

I. Objectives

The project involves widening of SR 0981, intersection improvements, and an offline shift of SR 0981 in Mount Pleasant Township, Westmoreland County. The stream and wetland mitigation sites will be constructed concurrent with the SR 0981, Section Q20 Improvement Project.

The scope-of-work includes widening and realigning sections of SR 0981 for approximately 4.5 miles beginning near the intersection with SR 0819 and ending north of the intersection with Windy Hill Court in Norvelt, PA. The project will include reconfiguring three stop-controlled intersections into three roundabouts, these intersections include; SR 0819 / SR 0981, SR 2007 / SR 0981, and SR 2021 / SR 0981. The roadway will be widened to provide two 12' travel lanes and 8' shoulders through the corridor. According to the United States Geologic Survey (U.S.G.S.) 7.5-Minute, Mt. Pleasant and Mammoth, PA Topographic Quadrangle maps, elevation in the project area peaks at around 1,200 feet above mean sea level just north of Carpentertown along SR 0981.

The project area is located in the Youghiogheny River drainage basin. Shupe Run is the first watershed within the southern project termini that flows in a southern drainage direction into Jacobs Creek, which is part of the Youghiogheny River. Proceeding to the east, Wilson Run, Boyer Run, and Hurst Run are tributaries to Sewickley Creek, which also empties into the Youghiogheny. All of the aforementioned streams are designated as Warm Water Fishes (WWF) Designated Use, according to the PA Code Title 25, Chapter 93 Water Quality Standards. A small portion of the project area at the northern terminus is within the Welty Run watershed. Welty Run is High Quality-Cold Water Fishes (HQ-CWF) Designated Water Use according to PA Code Title 25, Chapter 93 that flows into Sewickley Creek.

The stream and wetland mitigation site is located within the Daniel and Lisa Barron Property along Boyer Run, which is the largest stream within the project area. The mitigation site will require acquisition in excess of that required for the offline relocation of SR 0981. The property will be acquired in fee simple and be permanent Right-of-Way (ROW). Additional stream mitigation sites will be constructed along the existing and proposed project ROW and will also remain in permanent ROW.

Stream impacts associated with the project are summarized in Table 1. A total of 6405.5 linear feet (LF) of permanent intermittent and perennial stream impacts, of which 2,982.5 LF would be loss length are anticipated to occur with the roadway reconstruction. Stream mitigation totaling 3,036 LF will occur throughout the project as indicated in the form of relocations, stream day-lighting, and stream enhancements (i.e. toe logs, mud sills, log vanes, bank grading, and live plantings) to mitigate for the loss length of perennial and intermittent stream. In addition to the permanent impacts, temporary disturbance (impacts) to streams will occur due to construction access to construct bridges, drainage facilities, stream relocations, culvert replacements, fill slopes, and installation of erosion and sediment pollution control measures.

A total of 1.063 acres of vegetated wetland would be permanently impacted for the SR 0981, Section Q20 project. The permanently impacted wetlands are palustrine emergent (PEM), Palustrine Scrub-Shrub (PSS) and Palustrine Forested (PFO) and are not considered Exceptional Value (EV) resources. Table 2 provides a summary of the impacted wetlands including the vegetative classifications, wetland functions, impact description, and impacted acreage.

SR 0981, Section Q20 Mitigation Plan

Table 1 SR 0981, Section Q20 Stream Impacts							
Impact #	Subfacility Code	Resource Name	Chapter 87 Class	Permanent Impact (LF)	Stream Channel Loss (LF)	Stream Relocation / Mitigation (LF)	Permanent Impact Description
7804-ST-2-Perm	Culvert	ST-2	Perennial	530	530	282	Existing condition consists of 466' open stream, 31.6' slab bridge, 32.2' box culvert, 182' gabion basket and stone masonry wall and 466' open stream. Proposed condition consists of realigning 282' of stream. Replacing the slab bridge and box culvert with one 242.5' box culvert at the intersection of SR 0981 and SR 0819. End sections and rock aprons will be provided on upstream and downstream sides of the new culvert. The intersection of SR 0819 and SR 0981 will be reconfigured from a stop intersection to a roundabout to improve safety and provide additional traffic capacity.
6022-ST-3-Perm	Relocation	ST-3	Intermittent	64	-	94	Existing condition consists of the stream being conveyed by a 24" CPP followed by 28' of rip-rap lined open channel. Proposed condition will remove about 36' of the existing pipe and 28' of the channel. In the proposed condition, the stream will be regraded to reach the inlet side of the box culvert carrying ST-2. This portion of channel relocation is approximately 94' for a net gain of stream channel.
105178-ST-4-Perm	Culvert/Channel	ST-4	Perennial	107	107	39	Existing condition consists of 33' stone box culvert and 107' open channel. Proposed condition consists of 85' of 48" pipe plus rock aprons on upstream and downstream sides for a total length of 94'. 39' of channel will be realigned and with grass lined stream banks. SR 0981 will be realigned to improve a deficient horizontal curve and provide access for one driveway adjustment.
40098-ST-7-Perm A	Manhole Installation	ST-7	Perennial	11	-	-	Existing condition for this section of ST-7 part A consists of the stream being piped through a series of 18" & 30" pipes. The proposed condition will not alter this pipe configuration, the impact in this area will add one additional inlet at the driveway connecting to a manhole that is replacing the existing inlet along the driveway edge.
106848-ST-7-Perm B	Culvert	ST-7	Perennial	40	40	-	Existing condition for this section of ST-7 part B consists of a total 40' of open channel. Proposed condition will be a spring box/manhole, 23' of 24" pipe and 11' rock apron due to the roadway widening.
106965-ST-6-Perm	Culvert	ST-6	Intermittent	139	17	-	Existing condition consists of 95' of 24" pipe under SR 0981 out letting to ST-6. Proposed condition will replace pipe with 117' of 36" pipe. Approximately 17' of open channel will be lost due to roadway slope fill.
108800-ST-8-Perm A	Culvert	ST-8	Perennial	95	34	-	Existing condition consists of ST-8 flowing through Wetland 06 adjacent to Fiedors Grove Road and a private driveway. The proposed condition will realign a section of Fiedors Grove Road which requires 34' of stream loss to install a 63' long 60" x 38" Elliptical RCP pipe with endwalls and rock aprons totaling 95' long crossing for ST-8.
108895-ST-8-Perm B	Culvert & Stream Relocation	ST-8	Perennial	485	-	61	Existing condition consists of ST-8 from Wetland 06 piped through a 42" CMP joining at an inlet and then pipe through a 42" RCP, then through a 60" CMP with associated manholes and inlets along SR 0981. The proposed condition will remove the piped section of ST-8 under Fiedors Grove Rd. closest to SR 0981 will be realigned to eliminate 54' of existing pipe and grade in 61' open channel.
109526-OF-X0	Outfall Installation	ST-8 / X0	Perennial	13	-	-	Remove and replace the existing 18" pipe and rock apron outfall on ST-8 streambank. Permanent floodplain impact is for fill placement for SR 0981 within the assumed 50-foot floodway for ST-8.
109653-OF-Y0	Outfall Installation	ST-8 / Y0	Perennial	12	-	-	Installation of 18" pipe stormwater outfall and rock apron. Permanent floodplain impact is within the boundary for ST-8.

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Impact #	Subfacility Code	Resource Name	Chapter 87 Class	Permanent Impact (LF)	Stream Channel Loss (LF)	Stream Relocation / Mitigation (LF)	Permanent Impact Description
110140-ST-11-Perm	Stream Relocation	ST-11	Perennial	87	-	97	Existing condition consists of 47' open channel leading to 40' of 18" pipe crossing under existing SR 0981 to Wetland 08. Proposed condition consists of constructing a 97' stream relocation (net gain of 50' of channel) of ST-11 to converge with ST-10. The pipe crossing for ST-11 under SR 0981 will be plugged and abandoned.
110194-ST-10-Perm	Culvert	ST-10	Perennial	89	33	-	Existing condition consists of stone headwall and endwall with 35.3' box culvert conveying ST-10 under existing SR 0981 to Wetland 08. Proposed condition consists of replacing the box culvert with 64' of pipe under widened SR 0981. Rock aprons are applied on the upstream and downstream sides of the crossing.
110550-OF-AA0-Perm	Outfall Installation	ST-08	Perennial	4	4	-	Installation of 18" pipe stormwater outfall and rock apron conveying stormwater runoff to ST-8.
110752-ST-8-Perm C	Stream Relocation	ST-8	Perennial	210	210	195	Installation of channel leading from rock apron at outfall AA0 to stream ST-8 Part C.
111144-ST-8-Perm D	Stream Relocation & Culvert	ST-8	Perennial	513	326	345	Existing condition consists of 15' of open channel stream along the left side of SR 0981. A 146.3' of 48" RCP under Carpentertown Road. Followed by approximately 315' of open stream below the existing Carpentertown Road and converging with ST-9. Proposed condition consists of 32' of stream relocation to 56' of 84" RCP (91.5' total length of permanent impact) for relocated Carpentertown Road. Another 113' of stream relocation to 88' of 84" pipe (128.6' total length of permanent impact) under relocated SR 0981 out letting to another 200' of relocated stream.
11725-OF-FF0	Outfall	FF0	Perennial	14	14	-	Installation of 18" pipe stormwater outfall and rock apron. The permanent and temporary impacts are within the boundary for ST-8.
111250-ST-9-Perm	Stream Relocation	ST-9	Perennial	113	113	130	Existing condition consists of 113' of existing ST-9 stream. Proposed condition will consist of 130' of channel relocation for a net gain of 17' of stream channel. ST-9 will converge with ST-8 Part D that is relocated below the SR 0981 roadway embankment.
112629-ST-13-Perm A	Bridge	ST-13	Perennial	49.5	49.5	-	Existing condition and flow of ST-13 (Part A) will remain in the same stream configuration. Proposed condition will involve placing a bridge over the stream and there will be temporary impacts to ST-13 but the majority of these impacts are restricted to the floodplain.
112629-ST-13 & ST-8-Mitigation	Mitigation	ST-13 & ST-8	Perennial	1650	-	1650	On site stream and wetland mitigation for the project consisting of mud sills, cross vanes, bank grading and live plantings. The mitigation will be constructed in the wet. Wetland and stream mitigation construction will temporarily disturb the FEMA 100-year floodplain.
11710-ST-13-Perm B	Culvert	ST-13	Perennial	76	-	-	Existing condition and flow of ST-13 (Part B) will remain in the same layout running adjacent to old SR 0981 and then crossing under the roadway through the existing culvert. Proposed condition will involve mill and overlay of existing SR 0981 roadway and some reconstruction of left roadway shoulder. The existing bridge has a span of 11.5' 5' underclear, and length of 41.3' total length of impact is 76'.

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Table 1 SR 0981, Section Q20 Stream Impacts							
Impact #	Subfacility Code	Resource Name	Chapter 87 Class	Permanent Impact (LF)	Stream Channel Loss (LF)	Stream Relocation / Mitigation (LF)	Permanent Impact Description
11715-ST-15-Perm	Culvert System & Stream Relocation	ST-15	Intermittent	625	410	143	Existing condition for ST-15 consists of dual 48" oval pipes out letting into an open channel under existing SR 0981. The open channel runs parallel to the roadway for 33', then runs through a private 24" concrete pipe for 151'. ST-15 then crosses under Boyer Road for 56' through a 36" concrete pipe. ST-15 runs in an open channel for another 147' until it converges with ST-13. In the proposed condition the existing open channel on the left side of Old SR 0981 before Boyer Road will be eliminated. ST-15 will be piped under Old SR 0981 for a total of 490' with the outlet being after Boyer Road. The channel between Boyer Road and junction with ST-13 (143') will be regraded to follow a similar path and the old overhead Railroad Bridge will be removed.
115269-ST-29-Perm	Fill	ST-29	Ephemeral & Intermittent	75	75	-	Existing condition for ST-29 consists of 251' of ephemeral channel and 75' of intermittent channel converging with ST-21. In the proposed condition ST-29 is eliminated due to the relocated roadway and fill slope for SR 0981.
115412-ST-21-Perm A	Channel Work	ST-21	Perennial	30	30	-	Drainage ditch construction on left bank will permanently impact 30' of channel. Permanent impact of about 60' of the assumed 50' floodway will be required for the embankment construction.
115514-ST-19-Perm	Culvert	ST-19	Perennial	264	264	-	Existing condition for ST-19 consists of 264' of open channel stream. The proposed condition will require impacting to total length of 264' of this stream through a 24" pipe under the roadway and fill slopes of relocated SR 0981.
115919-ST-20-Perm	Fill	ST-20	Intermittent	38	38	-	Existing condition for SR-20 consists of 38' of open channel stream. ST-20 converges into ST-21. The proposed condition will result in fill placement within all of ST-20 and regrading a roadside swale adjacent to relocated SR 0981.
116059-ST-21-Perm B	Culvert	ST-21	Perennial	450	450	-	Existing condition for ST-21 Part B consists of a total of 450' of open channel stream. In the proposed condition 450' of open channel stream will be replaced with a 30" pipe crossing underneath the relocated SR 0981. Rock aprons will be installed on both the upstream and downstream sides of the crossing.
118029-ST-25-Perm	Culvert Replacement	ST-25	Intermittent	90	24	-	Existing condition for ST-25 consists of a 40' 24" steel pipe crossing under existing SR 0981 near Walton's Lane. The proposed condition will include replacing this pipe and extending the length to 66' to accommodate the widened roadway template and fill slope. The upstream end will extend slightly into wetland W-21. The downstream end will terminate in the same existing rock lined channel just at a discharge point 24' further downstream.
118602-ST-24-Perm	New Culvert	ST-24	Perennial	109	56	-	The existing culvert has a 29.75' out to out length 31' of channel impact. The proposed box culvert will have an out to out length of 44 with 87' of channel impact. Channel work downstream for drainage ditches will involve an additional 22' of channel impact for a total of 109' along Hurst Run. Permanent impact to the FEMA 100-Year floodplain will entail 9577 SF. of floodplain area for the widened roadway embankment.
21694-OF-AB18	Outfall Replacement	ST-23 AB18	Perennial	6	-	-	Replacement of existing 24" pipe stormwater outfall and rock apron. Permanent impact area is 12 SF.
10061-OF-XX0 & YY0	Outfall Installation	ST-23 XX0 / YY0	Perennial	18	18	-	Installation of 24" pipe stormwater outfall and rock apron. Permanent impact area is 337 SF and located within the boundary for ST-23 stream impact.

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Table 1 SR 0981, Section Q20 Stream Impacts

Impact #	Subfacility Code	Resource Name	Chapter 87 Class	Permanent Impact (LF)	Stream Channel Loss (LF)	Stream Relocation / Mitigation (LF)	Permanent Impact Description
22390-OF-AD0	Outfall	ST-23 / AD0	Perennial	5	5	-	Installation of 18" pipe and outfall channel for drainage system.
122241-ST-1-Perm	Culvert	ST-1	Perennial	215	135	-	Existing condition consists of stone headwall, 49' of 18" Steel Pipe, 83' of open channel, 34' of 18" CPP under Jasmine Lane to be removed, 28' of open channel, 46' of 18" CPP to be plugged and abandoned, 24' of open channel to ST-23. Proposed condition consists of removal of 135' open channel, replacing existing 18" pipe with 42" pipe. Rock apron and 29 LF of rock lined channel will be installed for new outlet location to ST-23.
Total Intermittent				1046	540	237	
Total Perennial				5359.5	2363	2799	
Total				6405.5	2982.5	3036	

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Table 2 Wetland Impacts						
Impact #	Name	Classification	Principal Functions & Values	Total Wetland (Acre)	Permanent Impact (Acre)	Impact Description
104979-W-02-PERM	Wetland W-02	PEM	GWR/D, FFA, NR,	0.411	0.197	Roadway Embankment Swale Drainage Structure
106963-W-03-PERM	Wetland W-03	PEM	FA	0.096	0.027	Widened Embankment New Swale / Drainage Structure
80096-W-06-PERM	Wetland W-06	PEM 80%/ PFO 20%	FA, STR	0.725	0.176	New Roadway/ Driveway Relocation/Outfall W1
108852-W-07-PERM	Wetland W-07	PEM	FA, STR	0.047	0.001	Rock Apron for Drainage Structure
109955-W-08-PERM	Wetland W-08	PEM 75%/ PSS 25%	FA, STR	2.890	0.062	Widened Roadway Embankment / New Drainage Structure
109544-W-09-PERM	Wetland W-09	PEM	STR, NR	0.099	0.018	Widened Roadway Cut Slope
110795-W-13-PERM	Wetland W-13	PEM	STR, PE, SSS	0.569	0.160	Stream Relocation / Relocated Roadway Embankment
112764-W-14-PERM	Wetland W-14	PEM	FA, STR, NRT, SSS	0.538	0.396	New Roadway Embankment for New Bridge & PCSM
11730-W-15-PERM	Wetland W-15	PEM	FA, STR	0.128	0.011	Stream Relocation Cut Slope
117803-W-21-PERM	Wetland W-21	PEM	FA	0.083	0.015	Replacement Drainage Structure
Total				5.586	1.063	

PEM = Palustrine Emergent Wetland
PSS = Palustrine Scrub-Shrub Wetland
PFO = Palustrine Forested Wetland

GWR/D = Groundwater Recharge/Discharge
FFA = Floodflow Alteration
NR = Nutrient Removal
STR = Sediment/Toxicant Retention
PE = Production Export
SSS = Streambank/Shoreline Stabilization

Mitigation Types, Amounts, and Methods:

Wetland Mitigation: One wetland mitigation site has been identified for the project. The mitigation site will be located at the property acquired from Daniel and Lisa Barron and will be capable of replacing the impacted wetland vegetative acreage and wetland functions. Table 3 presents the amount of wetland impacts by vegetative classification:

Table 3 Permanent Wetland Impacts and Provided Mitigation Acreage				
	PFO	PSS	PEM	Total (AC)
SR 0981, Section Q20 Permanent Wetland Impacts (AC)	0.035	0.016	1.012	
Provided Mitigation (AC)	0.100	0.100	1.470	1.490

The combined size of the created wetlands will be approximately 1.490 acres (AC) of wetland habitat, which provides approximately 0.478 AC. of additional wetland habitat, functions and values within the project area watershed.

Stream Mitigation: Stream mitigation activities where no stream impact is associated with the roadway reconstruction will occur along the project corridor as follows:

1. ST-13 – Boyer Run will receive stream enhancements to 1450 LF.
2. ST-8 (Trib to Boyer Run) will receive stream enhancements to 200 LF.

Stream relocations along the corridor will involve 1386 LF of perennial and intermittent stream relocations for the roadway reconstruction project. The aforementioned stream mitigation treatments will be applied to these sections of the streams and consist floodplain bench grading, live plantings, and channel relocations, to reestablish alluvial substrates providing stable channels with natural channel design concepts. All stream mitigation work would be done in conjunction with the SR 0981, Section Q20 project.

Functional Relationship of Mitigation to Watershed:

Wetland Mitigation:

The wetland has been designed to replace the lost functions of the impacted wetlands and the on-site in-kind mitigation will occur within the same watershed (Youghiogheny River). As noted in Table 2 impacted wetlands had one or more of the following functions: Groundwater Recharge/Discharge (GWR/D), Sediment/Toxicant Retention (STR), Floodflow Alteration (FFA), Nutrient Removal (NR), and Production Export (PE). Under CFR 332.3.(e) and (f) “the amount of compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions”. The proposed wetland will be capable of replacing all of the impacted wetland functions. The proposed wetland design will be capable of attenuating floodflow from the perennial tributaries and stormwater runoff. Sediments and nutrients conveyed by streams and overland runoff from upslope areas will be detained, absorbed and attenuated in the wetland system thereby, replacing STR and NR wetland functions. Depressions within the wetland will retain and attenuate sediment and toxicants for upslope transportation corridors from overland runoff of surrounding uplands. The streambank stabilization (SSS) functions will also be included within the replacement wetland by the plantings of live stakes and shrubs along the streambanks and floodway. The wetland is being located in a parcel adjacent to agricultural, residential, and commercial areas and within a former pond, which is predominately herbaceous floodplain area. Stream flood flows that enter and exit the wetland will provide Production Export functions to downstream areas. Wildlife

habitat will be enhanced by provided wetland and riparian habitat with mast and fruit producing species that will mitigate disturbances associated with commercial land use; thereby improving the connectivity through the valley. The proposed planting plan consists of mast and berry producing trees and shrubs that will provide food and cover habitat for wildlife. Additionally, habitat enhancement structures will also encourage feed, resting, and escape cover habitat within the mitigation site.

Stream Mitigation:

The stream mitigation is anticipated to replace the lost functions of the impacted streams and the mitigation will be located on-site and within the same watershed (Youghiogheny River) as the impacted streams. ST-8 and Boyer Run (ST-13) are the largest streams within the project area and also display evidence of bank erosion, sediment deposition, and instability. Five stream functions were evaluated to determine if the proposed stream mitigation would replace the lost functions due to anticipated project impacts, including:

- Floodplain Connectivity
- Surface Water/Groundwater Exchange/Recharge
- Channel Stability
- Riparian Vegetation
- Water Quality
- Habitat

The functions listed above work together to provide conditions suitable to support macroinvertebrate and fish communities. Diversity and type of individuals in the biological communities are dependent on the extent to which each function is performing within natural or acceptable ranges. Each of the functions is summarized below.

Floodplain Connectivity

Floodplain connectivity is anticipated to be fully functional along streams where flow accesses the floodplain on average every one to two years. In addition, functional performance of floodplain connectivity is higher along broad floodplains and less along narrow or constrained floodplains.

Surface Water/Groundwater Exchange (Hyporheic Exchange)

Surface water and groundwater are exchanged vertically through downwelling and upwelling through channel bed sediments. This vertical movement of water is commonly known as hyporheic exchange. Hyporheic exchange is important as it facilitates movement of heat, nutrients, toxics, and biota between the surface stream and groundwater (Hester 2008).

Channel morphology provides a primary control on hyporheic exchange by moderating hydraulic head gradients between surface water and groundwater. Channel morphology features such as pools, riffles, steps, debris dams, large wood, bars, meander bends, and side channels influence hyporheic exchange by increasing local streambed gradient, creating obstacles in the flow, and creating planform complexity. In addition, channel bed sediment affects hyporheic exchange by controlling general hydraulic conductivities (where coarser particles are more permeable) and spatial variability of sediment permeability. (Hester and Gooseff 2010).

In general, size and function of the hyporheic zone is expected to be highest along intermediate stream reaches and least in headwater streams (Boulton et al. 1998). D'Angelo et al. (1993) found that transient storage (hyporheic) zone size to channel cross-sectional area was largest in first order streams and decreased along higher order streams; however, total size of the transient storage zone increased with increasing stream order.

Channel Stability

Channel stability, in the form of sediment transport and lateral/bank stability, is a fundamental stream function. Stable streams are indicative of a balance of sediment transport with sediment supply. An imbalance of sediment transport and supply leads to channel bed degradation (erosion) or aggradation (excessive storage). Similarly, excessive bank erosion is indicative of an imbalance between erosive and resistive forces. Streams with stable sediment transport regimes and stable banks have optimal capacity for supporting other stream functions, such as hyporheic exchange, habitat, organic carbon cycling, and nutrient cycling.

Riparian Vegetation

Riparian vegetation plays an important role in providing shade, temperature regulation, and a source of organic matter (e.g., leaf fall, large woody debris, and sticks/twigs). The relative importance of riparian vegetation to provide a benefit to streams is related to the hydrologic regime (i.e., perennial and intermittent), stream size, water source (runoff from adjacent uplands or impervious surfaces), and flushing characteristics.

Water Quality

Water quality represents an assessment of overall stream conditions and the likelihood that the stream is able to support good water quality conditions based on anticipated non-point sources. Streams typically anticipated to have good water quality lacked obvious sources of pollution, and exhibited good floodplain connectivity, stable channel conditions, adequate riparian vegetation, and minimum sedimentation that would inhibit surface water/groundwater exchange.

Habitat

Habitat is generally more important for supporting macroinvertebrates and fish in perennial streams compared to intermittent streams and ephemeral channels. Fish species were observed in streams ST-2 (Shupe Run) and ST-13 (Boyer Run), both of which will receive stream relocations and/or habitat improvements in the project area. Habitat functionality is generally limited along intermittent streams and ephemeral channels due to the prevailing hydrologic regimes, including a lack of sustained baseflow, and extended periods of dry flow conditions between stormflow events or seasonal baseflow.

Existing Stream Functions Evaluation

Existing conditions were assessed in accordance with the Environmental Protection Agency (EPA) Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers including the physical characterization, benthic macroinvertebrates observation, and the low gradient stream habitat assessment was completed for all the project streams along the SR 0981, Section Q20 project. Additionally, all the project area impacted streams were assessed using the

Pennsylvania Department of Environmental Protection (PADEP) Level 2 Rapid Assessment Protocol. Each stream habitat parameter was rated as optimal, suboptimal, marginal, and poor based on visual observation. The goal of the stream habitat assessment was to provide a general understanding of the functional performance along the existing streams that could be used to compare with the anticipated functional performance along the proposed stream mitigation sites to evaluate if impacted stream functions are appropriately replaced with the proposed stream mitigation plan. Results of the existing conditions functions evaluation are summarized below for the impacted streams for which mitigation is anticipated and along the proposed stream mitigation sites.

All stream functions are anticipated to improve along the relocated sections of ST-2 (Shupe Run), ST-3, ST-4, ST-8, ST-9, ST-11, ST-15, ST-21 and ST-8 and ST-13 (Boyer Run) in the mitigation site due to the instream structures, grading, stream daylighting, and planting within the riparian zone. The floodplain connectivity, channel stability, riparian vegetation, and habitat will improve the proposed mitigation activities. Water quality is anticipated to improve due to the bank stabilization; however, agricultural, commercial, and transportation activities would provide a continued source of sediment and/or nutrient input within the watershed.

II. Site Selection

Mitigation Site Background Information:

The Pennsylvania Department of Transportation (PennDOT) has targeted sites within or adjacent SR 0981, Section Q20 project that would be suitable for wetland and stream mitigation and provide an environmental lift to the existing streams and land use. Two adjacent wetland and three off site stream mitigation sites within or adjacent to the project area were identified and investigated. After viewing the watershed it was determined that appropriate wetland mitigation could be completed at the parcel currently owned by Daniel and Lisa Barron and the stream mitigation could also be completed on this property.

The mitigation sites were selected for the following reasons:

- Located on-site and in-kind within the Youghiogheny River watershed,
- Are focused to treat existing streams with bank stability issues,
- Large enough to accommodate the wetland and stream mitigation requirements,
- Wetland and stream mitigation will be purchased in fee simple as permanent ROW,
- Located along and within the floodway of the streams impacted by the project, which would help support a wetland and stream ecosystem connectivity,
- Combining the wetland and stream mitigation adjacent to each other and on-site will reduce construction cost, and
- Converts a commercial parcel to wetland, riparian, and native upland habitat and enhances the stream and riparian corridor providing an environmental lift.

Agency Coordination:

An agency field view was conducted on January 15, 2019 with representatives from the PADEP, Pennsylvania Fish and Boat Commission (PFBC), United States Army Corps of Engineers (USACE), PennDOT District 12-0, and McCormick Taylor. The resource agencies concurred with the stream and wetland mitigation strategy and provided input on the stream treatment measures preferred for the subject streams. During this meeting the attendees' field

viewed the Daniel and Lisa Barron Property and impact locations and discussed requirements for wetland and stream impacts.

Based on this meeting and the amount of anticipated impacts, it was determined that the mitigation site and the relocations along the project limits would meet the wetland and stream mitigation requirements for the project. Additionally, recommendations made by the resource agencies are incorporated into the mitigation designs. **Appendix A** contains the meeting minutes from the above referenced meeting. A project location map is provided in **Appendix B - Figure 1**.

III. Site Protection Instrument

Coordination between PennDOT and the land owner has occurred and all property associated with stream and wetland mitigation will be permanently acquired as highway ROW purchased in fee simple. The Right-of-Way Plan will reflect that the acquisition of the parcel will be for highway improvement and natural resource mitigation. A copy of the Right-of-Way Plan is included in **Appendix C**.

IV. Baseline Information

Existing Aquatic Resources:

The wetland mitigation site has four sources of hydrology overland runoff, ST-13 floodflow, roadway runoff, and groundwater. One wetland is located within the mitigation site project area. The streams are classified as Warm Water Fishes Chapter 93 water use designation and are not considered to be of exceptional or significant value (**Figure 2 in Appendix B**). The wetlands within the study area are not considered exceptional value in accordance with PA Code Title 25, Chapter 105 § 105.17.(1) Exceptional Value Wetlands.

Hydrogeomorphic Characteristics:

Six sources of hydrology are available to the sites: perennial floodflow, high groundwater table, perennial spring discharge, overland flow, roadway runoff, and direct precipitation. The Soil Survey of Westmoreland County, Pennsylvania, identifies Melvin and Newark silt loams (Mn) 0% to 2% slopes, and Clarksburg silt loam (CIB) 3% to 8% slopes. Mn has a seasonal high water table of about 0.5 feet without a restrictive layer within 5 feet. CIB has a seasonal high water table of 2.3 feet, and has a fragipan at 2 to 3 feet as the restrictive layer. Overland runoff, roadway runoff, high groundwater table, and stream flood flows from the adjacent tributaries would provide source of hydrology for the site. The wetland cells will detain hydrology from the floodway. Overland runoff from the surrounding uplands and direct precipitation from approximately 13 AC would provide overland hydrology to the site. The watershed associated with ST-13 is approximately 1.5 mi² and would provide hydrologic input during high flow events. A FEMA delineated 100-year floodplain is provided for ST-13 in the project area and through the wetland in the proposed condition.

Fluvial Geomorphic Assessment:

A fluvial geomorphic survey was completed on perennial stream reaches along ST-08 and ST-13 is best described as a mildly sinuous channel, with a mixture of bed morphology, including run-riffle flow regime as defined in Montgomery and Buffington (1997). Montgomery and

Buffington (1997) describe run-riffle channels as typically occurring at moderate gradients, generally have narrow floodplains, have a vertically undulating bed of bars, runs and riffles, and have substrate that is typically gravel size and ranges from sand to cobble. Plane-bed channels are described by Montgomery and Buffington (1997) as occurring on moderate to high slopes, lacking rhythmic bedforms and discrete bars, and have large values of relative roughness (ratio of the 90th percentile grain size [D₉₀] to bankfull flow depth). Average stream bed slope along the existing ST-08 channel is about 1% and ranges from 0.8% to 4.2%. Existing channel bottom width is approximately 5-7 ft. and bank height varies 1 to 3 ft. The channel bed consists primarily of clay, gravel, cobble, and bedrock. Riffles occupy approximately 50 percent of the total channel length. The channel along the project reach ranges from being moderately entrenched to entrenched with a high width/depth ratio. The majority of the right descending floodplain and streambank appears to have been altered by past since a series of ponds were built when coal mining and coke ovens were operating in Carpentertown. Banks are abrupt with exposed soil, undercutting, slumping, and is generally vegetated with herbaceous species or the right overbank and pole stage and saplings in the left overbank.

ST-13 is best described as a mixture of bed morphology, including riffle-run-pool intermixed with clay plane bed as defined in Montgomery and Buffington (1997). ST-13 has a well developed floodplain with vertically undulating bed of bars, pools, runs and riffles, and has substrate that is typically substrate size and ranges from clay to cobble. Average stream bed slope along the existing channel is about 0.6% and ranges from 0.3% to 1.5%. Existing channel bottom width is approximately 3-10 ft. and bank height varies 3 to 6 ft. The channel bed consists primarily of clay, gravel, to cobble with bar development primarily attributed to slumping banks. Riffles occupy approximately 30 percent of the total channel length. The channel along the project reach is entrenched with a high width/depth ratio. The majority of both left and right streambanks are vertical to undercut with exposed soil and are generally poorly vegetated.

Water Quality:

The mitigation project is located along Boyer Run. The Pennsylvania Code Title 25, Chapter 93 Water Quality Standards designated use classifies Boyer Run as Warm Water Fishes (WWF). Streams within the watershed and project area are generally influenced by agricultural activities, residential, commercial, and transportation land use activities. It should be noted that all streams affected by the project appear to be first to third order tributaries.

Soil Characteristics:

The *USDA/SCS Soil Survey of Westmoreland County* was downloaded from the Pennsylvania Spatial Data Access (<https://datagateway.nrcs.usda.gov/>). The soils in the mitigation site are listed as Melvin and Newark silt loam (Mn) 0 to 2% slopes and Clarksburg silt loam (CIB) 3 to 8% slopes. Itmann (ItD) extremely channery loam, 0 to 25% slopes is also located near the mitigation site.

Fish and Wildlife Usage:

Small mammals, birds, reptiles, and Whitetail deer were observed during site visits. Fin-fish were observed within ST-2 (Shupe Run) and ST-13 (Boyer Run) in project area. The physical characteristics within ST-8 appear capable of supporting small fin-fish; however, aside from where the stream confluences with ST-13, fin-fish were not observed. The remainder of the

project area streams do not appear capable of supporting small fin-fish populations within the project area. Macroinvertebrate field observation was completed at each sample point.

Macroinvertebrates observed within ST-08 consisted of the following:

1. Sowbugs (Isopoda) were dominant ,
2. Caddisflies (Trichoptera) and Crane fly (Tipuliade) were abundant
3. Flatworms (Platyhelminthes) were rare.

Macroinvertebrates observed within ST-13 consisted of the following:

1. Caddisflies (Trichoptera) were dominant,
2. Mayflies (Ephemeroptera) were abundant,
3. Sowbugs (Isopoda) were common, and
4. Flatworms (Platyhelminthes) were rare.

The physical characteristics of the remainder of the streams, aside from ST-2, do not appear capable of supporting fin-fish populations. Creating wetland and improving the streams and riparian areas would also improve the habitat diversity, fish and macroinvertebrate migration to upstream habitat, riparian corridor connectivity, and encourage wildlife utilization by creating and replacing wetland habitat.

Habitat Diversity:

The land cover within the wetland mitigation site consists of floodplain, stream, and predominantly herbaceous vegetation. The habitat diversity appears to be marginal to poor; however, wildlife within the area would have the opportunity to utilize the created wetland and the stream and floodway modifications will promote wildlife usage of the riparian corridor. The wetland would be designed to incorporate the native species identified within the impacted wetlands and the adjacent riparian corridor and to minimize the propagation of invasive species.

Surrounding Land Use:

The wetland mitigation site is located adjacent to a Township Road (Boyer Road). Wooded hillside and residential land use occupy area further upslope. Historically the area was associated with the Carpentertown Mine.

V. Determination of Credits

Wetland Mitigation Availability:

The amount of impacted wetlands is approximately 1.063 AC for SR 0981, Section Q20. The size of the proposed wetland within the mitigation site is approximately 1.49 AC. The site design would provide for about 0.427 AC of additional wetland habitat than what is required for a 1:1 replacement ratio for the total impacted wetlands. The riparian areas adjacent to the wetland will be enhanced with live plantings, instream structures, and graded slopes.

Stream Mitigation Availability:

The stream relocations and enhancements along the SR 0981, Section Q20 Reconstruction Project include intermittent and perennial channel totaling 3,036 ft. of improvement to the stream functions. The water quality function may remain equivalent or experience slight

improvements; however, the physical lift to the stream channels will entail bank stability, riparian habitat, and instream habitat associated with the proposed stream treatments. Comparing this to the approximately 2,982.5 ft of anticipated channel loss impacts along the SR 0981, Section Q20 Reconstruction Project, the proposed stream mitigation is anticipated to adequately mitigate the anticipated stream impacts.

Wetland and Stream Construction Goals:

The goals of the wetland mitigation are to replace acreage and functions of wetlands being adversely impacted by the SR 0981, Section Q20 Improvement Project. Of the impacted wetlands in the project area, six out of ten have impacts less than 0.10 AC in size. Due to the small size of the wetlands, the influence of surrounding land use, and proximity to SR 0981, the delineated wetlands exhibited principle wetland functions associated with roadway, residential, and agricultural land use runoff. The functions of the delineated wetlands are Groundwater Recharge/Discharge (GWR/D), Sediment/Toxicant Retention (STR), Floodflow Alteration (FFA), Nutrient Removal (NR), and Production Export (PE).

Based on the requirements of CFR 332.3.(e) and (f) “the amount of compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions”. The wetlands have been designed to not only replace the lost functions of the impacted systems as provided in Section 1 Objectives, but to increase wetland habitat within the project area. The stream mitigation has been designed to create restore instream habitat by reducing sedimentation and bank erosion, and provide a riparian corridor, which will replace the lost functions of the impacted streams. In addition, the length of stream mitigation meets the impacted length by a ratio of 1:1. Therefore, based on the requirements of the CFR 332.3, the mitigation requirements are adequate compensation to the impacted resources.

In summary, the mitigation efforts for the project:

- are within a watershed of the project area,
- are within PennDOT ROW,
- are large enough to accommodate all of the wetland and stream impacts, but increase the amount of wetland acreage within the project area,
- can effectively replace the impacted wetland and stream functions,
- are easily accessible from the highway and could easily be constructed,
- can improve the wildlife and aquatic habitat diversity in the watershed,
- reestablish natural flow regimes and sediment transport, and
- alleviate flooding and stream erosion along the project tributaries.

VI. Mitigation Work Plan

Wetland and Stream Construction Feasibility:

The proposed mitigation sites are easily accessed from Boyer Road. There is also a gravel drive leading near the wetland mitigation site, which would be used to access the site. The open field within the property is potential area that could be utilized for staging materials and construction equipment. Temporary stream crossings will be required at the site for ST-13 and ST-8. With the appropriate grading, this area is well suited for wetland establishment and stream restoration.

The Mitigation Grading Plans:

The grading plans present the design for Mitigation Site (**Appendix D**). The grading plan has been designed to use the existing stream high flow discharge, roadway runoff, high groundwater table, and overland flow as the sources of hydrology for the wetland. The stream mitigation will occur in the wet to ensure proper elevations are met for instream structures during installation.

The Mitigation Planting Plans:

The Mitigation Site (**Appendix D**) will be planted with an emergent wetland seed mix for the wetland cells. Live shrubs, trees, and live stakes will be planted within the Wetland and Stream Mitigation Site. After the seed mix is broadcast the site will be rolled or tracked to provide good seed to soil contact and covered with erosion controls and/or mulching. The live planting and staking will occur after the seed mix has been broadcast. The Planting Plans for the stream relocations throughout the project corridor are also provided in **Appendix D**.

The Erosion and Sedimentation Control Plans:

The Erosion and Sediment (E&S) Control Plans have been prepared and submitted to the Westmoreland Conservation District for their review and approval. No site work will begin until an E&S Plan is approved. It is anticipated that the following temporary controls will be incorporated into the E&S Plan:

- Compost Filter Sock,
- Rock construction entrance,
- Temporary drainage swale,
- Water diversion devices and energy dissipater,
- Pumped water filter bag,
- Rolled Erosion Control Product, and
- Temporary stream crossings.

It is anticipated that following permanent controls will be incorporated into the E&S Plan:

- Turf establishment using topsoil with seed and mulch to create a permanent vegetative cover.
- Wetland and riparian vegetation establishment with wetland and floodway areas, respectively,
- Vegetated riprap spillway,
- Tree and shrub plantings, and
- Stream channel bed material, toe logs, log vanes, and live stakes for the streambanks.

VII. Maintenance Plan

The wetlands and streams will be monitored for a 5-year period to fulfill the requirements of the project's 404/105 Water Obstruction and Encroachment Permit.

Individuals monitoring during this time period should examine the vegetation within the wetland and eradicate invasive plant species that are growing within the replacement wetland to the fullest extent possible. The first measure in eradicating invasive plant species should consist

of manually applying herbicide directly to the plant but should avoid overspray. This would avoid or minimize eradicating desired plant species. Additionally, monitoring personnel shall observe the wetland vegetation and note damage caused by wildlife and vandalism, which should be noted on the "as-built" plans and presented to the land owner and District Environmental Manager.

If invasive species infest the area to the extent that the herbicide application method is not effective, another way to eradicate these species is to temporarily flood the area continuously to the maximum level during the spring and early summer germination period. Additionally, fall and early winter management activities shall consist of cutting the stems and re-flooding the area to stress the plants as needed to control undesired species and support the target species. The active management of plant species will be coordinated with USACE and PADEP.

PennDOT will be responsible for site management and protection of the proposed stream mitigation during the maintenance period (construction and monitoring time frames). Should construction or plant material deficiencies be discovered during the construction period, remedies will be made by the contractor as directed by the PennDOT Construction Engineer. Maintenance of the proposed stream mitigation reaches will be performed on an as-needed basis as determined through the monitoring effort. In the event that monitoring efforts indicate that the project reaches are not progressing toward meeting objectives, PennDOT will evaluate potential causes and identify appropriate measures. The identified measures will be coordinated with the USACE and PADEP to ensure agreement on the proposed actions.

VIII. Performance Standards

Wetland Mitigation

The Department will use best professional judgment, visual observations, and monitoring reports to evaluate attainment of performance standards and in determining whether part of or the entire site is successful or whether corrective actions are warranted. Success will be determined on a plot, or cell basis. All of the following standards will be used to assess project success and must be achieved each monitoring year.

Performance standards for the wetland mitigation site will address one or more of the following: total delineated wetland acreage; acreage of wetland by wetland type; achievement of wetland functions benefiting the watershed; diversity of hydrophytic vegetation; observed wildlife use/wildlife habitat; vegetative cover; hydrology; hydric soils; and invasive species control. Site specific performance measures will identify easily measurable and reasonably attainable ecologically based criteria to be used as a measure of the degree of success or failure of the wetland site to create the anticipated credits (such as Cowardin and the 1987 Wetland Delineation Manual Method).

Acreage by wetland type is utilized for the monitoring of the site specific mitigation success. A comparison of acreage of wetland by wetland type is also typically utilized as a performance measure. A standardized method for the identification of vegetative classes/wetland types is warranted to assure consistent and replicable assessment. A rapid assessment method utilizing percent cover will be applied in the determination of acreage by wetland type.

Wetland type will be defined utilizing the commonly accepted wetland classification system developed for the U.S. Fish and Wildlife Service Cowardin et al. (1979). To assure an accurate

assessment of PFO, PSS, and PEM habitats, within each identified wetland community, vegetative strata (Sapling/Shrub, Herb and Woody Vine) as defined in the 1987 Corps of Engineers Wetlands Delineation Manual and related Regional Supplement Eastern Mountain and Piedmont Section.

It is anticipated that the wetland site will develop three main types of palustrine wetland habitats including the following:

- PEM acreage,
- PSS acreage,
- PFO acreage.

PennDOT District 12-0 will review the data obtained from the monitoring reports to identify that the vegetative requirements and performance standards are being fulfilled. Should deficiencies arise as the wetland mitigation site develops, PennDOT District 12-0 would utilize the reporting protocols and adaptive management strategies to rectify site issues. It should be noted that performance standards for the forested and scrub-shrub vegetation would not be required since the impacted wetlands do not have forested or scrub-shrub components. The forested and scrub-shrub components incorporated into the wetland mitigation plan are to provide habitat diversity and to provide an environmental lift to the mitigation site and riparian corridor. The forested and scrub-shrub information provided below are for reference purposes.

Table 4. Forested Wetland Requirements

Year	Healthy Stems/Acre	Height
Initial	600	24 in.
1	550	80% demonstrating increase in height
2	500	80% demonstrating increase in height
3	450	80% demonstrating increase in height
4	400	80% demonstrating increase in height
5	350	80% demonstrating increase in height

Table 5. Scrub-Shrub Wetlands Requirements

Year	Live Crowns/Acre	Height
Initial	800	12 in.
1	600	With demonstrating woody, basal development
2	500	80% with demonstrating increase in height, cover, or stem increase
3	450	80% with demonstrating increase in height, cover, or stem increase or 65% canopy closure by woody, tree species.
4	400	80% with demonstrating increase in height, cover, or stem increase or 65% canopy closure by woody, tree species.
5	300	24 inches to 120 inches in height or 65% shrub canopy closure.

Table 6. Emergent Wetlands Requirements

Year	Aerial Coverage	% Perennial
End of 1st Year	70% aerial coverage of non-woody vegetation	0% perennial species
2	80% aerial coverage of non-woody vegetation	20% perennial species
3	85% aerial coverage of non-woody vegetation	40% perennial species
4	85% aerial coverage of non-woody vegetation	60% perennial species
5	90% aerial coverage of non-woody vegetation	90% perennial species

Open Water:

Areas ponded or inundated more than 14 consecutive days of the growing season; whether permanently inundated or ponded or affected to such as to preclude the development of perennial wetland plant species. Development of strictly aquatic vegetation indicates sufficient ponding to indicate an open water habitat and would be minimized by the site design.

Invasive Species:

Invasive, undesirable plant species are listed in the Pennsylvania Department of Conservation and Natural Resources (DCNR) publication, "Invasive Plant Species in Pennsylvania, 2019". No measured 10th acre grid shall include more than 10% coverage of invasive species to be considered successful. Exceeding 10% coverage should trigger treatment. In-case the development of a monoculture or a select invasive species the Department will work with the Pennsylvania Game Commission (PGC), USACE, PADEP, United States Fish and Wildlife Service (USFWS), and PFBC to develop a plan to control the unwanted species. The site is designed with water control structures. This will assist with any treatment of specific invasive species.

a. Hydrology

The performance standard for hydrology will be based on the current United States Army Corps of Engineers Wetland Delineation Manual, and any applicable regional supplements. In order for a wetland site to be in compliance with the performance standard for hydrology, the site will have to meet the definition of having wetland hydrology in the referenced manual.

b. Soils

The performance standard for soils will be based on the current United States Army Corps of Engineers Wetland Delineation Manual and any applicable regional supplements. In order for the wetland to be in compliance with the performance standard for soils, the site will have to meet the definition of having wetland soils, including the sections relating to problem areas and disturbed soils, in the referenced manuals.

Stream Mitigation Sites

Key components of success criteria for the stream restoration projects at the mitigation site and for the stream relocations throughout the project include (1) channel alignment stability, (2) channel bank stability, (3) channel bed stability, (4) riparian vegetation establishment, and (5) macroinvertebrate colonization. The following paragraphs provide descriptions for the aforementioned success criteria.

Channel alignment and bank stability will be considered successful if the thalweg or channel alignment closely follows the constructed alignment throughout the monitoring period. Any adjustments to the channel alignment should appear to be temporary in nature and progress toward self-stabilization. While minor adjustments are likely to occur, clear modifications to the constructed alignment should not occur. Channel alignment stability will not be considered successful if (1) the channel alignment adjustments appear to be relatively large and the erosion does not appear to be suitable for self-stabilization or (2) the channel morphology progressively aggrades or degrades over two consecutive monitoring periods.

The proposed channel bed material will be the reuse of existing streambed material of channel realignment at the site and is anticipated to remain dynamically stable under the full range of expected flows, where dynamically stable means there is a general balance between the sediment transported from the project reach and the upstream sediment supply. Channel bed stability includes both streambed erosion (degradation) and sediment deposition (aggradation). Channel bed stability will be considered successful if the proposed channel bed material remains intact at the built elevations, sediment transport through the constructed reaches would be balanced allowing for the natural flow regimes to occur as designed and/or any changes that may occur to the channel bed are localized in nature and are unlikely to spread upstream or downstream.

The banks along the mitigation sites should remain relatively stable during site establishment and as the sites mature. Channel bed and bank stability will be considered successful based on the following criteria:

- Stream bank stabilization areas will be effectively functioning and no evidence of excessive erosion will be present within the stream reach.
- A certain degree of bank adjustment has the potential to occur during the monitoring period as vegetation becomes established and roots establish to improve bank stability.
- For the purpose of this monitoring effort, excessive erosion is defined as erosion which appears to be active and likely to continue throughout the entire monitoring period.
- Erosion should not be considered excessive if it appears that it is local in nature and not likely to continue and/or spread either upstream or downstream.
- Lateral migration or undermining of instream habitat structures will be evaluated to ensure the stream flow is not compromising the structures.

Riparian vegetation establishment consisting of live stakes along the streambanks and herbaceous seed mixes throughout the graded slopes and floodplain areas. Riparian vegetation establishment will be considered successful based on the following criteria:

- Herbaceous areas exhibit a site wide average of 85% coverage by noninvasive plant species (planted and volunteer). This coverage must be exhibited throughout the site and in each sample station supporting herbaceous plants.
- Live stake and joint planting stakes exhibit a site-wide successful establishment.
- Trees and shrubs along the stream floodplain will be considered successful if they exhibit at least one of the following:
 - A site-wide average of 33 percent aerial coverage by woody species along with indications of a continued increase in percent cover, or
 - A site-wide average of consistent with the aerial coverage for scrub shrub and forested components described above in the wetland vegetation performance standards.

Invasive species will be documented and evaluated in the context of their influence on the stream mitigation areas attaining performance standards and meeting project objectives.

IX. Monitoring Requirements

PennDOT will monitor the wetland and stream mitigation site for a period of five years or until the agencies have agreed the wetland and streams are established. The information within the report will be a summary of the information presented below to meet Part VIII. Performance Standards. If any deficiencies or failures are observed at the wetland and stream mitigation site, a written plan to correct the failures will be developed. The stream relocations constructed as part of the project construction will be monitored for a minimum of two years to monitor stability and vegetative establishment. Photo documentation will be provided within the monitoring reports with locations provided on the drawings. During the monitoring period, reports shall be submitted to the PADEP every six months for the first two years of monitoring and then once a year for the remaining three years.

Wetland Monitoring

Wetland monitoring will be completed for the mitigation site and will analyze a minimum of three sample point locations within the proposed wetland areas. Data will be collected using the methodology described in the *U.S. Army Corps of Engineers (USACE) 1987 Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0), April 2012 (Supplement)*. The data will be recorded on the USACE Wetland Determination Data Form – Eastern Mountain and Piedmont, which is provided in **Appendix E**. Sample point locations will be staked in the field during the first monitoring event to ensure that sampling will occur at the same location throughout the monitoring period.

Vegetation will be sampled within a five-meter by five-meter quadrant around each sample point. All species within the quadrant will be identified, and the percent coverage of the dominant species will be estimated. The condition of each species will be noted and a determination will be made if each species was planted at the sampling location by examining the planting plan. Special note will be made if the species was planted on the site but not within the sample point. Tree and/or shrub species will be evaluated for health and survival.

One test pit will be dug at each sample point. The soil profile and hydric soil characteristics will be recorded. The presence of hydrology and other hydrologic indicators such as sediment deposits, watermarks, or drainage patterns will be recorded at each sample point. Soil pits will remain open for approximately 30 minutes to identify subsurface soil saturation.

Phase II of the sampling plan will involve an overall evaluation of the physical and functional characteristics provided by the wetland mitigation site. Visual observations of the floodflows, substrate composition and distribution, soil types and conditions, wildlife usage, degradation and aggradation issues, and visual observations of potential pollution will be recorded on the data forms. This data as described in the following bullets, along with the sample point data will be collectively analyzed and described in the report.

- Hydrologic data from each sample point will be evaluated to determine the overall hydrologic condition of the wetland site. Reference will be made to the grading plan to determine if saturation/inundation is above, at, or below the levels proposed.
- Weather conditions and precipitation data will be obtained from a local weather station. The data will be reviewed to determine how weather conditions may be influencing the site. Detailed water quality analysis is not included as part of this task. Visual observation will be conducted to identify potential water quality problems.
- Percent cover for herbaceous, shrubs, and trees at each sample point will be totaled and compared with the site planting plan. This total will be qualitatively compared to the overall site to determine the site vegetation coverage. The health and survival of planted vegetation and the amount of volunteer species and any invasive species over the site will be noted.
- Usage of the site by aquatic, herptile, avian, and terrestrial species will be determined through sight and sound observations. Evidence of past wildlife usage, including tracks, trails, nests, scat, browsing, and predation, will be noted. The type and degree of wildlife usage will be recorded.
- Soils data obtained at each wetland sample point will be used to evaluate the extent of hydric soil conditions throughout the site. In addition, the general condition of placed topsoil and any erosion and/or siltation throughout the site will be noted.
- Photographs of the site will be recorded to correspond to those locates depicted on the grading plan. The photograph locations will be staked in the field to ensure that the site photographs will be taken at the same location throughout the monitoring period. The photographs will be numbered and included in the report.

Stream Monitoring

Monitoring efforts proposed to evaluate project performance along the proposed stream relocations throughout the project and at the mitigation site include four broad categories (1) stream channel evaluation, (2) vegetation establishment evaluation, (3) photographs, and (4) physical characterization, habitat assessment and benthic macroinvertebrate field observation.

Stream Channel Evaluation

The stream channel evaluation component of the monitoring protocol is related to methods for evaluating (1) channel alignment stability, (2) channel bed stability, (3) channel bank stability, (4) substrate composition, (5) instream structures, and (6) scour protection.

The channel evaluation will be accomplished through a combination of (1) visual inspection along the stream areas and (2) repeat photographs taken at specific locations. The repeat photo locations will be established to provide an overview of the site in addition to specific features of interest. See the photograph discussion below for more details about the repeat photo locations.

The visual inspection along the stream areas will consist of walking the entire channel length and checking if the channel is functioning within the success criteria discussed above. Any areas found to be functioning outside the success criteria will have the location noted on the site plan, photographs taken, and a brief description of the conditions recorded.

Natural fiber matting is directly related to channel bank stability during the years immediately following construction as vegetation becomes established. Any bank erosion will likely be associated with areas of natural fiber matting that become detached, tear, or are sagging. Locations where the natural fiber matting is not intact along the edges, is torn, or sagging should be noted and photographed.

All notes will be recorded on site data sheets and locations will be noted on the site plan, including photo location and direction. Results of the channel evaluation should be reported to the PennDOT Environmental Manager in a timely fashion, especially any areas requiring maintenance.

Vegetation Establishment Evaluation

The vegetative monitoring effort focuses on evaluating the establishment of (1) trees and shrubs in the riparian zone, (2) live stakes along the streambanks and within the wetland, and (3) herbaceous species (seed mixes) throughout the stream areas. It is important to conduct the vegetative monitoring during the timeframes discussed above.

The vegetative establishment evaluation along the Mitigation Site is anticipated to be accomplished visually by walking the entire sites to evaluate live stake, tree, shrub, and herbaceous vegetation establishment. The visual inspection of vegetation establishment will consist of walking the entire site and documenting the following site-wide conditions:

- Live stake survivability
- Percent coverage by noninvasive herbaceous species
- Percent aerial coverage by woody species
- Number of woody stems (including planted and pioneer species that are a minimum of 24 inches in height)
- Note invasive species locations on the site map, including the number of woody stems and estimated percent ground cover of herbaceous species.

For the live stakes and scrub-shrub mix along the streambanks, establishment success includes evidence of growth leading to the development of healthy leaves and roots. The entire length of the stream areas will be walked and homogenous areas of vegetative establishment, including estimated survival rate (percent) and overall health and growth for live stakes and seed mix, will be drawn on the site plan.

For the riparian zone, including tree and shrub plantings and the seed mix, the following formation will be estimated for each site (1) species common name, (2) species scientific name, (3) stratum of species, (4) whether the species was planted as part of the channel relocations and enhancements or is a volunteer plant, (4) approximate percent cover provided by the species, and (5) percent bare ground and/or open water.

Photographs

During the first monitoring event, photograph stations will be established throughout each stream site that will provide a thorough photographic documentation of site conditions. Photograph stations will be permanently demarcated using metal pins, PVC pipe or similar material so that the locations can be readily found during field investigations. Photograph station locations will be surveyed or recorded with GPS and added to the site plan. The direction and number of photographs to be taken at each station will be noted. Repeat photographs will be taken at the photograph stations during each monitoring event for the duration of the monitoring effort.

Physical Characterization, Habitat Assessment and Benthic Macroinvertebrate Field Observation

Physical characterization, habitat assessment and benthic macroinvertebrate field observation will be conducted during the monitoring effort. This information will be collected following methods described in Environmental Protection Agency's rapid bioassessment protocols (Barbour et al., 1999). Specifically, physical, habitat and benthic macroinvertebrate information will be documented on the data sheets located in **Appendix E**. A minimum of one sampling point will be located along each relocated stream section and one for each mitigation section due to the relatively short length for each relocation.

Monitoring Report

The monitoring reports will document the wetland and stream sample point results, site conditions, and permit compliance issues following requirements provided in the USACE's Regulatory Guidance Letter No. 08-03 – *Minimum Monitoring requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (October 10, 2008)*. A brief summary of the data obtained and site observation during the monitoring event. Any unusual or problematic circumstances observed during the site investigation will be discussed. Recommendations to improve site conditions will also be provided if warranted. The reports will address the severity and potential causes of site deficiencies and recommended solutions. The report appendix will contain wetland and stream sample point data forms, As-built plans, site plan, and site photographs.

The comprehensive final report will:

- Tabulate and interpret monitoring data collected throughout the five-year monitoring period for the mitigation site;
- Document successes, failures, and permit compliance issues;
- Provide suggestions for further efforts, if warranted; and
- Identify physiological trends at the sites and suggest techniques that could improve deficiencies, if applicable.

Each monitoring report will be submitted to PennDOT for review and comment. Upon PennDOT approval, the monitoring report will be submitted to the PADEP and USACE.

X. Long Term Maintenance Plan

The stream and wetland mitigation site will be monitored for at least a five-year period or until the agencies have deemed the sites successful; therefore long term maintenance of the wetland and stream sites are not anticipated. The stream relocations constructed as part of the project construction will be monitored for a minimum of two years to monitor stability and vegetative establishment.

XI. Adaptive Management Plan

If for unforeseen reasons or events, this Mitigation Plan cannot be completed in accordance with the attached designs (Part VI. Mitigation Work Plan), or if the performance standards are not being met, PennDOT will notify the USACE and PADEP. If a significant modification to the plan is required, approval from the USACE and PADEP will be requested prior to completing the modified design.

XII. Financial Assurances

The PennDOT District 12-0 has approved the funding for the design, construction and long-term maintenance of the mitigation sites.