it is to use resources like David Hafer and Jacob Bausinger in rural communities like EBT; areas where there is significantly less documentation or published academia, experts like these are the key to a successful project.

Trail Drainage

When we first began this project, we initially thought that the main scope of the work that we would complete this semester would entail the extensive drainage issues present on the trails. Following our first walk-through of the park, we all agreed how severe of an issue the waterlogged trails were for the park's patrons. Yet, through research conducted in our literature review, and consultations with Bucknell's faculty, we now see that installing adequate drainage systems on the trails is not a feasible goal to complete in just one semester. It also became clear that this feat was less applicable to use with the new trails that were being added in March and April, and the fact that The Township was still in the midst of deciding which trails would no longer be maintained. This was a difficult truth to accept, because at the halfway point of the semester we as a group still believed that we would have time to give preliminary plans to integrate at least some drainage technology along the trails. Discovering that our primary goal was no longer achievable was disheartening, but if we did not change gears at the rapid pace that we did, we would not have the current projects that we have now. When we shifted our goal

from implementing drainage techniques to locating drainage issues and offering recommendations, we were able to create new goals with the information we had, and from this transition were able to come up with our idea of educational signage on the park's ecology. This shift stands as a marker with respect towards how any project must be adaptable. Being flexible can be a researcher's greatest skill in this field. While we may not have been able to physically install the drainage techniques we believed would best aid the trails, we have compiled the research and suggestions we have received to enable future groups to make educated decisions regarding Turtle Creek.

Conclusion

Despite all that we have completed over the course of the semester, the work our group has put into Turtle Creek Park only marks the beginning. The township's governance and the community are becoming linked together through the social bonds created in Turtle Creek that will enable the space to thrive and flourish. Already, interested members are emerging within the community to help The Township build this space, and the networks we have established will only continue to grow over the coming years. We are excited to see the future work that will occur at Turtle Creek and are proud to know the work we did this spring is laying the foundations for Turtle Creek to be a sustainable natural resource for the community into the future.

Recommendations and Next Steps

As an ENST411 group, we as the Turtle Creek group feel that we have been placed in a rare and fortunate situation: being the first group to ever work on this project. We feel honored to have been the first students to work with The Township on revitalizing and restoring the park, and it has been an exciting semester paving the way for students in future classes. However, because we are the pioneer group on this project, this means that a majority of the work we have done will not come to fruition this semester but is instead laying down the foundation for future 411 students. While it is slightly disheartening that we will not be able to see certain elements of our work physically out in the field before we graduate from Bucknell, we are excited to see what new direction The Township and future classes take this project to. It is also thrilling that the revitalization of Turtle Creek is a multi-year plan that may surpass ten years, because the final product will be such a well-developed benefit to the greater community with the multitude of work invested. We are confident that in the years to come, the Turtle Creek Park will continue to undergo changes that will help the park become a lush, interactive, and inclusive recluse for the residents of East Buffalo Township. There are a number of changes that we have researched and looked deeply into that we know we will not have time to implement but want to support those in the future who do by supplying our work and recommendations.

Trail Drainage

On April 7th, we met with Professor Rich Crago, a professor of Civil and Environmental Engineering at Bucknell who specializes in surface water hydraulics and drainage issues. He imparted to us a number of suggestions that we believe will be vital for future groups. He strongly recommends using boardwalks or raised platforms in the areas of stronger flow, and utilizing a topographic wetness index to judge which areas are in the most need of this. He also recommended using ArcGIS concentrated flow mapping to help with this process. He also mentioned using Google searching to find common solutions, or consulting companies that deal with drainage issues specifically. He also suggested digging trenches to allow for better drainage but warned that this may lead to erosion so to proceed with caution. He also recommended filling

in the wet spots with materials that would increase the slope to encourage drainage rather than puddling but warned that this technique may be disruptive in terms of short-term usability of the park's trails. For larger sentiments guiding the future students, he advised that including the whole Turtle Creek watershed will be crucial to concrete results, and that good mapmaking will be the key to correctly redirecting the water flow. Aside from the guidance we received from Professor Crago, we also collected and organized a plethora of literature on trial drainage, which is available in our literature review.

In addition, we are also providing a map layer on our ArcGIS map of Turtle Creek that identifies the specific areas where the drainage issues persist. As mentioned in our methodology section, we used GPS units to specifically pinpoint where on the trails the drainage issues were. We believe that this map will greatly benefit future groups and organizations who will tackle this issue. We as a group advise that with any technique, while proper stormwater drainage is the end goal, aim to keep as much of the natural character of the park preserved as possible. Turtle Creek is beloved for its natural characteristics, and too much drainage technology may detract from this quality.

Trail Mapping

As we come to the close of this project, we have finished the ArcGIS trail map of Turtle Creek, complete with map layers on drainage issues, special features, and locations for educational signage in order to hand it off to the Board of Supervisors of EBT. We believe that this map will be of great use to a number of people in future phases of restoring Turtle Creek Park. First, we believe that this map will be useful to HRG Engineering and all other organizations that are concerned and involved with fixing the drainage issues on the park's trails. We also believe that this map will be useful to Middle Creek Signs for showing where exactly we believe the signs should be installed within the park. We also believe that this map will be useful to those in the future who may want to create a physical trail map to be implemented in the park, because with the digital trail map already created, it would not be an arduous task to print the map and create a signpost with the map of available trails. We recommend that the best

place for this map would either be at the entrance of the park at the parking lot, or at the bridge over Turtle Creek, because these two areas are centrally located and garner the most foot traffic.

Educational Signage

As we are on the precipice of the end of the semester, as with other aspects of this project, the portion related to educational ecology signage is still ongoing. At this point (the beginning of May 2023), we have decided which species we want to highlight, we have created the five signs that we hope to implement in the park, and we have gotten approval on these drafts in terms of aesthetics and information from the Board of Supervisors of EBT. Currently, we are in back-and-forth discussions with Middle Creek Signs, a local, well established, sign and logo company that The Township is already using to create the entry sign at the trailhead of the park. As of now, we are waiting for price quotes on a few different options of wooden signage that our signs would be placed on top of using a digitally printed face on a PVC panel. Since we do not predict that we will still be in Lewisburg when these signs are physically implemented, we are handing off this portion of the project to the Board of Supervisors of EBT and Middle Creek Signs. The Board has expressed continual interest in the implementation of educational signage throughout the park, and it also directly builds on Goals One and Two that The Township outlined in the acquisition of the park: 1) Provide opportunities for recreational activities and accessibility for all ages, and 2) Remain available for environmental education and nature studies (East Buffalo Township, n.d.). As mentioned in our Methods Section, we have created a map layer within our ArcGIS map of Turtle Creek that is dedicated to the placement of education signage. For each of the 5 signs we have created, we have dedicated a plot point on the map that marks where we believe the sign should be placed. This is based on two factors: 1) If it is a specific species, then place the sign right in front of that type of species and 2) Areas that would gain the most foot traffic, for example near the main bridge. As for deciding the specific type of sign type from Middle Creek Signs, we advise to choose the most natural and simple option, while also being aware of the financial constraints that come from how much money The Township is willing to allot to this project.

Community Involvement

As outlined by the Board of Supervisors of EBT and HRG, the engineering company that the board has contracted to work on Turtle Creek, they are only in Phase 1 of the project, and that future phases would span many years. It is an inspiring and exciting notion that Turtle Creek will endure years of careful planning and improvement to provide the community with a park that benefits all in an inclusive manner. However, it is critical that future 411 groups maintain a strong linkage between the board and the community. A large part of our role this semester has been encouraging communication between both parties, and making sure that the board is not working for the greater community, but rather with the greater community. This has included posting updates about the park in the Lewisburg Community Facebook Group to help increase visitation numbers and creating flyers to help gather volunteers for tree planting at the park. Throughout future phases of the renovation, we want to impress the importance of keeping the community's opinion and needs at the center of the project, and the need for 411 groups to help incorporate the voices of individuals in the area.

Transfer of Project Ownership

Throughout this report's section, we have mentioned numerous individuals and groups that we have worked alongside this semester, such as Jim Knight and HRG Engineering, who we hope will continue with the work we have started together. However, we are now more than enthusiastic about the future of this project because of the hope that one engaged community member has given us. Following our post in the Bull Run Bulletin highlighting Turtle Creek Park, a local resident named Brian Aumun reached out to Prof. Stuhl about the specifics of the work we have completed and inquired about the project's future once the five of us graduate. He then communicated to Stuhl that he would love the opportunity to be considered as a point person for taking over the Turtle Creek project. On May 4th, all five group members held a 30-minute Zoom call with Brian, where we discussed the work we had completed, and what we would like to see happen in the future. After our conversation, the five of us are confident that our work is in good hands, and that we will continue to see improvement of Turtle Creek's ecology, signage, visitation, and community-engagement with Brian's involvement.

Acknowledgements

We would like to extend our deepest appreciation to the faculty, staff, and community members who have volunteered their time and expertise to assist us with this project. Each one of these Bucknell professors and local experts volunteered their own time to help us navigate the precision, conservation, and mapping skills necessary for this project. Without their time and dedication, this aspect of the project would not be the shape it is in now. As this is a project grounded in community-based research, we would have never been able to accomplish our goals this semester without the continued support and help from the East Buffalo Township Community.

- First and foremost, we would like to thank Jim Knight for being our community partner while working with East Buffalo Township, and for guiding us through this journey. From our conversations both in person and on zoom, walk-throughs in the park, and constant emails, we are so grateful for your help and oversight this semester. Thank you for everything Jim, we could not have done this without you.
- The Board of Supervisors of East Buffalo Township for allowing us to attend and participate in meetings, giving us the unique opportunity to talk to community members and hear their opinions about Turtle Creek firsthand.
- Char Gray, for her continuous support and guidance, we would not have been able to finish this project without her resources, connections, and persistence.
- Janine Glathar, for her constructive and essential help in navigating ArcGIS. From teaching us how to use the navigation units, to helping us create the digital map using LiDAR imagery, we are so grateful to Janine for being such a wonderful resource for this aspect of the project.
- Professor Rich Crago for his continual help in understanding drainage issues and technology, as well as his professional recommendations and ideas concerning future implementations of drainage technology.
- Professor Matthew McTammany for his expertise on Turtle Creek from both the standpoint of an environmental biology professor and a close neighbor.

- David Hafer for his insight on the birdlife of Turtle Creek, and his help in identifying native species throughout the park.
- Jacob Bausinger for his help in identifying species throughout Turtle Creek Park and helping decide which species to highlight in our educational signage.
- Emeritus Professor Warren Abrahamson for his in-depth analysis and advice on species to highlight in Turtle Creek Park, stemming from his years of experience through his work in the Bucknell Biology department.
- Gavin Davidson for his expertise and advice in handling the drainage issues present on the park's trails.
- Last, but certainly not least, we'd like to thank Professor Andrew Stuhl for the never-ending support and motivation through this journey, and for teaching us the skills to be successful at Turtle Creek and anywhere we go after.

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Appendices

Appendix A: Supplemental Turtle Creek Park Documentation

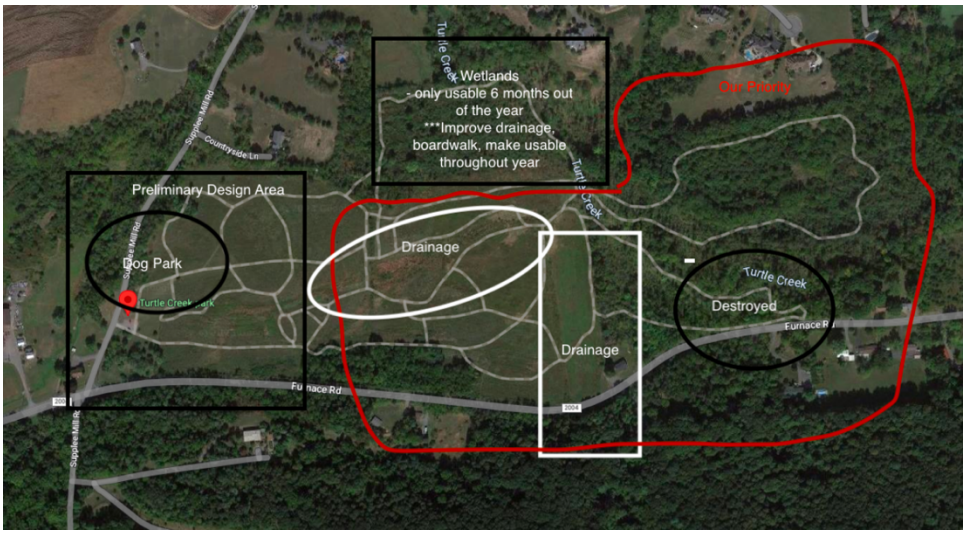

Figure A1: Initial Meeting Problem Map, created by Auden Block, n.d.

Document A2: Turtle Creek Park Acquisition Application Submission for Grant Funds:

Applicant: East Buffalo Township
Project Title: Turtle Creek Park Acquisition
Grant Program: Land Acquisition and Conservation
Date Submitted:

Advisor: M Fahringer
Phone: +1 570-401-2465
Email: mfahringer@pa.gov
Web ID: 2005624

Project Introduction	
Web ID	2005624
Project title	Turtle Creek Park Acquisition
Grant opportunity	Land Acquisition and Conservation
Project type	Community Program - Acquisition (COMM)
Advisor contacted	M Fahringer
Attended grant workshop?	Yes
Applicant Information Details	
Project applicant	East Buffalo Township
Federal ID	24-6001408
Vendor ID	141801
Address line 1	589 FAIRGROUND RD
Address line 2	
City	LEWISBURG
State	PA
Postal code	17837-8832
Locality	East Buffalo Twp
Applicant Type Details	
Applicant type	Municipality
Project Coordinator Details	
Project coordinator	Jolene Helwig
Organization	East Buffalo Township
Title	Manager
Prefix	Ms.
First name	Jolene
Last name	Helwig
Suffix	
Address line 1	589 Fairground Road
Address line 2	
City	Lewisburg
State	PA
Postal code	17837-8832
Phone	(570) 523-6320
Cell	
Fax	
Email	ebtmanager@gmail.com

Chief Elected Official Details

Chief elected official	Jim Knight
Organization	East Buffalo Township
Title	Chairman
Prefix	Mr.
First name	Jim
Last name	Knight
Suffix	
Address line 1	589 Fairground Road
Address line 2	
City	Lewisburg
State	PA
Postal code	17837
Phone	(570) 523-6320
Cell	
Fax	
Email	ebtjames@ptd.net

Project Details

Brief project description

East Buffalo Township is fortunate to have the opportunity to acquire a 79-acre parcel of land in our township for use as public park space. The property addresses a large deficit in public parkland per capita at both the county and municipal level. The most recent Union County Greenway Plan noted, “Countywide, the deficit currently stands at 217 acres which could increase to 322 acres by 2040 based on population growth projections. The single largest municipal deficit now, and projected for the future, is in East Buffalo Township, where population has increased substantially over the last several decades but the amount of community parkland has not kept pace.”

This property is located at the northeast corner of Supplee Mill Road and Furnace Road. It contains open fields, wetlands, woodlands and streams. The property is home to many deer, a variety of birds, fox and other small mammals, the occasional bear, and much more.
From 2008 – 2018, though the land was privately owned, it was open for public use under the name Turtle Creek Park. Many local residents, as well as people from around the region, enjoyed the park. In 2018, the Lewisburg Alliance Church purchased the property with the intent of building a new church complex. The church recently decided against building and approached the township about the possibility of purchasing the land, which we have successfully negotiated. Our township residents and others throughout the area are thrilled with the possibility of the Township taking ownership. Once again, the trails will be open for walking (both dogs and people!), hiking, trail-biking, cross-country skiing, snowshoeing and bird-watching. Local universities conducted studies on the land and streams. Local boy scout groups used the land for overnight camp-outs. Many lamented the loss when the park was shut down and sold to the church. This acquisition brings benefit to the broader Susquehanna Valley River area. In the past, the park welcomed visitors from Milton (Northumberland County), Williamsport (Lycoming County), Selinsgrove (Snyder County) and Danville (Montour County). Visibility as far as four counties! We will gladly share this wonderful asset with anyone who wants to enjoy it! The Susquehanna Valley Visitor's Center is ready to spread the word, noting, 'Over the last decade, the Susquehanna River Valley Visitors Bureau has focused our marketing efforts to showcase our assets and amenities to outdoor enthusiasts to establish our region as an outdoor recreation destination. We would be thrilled to add the Turtle Creek Park to our outdoor recreation assets. '
We have interest from multiple groups to help us achieve our goals. We are working with the Merrill Linn Land Conservancy to create a permanent conservation easement on the property. We are working with the Bureau of Forestry to help create a concept plan for the park. The Union County Conservation District is interested in planting trees and pollination gardens as well as help to manage the stream through the property. The Pennsylvania Game Commission has offered resources and trees for planting and offered assistance with the wildlife questions and management. We are excited to be able to return this land to an open space, passive use park for our community and the surrounding area.

Is statewide?	No

Primary location	Union
Is fee acquisition?	Yes
Is conservation easement?	No

Describe the negotiations had with the current landowner of the property

In 2018, the Lewisburg Alliance Church purchased the property known as Turtle Creek Park from a Boy Scout Organization. In 2022, when the church decided not to build as planned, they reached out to East Buffalo Township. The Lewisburg Alliance Church had previously told an EBT Township Supervisor that although they had purchased all 79 acres, they really only needed about 20 acres for their church. EBT expressed interest and the church and EBT agreed to 'stay in touch.' Once East Buffalo Township supervisors were notified of the chance to purchase the property, we proceeded with getting a certified land appraisal. Once we received the appraisal, we made an offer to the church and ultimately agreed upon a price. Following the verbal agreement, East Buffalo Township held a public hearing to gauge support from township residents. Community support to purchase the property was overwhelming. Prior to the public hearing, the township received numerous letters in support of the purchase - from residents as well as local organizations, as well as county and state groups. The township supervisors made a motion at the next township meeting to have the solicitor prepare and send a sales contract to the church. The contract was signed in October, with a 60 day or less close date. (Note actual number of acres varies from official document to document; it is between 78 and 79 acres).

Specific rights to be acquired and any rights severed from the property

East Buffalo Township will have all rights to the property.

Improvements or structures?	No

It is a wonderful combination of untouched open space - meadows, woodland, wetlands and streams.

Any environmental hazards?	No

No known hazards. This land had once been part of a larger farm in the area, but has not been farmed since the 1980s. Over the years, the farmland became fields of shrubs, trees and grasses.

Waiver for retroactivity?	Yes

Project Locations

Turtle Creek Park

Description	78.8 acres on the corners of Supplee Mill Road and Furnace Road in Lewisburg PA		
Site ID	01	**Leased**	No
Parcel #	002-044-087.00000	**Owner**	Lewisburg Alliance Church
Address 1	137 Supplee Mill Road	**Latitude**	-60.70413636
Address 2		**Longitude**	44.92949124
City	Lewisburg	**Acres**	78.80
State	PA	**Length**	0.7500000000
Zip Code	17837-8200	**Other Agr?**	No

Project Criteria Questions

Briefly describe your project needs, benefits, and urgencies and how they will be addressed through your proposed scope of work.

NEEDS: East Buffalo Township is fortunate to have the opportunity to acquire a 79-acre parcel of land in our township for use as public park space. The property addresses a large deficit in public parkland per capita at both the county and municipal level. The need was identified by the county and multi-municipal comprehensive plans, the county greenway and open space plan and confirmed by a recreation and parks consultant the township engaged. The recent Union County Greenway Plan noted, “Countywide, the deficit for municipal parks currently stands at 217 acres which could increase to 322 acres by 2040 based on population growth projections (Federal prison inmates were factored out for this calculation). The single largest municipal deficit now, and projected for the future, is in East Buffalo Township, where population has increased substantially over the last several decades but the amount of community parkland has not kept pace.” Since 1990 township population has increased by 41% (29% since 2000) while the amount of publicly accessible parks and open space remained the same and well below recommend levels.

For the past several years, East Buffalo Township has been struggling to address the park deficit issue due to there being very few properties available for acquisition that would be large enough for a regional community park (minimum of

25 acres) and because of escalating land costs. This land 'checked many of the boxes' of our criteria including: amount of land available, ability for multi-use and purpose, accessibility to township residents, support of township residents, long-term maintainability and sustainability, and a willing seller.

BENEFIT: This property is located at the northeast corner of Supplee Mill Road and Furnace Road, a section of the township easily accessible from all areas. It contains open fields, wetlands, woodlands and streams. The property is home to many deer, a variety of birds, forest mammals, the occasional bear, and much more. At a recent public hearing regarding the property, dozens of residents noted overwhelming support to 'bring the park back to how it used to be.' How it used to be was a privately owned dog park that was open to the public from 2008 to 2018 before it was sold to a local church and it included trails for walking (both dogs and people!), hiking, trail-biking, cross-country skiing, snowshoeing and bird-watching. Local universities conducted studies on the land and streams. Local boy scout groups used the land for overnight camp-outs. Many lamented the loss when the park was shut down and sold to the church. This acquisition brings benefit to the broader area, county and Susquehanna Valley River area.
Green outdoor spaces add value to the community. It provides us with beauty and brings us closer to nature, which has health and psychologic benefits. Green spaces like Turtle Creek Park have environmental benefits as well by adding oxygen producing plants that reduce carbon dioxide in our air, provide proper drainage of rainfall runoff, and provide a haven for wildlife and biodiversity.
Natural areas are aesthetically pleasing and attractive to people. They enhance our world and attract residents, visitors, and even investors to the region. They enhance quality of life of residents and visitors and provide much needed opportunities for leisure and fun activities. Data shows that these spaces improve public health, relieving mental fatigue and diminish feelings of aggression and violence.

We are fortunate to have interest, awareness and overwhelming support from multiple groups to help us achieve our goals. We are working with the Merrill Linn Land and Waterways Conservancy to create a permanent conservation easement on the property. We are working with the DCNR Bureau of Forestry to help create a concept plan for the park. The Union County Conservation District offered support in planting trees and pollination gardens (plant it and they will come. The butterflies!) as well as help to manage the stream and erosion control through the property. The Pennsylvania Game Commission has offered resources and trees for planting and offered assistance with wildlife questions and management. The local Audubon Chapter, Sierra Club, and Susquehanna Greenway Partnership have all enthusiastically embraced this acquisition as it helps to support and enhance each of their missions and visions. We are excited to be able to return this land to an open space, passive use park for our community and the surrounding area. Furthermore, acquisition of this land and restoring the property to public use will provide close to home recreation in an area of East Buffalo Township that has been identified as a high need by DCNR for providing parks and recreation opportunities within 10 minutes of where people live. Additionally neighboring Union Township to the south has no public parks and the greater Lewisburg area and eastern Union County have no dog parks.
Lastly the conservation of this property will benefit the greater Turtle Creek Watershed, which is designated as an impaired stream by the Pennsylvania Department of Environment Protection (DEP), by building upon prior land conservation and watershed restoration investments. The Union County Agricultural Land Preservation Program has preserved 1,200 acres of farmland west of this site through permanent conservation easements. Additionally, the Union County Conservation District working in tandem with DEP and other conservation partners has done extensive stream restoration work on Turtle Creek. Refer to this Story Map for more details on the watershed work that has been done: https://gis.dep.pa.gov/TurtleCreek/index.html. The organization Trout Unlimited, whose mission is in 'Protecting, Conserving & Restoring Pennsylvania's Coldwater Resources' in conjunction with Bucknell University's Environmental Science Program (see letter attached) would like to conduct water quality and stream projects to improve the habitat for fish, especially trout. An older gentleman walking the park with us one afternoon commented that when he was a boy, he used to fish for trout in Turtle Creek. Hopefully, this will be a possibility once again!
The acquisition of this site by East Buffalo Township will contribute to the larger conservation landscape in this area and will protect over 3,500 linear feet of Turtle Creek, 22 acres of the 100-year floodplain, the riparian corridor and associated wetlands. There will be opportunities for partner organizations to undertake additional stream restoration work and to demonstrate best practices.

URGENCY:
From 2008 – 2018, the land, though privately owned, was open for public use under the name Turtle Creek Park. In 2018, the Lewisburg Alliance Church purchased the property with the intent of building a new church complex. The church recently decided against building and put the land up for sale. They approached a number of potential buyers, including the township, and said that they wanted to sell quickly to get out from under the mortgage on the property. The urgency is time is of the essence and if East Buffalo Township did not purchase the property, someone else would have. This land is zoned Agricultural Residential, which allows for several types of development, including low density residential which could carve the land into 25 large lots. The real estate sales in the Lewisburg area have been very strong and available properties are short lived on the market. As we know, there are a lot of things that can be manufactured and produced, but open space land is not one of them. When it is developed, it is gone and there is no turning back.

The township contracted with a licensed land appraiser to conduct an appraisal, and successfully negotiated a sale price with the church. The township is in the process of finalizing the sale within the next 30 days. Please see attached draft Sales Agreement. East Buffalo Township requested and received a 'Waiver of Retroactivity' from DCNR for this acquisition. Please see attached approval letter.

Also adding to the urgency is the township has been able to secure matching funds for this project that may not be available in the future and the municipal political climate is currently conducive to acquiring the property. Both of these could change if the project is not advanced now.

Describe how your project will help to reduce the severity of current and future climate impacts through green and sustainable practices. Green and sustainable practices should be referenced in the project budget, scope of work, and site plan as applicable.

The project reduces the severity of current and future climate impacts through green and sustainable practices by preserving the property as undeveloped open space. The parcel will be placed in a permanent conservation easement held by the Merrill Linn Land and Waterways Conservancy. The property is zoned Agricultural-Residential allowing for the construction of single-family homes, churches, schools, and indoor recreation facilities. Such development would increase stormwater runoff, flood risk, and erosion and sedimentation caused by more intense weather events thereby further degrading water quality. Keeping the land in open space as a public park will protect the wetlands and the natural floodplain which provide critical water quality and groundwater recharge functions. The project will also prevent increased carbon emissions associated with additional vehicle traffic and building heating and cooling that would result from development.

The project will sequester carbon through the preservation of existing forest and vegetation. The Township will work with the Bureau of Forestry, Bucknell University, and other local conservation groups on a restoration plan to replant native trees and meadow plants in areas that were cleared during the past four years. This effort will increase the carbon absorption capacity of the land.

The Department is a strong proponent of public access for property acquired with grant funding and/or maintained with equipment acquired with grant funding. Briefly describe the anticipated level of public access for each property/easement to be acquired and/or maintained and what benefits will be realized by the proposed level of access.

Once acquired the site will be open to the public as a township park. This acquisition will secure, in perpetuity, the following public access benefits: 1) Provide opportunities for recreational activities and accessibility for all ages. Walking (both dogs and people!), hiking, trail-biking, cross-country skiing, snowshoeing, model airplane flying, kite-flying, horseback riding and bird-watching will once again be enjoyed by all. Although most of the trails are grass/dirt, we plan to have one ADA accessible trail near the entrance of the park. 2) The site will remain available for environmental education and nature study opportunities, for local schools, Bucknell University, Susquehanna University, and conservation organizations. This area had previously been used as a field study site for Bucknell University students studying biology and stream ecology. 3) Groups like the Audubon Society will be able to again conduct bird observation talk/walks at this park. 4) Local boy scout groups can once again use the land for overnight camp-outs, eagle scout and other volunteer projects. 5) Home school student groups will once again be able to use the park as a meeting site.

The benefits derived by the access will be numerous. It will provide a place for residents and their fury friends to unwind from the stress of daily life in a natural setting. As noted earlier there are no dog parks in proximity to East Buffalo Township and the greater Lewisburg area. In fact, some nearby municipalities prohibit dogs in their parks.

There has been much written about Nature Deficit Disorder in recent years and a project like this will provide opportunities for people to reconnect with nature close to home. Outdoor recreation also provides a public health benefit as park users engage in physical exercise to improve fitness and promote healthy outcomes by combatting obesity, diabetes, hypertension and other diseases that are exacerbated by sedentary lifestyles.

The environmental education benefits will be realized for decades to come as youth and adults use the site to learn about nature and witness firsthand conservation best practices for improving wildlife habitat, biodiversity, restoring native plants and trees, water quality, protection of floodplains and wetlands, etc.

Describe in detail how the public has been and/or will be engaged in the planning, design, implementation, long-term maintenance, and/or stewardship of your project (i.e. - public meetings, press releases, volunteer days, etc.).

As soon as the Township completed preliminary negotiations with the Church, and certainly before the Township made any final decisions, we held a public forum to discuss the acquisition. Notice of the meeting was advertised through the local newspaper and website. The residents present at the meeting showed overwhelming support in favor of the purchase. Many remembered the land as a park before the church had purchased it in 2018 – and enthusiastically hoped that this land would revert to a park once again. The township created and posted on our website an FAQ document to address questions raised and answered at the initial public meeting. Questions included: 1) How will we pay for it? 2) Will you raise my taxes? 3) Why do we need it? 4) What will be the park hours? etc. This allows for additional information to be available to those who could not or do not attend the meetings. Please see attached FAQ document. The township also received dozens of emails, letters or direct support for the acquisition. Please see attached for some of the resident letters of support. During the meeting, multiple residents offered suggestions for park maintenance, and the long-term planning, and the township is reaching out to residents for additional discussions. The township has discussed creating a resident committee, as we have done with other park projects, to solicit additional input. The two local newspapers have run several stories about the park since the initial public meeting.

Also, Union County conducted significant public outreach and involvement for the development of the Union County Greenways Plan including a steering committee that included East Buffalo Township residents, public meetings, online surveys and key person/stakeholder interviews. Those public engagement efforts revealed that land preservation, protecting riparian areas, and community parks were a high priority for residents. 94% of survey respondents agreed that protecting natural resources and open space is important and 83% agreed that it is appropriate for local governments to spend tax dollars on open space and parks.

Explain how your project will implement the Actions in *Recreation For All*, the 2020-2024 PA Outdoor Recreation Plan, pages 85-91 and/or the 2020-2024 Pennsylvania's Land and Water Trail Network Strategic Plan.

As noted earlier, East Buffalo Township was specifically called out in the Union County Comprehensive Plan and the County Greenway Plan as having a deficit in park space. The township, with about 7400 residents as per the 2020 US Census, only has about 16 acres of park space. This acquisition will fill that gap and be a great first step in making Recreation accessible to all! The land provides opportunity for a variety of recreational activities, for all ages and abilities.

Specifically, the project will further the RECREATION FOR ALL: Ensuring Equity in Access to Pennsylvania's Outdoors, by providing trails for all age groups and abilities.

- We will address 2a (incorporate universal design practices to improve access for people of all abilities) when planning an ADA accessible trail near the front of the park where the land is relatively flat. Following standard design practices (see example guidelines noted in the AllTrail Disability Accessible Trail guide attachment) such as type of surface, maximum height for tread obstacles, minimum trail width and max side-to-side grade will ensure wheelchairs can safely maneuver the trail.
- This type of ADA accessible trail will certainly also be a welcome feature for people with strollers, bikes and trikes which addresses 2e, developing and promoting easy trail loops. Lana Gulden from the local Sierra club, however, walked even some of the more hilly trails with us to view the property. As she noted, she could not think of a better way to spend her 79th birthday!
- Additionally, as we plan the park concept design we are encouraging input from potential users such as the Audubon Society, Sierra Club, Merrill Linn Land and Water Conservancy and local residents which addresses 2C, engage diverse users in the management, planning and design of the outdoor recreation spaces and access opportunities. As with other projects we've pursued in the township, we plan to form a citizen committee for ideas and input.

The project will further the Sustainable Systems goal by protecting and conserving lands and waters. Specifically, this acquisition addresses and supports

- 2c (native plants, pollinators in outdoor recreation areas) by working with our state forestry department to assist with a park design that will include using only native plants and trees, create pollinator gardens and provide a riparian buffer along the creek. We would like to put one pollinator garden near or through the ADA accessible trail. Not surprisingly, one of the first questions we get from most of the local groups we have approached is whether we intend to plant native trees, bushes and grasses. Our answer is always yes!
- 2e (Conserve 100,000 acres of land with a priority on climate resilient landscapes. About 30-35 acres of the land was clear-cut 4 years ago in anticipation of the church building a large facility. When this occurred many birds and small animals lost their habitats. We are working with the Union County Conservation District and the Bureau of Forestry to strategically design and re-plant to help ensure biodiversity and healthy ecosystems. Turtle Creek meanders through the property, and flows directly into the Susquehanna River. Shoring up the creek banks will ensure that further erosion is kept in check.
- 2f. (Plant 100,000 trees in outdoor recreation areas). We have had multiple groups offer to help plant trees, and once we have a finalized concept plan, we will certainly take them up on it! This is a great project for both boy and girl scout organizations. Bucknell, the local university in town, also requires students to do community outreach and service. This will be a great project in which to engage them as long as we start after lunch!

• 4.a (Design outdoor recreation areas to minimize impacts on the environment by investing in green infrastructure to create more resilient and sustainable recreation facilities and areas that will support multiple community needs. We are including language in the conservation easement with Merrill Linn Conservancy to allow for only a relatively small percentage of impervious space in the park. We don't plan for kids to be playing on pavement in this park; we hope that they go home with grass-stained knees! Please see pictures of the park included.

This project will support the Pennsylvania Land and Water Trail Network Strategic Plan
by providing trails for walking and hiking. The plan notes: 'One thing we learned from 2020 that many of us in the "recreation business" already knew: trails are a vital part of our mental and physical health. By helping us explore nature and our communities, the trails of Pennsylvania were there to help us get through a year full of unknowns, surprises, firsts, and changes.' The property has about 3 miles of multi-use (walking, biking, cross-country skiing, snowshoeing) trails that are maintained, and we hope to re-open about another 3 miles that has grown over in the past 4 years since the church took ownership of the property.

The Bureau priorities that are being addressed are: 1) providing recreation access in an area identified as high and medium need in East Buffalo Township by the DCNR Webmap, including providing access to low-income households, senior citizens, minorities, and the disabled; 2) implementing watershed restoration, and 3) acquiring lands that enhance climate resiliency and/or recreational access to existing public lands.

We'd like to put this saying on our Welcome sign at the park entrance:
If your doctor prescribed a walk rather than a pill, would you take it? (Yes!)

East Buffalo Township has reached out to numerous area organizations and agencies (Merrill Linn Conservancy, Sierra Club, Susquehanna Greenway Partnership, Audubon Society, Union County Conservation District, Pennsylvania Game Commission) to support our grant application. All recognize the potential to enhance healthful recreation opportunities in the region and the important conservation value of this project. Please see the attached letters of support. Please also see the numerous letters of support from residents.

Do you have written operations and maintenance plan or stewardship plan for your park(s), trail(s), property (ies), and/or equipment?

Yes

The Department requires that the site be properly maintained, kept in reasonable repair, and open and accessible to the public throughout its useful life. For equipment purchases, the Department requires that the equipment be properly maintained and kept in reasonable repair throughout its useful life. Please describe your strategy to operate, maintain, and/or provide stewardship to your project.

The township is expected to take ownership of the land in November 2023. The Township does not currently have a written maintenance or stewardship plan for parks and trails. A draft maintenance plan specific to this property is attached.

The Township will work to develop a Stewardship Plan with the assistance of
• Merrill Linn Conservancy. Please see attached draft Conservation Easement which we are working to complete with the Conservancy. Section 2 of the agreement defines the purpose of the conservation easement and is the key to a Stewardship plan: To assure that the Land will remain predominantly undeveloped and provide, for the public, open space benefits, to include maintaining and improving the quality of water resources, both surface and ground water, including the replenishing of their supply; establishing and protecting scenic views and vantage points for those views; preserving existing, planned and potential outdoor public recreation and conservation areas; preventing and reducing floods; providing natural habitat for animals, plants, and fungi; preventing the loss and depletion of soal; encouraging the planting and nurturing of plant and animal species that are native to this area; preserving features of historic, geologic or biologic significance; providing opportunities for education and research; and providing open space within and around developed lands.
• Bucknell University When the property had been a park previously, Bucknell University was actively involved in some planning aspects of the park. In fact, an Engineering group designed and built the wooden bridge that still exists across the creek. Bucknell's Center for Sustainability and the Environment (BCSE) has conducted ecology studies over the years. .During these projects, the students collected data on the stream including water chemistry/quality, biological surveys, of insects and fish, and also habitat and geological assessments, and so they have some good background data on the stream. They would like to get involved in an actual stream restoration project. (They are hopeful that the stream could be a candidate for trout stocking, which would be a terrific local resource for kids and others to eventually fish in some sections of the creek).
• Union County Conservation District have experts in the areas of stream restoration and the Chesapeake Watershed, which we will utilize for stream restoration knowledge, guidance and actual work efforts.
• DCNR Bureau of Forestry representative has walked the property with us several times, and is in the process of putting together a design concept plan (please see attached concept plan). He will address the 30 acres of the land that was clear-cut by the church. He will also address the section of wetlands, the riparian border along Turtle Creek. He will identify a possible route for an ADA trail, as well as sites for pollinator gardens.
• Other local and state entities. Entities such as the local chapter of the Audubon Society and the Sierra Club have expressed interest in providing guidance for pollinator gardens, planting of native trees and plants.

We anticipate completing the Stewardship Plan within one year of acquiring the property.

Project Plans

Priority	Date	Title
True	12/16/2021	Snyder and Union Counties Countywide Action Plan (CAP)

Union County Countywide Action Plan (CAP) for the Chesapeake Bay Watershed is a plan developed by the Union County Conservation District with the assistance of DEP to reduce sediment and nutrients entering local streams and ultimately the Chesapeake Bay. The CAP specifically recommends land conservation and riparian buffers as key tools to improve watershed health. As noted elsewhere in the narratives, a key creek (Turtle Creek) runs through this property and flows directly into the Susquehanna River. The conservation of this property will benefit the greater Turtle Creek Watershed, which is designated as an impaired stream by the Pennsylvania Department of Environment Protection (DEP), by building upon prior land conservation and watershed restoration investments. The Union County Agricultural Land Preservation Program has preserved 1,200 acres of farmland west of this site through permanent conservation easements. Additionally, the Union County Conservation District working in tandem with DEP and other conservation partners has done extensive stream restoration work on Turtle Creek. This project supports Action Items 1.1A, 1.4, 3.8, 3.9 and 3.10 of the CAP.

False	12/15/2009	Cultivating Community: A Plan for Union County's Future; Union County's Comprehensive Plan

Cultivating Community: A Plan for Union County's Future: The acquisition project advances the System Integrity sustainability key for the Natural and Agricultural Resources section of the plan by maintaining the integrity of woodlands, waterways, wetlands, animal and plant habitat and open space. This acquisition also prevents scattered development which was noted as a concern in the Natural and Agricultural Resources and Land Use chapters. Natural Resource Goals include managing forests for long-term sustainability, protecting water resources, protecting greenway corridors, etc. Strategy 4.2 specifically mentions the Merrill W. Linn Land and Waterways Conservancy working with landowners on acquisitions. Strategy 5.3 Land Use Goals notes protecting and preserving Union County’s valued natural resources (e.g. streams, wetlands, bird and animal habitat), woodlands, and open spaces.

False	01/01/2022	Keystone 10 Million Trees Partnership

The Keystone 10 Million Trees Partnership is a collaborative effort of national, regional, state, and local agencies, conservation organizations, outdoors enthusiasts, businesses, and residents committed to improving Pennsylvania's communities, economy, and ecology. The Union County Conservation District, Bucknell Center for Sustainability and the Environment, and the Lewisburg Neighborhoods Corporation are all partners in this effort, with whom we shall work to acquire trees. As noted in the plan, streamside buffers that reduce, filter, and absorb runoff provide the greatest return when it comes to reducing the amount of pollution entering our waterways. We look forward to noting in our park Kiosk that we were part of the effort to plant the trees in which our little footprint had an impact on the Chesapeake Bay nearly two hundred miles away.

False	01/03/2017	Greenways of Union County: Preserve+Connect+Enjoy Plan

Greenways of Union County: Preserve+Connect+Enjoy Plan Implementation number L-10 under Land Preservation states the following as an implementation action: "Make strategic additions to the state forest and other public lands. Partners listed were the Merrill Linn Conservancy and DCNR. Additionally, the plan supports and recommends the conservation of priority open space and greenways. Also it should be noted that public participation, via surveys and public meetings, revealed that members of the community identified land preservation as the top priority for investing in greenways and open space.

False	08/23/2010	Multi-Municipal Comprehensive Plan

The Multi-Municipal Comprehensive Plan for East Buffalo Township, Kelly Township, White Deer Township and the Lewisburg Borough (Eastern Planning area) promotes the Natural Resources and Land Use goals of the plan including the protection of water resources, riparian corridors, wildlife habitat, etc. and is consistent with previous maps that showed the area as a park. It also promotes the community facilities and recreation and parks goals and objectives of the plan. The plan reinforces Quality-of-life for residents in Union County is enhanced through diverse and accessible opportunities outdoor recreation in natural settings. The action in E-42 notes participation in regional park and recreation initiatives (e.g., network of recreational providers, regional parks and open space plans). Turtle Creek Park, prior to the church purchasing the property, was specifically called out in E-44 (Consider investing in Special Use Parks in the Eastern Planning Area (e.g., Turtle Creek Park, Kelly Township Ball Fields, Riverwoods Soccer Fields, White Deer Neighborhood Park) to better meet the park and recreational needs of future residents. Potential investments include: expand the availability of active/passive uses; update facilities to accommodate more users; improve accessibility to meet ADA requirements). Availability of outdoor recreational opportunities ranks high among residents as a strength of the County. Note: Part 3 Partnerships for Implementation is included in the Documents section.

False 01/01/2022 Linking Landscapes Initiative/Merrill W. Linn Waterways and Land Conservancy

Merrill W. Linn Waterways and Land Conservancy. This acquisition project enhances the mission of the Merrill Linn Conservancy to preserve and protect significant ecological sites in Union, upper Northumberland, and neighboring counties and to engage the public on conservation issues critical to the health of our environment. Merrill Linn is assisting the township in creating a conservation easement for this property. Through the Conservancy's Linking Landscapes Initiative, this will enhance habitat and wildlife protection by measurably increasing the number and extent of protected natural spaces and ecosystem corridors in our service area; engage measurable numbers of residents in the Conservancy's mission and work and encourage them to actively appreciate and nourish their connections with the natural environment; develop the long-term capacity, in terms of both financial and human resources.

Project Partners

Organization	General	Financial	Technical
Charles Degenstein Foundation	No	Yes	No

Charles B. Degenstein Foundation is a regional charitable organization whose mission is to improve the quality of people's lives through support of organizations that have a clear mission to promote and encourage progress in conservation and environmental work, education and enhancement of communities. The Degenstein Foundation has provided East Buffalo Township with a grant of $300,000 that is being used for our local matching funds. One board member has a particular interest in this park, as her father was one of the initiators of the original Turtle Creek Park back in 2008. She was heartbroken when the park was sold to the church. We have attached a copy of the $300,000 check and letter from the Charles B. Degenstein Foundation.

Union County Commissioners	Yes	No	Yes

Union County Commissioners – It is helpful to have the support of the local elected officials who represent a governmental entity and taxing body. Their letter of support for this acquisition notes that 'the county agricultural land preservation program has preserved via conservation easement over 1200 acres within the Turtle Creek watershed upstream of this parcel. This proposed township project would build on that prior conservation work.'

Union County Planning Department	Yes	No	Yes

Union County Planning Commission. The UC Planning Commission is the lead planning agency for the county and has historically provided technical assistance to the municipalities on projects, including providing guidance on the grant application process. The Planning Commission also has been a key partner in helping to identify conservation priorities and properties to target for conservation easements and acquisition.

Sierra Club	No	No	No

Sierra Club – The Sierra Club has been promoting the protection of 'wild' places for over 125 years. The organization encourages the exploration and enjoyment of wild places and encourages the protection and restoration of the natural environment. The local chapter is an advocate for this project and understands the value of conserving the property for future generations. We walked the park with one of the Board members who was celebrating her 79th birthday. She said that walking the park was the best present she had received that year!

Seven Mountains Audubon	Yes	No	No

Seven Mountains Audubon, local chapter of the National Audubon Society – The Audubon's mission is to protect birds and the places they need, today and tomorrow; to conserve and restore natural ecosystems, focusing on birds and their habitats, for the benefit of humanity and the earth's biological diversity. Seven Mountains noted the value in preserving this open land for the preservation of wildlife habitat, and additionally providing sustained public enjoyment of this natural resource. The local group is interested in providing bird resource information such as local birds (for use in a kiosk), conduct bird-watching walks, and suggest bird friendly plants as we repopulate the clear-cut areas.

Susquehanna River Valley Visitor's Bureau	No	No	No

Susquehanna River Valley Visitor's Bureau is the regional tourism promotion agency and has been strategically working to enhance outdoor recreation and tourism. SRVVB understands the value of having an abundance of pristine natural resources to support the tourism industry and local economy. Their marketing and outreach abilities will help to 'spread the word' about this new gem within Union County and the Susquehanna River Valley. Their website and literature highlight outdoor recreation areas and the natural beauty of our Valley. They understand the importance of what we have to offer. As is stated on their website: "Now I see the secret of making the best person; it is to grow in the open air and to eat and sleep with the earth." - Walt Whitman

Department of Forestry	Yes	No	Yes

The DCNR Bureau of Forestry has been promoting forestry and the knowledge of forestry by advising and assisting other government agencies, communities, landowners, forest industry, and the general public in the wise stewardship and utilization of forest resources. Jeff Osborne, from the Bureau of Forestry, has started to do exactly that for East Buffalo Township and this park. Jeff has just taken on a new position within the Bureau of Forestry and hasn't been replaced yet, but we will work with Jeff's replacement to complete the concept plan for the reestablishment of trees and plantings in the park started with Jeff. We've included a sample of the work which Jeff started for us. He has ideas for some tree groves. He has also GPS'd existing trails in the park. Jeff also noted that the Bureau of Forestry would like to use the park to conduct studies, for which we gladly endorse.

Bucknell University - Center for Sustainability and Environment	Yes	No	Yes

Bucknell University – Bucknell University and Bucknell Center for Sustainability and Environment have a long history of activities in the Turtle Creek Watershed and especially this property. Since 1980, faculty have been taking biology, geology and civil engineer classes to this property to explore ecological succession (e.g., former crop-to-meadow-to-forest), geomorphic landforms, historic mill dams and legacy sediments, stream restoration, watershed hydrology, aquatic ecology (aquatic insects and fish), terrestrial ecology (bird and mammal populations). We expect these to continue, but could envision additional activities. See the attached Letter of Support for additional details.

Union County Conservation District	Yes	No	Yes

Union County Conservation District noted the unique opportunity East Buffalo Township has to protect and preserve this important piece of property in Union County – with the property filled with various native trees, meadows, wetlands and woodlands. The District is willing to plant trees and pollinator gardens. Additionally, their Watershed and Chesapeake Bay experts would like to continue the stream restoration work they have started upstream on Turtle Creek.

Agricultural Land Policy

Active agricultural use?	No
Agricultural use in last 3 years?	Yes
Prime agricultural land?	Yes
Cause irreversible conversion?	No
Only feasible site available?	Yes

While the current owner leased a portion of the site to a farmer and harvested sorghum in 2021 it was not farmed this year. The current property owner planned to develop the property into a new church, parking lot, with significant stormwater requirements. The township is acquiring the property to preserve it as open space and is in the process of working with Merrill Linn Land and Water Conservancy to put a conservation easement on it. As such the project will not result in an irreversible loss of prime agricultural land. There is no similar land available in East Buffalo Township. Prior to the church's acquisition, the property had been a park (named Turtle Creek Park), which so many residents, organizations have enthusiastically supported.

Project Budget

DCNR Request	685,726.00

Match Amount	171,431.00
Total Project Cost	857,157.00
Percentage of Match	20.00
Project Authorization	
Appointed Title	East Buffalo Township Chairman
Appointed Email	ebtjames@ptd.net
Signed by	James C. Knight
Date signed	10/25/2022

Appendices

Appendix A: Supplemental Turtle Creek Park Documentation

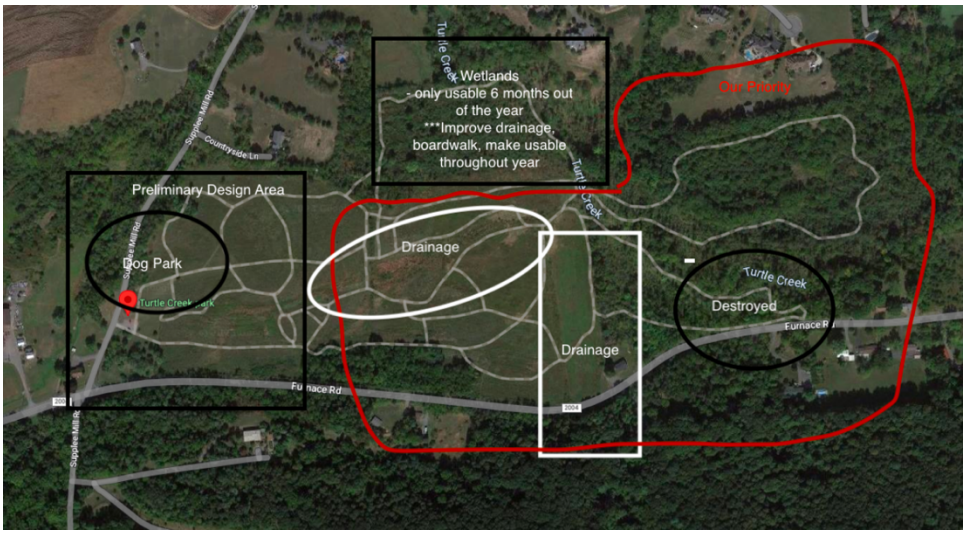

Figure A1: Initial Meeting Problem Map, created by Auden Block, n.d.

Document A2: Turtle Creek Park Acquisition Application Submission for Grant Funds:

Appendix B: Visual Examples of Different Types of Park Signage:

Figure B1: Park Maps. ("Map Signs". Vacker Sign Signs for Parks and Trails. 2023. https://vackersign.com/products/map-signs/)

Figure B2: Information/Bulletin Boards. (Lee, Anthony. *Lackawanna River Heritage Trail Sign.* Rails to Trails Conservancy. https://www.railstotrails.org/build-trails/trail-building-toolbox/design/signage-and-surface-markings/)

Figure B3: Educational/Interpretive Signs. (Pulse Design Inc. *The Hill School Schoolyard Ecosystem.* Interpretive Trail Signs Created for Parks & Urban Habitat. http://www.pulsedesign.com/outdoor-interpretive-signs-parks-urban-habitat-nature-conservation)

Figure B4: Directional Signs. (ISF Designs. *Wayfinding Directional Signs*. 2017. https://www.isfsigns.com/exterior-signs/wayfinding-directional-signs/)

Appendix C: Nature Based Stormwater Runoff Management

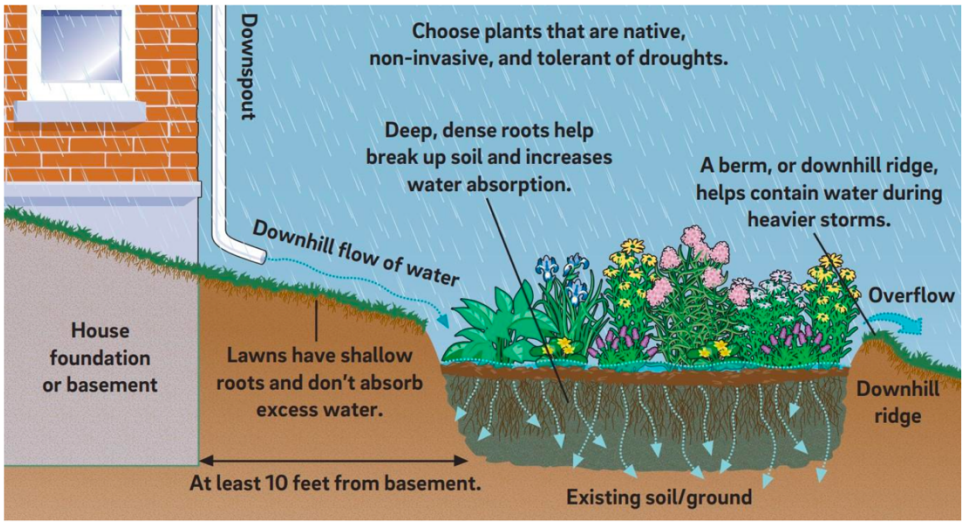

Figure C1: Rain Gardens. (Philadelphia Water Department. *Green Stormwater Infrastructure: Rain Gardens.* 2023. https://water.phila.gov/gsi/tools/rain-garden/)

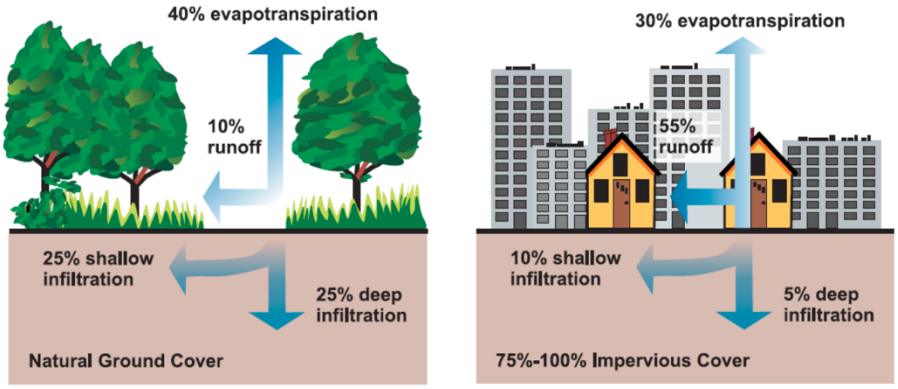

Figure C2: Street Trees. (Home & Garden Improvement Center. *Trees for Stormwater Management.* Clemson College of Agriculture, Forestry, and Life Sciences. 2020. https://hgic.clemson.edu/factsheet/trees-for-stormwater-management/)

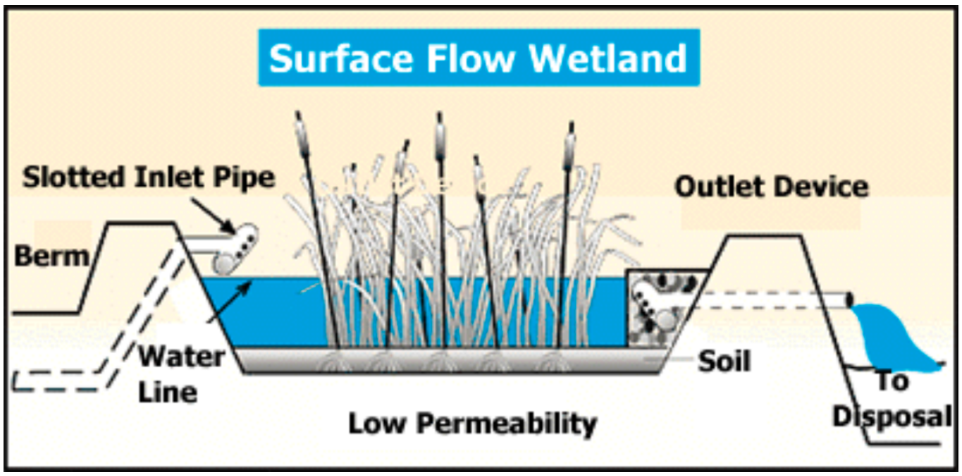

Figure C3: Constructed Wetlands. (Tilley et. al. *Constructed Wetlands.* Federal Remediation Technologies Roundtable. 2014. https://www.frtr.gov/matrix/Constructed-Wetlands/)

Figure C4: Wet Meadows. (Kost, Michael A. *Northern Wet Meadow.* Michigan Natural Features Inventory. Michigan State University Extension. https://mnfi.anr.msu.edu/communities/description/10663/northern-wet-meadow)

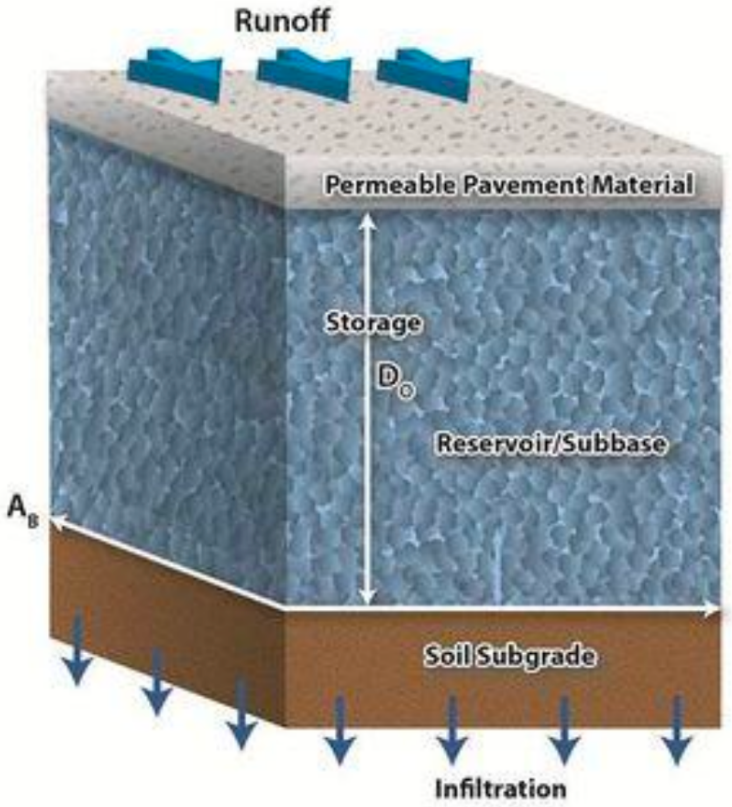

Figure C5: Permeable Pavement. (Minnesota Stormwater Manual. *Calculating Credits for Permeable Pavement.* 2022. https://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_permeable_pavement)

Figure C6: Vegetated Rooftops. (Setherton. *Green Roof Construction: How To Guide.* Permagard. https://www.permagard.co.uk/advice/green-roof-construction)

Figure C7: Streamside Forests. (Alliance for The Chesapeake Bay. *Streamside Forest Buffers are Important for Water and Wildlife.* 2017. https://www.allianceforthebay.org/2017/05/streamside-forest-buffers-are-important-for-water-and-wildlife/)

Appendix D: HRG's Turtle Creek Community Survey

East Buffalo Township Citizen Survey – Turtle Creek Park – Phase 1 Master Plan

East Buffalo Township recently acquired Turtle Creek Park as an open-space passive use recreation park. For those unfamiliar with the property, these 79 acres are located at the northeast corner of Supplee Mill Road and Furnace Road. The land includes a mix of open fields, wetlands, woodlands, and streams. From 2008 - 2018, though the land was privately owned, it was open for public use under the name Turtle Creek Park. A church purchased the land in 2018, and then in late 2022, East Buffalo Township acquired the land.

We are actively seeking the input of East Buffalo Township residents and park users to help us create a vision for the future of Turtle Creek Park. We plan to restore/develop the park in phases.

* Phase 1 encompasses the existing gravel parking lot, former fenced dog area (80' x100'), approximately ½ mile of trail section closest to the parking lot, and additionally will include a pavilion/picnic area, and pollinator gardens. See the map below for the location of Phase 1 Park project.

* Future phases will encompass the balance of the park land. Please see map below.

Figure D1: Turtle Creek Community Survey Pg. 1

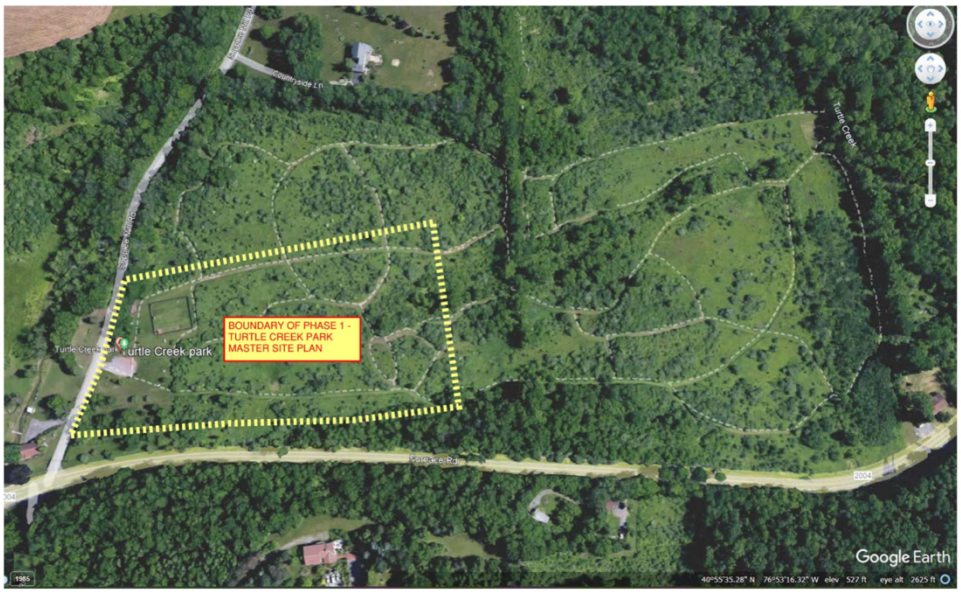

Figure D2: Turtle Creek Community Survey Pg. 2

1. Please take some time to complete this survey and tell us what you think about the park, what we can do better or what you would like to see developed. All responses are anonymous unless you would like to provide your contact information. Your assistance is greatly appreciated.

Name

Email Address

Phone Number

2. How important is recreation to you and your family?

- ◯ Very Important
- ◯ Important
- ◯ Somewhat
- ◯ Not at all Important

Figure D3: Turtle Creek Community Survey Pg. 3

3. Please select the number of males in your household in each age group.

	1	2	3	4	5	6
0-9	◯	◯	◯	◯	◯	◯
10-19	◯	◯	◯	◯	◯	◯
20-34	◯	◯	◯	◯	◯	◯
35-59	◯	◯	◯	◯	◯	◯
60+	◯	◯	◯	◯	◯	◯

4. Please select the number of females in your household in each age group.

	1	2	3	4	5	6
0-9	◯	◯	◯	◯	◯	◯
10-19	◯	◯	◯	◯	◯	◯
20-34	◯	◯	◯	◯	◯	◯
35-59	◯	◯	◯	◯	◯	◯
60+	◯	◯	◯	◯	◯	◯

Figure D4: Turtle Creek Community Survey Pg. 4

5. Please indicate your family's length of residency in the Township by checking the appropriate box below.

- ◯ 0-1 year
- ◯ 2-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ 16-20 years
- ◯ 21-25 years
- ◯ 26+ years

6. If you have been to Turtle Creek Park within the last decade, approximately how often did you, or a member of your household, visit it?

- ◯ A few times a year
- ◯ A few times a month
- ◯ A few times a week
- ◯ Daily

Figure D5: Turtle Creek Community Survey Pg. 5

5. Please indicate your family's length of residency in the Township by checking the appropriate box below.

- ◯ 0-1 year
- ◯ 2-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ 16-20 years
- ◯ 21-25 years
- ◯ 26+ years

6. If you have been to Turtle Creek Park within the last decade, approximately how often did you, or a member of your household, visit it?

- ◯ A few times a year
- ◯ A few times a month
- ◯ A few times a week
- ◯ Daily

Figure D6: Turtle Creek Community Survey Pg. 6

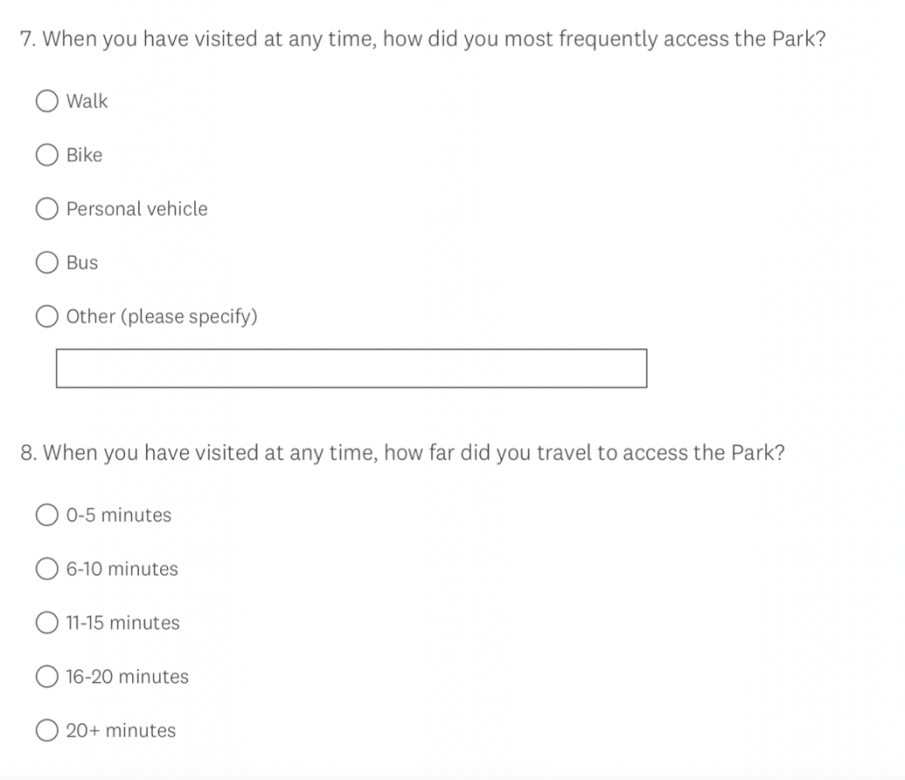

Figure D7: Turtle Creek Community Survey Pg. 7

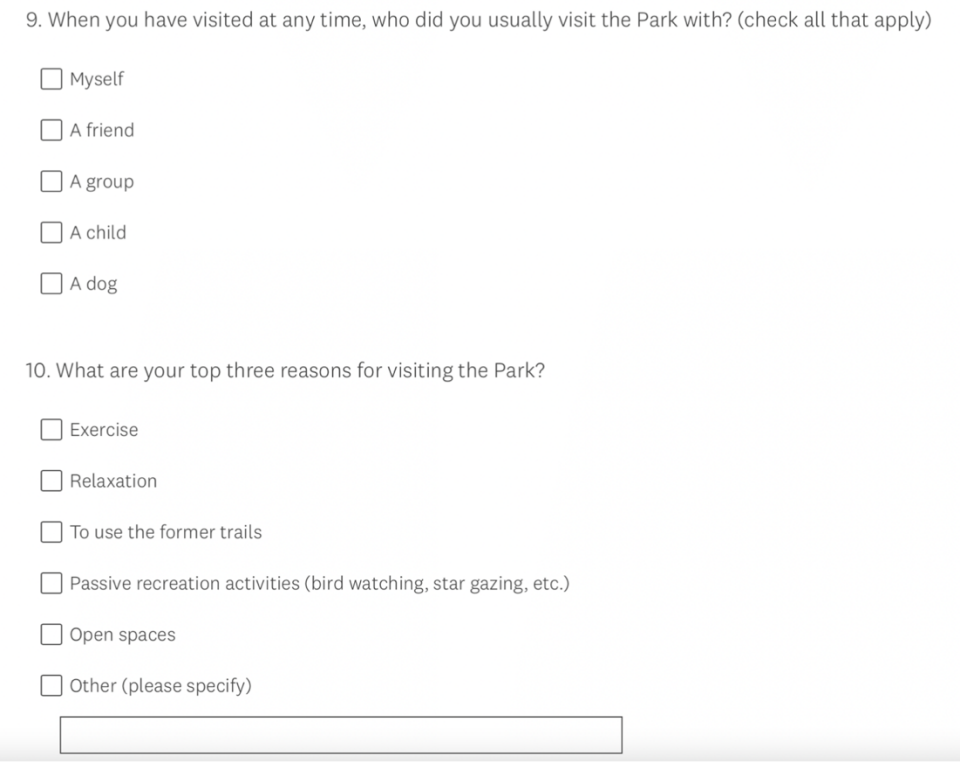

Figure D8: Turtle Creek Community Survey Pg. 8

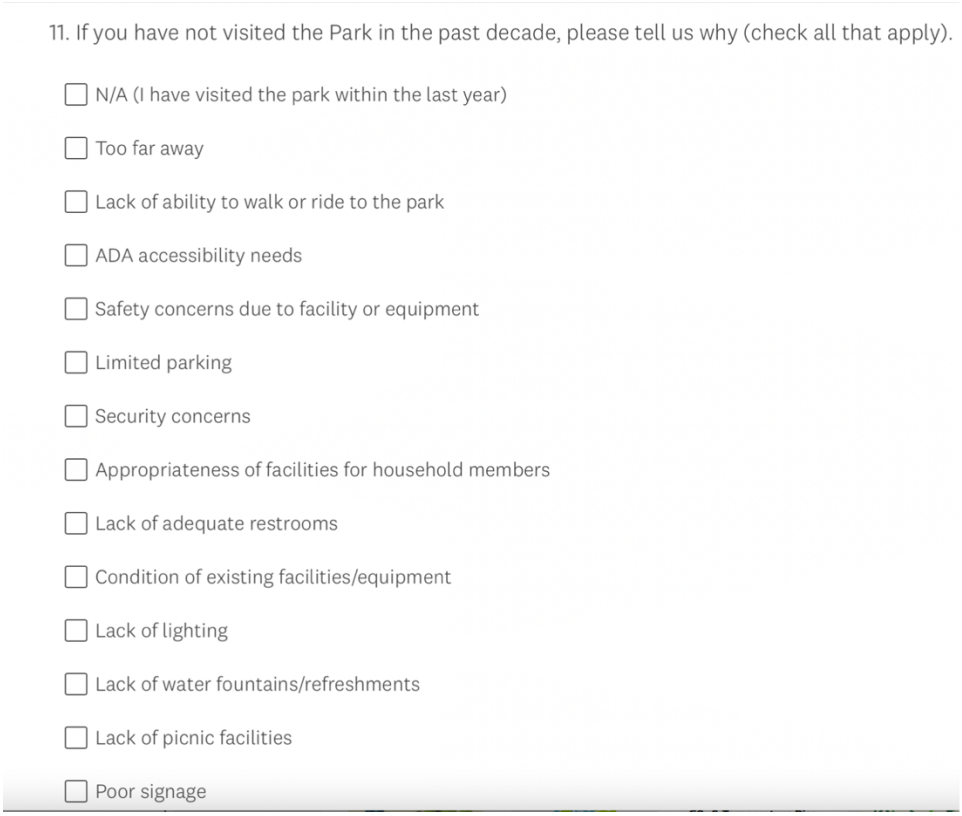

Figure D9: Turtle Creek Community Survey Pg. 9

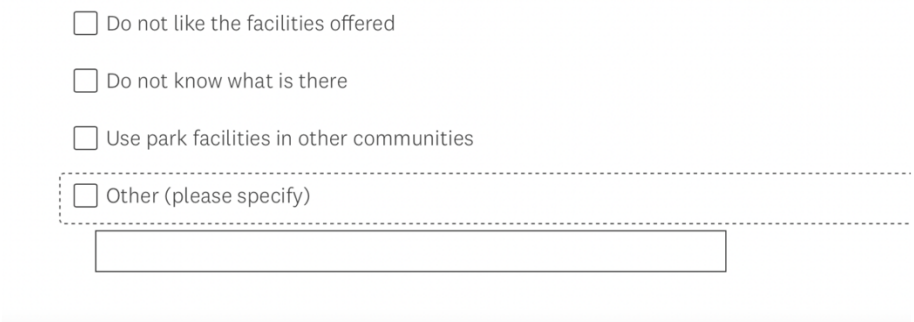

Figure D10: Turtle Creek Community Survey Pg. 10

12. What methods do you feel most effectively provide residents with information regarding park facilities, programs and activities offered in the Township?

- [ ] Township Newsletter
- [ ] Newspapers
- [ ] Bulletin Boards
- [ ] Emails
- [ ] Text Messages
- [ ] Social Media - Facebook/Twitter/Other
- [ ] Township Website (Turtle Creekboro.com)
- [ ] Signs placed along streets
- [ ] Other (please specify)

Figure D11 Turtle Creek Community Survey Pg. 11

13. Anticipated improvements for Phase 1 of the park include minor expansion of the existing gravel parking lot, reintroducing the former fenced dog park area (roughly 80' x100'), constructing an approximately ½ mile section of new trail loop closest to the parking lot, and installing a pavilion/picnic area, pollinator gardens and native landscape plantings. Based on these improvements, are there any features you would add, delete, or change for Phase 1? Please use the space below to provide your thoughts.

Figure D12: Turtle Creek Community Survey Pg. 12

14. Looking ahead to the next phases of the park development/restoration, what would you like to see as park improvements? Please see the overall park map below for reference and then check all that apply.

Figure D13: Turtle Creek Community Survey Pg. 13

- [ ] Additional trails re-opened
- [ ] Native trees planted
- [ ] Native pollinator gardens planted
- [ ] Stream restoration
- [ ] Bridge maintenance
- [ ] Additional picnic tables, picnic areas
- [ ] Grills
- [ ] Benches and ADA benches placed around the park trails
- [ ] Additional stream crossings
- [ ] Bird viewing platforms
- [ ] Tree species identification plaques
- [ ] Children's natural play area
- [ ] Park map
- [ ] Grass field for open play
- [ ] Other (please specify)

Figure D14: Turtle Creek Community Survey Pg. 14

15. Are there other improvements that you would like to suggest either for the park's long-term use? Please use the space below to provide your thoughts.

Done

Figure D15: Turtle Creek Community Survey Pg. 15

Appendix E

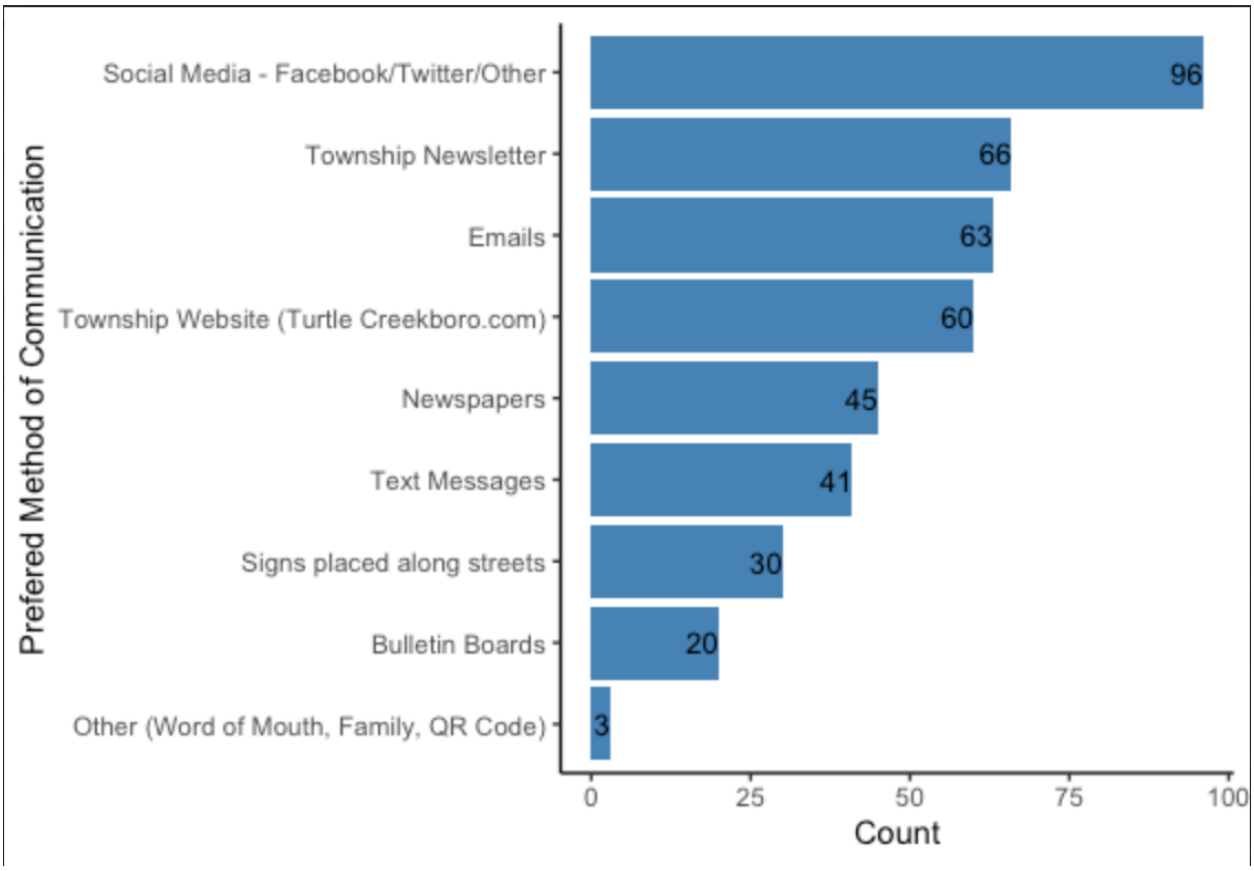

Figure E1: Preferred Communication method for surver respondents.

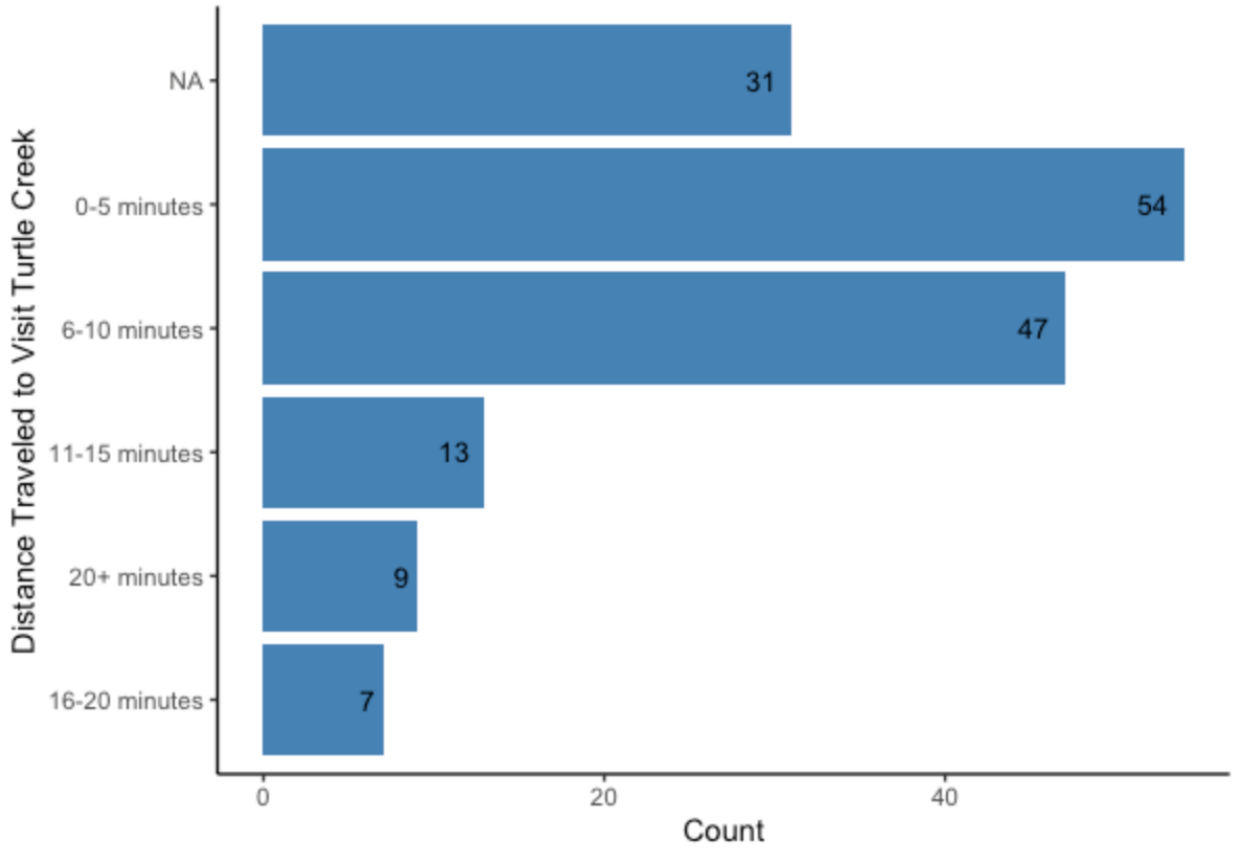

Figure E2: Distance traveled to visit Turtle Creek by survey respondents.

Appendix F: Educational Signage

Figure F1: Birds of Turtle Creek Park

Eastern Bluebird

Sialia sialis

The Eastern Bluebird is a small, plump bird with large eyes and long wings. Male bluebirds have a brilliant blue crown and wings and a deep red-brown underside. Female bluebirds have a gray head, gray-blue wings, and a light brown underside. Eastern Bluebirds are native to most of the United States east of the Rocky Mountains, and in some parts of Southern Canada.

Eastern Bluebirds mostly eat insects, berries, and wild fruit. However, they have also been known to eat larger prey, such as salamanders, snakes, lizards, and tree frogs. Bluebird eggs are bright powder blue with no dark spots; they can also occasionally be white.

Figure F2: Eastern Bluebird

The Hackberry Tree

Celtis occidentalis

- The Hackberry Tree is one of Pennsylvania's native species, and can be found in the warm temperate regions of the Northern Hemisphere. It is commonly located on river terraces and flood plains much like Turtle Creek's.
- The Hackberry tree can be distinguished by its unique bark pattern, marked by its rough, corky texture and deep ridges. The older the tree is, the more knobby the bark becomes, like the trees behind this sign display.
- The Hackberry is a large to medium sized tree, and can grow up to 90 ft. tall.
- The Hackberry is known as one of nature's "toughest trees" because of the species' ability to endure a wide range of soil conditions and its tolerance of extreme weather condition "toughest trees" because of the species' ability to endure a wide range of soil conditions and its tolerance of extreme weather conditions.

Figure F3: The Hackberry Tree

Northern Spicebush

Lindera benzoin

- The Northern Spicebush is one of Pennsylvania's native shrubs that can be found growing throughout the Eastern United States. Spicebush, which is a shrub in the laurel family, thrives in the understories of moist & deciduous forests, especially those with limestone rock formations like the one underneath your feet here at Turtle Creek.
- Spicebush gains its name from the spicy, pleasant fragrance its leaves and stems emit. The Spicebush's flowers bloom in early spring, and grow in small, yellow-green clusters. In the fall, the Spicebush's leaves turn from dark green to deep yellow-gold.
- The Spicebush's fruit, which are small, oblong berries that turn from dark green to bright red in late summer, can be dried and used as a spice for cooking. The taste is similar to black pepper, and can be used as an alternative to allspice.

Figure F4: Spicebush

Figure F5: Invasive Species of Turtle Creek

Appendix G: The detailed summary of the various species planted in Turtle Creek.

CONTAINERIZED		Total
Black Elderberry	**Black Elderberry**	10
Black Oak	**Black Oak**	10
Eastern Red Cedar	**Eastern Red Cedar**	10
Flowering Dogwood	**Flowering Dogwood**	10
Grey Birch	**Grey Birch**	15
Hawthorn	**Hawthorn**	10
Honey Locust	**Honey Locust**	10
Red-Osier Dogwood	**Red-Osier Dogwood**	15
Spicebush	**Spicebush**	15
Sweet Gum	**Sweet Gum**	5
Sycamore	**Sycamore**	15
	TOTAL CONTAINERIZED:	125

BARE ROOT		Total
American Hazelnut-Bare Root	American Hazelnut	5
Basswood-Bare Root	Basswood	15
Black Gum-Bare Root	Black Gum	15
Eastern Redbud-Bare Root	Eastern Redbud	15
Hackberry-Bare Root	Hackberry	5
Nannyberry-Bare Root	Nannyberry	15
Paw Paw-Bare Root	Paw Paw	15
Pin Oak-Bare Root	Pin Oak	10
Scarlet Oak-Bare Root	Scarlet Oak	15
Sugar Maple-Bare Root	Sugar Maple	10
Swamp White Oak-Bare Root	Swamp White Oak	15
	TOTAL BR:	**135**