East Pennsboro Township

Green Infrastructure Planning Study

December 2016

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EAST PENNSBORO TOWNSHIP
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CUMBERLAND COUNTY, PA

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Green Infrastructure Implementation Plan

Background/Overview

In 2016, East Pennsboro Township conducted a study of the area surrounding Central Penn College and East Pennsboro School District Campus to collect and analyze data related to land use, traffic, transportation, and socio-economics. The conclusions of this data collection and analysis were compiled into the EPT Regional Connections Study Report (The Report), which recommends improvements that cover the following broad subject areas:

- Safety
- Connectivity
- Accessibility and mobility
- Public transportation

Within these subject areas, seven specific improvements were proposed throughout the study area, and are as follows:

A. Improve bicycle and pedestrian accommodation along College Hill Road.
B. Improve pedestrian accommodation along B Street.
C. Improve pedestrian connectivity from the Central Penn College campus to Park Avenue (and by extension, the Summerdale Tract).
D. Plan for a grade-separated crossing of Valley Road.
E. Channelize pedestrian movement at the intersection of Valley Road and B Street.
F. Improve the frequency and accessibility of public transportation services.
G. Address bicyclist and pedestrian accommodation at critical intersections and key locations along corridors.

These seven improvements were discussed and mapped in the second half of The Report.

After conducting the initial Study, East Pennsboro Township hired Michael Baker International, an area planning consulting firm, to investigate green infrastructure options based on the improvements specified in The Report. These green improvements would be constructed in conjunction with the Study Improvements. Not only will they improve the stormwater runoff rates and pollutant loads from each specific area, but they will improve the aesthetics of the study area, thereby contributing to meeting the goals of the original study. In addition, East Pennsboro will receive credit for these green features under their existing General NPDES Permit.

Study Recommendations

Each improvement proposed in The Report was investigated for its compatibility with green features. Because not all of the proposed improvements in The Report were structural, green infrastructure is not practical in all cases. Costs associated with each improvement are given in the overviews before each section. The costs from the original Report are provided in the first column, and the second shows the increase (if any) to the overall improvement cost due to the green infrastructure.

The following green infrastructure types are proposed throughout this study:

1. **Rain Gardens**
   These features are shallow depressions that are planted with deep-root native plants and grasses. They are generally located at low areas to collect stormwater runoff that would otherwise go into a storm sewer. These allow for infiltration of rainwater, which filters pollutants out of the runoff. Overflows are provided in case a storm event exceeds the storage capacity of the garden.
2. **Bio-Swales**
   Bio-swales are swaled drainage courses with gently sloped sides filled with vegetation and other landscaping elements. Similarly to rain gardens, they are designed to infiltrate stormwater and remove pollutants and silt. Unlike rain gardens, they are designed to keep water moving along the swale, depositing any excess rain water into a structural storm sewer.
3. **Permeable Pavement**
   Instead of using an impermeable material such as concrete to create multi-use paths, permeable pavements are a great way to provide the needed pedestrian or cyclist travel space. The material utilizes small gaps to allow stormwater to pass through and infiltrate into the ground underneath. An impermeable surface provides no infiltration capabilities, with water flowing over the surface and onto adjacent ground.
   In addition, some permeable pavements - such as Flexipave - are created using old plastics that would otherwise end up in a landfill, encouraging recycling and providing pavement permeability.
4. **Infiltration Trenches**
   These features are similar to bio-swales, except they are designed to run longer distances, generally being used on roadsides or driveways. They are generally not landscaped, and are lined on the bottom with stone. Their primary purpose is to encourage maximum stormwater recharge.
5. **Stream Stabilization**
   Stream stabilization can be constructed using many different kinds of materials and methods, but in general, it stabilizes stream banks to prevent erosion. Erosion prevention is necessary to prevent excess sediment entering downstream waters, maintain the stream channel, prevent degradation of the surrounding area, and prevent the stream from changing path in the future. The following erosion prevention measures are proposed in this study:
   1) Rock Cross Vanes
      These are in-stream rock structures that stabilize the streambed while aiding in streambank stabilization. They are constructed using large stones to obstruct the path of the flow, redirecting streamflow away from the toe of the streambank and helping to stabilize the bank upstream and downstream of the structure.
   2) Log Cribwalls
      These natural structures are created using logs along the streambank to stabilize and protect the bank. They generally are constructed using a crossing pattern with the logs which provides long-term stability to the structure itself. These walls generally do not touch the water directly, but are placed at the toe of the bank. They are proposed for use in conjunction with rootwads (below).
   3) Rootwads

Rootwads are generally used in conjunction with log cribwalls (above) to stabilize the streambank. These are used at the toe of the streambank, and are constructed using cut tree trunks with the roots still attached. They are placed with the roots in the water along stream curves to armor and direct flow away from the bank, and even create fish habitat.

4) Riparian Buffer

This passive measure provides a buffer between the stream and surrounding area. This buffer is kept natural, free from impermeable surface or other construction improvements, allowing any stormwater runoff to be pre-treated before entering the stream.

6. Flow-Through Planters/Planter Boxes

These roadside features are intended to treat stormwater right off of the roadway, before reaching a conventional storm sewer system. They are usually constructed with curb cuts allowing runoff to enter the planter, where it feeds plants and grass and can infiltrate back into the ground. The planters can take different forms, either having an overflow inside the planter itself and overflowing directly to a storm sewer, or having a second curb cut which lets the water flow back out of the planter and back into the roadway, where it can be picked up by a roadway inlet.

7. Green Alleys

Lancaster, PA has implemented green alley infrastructure to address drainage problems in narrow alleys that have little opportunity for traditional stormwater improvements. The alley pavement is replaced with concrete sides that gently slope toward the center of the cartway, with pavers in the center to infiltrate runoff. This is visually pleasing, and provides stormwater treatment in areas that otherwise could not hold any structural features.

Table 1 below summarizes all of the green infrastructure improvements proposed with respect to their associated Study Improvements.

Table 1: Green Infrastructure Study Recommendations and Improvements Matrix

#	Study Recommendations	Priority	Recommended Improvements				
			#	Connectivity Study Improvement	Green Infrastructure Improvement	Figure #	Timing
A	Improve bicycle/pedestrian accommodation along College Hill Road	HIGH	A1	LED Pedestrian Scale Lighting	None	-	MED
			A2	College Hill Road Phase 1	None	-	SHORT
			A2	College Hill Road Phase 2	Construct shared-use path using permeable pavement materials.	1,2	MED
			A3	Option 1: White Edge Lines into the Summerdale Plaza	None	-	SHORT
			A3	Option 2: Shared Use Path into the Summerdale Plaza	Continue using permeable pavement around the corner and down to the plaza.	2	MED
			A3	Option 3: Sidewalk Switch Back into the Summerdale Plaza	None	-	LONG
			A4	CAT Bus Shelter Relocation and Sidewalk Connections	Propose moving the sidewalk and bus shelter farther back, allowing room for bio-swales between the sidewalk and roadway. Place a tiered rain garden in front of the building, with roof downspout connections. These could all be connected and eventually outlet near B Street. Utilize planters along the sidewalk as it bends down into the parking lot.	3	MED
B	Improve pedestrian accommodation along B Street	HIGH	B1	Pedestrian Crossings at the B Street Approach	Place bio-swale natural barrier between B Street and the student housing. Could include educational plaques here. Also could place bio-swales in front of student housing on College Hill Road, with roof downspout connections. These swales would connect with the swale on B Street downhill, and outlet to the stream.	4	SHORT
			B2	Option 1: Low-cost College Hill Road Crossing	None	-	SHORT
			B2	Option 2: Mid-cost College Hill Road Crossing	None	-	MED
			B2	Option 3: High-cost College Hill Road Crossing	None	-	MED
			B3	Change the Context of B Street	Adjust the proposed typical section of B Street, narrowing the travel lanes to make room for green infrastructure in buffer area on the left side of the road northbound. Utilize flow through planters or bio-swales. These features will outlet to the stream at the roadway sag on B Street. Retrofit the drainage basin south of the parking lot into a bio-swale. Place flow-through planters along the new proposed sidewalk.	5,6	MED
C	Improve pedestrian connectivity from the Central Penn College campus to Park Avenue (and by extension, the Summerdale Tract)	MED	C1	Trail Connection to the Park Avenue Cul-de-sac	Construct trail with permeable pavement type (similarly to improvement A2). Construct rain garden with educational features around the cul-de-sac at the head of the trail connection.	7	MED
			C2	On-road Connection through the Summerdale Village	Rework the existing Wayne Avenue to improve walkability and drainage. Add 4’ wide flow-through planters on each side of the roadway.	8, 9	LONG
D	Plan for a grade-separated crossing of Valley Road	MED	D1	Coordination of Valley Road Improvements	Recommend streambank stabilization for stream near proposed over/underpass. This stabilization will take the form of active measures like rock cross vanes, log cribwalls, and rootwads, and passive measures like riparian buffers.	10, 11	LONG
			D2	Valley Road Pedestrian/Bicycle Overpass	None	-	LONG
			D2	Valley Road Pedestrian/Bicycle Underpass			

#	Study Recommendations	Priority	Recommended Improvements				
			#	Connectivity Study Improvement	Green Infrastructure Improvement	Figure #	Timing
E	Channelize pedestrian movement at Valley Road and B Street	HIGH	E1	Valley Road Pedestrian Barrier	Use bio-swale as barrier for each side of the road. This will prevent most people from crossing mid-block. Also place a regular bio-swale next to the north parking lot to catch lot runoff. This swale can connect to the barrier bio-swale, and the surrounding drainage network, which runs uphill through the grass. Adjust the grading north of the parking lot to encourage downhill flow patterns.	12	SHORT
F	Improve frequency and accessibility of public transportation services	MED	F1	Coordinate with CAT Management as it Considers Route Restructuring and Service Frequency	None	-	-
G	Address bicyclist and pedestrian accommodation at critical intersections and key locations along corridors	HIGH	G1	Shady Lane/Enola Drive Intersection Accommodations	None		MED
			G2	Fill-in Missing Sidewalk along Shady Lane	Place flow-through planter boxes next to roadway if possible.	13	MED
			G3	College Hill Road/Enola Drive Intersection Accommodations	None		SHORT
			G4	Valley Road School Area and Crossing Enhancements	None		SHORT
			G5	Shady Lane/Humer Drive Intersection Accommodations	None		SHORT
			G6	Enola Drive School Area and Crossing Enhancements	None		SHORT
			G7	Panther Parkway Connector Road	Place multi-use path next to connector road, using permeable pavement. Place infiltration trenches along each side of the new road.	14, 15, 16	LONG
H	Provide green infrastructure to address drainage problems along alleys	MEDIUM	H1	Green Alley Improvements	Based on Lancaster PA's green alleys initiative, address existing drainage problems for East Pennsboro's alleys, using brick pavers to provide infiltration in narrow cartways.	17, 18	LONG

Table 1 Notes:

Timing:
SHORT = 1-2 years to implement
MED = 2-5 years to implement
LONG = 5+ years to implement

Study Recommendation

A **Improve bicycle and pedestrian accommodation along College Hill Road.**

Priority: **HIGH**

Green Improvement Discussion: Along with the proposed Study improvements, there are many possible green features along College Hill Road. The shared-use path can be made of permeable pavement. Rain gardens and bio-swales can be utilized where possible along College Hill Road, and, if possible, roof drain connections can be made to the bio-swales. These green improvements are further discussed in detail by improvement item below.

Planning-Level Construction Cost Estimate:

Improvement	Description	Report Estimate	Added Green Cost
A1	LED Pedestrian Scale Lighting	$115,000	N/A
A2	College Hill Road Phase 1	$15,000	N/A
A2	College Hill Road Phase 2	$450,000	$0
A3	Option 1: White Edge Lines into the Summerdale Plaza	$500	N/A
A3	Option 2: Shared Use Path into the Summerdale Plaza	$35,000	$0
A3	Option 3: Sidewalk Switch Back into Summerdale Plaza	$275,000	N/A
A4	CAT Bus Shelter Relocation and Sidewalk Connections	$25,000	$50,000

Recommended Improvements:

A1. The Township should install LED pedestrian-scale lighting along College Hill Road between B Street and the Summerdale Plaza driveway.

No green infrastructure improvements proposed.

A2. The Township should improve pedestrian and bicycle access along College Hill Road between Enola Drive and the Summerdale Plaza driveway.

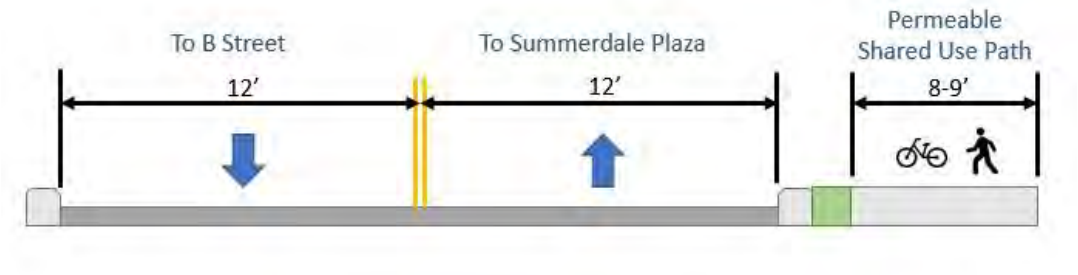
Phase 1: No green infrastructure improvements proposed.

Phase 2: The second phase should consider the following longer-term and higher-cost improvements which will physically separate pedestrians and bicycles from vehicles along College Hill Road between B Street and the Summerdale Plaza driveway.

Construct an 8-foot to 9-foot wide, curb-protected, shared use (pedestrians and bicyclists) path along the southern side of College Hill Road from the B Street intersection to the Summerdale Plaza driveway. This path can be constructed using permeable pavement types in order to allow infiltration of rainwater back into the ground, instead of running across an impermeable path and onto the roadway. Because all improvements are limited to the existing cartway, there is not enough room for green infrastructure between the path and roadway, aside from a common grass buffer.

See **Figure 1** for an updated typical section for College Hill Road.

Figure 1: Phase 2A, Shared Use Permeable Path on College Hill Road



A3. The Township should consider providing a safer means for pedestrians and bicyclists to access the Summerdale Plaza property from College Hill Road.

The only means of access by foot or bicycle from College Hill Road into and out of the Summerdale Plaza property is within the roadway along College Hill Road and the Plaza's northern driveway. A few different options are available for improvement. First, considering *Improvement 2*, *Phase 2A*, the permeable shared use path could round the driveway corner and terminate in the parking lot. Similar to the rest of College

Hill Road, there would likely also be some sort of grass buffer between the path and roadway, but not enough space is present to include any green infrastructure.

No green improvements are proposed for the switchback option.

Figure 2: Concept of Summerdale Plaza Access Green Improvements

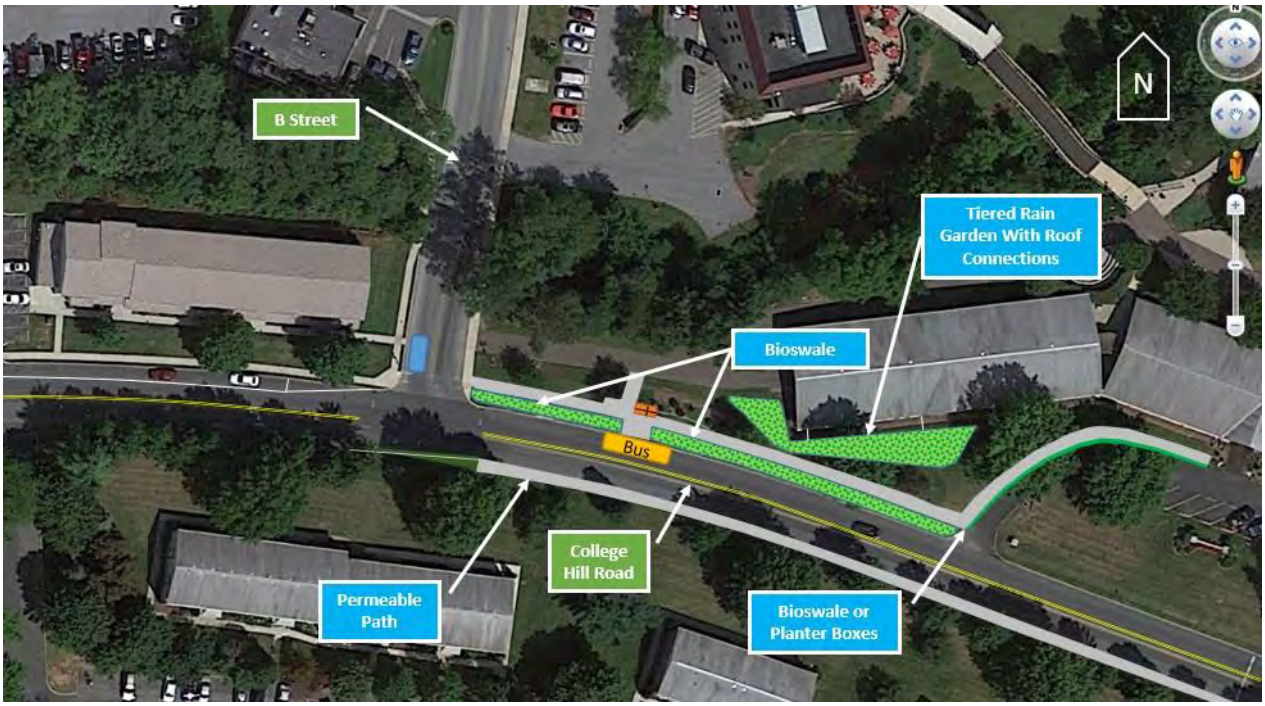
A4. The Township should setback the existing CAT bus shelter near the B Street intersection and construct sidewalk connections to the surrounding pedestrian infrastructure.

The Study proposes new sidewalk connections to a relocated bus shelter at the intersection of College Hill Road and B Street. This study recommends a few changes to the original Study improvements.

It is recommended that the new sidewalk be pushed a little farther back from the roadway, and bio-swales be placed in the new space between the walkway and roadway. These will collect runoff from the roadway, and also prevent mid-block pedestrian crossing. The sidewalk itself will generally follow the same path as previously proposed, running down the driveway and ending at the building. Planter boxes are proposed along the driveway next to the sidewalk.

In addition, a tiered rain garden system will be placed around the Bart A. Milano Hall building. This system will collect water from roof drains on the building, as well as overflow from the planter boxes. Because there is a slight slope to the existing area, the gardens will be tiered to encourage detention and infiltration.

Figure 3: Green Infrastructure around Bus Shelter Relocation and Sidewalk Connections



Study Recommendation

B **Improve pedestrian accommodation along B Street.**

Priority: **HIGH**

Green Improvement Discussion: B Street is a relatively short section of roadway, but it presents many opportunities for green infrastructure because of its sloping and sag conditions and its proximity to University Run. Green features placed in this area would provide valuable filtering and infiltration of any stormwater before it outlets into the stream. This is important because B Street collects a significant amount of runoff from surrounding streets, such as College Hill Road and Valley Road. University Run itself is considered impaired by PA DEP due to siltation. Any sediment reduction improvements to areas draining to University Run will be credited toward the Township's pollutant reduction requirements.

University Run in this area is affected by streambank erosion. Any added green infrastructure that takes some of the runoff away from the stream will be valuable in protecting the streambanks from degrading any farther.

Planning-Level Construction Cost Estimate:

Improvement	Description	Report Estimate	Added Green Cost
B1	Pedestrian Crossings at the B Street Approach	$20,000	$7,000
B2	Option 1: Low-Cost College Hill Road Crossing	$7,000	N/A
B2	Option 2: Mid-Cost College Hill Road Crossing	$22,000	N/A
B2	Option 3: High-Cost College Hill Road Crossing	$70,000	N/A
B3	Change the Context of B Street	$25,000	$77,000

Recommended Improvements:

B1. The Township should address the pedestrian crossings at the B Street approach to the College Hill Road intersection.

In order to funnel foot traffic to the proposed roadway crosswalks, The Report recommended placing a green feature between the housing and the roadway to act as a pedestrian barrier. These green infrastructure improvements build off of that concept, utilizing bio-swales to collect and pre-treat runoff before it enters University Run.

In addition to the bio-swale next to B Street, bio-swales are also proposed on College Hill Road between the apartments and the roadway. These upstream swales will connect with the above proposed swale using overflow piping. If possible, roof drains will also be utilized for the adjacent apartment buildings, with the drains connecting directly to the bio-swales. These improvements will require coordination with Central Penn College, but will provide valuable pretreatment and infiltration for stormwater that would otherwise enter directly into the roadway or stream.

Because if its proximity to the College, informational plaques could be placed near these swales and rain gardens to promote education on stormwater issues. These would provide credit for the NPDES permit.

Figure 4 below depicts these features in relation to The Report improvements.

Figure 4: Bio-Swales Near the Student Housing on B Street

B2. The Township should address the pedestrian crossings across College Hill Road at the B Street intersection.

No green infrastructure improvements proposed.

B3. The Township should change the context of the B Street corridor through the Central Penn College campus.

The Report recommends updating B Street's lane configurations and adding sidewalk along its entirety on the west side. A typical section was provided showing specific widths for each travel lane. This study recommends slight changes to these widths in order to provide buffer space in between the roadway and sidewalks. Not only would this provide space for planters, but would further encourage pedestrian safety as well, without taking much room from the roadway lanes.

Because there is an existing 5' wide sidewalk on the east side, the new roadway will be reconfigured from east to west in order to avoid tearing out the existing sidewalk. See **Figure 5** for the updated typical B Street section.

Figure 5: Updated B Street Typical Section

Along with the sidewalk improvements on B Street, a small portion of sidewalk is proposed along Valley Road near the restaurant and parking lot. This not only provides continuity for pedestrian travel, but also opportunities for more flow-through planter boxes between the sidewalk and roadway.

In addition to the sidewalk improvements, this study also recommends retrofitting the drainage basin to create a large bio-swale. Most of the parking lot drains southwest towards the basin. The current basin is grass-lined and does not have any features except for an overflow inlet that outlets directly to University Run. Native plants and soils would be added to the basin bottom, along with a switchback-style flowpath to increase the flow distance for any stormwater. This increases detention time, allowing for more infiltration. Weirs could also be utilized to create multiple levels of holding. **Figure 6** shows the updated layout for the Valley Road and B Street intersection.

There is also an additional basin approximately 350' west owned by the College that could be improved into a bio-swale. This basin is not as long as the basin described above, but is more of a square shape. The basin could benefit from weir structures being installed in the bottom, which would allow the basin

to function more like a swale, and increase infiltration and filter benefits. See **Figure 7** below for this retrofitted basin.

Figure 6: Green Improvements at Valley Road/B Street Intersection

Figure 7: Green Improvements West of Valley Road/B Street Intersection

Study Recommendation

C **Improve pedestrian connectivity from the Central Penn College campus to Park Avenue (and by extension, the Summerdale Tract).**

Priority: **MEDIUM**

Green Improvement Discussion: Some of the future development sites within the area are a large distance away for pedestrian traffic, especially travelling to and from the College. The Summerdale Tract is especially far away, existing on the other side of Summerdale Village. Because of this, pathways were proposed in The Report to connect the College campus with these outlying parcels. Many green improvements are available within these areas.

Planning-Level Construction Cost Estimate:

Recommended Improvement	Description	Report Estimate	Added Green Cost
C1	Trail Connection to the Park Avenue Cul-de-sac	$100,000	$13,000
C2	On-road Connection through the Summerdale Village	$175,000	$157,000

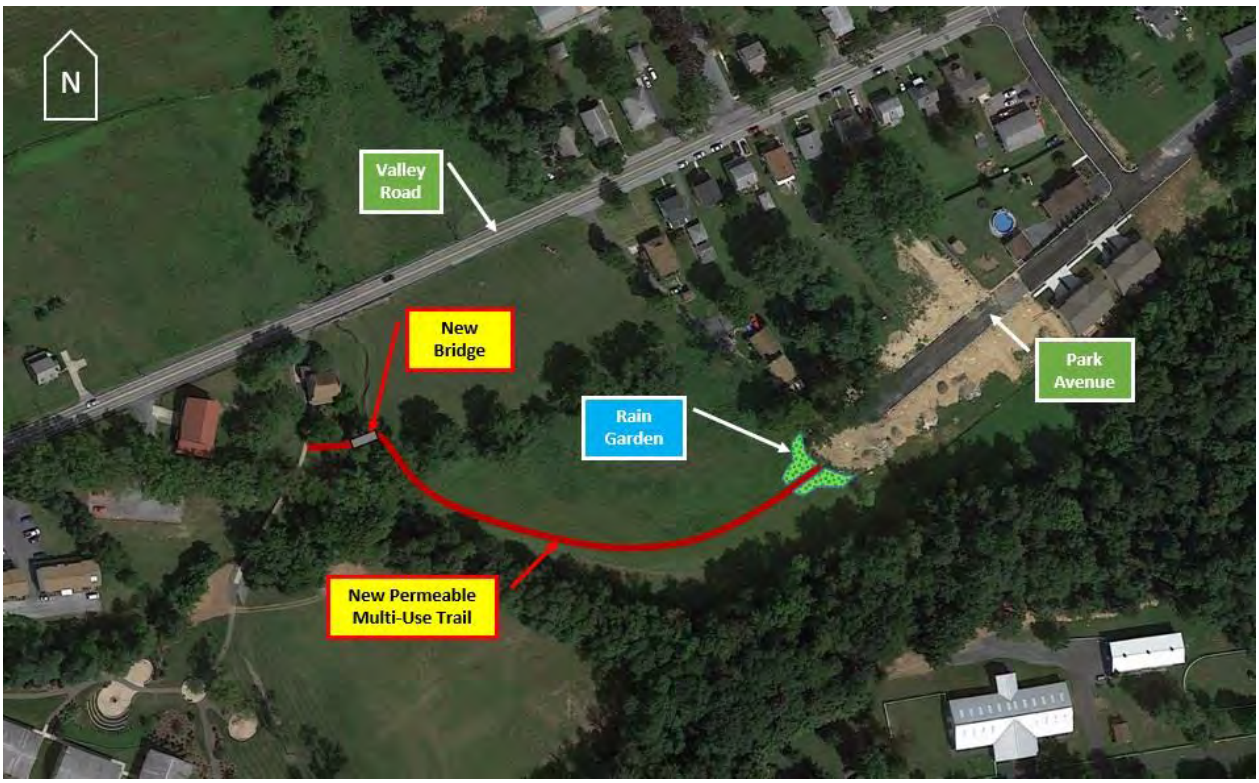
Recommended Improvements:

C1. The College should provide a trail connection from a point behind the Boyer House to the future Third Street/Park Avenue cul-de-sac.

In order to connect the cul-de-sac and Park Avenue, and the Summerdale Tract by extension, to the campus without requiring use of Valley Road, a multi-use path is proposed by The Report. Similarly to Improvement 2A, a permeable material is proposed for the path to encourage stormwater to pass through the path and back into the ground. Coordination would be needed for exact path placement because of its proximity to wetlands in the area. However, the permeable nature of the path would help mitigate any adverse effects of an otherwise impermeable surface.

Rain gardens are also proposed at the end of the cul-de-sac, on either side of the proposed path where it connects to the sidewalk on Park Avenue. Depending on existing site grading, these rain gardens would treat the stormwater coming from Park Avenue and the surrounding development. Educational signs or plaques could also be erected at these rain gardens. See **Figure 8** for approximate path and rain garden locations.

Figure 8: Concept of Sidewalk Connection from Campus to Park Avenue



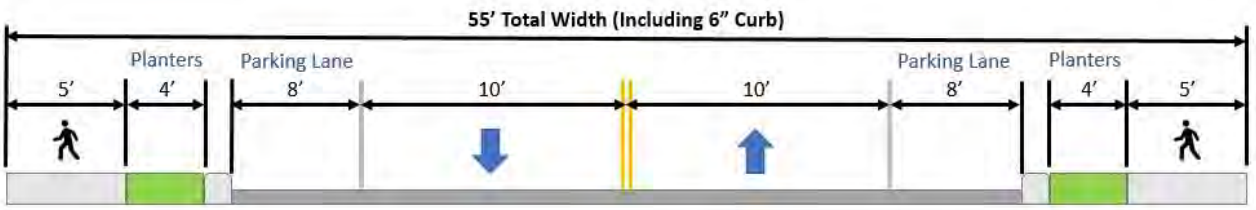
C2. The Township and Central Penn College should plan for on-road connections through Summerdale Village between the Summerdale Tract and any future development projects on the 22-acre parcel north of Valley Road.

As shown in **Figure 9**, a second option is presented for a campus connection to the Summerdale Tract, this time north of Valley Road. It proposes an on-road connection to the future development parcel west of Summerdale. A contiguous sidewalk on this section of roadway is proposed in The Report, so there is opportunity for flow-through planters. There is very little existing drainage, so the flow-through planters are necessary rather than the regular planter boxes.

This study recommends a rework of the Wayne Street corridor between 1st Street and the New Bridge. The typical section proposed can be seen in **Figure 10** below. The existing Right-of-Way along Wayne Street is 56', which provides plenty of room for improvement. With a 5' sidewalk on each side, 10' travel lanes, and 8' parking lanes, there is still enough room for 4' wide flow-through planters on each side. Including 6" curb, the total section with is 55', leaving 1' of additional Right-Of-Way width.

Figure 9: Pedestrian Connection between Undeveloped Lands and the Summerdale Tract

Figure 10: Wayne Street Typical Section



Study Recommendation

D **Plan for a grade-separated crossing of Valley Road.**

Priority: **MEDIUM**

Green Improvement Discussion: While there are no green infrastructure improvements possible specifically for an under or over pass, there are opportunities available to improve the overall quality of the surrounding area. This is important because it is a tributary to University Run, and because much of Valley Road and nearby open space drain to this point, at the sag curve of the road.

Considerations also must be made for areas north of Valley Road, and how the existing drainage patterns contribute to the area around the sag. The future development site provides possible opportunities that extend even beyond this study.

Planning-Level Construction Cost Estimate:

Recommended Improvement	Description	Report Estimate	Added Green Cost
D1	Coordination of Valley Road Improvements	N/A	$93,000
D2	Valley Road Pedestrian/Bicycle Overpass	$1,100,000	N/A
D2	Valley Road Pedestrian/Bicycle Underpass	$2,200,000	N/A

Recommended Improvements:

D1. The Township and College should coordinate with PennDOT on improvements to the sag curve on Valley Road by the Boyer House.

As shown in **Figure 11**, there are three proposed bridge crossings over Boyer Run.

Currently, there are major streambank erosion problems present along Boyer Run. Clumps of dirt and grass are clearly visible in the stream as a result of the bank washing out from underneath. If nothing is done to stabilize these banks, an increase in activity in the area (as a result of improvements proposed in The Report) will only exacerbate the erosion problems. Therefore three different forms of erosion prevention and stabilization are recommended to fix the current and future problems along Boyer Run.

First, because of the steeply sloped nature of the existing area, the streambed itself is also somewhat steep. As water flows quickly down the stream and around bends, erosion of the banks take place because there is nothing to slow the water down. This problem is exacerbated during rainfall events. In order to slow the water down along the edges of the stream, rock cross vanes are proposed to deflect the force of the flowing water away from the streambanks. Rock vanes are curved weir-like structures that slow the water flow down as it passes through. These structures are placed at intervals along the stream to keep velocities down along large sections, and wherever the stream curves.

Second, stabilization of the streambank itself is recommended. Using a combination of log cribwalls and rootwads, the bank itself would be stabilized, and the water flow would be directed away from the banks. These are also natural stabilization measures, as opposed to concrete or other man-made materials.

Finally, a riparian buffer is proposed along the length of the stream that will protect from encroachment on the streambanks. This buffer is a vegetated offset width from the stream centerline. No activities (construction or otherwise) will take place within this buffer. This will help protect the streambanks from outside sources of disturbance.

As shown in **Figure 11**, the above stabilization and protection measures will most likely run between the three bridges and down to the confluence, where there is the most opportunity for increased erosion. Limits of the erosion control may change based on final bridge placement.

Figure 12 provides details showing the specific erosion prevention measures proposed.

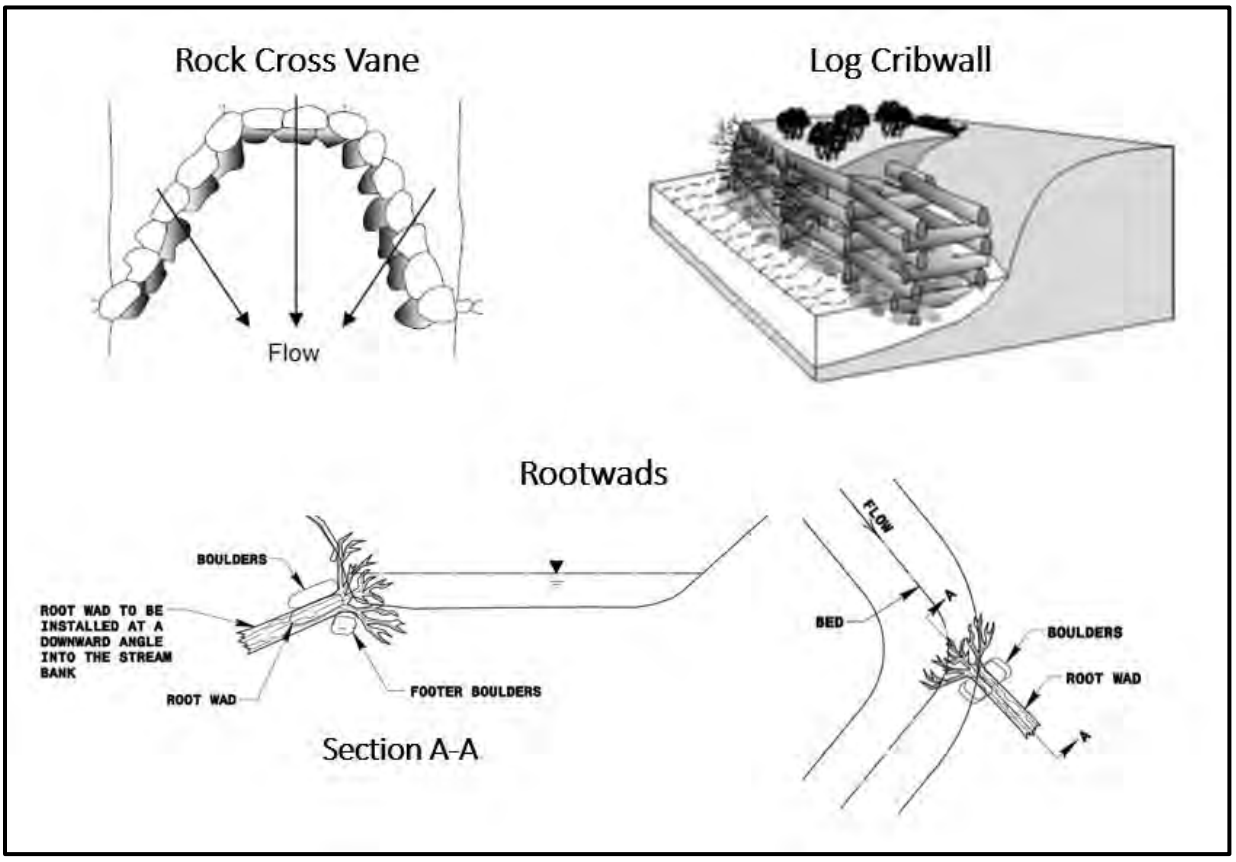
In order to implement these protection and stabilization measures a permit would be needed from PADEP. The type of permit required would depend on the stream to be improved and the acreage to be disturbed. General Permit (GP) 3 – Bank Rehabilitation, Bank Protection, and Gravel Bar Removal would be used for smaller stabilization projects of 500 feet of continuous streambank or less. Other exclusions apply and are listed within GP 3. Otherwise, an Individual Permit would be needed for any projects that are excluded from GP 3.

Rights for entering the stream for improvement is also an issue that would need to be addressed. Generally, easements or property acquisition would need to be considered for access. Acquiring the

property would provide the most access of the streambank during the project and into the future, and there are funds available for this kind of improvement through agencies such as the Pennsylvania Department of Conservation and Natural Resources (DCNR). Otherwise, easements would need to be acquired. If work was confined to the channel only, special permissions would not be needed, but because improvements include the streambank, easements at the least would be needed.

Figure 11: Streambank Stabilization Location

Figure 12: Streambank Stabilization Features



D2. Grade-separated crossings of Valley Road could include an overhead pedestrian sky bridge, or a pedestrian underpass.

No green infrastructure improvements proposed.

Study Recommendation

E **Channelize pedestrian movement at the intersection of Valley Road and B Street.**

Priority: **HIGH**

Green Improvement Discussion: The College currently desires to create barriers along Valley Road preventing mid-block crossings between the parking lot and College campus. Many people have been documented crossing the roadway directly from parking lot D to the campus building on the southeast corner of the intersection. The road itself has a speed limit of 35 mph, which makes crossing the road outside of a crosswalk dangerous.

Both existing parking lots north of Valley Road drain south toward the road, and have infiltration trenches running along them to catch runoff. The general drainage patterns of the area drain toward Valley Road, which have been known to cause flooding issues around the parking lots. Improved green infrastructure would help to alleviate these problems.

Planning-Level Construction Cost Estimate:

Recommended Improvement	Description	Report Estimate	Added Green Cost
E1	Valley Road Pedestrian Barrier	$55,000	$15,000

Recommended Improvements:

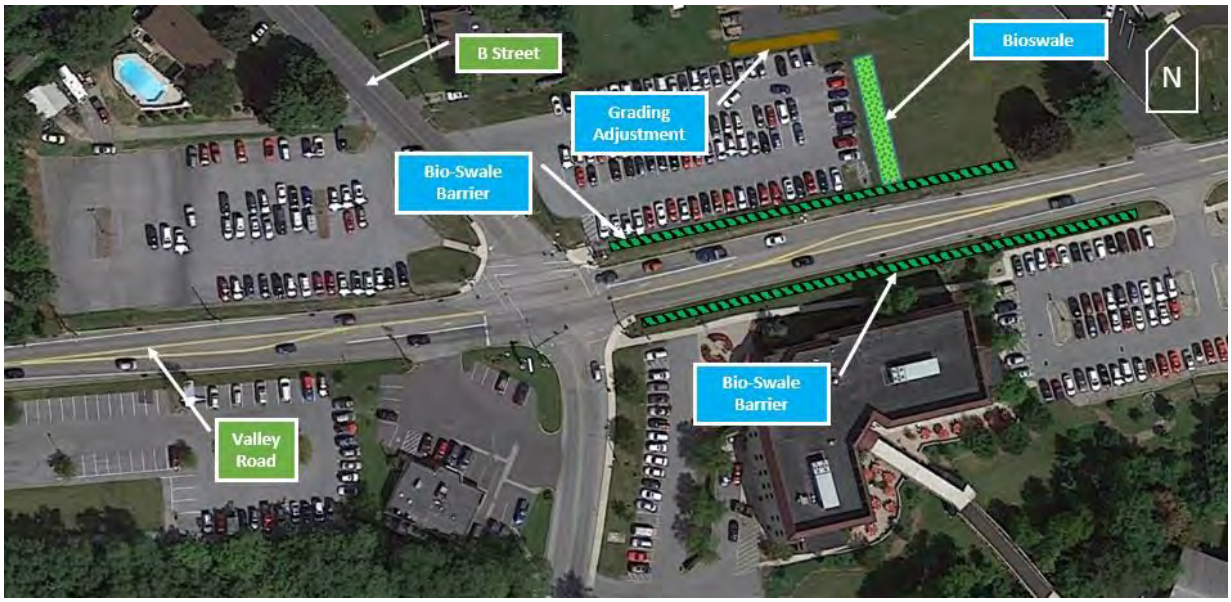
E1. The College should install a physical barrier to channelize, or encourage pedestrians to cross Valley Road at its signalized intersection with B Street.

While the College desires a traditional fence barrier to prevent mid-block crossing, a combination of green infrastructure and fencing would be most beneficial. Currently, there is an infiltration trench running along the southern side of parking lot D, and a drainage system running along the eastern and northern side of the lot. While the infiltration trench provides some drainage benefits from the parking lot, it does nothing to prevent mid-block crossings. If the trench was replaced by a bio-swale, then along with a traditional fence, pedestrians would be funneled to the intersection and prevented from crossing the road.

In addition, there is room on the eastern side for expanded green infrastructure, and the existing topography would allow for some kind of bio-swale to further treat stormwater coming from up the hill. The area north and east of the parking lot collects rain water from the surrounding hills and houses, and additional green features would help pretreat the runoff.

Finally, in order to encourage a positive flow pattern from up the hill, grading adjustment of the area just north of the parking lot is recommended. Currently, there is a sump condition between the parking lot and residential driveway, and while there is an inlet at the location, there is substantial flooding during larger rain events. A small amount of regrading would provide a secondary overland flow away from the area, removing the sump condition and helping to alleviate backups. The stormwater could then flow east and then south around the parking lot, and into the bio-swale proposed above. **Figure 13** shows the improvements on either side of Valley Road and around the parking lot.

Figure 13: Pedestrian Barriers and Green Improvements for Parking Lot D



Study Recommendation

F **Improve the frequency and accessibility of public transportation services.**

Priority: **MEDIUM**

Green Infrastructure Discussion: No green infrastructure improvements are proposed for this study recommendation.

Planning-Level Construction Cost Estimate:

Recommended Improvement	Description	Report Estimate	Added Green Cost
F1	Coordinate with CAT Management as it considers route restructuring and service frequency.	N/A	N/A

Recommended Improvements:

F1. The Township should coordinate with CAT management as it considers route restructuring and service frequency on an annual basis.

No green infrastructure improvements proposed.

Study Recommendation

G **Address bicyclist and pedestrian accommodation at critical intersections and key locations along corridors.**

Priority: **HIGH**

Green Infrastructure Discussion: This Study Recommendation proposes all of the smaller improvements that did not fit in the other Study Recommendations. Most of these involve restriping, lighting, or adding ADA access, and therefore present no opportunities for green infrastructure. There are a few opportunities where new sidewalk is proposed, and at the location of the new road. These improvements are discussed below.

Planning-Level Construction Cost Estimate:

Improvement	Description	Report Estimate	Added Green Cost
G1	Shady Lane/Enola Drive Intersection Accommodations	$50,000	N/A
G2	Fill-in Missing Sidewalk along Shady Lane	$30,000	$21,000
G3	College Hill Road/Enola Drive Intersection Accommodations	$10,000	N/A
G4	Valley Road School Area and Crossing Enhancements	$30,000	N/A
G5	Shady Lane/Humer Drive Intersection Accommodations	$15,000	N/A
G6	Enola Drive School Area and Crossing Enhancements	$30,000	N/A
G7	Panther Parkway Connector Road	$1,100,000	$240,000

Recommended Improvements:

G1. The Township should update/upgrade pedestrian accommodation at the signalized intersection of Shady Lane and Enola Drive.

No green infrastructure improvements proposed.

G2. The Township should fill-in missing sidewalk links along the north side of Shady Lane.

There is approximately 430 feet of sidewalk missing along the northern side of Shady Lane that, when filled in would provide a contiguous sidewalk. The red lines in **Figure 14** denote the missing sections of sidewalk along the north side of Shady Lane between Enola Drive and the Summerdale Plaza, and the green signifies possible flow-through planters to be placed. There is existing drainage present, however, because it is only the sidewalk being replaced, it would be preferable to have overflow run back into the street to be picked up by an inlet.

Figure 14: College Hill Road/Enola Drive

G3. The Township should improve pedestrian accommodation at the intersection of College Hill Road and Enola Drive.

No green infrastructure improvements proposed.

G4. The Township should revise the school zone speed limit signage and install enhanced pavement markings and school area signage along Valley Road in the vicinity of Panther Parkway.

No green infrastructure improvements proposed.

G5. The Township should address the intersection of Shady Lane and Humer Street.

No green infrastructure improvements proposed.

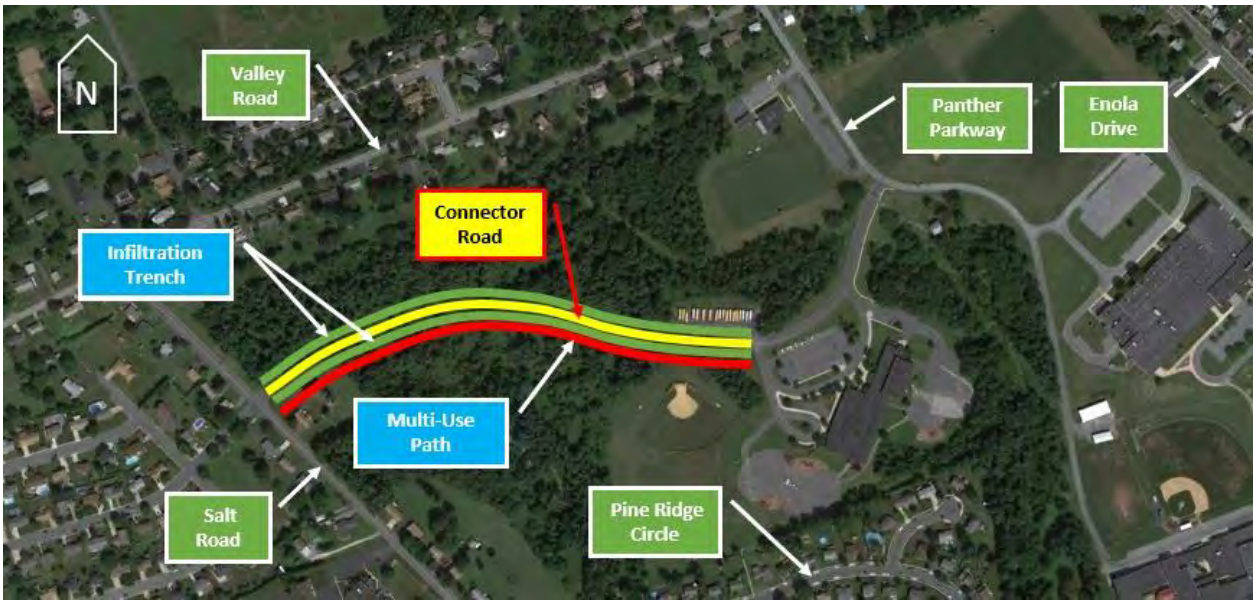
G6. The Township should revise the school zone speed limit signage and install enhanced pavement markings and school area signage along Enola Drive in the vicinity of the driveway to the East Pennsboro School District campus.

No green infrastructure improvements proposed.

G7. The East Pennsboro Area School District should consider constructing a connector road from Panther Parkway to Salt Road.

In order to connect the school to the neighborhoods to the west, a connector road is proposed by The Study through the wooded area west of the school. Pedestrian access currently exists to the south, connecting the campus to Pine Ridge Circle. This study proposes a single multi-use trail running on either side of the new roadway, constructed using permeable materials. In addition, infiltration trenches will be installed directly on either side of the roadway. The trail will be separated from the road by a trench. **Figure 15** depicts the approximately 1,850-foot long connector road, path, and infiltration trenches. The lines shown are intended to show the general order of the features, and are not to scale.

Figure 15: Panther Parkway to Salt Road Connector Road



Figures 16 & 17 show the typical roadway section for the connector road, and a detail of the infiltration trenches, respectively. The infiltration trenches are positioned on each side of the roadway to catch roadway runoff. Grass buffers are shown between the roadway and the trenches, and there is no curb proposed along the roadway, which allows runoff to flow directly to the trenches. The permeable shared-use path is proposed on one side of the roadway, and is separated from the road by the trench.

Figure 16: Connector Road Typical Section

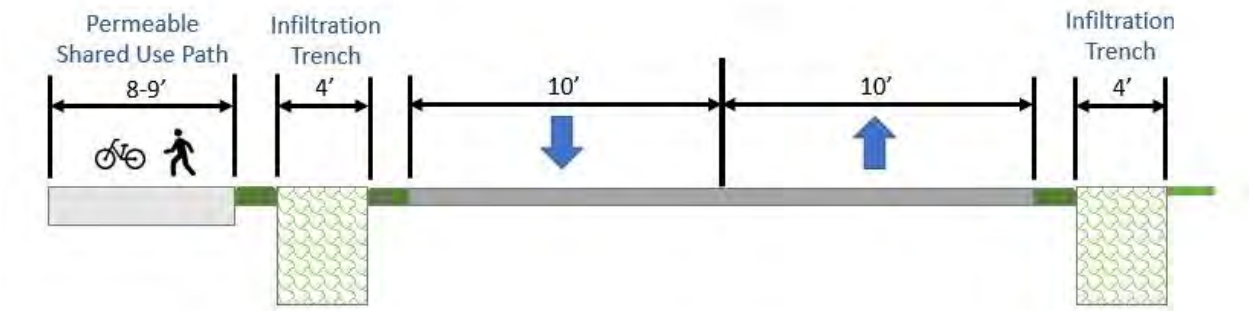
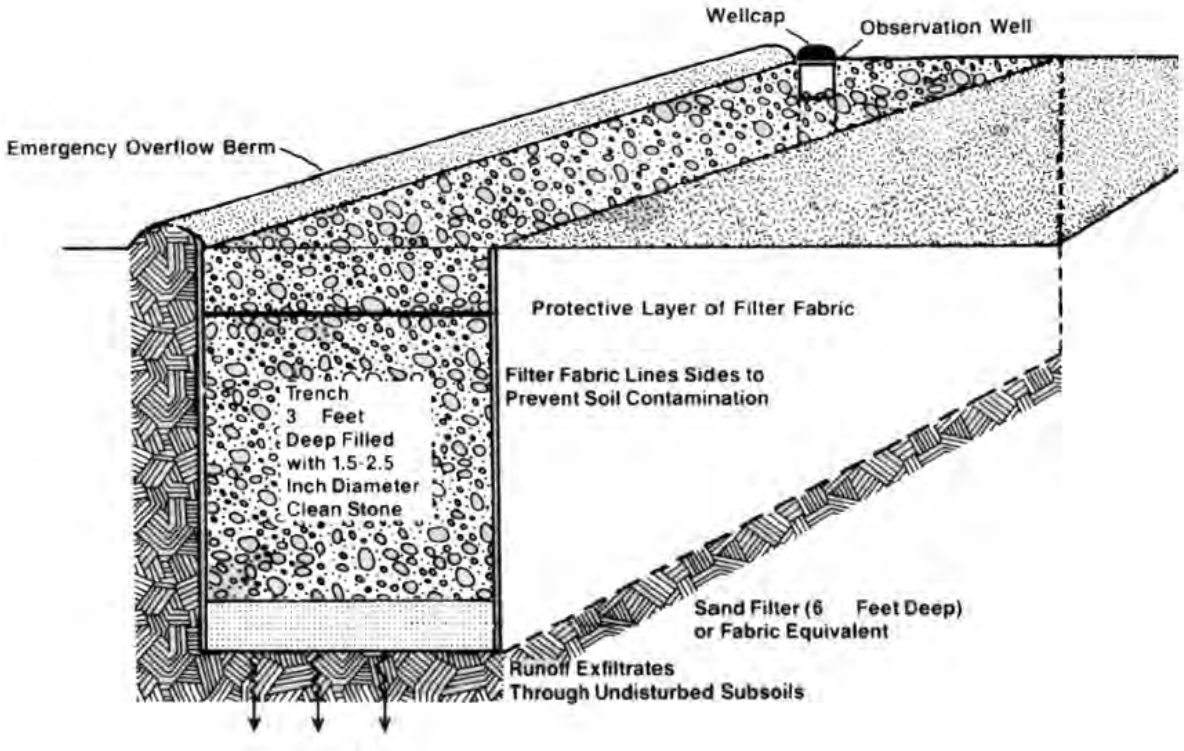


Figure 17: Infiltration Trench Detail



Study Recommendation

H **Green Alley Improvements**

Priority: **MEDIUM**

Green Infrastructure Discussion: Finally, the last item proposed is not addressed in the original Study, but is based on Lancaster, PA's answer to alleyway drainage problems. Green alley improvements are designed to improve alleys that have little or no opportunities for traditional drainage. While this may seem minor, many urban and suburban areas have alleys running throughout their street networks. The impermeable areas that are left untreated can really add up to create major issues for both motorists and landowners.

Planning-Level Construction Cost Estimate:

Recommended Improvement	Description	Estimate
H1	Green Alley Improvements	$160 Per Foot

Recommended Improvements:

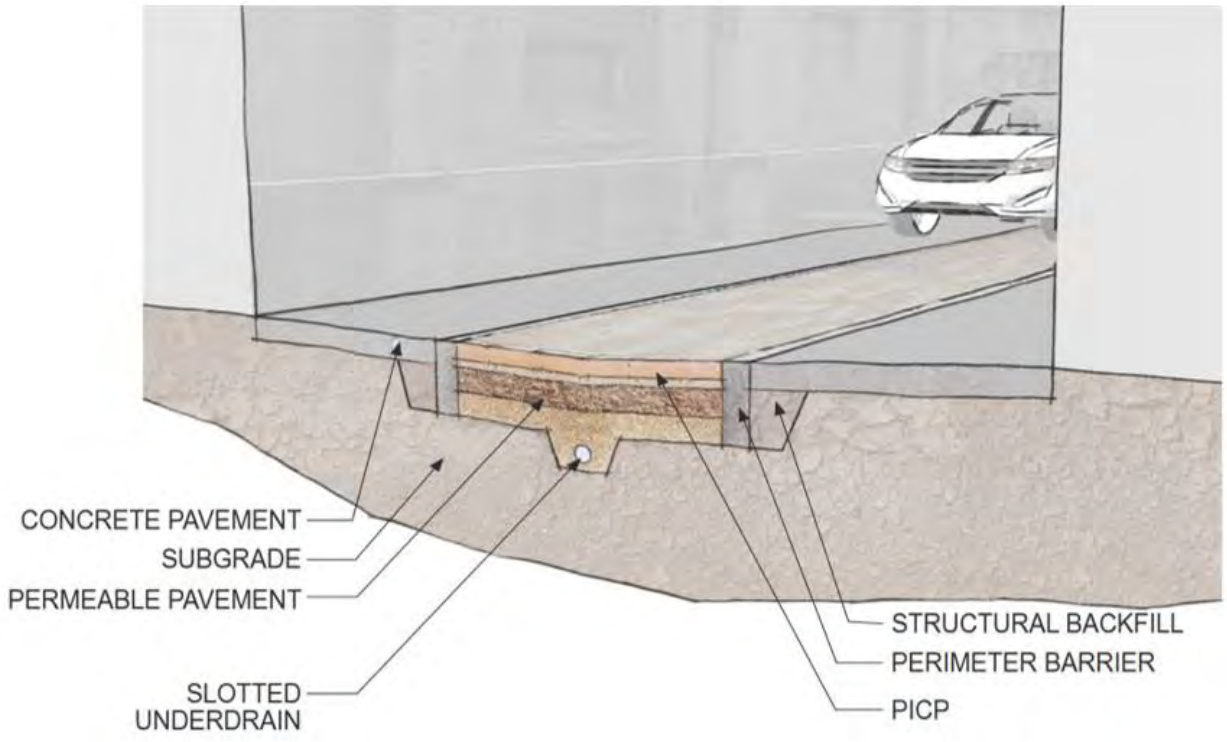
H1. Green Alley Improvements

To address both drainage issues stemming from the alleys that meander through the residential areas of the Township and the conditions of the alleys, the Township should consider green alley improvements. Alleys generally do not have traditional drainage features, and are in very close proximity to houses or businesses, so there is very little room for improvements. Lancaster, PA has recently implemented a green streets and alleys initiative to combat these issues. As seen in **Figures 18 & 19**, the alley is reconfigured to push runoff into the center of the alley where it can be infiltrated by permeable interlocking concrete pavement (PICP). PICP is a system of interlocking brick pavers that are positioned far enough apart to allow water to infiltrate through, and back into the ground. In the proposed configuration, all water is pushed to the center and forced to flow over the pavers. All alleys, whether they are permeable or not, should be graded and pitched to allow water to run to the center of the alley and then flow to the street. This prevents the need for additional sewer infrastructure and prevents adjacent properties from flooding. As shown in **Figure 19**, a slotted underdrain is an optional feature.

The picture below shows a fairly standard alley, with little or no space on the alley-side for improvements. Only the cartway is available for green infrastructure, which this design provides.

Figure 18: Lancaster, PA Green Alley Photo

Figure 19: Green Alley Detail



Summary

Along with the improvements proposed in the EPT Regional Connections Study Report, these green infrastructure improvements will provide comprehensive improvements to East Pennsboro, and will serve as a model for future improvement projects throughout the Township. Many drainage issues existing in East Pennsboro will be addressed by these improvements, and will be easily constructed alongside the other improvements proposed by the EPT Regional Connections Study Report.

Please see The Report for a summary of the existing funding options.

Review of Existing Land Use Ordinances

At the request of East Pennsboro Township, the Township's existing Land Use Ordinances have been reviewed to determine their compatibility with the green infrastructure improvements recommended in this study. Two documents were reviewed: Land Development Ordinance (Chapter 22) and Zoning Ordinance (Chapter 27). In general there were not any significant barriers in the ordinances to prevent the use of green infrastructure but the following updates are recommended to better clarify the use of green infrastructure:

Table 2: Green Infrastructure Land Use Ordinance Update Recommendations

Ordinance Section Number	Ordinance Update Recommendations
Land Development Ordinance	
22-202	Add definition of Green Infrastructure (GI).
Exhibit 22-C	Add Green Infrastructure to list of Improvements
22-506	Add provisions to allow for Green Street Construction and to allow for narrower paved streets to allow for reduction in impervious area and room for GI.
	Add design criteria for GI such as planter boxes, plant materials, bio-swales, permeable multi-use trails, etc.
	Clarify use of planting allowed in right-of-way for GI.
22-710	Add definition of Green Infrastructure (GI).
22-715	Add GI Design Standards.
22-715.H.3	Minimum Grass Lined Channel Slope should be clarified to allow slope less than 0.7% for Bio-swales.
Zoning Ordinance	
27-202	Add definition of Green Infrastructure (GI).
27-2102.I.11	Parking lot drainage – Remove criteria that requires piping to storm drainage facilities for parking lots greater than 50 spaces.
General	Consider adding Conservation Subdivision or Cluster/Open Space Design Criteria to the Zoning Ordinance to allow for reduction of impervious area and preservation of natural features without a reduction in density.

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