Design Consistency Guidelines

January 2025

Contents

Chapter 1 - INTRODUCTION

The following information was developed by the Pennsylvania Turnpike Commission (PTC) to be used as a set of guidelines in the design of Total Reconstruction projects and is intended to clarify and/or highlight the PTC's design preferences.

PennDOT Standards and Publications, American Association of State Highway and Transportation Officials (AASHTO) design guidelines and Commission specifications and standards should all be used in conjunction with these guidelines in design. It is understood that federal, state or local regulations may require deviations from these guidelines.

The information included herein will not be applicable to every project. Each project is to be designed on an individual basis, taking into account all applicable information included herein, yet making decisions using sound engineering judgment based on the unique aspects of each project. However, major exceptions must be approved by the Unit Manager and the Assistant Chief Engineer of Design.

FOR SECURITY PURPOSES, ANYONE THAT INTENDS TO MAKE A FIELD VISIT ON TURNPIKE DESIGN PROJECTS MUST NOTIFY THE APPROPRIATE MAINTENANCE FACILITY IN ADVANCE OF THE FIELD VIEW. OBTAIN THE MAINTENANCE FACILITY CONTACT INFORMATION FROM THE TURNPIKE PROJECT MANAGER AT THE START OF THE PROJECT.

Prior to Working within the PTC Right-of-Way

Consultants doing any work on Turnpike R/W (surveyors, drillers, utilities, R/W personnel, environmental specialists, etc.) should inform the PTC project manager (PM) prior to performing the work. A Personnel in Field Notification Form in Appendix A must be submitted with the request.

(The PTC PM will provide this information to the Operations Center Supervisor at the Operations Center.) On each day of work the consultant should telephone the Operations Center Supervisor at the Operations Center at 866-332-5889 or *11 by cellular and ask for the Operations Center Supervisor. He will need the location and vehicle description along with a telephone number for contact. (They keep a log of those on the PTC system so that they know who is where and what they are doing.)

The PTC Traffic Engineering and Operations Department will provide requirements for UAS within PTC R/W, if necessary. Please see the PTC PM for more details.

Chapter 2 - SURVEYS

2.0 Introduction

Engineering surveys shall be performed according to methods, practices and accuracies specified in PennDOT Publication 122M (Surveying and Mapping Manual) except as directed by this section, and any project specific directives issued by the Commission, in writing.

All surveys are to be based upon the "U.S. Survey Foot" definition. Any metric/U.S. Survey Foot conversions of data are to utilize the "1200 / 3937" ratio. All projects are to be on PA State Plane Coordinate System, NAD 83, with the Combined Grid Factor provided. The vertical datum shall be NAVD 88 unless otherwise directed by the Commission. Some existing projects may be on Project Grid.

2.1 Survey Control Network

A. Control/Monument Recovery

Recover available horizontal and vertical control points shown in field notes, mapping control reports, record of control data sheets, and plans provided by the Commission. This recovery shall include control points adjacent to the project, on adjoining sections, with the intent of utilizing adjacent projects' control to create a seamless control network between adjacent design/construction sections when possible.

B. Evaluation of Control for Final Design and Construction

The requirements for control of construction projects are defined in Section 2.3. Location, condition, stability, and spacing of recovered survey control points is to be reviewed to determine suitability as safe (out of jeopardy of destruction from future construction activities) and usable points for the duration of construction. If the evaluation of the available horizontal and vertical control is determined to not meet the requirements outlined in Section 2.3, densification / augmentation of the control network as described in Section 2.3 is necessary.

C. Verification of Mapping Accuracy

Perform map accuracy tests in accordance with PennDOT Publication 122M and as follows:

Coordinate with Commission survey personnel to determine locations for test profiles and cross sections on each design project. Test profile and cross section data will be compared with profiles and cross sections developed at the same location, from the aerial mapping DTM, and presented in tabular and graphic formats for comparison. The design consultant will provide written evidence of accepting the aerial mapping for proposed design.

2.2 Surveys for Supplementing Project Mapping

Extend project mapping control to collect additional information necessary to support design. Include Commission survey personnel in all conversations related to supplemental surveys prior to starting the work.

Traverses, GPS observations, and differential digital leveling for layout and data collection shall be tied to the expanded network of existing mapping control monuments and/or published NGS control. Report misclosures and/or mapping control discrepancies to the Design Manager and Commission survey personnel.

The design consultant shall supplement aerial mapping and collect information by conventional or other high accuracy surveying techniques for existing topographic features requiring precise location for design. These existing features will include but not be limited to:

- Existing pavement where accuracy greater than aerial mapping tolerances is required
- Bridge structure details (abutment, wing walls, parapets, beam seats, roadway clearances, footing elevations, etc.)
- Drainage structures (inlet grates, pipe inverts, headwalls, box/arch culvert details, etc.)
- Existing, ground, ditch, channel, stream, etc., at proposed drainage structure/feature outlets
- Areas noted as "OBSCURED" on the aerial mapping CAD files
- Other existing features deemed necessary by the design team.

2.3 Survey Control for Construction

The Final Design Consultant shall provide additional permanent/semi-permanent survey control to support project construction activities. Projects requiring Construction Surveying, Type A, Type B, and/or Type D pay items shall include horizontal and vertical control near the proposed limits of construction with a minimum of three (3) horizontal control points and three (3) vertical control points evenly spaced throughout the project. Closed loop differential bench levels are required to establish elevations on vertical control points. Nails and rebar will not be acceptable for vertical control. Construction projects greater than three (3) miles in length require horizontal and vertical control points spaced no more than one and one-half (1 1/2) miles apart. Control point requirements for projects including tunnels or large bridge structures will be determined by Commission survey personnel.

All control points will be placed within legal right-of-way or on Commission surplus property and outside of the proposed construction limits. Prior to setting control, a meeting with Commission survey personnel will be required to determine if proposed locations are acceptable. Reconstruction projects and large bridge structure projects may require a field view meeting.

Concrete monuments set for control shall be cast in place, a minimum of forty-eight inches in depth, a minimum of twelve inches in diameter, contain a ferrous metal rod, with a bronze disc (to be provided by the Commission). Rebar set for horizontal control shall be set flush and extend a minimum of thirty-six inches below grade and be a minimum of No. 6 (¾" diameter).

The Final Design Consultant will verify control points are stable and established NEZ values noted on contract documents are correct a maximum of sixty (60) days prior to title sheet.

2.4 Baseline Staking

In areas where proposed alignment deviates significantly from the existing roadway footprint and new roadways, wood stakes or painted points (as applicable) shall be placed on baselines at two-hundred (200) foot intervals to support field view orientation during the bid phase. Where it is not practical to set baseline lath, an appropriate offset line (preferably parallel/concentric with the baseline) shall be established with stations, offsets and whether the line is left or right of the baseline.

Within a maximum of sixty (60) days prior to title sheet submission, verify that the lath installed is intact for the bidding phase.

2.5 Survey Deliverables

Final Design Consultant shall submit the following to the Commission:

- Leveling data, field notes, GPS log sheets (if applicable)
- A "Combined Grid Factor" for the project and PA State Plane Coordinates for the point selected for its basis shall be provided (if applicable).
- A "Monument Data Recovery Form" (M.D.R.F.) and sketch plan for each control point established shall be completed (applicable fields completed) and delivered in both hard copy and digitally as a Microsoft Word document. See Chapter 20, Sample Letters and Forms.
- Coordinate point files for the raw (unadjusted) field control traverse, the adjusted PA State Plane Coordinates for all traverse points and horizontal control included in the network. Provide digital copies of raw traverse angles and distances, closure precision ratio for field traverses, and method of adjustment utilized.

2.6 Digital Delivery

For Projects designated for digital delivery, please see the Design Services Unit and the Digital Delivery link on the paturnpike.com homepage for standards, templates, workspaces, and other information regarding the Commission's Digital Delivery program.

Chapter 3 - ROADWAY DESIGN

3.0 Introduction

There are many factors that contribute to the decisions required in applying the geometric design elements within a given design project. This chapter presents the basic framework of the design guidelines required to tailor a consistent roadway network.

Additional sources of information to supplement these design guidelines and related concepts are contained in, but not limited to, AASHTO's "A Policy on Geometric Design of Highways and Streets"; PennDOT Publication 13M, Design Manual Part 2 – Highway Design; PennDOT Publication 70M, Guidelines for Design of Local Roads and Streets; PennDOT Publication RR-441, Access to and Occupancy of Highways by Driveways and Local Roads; PennDOT Publication 72M, Roadway Construction Standards; and the Pennsylvania Turnpike Commission Standards for Roadway Construction.

Utilize a design speed of 70 MPH unless directed otherwise. If project is adjacent to a previously reconstructed section of roadway, the limit of full depth reconstruction should be extended a minimum of 25-feet into the previously built section.

Please follow the PTC's Excess Excavation Guide located in the DOM for waste sites and management of fill policies.

See Section 3.11 for guidance on completing the Earthwork Summary Block.

3.1 Mainline Typical Sections – Flexible Pavement

On new construction or reconstruction projects having a flexible pavement, the roadway pavement structure shall extend two feet into the outside shoulder area. Locate the pavement base drain at this point. The widened portion of the pavement should be constructed at the same slope as the pavement, and the shoulder slope should begin at the edge of the widened pavement. Label all cross-slopes as a percentage (%).

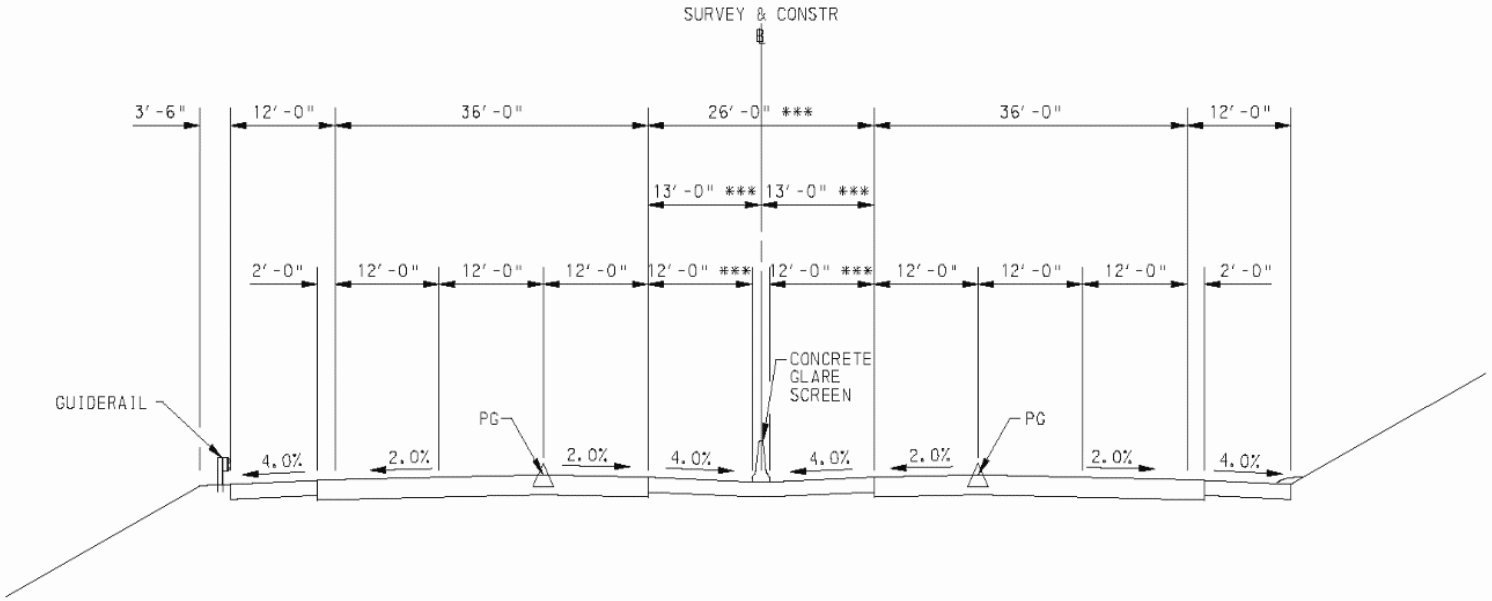
On the typical section, show both the total width of the travel lanes and shoulders as well as the width of the pavement section. This would consist of a 36-foot and 2-12-foot dimensions for travel lanes and inside/outside shoulders. The pavement structure widths will also be shown on the typical section. Show a two-foot dimension for the extension of the pavement structure into the outside shoulder area. On the plan sheets, show only the total width of the 36-foot travel lanes, median and shoulders (12 foot), not the width of the pavement structure.

Figures 3.1.1, 3.1.2, and 3.1.3 depict the typical sections for the six-lane tangent, six-lane superelevated ($2\% < SE < 6\%$), and six-lane superelevated ($SE > 6\%$) scenarios, respectively.

The following note shall appear on the typical sheet with the mainline typical:

ORIGINAL PAVEMENT CONSTRUCTION SHOWN. REPAIR AREAS OF FULL-DEPTH ASPHALT MATERIALS MAY BE PRESENT. EXCAVATION OF EXISTING ROADWAY TEMPLATE IS PAID AS CLASS 1 EXCAVATION REGARDLESS OF THE MATERIAL ENCOUNTERED.

Figure 3.1.1 illustrates two (2) tangent (Normal Crown) sections with the PG (Profile Grade) located between the inside and middle travel lanes.



TANGENT SECTION

(NORMAL CROWN)

NOTES:

PG = PROFILE GRADE

PROFILE GRADES MATCH ON BOTH SIDES

*** WIDTHS MAY VARY

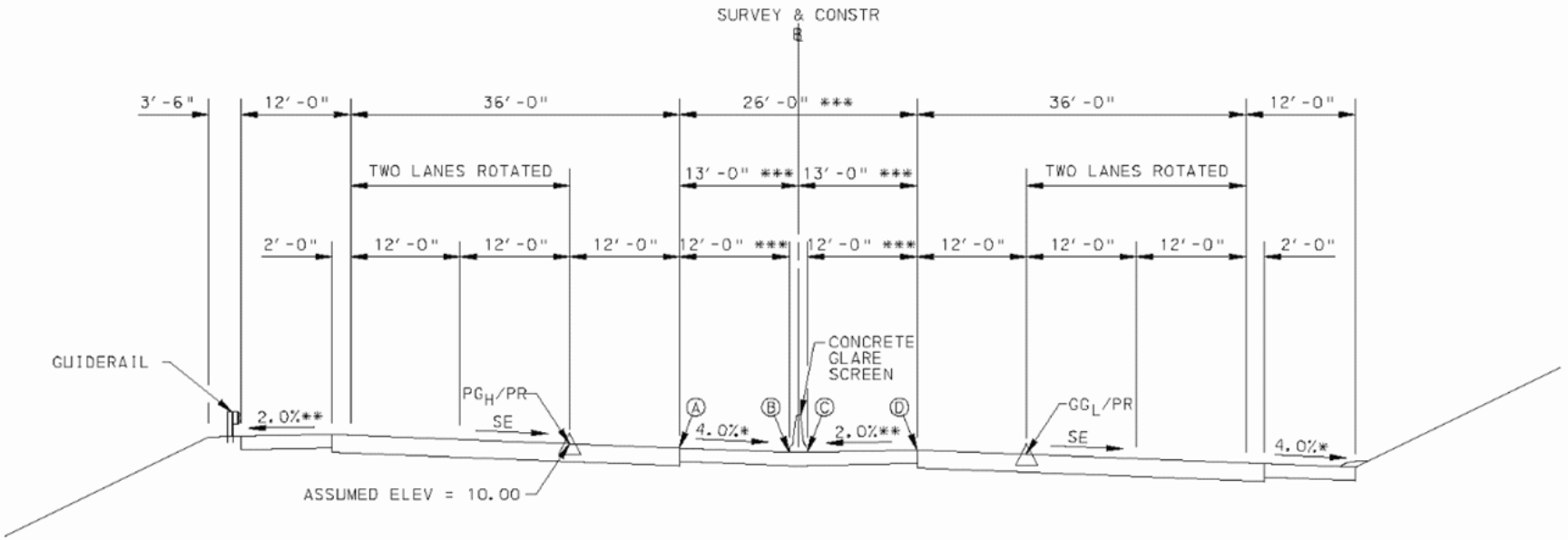
NOTE:

THE SECTIONS DEPICTED IN FIGURES 3.1.1 - 3.1.6 ARE NOT INTENDED TO BE THE FINAL TYPICAL SECTIONS INCLUDED IN THE CONTRACT DRAWINGS.

FIGURE 3.1.1 SIX-LANE MAINLINE SECTION

N.T.S.

H:\Projects\Ustation\0414\Roadway\FIG 3-1-1.dgn



SUPERELEVATED SECTION

(2% < SE < 6%)

NOTE:

THE SECTIONS DEPICTED IN FIGURES 3.1.1 - 3.1.6 ARE NOT INTENDED TO BE THE FINAL TYPICAL SECTIONS INCLUDED IN THE CONTRACT DRAWINGS.

NOTES:

PG_H/PR = PROFILE GRADE ON HIGH SIDE OF SUPERELEVATION/POINT OF ROTATION

GG_L/PR = GRAPHIC GRADE ON LOW SIDE OF SUPERELEVATION/POINT OF ROTATION

* MATCH SE RATE WHEN SE > 4.0%

** TRANSITION FROM 4.0% (INSIDE) TO 2.0% (INSIDE) WHEN INSIDE LANE TRANSITIONS FROM 0% CROSS SLOPE TO 2.0% (OUTSIDE). ALSO, THE OUTSIDE SHOULDER ON THE HIGH SIDE OF SUPERELEVATION WILL TRANSITION FROM 4.0% (OUTSIDE) TO 2.0% (OUTSIDE) AT THE SAME RATE.

*** WIDTHS MAY VARY, SAMPLE CALCULATIONS SHOWN IN TABLE 1 ARE ONLY FOR DIMENSIONS SHOWN.

USE FOUR LANE VALUES FROM CURRENT PENNDOT DM 2 - TABLE 2.4 FOR DETERMINING MINIMUM SUPERELEVATION TRANSITION (T), MINIMUM TANGENT RUNOUT (X), MINIMUM SUPERELEVATION RUNOFF (L), AND MINIMUM SPIRAL LENGTHS (L_S).

SPIRAL LENGTH (L_S) SHOULD BE IN EVEN MULTIPLES OF 10', I.E., IF THE MINIMUM SPIRAL LENGTH REQUIRED FROM TABLE 2.4 IS 293', A SPIRAL LENGTH OF 300' SHOULD BE USED. THIS LENGTH SHOULD ALSO BE USED TO ESTABLISH THE OVERALL SUPERELEVATION TRANSITION (T) LENGTH.

SUPERELEVATION TABLE 1

% SE SLOPE	ELEVATION ①				GG_L/PR = Ⓓ - 12 (% SLOPE)	GG Δ ②
	Ⓐ	Ⓑ	Ⓒ	Ⓓ		
2.0%	9.76	9.28	9.28	9.52	GG_L/PR = 9.52 - .24 = 9.28	0.72
3.0%	9.64	9.16	9.16	9.40	GG_L/PR = 9.40 - .36 = 9.04	0.96
4.0%	9.52	9.04	9.04	9.28	GG_L/PR = 9.28 - .48 = 8.80	1.20
5.0%	9.40	8.80	8.80	9.04	GG_L/PR = 9.04 - .60 = 8.44	1.56

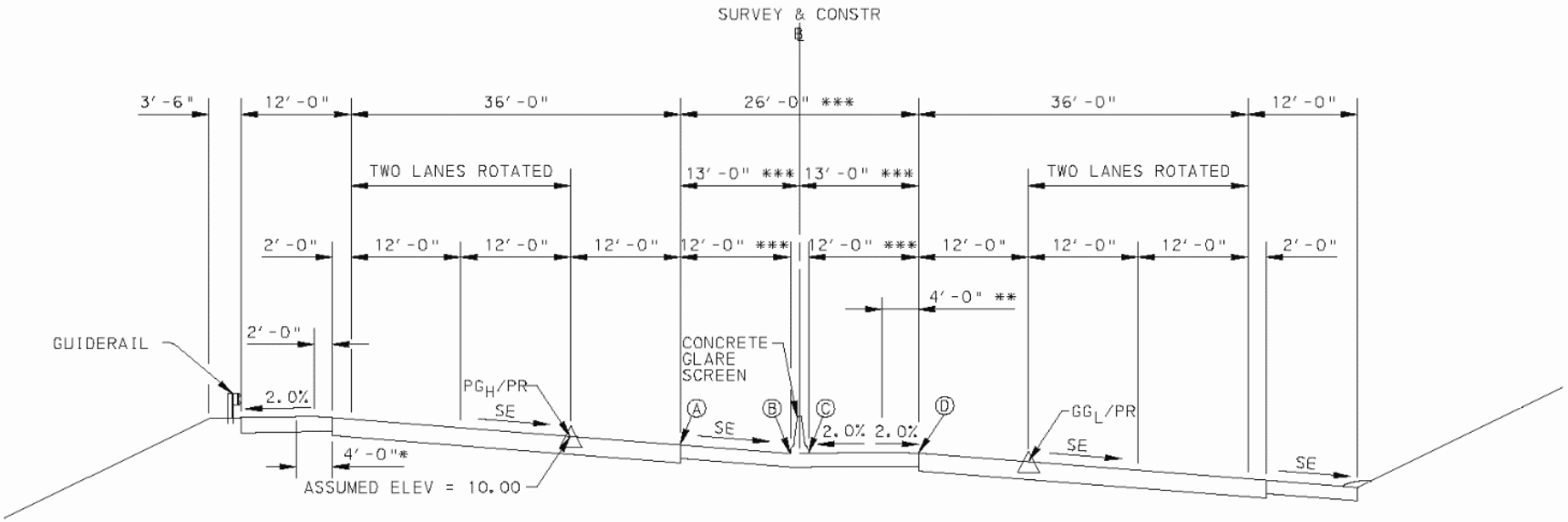
① BASED ON ASSUMED ELEVATIONS SHOWN ABOVE.

② THIS ELEVATION ADJUSTMENT, WHEN APPLIED TO EITHER THE SIMPLE CURVE PORTION OF A SPIRALED CURVE OR TO A CIRCULAR CURVE, IS THE ELEVATION DIFFERENCE BETWEEN THE PG_H/PR AND THE GG_L/PR.

FIGURE 3.1.2 SIX-LANE MAINLINE SECTION

N.T.S.

H:\Projects\Ustation\0414\Roadway\FIG 3-1-2.dgn



SUPERELEVATED SECTION

(SE ≥ 6%)

NOTES:

PG$_H$/PR = PROFILE GRADE ON HIGH SIDE OF SUPERELEVATION/POINT OF ROTATION

GG$_L$/PR = GRAPHIC GRADE ON LOW SIDE OF SUPERELEVATION/POINT OF ROTATION

* INTRODUCE 4′-0" ROUNDING 50′-0" PRIOR TO THE STATION AT WHICH SE EQUALS 6.0%.

** INTRODUCE CHANGE IN CROSS SLOPE 50′-0" PRIOR TO THE STATION AT WHICH SE EQUALS 6.0%.

*** WIDTHS MAY VARY, SAMPLE CALCULATIONS SHOWN IN TABLE 2 ARE ONLY FOR DIMENSIONS SHOWN.

USE FOUR LANE VALUES FROM CURRENT PENNDOT DM 2 - TABLE 2.4 FOR DETERMINING MINIMUM SUPERELEVATION TRANSITION (T), MINIMUM TANGENT RUNOUT (X), MINIMUM SUPERELEVATION RUNOFF (L), AND MINIMUM SPIRAL LENGTHS (L_S).

SPIRAL LENGTH (L_S) SHOULD BE IN EVEN MULTIPLES OF 10′, I.E., IF THE MINIMUM SPIRAL LENGTH REQUIRED FROM TABLE 2.4 IS 293′, A SPIRAL LENGTH OF 300′ SHOULD BE USED. THIS LENGTH SHOULD ALSO BE USED TO ESTABLISH THE OVERALL SUPERELEVATION TRANSITION (T) LENGTH.

NOTE:

THE SECTIONS DEPICTED IN FIGURES 3.1.1 - 3.1.6 ARE NOT INTENDED TO BE THE FINAL TYPICAL SECTIONS INCLUDED IN THE CONTRACT DRAWINGS.

SUPERELEVATION TABLE 2

% SE SLOPE	ELEVATION ① Ⓐ	Ⓑ	Ⓒ	Ⓓ	GG$_L$/PR = Ⓓ - 12 (% SLOPE)	GG Δ ②
6.0%	9.28	8.56	8.56	8.64	GG$_L$/PR = 8.64 - .72 = 7.92	2.08
7.0%	9.16	8.32	8.32	8.40	GG$_L$/PR = 8.40 - .84 = 7.56	2.44
8.0%	9.04	8.08	8.08	8.16	GG$_L$/PR = 8.16 - .96 = 7.20	2.80

① BASED ON ASSUMED ELEVATIONS SHOWN ABOVE.

② THIS ELEVATION ADJUSTMENT, WHEN APPLIED TO EITHER THE SIMPLE CURVE PORTION OF A SPIRALED CURVE OR TO A CIRCULAR CURVE, IS THE ELEVATION DIFFERENCE BETWEEN THE PG$_H$/PR AND THE GG$_L$/PR.

FIGURE 3.1.3 SIX-LANE MAINLINE SECTION

N.T.S.

Figure 3.1.2 illustrates a superelevated section (2%<SE<6%). This section introduces a graphic grade profile on the low side of superelevation so that a profile elevation adjustment can be made to ensure that the edges of median elevations are equal. Superelevation Table 1 depicts the elevation adjustments for the simple curve portion of a spiraled curve or a circular curve. Further explanation of the graphic grade profile can be found in Section 3.3.

Figure 3.1.3 illustrates a superelevated section (SE > 6%). This section also utilizes a graphic grade profile on the low side of superelevation and introduces a change in cross-slope transition on the low side inside shoulder and a four-foot rounding on the high side outside shoulder 50 feet prior to the SE = 6%. Superelevation Table 2 depicts the elevation adjustments as described in Superelevation Table 1, but for SE > 6%.

A. Shoulder Treatment Adjacent to Superelevated Pavement

Outside shoulder and median shoulder cross slopes adjacent to superelevated pavement should follow the criteria shown in Figures 3.1.2, 3.1.3, 3.1.7, and 3.1.8.

The notes on superelevation shall appear on the typical sections where applicable. These notes may only be modified when certain superelevation rates may not exist within the plan set. (i.e. no SE rates are greater than 6%).

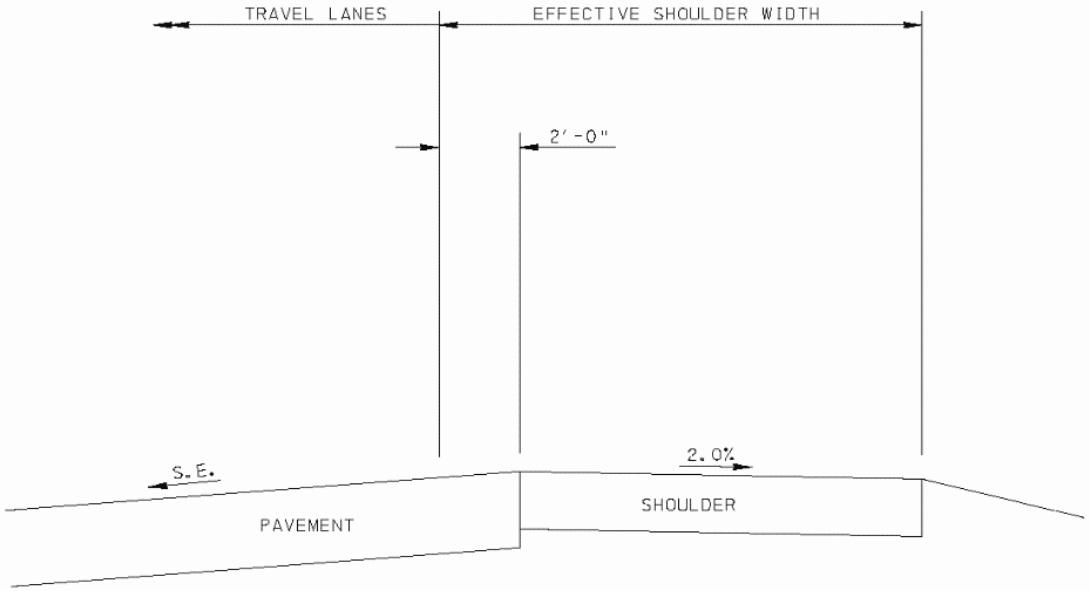
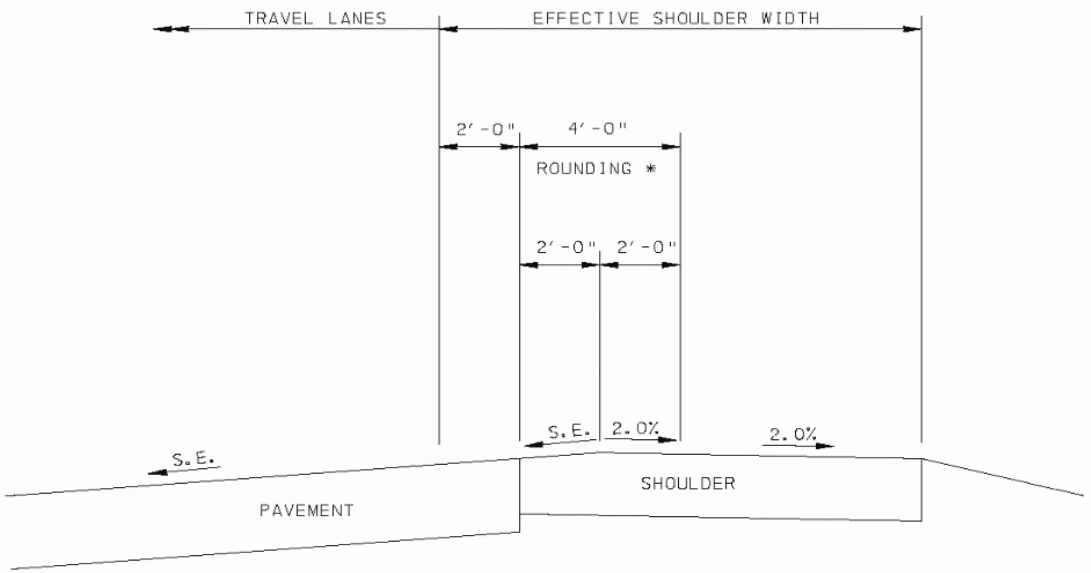


FIGURE 3.1.7 OUTSIDE SHOULDER TREATMENT (2% < SE <6%)

N.T.S.



* - INTRODUCE 4'-0" ROUNDING 50'-0" PRIOR TO THE STATION AT WHICH SUPERELEVATION EQUALS 6.0%.

FIGURE 3.1.8 OUTSIDE SHOULDER TREATMENT (SE $\geq$ 6%)

N.T.S.

H:\Projects\Ustation\0414\Roadway\FIG 3-1-8.dgn

3.2 Horizontal Alignment - Mainline

Horizontal alignments are to follow PennDOT Publications and AASHTO guidelines except where criteria within these guidelines supersede those manuals.

A. Maximum Degree of Curvature & Spirals

The maximum degree of curvature for mainline horizontal alignment shall not exceed 3°00'00".

Spirals shall be used on all mainline curves with a Degree of Curvature of 1°00'00" or greater. See note on Page 3-3, Figure 3.1.2.

B. Guidelines for Setting Bearings and Angles

1. The bearings of proposed roadways shall be set to seconds of a degree without decimals.
2. Bearings that tie into an existing roadway may be set to decimals of a second but is not recommended or encouraged.
3. Bearings of an existing roadway may be set to decimals of a second, but it is not recommended or encouraged.
4. Angles between proposed baselines should be set to seconds of a degree without decimals.
5. Angles shown in the curve data should produce the bearings shown for the roadway, and the roadway bearings should produce the curve data angle.

C. Plan Presentation

Follow PennDOT Publication 14M, Design Manual Part 3 – Plans Presentation, and the information provided below:

1. Baseline Labels

    a. Construction Plans –
    - PTC Mainline & Side Roads – Survey and Construction Baseline

    b. Right-of-way/Geometry Plans
    - PTC Mainline – Survey and Right-of-way Baseline and Original Right-of-way Baseline
    - Side roads – S.R. or T-_____Survey and Right-of-way Baseline

    The construction plan set for the Mainline Total Reconstruction projects are to include Right-of-way/Geometry Plans indicating the tie between the Original Right-of-way Baseline and the Survey and Right-of-Way Baseline.

2. Curve Data Presentation

   Horizontal curve data shall be presented as indicated in Figure 3.2.1 or Figure 3.2.1.A. Presentation shall be consistent throughout the plans.

3.3 Vertical Alignment – Mainline

Vertical alignments are to follow PennDOT Publications and AASHTO guidelines except where criteria within these guidelines supersede those manuals.

A. Maximum Percent Grade

The desirable maximum percent grade is 3%. Steeper grades can be investigated due to topography or other conditions that may justify the use of steeper grades and must be approved by the Project Manager and the Roadway Engineering Manager.

B. Guidelines for Setting Profile Grades and Elevations

1. PI stationing should be at a +25-foot interval, when possible, and decimals in the PI stationing are discouraged.
2. Normally, all grades are to be set and shown to two (2) decimal places.
3. When tying into an existing roadway, three (3) decimal places for the tie-in grade may be used.
4. Grades can be rounded provided the rounded grade produces no change to the elevations of the established or set points (PVI station and elevation).

   EXAMPLE: 17.18' (set difference in elevation)/480' (distance between PI's) = .03579 (3.5792%) = 3.58%. Grade is to be used.

   CHECK: .0358 (3.58%) x 480' = 17.184' and rounds to the set difference in elevation of 17.18'.

5. Elevations can be rounded provided the rounded elevation produces no change to the grade.
6. All PVI elevations are to be established using the rounded elevation of the back PVI.
7. PG elevations at any point along the survey and construction baseline are to be established using the rounded elevation of the PVI and the rounded grade.

   EXAMPLE: 3.58% (set grade) x 480' = 17.184' ~ 17.18' is to be used.

   CHECK: 17.18' / 480' = .03579 (3.579%) which rounds to the set grade of 3.58%.

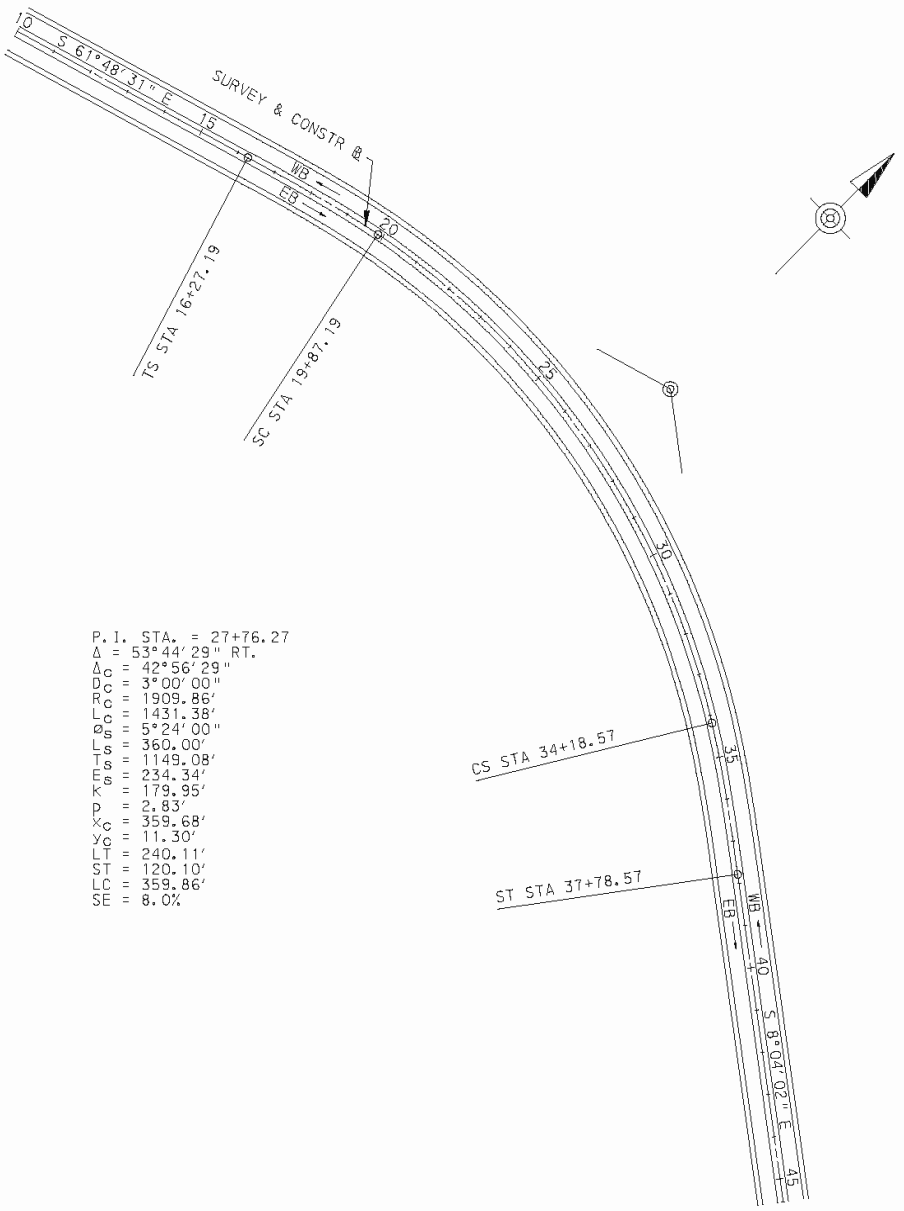


FIGURE 3.2.1 EXAMPLE ALIGNMENT AND CURVE DATA

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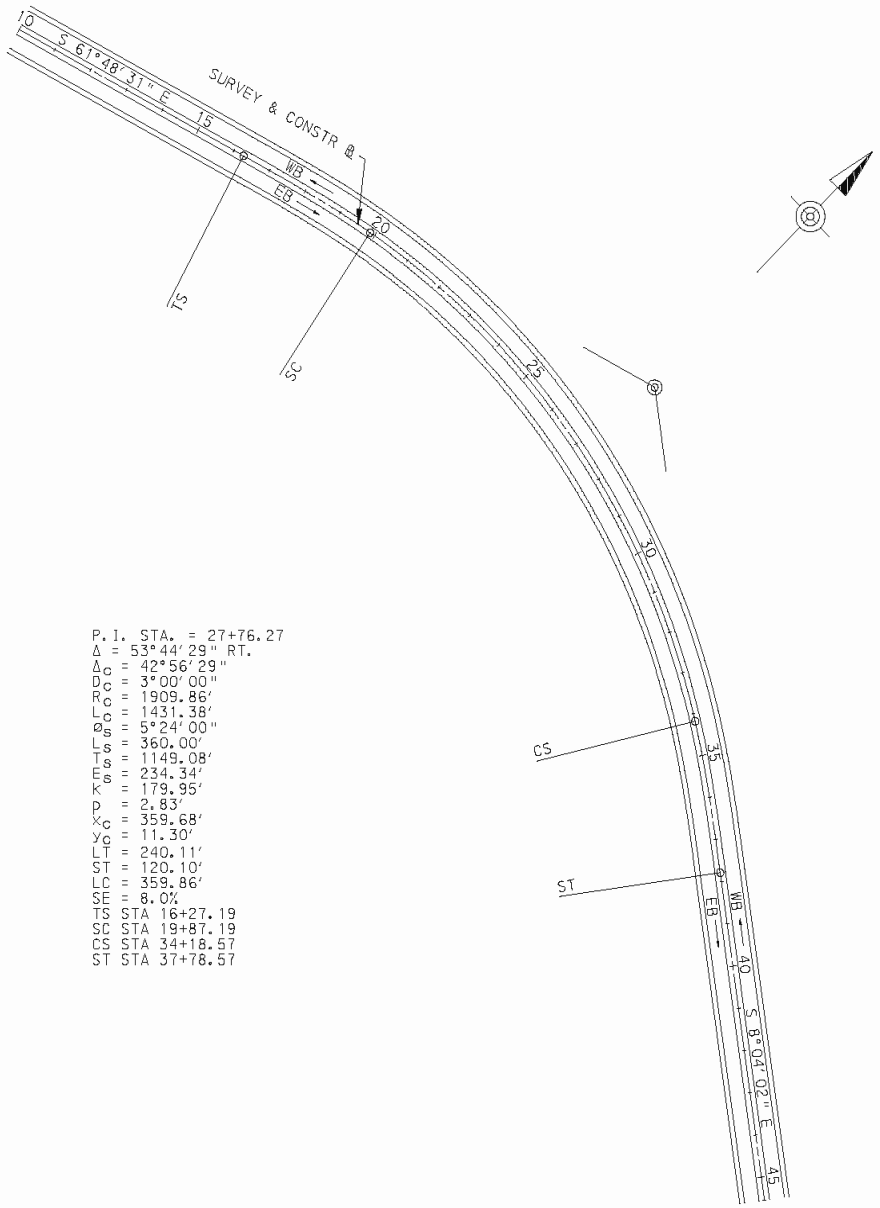


FIGURE 3.2.1(a) EXAMPLE ALIGNMENT AND CURVE DATA (ALTERNATIVE METHOD)

N.T.S.

C. Guidelines for Setting Graphic Grade Profiles and Elevations

As described and depicted in Section 3.1, Typical Sections, the low side of a superelevated curve will have a graphic grade (GG) to adjust the profile elevations so that the edge of median barrier elevations are equal in fully superelevated sections and within three (3) inches in transition areas.

1. A maximum of three-inch reveal and a minimum of zero (0) inch reveal must be maintained on the concrete median barrier throughout.

Graphic Grade Elevation Calculations in Full Superelevation

2. The Graphic Grade elevations will be determined utilizing the concepts depicted in Figures 3.1.2 and 3.1.3. This constant elevation adjustment, GG, will provide a three (3) inch reveal on each side of the concrete median barrier within a fully superelevated section.

Graphic Grade Elevation in Transition Areas

3. Since a constant elevation adjustment, GG, will occur in a fully superelevated curve, a transition from the profile grade to the PC or SC is needed. The following guidelines are to be used for spiraled curves and simple curves.

Spiraled Curves

4. Provide linear transitions from the profile grade to the constant elevation adjustment, GG between the TS and SC stations entering the curve and from the CS to ST stations exiting the curve.

Circular Curves

5. Provide linear transitions from the Profile Grade to the constant elevation adjustment, GG between the (PC-L), Where L = Length of Superelevation Runoff, and the PC station entering the curve and from the PT to (PT+L) station exiting the curve.
6. It is the designer's responsibility to evaluate profiles along the edge of roadway to avoid rapid grade changes and to ensure a smooth graphic profile. If necessary, make adjustments in the SE Transition.
7. Figures 3.3.1 and 3.3.2 depict how the aforementioned Graphic Grade Transitions occur for the example horizontal curve data provided in Figure 3.2.1.

D. Plan Requirements

1. Provide one mainline profile depicting the Profile Grades and Graphic Grades in accordance with Figure 3.3.1. Provide Profile Grades at 50-foot intervals. Provide Graphic Grades at 25-foot intervals in Transition Areas and at 50-foot intervals in constant elevation adjustment, GG areas. The existing elevations depicted on the single profile will be along the profile grade points.
2. Follow guidelines in Section 3.3.B, when applicable.

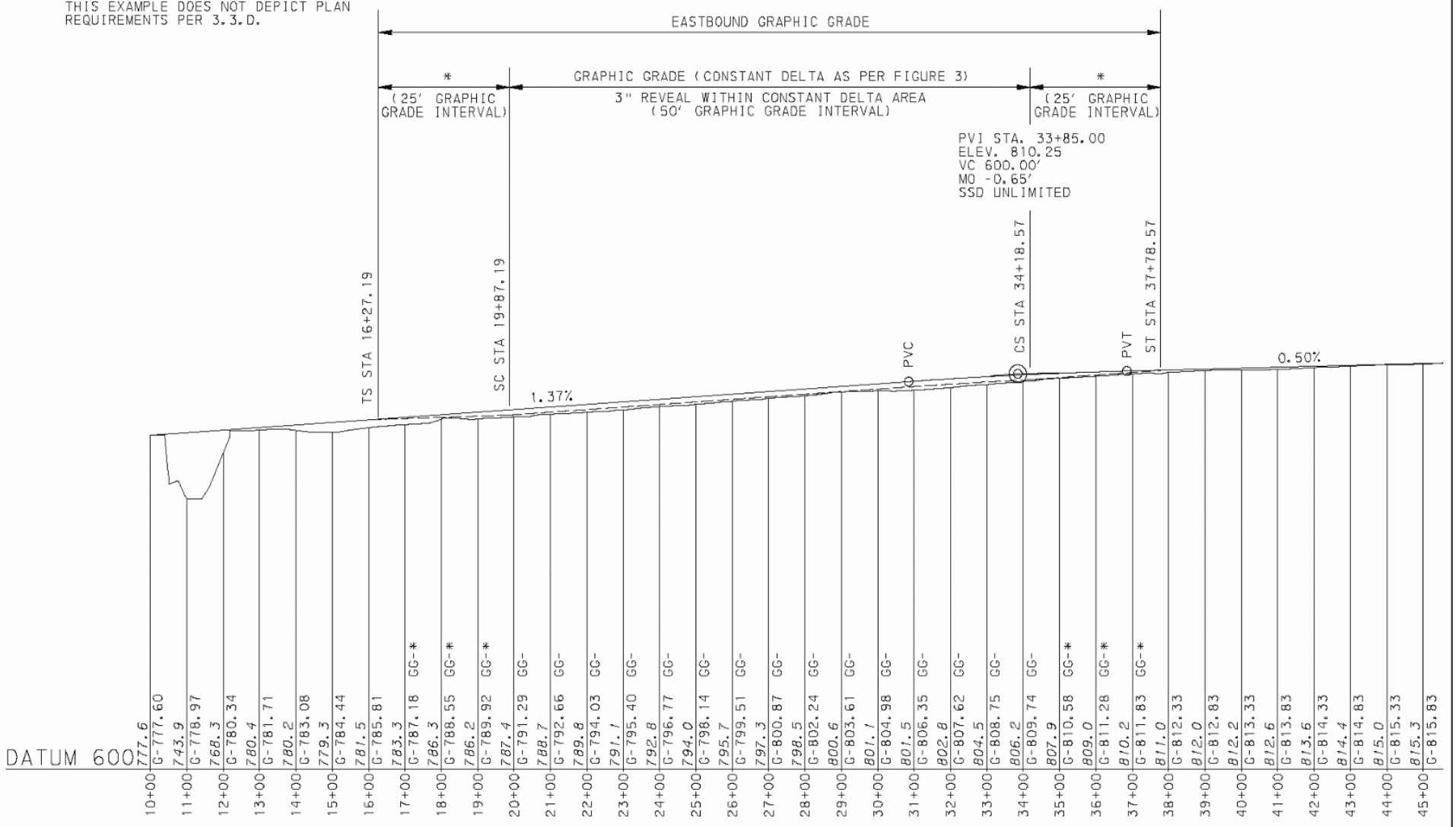
3. At locations where tying to existing conditions, set and tie one direction as Profile Grade, tie the opposite direction as Graphic Grade Transition Area, and label as per Figure 3.3.1.
4. Show clearances to all structures and overhead utilities.

3.4 Superelevation Transition and Spiral Lengths

1. As per typical sections presented in Section 3.1, use current PennDOT Publication 13M, Design Manual Part 2 – Highway Design, for determining minimum superelevation transition (T), Minimum Tangent Runout (X), Minimum Superelevation Runoff (L), and Minimum Spiral Lengths (LS).
2. Values shown in DM2 for minimum superelevation runoff (L) and minimum spiral length (Ls) should be adjusted to the next highest even multiple of ten feet (10'). The tangent runout length (x) should also be adjusted to provide a linear transition rate from normal crown to full superelevation using the value established for L or Ls as a basis.
3. Figure 3.4.1 illustrates the superelevation transitions for the same horizontal curve data presented in Figure 3.2.1.

3.5 Cross-Sections

1. Provide mainline cross-sections at 50-foot intervals and as required depicting unique existing and proposed features.
2. Partial cross section inserts to adequately show proposed storm drainage shall be provided when deemed necessary by the design manager, the project manager or as determined by the designer.
3. Provide 4:1 or flatter fill slopes when economically feasible. The use of 3:1 fill slopes shall be avoided unless in transition areas.
4. The hinge point for fill slopes without guiderail is to be at the same offset, typically 15'-6" from the edge of pavement, as those slopes with guiderail. See Appendix B – Typical Details, Detail #1.
5. Provide pavement base drain at the back edge of shoulder as the subbase drainage outlet for all fill slopes 4:1 and flatter.
6. Cross sections at Interchanges, Service Plazas, retaining walls, OH structures, mainline structures, etc. must accurately reflect the total quantity of excavation and correct Class of Excavation. I.e., there should be no gaps, and the Contractor should be able to replicate the quantities provided.
7. See Section 3.11 for guidance on completing the Earthwork Summary Block.



NOTE:
* - GRAPHIC GRADE TRANSITION AREA. REDUCE 3" REVEAL, AS NEEDED, ON CONCRETE GLARE SCREEN TO ENSURE SMOOTH INSIDE EDGE OF ROAD PROFILE. PROVIDE 25' PROFILE ELEVATIONS IN GRAPHIC GRADE TRANSITION AREAS.

SEE FIGURE 3.3.2 FOR ADDITIONAL DETAIL.

LEGEND

———— PROFILE GRADE

– – – – – GRAPHIC GRADE

FIGURE 3.3.1 PROFILE OF EXAMPLE ALIGNMENT

N.T.S.

NOTE:
THIS EXAMPLE DOES NOT DEPICT PLAN REQUIREMENTS PER 3.3.D.

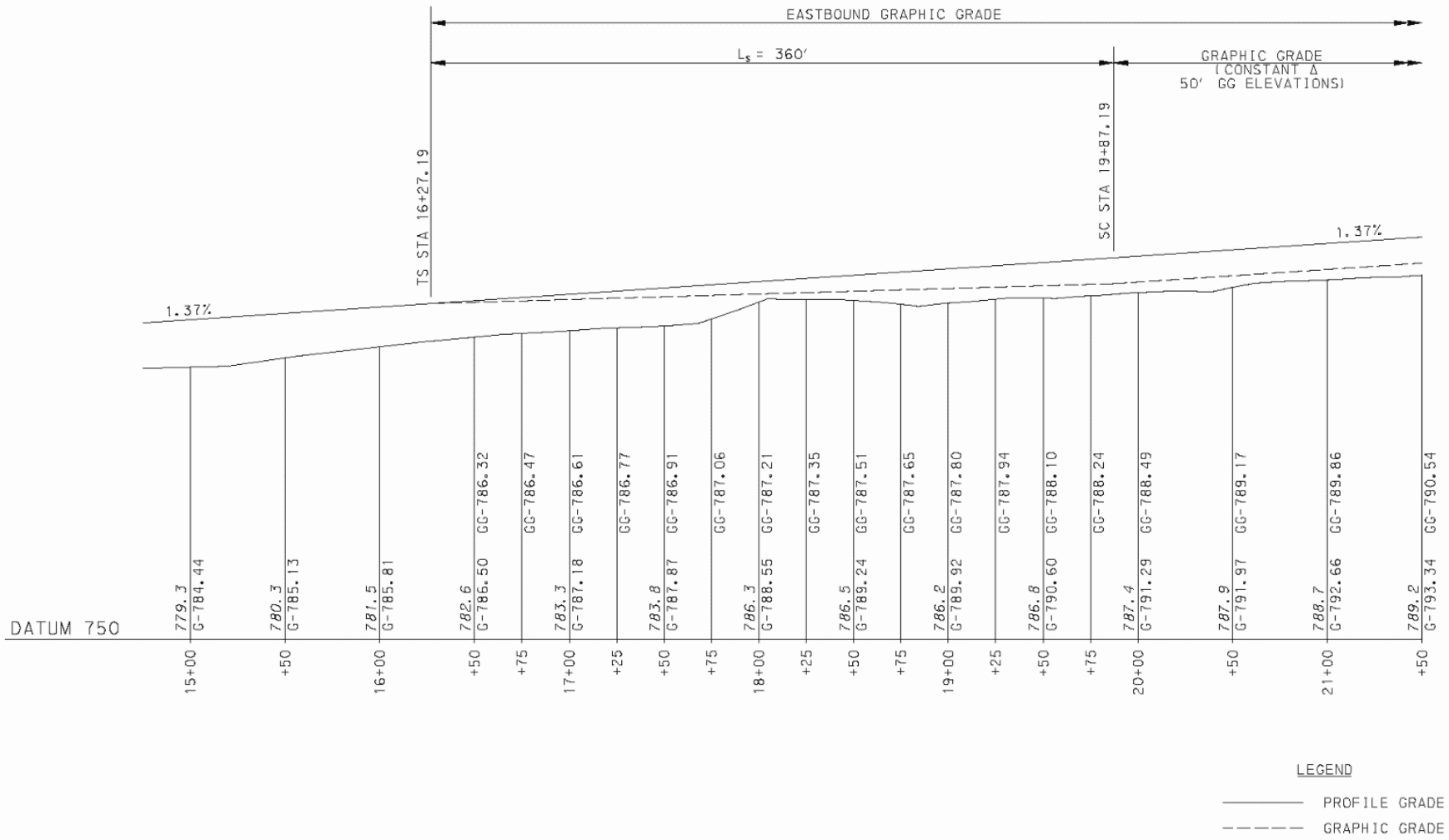
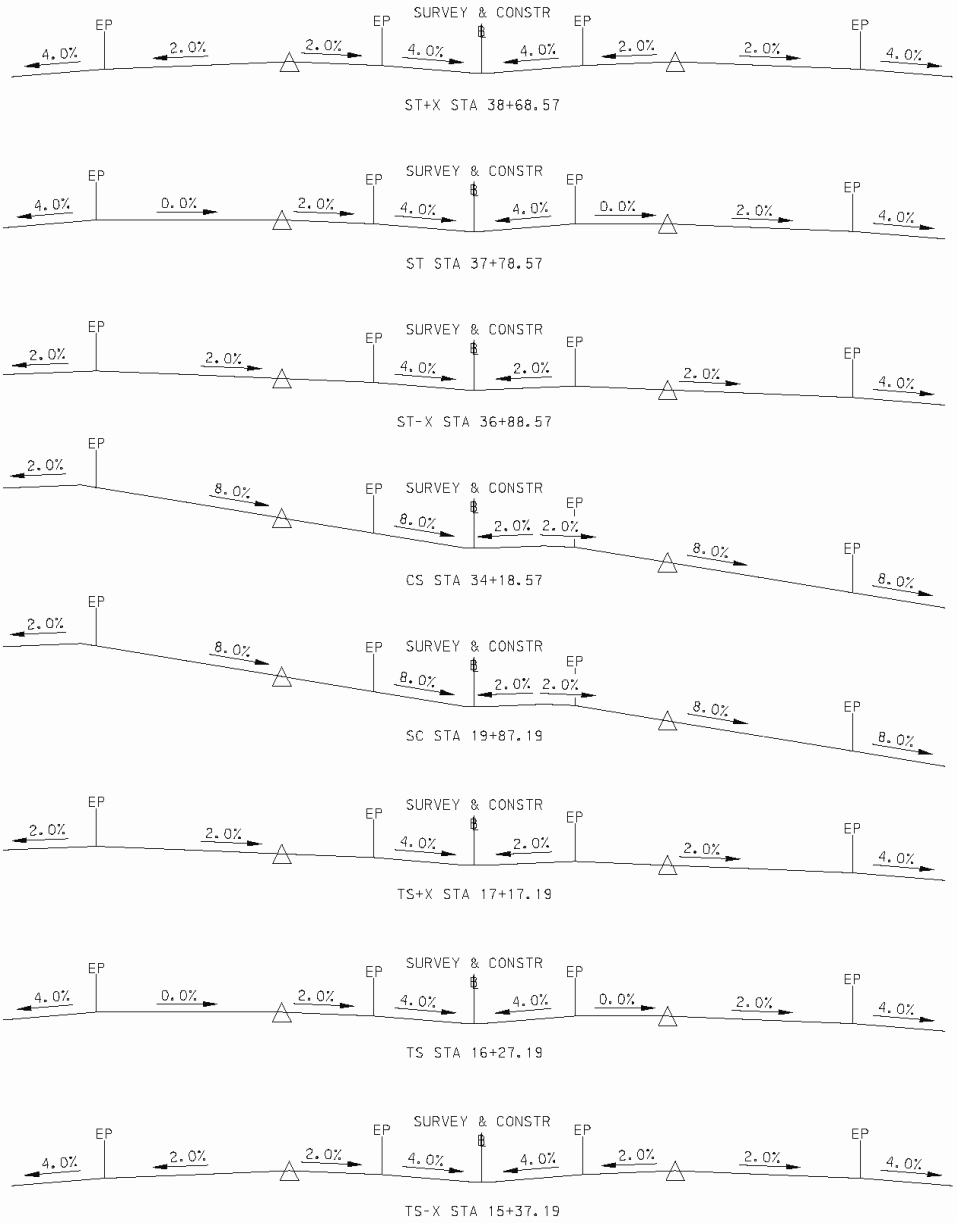


FIGURE 3.3.2 GRAPHIC GRADE PROFILE TRANSITION OF EXAMPLE ALIGNMENT

N.T.S.

$FILE$



NOTE:
FROM PENNDOT DM 2 - TABLE 2.4
FOUR LANES
e_{Max} = 8.0%
V = 70 MPH
L = 360'
X = 90'
T = 450'

FIGURE 3.4.1 SUPERELEVATION TRANSITION TEMPLATES FOR EXAMPLE ALIGNMENT

N.T.S.

3.6 Interchange and Service Plaza Ramps

Design interchange and service plaza ramps in accordance with AASHTO design criteria. Parallel ramps are preferred for both acceleration and deceleration ramps, but site conditions should be evaluated to determine the most practical design.

Ramp widths shall be designed as per AASHTO Table 3-29 "Design Widths of Pavements for Turning Roadways" – Case II for all ramps being designed as single lane ramps and as per Case III for dual lane ramps. Design Traffic Condition B shall be used when determining ramp width as per either Case II or Case III.

The attainment of superelevation over the gradually widening auxiliary lane and over the whole of the turning roadway terminals should not be abrupt. The design should be in keeping with the cross-slope controls as given in AASHTO Table 9-20.

The right shoulder shall be designed as a 10-foot full depth pavement shoulder. The left shoulder shall be designed as 8-foot full depth pavement when guide rail is present; when no guide rail is present a 4-foot Type 2 concrete shoulder shall be provided along with a 4-foot graded area. When guide rail is present anywhere adjacent to the left shoulder the entire shoulder length shall be designed as an 8-foot full depth pavement. Where left shoulders intersect the gore at the mainline the gore shall be designed as full depth pavement.

Ramp medians shall be designed as a 4-foot minimum with a 6-foot median as the desirable median width.

Ramps should be reviewed for future MPT requirements for maintenance contracts. A minimum of 14' ramp width for vehicles plus a work zone that allows the safe access to longitudinal joints shall be provided. Truck Turning Templates are to be provided to PTC Roadway and Traffic for future use on these MPT stages. If the 14' width cannot be provided, then detour and/or crossover patterns are to be discussed and developed with the Manager of Traffic Engineering and Roadway Engineering Manager.

3.7 Two-Lane to Three-Lane Transitions

To tie the new roadway to the existing roadway, transition the new 3-lane section to the existing 2-lane section at a rate of 100:1. See Appendix B – Typical Details, Detail #2 for a sample of this transition which includes information on the geometry, pavement markings and signage required to accomplish this.

3.8 Local Roadway Design

A. General

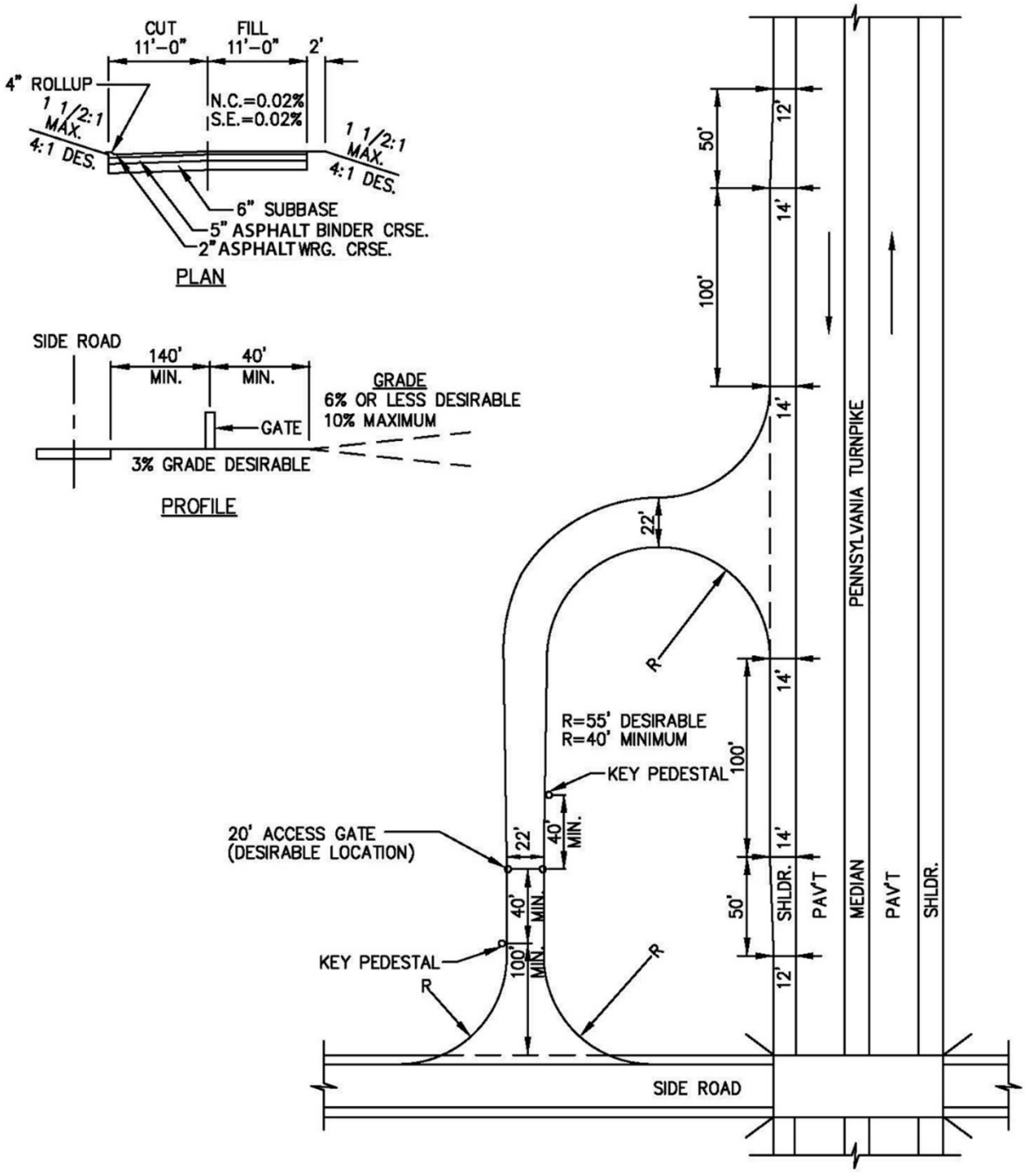
1. Follow local governmental design ordinances, PennDOT publications, and AASHTO guidelines when developing local roadway designs.
2. Prepare a Design Criteria Chart for each roadway containing the following information: roadway classifications, existing and design year average daily traffic

and design hourly volumes, existing posted speed limit, design speed, existing and proposed pavement and shoulder widths, existing pavement depths (if known), existing and proposed vertical grades along with sight distances, existing and proposed bridge width, and include any other design features such as sidewalks, parking lanes, etc. This Design Criteria Chart is to be reviewed by the Design Manager prior to submitting to local agencies and PennDOT.

3. Follow guidelines set forth in PennDOT Publication RR-441, Access to Occupancy of Highways by Driveways and Local Roads, for driveway adjustments due to construction.
4. Provide side road cross-sections at 25-foot intervals and at critical points (driveways, etc.).

3.9 Access Ramps

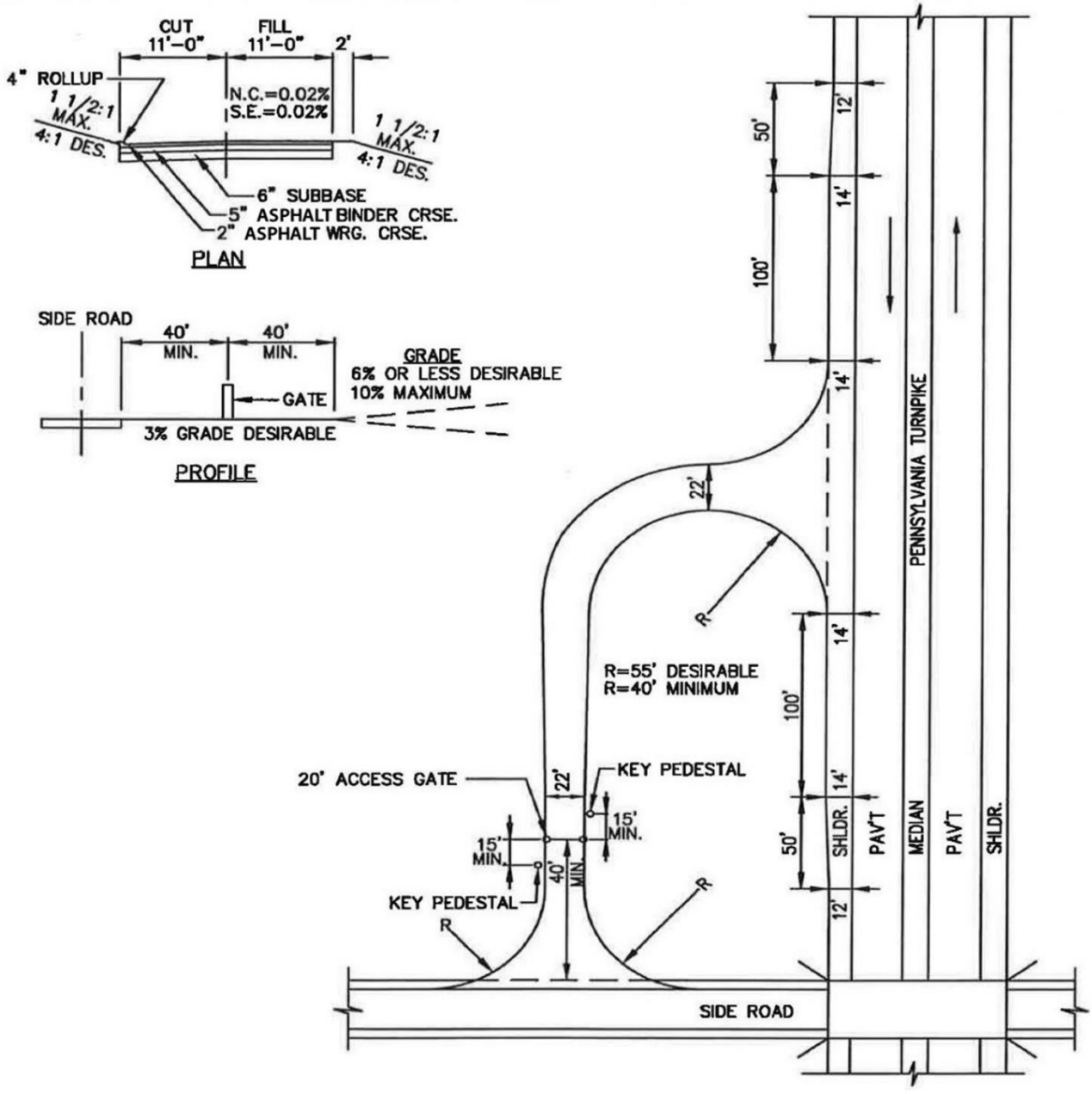
Access ramp design is to follow the details that are depicted in Figures 3.8.1A & 3.8.1B. See Chapter 15 for access drives to stormwater management facilities/basins.



1. MAJOR TURNAROUNDS ARE THOSE LOCATIONS WHICH SERVE AS THE LIMIT OF A MAINTENANCE DISTRICT AND/OR MAINTENANCE SHED. PROPOSED LOCATIONS TO BE VERIFIED WITH DISTRICT SUPERINTENDENTS.
2. SEE ACCESS RAMP – STANDARD TURNAROUND DETAIL FOR LOCATIONS WHICH ARE NOT A MAINTENANCE DISTRICT OR MAINTENANCE SHED LIMIT.

FIGURE 3.8.1A ACCESS RAMP – MAJOR TURNAROUND

N.T.S.



1. STANDARD TURNAROUNDS ARE THOSE LOCATIONS WHICH ARE NOT LOCATED AT THE LIMIT OF A MAINTENANCE DISTRICT OR MAINTENANCE SHED.
2. DISTANCES INDICATED FROM SIDE ROAD TO GATE AND FROM KEY PEDESTAL TO GATE ARE MINIMUMS AND SHOULD BE DESIGNED AS CLOSE AS FEASIBLY POSSIBLE TO MATCH THE DIMENSIONS OF THE MAJOR TURNAROUND.
3. DETAIL NOT INTENDED FOR SWM ACCESS DRIVES. SEE CHAPTER 7 FOR ACCESS DRIVE DETAILS.

FIGURE 3.8.1B ACCESS RAMP – STANDARD TURNAROUND

N.T.S.

3.10 Title Sheet and Limit of Work

A. Overhead Bridge Replacement Project

The project should be titled as "Replacement of Bridge B- _____ at Milepost _____.____". The labeled Milepost is the intersecting point of the Mainline and side road. Associated with this bridge replacement will be Limits of Work for both the Mainline and side road. These Limits of Work are to contain physical work (physical work does include the temporary pavement, median barrier removal, etc.; but does not include the advance signing associated with Maintenance and Protection of Traffic). These limits should appear on the Index Sheet, General Notes Sheet, Location Map, Construction Plans, etc.

B. Mainline Reconstruction Project

The project should be titled as "Roadway and Bridge Reconstruction from Milepost ____.___ to Milepost ____.____". The labeled Mileposts will be the point of Full Depth, full width reconstruction. Associated with this project will be Limits of Work for the Mainline and any impacted side roads. These Limits of Work are to contain physical work (physical work does include the temporary pavement, median barrier removal, etc.; but does not include the advance signing associated with Maintenance and Protection of Traffic). These limits should appear on the Index Sheet, General Notes Sheet, Location Map, Construction Plans, etc.

C. Title Sheet General

Sample Title as follows:

Drawings
For
CONTRACT NO. _____
ROADWAY AND BRIDGE RECONSTRUCTION
MP _____.___ TO MP _____.____
IN _____ COUNTY

3.11 Earthwork Summary Block

A. General

An Earthwork Summary Block is a crucial part of construction projects, providing a summary of the volume and type of material that needs to be moved. To successfully bid the earthwork, eliminate questions from the contractors and avoid claims during construction care must be taken to ensure that the earthwork is estimated accurately, all items of earthwork are accounted for, and the handling of the material is documented.

Careful consideration of the types of excavation needed, the selection of suitable borrow materials, and the identification and removal of unsuitable materials is necessary to

provide an accurate summary of the net volume. All attempts should be made to balance the earthwork (net zero volume) by utilizing readily available rock types for construction to avoid a borrow condition and to provide optional modified embankment (OME) areas to avoid a waste condition. Waste material should only include unsuitable material, which must be removed from the project site and any material in excess of the available capacity either on site and/or within the permitted boundary of the project. Please follow the PTC's Surplus Excavation Guide located in the DOM for waste sites and management of fill polices.

B. Completing the Earthwork Summary Block

Begin by downloading the latest version of the Earthwork Block Template from the PTC Reference Library in Kahua. Comprehensive, Total Reconstruction, Bridge Replacement and Resurfacing Templates are available.

The columns of the template are organized based on the different types of excavation, unsuitable material, completed embankment, and select borrow that may be encountered on a project. The columns provided to the right of the completed embankment columns can be modified and/or deleted as needed to fit the need of the project.

When calculating and recording the earthwork quantities in the summary block:

- Include all excavation and embankment for temporary widening, temporary roadways, temporary access roads, temporary crossovers and emergency pull-offs.
- For projects with proposed topsoil placement, to ensure a quantity is accounted for in the contract, consider including a detail in the plans to show the basis of the quantity estimate. The detail should include an assumed nominal depth and the approximate locations of the placement.
- Ensure the Class 1 excavation volume includes the RC-10 rounding of cuts slopes by showing the rounding on the cross sections.
- Consider including the incidental excavation associated with the Commission Specification sections 849, 850, 851, 861, and 864 if warranted based on the size of the project.
- For cross referencing purposes, include an "EMBANKMENT (FOR INFORMATION ONLY)" column in the roadway and drainage tabulation sheets.
- For Total Reconstruction Projects, provide earthwork values per stage.

Based on the specifics of the project, use the sample notes as applicable and modify as needed.

Provide notes to specify all incidental excavation and embankment earthwork associated with structures.

The quantities recorded for all pay items should match the quantities on the Summary of Items.

3.12 Pavement Joint Locations

Proper union between the construction phase lines of total reconstruction pavement structures is critical to ensuring the longevity and maintainability of the overall pavement section. All phase lines shall be designed and constructed as follows:

1. All full depth asphalt total reconstruction projects shall step the pavement courses as depicted in Figure 3.12.1.

2. The final longitudinal wearing surface joint must be located as shown on the PTS-980 standard. These locations accommodate future joint sealing without impacting the pavement markings. To arrive at the final longitudinal joint location specified in PTS-980, it may be necessary that up to a full lane width of the final wearing surface placed during the phases of reconstruction be resurfaced with the final wearing course on the subsequent phase. Designer shall ensure this additional work is reflected in the bid documents.

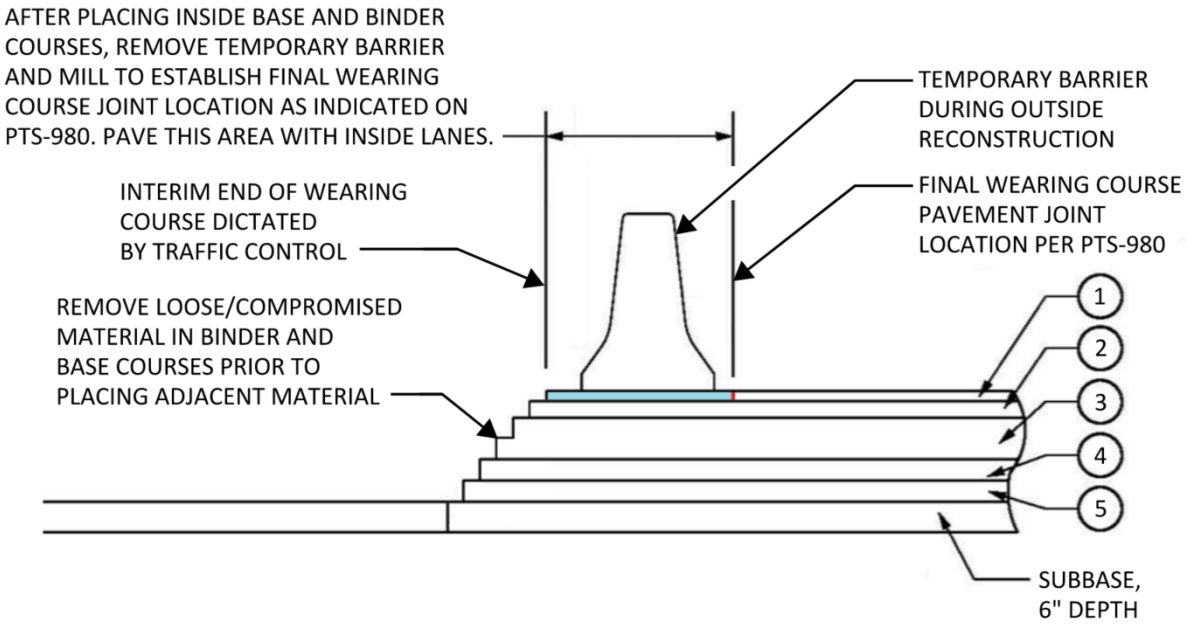


FIGURE 3.12.1

Chapter 4 - MAINTENANCE AND PROTECTION OF TRAFFIC

4.0 Introduction

The Maintenance and Protection of Traffic (MPT) Plan is to provide clear directions for safely and efficiently handling the flow of traffic through or around the work zone.

A comprehensive MPT plan is to be developed for the entire project which includes General Notes, a Tabulation of Signs and Devices (For Information Only), Special Details, Typical Sections and Plan Views.

Typical sections are to indicate the survey & construction baseline, work zone/area widths with hatching to indicate proposed work, temporary lane widths with direction arrows, existing barriers, temporary barriers, channelizing devices and temporary pavement markings. Typical sections can also be provided for structures where lane widths and work zone/area widths differ from the adjacent roadway. Do not indicate construction items (excavation depths, pavement courses, etc.) on these typicals as this information is to be presented in the roadway drawings typical sections and/or details.

The plan view drawings, at a scale of 1" = 50', are to be prepared to detail the lane transitions/tapers for each stage/phase of construction where traffic will be transitioning into and out of the work zone as well as at any other areas which deviate from the typical staging. These plan view drawings are to show all traffic control signs and devices except those signs shown on the MPT Standards, temporary barriers, temporary pavement markings, etc. Where applicable, the PTS 900 series will be utilized in lieu of detailed drawings and/or referenced on the drawings.

The PTC issued new MPT Standards in April of 2024. The series now consist of General Notes, PTS 000, PTS 910, PTS 920, PTS 930, PTS 940, and Appendix A. The PTC also has standards for PTS 960 and 980 series that should appear on the list of standard drawings sheet, if applicable. For purposes of the DCG, items referred to in this paragraph will be referenced as the MPT Standards.

Additional sources of information to supplement these design guidelines and the MPT Standards are contained in, but not limited to, PennDOT Publication 13M, Design Manual Part 2, Highway Design, PennDOT Publication 14M, Design Manual Part 3, Highway Plans Presentation, Chapter 4; PennDOT Publication 212, Official Traffic Control Devices; PennDOT Publication 213, Temporary Traffic Control Guidelines; PennDOT Publication 236, Handbook of Approved Signs; the Manual on Uniform Traffic Control Devices (MUTCD); and applicable PennDOT Traffic Standards from the various TCs.

The Designer is to provide a list of applicable Maintenance and Protection of Traffic Standard drawings under the Enumeration of Drawings and on the construction plans, if applicable, at the 60% over the shoulder review for concurrence.

4.1 General

Review PennDOT's Work Zone Safety and Mobility Policy (WZSM) found in PennDOT Publication 46, Traffic Engineering Manual, and apply as necessary to the project. Discuss results and recommendations with the Commission's Traffic Department.

Long term traffic control operations will include maintenance of 12-foot wide travel lanes. Interchange ramp traffic operations will include maintenance of 14-foot-wide travel lanes. Truck turning movement using a WB-67 vehicle must be performed to verify the 14-foot minimum travel lane will be adequate for the vehicle to safely traverse the ramp through the work zone. The number of lanes shall be consistent with existing lanes available and only be reduced if authorized by the Commission's Traffic Department.

Overhead bridge projects should utilize a 1-foot offset to the temporary barrier per the MPT Standards (Inside and Outside shoulder during all stages). Total reconstruction projects on the east-west mainline should consider a 1-foot offset to the temporary barrier on a case-by-case basis with the PTC PM, Total Reconstruction and Expansion Manager, Chief Engineer, Assistant Chief Engineers, Manager of Traffic Engineering, Manager of Incident Management & Traffic Operations, and the Director of TEO. Total Reconstruction Projects on the NE Extension should include a 1' offset to the outside shoulder temporary barrier in Stage 1. Consideration for a 1' offset for inside and outside shoulders should also be discussed for Stage 2.

Mainline turnpike traffic traveling in the same direction must be maintained on two (2) adjacent lanes for two (2) lane sections or three (3) adjacent lanes for three (3) lane sections and cannot be split.

Use a design speed of 55 MPH for all MPT plans on the Turnpike, unless directed otherwise by the PTC Traffic Dept. For lane shift traffic patterns, utilize a lane shift taper rate of 55:1 and a taper rate of 30:1 for all traffic control devices within construction zones. It is considered a shifting taper if the device is directly shifting traffic and a merging taper if the device is not directly shifting traffic. For lane closure traffic patterns, the normal speed limit should be used for the lane taper rate calculation.

For lane shift traffic patterns, preferred location of lane transitions is on tangent sections of roadway, for all projects.

Transition locations shall avoid the wheel path of traffic running over manholes/junction boxes. If the wheel path of traffic cannot avoid running over the manholes/junction boxes, then manholes must be designed for traffic load.

Typical MPT for the mainline total reconstruction projects will be 2 Stage construction. This staging will require an additional run of temporary barrier, including additional temporary structure mounted barrier on bridges and approach slabs, to accommodate the traffic switch from the first stage to the second stage. The additional run of temporary barrier is to eliminate continuous single lane patterns for the movement of temporary barrier between the main reconstruction stages. Once traffic is switched, that run of temporary barrier can be used for the other direction.

For Stage 2, Commission preference is to mill a portion of the wearing course placed in Stage 1 to permit the paving joint to be at the specified location. To accomplish this, have the temporary barrier removed from the roadway and replaced with channelizing devices. In addition, temporary pavement markings are to be placed on the milled surface at this time.

When traffic is pushed to the outside in a reconstruction job, use temporary barrier on the approach transition for the first 500' and then transition to existing or proposed guide rail, bridge approach, noise wall, etc. When the approach end is on a horizontal curve alignment, place temporary barrier throughout the curve and continue 500' beyond the point of tangency. Temporary barrier is only to be used where existing or proposed guiderail is present.

Restrict trucks and buses to use a specific lane when shifting of traffic results in one lane being narrower than the other lane(s) or if traffic will run on the shoulder/median. Consideration should be given for projects that are not typical (pushing traffic toward the median, multiple stage construction, superelevation issues, running over inlets, approaching mainline plazas and/or service plazas).

When traffic is pushed to the outside in a reconstruction job and trucks and buses are restricted to the left lane, include the following applications in addition to the requirements listed in the maintenance and protection of traffic special provisions:

1. Temporary 6" Edge Line Sonic Nap Alert Pattern (SNAP) in tangent or fill sections where guiderail, barrier, or noise wall is not present or required.
2. Flex Post Delineators with orange and white striping at 45-degree angle on right shoulder at 100' spacing in tangent or fill sections where guiderail, barrier, or noise wall is not present or required.
3. Provide 3' width of compacted 2A subbase along edge of paved shoulder where guiderail, barrier, or noise wall is not present or required.

Details for PTC-TBP pavement markings, PTC-TBLO sign, PTC-TBP sign, PTC-TBA sign, Temporary 6" Edge Line SNAPS, and Temporary Flex Post Delineation are included in PTS-980.

At the conclusion of the project, specify a 2-inch mill and pave from the limits of reconstruction to the limits of the traffic control transitions to eliminate the "ghosting" of the temporary line striping in these areas.

Stop conditions for acceleration lanes are not desirable. If the minimum allowable acceleration lane cannot be met, design alternatives must be explored such as sub-stages, additional widening, etc. and approved by the Manager of Traffic Engineering.

Highly Reflectorized Temporary Traffic Lines are to be specified on all mainline bridge replacement and reconstruction projects. Waterborne paint shall be applied directly to the temporary barrier for the entire length when the temporary barrier is placed on or adjacent to the existing lane line. Highly Reflectorized Temporary Traffic Lines are to be applied to the roadway surface only and not on the temporary barrier. For a

reconstruction project, a new application of the Highly Reflectorized Temporary Traffic Lines are to be applied replacing existing markings at the beginning of the project when traffic will remain in existing lanes. When Highly Reflectorized Temporary Traffic Lines are specified, temporary pavement markers are not required.

For all reconstruction and overhead bridge replacement projects that require traffic to be shifted, one (1) application of Highly Reflectorized Temporary Traffic Lines is required for each stage where traffic is shifted.

For resurfacing projects, the number and type of applications of temporary paint are dependent on the schedule of the project. For resurfacing projects that require one construction season to complete and final pavement markings are expected to be installed before the end of September of that construction season, two applications of temporary waterborne paint are required (one on the milled surface and one on the final wearing course). For resurfacing projects that require 2 construction seasons to complete, two applications of temporary waterborne paint are required (one on the milled surface and one on the final wearing course), and a milestone date should be added to complete any final pavement markings for a particular segment by the end of September. For resurfacing projects that require one construction season to complete and final pavement markings would not be installed before the end of September of that construction season, two applications of temporary waterborne paint (one on the milled surface and one on the final wearing course) and one application of Highly Reflectorized Temporary Traffic Lines are required.

Include any MPT related project specific general notes, in addition to the following, on the first sheet of the MPT drawings. General Notes are not to be repetitious of the Commission Specifications, Maintenance and Protection of Traffic Special Provisions or the MPT Standards.

1. THESE PLANS ARE NOT INTENDED TO RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY FOR THE PROTECTION OF THE PUBLIC AND CONSTRUCTION PERSONNEL. THE STANDARDS PRESCRIBED ARE MINIMUM AND ADDITIONAL PROTECTION MAY BE NEEDED IF PROBLEMS ARE ENCOUNTERED DURING THE TERM OF THE CONTRACT. THE CONTRACTOR WILL BE EXPECTED TO CONSTANTLY REVIEW THIS PLAN FOR ADEQUACY AND TO RECOMMEND CHANGES FOR THE REPRESENTATIVE'S APPROVAL WHEN INADEQUACIES ARE DISCOVERED.

2. FURNISH, ERECT, PLACE, AND MAINTAIN TRAFFIC CONTROL SIGNS AND DEVICES AND MAINTAIN TRAFFIC DURING HOURS OF CONSTRUCTION AND AT ALL OTHER TIMES ACCORDING TO THE METHODS INDICATED IN THESE DRAWINGS AND

    a. THE SPECIAL PROVISIONS OF THE CONTRACT.
    b. PENNSYLVANIA TURNPIKE COMMISSION STANDARD DRAWINGS.

c. PENNDOT PUBLICATION 212, OFFICIAL TRAFFIC CONTROL DEVICES.
d. PENNDOT PUBLICATION 213, TEMPORARY TRAFFIC CONTROL GUIDELINES.
e. PENNDOT PUBLICATION 408, SPECIFICATIONS
f. PENNDOT PUBLICATION 72, STANDARDS FOR ROADWAY CONSTRUCTION
g. PENNDOT PUBLICATION 111, TRAFFIC CONTROL – PAVEMENT MARKINGS AND SIGNING STANDARDS.
h. PENNDOT PUBLICATION 236, HANDBOOK OF APPROVED SIGNS.
i. PENNDOT PUBLICATION 35, QUALIFIED PRODUCTS LIST FOR CONSTRUCTION (BULLETIN 15).

3. INSTALL AND MAINTAIN TRAFFIC CONTROL SIGNS AND DEVICES THAT ARE IN NEW CONDITION THROUGHOUT THE DURATION OF THE PROJECT. ANY DAMAGE INCURRED WILL BE IMMEDIATELY REPAIRED OR REPLACED BY THE CONTRACTOR TO THE SATISFACTION OF THE REPRESENTATIVE.

4. MAINTAIN CONSTANT SURVEILLANCE OF THE TRAFFIC CONTROL OPERATION AND REPLACE OR CORRECT ANY MISSING, DAMAGED, INEFFECTIVE, OR MISALIGNED EQUIPMENT TO THE SATISFACTION OF THE REPRESENTATIVE.

5. COORDINATE A PRESS RELEASE WITH A PENNSYLVANIA TURNPIKE COMMISSION REPRESENTATIVE AT LEAST FOUR (4) WEEKS PRIOR TO THE START OF WORK AND/OR THE START OF A NEW CONSTRUCTION STAGE.

Include any detour related project specific general notes, in addition to the following, on the first sheet of the detour plan.

1. FURNISH, ERECT, PLACE, AND MAINTAIN TRAFFIC CONTROL SIGNS AND DEVICES AND MAINTAIN TRAFFIC DURING HOURS OF CONSTRUCTION AND AT ALL OTHER TIMES ACCORDING TO THE METHODS INDICATED IN THESE DRAWINGS AND THE SPECIAL PROVISIONS OF THE CONTRACT.

    a. PENNSYLVANIA TURNPIKE COMMISSION STANDARD DRAWINGS.
    b. PENNDOT PUBLICATION 212, OFFICIAL TRAFFIC CONTROL DEVICES.
    c. PENNDOT PUBLICATION 213, TEMPORARY TRAFFIC CONTROL GUIDELINES.
    d. PENNDOT PUBLICATION 408, SPECIFICATIONS
    e. PENNDOT PUBLICATION 111, TRAFFIC CONTROL – PAVEMENT MARKINGS AND SIGNING STANDARDS.
    f. PENNDOT PUBLICATION 236, HANDBOOK OF APPROVED SIGNS.

g. PENNDOT PUBLICATION 35, QUALIFIED PRODUCTS LIST FOR CONSTRUCTION (BULLETIN 15).

2. HAVE ALL TRAFFIC CONTROL DEVICES IN PLACE FOR INSPECTION BY THE PENNSYLVANIA TURNPIKE COMMISSION AND THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION LOCAL DISTRICT OFFICE OR THEIR REPRESENTATIVE BEFORE WORK BEGINS.

3. INSTALL AND MAINTAIN TRAFFIC CONTROL SIGNS AND DEVICES THAT ARE IN NEW CONDITION THROUGHOUT THE DURATION OF THE PROJECT. ANY DAMAGE INCURRED WILL BE IMMEDIATELY REPAIRED OR REPLACED BY THE CONTRACTOR TO THE SATISFACTION OF THE REPRESENTATIVE.

4. MAINTAIN CONSTANT SURVEILLANCE OF THE TRAFFIC CONTROL OPERATION AND REPLACE OR CORRECT ANY MISSING, DAMAGED, INEFFECTIVE, OR MISALIGNED EQUIPMENT TO THE SATISFACTION OF THE REPRESENTATIVE.

5. PROVIDE SUFFICIENT TYPE III BARRICADES TO COMPLETELY CLOSE ROADWAY DURING CONSTRUCTION.

6. PROVIDE SUFFICIENT TEMPORARY BARRIER TO COMPLETELY CLOSE ROADWAY NEAR THE STRUCTURE DURING CONSTRUCTION.

7. COORDINATE A PRESS RELEASE WITH PENNDOT DISTRICT COMMUNITY RELATIONS COORDINATOR AND A PENNSYLVANIA TURNPIKE COMMISSION REPRESENTATIVE AT LEAST FOUR (4) WEEKS PRIOR TO THE START OF WORK AND/OR THE START OF A NEW CONSTRUCTION STAGE.

8. NOTIFY AT LEAST TWO (2) WEEKS PRIOR TO THE START OF WORK AND/OR THE START OF A NEW CONSTRUCTION STAGE THE FOLLOWING - PENNDOT, TOWNSHIP SUPERVISORS, LOCAL EMERGENCY UNITS (POLICE, FIRE, MEDICAL, ETC), SCHOOL DISTRICT, LOCAL BUSINESSES, AND LOCAL MEDIA OR OTHERS AS AGREED UPON BY THE REPRESENTATIVE.

9. MAINTAIN ACCESS TO ADJACENT PROPERTIES AT ALL TIMES AT EXISTING DRIVEWAY ACCESS POINTS. RELOCATE MAILBOXES AS NECESSARY THROUGHOUT CONSTRUCTION. MAINTAIN ACCESS TO FIRE HYDRANTS AND UTILITIES.

4.2 Temporary Pavement

For temporary paving of existing medians, shoulders, and/or temporary widening, see Chapter 9.

4.3 Temporary Emergency Pull-Offs (EPO's)

EPO's are to be located at approximately one-mile increments per direction. A Service Plaza and Interchange can be considered as an EPO. Access gates, maintenance sheds and construction entrances/exits can not be considered as an EPO.

The Consultant must field view the project for locations of temporary EPO;s and proceed as follows:

1. Generate a list of existing wide-area locations and provide this list to the project manager for inclusion as an Attachment to the contract.
2. If the EPO's can be built on the existing grade without extensive grading and/or excavation, the design plans will not specify the locations of the EPO's.
3. If significant grading and/or excavation is required for the construction of the EPO's, the designer will specify the locations of the EPO's on the plans and cross-sections and tab each EPO individually. This must occur early in design as EPO's may have an impact on the project design (structures, permitting, quantities, etc.).

4.4 Detours

Coordinate proposed detours with PennDOT and applicable municipalities. For appropriate detour signing of numbered and un-numbered traffic routes, refer to PennDOT Publication 212, Official Traffic Control Devices; PennDOT Publication 213, Temporary Traffic Control Guidelines; PennDOT Publication 236, Handbook of Approved Signs; and the MUTCD.

For ramp detours in place continuously for five (5) consecutive days or less, place PCMS at all advanced guide signs with applicable detour message. For ramp detours in place continuously for more than five (5) consecutive days, place PCMS at all advanced guide signs with applicable detour message and cover all advanced guide signs with an approved sign cover.

See Appendix D for samples of detour plans, project specific sign fabrication detail and a tabulation of traffic control devices for detours.

4.5 Temporary Barrier

Use temporary barrier to separate traffic from work zones.

Pinning of the temporary barrier is required if the project involves traffic running adjacent to the temporary barrier and construction related drop-offs in excess of 12 inches that are less than 15 inches from the rear face of the barrier. A list of the location(s) for pinning the temporary barrier is to be included as an Attachment to the contract unless locations are indicated on the plans.

When terminating temporary barrier on a shoulder with an impact attenuator, taper the barrier at a rate of 30:1 to achieve a 6-foot minimum offset from the edge line to the impact attenuator.

Include the painting and repainting of the 6-inch temporary waterborne paint lines on the temporary barrier during construction in the temporary pavement marking quantities with the unit of measurement to be linear foot.

4.6 Guide Rail

Additional quantities of guide rail components are to be provided for the replacement of final guide rail damaged in the construction zone. Additional quantities will include 50% of total panel length and 20% of total posts and offset brackets.

4.7 Temporary Major Guide and Overhead Signs

Existing Major Guide and Overhead Signs are to be maintained or relocated as necessary during construction. Overhead Signs may be relocated as a ground mount Type A or Type E signs. If temporary signs are needed, include the Commission's standard special provision.

Payment for temporary Major Guide or Overhead Signs are to be incidental to the maintenance and protection of traffic.

Chapter 5 - STRUCTURAL DESIGN

5.0 Introduction

The intent of this section is to clarify the Commission's requirements for submission of type, size, and location (TS&L) studies, and for the design and detailing of bridges and other structures. In general, design specifications are in accordance with AASHTO LRFD Bridge Design Specifications and PennDOT Design Manual Part 4, except where superseded by requirements stated herein or as directed. All structures, including walls, toll gantries, and sign structures, are to be identified in the contract documents in accordance with the Turnpike Structure Designation Guidelines in Appendix E.

5.1 TS&L Submission

A. TS&L Submission Requirements

1. Follow Design Manual Part 4, PP 1.9.3.3 for general submission requirements. The Commission will provide direction if a Streamlined TS&L submission is to be employed.
2. Also, identify problem areas so that there are no surprises at the final plan submission. If problems or questions arise after approval of the TS&L Plan, these issues should be brought to the immediate attention of the Commission.
3. Quality Assurance (QA) Forms (per Design Manual Part 4, PP 1.9.3.3.1(f)) are only required for structures that will be transferred to PennDOT ownership.
4. Expansion dam movement and scupper need calculations are required.
5. The TS&L plan is to show all roadway items within the limits of the plan.
6. The TS&L Plan for retaining walls, culverts and other buried structures will not be approved until a foundation recommendation and report is submitted.
7. For structures over waterways or carrying waterways, the TS&L Plan will not be approved until a Hydrologic and Hydraulic Report has been submitted and preliminarily approved by the Commission.
8. The TS&L report and plans will be submitted as a PDF file through the Project Collaboration and Documentation system. Input and output from computer runs will be provided as a PDF file in an appendix to the TS&L Report.

B. TS&L Plans

In addition to the requirements of PennDOT DM-4, the following information is to be the minimum shown on all TS&L drawings submitted to the Commission. The scale for the plan and elevation will be no less than 1" = 30'. The submission may consist of more than one (1) drawing. A Key Plan is to be provided if the General Plan and Elevation does not fit on one (1) sheet.

<u>Plan View</u>

1. All existing topography. Label features being crossed.
2. North arrow.

3. Points of controlling vertical clearances.
4. Station at each centerline of bearing.
5. Proper lengths of wingwalls shown to scale and dimensioned.
6. Limits of approach slabs, if required.
7. Limits of slope protection and scour protection.
8. Proposed roadway items and right-of-way lines within the limits of the plan view.
9. Existing utilities and, if available, new and relocated utility lines.
10. Existing and proposed lighting, sound barriers and signs.
11. Existing streams and wetlands.
12. Approximate location of anticipated temporary shoring.
13. Proposed lane and shoulder widths on bridge and for roadways under bridge (existing and future proposals).
14. Equality stations for intersection of mainline Baseline and side road Baseline.
15. Existing and finished contours at two-foot intervals.
16. Scupper locations and end structure drainage, where required.
17. Minimum required and proposed lateral clearances.
18. Core boring layout.
19. Horizontal and vertical geometry data for mainline and side road
20. Skew angle(s).

Elevation View

1. Centerline of bearing station and profile grade at each substructure unit.
2. Location of proposed field splices.
3. Type of slope protection and type of scour protection.
4. Width and elevation of the bench in the abutment fill slope.
5. Protective fence, light poles, sound walls, and structure mounted signs, if required.
6. Normal pool elevations and the highwater elevations (for 100-year flood and record floods) for structures over waterways.
7. Identify lane and shoulder widths either by labels or illustrating pavement structures for underlying roadways.
8. Existing utilities and, if available, new and relocated utility lines, including aerial lines.
9. Anticipated footing types, spread or piles, etc. and estimated bottom of footing elevation.
10. Existing and finished ground lines. Indicate embankment and cut slope rates.
11. Span Lengths.
12. Minimum required and proposed vertical clearance.
13. Fixed and expansion support locations.
14. Joint type and movement classification.
15. Roadway grade and direction.

Typical Cross-section

1. Protective fence, light poles and sound barriers if required.
2. Electrical and fiber optic conduits, if required. See Mainline Structures Section for details.

3. Cross slope and superelevation rates.
4. Beam types, size and spacing. Indicate composite or noncomposite.
5. Slab thickness.
6. Type and thickness of wearing surface.

Additional Information to be Provided on TS&L Drawings

1. Proposed nonstandard details.
2. All **applicable** general notes for the type of structure proposed for final design. Refer to PennDOT Design Manual Part 4, for a listing of common general notes. Add special notes or revise the common general notes to meet special conditions on individual projects.
3. Typical sections indicating a future redecking scheme, if required.
4. Typical sections and, if necessary, plan views indicating the construction stages for bridges that are to be built using staged construction.
5. For projects with a four-lane typical section and wide median, show the future condition for the six-lane typical section with future beam spacing.
6. Conceptual details for temporary support or underpinning of a structure.
7. Live load rating summary.
8. Superelevation transition rate and profile of gutter lines to assure that there are no sag points on the bridge or along the wing walls, if applicable.
9. Existing structure data.

Bridge Replacement for Total Reconstruction (Overhead Bridges)

1. On the TS&L drawings show the proposed structure spanning the existing mainline configuration, e.g., four (4) travel lanes with 10-foot median. Show contouring, finished ground lines, drainage, guiderail/barrier and other proposed features for the interim condition with normal line weight and type. Show contouring, finished ground lines and guiderail/barrier for the future condition for the proposed mainline reconstruction with an alternate broken line type and line weight. Show proposed/future lane shoulder configuration and width.
2. On the TS&L drawings, indicate the horizontal and vertical geometry of the mainline for both existing and future conditions.

Bridge Rehabilitation Projects (include the following on the TS&L drawings)

1. Age of the existing structure and dates of past rehabilitation, present and cumulative ADTT, portion of existing structure to be replaced, type of existing steel for steel structures, date of last inspection, type of existing diaphragm connections (e.g. welded, riveted, or bolted), type and location of deterioration for both the superstructure and substructure, deck drainage, expansion dam type, parapet type, and other pertinent items.
2. Live load ratings for existing structural members before and after proposed strengthening. Live load ratings of existing members are to be calculated using the dead and live loads proposed for the rehabilitated structure.

3. Proposed methods for rehabilitating and strengthening deteriorated and deficient structural members in both the superstructure and substructure.
4. Recommendations for resetting expansion bearings, if required.
5. Recommendations for retrofitting fatigue-prone and seismic-prone details.
6. Typical sections and, if necessary, plan views indicating the proposed method of accomplishing the rehabilitation while maintaining traffic on and under the structure.

5.2 Bridges - General

1. Provide an aesthetic concrete coating on all exposed concrete surfaces without architectural surface treatment, except for the bridge deck surface, abutment backwalls and bearing seats. The colors will be provided by the Commission on a case-by-case basis. Coated areas include abutments, wingwalls, piers, all faces of the bridge parapet and the outside face of P/S concrete fascia beams. If bridge will be turned back to PennDOT, verify with the District and Turnpike Bridge Engineering Manager if an aesthetic concrete coating or protective coating should be applied on the inside face of the parapet and/or bridge deck.
2. Bid items for alternate structure designs will generally be utilized for both overhead and mainline structures. Only one (1) alternate structure will be used, consisting of a different material type than the designed structure (i.e. if steel is designed only P/S will be allowed as an alternate.)
3. For highly skewed structures investigate improving the skew to 70° or greater to improve performance. The ability to improve the skew is likely more attainable on mainline structures than for overhead bridges which may be governed by the alignment of the median pier.
4. Detail highway lighting components to eliminate the need for structure mounted poles. Any proposed structure mounted lighting must be approved by the Bridge Engineering Manager.
5. Two (2) General Plan and Elevation sheets will be prepared for Overhead Bridge Replacement contracts where future mainline widening is anticipated. The first will not show the future mainline lanes. The second will show the future mainline lanes and clearly state that the sheet is for information only.
6. The ownership of overhead structures carrying state routes (S.R.'s) over the mainline will be transferred to PennDOT upon replacement. Therefore, coordination and approvals with the appropriate PennDOT District throughout the design process is required. Essentially, anything that would need to be submitted if the PTC owned the structure would need to be submitted to PennDOT.
7. Conduct a field view meeting for all structures over or under state and local roadways. The meeting should occur in conjunction with the DFV and should review issues and document the decisions made. Invite the appropriate PennDOT personnel for state roads and Municipalities for local roads.

5.3 Approach Slabs

A. Mainline

1. Depress approach slabs five (5) inches and overlay with three (3) inches of asphalt binder course and two (2) inches of asphalt wearing course or as directed. Do not reduce approach slab thickness, maintain in accordance with PTS-111.
2. Extend approach slab width across travel lanes and the right shoulder with a minimum length of 25 feet measured along the shortest side of the skewed angle (see Standard Drawing PTS-111).
3. Do not extend the approach slab across the left shoulder or median.

B. Overhead

1. For structures carrying state routes, follow PennDOT guidelines to determine if an approach slab is warranted and verify with the PennDOT District Office to see if the approach slab is desired. Do not provide approach slabs for bridges carrying Township roadways, unless approved by the PTC Bridge Engineering Manager.
2. Do not depress the approach slab unless directed by the PTC Bridge Engineering Manager.

5.4 Substructure

A. General

1. Stub or mid-height abutments are preferred. Full height abutments may be used if required to attain minimum vertical clearance or to accommodate other site restrictions.
2. Use same wing wall type and orientation for all wings on a particular structure unless there is a significant cost savings or site needs to utilize different types. Differing wing wall types are subject to the approval of the PTC Bridge Engineering Manager.
3. Design the height of flared wingwalls tall enough to provide a minimum of 12" clear dimension between the top of the wing wall and finished grade on the back of the wing wall. Ensure the drawings clearly indicate this dimension.
4. Provide structure backfill as recommended in the structure foundation report for mainline bridges and PTC owned overhead bridges. Use current PTC standard drawings for details and pay limits. Use backfill in accordance with PennDOT standard drawings for all overhead bridges to be owned by PennDOT.
5. See Section 3.11 for guidance on completing the Earthwork Summary Block.
6. Submit details and basic dimensions for the proposed pier type for approval prior to starting the pier design and detailing. This information should be included as part of the TS&L and foundation submissions.
7. Minimum concrete cover over the steel reinforcement on all substructure units with architectural surface treatment will be measured to the point of maximum relief of the formliner.
8. Provide a 2-foot minimum to 4-foot maximum flat bench in front of stub and mid-height abutments for future maintenance and inspection needs.

9. Consider Design Manual 4, Section 1.9.4.4 Foundation Special Considerations.
10. For foundations in a river environment, spread footings on soil are only allowed with PTC approval.
11. For spread footings on soil, perform a minimum lab testing of one (1) classification series and one (1) direct or triaxle shear for each footing. Perform a minimum of one (1) consolidation test for saturated clay below each footing. Perform a minimum of one (1) corrosion series test for each structure.
12. Prepare a Foundation Report for each structure. The report will be a standalone document and not part of the Preliminary Geotechnical Engineering Report as indicated in DM 4.
13. 50 ksi steel H-piles may be designed for axial capacity using a steel yield stress of 50 ksi. Special consideration should be given to quality of the rock bearing stratum and pile driving requirements to achieve the proper design load/refusal without damage to the pile. For overhead bridges carrying state-owned roadways, verify the design criteria with the PennDOT District.
14. When calculating the bearing capacity of rock using q ultimate for an equivalent soil mass, choose a resistance factor, 0.35-0.55, based on rock quality and expected performance. (Consider rock RQD [%] and RMR method for determining how the rock will be modeled for bearing resistance computations.)
15. When selecting a friction angle for soil, referencing Foundation Analysis and Design by Joseph E. Bowles or older versions of Design Manual 4 is acceptable.
16. For replacement of existing structures on the same alignment, it may be beneficial, if feasible; to have one (1) of the proposed structure borings taken through the existing footing (to determine as-built BFE) and one (1) boring taken outside the existing foundation footprint (to determine a more accurate top of bedrock profile). Existing footings keyed 2' to 3' into rock may yield overly conservative proposed BFE's if only taken through existing footings.
17. The requirement for future jacking should be considered as part of the design. The placement of jacking stiffeners some distance in front of the bearing stiffeners should be included. These jacking stiffeners should be placed in front of the bearing if the abutment can be easily and efficiently widened or placed at a distance further out to clear the abutment wall if we know we can jack from the end slopes or abutment footing.
18. For high load bearings, provide a note on the plans to install anchor bolts in accordance with BC-756M, Sheet 1 of 6, and include this standard as a supplemental drawing.
19. Concrete bearing pedestal walls used with precast concrete arches will be limited to 3' in height.
20. Do not use inserts for future jacking in overhead bridge pier caps with a vertical clearance of 20-feet or less. If the vertical clearance is greater than 20-feet, verify with the Bridge Engineering Manager if these inserts are to be used.
21. Do not provide bearing pedestals on the substructure units. Step or slope bridge seat from bearing area to bearing area.
22. Provide 6-inch minimum height cheek wall at end of pier caps to hide bearings.
23. Provide a detail in the contract drawings to identify the limits of Class 1 Excavation vs. Class 3 Excavation.

24. Substructure construction joint intervals may exceed 45 feet with approval. Submit details to the PTC Bridge Engineering Manager for approval.

B. Mainline

1. Abutments for dual mainline structures should be continuous for the full out-to-out width of the combined superstructures. Show the locations of the construction and expansion joints.
2. Provide an architectural treatment on mainline structures only as directed by the Commission and in accordance with PTC sample details and aesthetic standards.
3. Provide slope protection in front of stub and mid-height abutments. Use Random Stone Slope for mainline structures over waterways and railroads.
4. Locate a new benchmark disc on top of the abutment, wing wall or safety wall at the northeast corner of all mainline bridges. Show location on plan sheet.

C. Overhead

1. Provide a 12-foot shoulder from the edge of Turnpike travel lane to the face of the abutment for full height abutments and to the curb for stub or semi-height abutments. (Early coordination with the PennDOT District office on offset measurement is required). Provide abutment transition pieces in accordance with PTS-145 for full height abutments.
2. Consideration should be given for 1' clearance from the 12' travel lane to temporary barrier (inside and outside) for MPT and safety purposes.
3. Vegetated slopes are to be used on all new fill slopes adjacent to the bridge. Use of rock or any other material must be approved by the Bridge Engineering Manager before specifying. If rock is approved, it must be a uniform class of rock, no project rock will be permitted.
4. Using 1.5:1 slopes in front of stub or mid-height abutments, in conjunction with articulating cellular concrete block slope protection, is permissible to minimize span lengths.
5. Provide slope protection between the abutment and the mainline shoulder for stub and partial-height abutments. Use articulating cellular concrete block or stamped concrete for all overhead structures with a properly detailed concrete toe wall/curb at the edge of the shoulder.
6. For overhead bridge replacement projects within the limits of a scheduled total reconstruction project, do not provide any slope wall treatment. Grade the end slopes to maintain the flow line at the back edge of normal shoulder for the interim condition until the mainline roadway is reconstructed.
7. Provide an architectural surface treatment on all overhead bridges, unless directed otherwise by the PTC. Provide necessary details of this treatment in the drawings. This treatment should be consistent throughout the project corridor. Treatment on the pier should only extend down to the top of the proposed adjacent concrete median barrier. If the roadway profile is to be revised with the mainline reconstruction project, consideration should be made for the proposed elevation of the top of concrete median barrier. Portion of the pier from top of concrete median barrier to grade is to be exposed concrete with no aesthetic coating.

8. For piers within the 10' existing median (interim condition), provide a minimum of 3'-6" clear from the edge of the lane to the face of the pier.
9. For piers within the 10' existing median (interim condition), do not permit pier cap to extend more than two (2) inches beyond the face of the stem when the pier cap is within the 16'-0" vertical clearance envelope.
10. For median piers (interim and final condition), connect concrete median barrier to both ends of the pier with a pier transition piece as indicated on PTS-147.
11. Median pier footing widths must be designed to a maximum width of 10 feet to prevent the need for any excavation or shoring in the adjacent travel lanes. Any exceptions must be approved by the Bridge Engineering Manager. For multi-span overhead bridges, use a wall type pier for all piers. Piers located within the median are restricted to a maximum wall width of 3'-0". Provide a pier cap with a maximum width of 3'-4" on all piers. The pier cap is to be a minimum height of 2'-0".
12. Exceptions will only be made for special site conditions or where bridge vertical clearance is greater than 25 feet. In these special cases other pier types (i.e. hammerhead, multi-column, etc.) can be considered with approval of the PTC Bridge Engineering Manager.

5.5 Superstructure

A. General

1. Eliminate deck joints as much as possible. Use concrete end diaphragms instead of backwalls where calculations permit. For multi-span bridges, make superstructure continuous over the piers.
2. Future redecking schemes (staged or detour) should be considered for beam/girder arrangements.
3. When staged construction results in placing a deck slab on a portion of a structure adjacent to a previously placed portion, the difference in deflection due to dead load must be less than three (3) inches. Because of web layover, curved and skewed structures require a suggested construction procedure.
4. When pre-stressed beams are to be placed under staged construction, design using a 1" minimum haunch to avoid the potential for negative haunch during deck placement of later stages due to excessive camber from longer creep durations.
5. Minimize or eliminate entirely the number of scuppers on the bridge deck but do not allow water to spread into the travel lane. Size and space roadway inlets off the structure to collect all runoff. Place scuppers before modular expansion dams, if feasible.
6. For beam rehabilitation designs, achieve an inventory rating factor of 1.0 or greater for the H-20, HS-25, ML-80 and TK-527 vehicles and an operating rating factor of 1.0 or greater for the P-82 and P2016-13 vehicles. Permit vehicle rating factor requirements may be waived by the Bridge Engineering Manager. Use the PHL-93 vehicle for all new beam designs. Include operating ratings for FHWA EV (Emergency Vehicles) in the load rating table.
7. For PTC owned structures, provide on the contract plans the unfactored shear and moment values at tenth points for continuous girders; or the maximum values and splice point values for simple spans. Include the values as indicated in DM 4. Also

include a table of reactions for dead load, superimposed dead load and positive and negative live load plus impact without load factors applied.

8. When required by PennDOT's DM-4, provide moment and shear diagrams on the plans for bridges that will be turned back to PennDOT.
9. Provide on the contract plans composite and non-composite section properties at each resisting section.
10. Properly detail the expansion slots in the sole plates of elastomeric bearings to account for the longitudinal movement due to end rotation of beams caused by camber.
11. For curved and skewed structures, indicate if the structure is to be plumb after steel erection or plumb under the full dead load existing at the end of construction (preferred). Provide on the contract plans the anticipated differential lateral deflection and resulting lateral rotation. For staged construction provide a suggested procedure for connecting diaphragms and constructing the deck slab. Do not use concrete end diaphragms for these structures.

B. Mainline

1. The cross-slope on the water table should be consistent with the roadway typical section. Use 4.0% on the right water table in a normal section.
2. Provide uniform beam spacing on all superstructures unless otherwise approved by the PTC Bridge Engineering Manager.
3. Do not specify a deck protective coating (i.e., boiled linseed oil) for exposed deck surface.
4. Provide a 4-inch nominal diameter galvanized steel conduit below deck in accordance with PennDOT ITS Standard Drawings (PennDOT Publication 647) and extend this conduit under the approach slabs to tie into the junction box located beyond the approach slab. No conduit is required in the parapets except for bridges at interchanges, where a 2" conduit in the outside parapets is to be provided for potential lighting or other electrical needs, or if requested by PennDOT on turnback bridges.
5. Provide a minimum vertical clearance of 16'-0" over all travel lanes, shoulders, and traversable areas where possible. At a minimum, meet existing vertical clearances for replacement structures. Coordination will be required with the local agency. Utilize a steel superstructure for clearances 15'-0" or less for easier repair if the bridge is struck.

C. Overhead

1. Provide a minimum vertical clearance of 16'-0" over all travel lanes, shoulders, and traversable areas. Exemptions may be given by the PTC for specific situations where this clearance cannot realistically be achieved over all points. At a minimum, 16'-0" vertical clearance must be achieved over one (1) lane in each direction of traffic.
2. Do not use weathering steel for structures over the mainline.
3. Adjacent box beam superstructures will not be allowed on any overhead bridges unless approved by Bridge Engineering Manager because of the longer construction time to set beams.

4. Provide protective fencing for full length of superstructure from centerline of bearing to centerline of bearing on both exterior barriers for all structures except on interchange ramp bridges. Anti-climb shields are to be installed. Do not extend fencing onto wing walls, unless directed.

5.6 Drainage

1. Inlets are to be placed beyond the end of the approach slab if present, with curbing extending from the wing wall or safety wall to the inlet. Do not place within approach slab. For long U-wings, place inlets at end of wingwalls. Design and space inlets on the down grade end of structures to properly handle runoff.
2. For mainline bridges, provide inlets in the shoulders and median on the low side of the bridge. Provide inlets in the median on the high side.
3. For overhead bridges, provide inlets in the shoulder on the low side and high side of the bridge. High side inlets located in cuts may be omitted if runoff is collected in other ways.
4. Provide a minimum of 50' of asphalt or concrete curbing extending out the front end of the wing wall or safety wing wall at all four (4) corners of the bridge, unless there is an inlet, in which case the curbing is to terminate at the inlet.
5. If allowed, free drop scuppers only into streams. Downspouting, along with ditches and/or pipes, is to be used at all other scupper locations.

5.7 Retaining Walls

A. General

1. Single-face barrier, 52” height, is required in front of all retaining walls located at the edge of mainline shoulder. Place barrier directly against retaining wall with no gap between. In the alternatives analysis for retaining walls, several factors should be considered. Engineering judgment should be applied and presented by the designer to the PTC Project Manager. If an MSE wall is to be used, then provide a moment slab underneath the shoulder with an integral single face barrier to accommodate any impact. If a post and plank wall is to be used, then no moment slab is required. See the PTC Project Manager or Bridge Engineering Manager if further clarification is needed.
2. Provide architectural treatment on all retaining walls visible from mainline and on other retaining walls at the direction of the PTC. This treatment should be consistent throughout the project corridor.
3. For drainage pipes located within the structure backfill of retaining walls, specify pipe with watertight joints in accordance with Chapter 7.
4. A T.S.&L. submission is required for all retaining walls.
5. The design consultant should prepare a design that will be bid as an either/or item as shown in the following example:

    Either:

    Retaining Wall, RE A-XXX.XX SB – As Designed

Or:

Retaining Wall, RE A-XXX.XX SB – Contractor Alternate

This either/or item will require a project specific specification.

6. Retaining wall systems that have a gravity wall component that introduces forces on an existing culvert, pipe, or other structure will only be allowed if approved by the PTC Bridge Engineer. Load calculations and all supporting details must be submitted for review proving that wall loading will be transferred directly into the footing. This includes, but not limited to, T-Wall and Gravix wall systems.

B. Soldier Pile/Post and Plank Walls (Non-Anchored)

1. The preferred design method should be in accordance with DM-4 using the LRFD discrete method of design. Alternate methods may be considered if project site conditions dictate, subject to approval by the PTC Bridge Engineering Manager.
2. When deflection controls design of steel post, limit deflection to 1".
3. Caissons are to be designed (diameter and length) using COM 624P or similar program.
4. Caissons are not to be reinforced.
5. Wall friction angle (delta) is 0 degrees when calculating passive pressure.
6. Multiple Ka values can be used to help reduce the active earth pressure.
7. An increased phi value can be used (reduced Ka) for rock.

5.8 Sound Barriers

1. Use steel posts for all sound barriers.
2. All steel posts are to be galvanized and then powder coated or painted. Color of posts should be determined prior to any public meetings and will be based upon the color scheme chosen for the project corridor. The public will not choose the color of the posts, only the architectural treatment and color of the panels that are visible from their side of the barrier.
3. Single face barrier, 52" height, is required in front of all sound barriers located at edge of mainline shoulder. Place barrier directly against sound barrier. Design wall panels such that the front face of the panel is flush and in line with the front face of the posts. The sound barrier should not be designed for impact.
4. The ground mounted sound barrier height will be measured from the top of caisson to the top of the post as per BD-678M. The structure mounted sound barrier height will be measured from the top of the barrier to the top of the post as per BD-679M.
5. In cut sections, the preferred location of the sound wall is 5 feet inside the right-of-way line. No right-of-way fence will be required at these locations.
6. The design of the sound barriers must consider accessibility behind the barrier for future maintenance access.
7. Provide architectural treatment to the sound barrier panels as per the direction of the PTC. This treatment should be consistent throughout the project corridor. The

Turnpike side of the sound wall will utilize formliners. The resident side can be formlined or stamped.

8. Stain, color will be provided by the PTC, will be applied to the turnpike side of the panels on the architectural treatment. The 1-foot header at the top of panels will be stained the same color as the posts.
9. Maximum panel height is 20 feet except on structure parapets where the maximum height above the parapet is 12 feet. Full height panels are preferred and are required for walls 12 feet or less in height and on structures. If the height of the barrier adjacent to the bridge cannot be maintained, the variation must be approved by the PTC Project Manager.
10. Stacked panels should be avoided if possible. If stacked panels are required, the minimum panel height is 6-foot.
11. If stacked panels are utilized, they must be "match cast" so that the horizontal joint is inconspicuous. Detail the joint as per detail B on sheet 6 of 7 of BC-776M.
12. For Commission owned structures, the panel length shall not exceed 12 feet.
13. A T.S.&L. submission is required for all sound barrier walls.
14. Absorptive sound barriers or other alternatives will only be considered with prior approval from the PTC.
15. Sound barrier panels should be installed flush to the Turnpike side of the barrier post flanges with no gaps between the concrete panel and steel post flange. Panels should have flared end treatments as needed to minimize the gap on the back side of the panel to a maximum 3 inches.
16. The Contract Sequence of Construction and Special Provisions should clearly identify the noise wall panels to be installed during Stage 1 (outside phase of construction), before switching traffic to this area. Special circumstances that severely limit Contractor access should be discussed with the Bridge Engineering and Total Reconstruction Program Managers.

5.9 Sign Structures

1. Use monopipe sign structures for all mainline sign structures in accordance with PTC standard drawings. Monopipe components are to be galvanized and then powder coated or painted.
2. A test bore should be drilled at each foundation location. Determine if the boring characteristics are within the parameters of the standard drawings for the monopipe foundations. If so, reference the standards in the contract documents. If not, perform a foundation design for the monopipe structure.
3. Pay the foundations for these structures as individual items, i.e. Class 3 Excavation, Class A Cement Concrete, Reinforcement Bars, Temporary Shoring, etc. Do not pay as incidental to the sign structure.
4. Utilize monopipe caisson transition pieces as indicated on PTS-148 to connect concrete median barrier to the monopipe caisson.
5. When designing the sign structure, increase the actual sign square footage by 25% to allow for the future sign square footage increases. Verify with PTC Traffic and PTC Structure liaisons prior to final design. The actual sign square footage, and as-designed sign square footage, shall be proved on the plan set.

5.10 Software

1. For abutment, wall, pier, and culvert design and analysis on structures where ownership will be transferred to PennDOT, use the current ABLRFD, PAPIER, and/or BXLRFD programs. For vertical pile lateral resistance, use COM 624P computer program (Wang & Reese, 1993).
2. For PTC owned structures, other design/analysis programs are acceptable, contingent on approval by the PTC Bridge Engineering Manager (i.e., GStab17, LPile, FBPier, etc.).

Chapter 6 - RIGHT-OF-WAY

6.0 Introduction

This chapter presents guidelines for the preparation of plans for the acquisition of real property. All plans are to be prepared in accordance with PennDOT Publication 14M, Design Manual Part 3 – Highway Plans Presentations, PennDOT Publication 16M, Design Manual Part 5, Utility Relocation, and as directed by the Commission.

6.1 Reestablishing Turnpike Right-of-Way Baselines

A. Turnpike Extensions

The original Pennsylvania Turnpike was built utilizing portions of the old Southern Pennsylvania Railroad and Mining Company (South Penn) Right-of-Way from Irwin, Pennsylvania (Turnpike milepost 67) to Carlisle, PA (Turnpike milepost 226). Through most of this section no permanent baseline reference monuments were set. Baselines were staked in the field and the only references were hubs and tacks or nails/tacks in trees. Accordingly, the highway itself (the original 24-foot-wide concrete cart-ways underneath the asphalt pavement), and associated structures like bridges, storm water structures, and the concrete median barrier is the monument.

The original Pennsylvania Turnpike Right-of-Way baseline utilized simple curve geometry. This was the line used for property acquisition. For construction, a construction baseline was spiraled in high degree-of-curve areas. The “Pennsylvania Turnpike Commission Standard Method for Spiraling Simple Curves”, a reference document (See Appendix J) detailing the mathematical relationship between simple and complex curves, should be used when establishing the unmonumented Right-of-Way baseline from the original Pennsylvania Turnpike’s construction baseline (based on physical constructs).

The “Philadelphia Extension” (Carlisle to Valley Forge, milepost 226 to milepost 326), the “Western Extension” (Ohio State Line to Irwin, milepost 0 to milepost 67), the “Delaware River Extension” (Valley Forge to the New Jersey State Line, milepost 326 to 359) were constructed with varying degrees of permanent references. Sections without permanent monumentation should be treated as an original Pennsylvania Turnpike section. The “Northeast Extension” (Norristown to Clarks Summit, milepost A-20.0 through A-131) was fully-monumented with rebar approximately forty-inches (40”) long, some set in concrete. Other extensions like Turnpike 43, 66, 576, and I-376 were built with circle references commonly seen on PennDOT plans.

B. Right-of-Way Baseline Best-Fit

For the original Pennsylvania Turnpike and extension sections lacking permanent reference monuments, structure centerlines established from substructure working points, the physical highway, and other significant structures like the concreter median barrier will be used to set the reestablished location of the original Right-of-Way baseline. Recovered and undisturbed Right-of-Way reference monuments on turnpike extensions will be the primary control for Right-of-Way alignment reestablishment. However, bridges, the original roadway, and significant structures should still be surveyed with their locations incorporated into the alignment reestablishment process.

When comparing the Right-of-Way baseline to the field-surveyed concrete median barrier use the simple curve to spiraled curve relation. The objective is to hold as much of the Right-of-Way alignment geometry as possible, primarily the tangents, and to adjust the curves as required while generally holding the radius. As a check for best-fit, offset distances will be computed between the re-established best-fit alignment and field-surveyed median barrier at one hundred-foot maximum intervals. Differences of one (1) foot or less will generally be acceptable. Areas of significant difference between the re-established and original Right-of-Way baselines will be reviewed with Commission survey personnel prior to finalizing the best-fit baseline. Offset comparisons and referenced field alignment tie comparisons will be submitted to the Commission via a written report of methodology, problems encountered, and resulting procedures used to achieve the best-fit alignment. The Commission will review and accept the best-fit alignment.

At the project's limits, the best-fit as-built alignment will be tied to the nearest curve PI outside the project's actual limits-of-work.

Prior to beginning the work to establish the best-fit as-built alignment, a meeting to review the above procedures will be held with Commission survey staff.

6.2 Plan Requirements

A. Right-of-Way - Mainline Only

The mainline Right-of-Way plan set will consist of, at a minimum, a title sheet, index sheets and property plot plans for properties requiring perpetual easements and/or fee simple acquisitions. The index sheets are to indicate the proposed survey and Right-of-Way baselines and property parcels only.

Right-of-Way acquisitions that affect the Turnpike mainline Right-of-Way will be referenced off the Turnpike's proposed survey and Right-of-Way baseline. All references (plusses and offsets) are to be shown on the plan as measured perpendicular or radial from the baseline.

For properties impacted only by temporary construction easements (TCE) an abbreviated property plot plan showing the required easement area will usually suffice for acquisition. Metes and bounds descriptions of the required TCE are not required unless directed otherwise by the Commission.

B. Right-of-Way - Side Road Bridges, Side Roads, and Access Ramps

For side road bridges, side roads requiring Right-of-Way acquisitions, side-road relocations, and access ramps discharging/accepting traffic onto/off public roads, a complete set of Right-of-Way plans are to be prepared in accordance with the manuals listed above.

Side road Right-of-Way plans will have a survey and Right-of-Way baseline for the side road and the original Right-of-Way baseline for the Turnpike. Right-of-Way acquisitions that affect the side road Right-of-Way will be referenced to the survey and Right-of-Way baseline for the side road.

For properties impacted only by temporary construction easements (TCE) an abbreviated property plot plan showing the required easement area will usually suffice for acquisition. Metes and bounds descriptions of the required TCE are not required unless directed otherwise by the Commission.

C. Title Sheet

See Appendix F for sample title sheet. The information to be presented on the Title Sheet shall be in accordance with Design Manual 3, Chapter 3, except as follows:

1. Maps.

    a) State Map with Pennsylvania Turnpike Commission Districts shown in the upper right corner.

    b) Location map with project shown in upper left corner with scale presented.

2. The design professional engineer and design professional surveyor will seal and sign the plan, and the Commission's Chief Engineer will sign in the designated signature block.

3. The Station Limits shall be shown as follows:

    a) For the Turnpike, identify the eastern/southern and western/northern most limits of Right-of-Way as:

        LIMIT OF ESTABLISHMENT, RE-ESTABLISHMENT, AND AUTHORIZATION
        STATION XX+XX
        MILEPOST XXX.XX

b) For state side roads, identify the limits of Right-of-Way as:

BEGIN AUTHORIZATION
STATION XX+XX
SEGMENT XX, OFFSET XX
S.R. XXXX, SECTION XX Right-of-Way

END AUTHORIZATION
STATION XX+XX
SEGMENT XX, OFFSET XX
S.R. XXXX, SECTION XX Right-of-Way

c) For non-state side roads, identify the limits of Right-of-Way as:

BEGIN AUTHORIZATION
STATION XX+XX
T.R. XXXX (Local Road Name)

END AUTHORIZATION
STATION XX+XX
T.R. XXXX (Local Road Name)

D. Preparation of Property Plot Plans

1. An overall project property mosaic will be prepared and submitted for review during the preliminary design phase and will require display of the following information in printed sheet, .pdf, and .dwg format:

    - Project Parcel Number
    - Recovered boundary evidence.
    - Planimetric features underlay.

    The survey consultant is required to retain records relative to placement of property lines displayed on the mosaic. These records will include, but are not limited to, deeds, survey plats, sub-division plans, deed closure errors, agreement with recovered field evidence, etc.
2. Legal metes and bounds descriptions shall be prepared for all fee simple and perpetual easement acquisitions except properties which are “total takes”. Total take acquisitions shall utilize the owner’s deed description, unless directed otherwise by the Commission. These descriptions are to be furnished by the consultant in electronic .docx format for each parcel where pluses (stationing) numbers for corners are shown as “encircled” (scaled dimension) on the Right-of-Way plans, the metes and bounds description shall identify the station as “±“. Where the baseline offset distance numbers for corners are shown as “encircled” (scaled dimension) on the Right-of-Way plans, the metes and bounds description shall identify the offset distance as “more or less”. See Appendix G for a sample legal metes and bounds description.

3. The Commission will acquire "total takes" from deeds of record and tax assessment data, supplied by the designer, as early as possible. A plot plan or other graphical drawing at the direction of the Commission will need to be submitted as part of the acquisition documents.
4. Plot plans will not be required for PTC required Right-of-Way for limited access on Commission surplus parcels. Submit a directional bearing/distance tabulation of the required area only.
5. For plot plan templates, general notes, legend etc. refer to Kahua's PTC Reference Library.
6. Plot the entire "deed of record" property on one sheet. The deed calls shall be labeled on each property line, parallel to the applicable line. Label or tabulate this information as it is shown in the deed. When perches are given, also add the (feet) conversion in parenthesis.
7. Submit a completed "PTC Property Plot Plan Q/C Checklist" with each property plot plan submission. See Appendix H.
8. Submit a COGO closure report for each permanent taking area.
9. The Pre-Final Date in the property claim block reflects the date of the submission for review by the Commission or the Commission's agent. All subsequent submissions for review will have a new Pre-Final Date. The Final Date in the property claim block reflects the date the plan was accepted by the Commission or the Commission's agent and was signed and sealed by the designer.
10. The plot plan should accurately reflect the limit of construction (Earthwork limits for swales, ponds, etc.).

E. Right-of-Way/Geometry Plans

This work involves the preparation of final Right-of-Way/Geometry Plans at a scale of 1"=50' to be included with the construction plans. The Right-of-Way/Geometry Plan Sheets will clarify ties between the proposed survey and construction baseline (to be labeled as survey and Right-of-Way baseline on these plans) and the original "best fit" alignment that has been reestablished as the original Right-of-Way baseline. All final legal Right-of-Way for limited access break points will be labeled with dual stations/offsets. Station and offset labels will denote values from the original Right-of-Way baseline in *slanted text* and values from the proposed survey and construction (survey and Right-of-Way) baseline in vertical text, with appropriate notations and legends. Include the northing and easting coordinate value at each station/offset label. Baseline stations and geometry (curve data, directional bearings), and a tabulation of baseline coordinates will be provided for both the original Right-of-Way and proposed construction (survey and Right-of-Way) baselines. The plans will also include existing planimetric features with side road names and route numbers, watercourse names with flow arrows, structure numbers, property owner names, project parcel numbers, old and new Right-of-Way numbers, north arrow, centerline mileposts, and existing horizontal and vertical control monuments. Proposed roadway construction features will not be displayed.

It is the design consultant's responsibility to obtain all recorded instruments (including PTC deeds or Declarations of Taking) to verify supplemental Right-of-Way information

provided by the Commission. Submit copies of all records to the Commission and the design manager.

Right-of-Way/Geometry Plans will indicate legal Right-of-Way line for limited access points to be monumented during construction. Commission survey staff will review the plans at the pre-PS&E submission and specify corners to be monumented by the contractor.

Right-of-Way/Geometry Plans will be prepared for side road bridge, or side road projects and mainline projects, but will only be included in the final construction plans set for mainline projects. They will not be included in side road bridge or side road construction plans sets.

F. Required Right-of-Way Lines

Required Right-of-Way is to be taken in chords (creating straight Right-of-Way lines and not curves). If a circumstance requires that a take creates a concentric-to-baseline or curved Right-of-Way line, approval by the Commission must be obtained. Avoid if possible, creating any new Right-of-Way corners/shifts in Right-of-Way on existing property lines separating adjacent owners. It is far more desirable to create new Right-of-Way corners away from existing property. If it is necessary to create a new corner/shift in Right-of-Way on an existing property line between adjoining owners retracing and reestablishing that boundary line will be required.

6.3 Right-of-Way Numbers and Kahua Right-of-Way Tracker

Commission staff will be responsible for assigning RW Plan and WBS numbers for all Right-of-Way claims. Consultants will be responsible for entering claimant information into Kahua's ROW Tracker and updating the information as necessary through final construction title sheet submission.

6.4 Utility Easements

The property plot plan and the construction plan shall show all utility easements. If a utility crosses the Turnpike Right-of-Way and the utility has an existing private easement connecting to the legal limited access Right-of-Way line, the private easement will remain for any portion of the easement bounded by the old and new Right-of-Way lines. A note shall also be included that indicates the name of the utility involved with the easement. See Figure 6.4.1

When it is necessary to acquire substitute Right-of-Way for a utility, the designer shall obtain a copy of the utility's existing Right-of-Way documents for the Right-of-Way overtaken by the highway. Also, a copy of the utility's current Right-of-Way agreement form shall be obtained. Prior to obtaining the Right-of-Way, a meeting with the utility shall be held to discuss the utility's rights. The legal description for the replacement Right-of-Way shall provide the replacement of the utility's existing private rights. The utility shall approve the legal description before it is finalized. When the Right-of-Way acquisition is complete, a copy of the legal description shall be provided to the utility.

Utility relocation on PTC surplus parcels will require property plot plans if the utility has current private easement rights.

Refer to PennDOT Design Manual Part 3, Section 3.7B for utility Right-of-Way terminology and plan presentation. Refer to Design Manual Part 5, Section 7.3, Utility Relocation for additional details on the acquisition of substitute Right-of-Way.

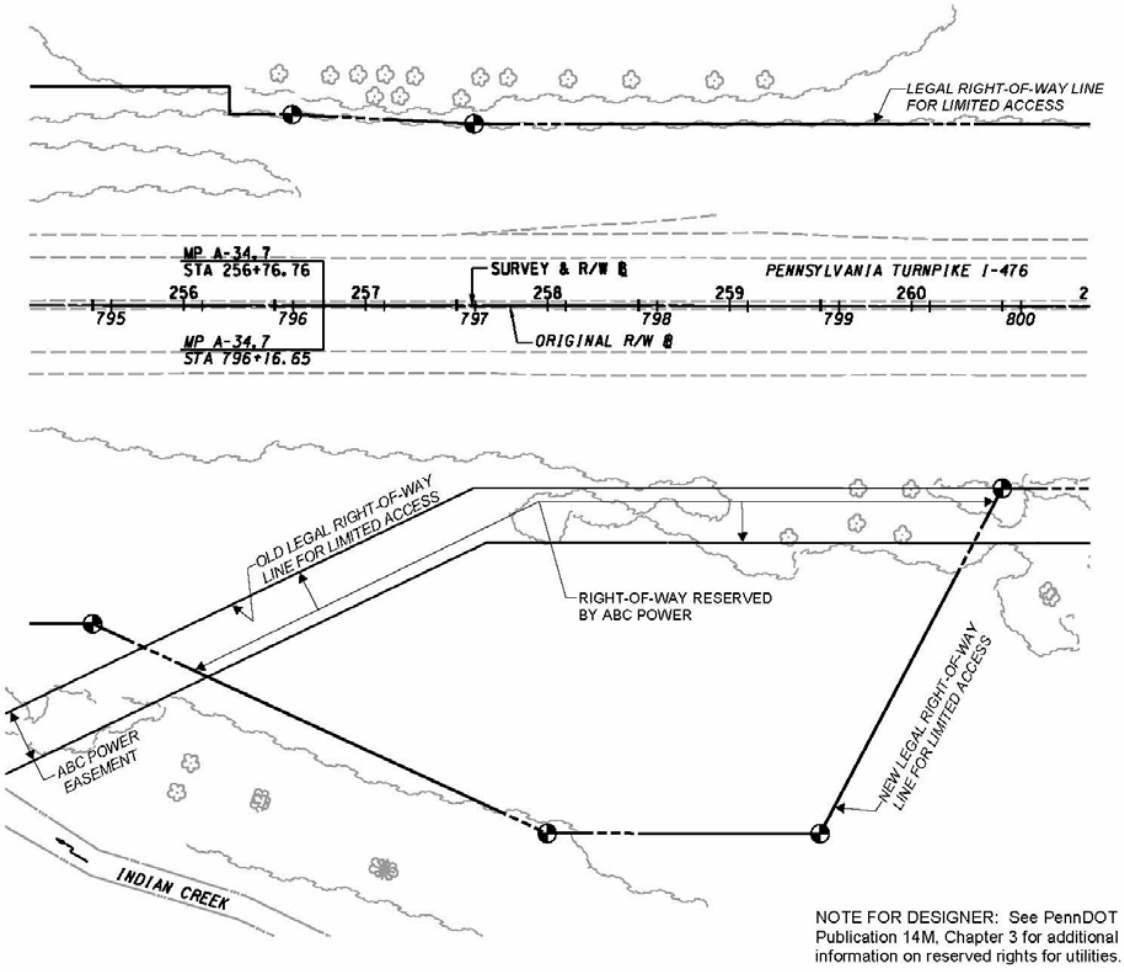


FIGURE 6.4.1

UTILITY EASEMENT

Chapter 7 - DRAINAGE

7.0 Introduction

While this chapter is divided into separate sections for Drainage and Stormwater Management, the designer must approach the layout of the roadway drainage system from a stormwater management perspective. As the Regulatory Agencies, Counties and Townships become more sophisticated in their approach to the regulation of stormwater discharges (i.e., the Post Construction Stormwater Management section of the NPDES permit), the use of sound stormwater management practices must be applied during the development of drainage designs.

7.1 Drainage Design Criteria

A. General

Primary References

1. Commonwealth of Pennsylvania, Pennsylvania Department of Transportation (PennDOT) Design Manual Part 2, Highway Design, Publication 13M, Chapter 10, Drainage Design, and Related Procedures, Latest Edition. Chapter 13, Erosion and Sediment Pollution Control, Design Manual Part 3, Plans Presentation, Publication 14M, Chapter 6, Contour Grading and Drainage Plans and Erosion and Sediment Pollution Control Plans, Latest Edition.
2. Commonwealth of Pennsylvania, Pennsylvania Department of Transportation (PennDOT) Publication 584, PennDOT Drainage Manual Chapters 12, Erosion and Sediment Pollution Control, Chapter 13, Storm Drainage Systems, and Chapter 14, Post Construction Stormwater Management, Latest Edition
3. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Pennsylvania Code Title 25, Chapter 102, Chapter 105, and Chapter 106.
4. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Erosion and Sediment Pollution Control Manual, Latest Edition.
5. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Pennsylvania Stormwater Best Management Practices Manual, Latest Edition.
6. Commonwealth of Pennsylvania, Department of Transportation, Publication 584, Latest Edition.
7. HEC – 22 Urban Drainage Design Manual
8. Commonwealth of Pennsylvania, Department of Transportation (PennDOT), Standards for Roadway Construction (RC), Latest Edition.
9. Pennsylvania Turnpike Commission (PTC), Standards for Roadway Construction (PTS), Latest Edition.
10. United States Department of Agricultural (Natural Resources Conservation Service), County Soil Survey

Compliance

1. Federal Emergency Management Agency (FEMA) flood maps will determine if the proposed activity encroaches on a regulatory floodway.
2. A water obstruction or encroachment in a stream or floodway with a drainage area of more than 100 acres requires agency authorization, such as a Joint Permit Application (JPA) (DEP and US Army Corps of Engineers) or general permit application (DEP), whichever is applicable. A Waiver of Permit should still be obtained if provisions fall below this threshold.
3. Provide supporting hydrologic and hydraulic computations as required by DEP.
4. Any stormwater management detention basin with an embankment 15 feet or greater in height, or with contributing drainage area exceeding 100 acres, or with impounding capacity at maximum storage elevation exceeding 50 acre-feet requires a DEP Dam Permit (DEP Chapter 105.81) and should be avoided where possible.
5. A Chapter 105 permit will be needed for any structure or activity that changes, expands, or diminishes the course, current, or cross section of a watercourse, floodway, or body of water. It is required to construct, operate, maintain, modify, enlarge or abandon a dam, water obstruction or encroachment.
6. A Chapter 106 permit will be needed for highway obstructions located in a floodplain.
7. Impacts involving historical, cultural, or archeological sites, National Registry or Natural Landmarks, stocked or wild trout streams, T&E species habitats, stream relocations/realignments, changes to waterway openings, or significant wetland impacts will likely require a JPA.
8. The PA Turnpike's E22-9995 General Maintenance Permit may be applicable for activities limited to performing bridge clearance and channel improvement and bridge rehabilitation projects, including limited substructure widening.
9. Coordinate with a PTC Environmental Liaison early in the process.

Drainage Systems

1. All drainage facilities less than 10 feet in depth from the existing or proposed finished grade to the top of the pipe will be replaced.
2. Drainage facilities greater than 10 feet in depth from the existing or proposed finished grade to the top of pipe will be inspected and the results included in a "Deep Culvert Inspection Report." The designer will physically inspect pipes greater than 36-inches in diameter. Pipes less than or equal to 36-inches in diameter will be video logged by the designer and a copy of the inspection video provided to the Commission as part of a "Deep Culvert Inspection Report". Pipes may need to be cleaned out prior to being video logged. Check with the PTC PM to determine if this will be done by PTC Maintenance or if it will need to be included with the video inspection. The "Deep Culvert Inspection Report" should indicate whether the drainage system is recommended for rehabilitation, reconstruction, or extension.
3. In developing the new drainage system and the construction staging for the project, consideration will be given to placing the new drainage system at the existing drainage location as much as possible to minimize boring.
4. See Section 3.11 for guidance on completing Earthwork Summary Block

B. Storm Drainage

Hydrology

1. Runoff factors should follow Design Manual 2, Chapter 10, Table 10.2.1 or local governing storm ordinances if the ordinances are more stringent for the design and approval by the necessary regulatory agencies.
2. For temporary conditions use a 2-year design storm frequency.

Storm Pipe

1. The minimum diameter of cross pipes under the roadway that are deeper than 10 feet shall be a minimum 24 inch.
2. A 0.5% minimum slope to be provided, with 1% being the desired minimum. Maximum slope to be 10% unless a steep slope pipe design is provided.
3. Combination storm sewer and underdrain is to be used for parallel storm sewers in cut conditions and in the median.
4. Two (2) pipe alternates will be used for all storm sewer pipes, including combination storm sewer and underdrain. In general, reinforced concrete and thermoplastic will be used for most conditions and coated polymer corrugated galvanized steel pipe or thermoplastic pipe will be used for slope pipe. The design will be based on the highest "n" factor for the alternatives. The pipe outlet design will be based on the lowest "n" factor for the alternates.
5. Reinforced concrete pipe will be Type A with an approximate 100-year expected service life. "PAIDD" must be used for all concrete pipes with fill heights greater than 15 feet.
6. Coated (polymer) corrugated galvanized steel pipe will be Type I with 2-2/3" x 1/2 " corrugations and designed with an approximate 50-year expected service life.
7. For thermoplastic pipe;
   - Slopes: Group V
   - All Other Areas: Group VI or VI P (Combination)
8. All pipes located within the backfill of MSE Walls, T-Walls, and U-Walls and stormwater basin outlet pipes, extending through the berm of the basin, are to specify the installation with watertight joints and should be tabulated as such.
9. Designers should consider the available sizes of pipes when developing drainage systems and verify that pipe sizes being specified are available as alternatives.
10. Pipe system should be set to avoid conflict with subgrade stabilization activities.

Inlets

1. Locations

a) Minimum spacing of inlets is to be 100 feet except in sag conditions. Bypass flow will be permitted to achieve economical spacing as long as depth and spread criteria are maintained.
b) Inlets in depressed or unpaved median sections are to be placed so the width of water flowing in the median does not exceed 2/3 the total median width, for medians greater than or equal to 22' width. For medians less than 22', see the project manager for requirements. Additional inlets beyond the minimum spacing criteria may be needed to achieve the 2/3 spread in certain instances, such as full superelevation or flat grade.
c) Provide inlets in the shoulders and median on the low side of mainline bridges. Provide inlets in the median on the high side. Inlets in the right shoulder are to be placed beyond the ends of the approach slabs with curbing extending from the wing wall or safety wall to the inlet.
d) Provide inlets in the shoulder on the low side and high side of overhead bridges. Locate the inlets beyond the ends of the approach slabs if present and provide curbing extending from the wing wall or safety wing to the inlet.
e) Outletting of median inlets into shoulder inlets and slope pipes is preferred.
f) Depress inlets in median and shoulder areas one (1) inch below the normal flow line, unless temporary traffic is anticipated over the inlets.
g) Designers should verify that pipe sizes including wall thickness being specified fit into inlet box being tabbed.

2. Types

a) Use Type C Inlets on shoulders which have approach slabs and concrete curbs.
b) Use Type M Inlets with frames in paved medians requiring drainage on only one (1) side of a concrete median barrier and on shoulders adjacent to single-face barrier.
c) Use Type M Double Inlets with concrete top units in paved medians requiring drainage on both sides of a concrete median barrier.
d) Use Type M Inlets with concrete top units in shoulders and unpaved medians, except as indicated above.
e) Type D-H inlets may be used to accommodate high storm runoff but may only be used if approved by the project manager. PTC has not utilized this type of inlet and it should only be used if approved by the Project Manager.
f) Designers should verify inlet box types to the OD of pipes for compliance with standard drawings.

Ditches/Swales

1. The minimum ditch grade to be used is 1.0 percent.
2. The minimum ditch depth to be used is one (1) foot.
3. Minimum rock size for rock lined ditches is R-4. Excavation for rock lined ditches is considered incidental to the rock lining in accordance with CS-850. Include a detail in

the project, as indicated in Appendix B, Detail #5, to indicate the associated limits of excavation.

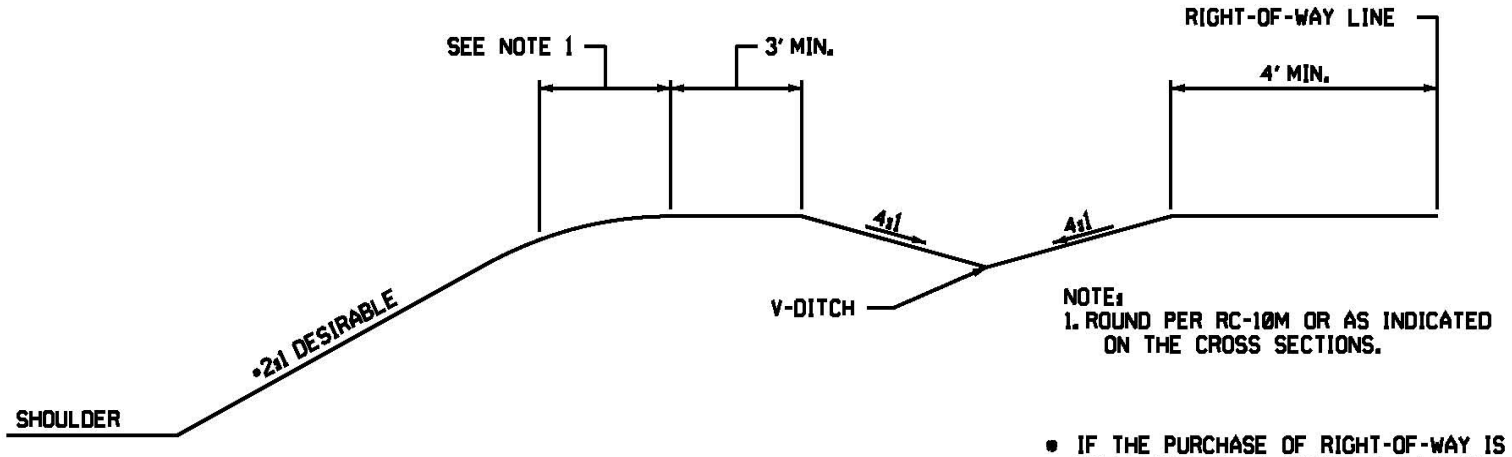
4. The class of excavation for earthen ditches is to be in accordance with RC-10 and is to be clearly indicated on the cross sections along with the associated area for the ditch.
5. Concrete lined ditches are not to be used.
6. Design ditches and their locations in accordance with the following hierarchy:

   Cut Slopes – Refer to the Figure 7.1.8(A) entitled, "Typical Ditch – Cut Slope"

   1. As indicated on the figure.
   2. As indicated on the figure with 3:1 side slopes on ditch.
   3. As indicated on the figure, eliminate the top of cut rounding with 3:1 side slopes on ditch.
   4. As indicated on the figure, eliminate the top of cut rounding with 2:1 side slopes on ditch.
   5. Locate ditch, with 2:1 side slopes, two (2) feet from right-of-way line. Ditch can intersect roadway cut slope (2:1) and round intersection point.
   6. Take additional right-of-way and use preferred ditch as indicated on the figure.

   Fill Slopes – Refer to the Figure 7.1.8(B) titled "Typical Ditch – Fill Slope."

   1. As indicated on the figure.
   2. As indicated on the figure with 3:1 side slopes on ditch.
   3. Extend embankment slope directly to bottom of ditch. Use 4:1 backslope to existing ground line to form V-ditch.
   4. Extend embankment slope directly to bottom of ditch. Use 3:1 backslope to existing ground line to form V-ditch.
   5. Extend embankment slope directly to bottom of ditch. Use 2:1 backslope to existing ground line to form V-ditch.
   6. Locate ditch, with 3:1 side slopes, eight (8) feet from right-of-way line.
   7. Take additional right-of-way and use preferred ditch as indicated on the figure.



NOTE:
1. ROUND PER RC-10M OR AS INDICATED ON THE CROSS SECTIONS.

• IF THE PURCHASE OF RIGHT-OF-WAY IS NOT REQUIRED TO OBTAIN A 3:1 SLOPE, AND THERE ARE NO OTHER ISSUES THAT WOULD HAVE MAJOR IMPACTS ON THE PROJECT, A 3:1 OR FLATTER SLOPE IS DESIRED.

FIGURE 7.1.8 (A) TYPICAL DITCH - CUT SLOPE

N.T.S.

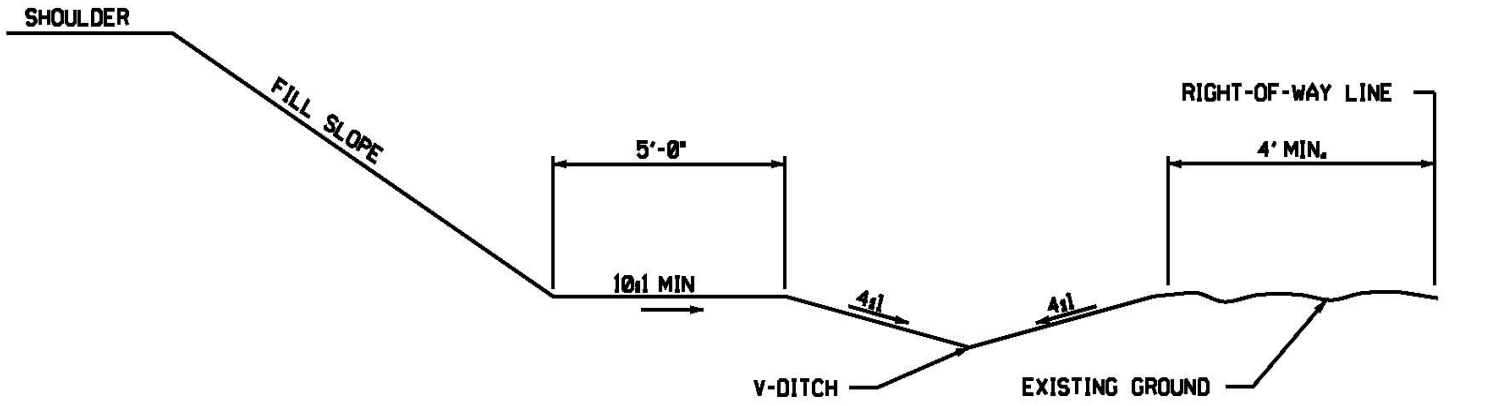


FIGURE 7.1.8 (B) TYPICAL DITCH - FILL SLOPE

N.T.S.

Pipe culverts under the Pennsylvania Turnpike

1. In general, shallow culverts, culverts less than 10 feet deep from the existing or proposed finished grade to the top of the culvert, will be replaced. Hydrologic analysis for the 50-year storm frequency will be used to determine flows. For culverts in excess of 100 feet in length, the 100-year storm shall be included in the hydraulic computations for flood risk evaluation.
2. Deep culverts, culverts greater than 10 feet deep will be addressed based on the results of the "Deep Culvert Inspection Report". Culverts that require rehabilitation will be lined with an acceptable material and system.
3. Where horizontal elliptical pipe is needed because of a restrictive vertical clearance, a concrete pipe will be used.
4. Culverts listed in the PTC bridge log should be inspected for replacement or rehabilitation and extension.
5. Unless directed by agencies, pipe culverts shall be installed with the invert a minimum of 6 inches below the natural streambed and so that the gradient of the invert shall not deviate from that of the natural streambed. In cases where the drainage area for the pipe culvert is greater than 1.0 square mile, the culvert shall be installed a minimum of 1'-0" below the natural streambed. For box culverts, refer to current guidance from the PA Fish and Boat Commission/PA DEP.

Endwalls and End Sections

1. Inlet Conditions

a) Concrete end sections shall be used.
b) All pipes, 36 inches and greater, require a Type D-W endwall, with paved apron.

2. Outlet Conditions

a) Concrete end sections shall be used to terminate pipes out letting on traversable slopes (without guide rail) within the clear zone.
b) All pipes, 36 inches and greater, require a Type D-W endwall, with paved apron.

Pavement Base Drain

1. Use six-inch minimum pavement base drains.
2. Base drains will extend to the limits of the project along both inside and outside edges of pavement in both tangent and superelevated sections of roadways and as follows:

a) Along the median centerline for paved medians unless combination storm sewer is used.
b) Along the back edge of shoulders in cut conditions unless combination storm sewer and underdrain is used.
c) Along the back edge of shoulders in fill conditions where subbase cannot be daylighted (slopes 4:1 and flatter).
d) Additional base drains are required along acceleration/ deceleration ramps.

3. Base drains will be outletted in accordance with the Commission Specification Section 615.
4. Outlet spacing is 300 feet desirable, 450 feet maximum. If this outlet spacing cannot be obtained, the size of the base drain shall be increased from six (6) inches to eight (8) inches.

Rock Armor, Rock Blanket, Asphalt Curb and Asphalt Roll-up

1. Rock armor is to be in accordance with PTS-124 and should be utilized on all fill slopes 2:1 or steeper in conjunction with guide rail to prevent embankment erosion.
2. Rock armor should extend to the top of rock in rock embankments.
3. Rock armor may also be utilized on fills with recurring erosion problems.
4. Rock Blanket is to be used on cut slopes and in accordance with PTS-125.
5. Asphalt curbs should be used to prevent sheet flow drainage onto retaining walls or geogrid reinforcement fill embankments.
6. Asphalt Roll-up is to be used at the back edge of shoulder on all cut slopes 3:1 and steeper and must be outside of the 12’ shoulder footprint.

Chapter 8 - GEOTECHNICAL DESIGN

8.0 Subsurface Exploration Planning Submission (SEPS)

A. Reconnaissance Plan

The Reconnaissance Plan is a presentation of geotechnical data obtained Office Investigations and Field Reconnaissance work. The Reconnaissance Plan is typically completed early in preliminary design and forms the basis for the identification of geotechnical areas of concern, the development of subsurface investigations, and for future analyses.

Office Investigation - Review available published and unpublished information including an evaluation of the Preliminary plans of the proposed construction to identify the geologic setting and potential areas of concern. The review should include:

1. As-built plans of the existing roadway and/or structures (if, applicable).
2. Surface features on topographic maps.
3. Geologic maps and other sources of geologic information (e.g., mining, sinkholes, landslides, acid bearing rock, etc.).
4. Soil survey maps.
5. Aerial photographs.
6. Previous geotechnical explorations in the vicinity of the project, including any studies done during the environmental evaluation for the project.
7. Location of water supply wells and/or springs.
8. Logs of existing borings and water wells.
9. Records and photographs regarding the construction and behavior of nearby structures relative to planned structures.

Field Reconnaissance – Conduct a site inspection to verify information obtained by the Office Investigation and to observe items that may impact the subsurface exploration or are pertinent to the proposed design and construction, including the following:

1. Location of proposed construction.
2. Existing structures (type and condition).
3. Surface soils.
4. Topography and vegetation.
5. Drainage features.
6. Rock outcrops, excavations, and other visible indications of subsurface conditions. If possible, confirm geologic contacts and formations.
7. Existing problem areas, such as slope movements, subsidence, mine shafts, or sinkholes.
8. Location of water supply wells and/or springs within 200 feet of proposed geotechnical borings.
9. Utility locations.

Provide the Reconnaissance Plan on a topographic base map with cross sections and profile. Since the SEPS typically occurs early in preliminary design, the development of project plans, cross sections, and profiles may be limited. The use of CAD is encouraged since it is easy to continually transfer the reconnaissance information to updated project line and grade plans as they are developed. Prepare the plans at a scale appropriate for the project.

B. Subsurface Exploration Planning Submission (SEPS)

In accordance with Pub. 293, Sections 1.1.7 & 1.5.3, and with modifications below:

A SEPS is to provide a brief report to obtain an overall perspective of the site, communicate problematic geotechnical issues which may warrant further exploration, and outline the proposed subsurface exploration and laboratory testing programs. Submissions of proposed subsurface investigation submissions are commonly submitted as discrete drilling work orders as design progresses and investigation plans are developed for different areas and structures.

A SEPS is commonly limited to only a boring location plan, boring schedule using the PTC standard form, and any necessary back-up, justification, and discussions can be included in the body of the email transmittal or a brief PDF letter. A full report, formatted in accordance with 1.5.3.1, may be warranted for complex projects and where review by PennDOT or County will be required.

Guidance for preparation of the Subsurface Exploration Plan, Schedule of Drilling and Engineer's Cost Estimate.

1. The Subsurface Exploration Plan should show the proposed subsurface exploration program (e.g. borings, test pits, geophysics, etc.) on a copy of the Reconnaissance Plan.
2. Provide a Schedule of Drilling that includes a summary table that identifies each boring, boring depths, depths of soil to be sampled, depths of bedrock to be cored, applicable borehole termination criteria, and costs. Provide clear description of the borehole termination criteria. For structures, get a full subsurface geologic section where practical.
3. Typical termination criteria may include:

    a) Include a single boring at each sign structure location (see Section 11.1). Assume a 30-foot depth for planning purposes.
    b) Spread Footings: Two (2) borings per substructure; one of which extends 2B (width) below the estimated bottom of footing and the other extends 10 ft into rock below the estimated bottom of footing.
    c) End-bearing piles: Two (2) borings per substructure, 15 ft into rock below the anticipated pile tip.
    d) Drilled shafts: Two (2) borings per substructure; typically, five (5) times the diameter of the shaft into rock for common shaft diameters. The required depth should also be based on variability and dip of anticipated subsurface conditions.

e) Friction piles: Where bedrock is anticipated below deeper soils, bedrock should still be sampled and alternatives considered. In deep soil horizons where bedrock is not anticipated, estimate appropriate sampling depths based on conceptual analyses of friction piles.
f) Roadway Embankment: 5 ft into rock or suitable % of embankment height and upon reaching competent material.
g) Micropiles: 40 feet below top of rock. Additional length may be required in karst areas.
h) Roadway Cuts: 10 ft of stratigraphic overlap, in rock, with adjacent borings or 10 ft below the proposed finish or subgrade elevation.

4. If drilling is by PTC open-end drilling contract, adapt the submission to comply with the requirements of **Section 8.1 Drilling Contract Guidelines, Administration and Procedures.**
5. If the Consultant is administering a Subsurface Boring Sampling and Testing Contract (SBSTC), then a copy of the contract documents with special provisions should be provided with the SEPS.

C. Deliverables

1. Electronic file Submission - Submit electronically in PDF format through the prime consultant.
2. A presentation of the SEPS, particularly the Reconnaissance Plan, Subsurface Exploration Plan, Schedule of Drilling and Anticipated Laboratory Testing Program shall occur with the project team at a special geotechnical meeting. Parties to the discussion may include the PTC, General Engineering Consultant (GEC), the Design Manager, the geotechnical consultant, and the designer. Collectively the geotechnical representatives of the PTC, GEC and the Design Manager are referred to as the Geotechnical Design Management Team (GDMT). A summary of the key findings of the final deliverable can be presented at a design status meeting.

8.1 Drilling Contract Guidelines, Administration and Procedures

Subsurface Investigations are typically administered through PTC open-end drilling contracts by the PTC Drilling Manager and PTC Geotechnical Project Manager, with support from the designer and Geotechnical Design Manager. Guidelines (White Papers) for procedures in administrative responsibilities of each party, with respect to planning and performing the field work, are maintained by the Geotechnical Unit. A copy of the PTC Drilling Protocols can be found in Appendix K. Contact the PTC Geotechnical Project Manager for a copy of the current Drilling Contract Guidelines and MPT Protocol. The need for consultant administered contracts should be determined during scoping.

8.2 Geotechnical Engineering Report (GER) Submission Guidelines

The distinction between a roadway project with a bridge and bridge project with roadway work is up to the project team with the Commission's approval. In general, when the

project includes less than 1,000 feet of roadway work and unusual conditions are not anticipated, the project can be considered a bridge project and a roadway GER is not required.

A. Objective

As per Pub. 293, Section 1.5.5.1, Except that content requirements and outline have been streamlined as identified below.

B. Scope of Work

The process from collection of field data to GER approval can be expedited through the use of three (3) major steps:

1. Collection and Submission of Data to be Used for Geotechnical Design (Geotechnical Data Submission)

   Upon completion of the boring and testing programs, submit draft versions of the as-drilled boring location plan, typed engineer's boring logs, and relevant boring profiles. Submit a summary of soil, rock and water testing performed, along with the laboratory test reports. Reference the date of the boring and testing program approval, and note any major discrepancies. Also submit other significant subsurface information to be considered during geotechnical analysis. Include a paragraph that summarizes the Geotechnical information and any readily identifiable geotechnical problems or concerns. It may be appropriate to submit cross sections of such problem areas or concerns showing conceptual treatments. This information will receive a preliminary QC review for format, content and completeness.

2. Informal Discussion of Geotechnical Data to be Considered and Analyses to be Performed by means of Geotechnical Working Meetings

   After submission of the data and prior to the consultant's formal evaluation of geotechnical findings and results, informal discussions will be held to review the data at one (1) or more geotechnical working meetings. Parties to the discussion may include the members of the GDMT. PennDOT representatives will be invited to participate where applicable. As a result of this discussion, geotechnical concerns will be identified for further evaluation. The need/requirement for detailed analysis of geotechnical information will not be warranted if the outcome is predictable from review of the basic data.

   Informal discussions will arrive at a consensus as to the geotechnical concerns, further geotechnical evaluation needs and geotechnical design recommendations anticipated from this effort. The geotechnical consultant will prepare and distribute minutes of the meeting discussions. The meeting's conclusions and issues for further analyses, with a schedule of action items (e.g., further drilling, testing, study, analysis, etc.) will be submitted with the meeting minutes.

Larger projects requiring significant earthwork, such as off-alignment and total reconstruction projects, may warrant an additional separate cross-section review meeting. This meeting would be a follow-up to the initial review of data meeting.

3. Draft and Final GER Submission

   The GER generally follows PennDOT Pub 293 with several simplifying changes that include:

   - No straight-line diagram.
   - No repetitions from chapter to chapter - keep it brief. ALL recommendations are in Section 2 as a concise list or table.
   - Recommendation list does NOT have to follow the PennDOT outline list.
   - Structure reports are completely separate. Information from the structure reports are not to be reiterated in the GER. Instead, only identify the structures on the project and the respective separate reports to be prepared.

   The submission is to include the report, geotechnical treatment plan, subsurface profile plans, draft details and draft special provisions for construction. It should build upon the previous SEPS, Reconnaissance Plan, and Geotechnical Data submissions.

   Maintain consistency among cross sections (basis for construction), geotechnical treatment plan (pictorial rendering with caveat), tables (if/as necessary – e.g.; coal), details (show limits) and text (if/as necessary). Example geotechnical special provisions and details are available upon request. A list of current sample specifications will be provided upon request. PTC geotechnical special provisions are not to be modified. If changes are necessary, coordinate with the GDMT.

   The report itself should be kept to a minimum by avoiding repetitive text while still providing appropriate documentation to support the recommendations (including relevant meeting minutes). Incorporate figures and tables within the body of the report or at the end of the text, but not a mixture of both.

The following items are to be provided in the report, IN THE ORDER PRESENTED BELOW:

COVER PAGE– Include a disclaimer, in red text, stating:

Design is an iterative process. This report was prepared prior to completion of final construction documents. Therefore, this report may not reflect final design as contained in the construction documents.

TABLE OF CONTENTS

1. *INTRODUCTION – Include project location and description. This should be a brief overview discussion, of not more than three (3) paragraphs. Provide the general conditions, features, and any relevant items of note.*

2. *RECOMMENDATIONS – This is a concise summary of the geotechnical recommendations, referencing the Geotechnical Treatment Plan and including a list of applicable special provisions and construction details, a list of the construction notes to appear on the plans, and design guidance (including geotechnical parameters) for the engineer. For reconstructions and expansion projects a table, within Section 2 of the report, is required. The table is to be arranged by station to station limits (as well as basic offset: left or right), and indicate any associated cut slope ratios, fill slope ratios, and any special treatments for each station to station limited listed. Also, reference special provisions and/or detail that apply.*

   In order to expedite the design, use the Commission's Construction Standards and Specifications as a basis for recommendations. Discuss deviations with the GDMT prior to making formal revisions.

   The recommendations section shall address, as applicable:

   - *Embankment Construction.*
   - *Cut Construction.*
   - *Use of On-Site Materials.*
   - *Transition Zones and Subgrade Construction.*
   - *Pavement Design Parameters.*
   - *Special Treatments Not Listed Above.*
   - *Instrumentation for Construction Control.*
   - *Additional Testing, Study and Analysis needed for Final Design. (Applicable when a Preliminary GER is prepared during preliminary design on major projects.)*

3. *ANALYSIS OF DATA AND CONCLUSIONS – Prepare this chapter to generally parallel Chapter 2.0 Recommendations on a section-by-section basis. This is an analysis of the field and laboratory data and assessment of the site conditions, subsurface investigations and laboratory findings. The analysis and interpretation must support the conclusions. Minimize geotechnical analysis where standardized details and specifications are applicable. During the analysis and design process, identify the basis for using any value, parameter or procedure, e.g., laboratory test results, reference material and/or engineering judgment.*

   Identify and estimate the amount of each rock type available from project excavations, i.e., Type B Rock, Type C Rock and Non-Durable Material. The sum of these materials will equal the total amount of rock excavation. Assume that rock layers thinner than 10 ft can not be excavated cleanly without mixing with surrounding material and assign an appropriate average material type designation. Include these calculations with the appendix.

   The conclusions are to be developed from the analysis. The conclusions shall be concise, specific and supporting of each recommendation. Do not repeat recommendations in this chapter.

Include in this section, a brief statement as to why items or issues common to the project's general area are not addressed in the report. Examples are karst conditions, coal mines, oil & gas wells, etc.

4. *SOIL, ROCK AND HYDROLOGIC SETTING – Provide a concise, integrated summary of findings of the office investigation, field reconnaissance, test drilling and laboratory testing, as they relate to proposed roadway construction. The section will include:*

    - *Regional Physiography and Topography.*
    - *Soils - Provide a concise written overview of soil classifications (USCS, AASHTO), types (alluvium, colluvium, etc.) and identified problem soils. Do not reiterate the USDA soil identifications from published soil maps.*
    - *Geology - Summarize bedrock units with elevation ranges on a stratigraphic column and show key stratigraphic units (marker beds) on the Reconnaissance Map.*
    - *Hydrology - Include surface drainage and groundwater.*
    - *Coal and Mining or other special Issues - Summarize in the text or on a table and show on Reconnaissance Map.*

5. *RECONNAISSANCE – Document the findings from site reconnaissance performed at the site during the project. Include pertinent findings that support geotechnical recommendations. Provide photos, if appropriate and helpful, to substantiate the observed conditions during reconnaissance. This can be generated from the SEPS data, supplemented by any additional, subsequent work.*

6. *GEOTECHNICAL INVESTIGATIONS - Provide a very brief summary of the boring and testing programs conducted for the project. Reference the boring logs and test results.*

7. *ENVIRONMENTAL CONCERNS – Include hazardous waste or potentially contaminated media sites, wetlands, streams, water wells, oil wells and gas wells, underground storage tanks, and potentially acid bearing rock associated with geotechnical activities (see Section 8.9 regarding procedural requirements for acid bearing rock).*

8. *ECONOMIC CONSIDERATION – Discuss any economic aspects of the geotechnical work associated with the project. Items that shall be considered include:*

    - *Presence of mineable coal or other minerals, and unsuitable material.*
    - *Presence of aggregate grade rock.*
    - *Evaluate mass balance of project earthwork. Determine if waste material is marketable elsewhere or if on-site areas are available to waste excess material. For borrow projects, evaluate if it is more economical to modify grade to minimize/eliminate borrow material required for the project.*
    - *Cost saving options to limit right-of-way acquisitions.*

9. *REFERENCES*

APPENDICES - Provide the following appendices to the report:

A – Geotechnical Treatment Plan ("Also Plans") as outlined in Section 8.5 (Add a note: "Refer to the details and cross sections for precise locations and applications."). Mark all drawings as DRAFT.
B – Draft Special Provisions and Details. Mark all as DRAFT.
C – Soil Profile Plan ("Also Plans") as outlined in Section 8.4. Mark all as DRAFT.
D – Plan of borings, with reconnaissance notes and mapping. Mark all as DRAFT.
E – Test Boring Records.
F – Laboratory Test Results.
G – Calculations.
H – Relevant Correspondence.

Provide unique page numbers for all sheets within each Appendix. Additional Appendices may be provided for photographs, mine maps, or other relevant materials.

For tables, provide only those tables that are needed during the natural course of design development. Do not develop tables simply to meet any perceived GER submission requirement.

Organize calculations with a table of contents. Include method and calculation used to estimate quantities of various types of rock anticipated during excavation for the project. Include a cover sheet containing a list of persons whose initials appear on the calculations, with a statement prepared, signed and sealed by a Professional Engineer, registered in the Commonwealth of Pennsylvania, that all calculations are checked. Where calculations are prepared by a consultant other than the geotechnical consultant, include a cover letter and statement from the geotechnical engineer, signed and sealed, indicating that the calculations were reviewed and that the geotechnical parameters and subsurface modeling agree with the geotechnical engineer's recommendations.

C. Deliverable

Submit the Draft GER with the 75% submission and the Final GER with the Pre-Final PS&E submission. Submit he GER as electronic pdf files. Bookmarks within the pdf file should be provided for each section and appendix of the report.

The GER is to be modified in response to comments on the Draft GER submission. Modifications can be made through submission of individual pages or report sections, for approval. After approval of modifications is received, provide a complete final GER submission.

A meeting to discuss the cross sections and geotechnical details should occur prior to incorporation into the contract documents.

8.3 Soil Profile Plan Submission Guidelines

A. Objective

The Soil Profile Plan is to be prepared in accordance with PennDOT Strike Off Letter 481-15-01, Attachment B, and the following. The Soil Profile Plan is to provide an illustrative view of the subsurface conditions across the project on exaggerated scale profile plans and on cross sections where subsurface investigation data is available. It is to be considered a tool to identify and communicate subsurface conditions of concern, potential sources of material required for construction, material located at the bearing elevation of proposed structures; and support the construction of the project. The Soil Profile Plan will be incorporated into the PS&E as a set of "Also Plans."

This submission may not be required on single bridge projects. Such projects have limited subsurface information which is adequately shown on the structure tracings of all borings.

B. Scope of Work

A soil profile is a restatement of subsurface boring information which generally emphasize the vertical axis or elevation and deemphasizes the horizontal and is usually oriented along the construction or stationing centerline (exaggerated scale). Because of the orientation being along the construction or stationing centerline, the subsurface profiles are typically aligned perpendicular to major structural features.

Where more than one (1) boring is at or near the same station, show the subsurface boring information on the closest regularly spaced cross section. Borings nearest the project centerline will appear in both the subsurface cross sections and profile. Show only those cross sections which have boring information. Borings which do not appear on either the subsurface cross sections or profile should be shown on a separate sheet(s).

Include the following on the Soil Profile Plan:

1. Centerline with stationing along the x-axis and elevation to mean sea level along the y-axis for the profile.
2. Correct elevation and stationing of project structure locations.
3. Existing and finished ground lines.
4. Correct elevation, stationing and offset of project boring.
5. Proper soil and bedrock symbols for units encountered in the boring on graphical logs, plotted at proper elevation (No black-line boring log, must be graphical log. No different scale log, must be same scale as profile.).
6. Correct groundwater elevation. Provide note at the bottom of the boring if it was dry or that water was not encountered.
7. Correct normal pool elevation of water body (if encountered).
8. Potential sources and estimated type and quantity (or quantities) of rock available within the project limits that may be required for stability and/or drainage.
9. Significant geologic formations and/or seams, e.g., Morgantown Sandstone, Pittsburgh Coal.

10. A note indicating that the Soil Profile Plan is to be used for informational purposes only.
11. For sandstone strata, edit the default gINT output of "SANDSTONE" to more accurately describe the anticipated quality of the unit by identifying if it is interbedded, fissile, or other condition shown on the logs that are anticipated to preclude its suitability for use as Type B rock.

C. Deliverable

The deliverable is submitted as draft and final submissions with the GER. The draft submission is reviewed, and comments are provided. The final submission addresses the comments and serves as the final Soil Profile Plan for the project.

8.4 Geotechnical Treatment Plan Guidelines

A. Objective

The Geotechnical Treatment Plan's ("Also Plans") purpose is to present recommended geotechnical treatments which impact the design and construction of the roadway and its associated structures. The objective of the Geotechnical Treatment Plan is to provide an efficient description of geotechnical design features that must be incorporated into the construction effort.

The draft Geotechnical Treatment Plan is to be developed (as necessary) for geotechnical treatments identified at the Design Field View. The final Geotechnical Treatment Plan is to be incorporated as a set of "Also Plans" in the PS&E. They are to be sealed by an Engineer registered in the Commonwealth of Pennsylvania.

B. Scope of Work

The Geotechnical Treatment Plan is an index or overview "working drawing".

For each Geotechnical Treatment Plan use/show:

1. These plans are to be black and white.
2. Scale of 1" = 200'
3. Topographic base map with alignment, cut/fill limits, roadways and structures.
4. Anticipated locations of the types of treatments along with the limits of such treatments. Utilize patterned areas to distinguish the treatment; not numbering schemes.
5. Include a legend on each sheet of treatments shown. Ensure the graphical scale of the legend matches that used on the plan depictions.
6. North arrow
7. Title block
8. Existing and Proposed Structures

C. Deliverable

The deliverable is submitted as draft and final submissions with the GER. The draft submission is reviewed, and comments are provided.

8.5 Structure Foundation Submission Guidelines

A. Objective

The Foundation Submission is to be in accordance with DM-4, Section 1.9.4 and Pub. 293, Section 1.5.7, with the following modifications.

B. Scope of Work

The process from collection of field data to foundation approval can be expedited through the use of three (3) major steps:

1. Data Submission

   Upon completion of the boring and testing programs, submit draft versions of the as-drilled boring location plan, typed engineer's boring logs, and relevant boring profiles. Submit a summary of soil, rock and water testing performed, along with the laboratory data reports. Reference the date of the boring and testing program approval, and note any major discrepancies. Also submit other significant subsurface information to be considered during foundation analysis (prior to Com 624, ABLRFD, and similar computer analyses). This information will receive a preliminary QC review for format, content, and completeness.

2. Data Submission Review Meeting

   After submission of the data and prior to formal evaluation of foundation alternatives, a meeting (or meetings on multi-structure projects) will be held to review the data. Depending on the project, parties to the discussion may include the PTC, GEC, and/or the Design Manager, collectively known as the Geotechnical Design Management Team (GDMT); the design engineer, the geotechnical consultant, and the structural designer. PennDOT representatives will be invited to participate where applicable. As a result of this discussion, foundation alternatives will be identified for further evaluation, including cost comparisons, as warranted. The requirement for detailed analysis of any foundation alternative will not be warranted if the outcome is predictable from review of the basic data.

   The alternative analyses will be summarized and submitted for concurrence. Informal discussions will arrive at a consensus as to the foundation type(s) and the general substance of the geotechnical foundation recommendations. Maintain coordination with the GDMT during analyses. Perform technical and economic comparisons for the various options considered only when approved.

The geotechnical consultant will prepare and distribute minutes of these discussions and meetings.

3. Draft and Final Foundation Submission

   Prepare Structure Foundation Reports (SFR) in accordance with DM-4 1.5.7.1 and as follows:

   - Cover Page – Add the following disclaimer to the cover page, in red text: *Design is an iterative process. This report was prepared prior to completion of final construction documents. Therefore, this report may not reflect final design as contained in the construction documents.*

   - Recommendations – This is a concise summary of the geotechnical foundation recommendations, including the summary table required by DM-4 subsection 1.9.4.3(a), a list of applicable special provisions and construction details, a list of the foundation notes to appear on the structure plans, and design guidance (including geotechnical parameters) for the structural engineer. Place the table at the front of the text for this chapter, not at the end of the report. In order to expedite the design, use the Commission's Construction Standards and Specifications as a basis for recommendations. Discuss deviations with the GDMT prior to making formal revisions. Minimize geotechnical analysis where standardized details and specifications are applicable.

   - Calculations –

     - Organize calculations with a table of contents.
     - Include the method and calculations used to estimate quantities of various types of rock anticipated during excavation for the project.
     - Include a cover sheet containing a list of persons whose initials appear on the calculations, with a statement prepared, signed and sealed by a Professional Engineer, registered in the Commonwealth of Pennsylvania, that all calculations were performed by or under the supervision of a Professional Engineer.
     - Where calculations are prepared by a consultant other than the geotechnical consultant, include a cover letter and statement from the geotechnical engineer, signed and sealed, indicating that the calculations were reviewed and that the geotechnical parameters and subsurface modeling agree with the geotechnical engineer's recommendations.
     - ABLRFD or analyses from other structure packages do not replace the need for independent evaluations in accordance with DM-4, or industry standards for topics not addressed by DM-4 or Pub. 293.

   - QA Forms - QA Forms are only required for PennDOT owned structures.

C. Deliverable

Submit the SFR as an electronic pdf file. Bookmarks within the pdf file should be provided for each section and appendix of the report.

The SFR is to be modified in response to comments on the Draft SFR submission. Modifications can be made through submission of individual pages or report sections, for approval. After approval of modifications is received, provide a complete final SFR submission.

8.6 Requirements for Final Engineers Logs and Structure Boring Plan Sheet Logs

A. Objective

So as not to withhold superior information from the Contractor:

- Provide subsurface material descriptions which identify both the content of the corebox(s) and comments and observations which identify the in-situ subsurface conditions encountered by the boring.
- Present the same pertinent subsurface information on both the Final Engineers Logs and the Structure Boring Plan Sheet Logs.

B. Scope of Work

The Commission follows the requirements of PennDOT Publication 222, Section 3.6, for the completion of boring logs. The gINT software is to be used in conjunction with the templates developed by PennDOT for the completion of typed logs and structure boring sheets.

The gINT "*Standard Descriptors"* shown on the log for soil and rock are to be verifiable by the review of the contents of the core box at a later date by the Contractor. Use gINT "*General Descriptors"* to describe pertinent information that cannot be observed from the core box. The following are some examples of conditions that are to be logged:

- Due to the physical limitation of SPT and coring samples, cobbles and boulders cannot be retrieved and placed in the corebox. Thus, "*Standard Descriptors"* for Cobbles and Boulders should not be used. However, the existence of cobbles and boulders, and the evidence thereof, should be recorded using "*General Descriptors"* as per "*FAQ's: PennDOT gINT Data Template and Library."*
- The "*Standard Descriptor"* "Mechanically Broken Rock" (with no other primary or secondary constituents) is to be used to describe the recovery of rock broken by the impact from Standard Penetration Test (SPT) sampling. However, additional "*General Descriptors"* must be used to represent the stratum more accurately, e.g., decomposed shale bedrock, sandstone boulder, etc. The goal is not to only describe the material in the split-barrel sampler (Mechanically Broken Rock) but to use "*General Descriptors"* to describe the source of the material so that misleading representations and conclusions do not result.

- As per PennDOT Pub. 222, Chapter 5-SBST Contract Documents, Section 202-Standard Soil Boring, Sampling and Testing, the top of bedrock is defined by blow counts or auger refusal, but this elevation may not be representative of the top of weathered rock which could be SPT sampled. Include top of weathered rock, as applicable.
- Indicate the depositional environment, if identifiable. Examples for soil include fill, residual, colluvial, alluvial, etc. (see PennDOT Pub. 222, Section 3.6, Table 20). For bedrock, include the member name.
- Note the presence of voids and the anticipated reason for the voids.
- If identifiable, note apparent groundwater & drill-water conditions, such as perched water tables, loss or return of drill water, artesian conditions, etc.

Within the gINT software, use the 'General Soil Descriptions', 'General Rock Descriptions', 'Depositional Environment', and 'Composition Modifier' input fields, as appropriate. Input notes, as appropriate, at or near the proper depth to ensure data is properly represented on the final printed log.

Structure Boring Plan Sheet Logs output from the same gINT software, are to also adhere to these requirements. When preparing Structure Boring Plan Sheet Logs, pair adjacent borings by substructure unit on a single sheet. Line up borings by elevation. If borings are too long for one (1) sheet, continue the paired borings on additional sheets. Do not simply fill a sheet with a single boring in multiple columns unless the boring has no pair.

On the last sheet(s) of the Structure Boring Plan Sheet Logs set, include tabulations of all laboratory testing completed as a part of the geotechnical investigation for the structure design.

C. Deliverable

Typed Final Engineer's Boring Logs and Structure Boring Plan Sheet Logs are to be submitted as a part of their respective, applicable, geotechnical report (GER or SFR) as detailed in previous sections of this chapter.

8.7 PS&E Review Guidelines

A. Objective

The geotechnical consultant is to review the 75% PS&E submission plans, special provisions, details, and cross sections for accuracy and ensure that the geotechnical recommendations are being correctly interpreted in the design. Additionally, check and confirm that the special provision, Display of Geotechnical Documents has been accurately incorporated into the PS&E.

B. Scope of Work

Prior to submission of the 75% PS&E, plan for incremental review meetings of PS&E components with the GDMT, as needed. Incremental review meetings could consist of:

- Cross section reviews - All geotechnical treatments are to be shown, details complete, and special provisions included, for discussion during the meeting.
- Structure Plans reviews - All geotechnical treatments are to be shown, foundation notes finalized, details complete, and special provisions included, for discussion during the meeting.

Areas for excess material should follow the guidelines in the DOM.

C. Deliverable

The geotechnical consultant is to complete the QA/QC form, acknowledging that the review has been completed and that the PS&E documents appropriately incorporate the geotechnical recommendations. This form is to be submitted with the 75% PS&E submission documents A sample form is provided as Figure 20.7 at the end of the Design Consistency Guidelines.

8.8 Record Set of Geotechnical Documents

The record set of geotechnical documents is a compilation of all geotechnical information and associated construction documents prepared for the project. The information will be consolidated and available for review by prospective contractors during the bidding phase of a construction project. A record set of geotechnical and bid documents will be available for review as stipulated in the Display of Geotechnical Documents Special Provision.

8.9 Miscellaneous

A. Laboratory Testing

Guidelines (White Paper) for laboratory testing sample selection and method requirements procedures are maintained by the Geotechnical Unit. Contact the PTC Geotechnical Project Manager for a copy of the current Laboratory Testing Guidelines.

B. Notes for PTS-100 Use

PTS-100 is intended as a guide for embankment bench design and construction. It is not intended to replace project-specific analysis of proposed embankments. The limits and dimensions shown on the details may be modified to ensure adequate stability based on project-specific analysis. The minimum factor of safety required for embankments is 1.3. For embankments within 50 ft of a structure the minimum factor of safety is 1.5. It is recognized that problematic areas may exist where the minimum factor of safety can't be obtained through reasonable design approaches. In these areas, the minimum global stability after construction is required to be at least equal to existing embankment's stability. This may require back-analysis of existing conditions to determine appropriate assumptions. It is important that the existence of this condition be captured in correspondence to the Designer and PTC. Include the extent and limits of where this situation occurs within the project.

C. Guidance for Rock Embankment Design

Attempt to utilize on-site materials for embankment construction and avoid a borrow condition. The rock types identified in the PTS standards were selected to perform adequately in cases where geotechnical information is limited or absent. The Geotechnical designer should evaluate if an onsite rock type of lower quality is adequate for stability. Type A Rock must be obtained from a Bulletin 14 approved source and therefore should only be utilized when design requirements cannot be satisfied with the use of on-site materials and/or Types B and C Rock. Refer to CS 206 for the specific requirements for each rock type.

In the GER (but not in contract documents) identify and estimate the amount of each rock type available from project excavations, i.e., Type B Rock, Type C Rock and Non-Durable Material. The sum of these materials will equal the total amount of rock excavation. Assume that rock layers thinner than 10 ft cannot be excavated cleanly without mixing with surrounding material and assign an appropriate average material type designation.

Attempts should be made to utilize readily available rock types for construction provided that adequate stability is maintained. If such rock types do not fit the strict definition of either Type B or Type C Rock, then project specific special provisions can be written to allow the use of a suitable project specific rock type. For example, a "Type B-Modified Rock" special provision could be developed to permit the use of either a hard siltstone or a suitable limestone. In these instances, the specific borrow location is to be identified in the special provision. The Designer should request permission from PTC-Geotech to pursue a modified type rock material and only allowed from project excavations. This request should be accompanied by boring logs and testing as justification.

The Contract will define the rock embankment requirements for construction but not to define the source location of the rock. The only information to be provided regarding the source of the rock types is in the Soil Profile Plan (included in the Contract as "Also Plans"). Here the laterally continuous and substantially thick layers (greater than 10 ft) are labeled without any markings delineating the upper, lower or lateral boundaries. However, the Contract should be clear as to the general acceptability of onsite material for construction of embankments, especially, steepened embankments.

The Geotechnical designer should work closely with the roadway design team as the rock embankment requirements (toe bench, drains, blanket, etc.) are being placed on the contract documents.

<u>Type A Rock</u>

The utilization of Type A Rock should be limited to areas where significantly high drainage flow is anticipated or high strength is required. In the contract, provide a borrow quantity for the amount of Type A Rock required for construction. Use typical strength parameters in the range of phi = 40 to 45 degrees or higher for Type A Rock design.

Type B Rock

In order to assess the constructability of a project, during design, tabulate the quantity of Type B Rock available from the project excavation. Do not consider seams less than 10 ft thick, seams that are not greater than 90% pure in the tabulation, or especially interbedded, platey, or of graded quality. Furthermore, use a reduction factor of: 0.8 for seams 10 to 15 ft thick; 0.85 for seams 15 to 20 ft thick; and 0.9 for seams over 20 ft thick. Identify in-situ locations and quantities of Type B Rock available. Make comparisons between the rock available from excavations and the rock required for construction. If appropriate, consider staging.

Type B Rock is acceptable as rock toe material, even below drainage, where conditions are anticipated to be saturated and/or with normal seepage. The typical strength parameter range for Type B Rock is phi = 36 to 40 degrees.

Type C Rock

In some situations, Type C Rock can be specified for use when other rock types are not available. Typical strength parameters cannot be readily defined because of the project specific nature and inherent variability of this rock type.

D. Guidance for Temporary Shoring Investigations

Provide sufficient borings to characterize the subsurface conditions where temporary shoring is anticipated to support a roadway, structure, or otherwise indicated on the plans. The drilling of additional borings specifically for temporary shoring can be minimized by utilizing nearby structure or other borings, provided the subsurface information is relevant. The intent is to provide sufficient subsurface data, for use by the contractor, which brackets the area of required temporary shoring; thereby giving the contractor a reasonable basis for bids. At the contractor's discretion, they are to perform additional borings to further characterize the site. Therefore, engineering judgement is necessary in determining how many additional, if any, temporary shoring specific borings are needed during design to supplement existing structure and roadway boings in the area.

If no other suitable borings are in the vicinity or if some supplemental borings are necessary, utilize the following guidance in developing a subsurface investigation program for temporary shoring specific borings:

- Provide one (1) boring for every 100 linear ft of anticipated shoring at bridge construction locations.
- Generally, two (2) borings spaced across the anticipated shoring, are needed.
- For very long shoring, such as shoring for the construction of MSE walls that will parallel the roadway, borings should not be spaced more distant than 500 ft.
- If tie backs or similar items are anticipated, provide one (1) or more borings to investigate potential bond zones.
- Provide additional borings at a closer spacing where variable site conditions and/or subsurface conditions are anticipated (e.g. changes in top of rock elevation,

groundwater conditions, cut/fill transitions, limits of existing structure backfill at existing structure locations, etc.). Obtain concurrence from the PTC Geotechnical Unit Representative and/or Geotechnical Design Manager prior to drilling contingency borings.

Do not perform laboratory testing on borings performed specifically to support temporary shoring design, in order to retain all samples for the contractor's engineer.

Prepare and submit a Temporary Shoring Data Report which includes:

- All typed boring logs for supplemental borings performed specifically for the temporary shoring,
- All typed boring logs for roadway, structure, or other borings in the vicinity of the temporary shoring location that the geotechnical consultant determines to be applicable,
- Include a watermark on all boring logs, indicating "NOT FOR CONSTRUCTION,"
- All laboratory testing results of included borings,
- Simple 8-1/2" x 11" plan sheets showing the locations of all included borings.

Submit the Temporary Shoring Data Report after approval of the associated structure's SFR and before the final PS&E submission.

E. Potential Acid Bearing Rock

It is the responsibility of the PTC and/or Design Manager to interact with the agencies regarding Acid Bearing Rock (ABR) issues. The PTC will respond to agency comments on a case-by-case basis if the issue arises during reviews.

The PTC utilizes its past local experience to identify which, if any, of the project's rock units require special handling for ABR issues. Therefore, a comprehensive program of drilling, sampling and testing to determine the acid potential of each rock strata is not required.

On projects containing coal or carbonaceous material, the PTC's practice is to assume that coal and carbonaceous material is ABR. Therefore, the designer should anticipate the use of the PTC's standardized notes, details, and special provisions to segregate and encapsulate these materials.

F. Cement Stabilized Subgrade

Bid results and value engineering proposals on multiple projects indicate that cement stabilization of the subgrade is preferred to traditional undercutting/backfilling (Class 1A). Advantages could include, savings, time, predictability, reduced waste sites and a better product.

For Total Reconstruction Projects and other projects having extensive subgrade undercut, include special provisions for cement stabilization using cement at an application rate determined during design. Except for the typical exclusion zones around shallow

drainage pipes, structure backfill and exposed bedrock, the stabilization should be 100% of the project's length and extend from outside of shoulder to outside of shoulder. The design should be kept relatively simple with generally one (1) application rate and depth across the entire project. Special provisions for as-directed, localized increases in the application rate should be included. The stabilized subgrade should be utilized only as a work platform and its strength not included in the pavement design. No alternate for traditional undercut should be included.

For projects with limited subgrade work, e.g., overhead bridge replacements, toll gantries, interchange, and service plaza improvement projects, include as an either/or item allowing bidders to choose between Class 1A excavation Undercutting and cement stabilization to stabilize unstable subgrade soils. The advantage with this method is that each bidding contractor selects the option which is best for them and the project while producing a desired outcome. The quantity of waste for the Class 1A excavation option will need to be accounted for in waste areas in the event a contractor picks that option.

Additional details and guidance on design goals and procedures for performing the stabilization will be needed. The Geotechnical Unit will advise each design team on a project-by-project basis as the guidance above may need to be discussed, specifically for projects with limited subgrade work.

Chapter 9 - PAVEMENT DESIGN

9.0 Permanent Pavement – Flexible Pavement

A. General

The pavement analysis and design shall be completed in accordance with the following guidelines and in conjunction with the policies and procedures provided in the AASHTO Guide for the Design of Pavement Structures and the PennDOT Publication 242, Pavement Policy Manual, hereinafter referred to as AASHTO and Publication 242, respectively. The pavement design computations shall be conducted using AASHTOWare DARWin 3.1 software or current version, hereinafter referred to as DARWin.

The Project Manager should discuss whether a pavement design is needed for a certain section of Total Reconstruction with the Total Reconstruction Program Manager and Roadway Engineering Manager. If the PTC chose to forego a pavement design, subgrade testing and analysis of traffic volume and composition will still be required.

The use of the publications noted above does not preclude the application of engineering judgment for any unusual situations or problems that may be encountered on a specific project. Federal, state or local regulations may also require deviations from the aforementioned guidelines. All deviations from these policies and design procedures must be fully documented.

B. Flexible Pavement Design Guidelines

All total reconstruction projects are to be designed utilizing Stone Matrix Asphalt for the wearing course on the final travel lanes (do not use on shoulders used as travel lanes for MPT purposes) and Superpave mix design specifications for wearing courses on shoulders as well as the binder and base courses. All other projects will continue to be designed utilizing Superpave mix design specifications for wearing and binder. The selection of the PG-binder for the wearing course is to be in accordance with Commission Specification, Section 413. For all Turnpike mainline paving, use an asphalt mixture with a 10 to < 30 million ESALs design life for binder, base and wearing courses. All pavements are to utilize SRL-E wearing courses.

All projects are incorporating a minimum pavement structure comprised of two (2) inch wearing course and three (3) inch binder course layers, a Superpave base course layer of variable depth (to be computed), a four (4) inch drainage layer of asphalt treated permeable base course, and a six (6) inch subbase layer. The bottom four (4) inches of base course shall be a “rich bottom mix”. The “rich bottom mix” is achieved by adding additional PG 64E-22 asphalt.

The Superpave base course layer is the only pavement layer that varies significantly in depth from project to project. The depth of the base course layer is not only a function of the anticipated traffic loadings but also of the subgrade soil conditions. This is consistent

with the Publication 242 design approach for flexible pavements on weak subgrade soils, which is to provide a stronger base course able to withstand the effects of lower bearing support in the subgrade soils. It is this layer that is adjusted to provide the needed structural strength required by the pavement design.

Roadbed soil testing must be conducted to evaluate the condition of the roadbed soil. Areas of low subgrade support and/or frost heave susceptible soils must be identified. Procedures used to improve subgrade support where needed, such as undercutting or subgrade stabilization, must be analyzed and the most feasible and economical solution chosen that does not reduce pavement thickness. Methods to reduce the detrimental effects of frost heave on the pavement, such as undercutting or increasing pavement base course layer depth, shall be considered and the most feasible and economical solution chosen. Refer to Chapters 3 and 5 of Publication 242 for additional guidance on subgrade soil evaluation procedures.

The following pavement layers are the minimum to be used on any Total Reconstruction project:

- 2-inch Stone Matrix Asphalt Wearing Course, SRL-E, (12.5mm) PG 64E-22
- 3-inch Asphalt Binder Course, Superpave (19mm) PG 64E-22
- 10-inch Asphalt Base Course, Superpave (25mm) PG 64E-22
- 4-inch Asphalt Treated Permeable Base Course
- 6-inch Subbase (No. 2A)
- 25-inch minimum depth

The thickness of the Superpave base course will be determined by subtracting the difference between the required structural number of the entire pavement structure and the structural number of the other pavement layers.

C. Permanent Pavement Design Parameters

This section describes the Design Parameters recommended for use in the design of permanent flexible pavements. For the most part, the parameters given are to be standard for all projects; however, there are specific parameters that must be determined by the designer. For example, traffic input parameters must be calculated from traffic data provided by the Commission, and roadbed soil input parameters must be determined from various test results of soils from the project area. These computed parameters are noted in Table 9.1.1.

The selection of the design parameters for input into the DARWin™ software shall be in accordance with Chapters 6, 7, and 9 of Publication 242. The ESAL Calculation method in DARWin™ shall be used to compute the total 18-kip ESALs for a project's performance period. The Compounded Growth Rate calculation method in DARWin™ should be used to determine the total 18-kip ESALs unless historical evidence or traffic studies show a linear growth trend. If a linear growth trend exists, then the Simple Growth Rate calculation method in DARWin™ should be used. Use either the Specified Thickness Design method or the Optimized Thickness Design Method in DARWin™ to determine the pavement layer thicknesses.

DESIGN PARAMETER DESCRIPTION	DESIGN VALUE
DESIGN VARIABLES	
Performance Period	**20 years**
Analysis Period	**20 years**
Total 18-kips Design ESALs Traffic counts to be provided by the Turnpike Commission. See Table 9.1.2 to convert Turnpike vehicle classifications to PennDOT classifications.	**Must be computed. See Publication 242, Chapter 7.**
Reliability	**98%**
PERFORMANCE CRITERIA	
Initial Serviceability	**4.2**
Terminal Serviceability	**3**
PSI Loss due to Frost Heave of Natural Subgrade No reduction will be allowed for stabilized subgrades.	**Must be computed. See Publication 242, Chapter 9.**
ROADBED SOIL CONDITIONS	
Effective Roadbed Resilient Modulus Natural subgrade bulk sample must be representative of roadbed soils and must be tested at field moistures. The number of tests is dependent upon variations in soil characteristics. Adjust the effective roadbed resilient modulus value for seasonal variations.	**Must be computed. See Publication 242, Chapter 6.**
DRAINAGE CHARACTERISTICS	
Drainage Factor for Layer Coefficient - Good Based upon new construction.	**1.0**
STANDARD DEVIATION	
Relatively confident of ESAL calculation	**0.45**
STRUCTURAL LAYER COEFFICIENTS	
Asphalt Wearing Course	**0.44**
Asphalt Binder Course	**0.44**
Superpave Base Course	**0.40**
Asphalt Treated Base Course	**0.20**
Subbase	**0.11**

TABLE 9.1.1 PERMANENT PAVEMENT DESIGN PARAMETERS – FLEXIBLE PAVEMENT

CONVERSION FACTORS TO CONVERT TURNPIKE CLASSIFICATIONS TO PENNDOT VEHICLE TYPES IN PERCENTAGES									
PENNDOT VEHICLE TYPE	TURNPIKE CLASSIFICATION								
	1	2	3	4	5	6	7	8	9
Passenger Cars / Non Trucks	99%	1%							
2-Axle, 6-Tire	1%	61%	27%	3%	1%				
3-Axle, Single Unit		13%	29%	6%	1%				
4-Axle, Single Unit			2%	1%			1%	1%	50%
3-Axle, Single Trailer		8%	10%	1%	1%				
4-Axle, Single Trailer		17%	2%	7%	1%	1%	1%	1%	
5+-Axle, Single Trailer			30%	81%	88%	86%	91%	90%	30%
5+-Axle, Twin Trailer				1%	8%	13%	7%	8%	20%
TOTAL %	100%	100%	100%	100%	100%	100%	100%	100%	100%

TABLE 9.1.2 PENNSYLVANIA TURNPIKE COMMISSION PAVEMENT DESIGN MATRIX

9.1 Permanent and/or Temporary Median and Outside Shoulders – Flexible Pavement

The following minimum pavement structure is the standard for permanent shoulders:

- 2-inch Asphalt Wearing Course, Superpave (12.5mm) PG 64E-22
- 3-inch Asphalt Binder Course, Superpave (19mm) PG 64E-22
- 4-inch Superpave Base Course PG 64E-22
- 6-inch Subbase (No. 2A)

This standard pavement structure has a structural number of 4.46. If traffic will be running on the shoulder, a pavement structure must be designed based on roadbed soil conditions, traffic, and the duration of time that traffic is running on the shoulder. The permanent shoulder pavement shall be designed using the same roadway pavement design parameters as detailed in Section 9.0B. The structural number of this pavement design shall be checked against the standard 4.46 structural number. If the required shoulder structural number is less than the minimum 4.46 structural number, then the standard (minimum) pavement structure shall be used. If the required shoulder structural number is greater than the minimum (4.46) structural number, then the subbase depth will be increased to a maximum of 12-inches until the required structural number is met. If the required structural number is not achieved using 12-inches of subbase, adjust both the Superpave base course depth and subbase depth to achieve the most economical design.

For two-stage construction, signing to keep trucks and buses out of the right lane is typically used as part of the maintenance and protection of traffic. A value of 25% trucks should be used for the percentage of all trucks in the design lane for the shoulder evaluation. The temporary pavement design parameters to be used are provided in Table 9.3.1.

If the maintenance and protection of traffic scheme uses the existing shoulders as part of the traveled way, then the structural number requirements must be met in addition to surface milling/overlay work to provide ride quality, if necessary. If these requirements cannot be met, then a temporary pavement shall be designed to accommodate the anticipated traffic loadings.

For projects such as an overhead bridge replacement, which requires traffic to run on the existing median or shoulders for a short length of time for maintenance and protection of traffic purposes, no pavement design is needed. A temporary pavement consisting of a 2-inch Asphalt wearing course layer on a 6-inch Asphalt binder course layer should be utilized for the short-term traffic pattern. However, if Fiber Optic is currently installed in the shoulder, consideration must be given for the shoulder reconstruction pavement depth.

9.2 Permanent Pavement for Local Roads and State Routes

Turnpike construction that impacts local or state route roadways will require a pavement design for the replacement pavement structure or rehabilitation (e.g. mill/overlay) for the impacted side roads. For local roads, the local municipality ordinances must be reviewed

to determine the appropriate design and materials for the rehabilitation or replacement pavement structure. If local ordinances are not available, Publication 242 guidelines shall be followed. The pavement design of the Pennsylvania states routes impacted by Turnpike construction shall be completed in accordance with Publication 242. The pavement design of local routes and states routes must be reviewed and approved by the local municipality and PennDOT, respectively.

DESIGN PARAMETER DESCRIPTION	DESIGN VALUE
DESIGN VARIABLES	
Performance Period	**Construction Duration**
Analysis Period	**Construction Duration**
Total 18-kips Design ESALs Traffic counts to be provided by the Turnpike Commission. See Table 9.1.2 to convert Turnpike vehicle classifications to PennDOT classifications.	**Must be computed. See Publication 242, Chapter 7.**
Reliability	**95%**
PERFORMANCE CRITERIA	
Initial Serviceability	**3.6**
Terminal Serviceability	**2.5**
PSI Loss due to Frost Heave of Natural Subgrade	**Must be computed. See Publication 242, Chapter 9.**
ROADBED SOIL CONDITIONS	
Effective Roadbed Resilient Modulus Natural subgrade bulk sample must be representative of roadbed soils and must be tested at field moistures. The number of tests is dependent upon variations in soil characteristics. Adjust the effective roadbed resilient modulus value for seasonal variations.	**Must be computed. See Publication 242, Chapter 6.**
DRAINAGE CHARACTERISTICS	
Drainage Factor for Layer Coefficient - Poor	**0.90**
STANDARD DEVIATION	
Relatively confident of ESAL calculation	**0.45**
STRUCTURAL LAYER COEFFICIENTS - NEW PAVEMENT	
Asphalt Wearing Course	**0.44**
Asphalt Binder Course	**0.44**
Superpave Base Course	**0.40**
Asphalt Treated Base Course	**0.20**
Subbase	**0.11**
STRUCTURAL LAYER COEFFICIENTS - EXISTING PAVEMENT	
Asphalt Courses	**0.25-0.35***
Subbase	**0.07-0.09***
*** Typically use value at high end of range.**	

Table 9.2.1 TEMPORARY PAVEMENT DESIGN PARAMETERS

9.3 Standard Pay Items – Total Reconstruction Pavement

The following is a list of typical pay items for the pavement reconstruction:

2419-1000	SY STONE MATRIX ASPHALT MIXTURE DESIGN, WEARING COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 12.5 MM MIX, 2" DEPTH, SRL-E
2413-0412	SY SUPERPAVE ASPHALT MIXTURE DESIGN, WEARING COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 12.5 MM MIX, 2" DEPTH, SRL-E *(Note: For mainline shoulders)*
2413-6078	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BINDER COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 19.0 MM MIX, 3" DEPTH
2313-0822	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 4” DEPTH
2313-0824	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 5” DEPTH
2313-0826	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 6” DEPTH
2313-0828	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 7” DEPTH
2313-0830	SY SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 8” DEPTH
2313-1623	SY RICH BOTTOM SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE, PG 64E-22, 10 TO < 30 MILLION ESALS, 25.0 MM MIX, 4" DEPTH
0360-0001	SY ASPHALT TREATED PERMEABLE BASE COURSE, 4" DEPTH

2350-0106 SY SUBBASE 6" DEPTH (NO. 2A)

For other Pavement Items, see the PTC Master Item List available in Kahua.

The restricted performance specification is not used.

To convert roadway materials from square yards to tons, utilize the following conversion factors:

- 9.5 mm Wearing Courses - 113 LB/SY/Inch
- 12.5 mm Wearing Courses - 110 LB/SY/Inch
- 19 mm Binder Courses - 116 LB/SY/Inch
- 25 mm Base Courses - 114 LB/SY/Inch
- 25 mm Rich Bottom Base Course - 113 LB/SY/Inch
- Asphalt Treated Permeable Base - 116 LB/SY/Inch
- Subbase (No. 2A) - 113 LB/SY/Inch

Chapter 10 - GUIDE RAIL AND CONCRETE BARRIER

10.0 Introduction

These guidelines are based on AASHTO Roadside Design Guide, PennDOT Publication 13M, Design Manual Part 2, Highway Design, PennDOT Publication 72M – Roadway Construction Standards and Pennsylvania Turnpike Commission Standards for Roadway Construction.

The following information and criteria are guides and should be supplemented with sound engineering judgment. For additional guidelines, refer to the Standards for typical guide rail and barrier placement and installation details.

The following guidelines should be applied for the design of guide rail, concrete barriers and end treatment installations on the Pennsylvania Turnpike. Installations on state and local roads should follow PennDOT Design Manual Part 2.

10.1 Guide Rail

A. General

Guide rail is to be installed as indicated on the standard drawings or contract documents.

Guide rail currently located outside of the determined Clear Zone should be evaluated for removal. Specifically, guide rail at the back edge of a pull-off area should be reviewed to determine if a hazard/obstruction is present behind the existing run of guide rail.

All Vehicle Attenuating Terminal End Treatments (VATET's) will have a unique identifying number, assigned by the Roadway Engineering Manager, which is to be indicated in the remarks column on the Tabulation sheets. Coordinate with Project Manager to have ID #'s assigned at the 60% Over the Shoulder review.

B. Clear Zone Concept

For Clear Zone information, refer to the PennDOT Design Manual Part 2, AASHTO's "A Policy on Geometric Design of Highways and Streets," and the AASHTO Roadside Design Guide.

C. Slopes

For guide rail installation on fill slopes, refer to the PennDOT Design Manual Part 2, AASHTO's "A Policy on Geometric Design of Highways and Streets," and the AASHTO Roadside Design Guide.

D. Tapers

Guide rail is to be tapered at 30:1 inside the shy line.
Guide rail is to be tapered at 15:1 outside of the shy line.
A 10:1 or flatter slope must be maintained in front of the guide rail.
Provide the necessary detailing in the contract documents to indicate this required grading.
No asphalt curb or wedge is to be installed in front of guide rail attenuators or thru the taper of the buried in backslope detail.
Provide shoulder backup as per the PTS-100 Series Standard Drawings.

E. Outside of Horizontal Curves

Guide rail runs should be determined by using the Length-of-need (LON) calculations and applying the curve correction factor in accordance with DM-2.

F. Length of Need Equation

In an area where multiple hazards/obstructions (bridge abutment or parapet, fill slopes 3:1 or steeper, endwalls, etc.) are located in close proximity to one another, a length of need (LON) calculation is to be performed for each hazard/obstruction to determine the greatest LON distance for that area.

LON calculations are to be performed per the current PennDOT Design Manual Part 2 for each run of guide rail.

Use the shoulder width at the obstruction (distance from the white solid line to the face of the obstruction) for the L_2 value in the LON equation.

In locations where the guide rail must be tapered at a rate of 30:1 to reach either the shy line or the back edge of the paved normal shoulder, include that length of guide rail tapered at 30:1 with the tangent length of barrier upstream from the obstruction to determine the L_1 value in the LON equation.

Use the 15:1 taper rate in the LON equation (i.e.: b=1 and a=15). For ramp LON equations, adjust the taper rate in accordance with the ramp design speed.

No portion of the VATET length is to be included as part of the guide rail LON.

Perform all Length of Need Calculations using the Commissions' LON spreadsheet. The electronic version of this spreadsheet is available directly from KAHUA and shall be used as provided and submitted with the Pre-Final PS&E and final deliverables for the project in the original excel file format. The file should be for the entire project. Final Excel and PDF version of the LON file is to be provided to Roadway Engineering for their records.

G. Guide Rail Approach End Treatments

The preferred methods, in order of preference, of terminating the approach ends of guide rail are:

1. Bury in backslope;
2. Attenuate with Vehicle Attenuating Terminal End Treatments (VATET), Flared;
3. Attenuate with Vehicle Attenuating Terminal End Treatments (VATET), Tangent; or
4. Maintenance Opening, only where necessary.

Provide the necessary detailing in the contract documents to indicate the required grading of the roadside approach to the VATET as indicated on the Standard Drawings as well as the grading required to obtain the manufacturer's recommended clear runout area behind the VATET.

H. Burying In Backslope

Earth mounds are not to be created for the burying of guide rail.

A **Buried-in-Backslope Terminal** is to be used to bury the guide rail as shown on the Standard Drawings.

When the width needed to bury the end anchorage necessitates a taper length greater than or equal to 125 feet, install the last 50 feet (or "quick taper") per the PennDOT Standard Drawings, RC-54M. Extend the guide rail for a minimum of 75 feet beyond the cut/fill line at a taper rate of 15:1, parallel, or a combination thereof prior to the "quick taper."

I. Trailing End of Guide Rail

A TYPE 31 STRONG POST ANCHOR TERMINAL AND TERMINAL SECTION, SINGLE per the Standard Drawings shall be used at the end of the obstruction.

J. Drainage Features

The preferred methods, in order of preference, of addressing existing drainage ditch located inside the Clear Zone are:

1. Regrade the ditch such that the ditch is traversable;
2. Relocating the ditch outside the clear zone;
3. Extend drainage pipes to be outside the clear zone;
4. Install a traversable concrete end section on the pipe;
5. Install guide rail.

K. Rounding of Guide Rail Panel Lengths

Always round up to the next full guide rail panel (12.5 feet) when determining the total length of guide rail required in each individual run of guide rail for installation and removal.

L. Terminating Guide Rail at Access Ramps

Design the project to accommodate the installation of an appropriate guide rail end treatment as described herein. For a guide rail installation where LON cannot be obtained prior to an access point or access ramp, redesign the grading and access to achieve an appropriate end treatment design

Use of a Driveway Entrance as indicated on RC-54M to terminate the guide rail shall be approved by both the Roadway Engineering Manager and Manager of Traffic Engineering. If approved, guide rail extending from the trailing side of the access ramp must be protected with appropriately designed guide rail on the approach side of the ramp.

M. Maintenance Openings

A Maintenance Opening is an opening in a run of guide rail to allow the Commission's Maintenance Forces access to perform routine maintenance (mowing of grass, SWM Facility access, etc.). Coordinate locations of these openings with the Project Manager and Roadway Liaison.

Design the Maintenance Opening as shown on PTS-130 with a TYPE 31 STRONG POST ANCHOR TERMINAL AND TERMINAL SECTION, on both ends of the guide rail.

10.2 Concrete Median Barrier and Single Face Barrier

A. Concrete Median Barrier

Mainline

1. All median barriers are to be concrete median barrier as per the PennDOT Standard Drawings.
2. Typically, all median barrier transition sections, tied to various types of existing barriers at either end of the project, are to be per the Standards Drawings.
3. MASH Barrier should be computed as 12’-1½” in length for design quantities.

Interchange Ramps

1. Typically, all median barriers on two-way ramps are to be 42-inch concrete median barrier per the RC standards.
2. For curves with a radius equal to or less than 450 feet, specify Cast-In-Place barrier sections from the PC to the PT.

Where the two-way ramp split into two (2) single ramps, the 42-inch concrete median barrier should be designed to follow the deceleration ramp and taper away from this ramp at the appropriate taper rate for the design speed of this ramp.

Following this procedure, the barrier will typically end in the middle of the gore area between the ramps. An impact attenuator is to be placed on the end of the barrier. The gore/shoulder area on either side of the barrier should be paved and extended a minimum of 15 feet beyond the Attenuator. This barrier should be reviewed with the MPT for future crossovers as necessary.

In addition, the drainage in this area is to be designed to ensure that no ponding occurs.

B. Single Face Concrete Barrier

Utilize 52" single face barrier on all cut slopes steeper than 2:1, in front of retaining walls and sound barrier walls located along the back edge of shoulders and in other areas as required. Extend shoulder paving beneath the barrier for installation in accordance with the Standard Drawings. The use of lower barrier in front of currently designed sound walls and retaining walls should be coordinated with the Manager of Traffic Engineering, the PTC PM and the Roadway Engineering Manager.

The preferred methods, in order of preference, of terminating the approach end of single face barrier are:

- Bury in backslope slope; or
- Transition to guide rail.

For 52" barrier, utilize a 59" to 41" Transition Section and an End Transition to bury the barrier.

Terminate the trailing ends of 52" single face barriers by connecting to guide rail utilizing a Terminal Section, Bridge Connection or with an End Transition if guide rail is not required. Utilize a 52" to 34" Transition Section prior to connecting the guide rail Transition. Follow RC-58M – Moment Slab with Barrier and Transition (Approach End) for the connection of Approach Guide Rail to Single Face Concrete Barrier.

Chapter 11 - SIGNING, PAVEMENT MARKINGS AND DELINEATION

11.0 Introduction

In addition to these guidelines for Signing and Pavement Markings, refer to the Manual of Uniform Traffic Control Devices (MUTCD), PennDOT's Standard's: Publication 111 that includes the TC-8600 Series (Pavement Marking and Markers) and TC-8700 Series (Sign Lettering and Spacing); PennDOT's Publication 236, Approved Sign Handbook, the PTC Signing Handbook, the Pennsylvania Turnpike Commission Interchange Signing Plan (ISP), and the Pennsylvania Turnpike Commission Standards for Roadway Construction.

General Notes are not to be repetitious of the Commission Specifications.

11.1 Signing

A. General

All signage within the project limits is to be replaced, unless otherwise directed by the Commission. Design all Major Guide Signs and Overhead Guide Signs with 20"/15" lettering using Clearview lettering. 16" lettering is permissible on Overhead Guide Signs when the preferred 20" lettering is not feasible due to sign structure limitations. All text on Major Guide Signs and Overhead Guide Signs must be approved by the PTC. Overhead Guide Signs designed sign area shall be increased by 25% for sign structure design to account for future sign replacements.

Major Guide Signs in all 3 lane roadway sections are to be installed overhead.

Fabrication drawings for all Major Guide Signs and Overhead Guide Signs should indicate a sign with square (90°) corners on the sign edges with a rounded border.

B. Presentation of Plans

If Signing and Pavement Marking Plans are provided, all signing shall be shown on the Signing and Pavement Marking Plans. The plans shall include the sign nomenclature, size and type of mount listed under each sign. Identification Numbers (ID #) are to be provided on the plans for all new and/or relocated Major Guide Signs or Overhead Guide Signs. The ID #'s for existing signs that are to be relocated will use an italicized font while new signs will use a standard font. Signs that are to be removed do not require an identification number. Secondary signings do not require identification numbers.

For resurfacing projects, the Commission's Traffic Engineering Department will provide the tabulation of proposed and existing secondary signing on the Turnpike to be included in the contract specifications as an attachment. For reconstruction projects, the Commission's Traffic Engineering Department will provide a tabulation of existing signs.

The Designer will prepare Signing and Pavement Marking Plans showing existing signs and adding any new signs required due to the proposed design of the project.

For resurfacing projects involving an interchange, all signing shall be included on Signing and Pavement Marking Plans as well as a tabulation of proposed and existing secondary signs in the contract specifications as an attachment. All proposed signing along interchange ramps shall be in accordance with the PTC Interchange Signing Plan (ISP).

Secondary signing on state and local roads is to be shown on the Signing and Pavement Marking Plans.

Fabrication drawings for PTC specific signs (i.e. signs beginning with "PTC - ___"), located in the PTC Signing Handbook shall be included in the contract specifications as an attachment.

C. Reflectivity

All Signs are to have PennDOT approved Type XI reflectorized material.

D. Mounting (Ground/Overhead)

All major ground mounted signs are to be Type A, including Gore Area Exit signs, and are to have a minimum of 7-foot clearance under the sign, unless approved by the Commission's Traffic Engineering Department.

See PTS-980 for Structure Mounted Flat Sheet Aluminum Signs mounting details for mounting signs onto overhead structures. Overhead structures which do not permit the use of the PTS-980 detail are to have a specific mounting detail developed for approval by the Commission.

E. Sign Structures

Design guide rail or concrete barrier to shield sign structures per the Standard Drawings.

F. Signing Guidelines for Ramps

Curve departure and truck rollover warning signage, wrong way signing, and acceleration/deceleration lane signing are to be shown along ramps and the ramp/mainline area as required by the current version of the Pennsylvania Turnpike Commission Interchange Signing Plan (ISP).

G. Access Road Signing

The Private Roadway (PTC-PR) and Private Property No Trespassing (PTC-LAW) signs are to be located at the intersection of the Access Road and the state/local road as indicated on PTS-980.

11.2 Pavement Markings

A. General

All pavement markings on state and local roadways must be according to the MUTCD and PennDOT's TC-8600 Series. All pavement markings on the Turnpike must be according to Commission specifications and Standard Drawings, with the exception of pavement marking legends. Ensure that the removal of existing and temporary pavement markings is accounted for on the summary and tabulation sheets, in addition to proposed final marking quantities. This removal would include temporary pavement markings placed on outside edge of pavement during total reconstruction projects.

B. Highly Reflectorized Pavement Markings

All permanent pavement marking lines along the mainline and the 8" paint lines on ramps, including gores, are to be highly reflectorized pavement markings except the 24" wide gore pavement markings which are to be hot thermoplastic pavement markings, and the pavement markings within the tunnel crossover limits which are to be waterborne pavement markings. Permanent pavement markings are to be placed 4" from the edge of pavement/construction joint. All pavement markings on ramps beyond the 8" lines at the gores are to be waterborne pavement markings. Do not include Snowplowable Raised Pavement Markers (SRPM) in areas of highly reflectorized pavement markings. Temporary and permanent Auxiliary Lane Lines at interchanges and lane drop locations are to be installed in accordance with PTS-980. Verify with the Commission's Traffic Engineering Department the type of pavement marking material to be specified. All temporary and permanent pavement markings are to be in accordance with PTS-980.

C. Paint Patterns

For mainline concrete pavements and mainline concrete bridge decks exceeding 500' in length, a 10' black line will be placed directly after the 15' white skip mark and a 2' black line will be placed after the 3' white auxiliary line, as indicated on PTS-980. For ramp concrete pavements, confirm use of black line with Project Manager.

11.3 Delineation

A. General

For resurfacing projects, include the replacement of median delineation devices for the entire project limits.

Chapter 12 - LIGHTING

12.0 Introduction

This chapter presents the design criteria for the formulation of conventional and high mast lighting systems. The information herein is written for qualified lighting engineers and to assist them in preparing a uniform and standard lighting design. The designer's engineering judgment in the application of the criteria is subject to review and concurrence by the Commission. The designer shall obtain prior approval from the Commission on matters of design which raises questions in the application of these criteria to a specific condition.

Current versions of the following references may be used in addition to this chapter:

1. AASHTO *Roadway Lighting Design Guide*.
2. AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.
3. ANSI/IES RP-8, *Recommended Practice: Lighting Roadway and Parking Facilities*.
4. FHWA *Lighting Handbook.*
5. National Fire Protection Association (NFPA), NFPA 70, *National Electrical Code,* Latest Edition.
6. National Fire Protection Association (NFPA), NFPA 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways.*
7. PennDOT Design Manual, Part 1, Part 1C, Part 2, Part 3, and Part 4, as applicable.
8. PennDOT Publication 72M, *Standards for Roadway Construction – Highway Lighting Drawings*, RC-80M, RC-81M, RC-82M, RC-83M, and RC-84M.
9. PennDOT Publication 219M, *Standards for Bridge Construction*, BC-721M and BC-722M.
10. PennDOT Publication 408, *Specifications*, as supplemented by Commission Specifications, where applicable.
11. International Dark Sky recommendations.

Good Neighbor Policy – The Commission would like to maintain good neighbor status with local residents. Consider the impact of lighting on surrounding residential areas. Lighting systems will be designed and installed to limit light trespass onto adjacent properties where possible. In general, arm-mounted, conventional cobra-head luminaires with cutoff optics are preferred over high mast or tenon-mounted luminaires. This preference does not preclude considering other systems. These systems should be considered if other factors such as ease of maintenance, light distribution limits, or economic savings support an improved final product. House–side shielding on luminaires may be used to minimize light trespass. Lower mounting heights may also be considered, but not desirable. The designer should evaluate concerns and present to the Commission for consideration.

Local Ordinances – The Commission is considered its own political jurisdiction; however, if local municipalities enforce stricter rules, the Commission may opt to comply

with local ordinances as a good neighbor. The lighting designer will be required to contact local authorities for their standards.

The Commission will be responsible for all energy and maintenance related costs unless other provisions are established for these costs. Energy and Maintenance Agreements with local agencies will be required to establish responsibilities if others will perform maintenance or supply energy to the lighting system. If multiple agencies are involved, determine delineation of responsibilities for installation, maintenance and operation. Separate facilities as necessary.

Sign lighting of overhead sign structures is not required.

12.1 Design Process

During the early stages of design, a pre-design meeting shall be held to review and discuss lighting design criteria, and to address all project-specific requirements relating to the highway lighting design, including the scope of work. Other items to be discussed at this meeting should include luminaire and pole type selections, mounting heights, Light Loss Factor (LLF) for photometric calculations, minimum average illumination, maximum uniformity ratios (average/minimum), and the coordination of proposed lighting with adjacent roadways. Current design manuals, standards, and criteria should also be discussed at this meeting. Any discrepancies or preferences between criteria should also be discussed at this meeting including AASHTO and ANSI/IES RP-8.

Highway lighting designs typically include a conceptual (Lighting Study), a preliminary and a final submission. The conceptual (Lighting Study) submission should include an evaluation of options and alternatives such as the use of high mast lighting, conventional lighting and post mounted tenon lighting within the project. Also included should be the general limits of the proposed lighting, as well as luminaire mounting height and wattage data, and any required recommendations to avoid light trespass. The conceptual (Lighting Study) submission should include typical lighting calculations for each lighting type specified. The conceptual (Lighting Study) submission requirement may be waived by the Commission if the project is clearly not suitable for high mast or post mounted tenon lighting, as determined at the pre-design meeting.

Upon approval of the conceptual (Lighting Study) submission, a preliminary submission should be prepared that includes highway lighting plan sheets indicating each luminaire mounting height and offset, and each luminaire location by station.

A preliminary highway lighting report should be submitted along with the plans that includes a summary of all lighting design criteria, IES photometric file for the luminaire, calculations that indicate the end of rated life average maintained illuminance, uniformity ratio and veiling luminance ratio for each unique pole spacing in accordance with PennDOT Design Manual Part 2, Chapter 5. Footcandle calculations shall be provided for ramps, transition zones, toll plaza areas and employee parking lots only. The lighting of mainline roadways is not required, with the exception of tunnels and potentially

underpasses. Any lighting falling on these areas is considered incidental light. The lighting of shoulders is not required.

The final submission should include final lighting plans, complete with tabulation of quantity sheets, circuit wiring diagram sheets, special detail sheets and plan sheets in accordance with Design Manual Part 3, Chapter 9. Also included in the final submission shall be electrical calculations, guide rail clearance worksheets, special provisions, cost estimates and all necessary design information such as roadway cross sections, drainage plans, contour grading plans, and structure drawings to allow satisfactory review of the lighting design.

12.2 Site Inspection

It is the responsibility of the design consultant to become familiar with existing installations, including existing facilities, overhead and underground installations, power supplies, and controls that may be affected by this work. The lighting design should also be coordinated with proposed facilities such as underground drainage pipes and inlets, guide rails, utility relocations, overhead sign structures, and bridge structures.

Attempts shall be made to avoid mounting lighting poles on bridge structures unless necessary to maintain satisfactory footcandle levels. Where necessary, locate poles as close to pier locations as possible, the distance from the pier not to exceed one-third of the length between adjacent piers.

Make arrangements with the Commission for inspection of all existing power supply facilities that may be affected by this work. Coordinate with the local electric utility to determine the type and location of all available electric sources, if an existing PTC power supply is not present.

Interchange lighting will be controlled from a central location using a photoelectric cell and lighting contactor. Controls will utilize a manual-automatic switch and High Intensity Discharge (HID) rated lighting contactor. Avoid locating the photoelectric cell near a light pole to avoid on-off cycling of the lighting system. Time clocks are not acceptable.

12.3 Conceptual Lighting Design (Lighting Study)

A. General

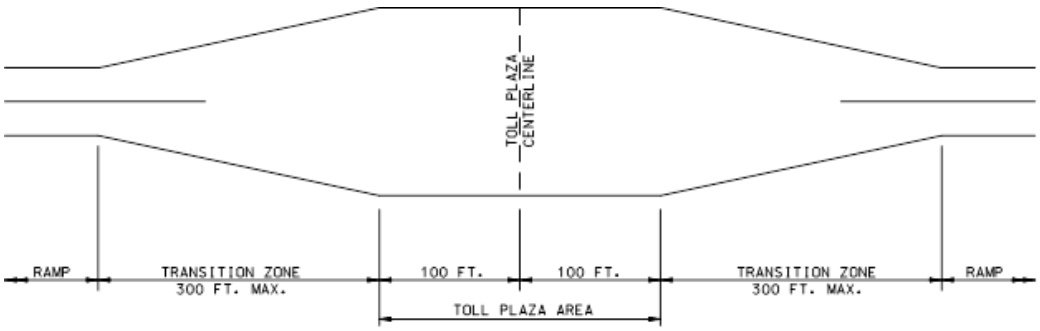
1. LED lighting systems will be used for new lighting projects and for projects where lighting is being converted to LED.
2. For existing projects where other legacy lighting sources are in use (HPS, MH, etc.), lighting for partial ramp/roadway lighting replacements may or may not match the existing lighting system as described earlier in this Chapter.
3. Depreciation (Light Loss) – The depreciation factor for different lighting sources will be as follows:

Source Type	Lamp Lumen Depreciation	Dirt Depreciation	Light Loss Depreciation
HPS	.80	.80	.64
MH	.70	.80	.56
LED	.90	.80	.72

4. The life of the light may alter the lamp lumen and light loss depreciation.
5. Design for a maximum maintained uniformity (Average horizontal footcandles (fc) to Minimum horizontal fc) ratio of 4:1.
6. Design for a maximum veiling luminance ratio of 0.3:1.

B. Description of Toll Plaza/Interchange Area

1. General Diagram for identifying toll plaza area, transition zones, and ramps within an interchange.



TRANSITION ZONE DIAGRAM

2. In general, the PTC prefers to utilize RP-8, but this should be discussed at the pre-design meeting.
3. All lighting poles in the transition zone area will be mounted on non-breakaway bases and foundations conforming to the latest AASHTO requirements. Lighting in this area will be connected to the interchange generator, where available.

C. Considerations for Mainline Turnpike Ramp Roadway Lighting

1. The Conceptual Lighting Design will include an evaluation of options and alternatives such as the use of high mast lighting, conventional lighting, post mounted tenon lighting, and possibly a hybrid combination of high mast & conventional lighting within the project limits. Note where underpass lighting may be required. Include general limits of the proposed lighting, as well as luminaire mounting height and wattage data.
2. AASHTO lighting warrants are not necessary to determine the extent of lighting at mainline interchanges. Full interchange lighting will be required.
3. Spill light onto the Turnpike or local roadways is considered incidental. In areas where ramps run parallel with Turnpike or local roadways and ramps, only lighting that is cast upon the ramp will be used for roadway calculations.

4. The Consultant will provide for all systems being considered; the construction cost estimate, annual energy cost comparisons, 30-year operation and maintenance cost comparisons, safety concerns, and light trespass concerns as part of the conceptual lighting design.
5. Sample lighting design calculations should be included for each lighting scheme.
6. The consultant will recommend the best lighting option to pursue for lighting design and include supporting documentation.

D. Considerations for Mon-Fayette and Southern Beltway Projects

1. Investigate lighting warrants to determine either full or partial lighting.
2. Full lighting is defined as the complete lighting of the entire ramp/roadway system at an interchange, from the intersection of ramps to the local roadway or Turnpike. The intersection of ramps to the local roadway or Turnpike will include lighting from the gore areas to a distance on the ramp that includes 600-800 feet parallel to the main roadway or Turnpike. This is applicable to ramps with both toll plaza and non-toll plaza facilities. Cross road intersections will be lighted. Only illumination of the ramp widths will be considered in the lighting calculations for design purposes.
3. Partial lighting will include lighting of toll plaza areas and transition zones and at areas where ramps intersect local roadways or the Turnpike On toll plazas without toll facilities, partial lighting will include only illumination where ramps intersect local roadways or the Turnpike. At a minimum, the Commission will provide partial lighting. A minimum of two (2) fixtures is required at each ramp terminal for partial lighting.
4. Only conventional type lighting will be considered. High mast lighting is not acceptable. Post mounted tenon lighting will be considered at Mainline Plazas only.
5. Lighting warrants will be based on the traffic counts for the roadway "design" year.

E. Considerations for Modifications to Existing Lighting Systems

Where existing lighting systems are being partially modified, the new lighting standards will be reviewed to determine if the existing lighting system can be matched or if the entire system must be upgraded. Due to the limited availability of outdated technology, this may not be feasible or reasonable from an availability and cost perspective. If matching the existing system is achievable, we should match the existing system including pole heights, luminaire and arm types, materials, etc. If possible, existing lighting standards may be reused on new foundations if they are inspected by the Designer and in serviceable condition. However, the age of the pole, economics of inspection vs replacement, and the anchor bolt pattern must be considered. If breakaway features are required, current AASHTO requirements must be met.

12.4 Preliminary Lighting Design

A. General Considerations

Roadway Width

Roadway Width is defined as follows:

1. Edge of traveled pavement for all open roadways. Entire cartway (parapet to parapet) on bridge decks. Curb-to-curb for all curbed roadways.
2. Although shoulders will be incidentally lighted, light levels on these areas will not be part of roadway lighting calculations.

Transition Zones

Transition zones will be designed to gradually transition the average maintained lighting levels in accordance with the design criteria.

Lighting circuitry will be connected to the interchange standby generator, where available.

Toll Plaza Areas

Lighting contribution from canopy fixtures will not be considered in the lighting design analysis.

All lighting poles in this area will be mounted on non-breakaway bases and foundations conforming to latest AASHTO requirements.

Lighting circuitry in this area will be connected to the interchange stand-by generator, where available.

Employee Parking Areas

Employee parking areas adjacent to the interchange building will be designed for 1.00 average maintained horizontal footcandles. All lighting poles in this area will be mounted onto non-breakaway bases and foundations conforming to latest AASHTO requirements. Design special pole foundations with elevated pedestals at all pole locations that may be subject to vehicle contact within the parking lot. Pedestal foundations shall be a minimum of 24 inches above the parking lot surface. Lighting circuitry in this area will be connected to the interchange stand-by generator, where available.

Underpass Lighting

Under certain conditions, underpass lighting may be required to maintain adequate levels of illumination. These conditions include, but are not limited to, the overall width of the overpass and the vertical clearance beneath the overpass. If underpass lighting is required, the underpass roadway will be designed for the same average maintained footcandle as

the roadway outside and adjacent to the underpass area. 70-watt or 100-watt LED, wall-mounted luminaires shall be used for underpass lighting, when possible.

If the concrete bridge abutment or pier cap is greater than 30 feet from the edge of traveled roadway, 70-watt or 100-watt LED, overhead-mounted underpass luminaires will be considered. If overhead-mounted luminaires are required, they should be attached to the bridge structure steelwork directly over the edge of pavement. Do not attach the luminaires to the underside of the concrete deck. Mount bottom of luminaire flush with bottom of steelwork. Attachment to concrete girders will require a special design. Coordinate with the bridge design to ensure that all structure mounted lighting items such as junction boxes, conduits and mounting brackets are included in the bridge design.

Temporary Lighting

Ramp/Roadway lighting levels will be maintained throughout construction. Temporary lighting will be specified for projects affecting existing lighted ramps/roadways.

Specifications will be performance based. The consultant will provide criteria for the Contractor to design and install a temporary lighting system during construction. Minimum lighting levels, uniformity, and glare ratios must be specified. The Designer should consider a note or specification stating "where installations present adverse conditions, the contractor must perform corrective measures to adhere to the design criteria".

The Consultant shall require that the Contractor provide lighting calculations for temporary lighting.

Temporary lighting will be included in the construction bid as a lump sum cost that includes all materials, labor, and equipment for installation, operation, removal, and adjustment of temporary lighting.

Temporary lighting will, as a minimum, meet current AASHTO requirements for breakaway or non-breakaway installations.

The Contractor will be responsible to power and control the temporary lighting system. Existing power sources, if available, may be used or temporary power sources may be used for temporary lighting. The Contractor is responsible to provide all materials, labor, and equipment to extend power and control to the temporary lighting system.

Temporary electric service installations, if used, will meet the local utility company's rules and regulations.

On existing reconstruction projects where all, or portions of, existing lighting need to be removed for roadway/toll plaza construction, temporary lighting will be required to provide adequate lighting to maintain operations of the toll plaza facility. Temporary lighting may consist of wood poles and overhead wiring.

Utilize the equivalent LED with similar light distribution and output of 250 and 400 watt HPS, M-SC-II, conventional (cobra-head) luminaires, at a 35 foot luminaire mounting height.

Lighting parameters should follow permanent lighting.

Provide arm lengths that provide the required overhangs to the edge of roadway. 20-foot arms or longer may be required. Refer to PennDOT Standard Drawing RC-80M for definitions. Limit overhead conductor span lengths to 250 feet and install guy wires as necessary. Locate the poles in areas protected from traffic, or provide protection by use of guide rail, crash barrier or other approved devices.

Provide material meeting the applicable sections of the Standard Specifications. New materials are not required as long as the performance of the material being used meets the applicable specification.

Provide Creosote, Penta, CCA or equivalent wood poles as permitted meeting environmental requirements. Provide either copper or aluminum aerial cable.

Electric supply to the temporary lighting system may be obtained from the existing lighting circuitry, from existing electrical service from the toll plaza facility or from a separate service drop from an electrical utility company service. Where applicable, power supply materials and installation will meet NEC and Power Company requirements. Enameled or hot dipped galvanized enclosures may be used in addition to stainless steel or aluminum. Where applicable, provide luminaires with individual photoelectric control, or provide a main contactor and photocontrol at the main power supply location. Ground the lighting system in accordance with the requirements.

Coordinate any required electrical service drop with the electric utility company. Select a location for the power supply pole to minimize the distance to the light fixtures to minimize voltage drop. Size the cable to operate the luminaires with a maximum 5 percent voltage drop to the end of the circuit. Provide equipment for the service as required by the electric utility company and as required to provide an operable lighting system. As a last resort, consider the use of portable generators when electric power is not readily available. Provide a single point of contact for 24/7 emergency.

Light Source Information for Existing Installations

1. The following luminaire and light source information is intended only for existing installations where the fixture has not been upgraded to LED. Currently, the PTC is upgrading existing HID lighting sources with LED lighting sources. The PTC project manager should provide information to the Consultant on the status of the lighting system at the project's location as it may have been replaced or is in the process of being replaced with LED lighting fixtures. The type of lighting source should be determined early in project design.
2. **Photometric Data** – The Photometric data utilized in all calculations shall be in accordance with the latest Commission requirements. The past standard light source for conventional lighting was high pressure sodium.

3. **High Pressure Sodium Lamps** – High pressure sodium lamps with the following initial lumens shall be used:

Wattage	ANSI Designation	Rated Avg. Life Hours	Initial Lumens
70	S62ME-70	24,000	6,300 (Underpass)
100	S54SB-100	24,000	10,500 (Underpass)
200	S66WA-200	24,000	22,000
250	S50VA-250	24,000	27,500
400	S51WA-400	24,000	50,000

4. **Metal Halide Lamps** – Metal halide lamps with the following initial lumens may be specified by the Commission for use in areas adjacent to toll booths and toll plaza buildings:

Wattage	ANSI Designation	Rated Avg. Life Hours	Initial Lumens
250	M58/E-250	10,000	22,000
400	M59/E-400	20,000	36,000

B. Conventional Lighting

Luminaire Information

1. Provide LED luminaires. HPS and MH luminaires may only be provided when directed or approved by the Commission.
2. Acceptable conventional LED luminaires for both new and existing PTC installations are as follows:

   a) Acceptable Manufacturer – American Electric Lighting

Series	Catalog No.	IES Distribution	HPS Equivalent
ATB0	ATB0-P203-MVOLT	As required	150-watt
ATB0	ATB0-P304-MVOLT	As required	250-watt
ATB0	ATB0-P453-MVOLT	As required	400-watt

Luminaire Mounting Height

The luminaire mounting height is the height of the luminaire above the finished pavement surface. Pole shaft lengths may vary to compensate for the difference in elevation between the top of the pole foundation or anchorage and the roadway surface. This adjustment to the pole shaft is noted by the C-dimension as shown on the Standard Drawings and shall be indicated on the lighting plans.

The standard nominal mounting height for conventional luminaires shall be 40 feet. Mounting heights of 35 feet and 45 feet may be permitted if special conditions exist. Each Commission Maintenance District operates a 65-foot bucket truck to maintain lighting systems. The reach of the 65-foot boom limits excessive pole heights. If it is necessary for

the bucket truck to extend its boom horizontally, the 65-foot height will be reduced accordingly. The boom will also be used to lift and remove the lighting standard. The weight of the pole may also be a limiting factor. Verify that Commission maintenance equipment is capable of servicing luminaires with mounting heights greater than 40 feet if higher mounting heights are required.

Design Criteria

Locate poles in accordance with PennDOT Design Manual Part 2, Chapter 5.3.C.8. Ensure minimum pole clearances to overhead sign structures and bridges are provided.

Unprotected lighting poles that are within the clear zone will be mounted on breakaway bases (Type S) and foundations conforming to latest AASHTO requirements. Lighting poles that are outside the clear zone, or that are protected by guide rail or concrete barrier will be mounted onto non-breakaway bases (Type A) and foundations conforming to latest AASHTO requirements.

Negative luminaire overhangs (-5-foot, -10-foot) may be considered in the lighting design; however, luminaire overhangs must be consistent within the same area.

Calculation Methods

Calculations should be submitted in a form that is legible and that can be easily reviewed. Provide all applicable photometric curves, point-to-point calculations, straight-line calculations, etc. Provide IES luminaire photometric information in electronic form. Provide an electronic file with site-specific software files in VISUAL, version 2.0 or later format for all computer-assisted calculations. Provide all input criteria for the software including luminaire coordinates. Other programs including AGi32 may be considered.

While calculation of entire ramps or roadway areas may assist the designer with layout and spacing of luminaires, the overall area illumination statistics will not be accepted as meeting the Commission's lighting criteria.

Interchange ramp lighting calculations and tabulations will be submitted in the form detailed in PennDOT Design Manual Part 2, Chapter 5.11. Use a calculation point spacing in accordance with the PennDOT Design Manual Part 2, Chapter 5.

Interchange toll plaza areas, transition zones, and parking lot calculations will be provided in sufficient detail and with enough lighting calculation points to determine the adequacy of the lighting system. Use a calculation point spacing in accordance with the PennDOT Design Manual Part 2, Section 5.

Computerized Calculation Information:

Plan view of each calculation zone with all plan information required in 12.3-A with the following additional information:

1. Point by point shown with footcandle values
2. Elevation of statistical area (high mast only)
3. End of Rated Life statistics of the area including Average Horizontal Illuminance, Minimum Horizontal Illuminance and Uniformity Ratio (average to minimum).
4. Maximum veiling luminance ratio calculation (conventional lighting, underpass, high mast)

C. High Mast Lighting

Luminaire Information

High mast LED luminaires and distributions are currently being reviewed for use on PTC projects and an acceptable manufacturer has not been determined. LED luminaires for high mast lighting will have IES Type 5 distribution similar to the HPS luminaire specified in PennDOT Publication 408. Fixture and distribution to be submitted to PTC for review and acceptance.

Luminaire Mounting Height

The nominal mounting height for high mast lighting is 100-foot. Lighting poles between 80 and 120 feet may be used for lighting design to achieve desired results. High mast poles shall not exceed 120 feet.

High mast lighting systems utilizing 60-foot mounting height may be considered for extenuating circumstances. Approval by the Commission is required.

Design Criteria

Locate high mast light poles in accordance with PennDOT Design Manual Part 2, Chapter 5.5.D.7.

Use 400-watt LED lamps with the required number of luminaires necessary to achieve the proper footcandle and uniformity ratio. The maximum number of luminaires permitted at each high mast pole is 10. If more than 10 luminaires are required on a single high mast lighting structure, structural calculations for the high mast pole design, sealed by a Professional Engineer licensed in the state of Pennsylvania, must be submitted for review and approval.

High mast poles will be constructed of galvanized steel. Weathering steel is not acceptable for new or replacement poles. Where applicable, new galvanized steel high mast poles will be used to replace existing weathering steel high mast poles. Provide at least one (1) portable winch drive motor per interchange project for new luminaire lowering ring assemblies.

The required candlepower and footcandle data necessary to accomplish this lighting design shall be furnished to the Consultant by the Commission at the time of the pre-design meeting. Lumen contributions at angles greater than 75 degrees need not be considered.

Roadway baseline elevations shall be considered when performing high mast lighting calculations.

Calculation Methods

Manual computations should not be utilized. The calculation of the footcandle level at each point is to be accompanied by use of Visual lighting design software, version 2.0 or later. Other programs including AGi32 may be considered.

a) Divide the interchange area into sections for each ramp, toll plaza, parking lot and the crossroad. Each roadway shall be further subdivided if the baseline elevation changes more than +/- 5 feet within a 400-foot section of roadway. Provide baseline elevation data with the calculations for all roadways where high mast lighting is designed.
b) When a portion or section of the highway is under analysis, it shall be analyzed as self-contained areas of analysis. The self-contained areas of analysis shall correspond to the highway geometry under investigation and the Commission's requirements.
c) The point-to-point interval shall be in accordance with PennDOT DM 2.
d) For single lane areas (equal to or less than 12 feet), the point-to-point interval shall be 5 feet longitudinally and 3 feet transversely.

D. Offset Lighting (Post Mounted Tenon)

Offset lighting shall be considered for use at transition zones, toll plaza areas and employee parking areas where the total roadway width exceeds the limitations of conventional, arm mounted luminaires. LED luminaires shall be used. HPS or MH luminaires shall be considered for use at existing areas where portions of the existing lighting systems utilize HID lighting and will remain in operation in the areas noted above. **Tenon mounted LED fixtures will be as manufactured by American Electric Lighting Series IES Type 2 Distribution.**

12.5 Preliminary Lighting Design Report

Provide a Preliminary Design Report including plans, calculations, and details in accordance with PennDOT Design Manual Part 2, Chapter 5.3.

12.6 Final Lighting Design

The final design for proposed highway lighting shall contain all information shown in PennDOT Design Manual Part 2, Chapter 5.4, as applicable and as follows.

1. All lighting pole assemblies shall be installed with transformer bases. Provide breakaway bases (Type S) with frangible type bases and anchor (non-breakaway) (Type A) bases with non-frangible bases.
2. Do not install transformers bases on structure mounted light pole assemblies. Provide junction boxes (Type JB-25), in the bridge parapets, or retaining walls to be used as a means for the line splice to the luminaire.
3. Maximum arm length for a breakaway pole is 20-feet.

4. All conventional type lighting poles will be truss-type aluminum poles similar in style and appearance as shown on PennDOT Standard Drawing RC-80M, Sheet 1 of 3. Conventional steel lighting poles are not acceptable.
5. The Commission Highway Lighting Plans are typically bid as a lump sum pay item, with a breakdown of material items and quantities listed on the lighting plan quantity sheet for information only. Utilize standard PennDOT pay item material descriptions to list material items. On Commission projects associated with PennDOT, which may require Federal participation, detailed "Tabulation of Quantity" summary sheets, listing all individual unit price pay items and light pole location descriptions shall be utilized. Format to be determined at the lighting pre-design meeting.
6. Typically, Turnpike related highway lighting systems utilize circuitry from a 277/480 volt, 3 phase, 4 wire system, associated with mainline utility building installations, with lighting connected at 277 volts, single phase. For remote locations, a 240/480 volt, single phase, three-wire system, with lighting connected at 240 volts, shall be considered. Where only a 120/240-volt, single phase, three-wire system is available, a step-up transformer to 240/480-volt will be considered.
7. Provide single pole circuit breakers for all lighting circuits.

12.7 Final Lighting Design Report

Provide a Final Design Report including plans, calculations, details, specifications, and construction cost estimate in accordance with PennDOT Design Manual Part 2, Chapter 5.10.

1. Prepare plans in accordance with PennDOT Design Manual Part 3, Chapter 9.
2. Calculations

    a) Provide voltage drop calculations for all lighting circuits. Wire loss will not result in more than 3% voltage drop at any lighting fixture on the circuit, with the exception of temporary lighting.
    b) Include a Guide Rail Clearance worksheet for all lighting poles that are located behind guide rail to ensure that proper guide rail clearances are maintained. A sample worksheet is included with these guidelines.

3. Special Provisions shall be included for all nonstandard items.
4. A construction cost estimate for all proposed lighting and all lighting to be removed and/or modified shall be included in the final design report.

12.8 LED Light Fixture Procurement

Where LED lighting is being installed on new or replacement projects, the design should be based on the following luminaires:

Conventional			
HPS Equivalent	Manufacturer	Cat. No. (LED)	Notes
70-watt HPS	AEL	ATB0-P201-MVOLT-R2-NL-P7-SH	1
100-watt HPS	AEL	ATB0-P202-MVOLT-R2-NL-P7-SH	1
150-watt HPS	AEL	ATB0-P203-MVOLT-R2-NL-P7-SH	1
250-watt HPS	AEL	ATB0-P304-MVOLT-R2-NL-P7-SH	1
400-watt HPS	AEL	ATB0-P453-MVOLT-R2-NL-P7-SH	1

High Mast			
HPS Equivalent	Manufacturer	Cat. No. (LED)	Notes
400-watt HPS	TBD	TBD	IES Type V distribution only

Wall-mounted			
HPS Equivalent	Manufacturer	Cat. No. (LED)	Notes
70-watt HPS	TBD	TBD	1
100-watt HPS	TBD	TBD	1
250-watt HPS	TBD	TBD	1

Tenon-mounted			
HPS Equivalent	Manufacturer	Cat. No. (LED)	Notes
100-watt HPS	AEL	TBD	1
150-watt HPS	AEL	TBD	1
250-watt HPS	AEL	TBD	1
400-watt HPS	AEL	TBD	1

Notes:

1. IES lighting distribution will be as required for lighting design and should be included as part of the catalog number. Provide all accessories required for a complete installation.

   In order to maintain consistency through construction, the Consultant should include a table with the bid documents with the location of the luminaire(s), Ramp and Station, and the catalog number. The catalog number will include all information to purchase a complete fixture including all accessories and the proper distribution type.

   The table should summarize the quantity of each type of fixture required for the entire project. The PTC will typically order 5% to 10% additional fixtures for inventory. Inventory to be turned over to the PTC after construction.

The Consultant will include procurement in the project specifications as detailed above. Include delivery requirements or delivery milestone dates. Establish delivery requirements in the specifications (Delivery to the site, packaging, acceptance inspection, insurance, site storage requirements, etc.).

Provide the quantity, catalog numbers, and the delivery date for the fixtures required to be ordered by the Commission at the final design submission. Delivery options can be discussed with the PTC on a project basis.

12.9 Procurement

1. The PTC will procure new LED luminaires as required by design for installation by the Contractor unless otherwise directed by the PTC Design Project Manager. The PTC will generally obtain 10% additional fixtures of each type required on the project as spares.
2. The designer will provide a list of luminaire types, distributions, and quantities for procurement.
3. The PTC will not provide materials for lighting standards, foundations, wiring, conduits, or other lighting related items.
4. The PTC Design Project Manager will be required to submit a request to procure light fixtures to and coordinate delivery of the luminaires with the appropriate representative of the PTC's Engineering – Facilities Design Unit.

GUIDE RAIL CLEARANCE WORKSHEET

PROJECT:

MILEPOST: SHEET NO. OF

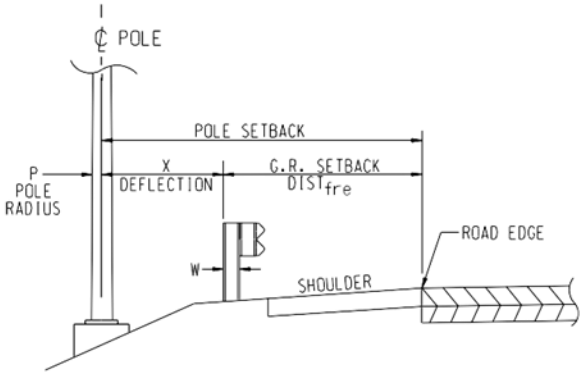
Computec By: Date: Rev:

Checkec By : Date: Rev:

POLE LOCATION			EQUIPMENT DATA				SETBACK	DIST fre	DEFLECTION	O.H.	CLEARANCE
ROADWAY	STATION	LUMINAIRE I.D.	MTG. HGT.	LUM. WATT	ARM LENGTH	POLE DIA.	POLE SETBACK/ft	G.R. SETBACK/ft	SEE NOTES	SEE DESIGN	FORMULA BELOW

NOTE: MEASURE FROM ROAD EDGE, i.e. CURB/SHOULDER INTERFACE WITH ROAD.

NOTE: PROVIDE DEFLECTION DISTANCE THAT MEETS THE MINIMUM UNOBSTRUCTED DISTANCES IN THE CURRENT EDITION OF PENNDOT DESIGN MANUAL, PART 2, CHAPTER 12. FOR POLES BEHIND TYPE 2 G/R, USE DISTANCES FROM OCTOBER 2016 EDITION OF PENNDOT DESIGN MANUAL, PART 2, CHAPTER 12.



SETBACK=(L_{arm}+2)- (+/-O.H.)ft. 200 to 400 Watts

SETBACK=(L_{arm}+1.5)-(+/-O.H.)ft. 50 to 150 Watts

FILL IN KNOWN DATA ABOVE OR MEASURE AS REQUIRED. IF CLEARANCE IS A NEGATIVE NUMBER, PICK THE NEXT LONGER ARM THAT GIVES A POSITIVE CLEARANCE. CONTACT HIGHWAY LIGHTING DESIGN DATA FOR OVERHANG. (O.H.)

CLEARANCE= SETBACK - P - $DIST_{fre}$ - DEFLECTION

- SETBACK — MUST BE POSITIVE
- P — SEE ABOVE
- POLE RADIUS
- $DIST_{fre}$ — MEASURE
- DEFLECTION — SEE ABOVE

X_{hm}= 10' - 12' MIN. (HIGH MAST POLES)

Chapter 13 - UTILITIES

13.0 General

1. PennDOT Publication 16, Design Manual Part 5, Utility Relocation, will be used to guide this work.
2. Coordinate the design of the entire project with all utility agencies having existing (or proposed) facilities within the project limits. In addition, coordination with the Commission's Fiber Optic Operations, Maintenance and Commercialization vendor will be required. The Turnpike Utility Coordinator will supply a list and/or plans for public utilities as well as for the Commission owned facilities, including fiber optic lines, utilizing the Commission's Utility Management Application (UMA).
3. Utility meetings are to be set up and conducted by the Design Consultant with the minutes completed for all meetings and uploaded to the project collaboration system in a timely manner.
4. All exchanges of information with the Utilities, submissions and responses, will be the responsibility of the Design Consultant. PennDOT forms are to be forwarded, along with the Designer's drawings, either electronic or paper per the Utilities request. Upon receipt and approval of relocation plans, proof of property rights, and a completed estimate (4181 package), the Design Manager will notify the Utility Coordinator to prepare a reimbursement agreement for execution by the Commission. Relocation work less than $50,000 can be approved by the Commission's letter agreement. Relocation work for more than $50,000 must follow the Commission Agenda process and be formally approved before finalizing and executing a reimbursement agreement. Upon the Design Manager's review and approval of all required documentation, the Commission will issue a notice to proceed to the Utility.
5. Prior to the Commission letting the project for bid, the Design Consultant will be responsible for obtaining the completed 4181-UC from the Utilities and reviewing the provided information to ensure it is correct and meets the project needs for "Type of Relocation Work" and associated "Number of Days Required". Upon acceptance of the 4181 UC, the Design Consultant will update/revise the contract special provision to reflect this information.

13.1 Utility Tracking Chart

The Design Consultant is to maintain a current Utility Tracking Chart that will be kept in the project collaboration system. This chart is to be updated within five (5) business days of any new pertinent utility information.

13.2 Pipeline Attachments to Overhead Structures

1. The attachment of pipelines to overhead structures owned by the Turnpike is not permitted, and any attachment requests must be reviewed and approved by the Commission's Bridge Department. If a Utility requests to attach a pipeline to a Turnpike owned structure, the Utility will be required to provide 2 estimates, 1 for attachment to the structure and 1 to cross the Turnpike off the structure (underground)

for comparison purposes. The Utility will also be asked to provide load analysis calculations for attachment consideration.

2. For overhead structures whose ownership will be transferred to PennDOT, any attachment will need PennDOT approval.
3. All crossings, whether on Turnpike owned structures or structures being transferred to PennDOT, will require shut-off valves to be installed outside the Commission's right-of-way. In addition, a crossing agreement will be required which contains a "Loss of Revenue" clause for future coverage due to possible ruptures, leaks, etc.

13.3 Railroad Coordination

Projects involving Railroad crossings will require coordination with the Railroad and the PUC and should follow the process outlined in the PTC DOM.

Chapter 14 - ITS DEVICES AND FIBER OPTIC INFRASTRUCTURE

14.0 Introduction

The intent of this section is to clarify the Commission's objectives for the installation, upgrade, or relocation of ITS and fiber optic infrastructure in total reconstruction projects.

All total reconstruction projects will include permanent fiber optic infrastructure and connection to existing, new, and future ITS infrastructure and facilities (maintenance sheds, access gates, administration buildings, etc.).

14.1 General

ITS and fiber optic infrastructure are managed by two different departments at the PTC. As a result, timely coordination with the correct department is critical:

- **ITS:** ITS infrastructure is managed by the Traffic Operations department. Contact the Manager of Incident Management and Traffic Operations for all ITS infrastructure inquiries. This includes Changeable Message Signs (CMS) (formerly known as Dynamic Message Signs or DMS), Closed Circuit Television (CCTV) traffic cameras and Roadway Weather Information Systems (RWIS), etc. Fiber optic infrastructure is used by the PTC as a communication medium between an ITS device and the PTC's enterprise network.

- **Fiber:** Fiber optic infrastructure is managed by the Information Technology (IT) department. Contact the Manager of Transportation Technology and Communications for all fiber optic infrastructure inquires.

  There are four types of fiber optic infrastructure that can be encountered along the roadway – PTC backbone fiber, PTC owned commercial fiber, PTC distribution fiber, and fiber optic laterals. Backbone, commercial, and distribution fiber will all be found collocated within the shoulder of the roadway, or aerial in a temporary condition along the roadway. Fiber optic laterals are defined as the fiber optic cables that connect devices or other roadside infrastructure to the distribution fiber network or to a wireless antenna. Fiber optic laterals also include fiber optic cables that connect the commercial fiber optic network to non-PTC commercial assets outside of the PTC right-of-way.

Refer to the PTC's ITS Project Management Manual for design preferences on the permanent fiber optic laterals (or campus fiber) as well as ITS devices. The Traffic Operations department maintains an ITS Project Management Manual. Contact the Manager of Incident Management and Traffic Operations for the latest version of the manual.

Refer to the PTC PM for standards, specifications and guidance on how to prepare the bid documents for areas with existing fiber either in the shoulder or aerially.

14.2 ITS Infrastructure

A. ITS Overview

Projects may include the installation, upgrade, or relocation of CMSs, CCTV, RWIS, or other devices. At the start of each project, determine if there are any existing ITS devices within the project limits and coordinate with the Manager of Incident Management and Traffic Operations to determine the specific ITS needs for the project.

For simplicity and ease of review, include ITS plans (includes ITS and fiber optic infrastructure) as an "Also Plan" to the overall project plan set.

Existing fiber optic infrastructure and ITS as-builts should be obtained and verified in preliminary design.

ITS standard special provisions can be acquired from the Manager of Incident Management and Traffic Operations.

B. Miscellaneous

Existing ITS infrastructure may need to be maintained during construction (CMS, CCTV, RWIS). Consideration should be given on how this can be accomplished, and it may require deviation from the guidelines.

14.3 Fiber Infrastructure

A. Overview

All total reconstruction projects are to include the installation of fiber infrastructure within the future shoulder. The PTC is developing standard details and special provisions for Fiber Infrastructure. Contact the PTC Engineering PM for standards, specifications, and guidance on how to prepare the bid documents for areas with existing fiber either in the shoulder or aerially.

The PTC Design/Build Fiber Optic Network will consist of the Mainline (east and west), Beaver Valley Expressway I-376, Amos K. Hutchinson Bypass TPK-66, and the Northeast Extension. The PTC has an entity, Plenary Broadband Infrastructure (Plenary), on board for operation, maintenance and commercialization of this infrastructure once built. Plenary is the only entity authorized to connect ITS devices to the distribution cable.

Some of the Fiber Optic Network was or will be installed in the existing shoulder and others aerially at the back edge of shoulder if they will be impacted by a future impending Total Reconstruction Project. In areas where the fiber was installed aerially, the poles will need to be moved during construction to facilitate the total reconstruction. The location of the new poles should be included in the project and the environmental permits should include the location of the temporary poles.

The PTC coordinated with Plenary on how the existing Fiber, temporary relocation of Fiber and permanent location of Fiber should be handled in the contract bid documents for Total Reconstruction Projects for existing aerial Fiber. The bid documents will be reviewed to determine if they should be altered for future projects and how they would apply to projects that encounter underground Fiber within the existing shoulder.

B. HDPE Microduct Conduit

The PTC is intending to have a consistent fiber infrastructure system across the entire Turnpike. The PTC is utilizing 8-way HDPE 16 mm/12 mm MicroDuct conduit bundle with an integrated #16 AWG tracer wire. The conduit bundle must be uniform and color specific. The size of the ducts is specific to the fiber being utilized, so that it can be easily blown through once the fiber is constructed.

The PTC does not have a preference for what side of the road the conduit should be on if there is a compelling reason to cross the fiber from one side of the road to the other. However, this should be avoided as it would be more difficult to maintain (lane closures in both directions) and more difficult for future projects requiring excavation of drainage, etc. Keep in mind that ITS devices may require fiber for the ITS device itself to cross the road.

C. Microduct in Galvanized Steel Conduit

When crossing bridges and installing fiber optic cable to structures, use 4-inch galvanized steel conduit through a 5" sleeve in the backwall. Supports should be spaced no more than 12 feet 6 inches apart. Continue the galvanized steel conduit beyond the approach slabs to the first underground junction box.

D. Junction Boxes

Since the Fiber Infrastructure is required in the shoulder, the PTC modified the standard junction box details. A delineator post should mark the stub out from the junction box. The junction box will require flowable backfill for compaction purposes.

E. Temporary Fiber Relocation

The Operation, Maintenance and Commercialization Entity (Plenary) will be involved in the temporary fiber relocation (during construction). Design/Build requirements were developed for the Contractor that allows the Contractor flexibility during construction, but still meets the needs of the Turnpike. Plenary will handle moving existing aerial fiber to the Contractor built temporary pole locations. This work will be restrictive in the sense that the Contractor must allow room for Plenary to complete their work. Currently, Plenary prefers to relocate no more than a minimum of 1 mile per mobilization and their production rates are about 1,500' per day. The Contractor may not cross the mainline with the temporary fiber relocation. Once the permanent fiber microduct is installed in the future shoulder, Plenary will blow fiber through. However, they will not utilize this fiber until the project is close to complete and traffic is no longer running on the shoulder. This is due to needing access to the fiber during construction in the event repair and/or

maintenance is required. For this reason, the temporary fiber relocation must be active for the entirety of construction. To the greatest extent possible, construction phasing should enable Plenary to install the permanent fiber optic cable in the microducts behind barriers to enhance safety and to maximize the distances between splices.

Chapter 15 - ENVIRONMENTAL ISSUES, PERMITS, AND MITIGATION

15.0 General

Design to avoid and minimize impacts to environmental resources to the extent practical. This includes, but is not limited to, mimicking existing drainage characteristics and minimizing impacts to wetlands, streams, floodways and floodplains (e.g. steepen slope to avoid/minimize permanent impacts) in accordance with the applicable regulations. Justification for impacts to resources may need to be provided in the permitting process and factors to consider include excessive cost, right-of-way issues, safety, constructability, etc. The location and feasibly of Stormwater Control Measures (SCM) and construction needs to be planned for early in the design process to ensure success. Coordinate with the assigned PTC Environmental Liaison early in the design process.

15.1 Department of Environmental Protection (DEP)

The PTC established a Memorandum of Understanding (MOU) with Pennsylvania Department of Environmental Protection (DEP) in 2019. The MOU moved the processing of all Chapter 102, Chapter 105, and Chapter 106 permit applications from their Regional Offices to PADEP's Regional Permit Coordination Office (RPCO). RPCO staff are responsible for coordination of those permit applications and for associated matters for the Turnpike Commission. County Conservation Districts (CCDs) still review and process Chapter 102 permit applications in accordance with their delegation agreements with DEP. This generally includes processing and authorizing General NPDES permits and reviewing components of the Individual NPDES permits.

In current DEP applications, there is a section requesting 'Compliance History'. Complete this section with input from the assigned PTC Environmental Liaison or the Planning and Environmental Manager for the latest status on this matter.

15.2 Chapter 105

Per 25 PA Code Chapter 105, authorization is needed for any structure or activity that changes, expands, or diminishes the course, current, or cross section of a watercourse, floodway, or body of water.

Certain Chapter 105 activities may be waived and approval from DEP is not required. However, consult with the PTC Environmental Liaison to determine if coordination or confirmation from DEP is warranted. Typically, PTC wants documentation of DEP concurrence for waived activities.

The PA Turnpike's E22-9995 Generic Maintenance Permit is not common but may be applicable general maintenance of older bridges for which there is no permit of record. Generally, activities are limited to channel cleaning, minor pier and abutment repairs, superstructure maintenance, and superstructure replacement that does not alter the hydraulic opening. Replacement of over 50% of a structure does not qualify as

maintenance. Coordinate with a PTC Environmental Liaison to determine if our Generic Maintenance Permit is applicable.

15.3 Submerged Lands Licenses Agreements

The Commission is not subject to Submerged Lands License Agreements (SLLA) associated with Chapter 105 authorizations. The following language can be used to demonstrate such: "The Pennsylvania Turnpike Commission is an instrumentality of the Commonwealth created by Act 211 of the Pennsylvania General Assembly on May 21, 1937."

15.4 U.S. Army Corps of Engineers (USACE) – Section 404 Permits

The Corps also has regulatory responsibility for potential impacts to waters of the U.S and wetlands. The Turnpike system passes through three (3) different USACE Districts: Philadelphia, Baltimore and Pittsburgh. Permitting for most projects will be through the Joint Permit Application which is coordinated via DEP's RPCO.

The PTC executed a Memorandum of Understanding (MOU) with the USACE in July 2024. The MOU ensures a consistent contact for each of the three (3) USACE Districts, who will review the Commission's applications.

Coordinate with the assigned PTC Environmental Liaison early in the design process and for the appropriate USACE contacts.

15.5 Water and Wetlands Mitigation

Water and Wetland mitigation may be required for DEP and/or USACE permits. The Commission's preferred method of mitigating for impacts to waters and wetlands is to participate in the Mitigation Banking process that is overseen by the DEP and UASCE.

15.6 Chapter 106

Per 25 Pa Code Chapter 106, authorization is needed to construct, modify, remove, destroy or abandon a highway obstruction or an obstruction in a floodplain. The Commission may need Chapter 106 authorization for work located in a floodplain. Coordinate with the environmental liaison.

15.7 Chapter 102

Per 25 PA Code Chapter 102, authorization is needed for certain earth disturbance activities. Even if a permit/authorization is not required, PTC requires all projects involving earth disturbance require an Erosion and Sediment Control (E&S) plan to be developed and implemented.

General NPDES (PAG-02) permit registrations and Individual NPDES applications are reviewed and processed by County Conservation Districts (CCDs) in accordance with

their DEP delegation agreement and by RPCO on behalf of DEP, if applicable, per the DEP MOU.

The General Notes on the E&S/NPDES plans need to include information about locating the Commission owned utilities in addition to PA One Call. The following language should be added to the PA One Call note(s): "The Contractor must also contact the PTC Project Representative, providing a fourteen (14) day notice, for locating PTC utilities utilizing the Utility Management Application (UMA), and notify the District Fare Collection Manager, providing a three (3) day notice, when working near an interchange."

If a project includes Road Maintenance Activities (RMA), for concurrence on plans, the NPDES Permit Boundary needs to be clearly defined and include the entire project site. For a multiple phase/multiple year project, the NPDES Permit Boundary, right-of-way line and easement lines should be coincidental. Use engineering judgment for all other projects. The Design Consultant will be responsible for preparing and submitting the NPDES Permit Package. The NPDES Permit Package will consist of a complete NPDES Permit Application and Checklist, a completed Conservation District Review Application, the General Information Form (GIF), Act 14, 67, 68, and 127 letters, PHMC approval letters, a U.S.G.S Topographic Map Section 1" = 2000' with coordinates showing the location of the project, and copies of up-to-date PNDI Receipt and any associated Agency clearance letters. In general, the Commission will be the applicant and the Assistant Chief Engineer – Design will sign for the permits. Upon award of the construction contract, the Contractor(s) will become Operator Co-Permittees. The specific requirements of Design-Build projects may vary.

There are review fees for Chapter 102 applications/registrations. However, the Commission is exempt from fees per Chapter 102.6(b)4. Conservation Districts may also charge additional fees according to the Conservation District Law. The Commission in coordination with the PA Association of Conservation Districts, established a uniform fee structure within the counties through which the Turnpike traverses and executed agreements with each County. Per the agreements, the Commission will pay the County Conservation District (CCD) $150 per disturbed acre (rounded to the nearest acre) for the review of Erosion and Sediment Control Plans and Post Construction Stormwater Plans submitted to the CCD.

15.8 Pre-application Meetings

A pre-application meeting must be held prior to the submittal of a DEP Chapter 105, 106 and/or 102 application with RPCO and/or the appropriate County Conservation District (CCD). The application materials should then be revised based upon any comments the Agencies may have and be submitted promptly following the pre-application meeting. The Design Consultant will contact the environmental liaison to coordinate the appropriate CCD and/or RPCO meetings. The PTC has scheduled meeting hold dates with DEP and the USACE.

15.9 Other Agency Coordination

In addition to the agencies mentioned in the previous sections, coordination and/or authorizations may likely be necessary with a number of other agencies, including, but not limited to the following:

- Pennsylvania Fish and Boat Commission (PFBC)
- Pennsylvania Department of Conservation of Natural Resources (DCNR)
- Pennsylvania Game Commission (PGC)
- US Fish and Wildlife Service (USFWS)
- Pennsylvania Historical and Museum Commission (PHMC)
- Pennsylvania State Historic Preservation Office (SHPO)

Coordinate with the PTC Environmental Liaison on matters dealing with any of the other agencies.

Chapter 16 - STORMWATER MANAGEMENT

16.0 Introduction

The regulation of stormwater discharges (i.e., the Post Construction Stormwater Management (PCSM) section of 25 PA Code Chapter 102, including NPDES permits), requires the use of sound stormwater management practices during construction and development.

16.1 Drainage Design Criteria

A. General

Primary References

1. PTC's 'Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designers Scope of Work'. See Appendix L.
2. Commonwealth of Pennsylvania, Pennsylvania Department of Transportation (PennDOT) Design Manual Part 2, Highway Design, Publication 13M, Chapter 10, Drainage Design, and Related Procedures, Latest Edition, Design Manual Part 3, Plans Presentation, Publication 14M, Chapter 6, Contour Grading and Drainage Plans and Erosion and Sediment Pollution Control Plans, Latest Edition.
3. Commonwealth of Pennsylvania, Pennsylvania Department of Transportation (PennDOT) Publication 584, PennDOT Drainage Manual Chapters 12, Erosion and Sediment Pollution Control, Chapter 13, Storm Drainage Systems, and Chapter 14, Post Construction Stormwater Management, Latest Edition
4. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Pennsylvania Code Title 25, Chapter 102 and Chapter 105.
5. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Erosion and Sediment Pollution Control Manual, Latest Edition.
6. Commonwealth of Pennsylvania, Department of Environmental Protection (DEP), Pennsylvania Stormwater Best Management Practices Manual, Latest Edition.
7. HEC – 22 Urban Drainage Design Manual
8. Commonwealth of Pennsylvania, Department of Transportation (PennDOT), Standards for Roadway Construction (RC), Latest Edition.
9. Pennsylvania Turnpike Commission Standards (PTS), Latest Edition.
10. United States Department of Agricultural (Natural Resources Conservation Service), Web Soil Survey.

B. Storm Drainage

1. Hydrology for stormwater analysis and as needed for NPDES permit and/or local governing storm ordinance.

a) Runoff factors should follow Design Manual 2, Chapter 10, Table 10.2.1 or local governing storm ordinances if the ordinances are more stringent for the design and approval by the necessary regulatory agencies.

b) Design storm frequency:

- For temporary conditions use the 5-year, 24-hour storm event when in a HQ/EV watershed. Otherwise, use the 2-year, 24-hour storm event.
- For permanent conditions use the 10-year, 24-hour storm event for conveyance features, at a minimum.

16.2 Stormwater Management

A. Stormwater Management Ordinances

Stormwater Management Ordinances should be met according to the regulations as described below and in Section 7.2.B.1. A matrix comparing these Ordinances should be prepared and submitted to the PTC PM. This matrix will show the requirements and any discrepancies between a through c below, at which point the Commission can make a decision on the criteria to follow. It is possible for a job to pass through multiple municipalities and Act 167's.

a) Municipal Ordinance (City/Township/Borough)
b) Approved Act 167 Plan
c) DEP Chapter 102 regulations

B. Act 167 Plans and Municipal Ordinances

The Commission should be consistent with the standards of watershed-based stormwater management plans approved and implemented under the Stormwater Management Act (1978 Act 167); The Commission strives to maintain good relations with local municipalities and, at the Commission's discretion will comply with local ordinances when feasible and practicable. It is the intent of the Commission to submit the Post Construction Stormwater Management Plan (PCSM Plan) to each municipality for their review. The Design Consultant will request a Stormwater and Floodplain Consistency letter from the municipality for inclusion in the Joint Permit Application and NPDES Permit Application. If after significant coordination, the local municipality will not provide the requested Consistency letter, then the Design Consultant will submit to DEP appropriate correspondence documenting said coordination efforts in lieu of the Consistency Letter.

If there is no Act 167 plan or municipal ordinances, follow DEP Chapter 102 regulations.

C. Anti-degradation

Four (4) key measures are used to assess the potential for impacts from stormwater runoff – volume, rate, thermal impact and water quality. The goal of the PCSM Plan is to prevent or minimize any increase in the quantity (rate and volume) of runoff while also minimizing the factors affecting the water quality and thermal.

impact. The best way to achieve antidegradation is to mimic the natural, pre-development hydrologic conditions, which are usually dominated by infiltration and

evapotranspiration. This is a two-fold solution because stormwater management strategies that address quantity normally also address water quality and thermal impact.

D. PCSM Plans

Often the linear nature of highway projects could limit viable options for size, as well as rate and volume reduction. Therefore, it is also important to have a combination of strategies that reduce the amount of runoff being generated. Serious consideration must be given to the property impacts that occur due to meeting the requirements and it is possible that a balance between criteria and property impacts must be evaluated. It is important that the Designer develop plans to a sufficient level of detail that can be coordinated early with the regulatory agencies and municipalities before being presented to the public; therefore, it is important to coordinate early with regulatory Agencies and municipalities. A windshield study, or desktop evaluation of secondary sources, in preliminary design may aid the design by identifying any limiting factors. The Commission does not want to present a stormwater plan to the public that will require significant changes in final design. The design must also consider access for long-term maintenance.

For PCSM guidelines, refer to DEP's Pennsylvania Stormwater Best Management Practices Manual, Latest Edition. It is the intent of the Commission to use similar SCMs and materials for ease of maintenance and as such, the design of these facilities should be coordinated with the PTC Post Construction Stormwater (PCSM) Liaison. Specifically, a post construction SWM scoping meeting can be combined with the same meeting referenced under drainage at the beginning of final design. This meeting should occur at the beginning of final design and be scheduled with the design team including the PTC Environmental Department and PCSM Liaison to finalize the SCM type, maintenance access, etc. The team will be able to provide current information on PTC SWM design and possibly provide an NPDES example and set of plans to follow. Once developed and 60 days before they are submitted to the Agencies, the NPDES application package, including Reports and Plans, should be submitted to the PTC PCSM Liaison and Environmental Liaison for approval. Submit a copy of the approved PCSM application package, including report and plans, in Kahua and notify the PTC PCSM Liaison and Environmental Liaison once the NPDES authorization is issued.

In general, the County Conservation District (CCD) will review the NPDES permit application package for completeness to make sure that all elements required have been submitted. Based on the CCD delegation, the CCD and/or DEP will review the application. DEP review and processing will be done by DEP's Regional Permit Coordination Office (RPCO) per DEP and PTC's MOU.

A SCM Summary table shall be included in the PCSM Plan in order to assist with completing the SCM Construction Certification. The table shall include the following information for each SCM: SCM ID No, SCM Name, Municipality(s) and County(s) in which the SCM is located, Latitude and Longitude of the SCM centroid, Overall Drainage Area to the SCM in acres, Impervious Area contributing to the SCM in acres

and if infiltration credit is taken for the Volume Management. Please see Table 16.2.1 Below for a sample table.

TABLE 16.2.1 Sample SCM Summary Table

SCM ID No.	SCM Name	Municipality(s)	County(s)	Latitude of SCM Centroid	Longitude of SCM Centroid	Drainage Area (Acres)	Impervious Area (Acres)	Infiltration Credit Taken for Volume Management (Yes/No)

A peak flow control summary shall be included in the PCSM Plan, including summary tables of hydrologic parameters and pre and post-development peak discharges. It is the intent of the Commission to manage stormwater per the criteria where practical and feasible. Under Chapter 102.8.g(2)(ii), the PTC is not required to consider the existing impervious area within the existing roadway cross section as meadow in good condition for volume and water quality analysis (PennDOT Pub 584, Chapter 12, Appendix E for guidance on defining the roadway cross section). If a local ordinance is more stringent, the PTC should coordinate with the municipality.

If these criteria cannot be fully met, then all appropriate documentation shall be included in the PCSM Plan for review and concurrence by the County Conservation District and DEP's Regional Permit Coordination Office.

A PCSM Plan must be included with the NPDES Permit application submittal as a separate document and shall document all permanent stormwater control measures (SCMs). It should not be incorporated into the erosion and sediment pollution control plan and narrative. However, the development of both plans as well as any Chapter 105 application should be closely coordinated.

E. Permanent Stormwater Control Measures

1. All Stormwater Control Measures are to be identified in the contract documents in accordance with the PTC Stormwater Control Measure (SCM) Identification Guidelines, see Appendix I.
2. Site specific soil analysis and infiltration testing needs to be performed in accordance with the PTC's 'Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designers Scope of Work'. See Appendix L. If site conditions prohibit infiltration (i.e. shallow bedrock, karst geology, shallow groundwater, etc.), then specific information from the Subsurface Exploration Planning Submission (SEPS) should be included to document these constraints. Infiltration testing should not occur prior to a public meeting.
3. See the following Figures 16.2.1 for general guidelines for all permanent stormwater control measures requires fencing, use Type 1 Right-of-way Fence, per RC-60M, around the perimeter of the stormwater management facility with a Vehicular Access Gate (swing gate). Install the gate where the access drive meets the fence. It should

be noted that if a facility is in a populated area, the Commission would consider alternative fencing types.

4. If a stormwater control measure is within Commission right-of-way and Commission right-of-way is fenced, then no fencing around the stormwater control measure is required.
5. Provide maintenance access to each stormwater control measure. This access may be via an access drive at the end of the guide rail run beyond the stormwater management facility, as indicated herein, or by other means which do not require the construction of the formal access drive. The access drive will not be behind a guide rail whereby the guide rail needs to be removed in order to access the SCM. All proposed access to the stormwater control measures shall be reviewed and discussed with the PTC PCSM Liaison during the initial discussion of their locations.
6. Provide a minimum 10-foot-wide berm around the perimeter of the stormwater management facility.
7. Use 10-inch minimum depth of 2RC Aggregate around the top of the berm.
8. Use 10-inch minimum depth of 2RC aggregate for access drives with grades less than 6 percent. Pave the access drive with six (6) inches of subbase and four (4) inches of binder for access drives with grades of 6 percent or greater.
9. Mosquito issues should be considered during the design of a stormwater control measures.
10. Design stormwater control measure following review of the local stormwater ordinances and with an aesthetic approach to the final look, particularly when the facility will be highly visible.
11. Designers should attempt to avoid detention basins that require jurisdictional dam permits per DEP regulations, see Section 16.1.A.2.
12. Access drive desirable width is 15 feet and minimum width is 12 feet.
13. The desired radius off the mainline is 50’ and the minimum is 40’.
14. Provide correct grading at the connection of the access drive to the mainline. Maximum side slopes of 6:1 are required within the clear zone.
15. Provide guide rail as required by current design criteria.
16. Use sediment forebays for all Rain Gardens/Bio-Retention and Permanent Basins (See Figure 16.2.3).
17. Construction vehicles should not be permitted to traverse across the SCM area.
18. Any amended soil mix used for any SCMs will follow the PTC Stormwater Control Measure Amended Soil special provision.
19. Use the PTC SCM Final Surface Preparation Special Provision for all SCMs.
20. Use SCM Plantings List as a recommended guide for all SCMs requiring plant material.
21. Use the Critical Stages Checklist – The checklist needs to be filled out by the designer indicating the Critical stages of the SCM Installation. Provide Critical Stages Checklist, Critical Stages Flow Chart, and the Critical Stages of BMP/SCM Installation special provision for the contract documents.
22. Use the Stormwater Control Measures (SCM) Construction Tolerances special provision for all SCMs.

23. For sediment basin and trap conversion to a permanent stormwater basin, use the PTC Sediment Basin or Trap Conversion to Permanent Stormwater Management Basin special provision.

F. SCM Plantings List

Plantings for SCMs, including bioretention basins and rain gardens, are importance as they are necessary for the SCM to function as designed. Species that meet the site conditions needed to be utilized to maximize success (e.g. salt tolerant when roadside). For SCMs, consider utilizing an appropriate native seed mix and/or plants, which includes herbaceous species with a deeper penetrating root system. Individual plants, trees, and shrubs should only be used in an SCM after the approval of the Environmental Liaison. Consult with your Environmental Liaison for additional guidance on your specific project.

For plant recommendations, refer to the following resources:

1. The plant list the Philadelphia Stormwater Guidance Manual - Appendix I: Plant Lists (as amended);
2. The plant list from PADEP's Draft Stormwater Manual – Appendix I: Vegetation For Use in Stormwater Management (and as amended when Finalized); or
3. Other Resources with equivalent native species.

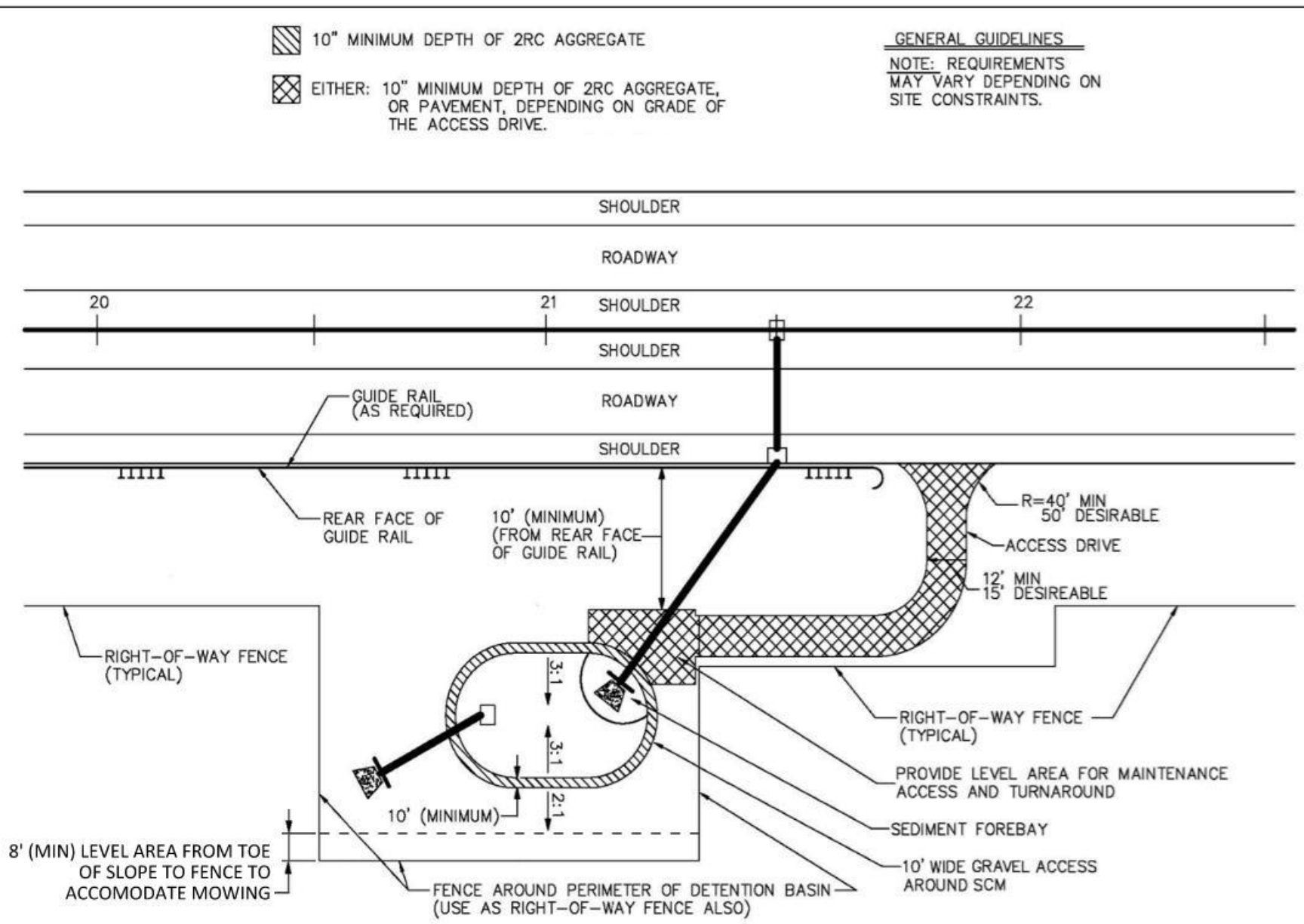


FIGURE 16.2.1

PLAN FOR TYPICAL ROADSIDE SCM LAYOUT WITH ACCESS

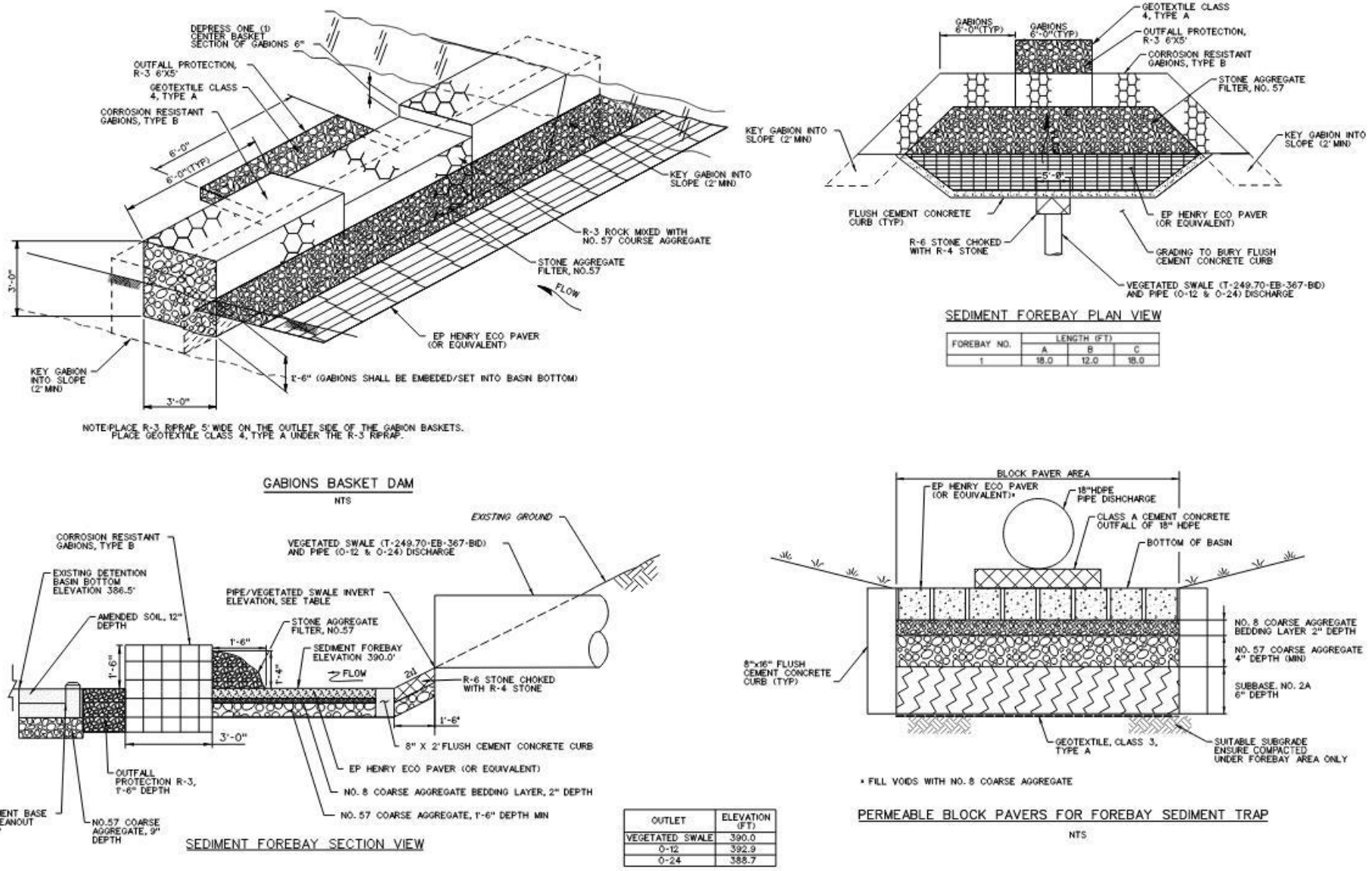
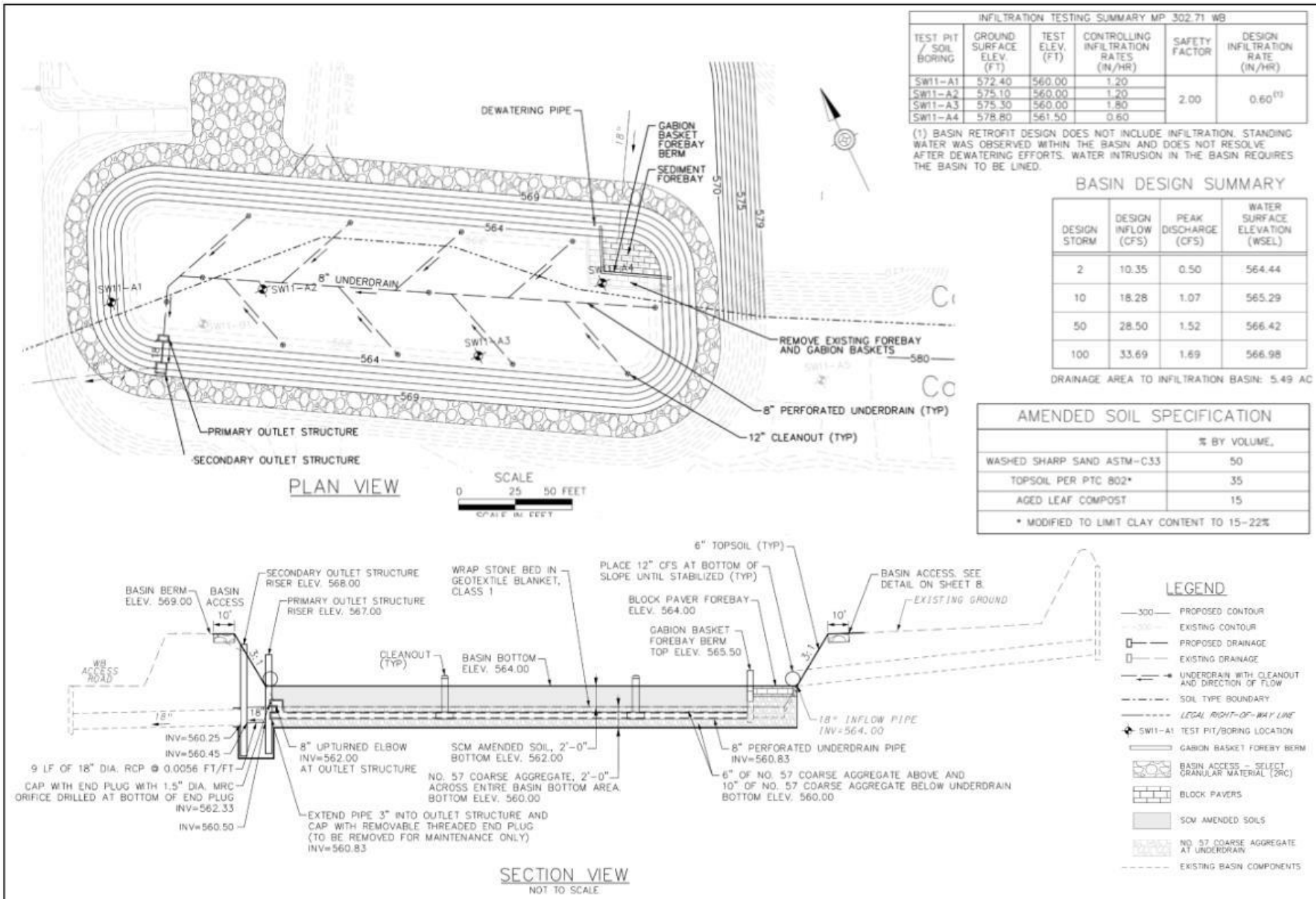


FIGURE 16.2.2

SEDIMENT FOREBAY SAMPLE PLAN



INFILTRATION TESTING SUMMARY MP 302.71 WB

TEST PIT / SOIL BORING	GROUND SURFACE ELEV. (FT)	TEST ELEV. (FT)	CONTROLLING INFILTRATION RATES (IN/HR)	SAFETY FACTOR	DESIGN INFILTRATION RATE (IN/HR)
SW11-A1	572.40	560.00	1.20	2.00	0.60[1]
SW11-A2	575.10	560.00	1.20		
SW11-A3	575.30	560.00	1.80		
SW11-A4	578.80	561.50	0.60		

(1) BASIN RETROFIT DESIGN DOES NOT INCLUDE INFILTRATION. STANDING WATER WAS OBSERVED WITHIN THE BASIN AND DOES NOT RESOLVE AFTER DEWATERING EFFORTS. WATER INTRUSION IN THE BASIN REQUIRES THE BASIN TO BE LINED.

BASIN DESIGN SUMMARY

DESIGN STORM	DESIGN INFLOW (CFS)	PEAK DISCHARGE (CFS)	WATER SURFACE ELEVATION (WSEL)
2	10.35	0.50	564.44
10	18.28	1.07	565.29
50	28.50	1.52	566.42
100	33.69	1.69	566.98

DRAINAGE AREA TO INFILTRATION BASIN: 5.49 AC

AMENDED SOIL SPECIFICATION

	% BY VOLUME
WASHED SHARP SAND ASTM-C33	50
TOPSOIL PER PTC 802*	35
AGED LEAF COMPOST	15
* MODIFIED TO LIMIT CLAY CONTENT TO 15-22%	

FIGURE 16.2.3

MANAGED RELEASE CONCEPT (MRC) SAMPLE PLAN

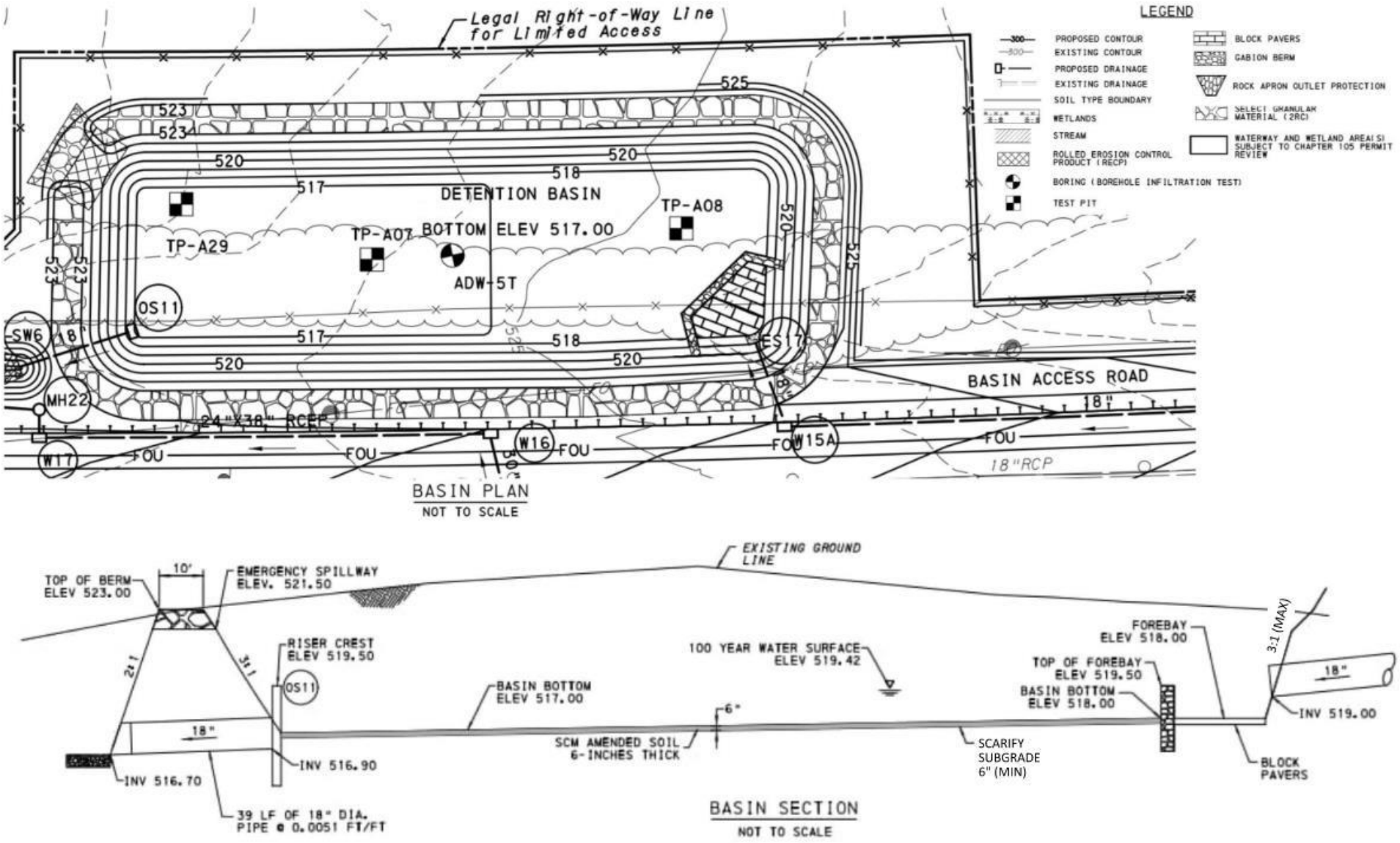


FIGURE 16.2.4

DETENTION BASIN SAMPLE PLAN AND SECTION

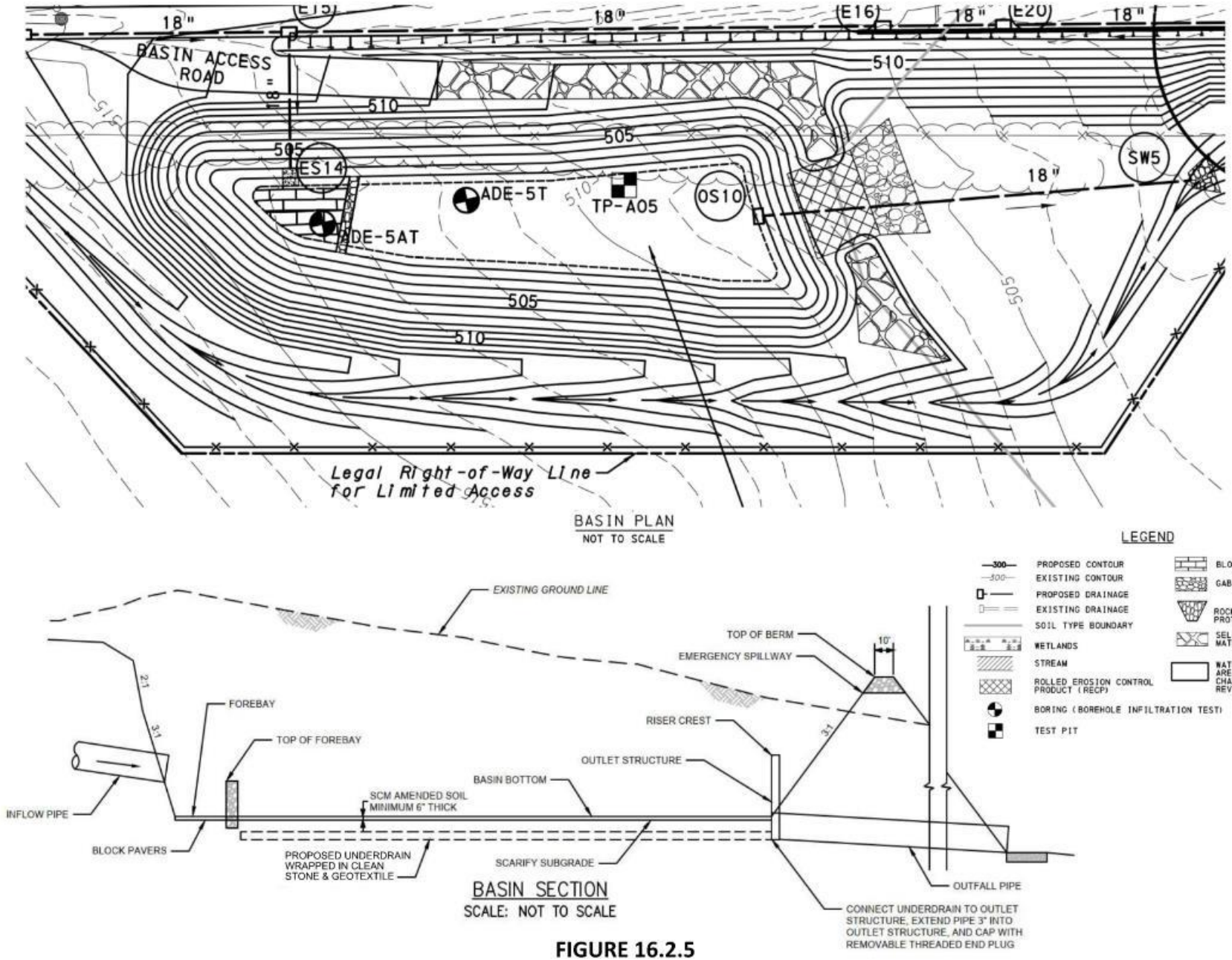
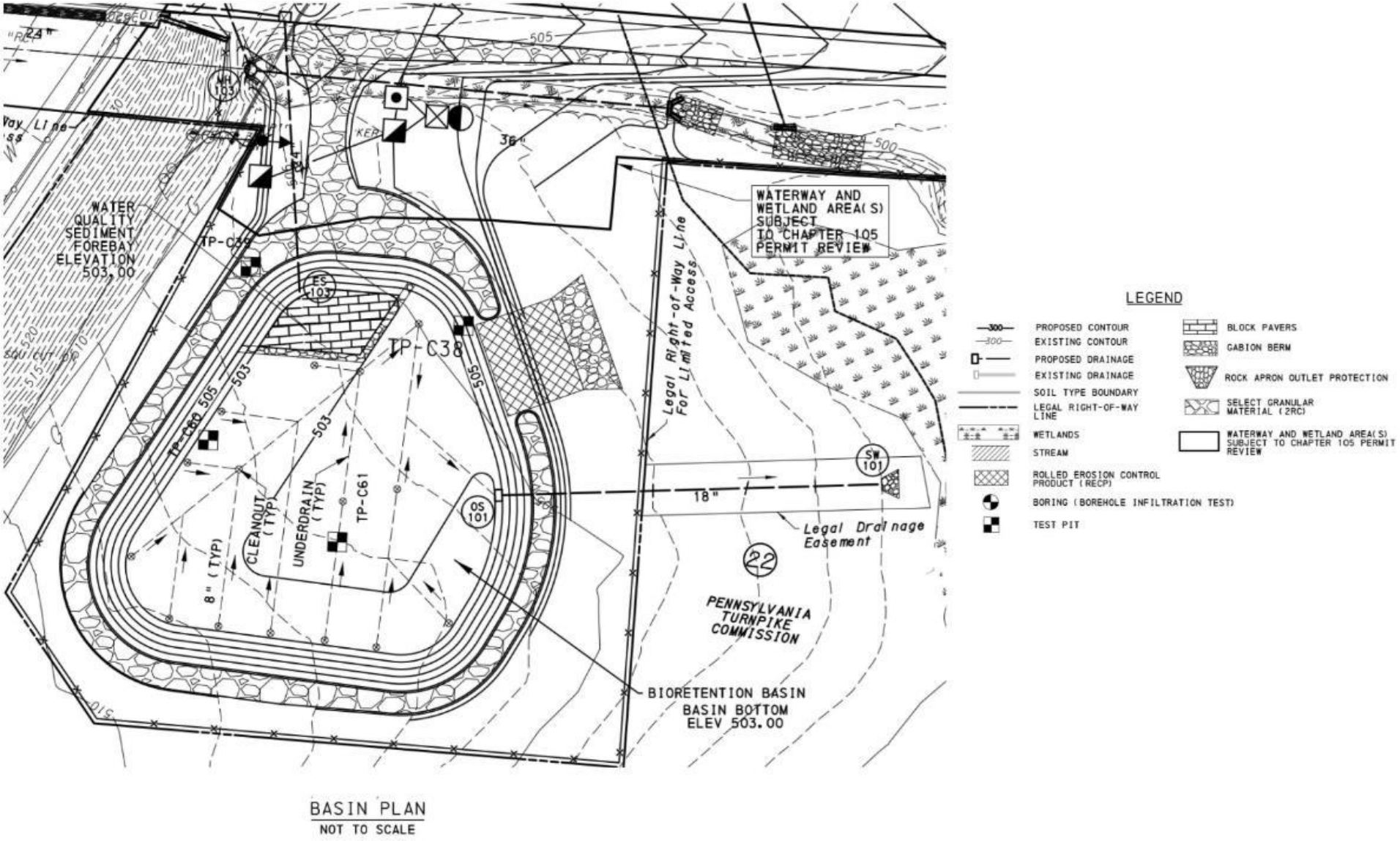


FIGURE 16.2.5

INFILTRATION BASIN SAMPLE PLAN AND SECTION



BASIN PLAN
NOT TO SCALE

FIGURE 16.2.6

BIORETENTION BASIN SAMPLE PLAN

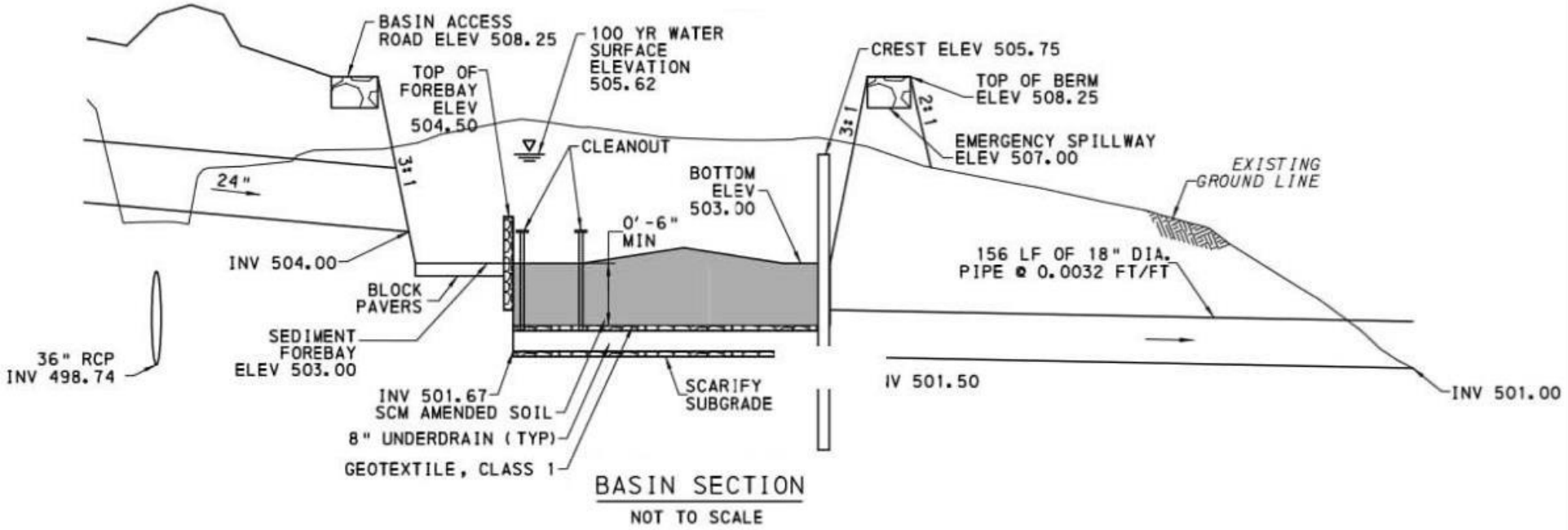


FIGURE 16.2.7

BIORETENTION BASIN SAMPLE SECTION

Chapter 17 - ROADSIDE DEVELOPMENT

17.0 Permanent Pull-off Areas

No permanent pull-off (parking) or stopping areas will be designed into Total Reconstruction projects. All existing pull-off and stopping areas are to be eliminated.

17.1 Landscape Planting

Landscape planting plans, when required, are to be prepared by the consultant and coordinated with the PTC Environmental Liaison. Complete utility coordination in accordance with Chapter 13. In addition, ensure required Clear Zones and proper sight distances are provided.

Typically, landscape planting should not be included as a lump sum item in the construction contract.

17.2 Tree Trimming and Clearing

Generally, the PTC has been attempting to clear trees along the existing Turnpike to improve safety. Most total reconstruction projects require the removal of trees within the right-of-way. If trees are not to be removed, the Designer should include this information on the roadway plans.

Due to the possible presences of Threated and/or Endangered Species a project may require a tree cutting restriction. Depending on the timing of the project, the PTC may complete tree felling in advance under a separate contract. This should be discussed 2 years prior to when the tree removal is required as the PTC may have to bid a tree removal contract.

A contract special provision shall be included to perform any required clearing beyond the specified limit of disturbance. Clearing and grubbing item typically includes removal of the felled trees when felling is completed in advance.

17.3 Topsoil

All disturbed areas within the project limits, including all slopes flatter than 2:1 are to have a minimum of 6-inches of topsoil placed prior to seeding. Please review the PTC CS's for clearing and grubbing and topsoil as the PTC uses a different method for payment than PennDOT.

Chapter 18 - SPECIFICATIONS, ITEM NUMBERS, QUANTITIES AND COST ESTIMATING

18.0 Introduction

The intent of this section is to clarify the Commission's use of specifications, formatting of quantities and cost estimating procedures.

18.1 Specifications

A. General

1. For all projects except for facilities projects, specifications consist of the following:

    - PennDOT Publication 408;
    - Commission Specifications (CS-XXX);
    - Commission Standard Special Provisions; and
    - Non-Standard Project Specific Special Provisions

2. For facilities projects (multi-prime contracts), specifications consist of the following:

    - PennDOT Publication 408;
    - General Provisions for Facility Projects;
    - Commission Standard Special Provisions; and
    - Non-Standard Project Specific Special Provisions

B. PennDOT Publication 408

In general, all work is to be performed in accordance with PennDOT Publication 408 unless replaced by a Commission Specification (CS-XXX) or General Provision for Facility Project or modified by a Special Provision.

C. Commission Specifications

Commission Specifications (CS-XXX) replace in whole the corresponding PennDOT Publication 408 Specifications section.

Commission specifications are never changed. They are only modified by project specific special provisions.

D. General Provisions for Facility Projects

General Provisions for Facility Projects replace in whole the corresponding PennDOT Publication 408 Specifications section.

General Provisions for Facility Projects are never changed. They are only modified by project specific special provisions.

E. Commission Standard Special Provisions

Commission Standard Special Provisions fall into two (2) categories: Categories A thru E and Category F. Each provision includes a date following the title. When a Commission Standard Special Provision is used with no modifications, the date of that Special Provision is to be shown where indicated in the title in the spec book but not in the index.

Various Standard Special Provisions in Categories A thru E include different applications which are identified with an "*" and are typed in bold and italic lettering. These notes are to be removed by the designer/consultant prior to the provision being included in a spec book. The date of the Special Provision is to remain when text is modified to address designer notes.

Various Standard Special Provisions in Category F contain notes to designers marked with an "*" and are typed in bold and italic lettering or have left space or XXXX for project specific information to be added. These notes are to be removed, spaces are to be filled in, and the underline removed (if it exists), prior to the provision being included in a spec book.

1. Categories A thru E (no modifications)

   When a Commission Standard Special Provision in Categories A thru E is used with no modifications, that Special Provision along with the date of the Special Provision is included in the spec book. Deletion of information not relevant to the given project does not constitute a modification as long as the remaining information is not revised. As previously noted, the date of the Special Provision is only shown where indicated for the Special Provisions in the spec book; it is not shown in the index.

2. Categories A thru E (modified)

   When a Commission Standard Special Provision in Categories A thru E is modified, the Standard Special Provision is replaced with a Project Specific Special Provision and is included in the spec book as FXX.00. The date that was associated with the Commission Standard Special Provision is not used.

3. Category F (no modifications)

   When a Commission Standard Special Provision in Category F is used with no modifications, that Special Provision along with the date of the Special Provision is included in the spec book. Completion of the information in the blank or XXXX spaces where project specific information is to be added or deletion of information not relevant to the given project does not constitute a modification as long as the remaining information is not changed. The date of the Special Provision is only shown where indicated for the Special Provision in the spec book; it is not shown in the index.

4. Category F (modified)

   When a Commission Standard Special Provision in Category F is modified the item number associated with that Standard Special Provision is changed to 4XXX-XXXX and the date associated with the Commission Standard Special Provision is not shown. Completion of the information in the blank or XXXX spaces where project specific information is to be added or deletion of information not relevant to the given project does not constitute a modification as long as the remaining information is not changed in any way.

F. Category F - Non-standard Project Specific Special Provisions

Specifications in this category are those that are specific to a project and either modify a Commission Specification (CS), a Commission Standard Special Provision, a PennDOT Specification or do not relate to any of the above. They are included in Section F in the spec book. No dates are shown with these Special Provisions.

18.2 Item Numbers

A. General

The PennDOT and PTC Master Items list are used as a basis for establishing item numbers on a project. All item numbers appear on the Summary Sheet, Tab sheets, and in the Schedule of Prices in numerical order as if that item were in the PennDOT Master Items List, regardless of the first digit. Items proceeded by a 0 or 1 indicate that all work pertaining to that item is in accordance with PennDOT Publication 408. Items preceded by a 2 indicate that PennDOT Publication 408 has been modified by either a Commission Specification (CS) or a Commission Standard Special Provision. Items preceded by a 3 indicate that PennDOT Publication 408 has been modified by a non-standard project specific special provision. Items preceded by a 4 indicate that either a Commission Specification (CS) or a Commission Standard Special Provision has been modified by a non-standard project specific special provision.

The PTC Master Item List generally includes items frequently used in Commission contracts and may not be all-inclusive. If an item is needed in a project and all material, construction and payment are in accordance with a Commission Specification without any modification, Tab Wizard will allow the creation of a “standard” PTC item for the project.

In certain instances, the Commission has established standard item numbers for items covered by either a Commission Specification or Commission Standard Special Provision that do not appear in the PennDOT Master Items List. These items are identified in the PTC Master Item List and/or the Standard Special Provision.

B. PennDOT Publication 408

Work to be performed in accordance with PennDOT Publication 408 is shown on the Summary Sheet, Tab Sheets and in the Schedule of Prices with a standard PennDOT item

number. The reference on the Summary Sheet in the column headed “Specification Reference” is shown as 408.

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
0205-0100	13,666	CY	FOREIGN BORROW EXCAVATION	408	

C. Commission Specifications

When a Commission Specification (CS-XXX) is used, the item number to which that specification pertains is shown on the Summary Sheet, Tab Sheets and in the Schedule of Prices as 2XXX-XXXX and the reference on the Summary Sheet on the column headed “Specification Reference” is shown as CS. As an example, CS-350 “Subbase” and CS-1001 “Cement Concrete Structures” are Commission Specifications that replace in whole Sections 350 and 1001 in PennDOT Publication 408. When these Commission Specifications are used on a project, the items to which they pertain are shown on the Summary Sheet as:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
2350-0106	12,726	SY	SUBBASE 6" DEPTH (NO. 2A)	CS	
2001-0010	22	CY	CLASS A CEMENT CONCRETE	CS	

D. Commission Standard Special Provisions

The item number to be shown on the Summary Sheet, Tab Sheets and in the Schedule of Prices is the item number associated with that particular Special Provision. The reference on the Summary Sheet in the column headed “Specification Reference” is shown as SP.

For example, if Commission Standard Special Provisions AXX.00 “Construction Schedule”, B0X.00 “Construction Lighting”, FXX.00 “Temporary Traffic Signals” and FXX.00 “Underdeck Protection Shields” were applicable to a project and were to be used with no modification, they would be shown on the Summary Sheet as follows:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
2108-0001	---	LS	CONSTRUCTION SCHEDULE	SP	
2901-0202	10	EA	CONSTRUCTION LIGHTING	SP	
2901-1000	---	LS	TEMPORARY TRAFFIC SIGNALS	SP	
2090-0200	5,000	SF	UNDERDECK PROTECTION SHIELDS	SP	

There are instances where Standard Special Provisions incorporate materials that are required by the particular item of work but wholly provided by the PennDOT 408 and/or

Commission specification without materially revising the item. These items are identified within the Standard Special Provision as a standard PennDOT or Commission item number. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as 408 or CS.

E. Non-standard Project Specific Special Provisions

1. General

   Items in this category are those that are specific to a project and either modify a Commission Specification (CS), a Commission Standard Special Provision, a PennDOT Specification or do not relate to any of the above. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as SP.

   There are instances where Non-standard Project Specific Special Provisions incorporate materials that are required by the particular item of work but wholly provided by the PennDOT 408 specification without materially revising the item. These items are identified within the Standard Special Provision as a standard PennDOT item number. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as 408.

   There are also instances where non-Standard Special Provisions incorporate materials that are required by the particular item of work but wholly provided by the CS without materially revising the item. These items are identified within the non-Standard Special Provision as a standard CS item number. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as CS.

2. Modifications to Publication 408

   When a Publication 408 Specification is modified and there is no Commission Specification or Commission Standard Special Provision, it becomes a Non-standard Project Specific Special Provision and the item number will begin with a 3. The other 7 digits must match the PennDOT Master Items List. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as SP.

   For example, if it were necessary to modify the Publication 408 specification for mobilization to be job specific, the item number would be shown on the Summary Sheets as follows:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
3608-0001	---	LS	MOBILIZATION	SP	

3. Modifications to either Commission Specifications or Commission Standard Special Provisions

The item number associated with the Commission Specification or Commission Standard Special Provision is changed so that the first number comprising the item number is always a 4. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as SP.

For example, if Commission Specification CS-350 "Subbase" and Commission Standard Special Provisions AXX.00 "Construction Schedule", B0X.00 "Construction Lighting", and FXX.00 "Underdeck Protection Shields" were modified, they would be replaced with Non-standard Project Specific Special Provisions and included as FXX.00 "Subbase" FXX.00 "Construction Schedule", F0X.00 "Construction Lighting", and FXX.00 "Underdeck Protection Shields".

These items would be shown on the Summary Sheets as follows:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
4108-0001	---	LS	CONSTRUCTION SCHEDULE	SP	
4350-0106	12,726	SY	SUBBASE 6" DEPTH (NO. 2A)	SP	
4901-0202	10	EA	CONSTRUCTION LIGHTING	SP	
4090-0200	5,000	SF	UNDERDECK PROTECTION SHIELDS	SP	

4. Items that do not relate to any PennDOT or Commission Standard Specification

   All items in this category are shown on the Summary Sheet, Tab Sheet and in the Schedule of Prices as: 4000-XXXX. The reference on the Summary Sheet in the column headed "Specification Reference" is shown as SP.

   Examples of such items are:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
4000-0046	---	LS	EXPRESS E-Z PASS POWER SUPPLY	SP	
4000-0047	---	LS	UNINTERRUPTIBLE POWER SUPPLY	SP	
4000-0050	---	LS	DEMOLITION OF PORTION OF EXISTING TOLL PLAZA	SP	

F. Alternate Structure Items

If alternate structures are included with "either/and/or" line items, each like item of work for each structure must have a unique item number. This unique number may be associated with the alternate if the alternate provides for "and" items. This item must also be different than a like item that is not included in the "either/and/or" line items.

The following illustrates the proper item number assignment:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
1002-0001	28,000	LB	REINFORCEMENT BARS		
1002-0053	7,200	LB	REINFORCEMENT BARS, EPOXY COATED		
1002-0153	20	EA	MECHANICAL SPLICE SYSTEM FOR NO. 6 REINFORCEMENT BARS, EPOXY COATED		
EITHER: 4120-0001	---	LS	BRIDGE STRUCTURE AS DESIGNED, ABC-123		
AND: 1002-0114	104	EA	MECHANICAL SPLICE SYSTEM FOR NO. 7 REINFORCEMENT BARS		
AND: 1002-0152	628	EA	MECHANICAL SPLICE SYSTEM FOR NO. 5 REINFORCEMENT BARS, EPOXY COATED		
AND: 1002-1153	538	EA	MECHANICAL SPLICE SYSTEM FOR NO. 6 REINFORCEMENT BARS, EPOXY COATED		
AND: 1002-0180	50,395	LB	REINFORCEMENT BARS		
AND: 1002-0190	231,370	LB	REINFORCEMENT BARS, EPOXY COATED		
AND: 2005-1825	9,205	LF	STEEL BEAM BEARING PILES, HP12x74		
AND: 2005-1925	225	EA	STEEL BEAM PILE TIP REINFORCEMENT, HP12x74		
OR: 4000-0001	---	LS	PRESTRESSED CONCRETEBRIDGE STRUCTURE, ABC-123		
AND: 2005-1825		LF	STEEL BEAM BEARING PILES, HP12x74		
AND: 2005-1925		EA	STEEL BEAM PILE TIP REINFORCEMENT, HP12x74		
EITHER: 4120-0002	---	LS	BRIDGE STRUCTURE AS DESIGNED, XYZ-789		
AND: 1002-0181	35,570	LB	REINFORCEMENT BARS		
AND: 1002-0191	200,927	LB	REINFORCEMENT BARS, EPOXY COATED		
AND: 1002-1114	70	EA	MECHANICAL SPLICE SYSTEM FOR NO. 7 REINFORCEMENT BARS		
AND: 1002-1152	676	EA	MECHANICAL SPLICE SYSTEM FOR NO. 5 REINFORCEMENT BARS, EPOXY COATED		
AND: 1002-2153	600	EA	MECHANICAL SPLICE SYSTEM FOR NO. 6 REINFORCEMENT BARS, EPOXY COATED		
AND: 2005-1825	12,995	L.F	STEEL BEAM BEARING PILES, HP12x74		
AND: 2005-1925	171	EA	STEEL BEAM PILE TIP REINFORCEMENT, HP12x74		
OR: 4000-0002	---	LS	PRESTRESSED CONCRETEBRIDGE STRUCTURE, XYZ-789		
AND: 1005-1114		LF	STEEL BEAM BEARING PILES, HP12x74		
AND: 1005-1164		EA	STEEL BEAM PILE TIP REINFORCEMENT, HP12x74		

G. Item Number Sequencing

All item numbers appear on the Summary Sheet, Tab sheets, and in the Schedule of Prices in numerical order as if that item were in the PennDOT Master Items List , regardless of the first digit. Item numbers associated with Project Specific Special Provisions (4000-XXXX) are the last item numbers shown in the Summary Sheet, Tab Sheets and in the Schedule of Prices.

An example of the proper arrangement of items on the Summary Sheet, Tab Sheets, and in the Schedule of Prices follows:

ITEM NO	QTY	UNIT	DESCRIPTION	REF	TAB ON SHEET
2108-0001	---	LS	CONSTRUCTION SCHEDULE	SP	
0205-0100	263	CY	FOREIGN BORROW EXCAVATION	408	
4350-0106	12,726	SY	SUBBASE 6" DEPTH (NO. 2A)	SP	
0501-0020	8,567	SY	PLAIN CEMENT CONCRETE PAVEMENT, 4” DEPTH	408	
3608-0001	---	LS	MOBILIZATION	SP	
0703-0025	790	CY	NO. 57 COARSE AGGREGATE	408	
0850-0021	12	CY	ROCK, CLASS R-3	408	
2001-0010	56	CY	CLASS A CEMENT CONCRETE	CS	
1002-0190	183,564	LB	REINFORCEMENT BARS EPOXY COATED	408	
2005-1825	9,205	LF	STEEL BEAM BEARING PILES, HP12x74	SP	
2018-0001	---	LS	REMOVAL OF BRIDGE NO. ___, MP.	SP	
4090-0200	5,000	SF	UNDERDECK PROTECTION SHIELDS	SP	
4000-0001	---	LS	REMOVAL OF PORTION OF EXISTING CANOPY	SP	
4000-0002	---	LS	MODIFICATION OF EXISTING CANOPY	SP	

18.3 Quantities

Do not tabulate any lump sum or PDA items, except items on structure tabs. All lump sum and PDA items are to be NO TAB. In addition, the following items are to be NO TAB:

- Shadow Vehicle With Truck Mounted Attenuator (TMA)
- Construction Lighting
- Arrow Panel
- Portable Changeable Message Signs

For all construction contracts for expansion, total reconstruction, pavement reconstruction, and mainline bridge projects, contact the PTC Materials Manager to determine the need to include Item 2609-0011 Field Laboratory within the contract bid documents. Typically,

construction contracts for these types of projects with 1000 tons or more of aggregate used for subbase applications under the roadway and shoulders will require a field laboratory.

See Section 3.11 for guidance on recording the excavation quantities in the Earthwork Summary Block.

The Designer should review the Commission specifications to determine how the specification applies and if it is different than the PennDOT specification. Specifically, the PTC pays for certain items differently, including but not limited to the following:

- Clearing and grubbing as the first 8" of topsoil removal is incidental
- Tack Coat
- Pavement Base Drain

18.4 Cost Estimating

Construction cost estimates are to be prepared in accordance with the Commission's cost estimating manual, DOM and DQI at the following stages of design:

- Design field view
- 60 % Over The Shoulder Review
- 75% submission
- Pre-Final PS&E submission
- Final PS&E Submission
- Monday prior to BID
- Any Time there is a major project change

Chapter 19 - PLAN PRESENTATION

19.0 Introduction

All plan drawings are to be developed in accordance with the Pennsylvania Turnpike Commission's Engineering Department current CADD standards and the Design Deliverable Scope with this Manual superseding the current CADD standards where applicable. All other CADD standards or plan presentation details not covered by the previously noted documents shall be in accordance with PennDOT Publication 14, Design Manual Part 3, Highway Plans Presentation.

19.1 Tips for Design Field View Presentation

1. Show existing drainage on the proposed cross sections.
2. Show proposed drainage on the proposed cross sections.

19.2 Tips for Plan Presentation

1. Right-of-Way lines for all state and township highway easements are not shown through Turnpike limited access Right-of-Way.
2. On index maps – show Structure numbers, Mile Post, Stationing, etc.
3. Show contours on construction plans only for special conditions.
4. Show match lines between drawing sheets denoting adjacent sheet numbers.
5. Right-of-Way numbers are not shown on construction drawings; but, they are shown on the Right-of-Way/Geometry Plan.
6. Station/Offset values for right-of-way breaks are to be indicated on the Roadway Construction Plans and the Right-of-Way/Geometry Plans.
7. Items are to be arranged in the tabulation and summary sheets based on the last three (3) digits of the first grouping of four (4) digits.
8. Typical sections do not show stationing on final plans.
9. Do not include the inlets conditions (CS-605.3) on the plan sheets unless directed on a resurfacing project without cross sections.
10. Profiles – do not show longitudinal drainage.
11. Graphic Scale Bar shall be used on all scaled drawings.
12. For Mainline sections, provide Milepost references every tenth of a mile.
13. Labels for BEGINS and ENDS for pavement markings are to run with the stationing. Do not run the BEGINS and ENDS with direction of travel.
14. Temporary shoring is to be indicated on the plans with a zig-zag line, as is customary. Include a legend on the plan for the shoring that states "Temporary Shoring – See Special Provision". (This is being done so contractors don't assume that the shoring is to be sheet piling).

19.3 Tips for Property Plot Plans

1. Display either Deed or Calculated area only. If deed cites area, display this value. If deed does not cite area, the surveyor of record must calculate the area. The Commission will provide specific direction if a boundary survey is performed. Areas to be shown in acre units to three (3) decimal places. Square feet to be used for areas less than 40 square feet. If the deed area is square feet, then show the take area in both square feet and acres.
2. Calculate and subtract legal right-of-way areas (S.R.'s, Township Roads).
3. Take area descriptions should be based upon the project bearings except for total takes.
4. Plots without limited access takes do not need oil, gas or surface mining note.
5. Cut and Fill lines should not be screened on property plot drawings.
6. Proposed and existing roadway pavement lines should be shown.
7. Existing PTC limited access right-of-way can be shown as an adverse or exception, as applicable.
8. Show adverse and exception areas, but do not show the bearings and distances on these areas.
9. Show all features close to the right-of-way that may experience damage (fences, mailboxes, lights, statues, swings, shrubs, trees, etc.) and features (buildings, septic systems, wells, etc.) affecting the property assessment.
10. Show details of existing driveways and proposed driveways.
11. Proposed utility work should be shown.
12. Remove any hatching where it obscures important topographic features.
13. Required Right-of-Way breaks should be set with whole numbers (+00.00, +05.00, etc.) when ever possible.
14. Scaled offset values should be rounded to the nearest foot.
15. New offset values should be expressed to 2 decimal places.
16. With the exception of "total takes", avoid creating new right-of-way corners / changes in direction upon existing property lines. Establish and define new right-of- way corners by station (plusses) and offset distances from baselines. Creating a new right-of-way corner / change in direction on an existing property line could require record research and field recovery of evidence to re-establish that property line.
17. If possible, try to avoid creating any new right-of-way or easement corners radial to spiraled baselines. In spirals, try to make "required" Right-of-Way lines straight lines originating and ending at points perpendicular to tangents and radial to simple curves.
18. A submission of the computer printout denoting all courses and error of closure is to be submitted with the original deed.
19. Legal descriptions should always be in a clockwise direction.
20. No abandonment or vacations should be shown without approval of legal department.
21. The use of abbreviations should be avoided.
22. Limits of the 100-year flood plain should be shown on the plot when it is in the vicinity of the required take area.
23. Display the milepost range of the take area in the lower right-hand corner of the plot plan beneath the project parcel number circle.

24. The ultimate excavation/embankment limits, or any proposed construction which justifies the proposed acquisition, must be depicted on the property plot plans. This will include but not be limited to slope limits for proposed ditches/swales, etc.

19.4 Tips for Cross Section Presentation

1. Should be presented using PennDOT Design Manual Part 3 and the following:
2. Label Superelevation rates on each section when in transition or pick a point in the pavement and state the elevation difference from the profile grade.
3. Show the following on the cross sections: guide rail without the start/stop notes, right-of-way lines, perpetual easements, drainage inserts and super elevation.
4. Label the Legal Right-of-Way Lines and Perpetual Easements (i.e. Drainage Easements, Utility Easements)
5. Ensure that the Graphic Grade (GG) elevations are labeled where applicable.
6. Clearly label the Edge of Barrier elevations at the Concrete Median Barrier when the reveal varies throughout the Graphic Grade transition areas.
7. Provide lateral offsets from the Survey and Construction Baseline to objects that vary with respect to the Baseline. (i.e. retaining walls, 50’ rounding when SE >6%)
8. Provide lateral offsets and elevations for pavement breakpoints that are not clearly defined either on the plans or typical sections. (Examples could include, but are not limited to, interchange gore locations and mainline/auxiliary lane junctions)
9. Label the invert elevations of parallel ditches along with the class of excavation (based upon RC-10, typically Class 2) and the associated area.
10. Provide Earthwork Quantities (Cut/fill) by the overall major stage and not each phase in each stage. In addition, label or tabulate areas for benching and borrow excavation including rock type.
11. Cross section grids are generally acceptable as generated by the design software and only needs to be shown in the area of the cross section.
12. Label inlet conditions along with the required drainage data.

Chapter 20 - SAMPLE LETTERS AND FORMS

Figures 20.1, 20.2, 20.3 and 20.5 should include the project website, if applicable.

Figure 20.1 – Notification of Project to Municipalities

Date

Name
xxxx Township
Address
Address

RE:
Design Contract No. xx-xxx-xxxx
Total Reconstruction – Milepost xx to
Milepost xx xxxx Townships
xxxx County

Dear *Name*:

The Pennsylvania Turnpike Commission (PTC) has initiated preliminary design for the reconstruction and widening of the Pennsylvania Turnpike from Milepost *xx*, approximately *xx* miles east of *xxxx* Interchange, to Milepost *xx*, approximately xx mile east of *xxxx* Interchange, in *xxxx* County. The municipalities that are affected include *xxxx* Townships.

The PTC will conduct a study as one of the first tasks to determine the impacts to utilities, local road and stream crossings, and properties adjacent to the Turnpike due to the roadway widening and will investigate and evaluate impacts from flattening existing substandard horizontal curves.

In addition, this project will require the replacement of bridge structures carrying local traffic over or under the Turnpike and the potential elimination of a few of these low traffic volume structures during the study task will be evaluated. The PTC will investigate the distribution of local road traffic during the construction activities at each bridge structure and will evaluate the need for separate construction contracts in order to utilize effective detour routes where detours are required. *Consultant name* is under contract with the Commission to perform the study task as well as the design for the project. They may be contacting you in the near future for pertinent traffic or other information. Your cooperation and input will be greatly appreciated.

At the completion of the widening study task (six to eight months), the PTC will schedule a public officials meeting to discuss our findings and to hear your concerns. Should you have any questions, please contact me at (717) 939-9551, extension *xxxx,* or by email at *xxxxx*@paturnpike.com.

Sincerely,

Name
Title

Figure 20.2 – Notification of Project to Local Officials

Date

Name
Title of Position
Address
Address

RE:
Design Contract No. xx-xxx-xxxx
Total Reconstruction – Milepost xx to Milepost xx
xxxx Townships
xxxx County

Dear *Name*:

The Pennsylvania Turnpike Commission (PTC) has initiated preliminary design for the reconstruction and widening of the Pennsylvania Turnpike from Milepost *xx*, approximately *xx* miles east of *xxxx* Interchange, to Milepost *xx*, approximately *xx* mile east of *xxxx* Interchange, in *xxxx* County. The municipalities that are affected include *xxxx* Townships.

The PTC will conduct a study as one of the first tasks to determine the impacts to utilities, local road and stream crossings, and properties adjacent to the Turnpike due to the roadway widening and will investigate and evaluate impacts from flattening existing substandard horizontal curves.

In addition, this project will require the replacement of bridge structures carrying local traffic over or under the Turnpike and the potential elimination of a few of these low traffic volume structures during the study task will be evaluated. The PTC will investigate the distribution of local road traffic during the construction activities at each bridge structure and will evaluate the need for separate construction contracts in order to utilize effective detour routes where detours are required. *Consultant Name* is under contract with the Commission to perform the study task as well as the design for the project. They may be contacting you in the near future for pertinent traffic or other information. Your cooperation and input will be greatly appreciated.

At the completion of the widening study task (6-8 months), the PTC will schedule a public officials meeting to discuss our findings and to hear your concerns. Should you have any questions, please contact me at (717) 939-9551, extension *xxxx,* or by email at *xxxx*@paturnpike.com.

Sincerely,

Name
Title

Figure 20.3 – Notification of Project to PennDOT

Date

Name
District Engineer
Pennsylvania Department of Transportation
Engineering District x-0
Address
Address

Re: *Design Contract No. xx-xxx-xxxx*
Total Reconstruction – Milepost xx to Milepost xx
xxxxxxxx County

Dear *Name*:

The Pennsylvania Turnpike Commission has initiated the design for the total reconstruction of the Pennsylvania Turnpike mainline from Milepost *xx*, approximately *xxxx* miles east of *xxxx* Interchange, to Milepost *xx*, approximately *xx* miles east of *xxxx* Interchange. *Consultant Name* will perform the design for this reconstruction project. Due to the coordination that will be required between the Department and the Commission for traffic control, detour routes, highway occupancy permits, and other issues, we are writing to inform you of this project.

The total reconstruction project will include the removal of the existing asphalt and concrete pavement and replacement with a full-depth asphalt pavement, the replacement of the drainage, and the widening of the median from the existing 10-foot width to a 46-foot width, if possible. We are currently in the Study Phase of this project to determine if a 46-foot width median is feasible, and, if not, what widths can be obtained.

The additional median width will require replacement or possible elimination of overhead bridges and replacement or widening of the mainline Turnpike bridges to accommodate the proposed typical section. The Commission has identified the replacement or elimination of the following bridges as key components within this project.

Bridge Number	Milepost	Overhead or Mainline	Intersecting Feature	Number of Spans	Structure Type

Currently, it is anticipated that the study and design work for this project will extend from _____ through _____. It is also anticipated that construction for the mainline Turnpike total reconstruction project will extend from the 200 through the 200_____ construction seasons. However, some of the bridge replacements or possible eliminations may occur in separate contracts in which the construction could be as early as the 20_____ construction season. This would ensure that two bridge crossings in the same vicinity are not being detoured at the same time.

As the design efforts for this project progress, we will continue to keep you informed of any issues with regard to this project that require Department attention. We currently anticipate scheduling a preliminary coordination meeting for this project between the Department and the Commission at the end of the study phase/beginning of the design phase, which will be in approximately six months. We will contact you closer to that time to set up a meeting date, time, and location. Should you have any questions concerning this project, please do not hesitate to contact me at (717)939-9551, extension *xxxx*, or via e-mail at *xxxx*@paturnpike.com.

Sincerely,

Name
Title

Figure 20.4 – Intent to Enter

Date

County: Name
Municipality: Name
Parcel Number: xx-xx-xx-xxx

Name
Address
Address

Re: Notice of Intent to Enter

Dear Property Owner:

The Pennsylvania Turnpike Commission is beginning engineering and environmental studies for the reconstruction of the Pennsylvania Turnpike from Milepost *xx*, approximately *xxxx* miles east of *xxxx* Interchange, to Milepost *xx*, approximately *xxxx* mile east of *xxxx* Interchange. In order for these studies to be performed, it will be necessary for employees and/or agents of the Commission to enter properties in this vicinity to obtain information required to complete surveys and obtain information for permits and reports and may include the use of Unmanned Aircraft Systems (UAS).

You are hereby notified, pursuant to Act of May 4, 2006, Number 34, Section 1, P.L. 112 known as the Eminent Domain Code (26 Pa. C.S.A. §309), that in order to conduct surveys, studies, tests, soundings, core borings, and/or appraisals, it will be necessary for employees and/or agents of the Pennsylvania Turnpike Commission to enter your property or properties along, adjacent to, or in the vicinity of the contemplated highway improvements on or after ten (10) days from receipt hereof and continuing until the completion of the work. Some or all of the listed work may be done on your property including UAS overflights conducted from and/or over your property to obtain aerial surveys, images and data necessary for the engineering and environmental studies.

The employees and/or agents of the Commission who may need to enter your property have been cautioned to do their work expeditiously, courteously, and with minimal interruption to your use of the premises. All UAS flights conducted from and/or over your property shall be done in compliance with all federal, state and local laws, regulations and ordinances applicable to UAS operation and use. Also, they have been instructed to minimize disturbance of property and to assure its expeditious restoration. Your cooperation with them in their performance of this necessary work is gratefully appreciated. Should you have any questions after receipt of this letter, please contact *Project Manager Name,* at (717) 831-*xxxx*.

This notice is <u>not</u> to be interpreted as a condemnation of your property.

Sincerely,

Jeanmarie McLaughlin
Assistant Counsel

Figure 20.5 Notification of Sound Barrier Meeting

Date

Name
Address
Address

Re: ***Design Contract No. XX-XXX-XXXX***
Roadway and Bridge Reconstruction from
Milepost XXX to Milepost XXX
XXXXXXXX County
Sound Barrier Meeting

Dear Property Owner:

The Turnpike Commission is currently performing the engineering design work for the reconstruction of the Carlisle Interchange on the inside of the toll booths. As part of the design efforts for this project the Turnpike Commission conducted noise analysis studies throughout the project limits. The noise analysis studies indicated the area along the Eastbound Exit Ramp, south of the Turnpike, as a potential sound barrier location.

Since your property is adjacent to the potential sound barrier, the Turnpike Commission seeks your opinion on whether or not the proposed sound barrier should be constructed at this location. If there is agreement among property owners in the adjacent residential neighborhood to proceed with this sound barrier construction, then the Turnpike Commission seeks your opinion on the appearance of the proposed sound barrier facing the residential neighborhood.

A meeting is scheduled for *Date* from *XX:XX XM* to *XX:XX XM* at the *Location*, *Address* to discuss the proposed sound barrier for the above referenced project. In order to have an influence on this process, you must be present at this meeting.

During this meeting, you will be shown the location and height of the proposed sound barrier, along with texture and color options. A consensus needs to be reached on the desire for a sound barrier, and if a sound barrier is desired, a consensus also needs to be reached on the texture and color of the sound barrier on the side facing the residential neighborhood.

Please contact me at *Telephone Number* to let me know if you are able to attend this important meeting. Your cooperation in this matter is appreciated.

Sincerely,

Name
Title

cc: *Company*

Figure 20.6 Sound Barrier Survey Form

PENNSYLVANIA TURNPIKE COMMISSION
***ROADWAY AND BRIDGE RECONSTRUCTION* – MP XXX to MP XXX SOUND BARRIER SURVEY**

DATE

Where do you live?	**Do you own the property where you live?**
• ___Along Hill Drive • ___Other _____ _____ (Specify)	• ___yes • ___no
	Do you want a sound barrier constructed? • ___yes • ___no

Which wall texture do you prefer? Please rank your first and second choice.
(1 for first; 2 for second)

- ___ (A) STONE
- ___ (B) 6" CEDAR
- ___ (C) GRAPE STAKE
- ___ (E) SHIPLAP

Which color do you prefer? Please rank your first and second choice for the textures chosen above.
(1 for first; 2 for second)

• STONE	_____ GRAY			
• 6" CEDAR	_____ RED	_____ TAN	_____GRAY	
• GRAPE STAKE	_____ BROWN	_____ TAN	_____GRAY	
• SHIPLAP	_____ BROWN	_____ TAN	_____GRAY	

General Comments:_____
_____
_____
_____

Please print.	**Please leave this comment form with or mail to:**
Name:_____ **Address:**_____ _____ **Telephone:**_____	*Name* *Title* *Company* *Address* *Address* *e-mail:*

Place
Stamp
Here

Name
Company
Address
Address

Figure 20.7 – Geotechnical Quality Assurance Form-PS&E Review

GEOTECHNICAL QUALITY ASSURANCE FORM - PS&E REVIEW

PROJECT NAME
PTC DESIGN CONTRACT #
Element of Design:_____

By signature and seal, I hereby certify that:

(1) I have completed the following required design review meetings prior to submission of the 75% PS&E documents (or Pre-Final if no 75% submission is planned):

Review Meeting	Date	Initials
Cross Section Review Meeting(s)		
Structure Plans Review Meeting(s)		

(2) I have reviewed the Final PS&E plans, special provisions, details and cross-sections, and other PS&E documents; and verified that they accurately and appropriately represent the Geotechnical Designer of Record's recommendations.

(3) I have submitted final electronic copies of all approved geotechnical reports, design memorandum, and Temporary Shoring Data Reports to the GDMT & PTC PM.

_____
Printed Name
(Geotechnical Designer of Record)

_____
Signature

_____
Firm Name

_____
Date

Note: An electronic pdf copy of this completed form is to be included with the Final PS&E Submission.

Figure 20.8 Monument Data and Recovery Form

Data Requested	*Entry*
Project Name:	
Contract Number:	
Name of Consulting Firm:	
Address, Line 1:	
Address, Line 2:	
City:	
State:	
Zip:	
E-Mail Address:	
Phone Number / Extension	
Fax Number:	
Responsible Contact Person:	
Job Title of Responsible Contact Person:	
Website Address: (Optional)	
E-Mail Address:	
Monument / Pt. Type: ("Vertical", "Horizontal", "Horizontal & Vertical" or "Right-of-Way").	
Milepost: (Presented to hundredths of a mile)	
Route ("A", "B", "C", "G", "M", "O", "S", or "T"): A - Northeast Extension, (I-476) .....B- Beaver Valley Expy. (J. Manderino Hwy), (PA. Toll 60) C- Breezewood Connector.....G- Greensburg Bypass (A. K. Hutchinson Byps), (PA. Toll 66) M- Mon-Fayette Expy., (PA. Toll 43)... O- Original Tpk. (Laurel, Rays Hill, & Sideling Hill Tunnels) S- Southern Beltway, (S.R. 0576)..... T- Mainline Turnpike, (I-76, I-70, & I-276) ?? – Interstate Rte. 80	
Latitude: (dd,mm,ss.sssss) – (5 deci. Places)	
Longitude: (ddd,mm,ss.sssss) – (5 deci. Places)	
P.S.P.C. N. Coordinate, [U.S. Survey Feet (Y)]:	
P.S.P.C E. Coordinate, [U.S. Survey Feet (X)]:	
Note: Must use conversion factor of: ***U.S. Survey FEET x 1200/3937 = METERS,*** **EXACTLY!**	
P.S.P.C. N. Coordinate, [Metric (Y)]:	
P.S.P.C. E. Coordinate, [Metric (X)]:	
Combined Scale Factor:	
Horizontal Datum:	
Geoid:	
State Plane Zone (North / South) : Projects in Dist. 5, at M.P. A-070.00±, Choose N. or S., not both.	
Horizontal Accuracy / Order	
Elevation in U.S. Survey Feet:	
Note: Must use conversion factor of: ***U.S. Survey FEET x*** **1200/3937 =** ***METERS,*** **EXACTLY!**	
Elevation in Meters:	
Vertical Datum:	
Vertical Accuracy / Order:	
U.S.G.S. Quadrangle Name:	

Data Requested	*Entry*
Turnpike Maint. District, ("1", "2", "3", "4", or "5")	
County:	
Township:	
Municipality:	
Route Type: ("State Route", "Interstate Hywy", "Township Rd.", "County Rd", "Private Rd", "Ramp", "Turnpike", "U.S. Hwy", or "Other")	
Route Number:	
Baseline/Centerline Stationing:	
Offset Direction ("Right" or "Left"):	
Offset Distance (U.S. Survey Feet)	
Note: Must use conversion factor of: ***U.S. Survey FEET x* 1200/3937 = *METERS,* EXACTLY!**	
Offset Distance (Meters)	
Point Name:	
Monument Description: a. Capped Rebar (specify size and describe cap) b. bronze disk in concrete c. brass disc in concrete d. aluminum disk in concrete e. bronze disk in rock outcropping f. brass disc in rock outcropping g. aluminum disk in rock outcropping h. bronze disk in structure (pier, abutment, wheel guard, wing-wall, parapet, etc.) (Specify structure number if available) i. brass disk in structure (pier, abutment, wheel guard, wing-wall, parapet, etc.) (Specify structure number if available) j. aluminum disk in structure (pier, abutment, wheel guard, wing-wall, parapet, etc.) (Specify structure no. if available) k. railroad spike l. chisel cut in "……" m. Bolt in "……"	
Monument Markings / Stampings:	
Date Monument Established:	
Established By (Name of Firm / Agency):	
Established By (Name of Individual):	
Monument Stability: ("excellent", "good", "fair", or "poor")	
Monument Condition: ("excellent", "good", "fair", "poor", "leaning", "bent", "sheared-off", "chipped", or "removed")	
Date Last Recovered:	
Recovered By (Name of Firm / Agency):	
Recovered By (Name of Individual):	
Photos? How many? (Submit in " .tif" format if possible)	

Data Requested	*Entry*
Narrative Description for Monument Recovery: (For example: From the intersection of State Route (S.R.) No. 0000 and Township Road (T) No. 000, go East on S.R. 0000 for two and three-tenths miles to intersection with U.S. Highway 000. Head North on U.S. 000 for three and three-tenths miles. Monument is a brass disk set in a rock outcropping 66 feet more or less right (East) of the centerline of highway U.S.000, fifty feet plus or minus south of a concrete end-wall, and one-hundred-twenty feet north of wooden utility pole no. R-22774-K)	

Location Sketch - (required)

a. For new monuments, show the three distance swing ties to visible stable objects. If no objects can be found within 200 feet, set three ferrous objects (nails, railroad spikes, or ½" re-bars 24" long, etc) and pull swing ties to points..
b. If new monument / point falls within one hundred (100) feet of Right-of-Way fence, show distance (nearest tenth of a foot) tie from monument to shortest distance to fence.
c. If new monument / point falls within five hundred (500) feet of a structure or perpendicular / radial storm pipe, measure longitudinal distance (along Turnpike) to the nearest foot (Rollotape ® distance acceptable) to confirm stationing, and show it on the sketch.
d. Show at least one "Milepost Indicator" (to the tenth of a mile) with equivalent stationing, on the sketch if monument / point falls within 200 feet of Turnpike.
e. Show north directional arrow on Sketch
f. Present graphic scale if plotted to scale. If not plotted to a uniform scale, show "N.T.S.".
g. If monument / point are within two hundred (200) feet of Turnpike travel lanes, show Turnpike centerline/baseline and station/offset distance.
h. If monument/point is so far away from the Turnpike that station/offset measurements are impractical for recovery, show at least 3 distance ties to roadway edges, buildings, structures, drainage pipes, driveways, fences, utility poles, etc. to facilitate said recovery.
i. Provide notations (if within 500 feet of road) along the road, with distances to nearest intersections, towns, or interchanges.
j. Location Sketch should conform to a seven (7) inch by seven (7) inch size, no larger or smaller. It may be submitted to the Turnpike as a 7" x 7" hard copy or in " .tif" digital format on C.D. R.O.M.

G.P.S. Accessible? "5" – Excellent 10° Up, "4" – Good 20° Up, "3" – Medium 30° Up "2" – Poor (one Side Obstructed, Trees, Etc.), "1" – Badly (Obstructed) "0" - Unusable	
Fiberglass (Carsonite®) Marker Post? ("Yes" / "No")	
Rubbing of Top of Monument? ("Yes" / "No"): If "Yes", please submit a scanned image of the rubbing in " .tif" format or a 7" x 7" hard copy.	

APPENDIX

Appendix A: Personnel In Field Notification

Personnel in Field Notification

Dial *11 to notify PTC Traffic Operations prior to entering and leaving the field each day.

Crew #1: _____

Company Name: _____

Dates: _____

Approximate Location: _____

Scope Of Work: _____

Staff Name	Cell

Vehicle Make/Model: _____

Color: _____

License Plate #: _____

Crew #2: _____

Company Name: _____

Dates: _____

Approximate Location: _____

Scope Of Work: _____

_____

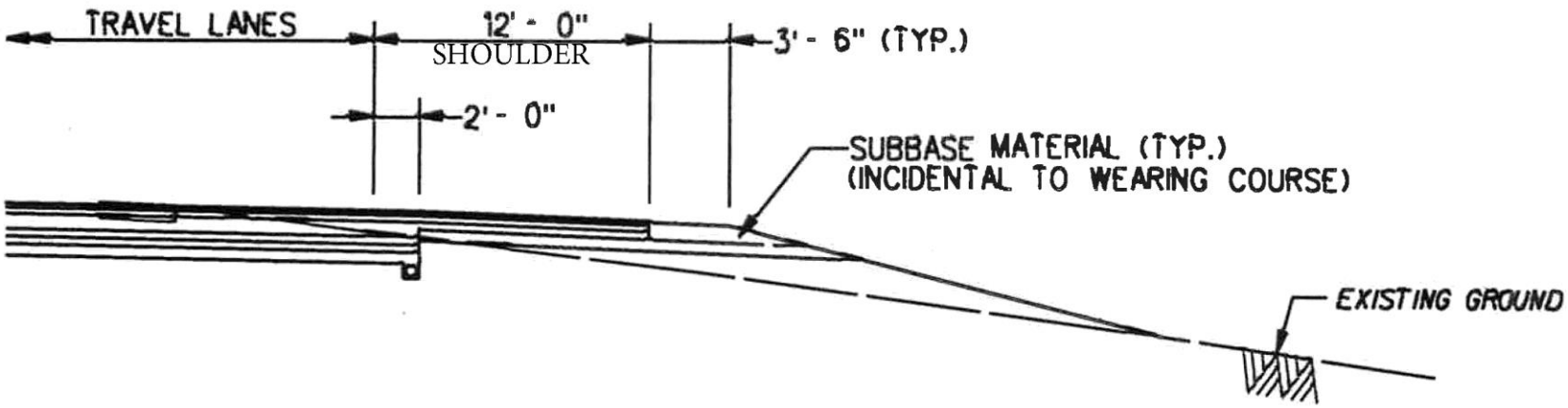
Staff Name	Cell

Vehicle Make/Model: _____

Color: _____

License Plate #: _____

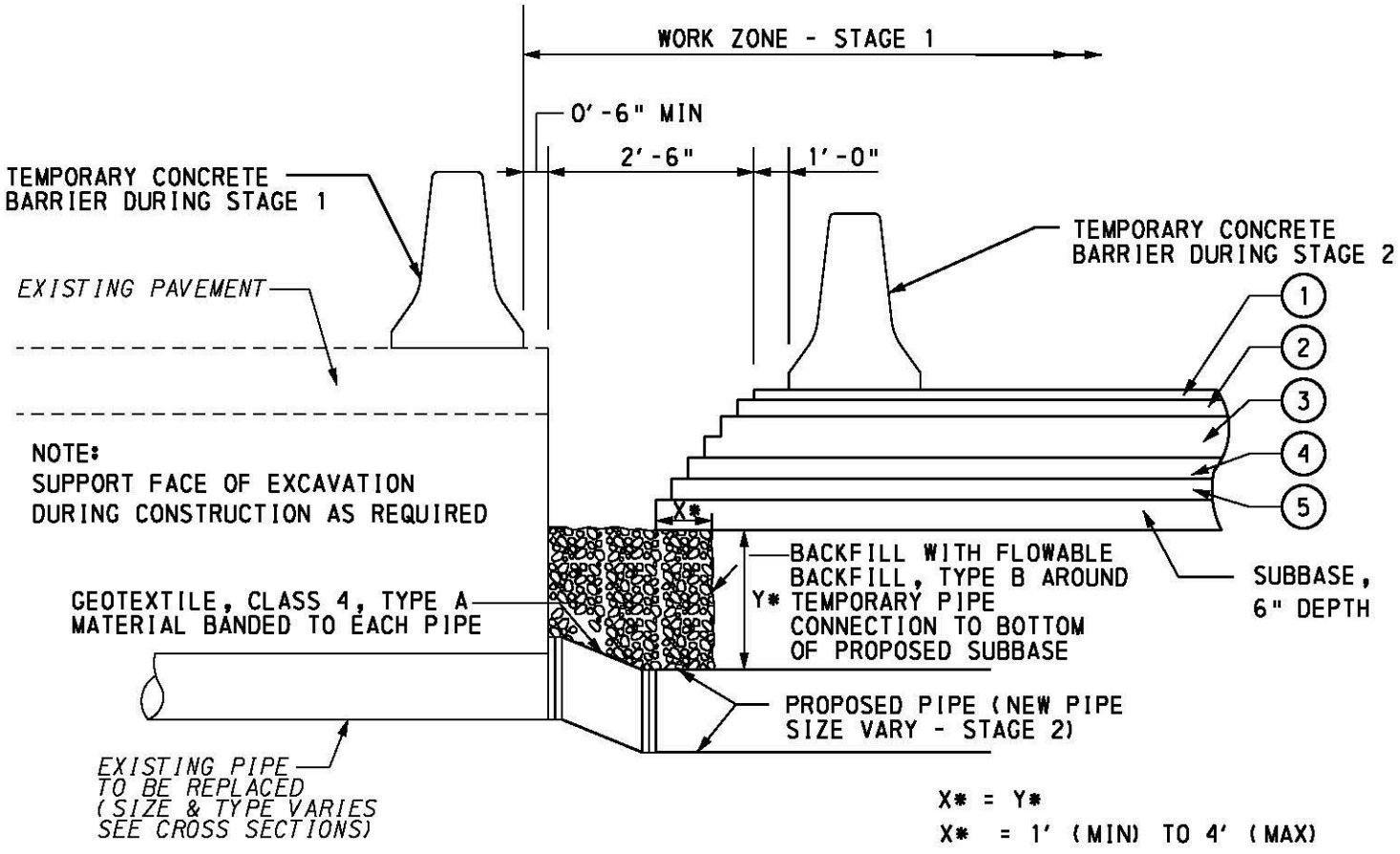
Appendix B: Typical Details



PARTIAL SECTION - EMBANKMENT SLOPES

WITHOUT GUIDERAIL

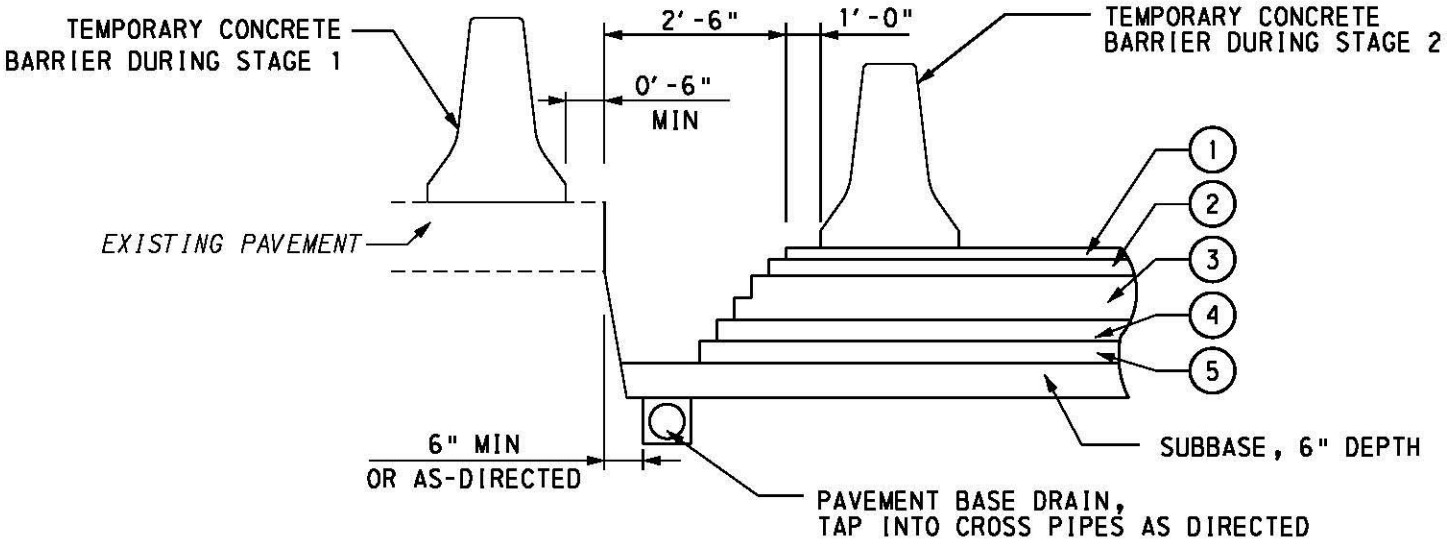
Note: For slopes between 2:1 & 4:1, the shoulder subbase is extend to daylight on the slope as shown. Slopes 4:1 and flatter require pavement base drain at the back edge of shoulder



① STONE MATRIX ASPHALT MIXTURE DESIGN, HMA WEARING COURSE
② SUPERPAVE ASPHALT MIXTURE DESIGN, HMA BINDER COURSE
③ SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE
④ RICH BOTTOM SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE
⑤ ASPHALT TREATED PERMEABLE, BASE COURSE

TEMPORARY FLEXIBLE PIPE CONNECTOR

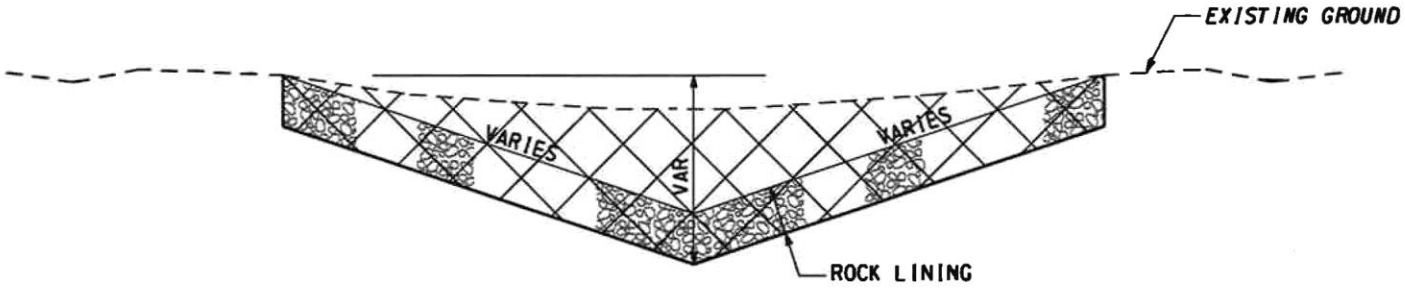
(ITEM NO. 2601-9999)



① STONE MATRIX ASPHALT MIXTURE DESIGN, HMA WEARING COURSE
② SUPERPAVE ASPHALT MIXTURE DESIGN, HMA BINDER COURSE
③ SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE
④ RICH BOTTOM SUPERPAVE ASPHALT MIXTURE DESIGN, BASE COURSE
⑤ ASPHALT TREATED PERMEABLE, BASE COURSE

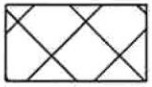
6" PAVEMENT BASE DRAIN, STAGE DRAIN

(ITEM NO. 2610-7004)



EXCAVATION FOR ROCK LINED DITCHES / CHANNELS

Note: Ditch configurations may vary

 - EXCAVATION INCIDENTAL TO ROCK LINING

Appendix C: MPT Protocols for Drilling Contracts (1)

APPENDIX C

Turnpike Mainline Maintenance and Protection of Traffic Contract Administration Protocols Open-End Drilling Contracts

Purpose – Define the roles and responsibilities of various key personnel involved with the implementation of Maintenance and Protection of Traffic (MPT) on the mainline during Open-End (OE) Drilling projects for the Pennsylvania Turnpike Commission (PTC).

General Roles and Responsibilities - Below are the defined roles and responsibilities related to the implementation of MPT on OE Drilling Projects for various key individuals:

PTC-Drilling Manager – Responsibilities include:

- **Request the assignment of a PTC-Construction Manager** from the designated Construction Engineering Manager. Currently:

    - S. Hrvoich = MP-0 to MP-122, Greensburg, Beaver Valley, Mon-Fayette, and Southern Beltway;
    - J. Cottle = MP-122 to MP-300; and
    - A. Williamson = MP-300 to the Delaware River Bridge and NE Extension.

    Copy M. Burd, Assistant Chief Engineer-Construction and B. Ranck, Construction Engineering Manager-Quality Control on the request. Include a description of the project limits, timeframe, scope and other relevant information with the request.

- **Schedule the pre-drilling field view** upon receipt of an approved PSDEP from the lead geotechnical design liaison on the project. Field view attendees include:

    - Required: OE Drilling Contractor's Foreman;
PTC-Construction Manager;
Design Consultant's Lead Inspector;
PTC-Drilling Manager;
PTC-Lead Geotech Liaison

    - Optional: PTC-Maintenance Foreman;
PTC-Design Liaison;
QA Manager and Assigned Staff; and
Others from Facilities and Fare Collection, if applicable.

- **Attend the pre-drilling field view**.

- **Notify the local PA State Police (PSP) work zone coordinator of the upcoming drilling project** and that the Design Consultant's Lead Inspector will be overseeing the MPT on behalf of the Commission. Provide the PSP Work Zone Coordinator with the Lead Inspector's contact information and the anticipated drilling schedule.

- **Provide general oversight and guidance** throughout the drilling process.

OE Drilling Contractor's Foreman – A full-time on-site individual designated by the OE Drilling Contractor who will represent the OE Drilling Contractor on all issues including MPT throughout the duration of the work order. This individual is to be identified at the pre-drilling field view and his contact information (including cell phone number) documented in the meeting minutes. The Design Consultant's Lead Inspector must be notified at least twenty-four (24) hours in advance of any personnel changes in this position. During cold weather (37 ^{o}F or below) request utilization of PTC Maintenance to assist with application of salt to the Turnpike's roadway if available. The request must be made by the OE Drilling Contractor's Foreman to the Design Consultants Lead inspector. A minimum of 200 lbs of salt will be required to be on hand at the beginning of a cold weather shift. If this requirement is not satisfied, work will not be permitted.

PTC-Construction Manager – A designated individual from PTC-Construction responsible for following the detailed roles and responsibilities described herein.

Lead Inspector, Design Consultant – A designated individual, typically employed by the geotechnical sub-consultant to the Designer, responsible for following the detailed roles and responsibilities described herein.

PTC-Quality Assurance – Maintain an oversight role on proper MPT. Observe and report deficiencies to the Design Consultant's Lead Inspector for corrective action. Provide a copy of all correspondence to the PTC-Drilling Manager and the assigned PTC-Construction Manager.

Trooper, Troop T, PA State Police (PSP) – In emergency or urgent situations a patrol officer may provide direction regarding the MPT set-up and its negative impact on the safety of the travelling public to the Design Consultant's Lead Inspector. Adherence to their direction is mandatory.

PTC MPT standard requirements are deemed adequate for establishing work zones and the assignment of PSP officers within drilling patterns is not required. However, in unusual situations, requests for additional PSP presence can be made. If available, additional patrols within or near the drilling MPT will occur. Requests for additional PSP presence can be made by the Design Consultant's Lead Inspector directly to the local PSP work zone coordinators.

PTC Maintenance Foreman or Assistant Foreman - If requested, and available to assist, PTC Maintenance will be utilized to apply salt to the Turnpike's roadway during OE drilling operations in cold weather (37 ^{o}F or below). The request must be made by the OE Drilling Contractor's Foreman to the Design Consultants Lead inspector.

Detailed Roles and Responsibilities

PTC-Construction Manager – This person functions in a supervisory role on MPT issues and provides oversight and guidance to the Design Consultant's Lead Inspector.
The PTC-Construction Manager's role and responsibilities through the course of the drilling project are:

Pre-Drilling Field View Meeting

- **Attend the Field View Meeting**. The PTC-Construction Manager will only be invited to the field view when drilling projects will be drilled in or accessed from the travel lanes.

- **Provide contact information**, i.e., cell phone number and email address.

- **Review** and comment on the **proposed MPT** set-ups proposed for use, e.g., proposed use of shoulder vs. single lane closure patterns.

- **Provide information regarding potential conflicts with other MPT** in the adjacent area.

- **Provide guidance criteria** to the Design Consultant's Lead Inspector regarding what constitutes "no go" situations regarding the permissibility of setting and maintaining MPT due to road conditions, e.g., fog, rain, ice, snow, other. Permissibility of setting and maintaining MPT is to be based road conditions as it relates to the ability of the public to safely travel through the pattern.

  It is to be understood that the OE Drilling Contractor has an independent and overriding "no go" decision to make regarding whether drilling crews work in various conditions. Examples of such overriding conditions causing the OE Drilling Contractor to cancel work include but are not limited to weather (cold, lightning, perhaps rain), equipment/mechanical issues, or health/illness of drilling crew.

After the Pre-Drilling Field View

- **Review** the meeting minutes from the field view and comment on applicable MPT issues.

During Drilling

- **Provide additional guidance,** on an as-needed basis, to the Design Consultant's Lead Inspector **regarding the permissibility of setting MPT** due to changing road conditions.
- **Receive** (via email) from the Design Consultant's Lead Inspector and, **if necessary, comment on the "Daily Lane Closure Reports"** completed and submitted by the Design Consultant's Lead Inspector.

- **Be available via phone** to **answer questions** from the Design Manager's Lead Inspector about MPT and/or the guidance criteria provided to them.

- **Spot-check the MPT** set-ups for adherence to the Contract specification. If improperly set, immediately provide the Design Consultant's Lead Inspector with the required corrective action. Keep your own documentation and follow-up in writing to the Design Consultant's Lead Inspector and copy PTC-Design's Drilling Manager.

Design Consultant's Lead Inspector

In general, the design consultant's geotechnical inspectors are required to be a third-party Contract Representative in the field for OE Drilling Contracts. This applies to both Commission and Design Manager let contracts.

The Design Consultant's Lead Inspector has a specialized role among geotechnical inspectors. Specific responsibilities and protocols to follow related to the OE Drilling Contract's Maintenance and Protection of Traffic (MPT) include, but are not limited to:

Pre-Drilling Field View Meeting

- The designated Lead Inspector must **attend the Pre-Drilling Field View**. Record meeting minutes.

- **Provide contact information for a smart phone** to be utilized during drilling, i.e., phone number and email address. The phone must have full-time on-site cellular service and capabilities of making and receiving phone calls, email, text messages and the ability to photograph and transmit pictures.

- Coordinate with the PTC-Construction Manager, prior to the field view, to **obtain information on potential conflicts with adjacent MPT**. Then inform the drilling team of the MPT conflict.

- **Understand the various MPT set-ups** proposed for use, e.g., proposed use of shoulder vs. single lane closure patterns and when they are required.

- **Obtain roadway condition guidance** from the PTC-Construction Manager regarding potential "no go" situations requiring work stoppage/cancellation of work. The guidance will be **related to the permissibility of MPT set-ups in the event of adverse traffic and/or road conditions**, e.g., fog, rain, ice, snow, other. The "no go" decision is to be based on roadway conditions that adversely impact the ability of the public to safely travel through the MPT pattern.

- Establish PTC Maintenance contacts for salt application and reapplication if drilling on the Turnpike's roadway during cold weather (37 ^{o}F or below). Ensure that the OE Drilling Contractor has a minimum of 200 lbs of salt on hand at the beginning of the shift. If this requirement is not satisfied work will not be permitted.

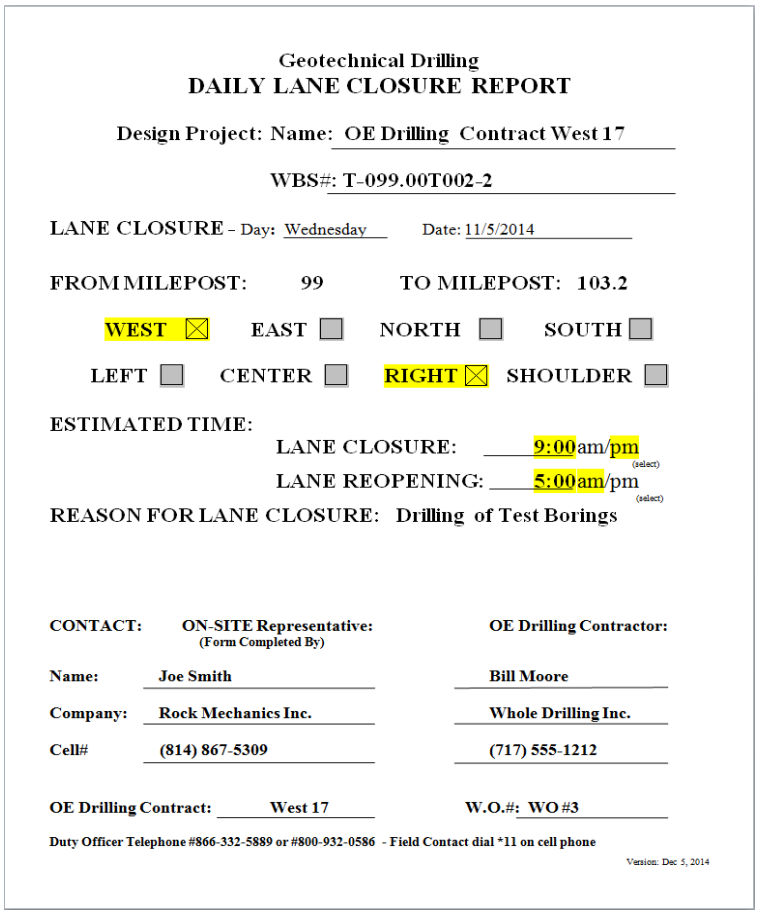
After the Pre-Drilling Field View

- **Prepare the field view meeting minutes** and document the guidelines received from the PTC-Construction Manager on MPT issues.

During Drilling

- **Complete and submit the *Daily Lane Closure Report*** to the PTC Operations Center; opsctr@paturnpike.com, at least six (6) to twelve (12) hours prior to the work shift. Additionally:
    - Send copies of the completed form to:
        - PTC-Construction Manager assigned to work order
        - Local Maintenance Foreman
        - Fare Collection and/or Facilities (if applicable)
        - Patrick Neil, Assigned PTC-Geotech Liaison and Ken Heirendt
        - Pam Leiby and QA person assigned to work order
        - Any other Engineering contacts designated at the Pre-Drilling Field View Meeting.

- Below is a completed example of the ***Daily Lane Closure Report***:



Geotechnical Drilling
DAILY LANE CLOSURE REPORT

Design Project: Name: OE Drilling Contract West 17

WBS#: T-099.00T002-2

LANE CLOSURE - Day: Wednesday Date: 11/5/2014

FROM MILEPOST: 99 TO MILEPOST: 103.2

WEST ☒ EAST ☐ NORTH ☐ SOUTH ☐

LEFT ☐ CENTER ☐ RIGHT ☒ SHOULDER ☐

ESTIMATED TIME:

LANE CLOSURE: 9:00 am/pm (select)

LANE REOPENING: 5:00 am/pm (select)

REASON FOR LANE CLOSURE: Drilling of Test Borings

CONTACT:	ON-SITE Representative: (Form Completed By)	OE Drilling Contractor:
Name:	Joe Smith	Bill Moore
Company:	Rock Mechanics Inc.	Whole Drilling Inc.
Cell#	(814) 867-5309	(717) 555-1212

OE Drilling Contract: West 17 W.O.#: WO #3

Duty Officer Telephone #866-332-5889 or #800-932-0586 - Field Contact dial *11 on cell phone

Version: Dec 5, 2014

  - If work is delayed by less than 4 hours:
    - "Reply all" to the initial email recipients explaining the delay.
    - No resubmission of the ***Daily Lane Closure Report*** is required.
  - If work is cancelled for the day or shift:
    - "Reply all" to the initial email recipients explaining the cancellation.
    - Send a new email/report six (6) to twelve (12) hours before work is to resume.
- Arrive on-site each day at prior to the start of the work shift. Confirm that MPT set-up will occur as previously scheduled.

- For drilling operations on PTC roadway during cold weather (37 ^{o}F or below) – Promptly notify PTC Maintenance for salt application or reapplication requests made by the OE Drilling Contractor's Foreman. Confirm that the salt application area extends beyond the area of pavement that is wet due to drilling operations.

- N**otify the PTC Operation Center Supervisor in the operations center (approx. 15 min in advance via phone) that the pattern placement is about to commence. Confirm that the MPT set-up appears to be correct**. Then be on-site full-time throughout the entire shift. Remain on-site until after the MPT pattern is removed. Then, **call and notify the PTC Operation Center Supervisor in the operations center that the MPT removal is complete.**

- If needed for the project, provide on-site coverage during the advanced placement or delayed removal of signing, e.g., when the contractor places or removed covered PTS-900 signs. **Maintain a reference copy of the OE Drilling Contract** in the field for use during drilling.

- **Be the contact person** to receive MPT related input from all possible sources PTC-Construction Manager/PTC-State Police/PTC-Maintenance/PTC-Quality Assurance.

- **Make (as needed) "no go" decisions** regarding the MPT based on the ability of the public to safely travel through the pattern. Utilize guidance received from the PTC-Construction Manager in rendering decisions. Contact the PTC-Construction Manager by phone, for additional guidance in the event of changing conditions.

  It is to be understood that the OE Drilling Contractor has an independent "no go" decision to make regarding the safety or ability of the drilling crew to work in various conditions or situations. Factors which could cause the Contractor to cancel or cease work include weather, equipment/mechanical issues and health/injury/illness of crew. The drilling Contractor is responsible for the safety of drilling crew and always has the ability to cancel/cease work as needed.

  If the Contractor decides to cancel/cease work then no reduced workday compensation is earned. However, if the Commission (or its representatives, e.g., Design Consultant's Lead Inspector) cancels work then reduced workday compensation is earned as per the terms of the Contract.

  If possible, make timely "no go" decisions with respect to the Drilling Contract's provisions to minimize the cost of canceled MPT. Currently, no payment is earned (for MPT) if a "no go" decision is made more than four (4) hours in advance of the start of the shift. Only a 50% MPT payment is earned if the "no go" decision is made within two (2) to four (4) hours of the shift. Full MPT payment is earned for "no go" decisions made within two (2) hours of the shift or during the shift. However, a delayed start of up to four (4) hours is to be considered when a passing weather event occurs at the beginning of a shift, e.g., morning fog (day drilling) or evening thunderstorms (night drilling).

  If "no go" conditions cannot be predicted in advance (with certainty) then "go" until a "no go" situation exists with certainty.

- **Record** on the Inspector's Daily Report **all "no go" decisions** made and indicate site conditions, time of decision and who made the decision, i.e., the Design Consultant's Lead Inspector or OE Drilling Contractor to cancel work.

- **Check the MPT set-ups** for adherence to the Contract specifications. **If the MPT appears to be improperly set, immediately notify the Drilling Foreman so that** corrective action can be taken. Keep documentation and follow-up with an email to the PTC-Drilling Manager. Additionally, include any comments from the PTC-Construction Manager.

- **Monitor roadway conditions during the work shift and make** "work stoppage" decisions if needed. Also, adhere to work stoppage requests from PTC-State Police.

Appendix D: Sample Detour Plan and Sign Fabrication Detail

LEGEND

- STATE HIGHWAY
- INTERSTATE
- LOCAL ROAD
- MUNICIPAL BOUNDARY
- DETOUR
- WATERWAY
- DETOUR SIGN
- DETOUR SIGN ON TYPE III BARRICADE
- TRAFFIC FLOW ARROW
- WORK AREA
- FINAL PAVEMENT

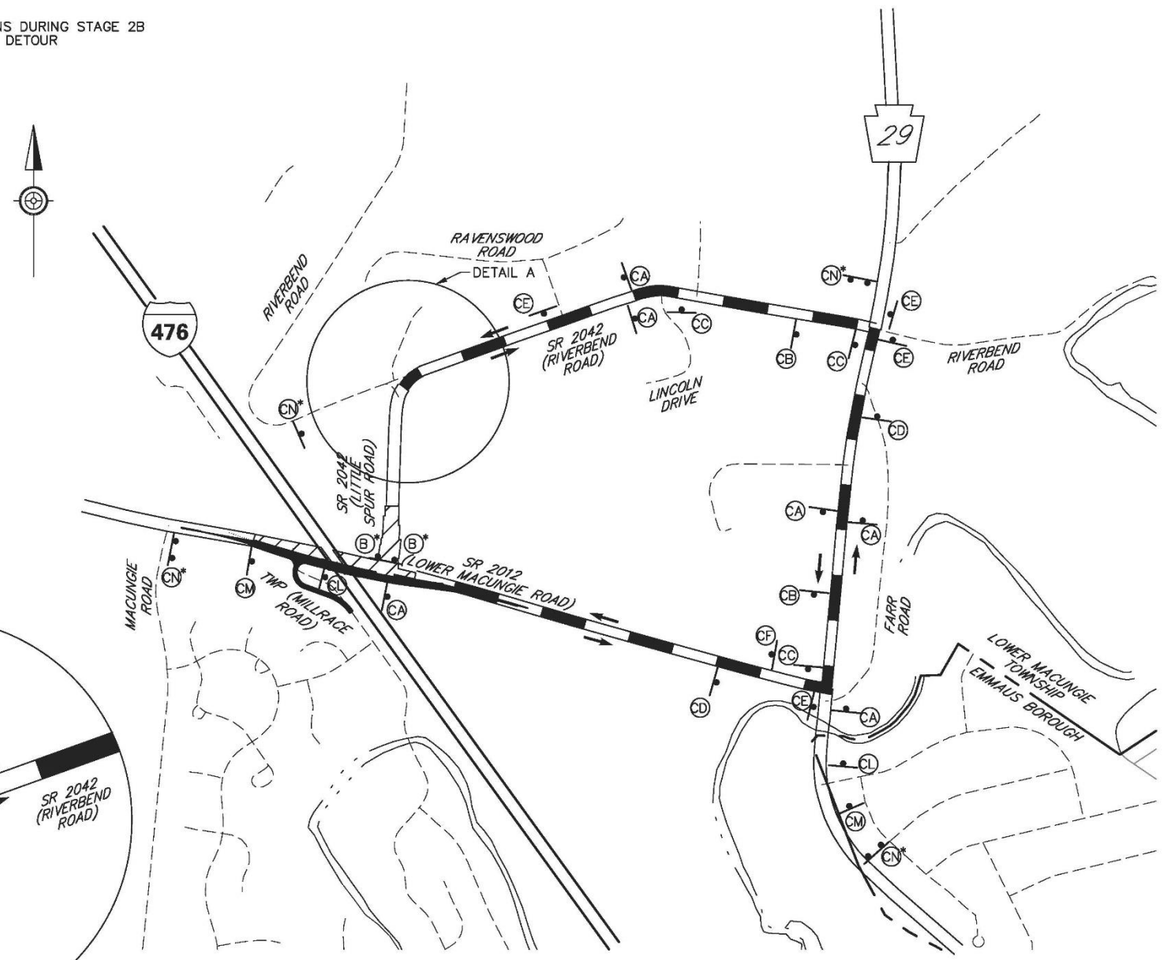
* REMOVE/COVER REDUNDANT SIGNS DURING STAGE 2B
SR 2012 (LOWER MACUNGIE ROAD) DETOUR

TABULATION OF TRAFFIC CONTROL SIGNS

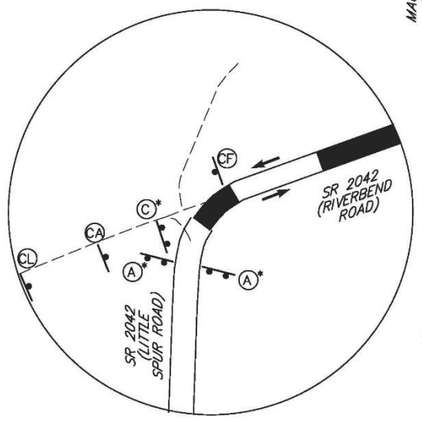
INCLUDED IN ITEM 2901-0001
(FOR INFORMATION ONLY)

SIGN	SIZE	NUMBER REQUIRED	REMARKS
R11-2	48"x30"	5	BARRICADE ENTIRE ROADWAY
M4-8A	24"x18"	2	-----
M4-9L	30"x24"	4	-----
M4-9R	30"x24"	3	-----
M4-9S	30"x24"	7	-----
M4-9SL	30"x24"	2	-----
M4-9SR	30"x24"	2	-----
M4-10R	48"X18"	2	-----
M4-10L	48"X18"	1	-----
W20-2	36"x36"	5	-----
W23-101	96"x48"	2	-----
W30-1-1	20"x6"	3	-----
W30-1-2	20"x6"	2	-----
SP-5	48"X42"	4	LSR CLOSED AT LMR
SP-3	42"X18"	25	LITTLE SPUR ROAD

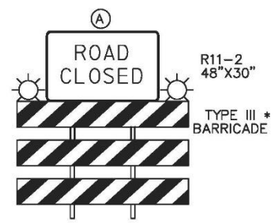
* THE SIZES SHOWN ARE MINIMUM REQUIREMENTS

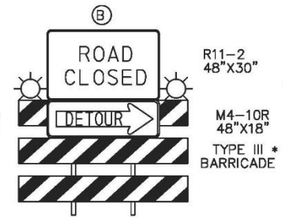


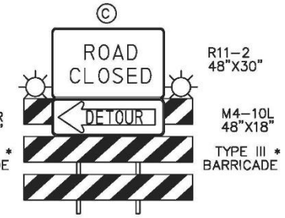
DETOUR LENGTH 1.70 MI

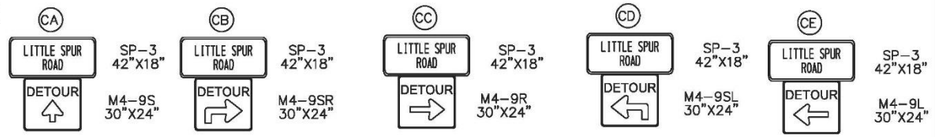


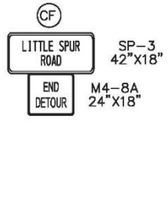
DETAIL A
NOT TO SCALE

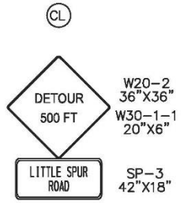


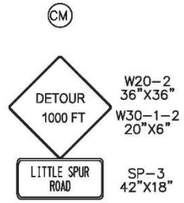


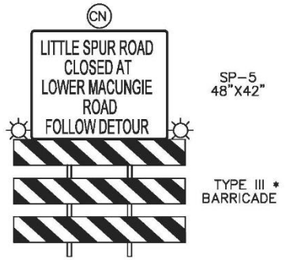












*INSTALL STRIPES ON BARRICADE RAILS PER PENNDOT PUBLICATION 213, GENERAL APPLICATION 11-B

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL — MARTIN ROSEN — ENGINEER — No. 075647

PREPARED BY:
TRAFFIC PLANNING AND DESIGN, INC.
2500 EAST HIGH STREET, SUITE 650
POTTSTOWN, PA 19464

PREPARED FOR:
THE PENNSYLVANIA TURNPIKE COMMISSION

PENNA TURN PIKE

NO.	REVISIONS	DATE	APPR.

WBS NO. **A-053.00T001-3-05**
NETWORK NUMBER: 7010366
FILE NAME: 5357MPTdp04.dgn
DRAWING TYPE: **1A**
STRUCTURE NUMBER: **NB-336**
SCALE: 0 500 1000 SCALE IN FEET

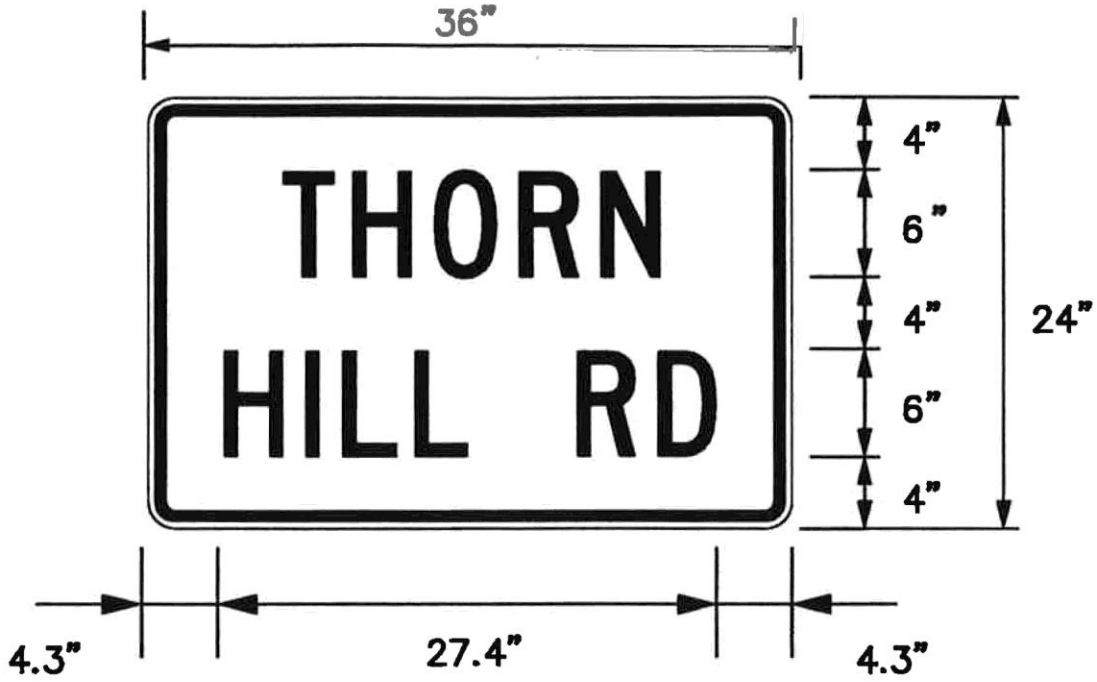
REPLACMENT OF BRIDGE NO. NB-336
AT MILEPOST A-53.36
SR 2012 (LOWER MACUNGIE ROAD)

TRAFFIC CONTROL PLAN
SR 2042 (LITTLE SPUR RD)
DETOUR PLAN
STAGE 2B/3A

DISTRICT: 5 | COUNTY: LEHIGH | DRAWING 1 OF 1
TOWNSHIP / BOROUGH: LOWER MACUNGIE | SHEET 24 OF 25

FILE: pw:\\vgfnet-pw.bentley.com:gfnet-pw-01\Documents\Projects\59828\A-53 to A-57 Total Reconstruction\CADD Files\03 MPT\TPD MPT\04 Plans\Lower Macungie Road\5357MPTdp04-LMR.dgn
DATE: 4/23/2024
TIME: 10:30:56 AM

SPECIAL–3



0.6" BORDER WITH 1.5" RADIUS ON CORNERS WITH 0.375 MARGIN

6" U.C. LET. LET. SERIES C		6" U.C. LET. LET. SERIES C	
7.5		4.3	
4.0	–T	4.5	–H
4.5	–H	2.1	–I
4.7	–O	4.0	–L
4.5	–R	3.0	–L
3.3	–N	6.0	
7.5		4.5	–R
		3.3	–D
36.0		4.3	
		36.0	

NOTE:

1. ALL SIGNS SHALL HAVE AN ORANGE REFLECTORIZED TYPE XI SHEETING BACKGROUND WITH BLACK NON–REFLECTORIZED LEGEND AND BORDER.

APPENDIX D:
SAMPLE SIGN FABRICATION DETAIL -
TEMPORARY STREET NAME SIGN FOR DETOURS
SHEET 2 OF 2

Appendix E: PTC Structure Designation Guidelines

APPENDIX E
PTC Structure Designation Guidelines

All PTC structures are to have a unique designation. For new bridges or culverts as well as existing bridges and culverts which have standard bridge numbers (B-102A/B-111A, S-228A) coordinate with the Bridge Engineering Manager to have a unique number assigned to these structures. For new retaining walls, noise walls, sign structures, and tolling gantries, utilize the following to determine the proper, unique, designation which includes:

- Structure Type;
- Highway/route designation;
- Milepost; and
- Side of Highway.

Structure Type:

- TG = Tolling Gantry (TS or ORT previously used)
- SS = Sign Structure (including DMS)
- RE = Reinforced Earth Wall
- PP = Post and Plank Wall
- RC = Reinforced Concrete Wall
- CR = Crib Wall
- AS = Anchored Soldier Pile Wall
- SN = Soil Nail Wall
- TW = T-Wall or CM = Concrete Modular Wall (Gravix or T-Wall)
  ** Confirm T-Wall or Concrete Modular Wall naming with Bridge Engineering Manager at the TS&L stage.
- N = Noise Wall
  ** For noise walls atop retaining walls, discuss with Bridge Engineering Manager at the TS&L stage.

Highway/Route Designation:

- T = East/West Mainline / I-76, I-70, I-276
- B = Beaver Valley Expressway / I-376
- G = Amos K Hutchinson (Greensburg) Bypass / PA 66
- M = Mon-Fayette Expressway / PA 43
- S = Southern Beltway / PA 576
- A = Northeast Extension / I-476
- C = Connector / Breezewood Connector to I-70
- H = I-95

Milepost:

- Use the milepost at the beginning of the wall, in the direction of travel, rounded to the nearest hundredth. For walls located on the westbound and southbound side of the roadway, this will be at the end of wall station.
- For walls along ramps, the milepost should be determined by projecting a perpendicular line from the point where the wall begins, in the direction of traffic, to the mainline centerline and the corresponding milepost at that location.

Direction:

- EB = Eastbound
- WB = Westbound
- NB = Northbound
- SB = Southbound
- BD = Bi-Directional

The following are examples of a few types of wall designations:

- PP 207.66EB (Post and Plank Wall on eastbound side of E/W mainline)
- RE A-102.53SB (Reinforced earth wall on southbound side of Northeast Extension)
- SN M-57.63NB (Soil Nail Wall on northbound side of Mon-Fayette Expressway)

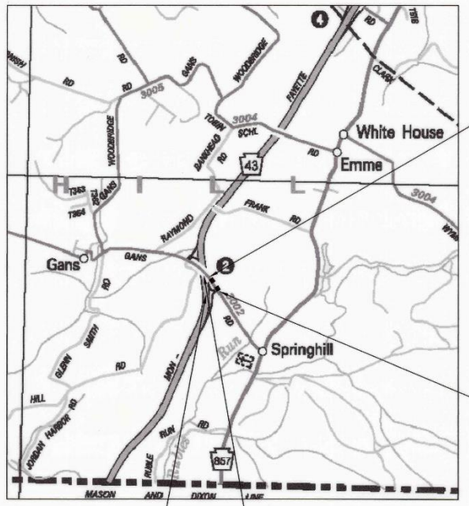
Appendix F: Sample Right-of-Way Plan Title Sheet

COMMONWEALTH OF PENNSYLVANIA

PENNSYLVANIA TURNPIKE COMMISSION

DRAWINGS FOR

RE-ESTABLISHING LIMITED ACCESS RIGHT-OF-WAY
FOR
SR 0043, SECTION 50B
IN FAYETTE COUNTY
FROM STA. 291+48.17 TO STA. 296+98.12 LENGTH 549.95 FT.,0.104 MI.
MP M-001.42 TO MP M-001.52
AND AUTHORIZING RIGHT-OF-WAY
FOR
SR 3002 (GANS ROAD)
IN FAYETTE COUNTY
FROM STA. 90+65.00 TO STA. 96+75.00 LENGTH 610.00 FT., 0.116 MI.
SEG. 0064 OFFSET 1185 TO SEG. 0064 OFFSET 0575



LIMIT OF AUTHORIZATION
STA 90+65.00
SEG 0064, OFFSET 1185
SR 3002
SPRINGHILL TOWNSHIP
FAYETTE COUNTY

LIMIT OF AUTHORIZATION
STA 96+75.00
SEG 0064, OFFSET 0575
SR 3002
SPRINGHILL TOWNSHIP
FAYETTE COUNTY

LIMIT OF REESTABLISHMENT
STA 291+48.17
SR 0043
MP M-001.42
SPRINGHILL TOWNSHIP
FAYETTE COUNTY

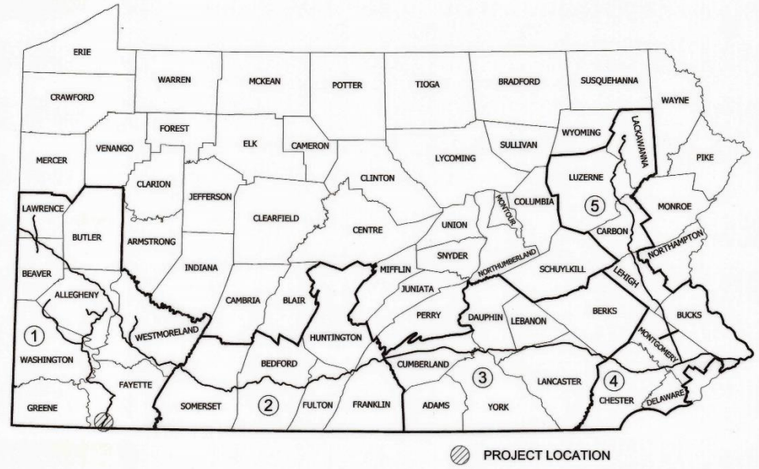
LIMIT OF REESTABLISHMENT
STA 296+98.12
SR 0043
MP M-001.52
SPRINGHILL TOWNSHIP
FAYETTE COUNTY

LOCATION MAP

SCALE IN MILES
0.5 0 0.5

LEGEND

PROJECT
STATE HIGHWAY
TOWNSHIP ROAD



PROJECT LOCATION

DISTRICT	COUNTY	TOWNSHIP / BOROUGH	SECTION	SHEETS
1	FAYETTE	SPRINGHILL TOWNSHIP		3

SR 3002 PREVIOUSLY KNOWN AS LR 26080

RECORDED IN THE OFFICE FOR THE RECORDING OF DEEDS, ETC. IN _____ COUNTY, PENNSYLVANIA.

BOOK _____ PAGE _____

WITNESS MY HAND AND SEAL OF OFFICE.

_____ DATE

_____ RECORDER

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF _____
BEFORE ME, A NOTARY PUBLIC, PERSONALLY CAME _____
OF THE PENNSYLVANIA TURNPIKE COMMISSION WHO ACKNOWLEDGED THE WITHIN PLAN, COMPRISING ___ SEPERATE SHEETS, TO BE AN OFFICAL PLAN OF THE PENNSYLVANIA TURNPIKE COMMISSION AND DESIRED THAT THE SAME BE RECORDED AS SUCH.

WITNESS MY HAND AND NOTORIAL SEAL.

_____ DATE

_____ NOTARY PUBLIC

APPROVED:

_____ DATE

_____ DEPUTY SECRETARY FOR HIGHWAY ADMINISTRATION, PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

THIS PLAN PREPARED PURSUANT TO PENNSYLVANIA TURNPIKE COMMISSION ENABLING ACTS, ACT 211 OF MAY 21, 1937, P.L. 774, 36 P.S. § 652 ET SEQ. AND AS AMENDED AND ACT 61 OF SEPTEMBER 30, 1985, P.L. 240, 36 P.S. § 651.1 ET SEQ. AND AS AMENDED.

SCALE
HORIZONTAL 0 50 100 FEET

WBS NO. EN-00251-04-01
NETWORK NUMBER: 6012090
FILE NAME:
DRAWING TYPE:
STRUCTURE NUMBER:

PREPARED BY:

_____ DATE

_____ DATE

RECOMMENDED:

_____ DATE

_____ CHIEF ENGINEER, PENNSYLVANIA TURNPIKE COMMISSION

APPROVED:

_____ DATE

_____ ASSISTANT SECRETARY AND TREASURER, PENNSYLVANIA TURNPIKE COMMISSION

_____ COMMISSION APPROVAL

File name: T:\Survey Contract\Survey Contract 2017-2019\WO 10-RW Plan @ M-1.45\Contract #4400007864-10\CADD Files\02 Right-of-Way\04 Plans #-#\SR 3002 RW TITLE.dwg Jan 26, 2021-8:35am rmeese

Appendix G: Sample Deed Description

ALL THAT CERTAIN tract or parcel of land situated in xxxx Township, xxxxx County, Commonwealth of Pennsylvania, being bound and described according to the Pennsylvania Turnpike Commission Plan No. R/W xxxx, WBS No. xxxx, dated xxxxx xx, xxxx, and as follows to wit:

REQUIRED RIGHT-OF-WAY FOR LIMITED ACCESS:

BEGINNING at a point on the westerly legal right-of-way line for limited access of the Pennsylvania Turnpike Commission and southerly line of lands now or formerly of John Doe and Jane Doe, said point being located xxx.xx feet, more or less, left of and opposite Survey and Right-of-Way Baseline Station xxx+xx±;

Thence along the southerly line of lands now or formerly of John Doe and Jane Doe, South xx° xx' xx" West, a distance of xxx.xx feet to a point being located xxx feet, more or less, left of and opposite Survey and Right-of-Way Baseline Station xxx+xx±;

Thence through lands now or formerly of John Doe and Jane Doe the following two (2) courses and distances:

1) North xx° xx' xx" West, a distance of xxx.xx feet to a point being located xxx.xx feet left of and opposite Survey and Right-of-Way Baseline Station xxx+xx.xx;

2) North xx° xx' xx" West, a distance of xx.xx feet to a point on the northerly line of lands now or formerly of John Doe and Jane Doe, said point being located xxx feet, more or less, left of and opposite Survey and Right-of-Way Baseline Station xxx+xx±;

Thence along the northerly line of lands now or formerly of John Doe and Jane Doe, by a curve to the right having a radius of xxxx.xx feet, an arc length of xxx.xx feet, and a chord bearing of South xx° xx' xx" East, a chord distance of xxx.xx feet to the point of BEGINNING.

CONTAINING x.xxx Acre(s).

BEING a portion of *County Tax Parcel ID.*

BEING a portion of the same property which *plot plan grantor*, by deed dated xxxxx xx, xxxx and recorded xxxxx xx, xxxx, in the Recorder of Deeds Office in and for xxxxx County, Pennsylvania, in Deed Book Volume xxxx, Page xxx, granted and conveyed unto *plot plan property owner*, grantor herein.

Appendix H: PTC Property Plat Plan QC Checklist

APPENDIX H:
PTC PROPERTY PLOT PLAN Q/C CHECKLIST

PROJECT: _____

RIGHT-OF-WAY NUMBER: _____

CONSULTANT PREPARING R/W PLAN: _____

PARCEL ID NO.: _____ **CHECKED BY:** _____ **DATE:** _____

- ☐ Preliminary Submission (Prior to Submission to PTC/DM (Internal QC Review))
- ☐ Preliminary Submission (Submission to PTC/DM - Submit Q/C Checklist)
- ☐ Final Submission (Submission to PTC)

Legend for Checklist:
- ☑ = Item Satisfactory
- ☒ = Item Needs Addressed (Comments made as to the issue)
- ☐ ~~= Item Not Applicable~~

1) **PROJECT INFORMATION / SHEET BORDER** (All Drawings)
   - a) ☐ Verify that the latest PTC Property Plan Border is used
   - b) ☐ Verify the WBS No.
   - c) ☐ Verify the Network Number
   - d) ☐ File Name
   - e) ☐ Drawing Type
   - f) ☐ Scale
   - g) ☐ Prepared By Title Block
   - h) ☐ Seals
   - i) ☐ Verify PTC Project Parcel No.
   - j) ☐ Verify Property Owner Name(s)

     Exactly as they appear in the Deed(s), with clarifiers such as - Husband & Wife, Pennsylvania Corporation, etc.
   - k) ☐ Verify Grantor(s)
   - l) ☐ Township / Borough
   - m) ☐ County
   - n) ☐ PTC District
   - o) ☐ Drawing Number
   - p) ☐ Sheet Numbers (Blank Until Plot Plans are included in ROW Plan)
   - q) ☐ Parcel Number in Circle at Lower Right Corner
   - r) ☐ Mile post range of take area displayed in lower right hand corner underneath project parcel number circle (see PTC DCG 19.3.Y)

2) **PROPERTY INFORMATION -** ☐ **Supplemental Table(s) Required**
   - a) ☐ Verify Deed Book Volume and Page / Instrument No.
   - b) ☐ Date of Deed
   - c) ☐ Date of Record
   - d) ☐ Consideration
   - e) ☐ IRS / Tax Stamps (State tax only)
   - f) ☐ Tax Map Parcel (County Tax Map)
   - g) ☐ Parcel No. (County Tax Parcel No.)
   - h) ☐ Verification Date (Must be within 30 Days of Final Date - Item 3)

PROJECT:_____ PARCEL NO.:_____ DATE_____

R/W NO.:_____ CHECKED BY:_____

3) **PROPERTY AREA INFORMATION -** ☐ **Supplemental Table(s) Required**

a) ☐ Verify Deed Area
b) ☐ Verify Calculated Area
(See PTC DCG 19.3.A)

c) ☐ Verify Exception / Adverse Area - ☐ Supplemental Table Required
d) ☐ Verify Legal R/W Area
e) ☐ Verify Effective Area (See PTC DCG 19.3.A)
f) ☐ Verify Required R/W Area
g) ☐ Verify Total Residue
h) ☐ Verify Left Residue
i) ☐ Verify Right Residue
j) ☐ Required R/W for Limited Access Area Agrees with Table(s)
k) ☐ Required R/W for State Road/Township Road/Borough/City Street Area Agrees with Table(s)
l) ☐ Required Temporary Construction Easement Area Agrees with Table(s)
m) ☐ Required Drainage Easement Area Agrees with Table(s)
n) ☐ Required Slope Easement Area Agrees with Table(s)
o) ☐ Required Substitute R/W for _____ Area Agrees with Table(s)
p) ☐ Additional Take Areas such as Private Access Areas, Occasional Flowage Easement, etc.
q) ☐ Pre-Final Date (Date Plot Plan Submitted - to be revised for each submission - see PTC DCG 19.3.I)
r) ☐ Final Date (Blank until ROW Plan is submitted)

4) **DRAWING - PROPERTY PLOT PLAN**

ALL PROPERTY PLOT PLAN DRAWINGS

a) ☐ Verify *slanted* text labels for all existing features, and vertical text labels for all proposed features
b) ☐ Verify Entire Parcel is Shown - ☐ PL's for Parcel Shown Bold ☐ *POB* of Deed Indicated ☐ POB of required rights-of-way and / or permanent easements
c) ☐ Deed Description Table - ☐ Verify Labeling on Property Plot Plan
d) ☐ Topography Turned On - ☐ Topography Labeled - Improvements, Watercourses, Usages, Etc.
e) ☐ North Arrow
f) ☐ Scale
g) ☐ Right-of-Way Baselines including Labels, Stations and Circles of PC, PT, TS, SC, CS and ST (label Bearings if no Detail Drawing Provided)
h) ☐ Required Right-of-Way Lines
i) ☐ Existing Roadway Labeled with Name and Route Number
j) ☐ Property Owner Name(s) and Parcel No.
k) ☐ Adjacent Property Owners Name and Parcel No.'s (use *N/F* only if no Parcel No. Assigned)
l) ☐ Detailed Drawing(s) and /or Supplemental Sheets Required
☐ Detail Area Indicated ☐ Cross Reference Note(s)
m) ☐ Verify scaled and monumented dimension presentation (PennDOT Pub 14M (DM-3), section 3.4.H.5.(c))
n) REQUIRED NOTES
☐ Oil and Gas Note (see PTC Property Plot Plan Notes) - only with limited access takes
☐ Surface Mining Note (see PTC Property Plot Plan Notes) - only with limited access takes
☐ The Ties, Bearings and Distances Note (PTC DCG 6.2.D.4)
☐ This Property Plot Plan is Plotted Note (PTC DCG 6.2.D.4)
☐ Plotting of Property Lines Note (PTC DCG 6.2.D.4)
☐ This Property Plot Plan is not to be Substituted Note (PTC DCG 6.2.D.4)
☐ Fee Simple Note (PTC DCG 6.2.D.4)

o) ADDITIONAL NOTES (Change Department to Commission when appropriate)

- ☐ C and/or O Note (PennDOT Pub 14M (DM-3), section 3.4.H.5.a and/or 3.4.H.5.b
- ☐ Slope Easement Note (PTC DCG 6.2.D.4)
- ☐ Drainage Easement Note (PTC DCG 6.2.D.4)
- ☐ Channel Easement Note (PennDOT Pub 14M (DM-3), section 3.6.A.12.(d))
- ☐ Occasional Flowage Easement Note (PennDOT Pub 14M (DM-3), section 3.6.A.12.(e)) with flood frequency information on the Property Plot Plan
- ☐ Temporary Construction Easement Note (PTC DCG 6.2.D.4)
- ☐ Vacation Note (PTC DCG 6.2.D.4)
- ☐ Abandoment Note (PennDOT Pub 14M (DM-3), section 3.4.H.5.(j))
- ☐ Underground Anchor Easement Note (PTC DCG 6.2.D.4)
- ☐ Underground Structure Support Easement Note (PennDOT Pub 14M (DM-3), section 3.6.A.12.(g))
- ☐ Right-of-Way for Local Roads and Streets Note (PennDOT Pub 14M (DM-3), section 3.6.A.12.(i))
- ☐ Aerial Easement Note (PennDOT Pub 14M (DM-3), section 3.4.H.5.r) with extra note (see PTC Property Plot Plan Notes) and Aerial Easement Sketch with notes (PennDOT Pub 14M (DM-3), section 3.4.H.5.r)
- ☐ Utility Rights Information when Substiture ROW is taken
- ☐ Other Applicaple Easement Notes

p) ☐ Legend - Verify Only Appropriate Symbols Shown

q) ☐ Hatching of Take Areas Match Hatching in Legend

ALL PROPERTY PLOT PLAN DRAWINGS IF NO DETAIL DRAWING PROVIDED

r) ☐ Verify Station and Offset Labels with COGO output

s) ☐ Right-of-Way Fence Shown and Labeled Correctly

t) ☐ Proposed Roadways

u) ☐ Proposed Drainages

v) ☐ Proposed Structures

w) ☐ Curve Data as Applicable

x) ☐ Existing Roadway's Legal R/W Shown and Labeled

5) **DRAWING - SUPPLEMENTAL DATA**

a) ☐ Table of Bearing and Distances for all required areas. Proceed clockwise from POB.

b) ☐ Verify Table Labels Agree With Take Areas

c) ☐ Verify Tables with COGO output - ☐ Bearing / Distance ☐ Area

COMMENTS

PROJECT:_____ PARCEL NO.:_____ DATE_____

R/W NO.:_____ CHECKED BY:_____

6) **LISTING OF DETAIL DRAWINGS**

a) ☐ Drawing 2 - Description _____

b) ☐ Drawing 3 - Description _____

c) ☐ Drawing 4 - Description _____

d) ☐ Drawing 5 - Description _____

e) ☐ Drawing 6 - Description _____

COMPLETE ITEM 7 FOR ALL DETAIL DRAWINGS INDICATED ABOVE - USE AS MANY SHEETS AS REQUIRED

7) **DETAIL DRAWING NO._____**

a) ☐ Verify Detail Area matches Area indicated on Property Plot Plan Drawing

b) ☐ Topography turned on and labeled - Improvements, Watercourses, Usages, etc.

c) ☐ North Arrow

d) ☐ Scale

e) ☐ Right-of-Way Baselines including Labels, Stations, Circles of PC, PT, TS, SC, CS and ST and Bearings

f) ☐ Required Right-of-Way Lines with Stations and Offset Labels (verify with COGO output)

g) ☐ Existing Roadway Labeled with Name and Route Number

h) ☐ Existing Roadway's Legal R/W Shown and Labeled

i) ☐ Property Owner Name(s) and Parcel No.

j) ☐ Adjacent Property Owners Name and Parcel No.'s (use N/F only if no Parcel No. Assigned)

k) ☐ Cross-Refernce Note(s) to Property Plot Plan Drawing

l) ☐ Verify Station and Offset labels

m) ☐ Right-of-Way Fence Shown and Labeled Correctly

n) ☐ Proposed Roadways

o) ☐ Proposed Drainage, E&S, etc.

p) ☐ Proposed Structures

q) ☐ Curve Data as Applicable

r) ☐ Legend - Verify Only Appropriate Symbols Shown

s) ☐ Hatching of Take Areas Match Hatching in Legend

COMMENTS

_____

_____

_____

_____

Appendix I: PTC Stormwater Control Measure Cataloging

APPENDIX I:
PTC Stormwater Control Measure (SCM) Identification Guidelines

An individual Stormwater Control Measure gets its unique identifier from five (5) attributes separated by single dashes. The five (5) attributes are as follows:

1. Route
2. Milepost
3. Direction
4. Offset
5. SCM Type

Route: There are eight (8) routes that are part of the PTC system, each with its own lettered symbol. Symbols and associated routes as follows:

- T = Mainline / I-76, I-70, I-276
- B = Beaver Valley Expressway / I-376
- G = Amos K Hutchinson (Greensburg) Bypass / PA 66
- M = Mon-Fayette Expressway / PA 43
- S = Southern Beltway / PA 576
- A = Northeast Extension / I-476
- C = Connector / Breezewood Connector to I-70
- H = Interstate 95 (Previously T-356.4 to 359)

Milepost: Using the centroid of the SCM, delineates what milepost along the route it is located, round to the nearest hundredth. Location determined via line from centroid of BMP to point perpendicular to the centerline of the Turnpike route.

Direction: Describes what side of the route the SCM is located on. Options as follows:

- EB = Eastbound
- WB = Westbound
- NB = Northbound
- SB = Southbound

Offset: The perpendicular distance, in feet, rounded to the nearest whole number, of the SCM's centroid from the PTC centerline.

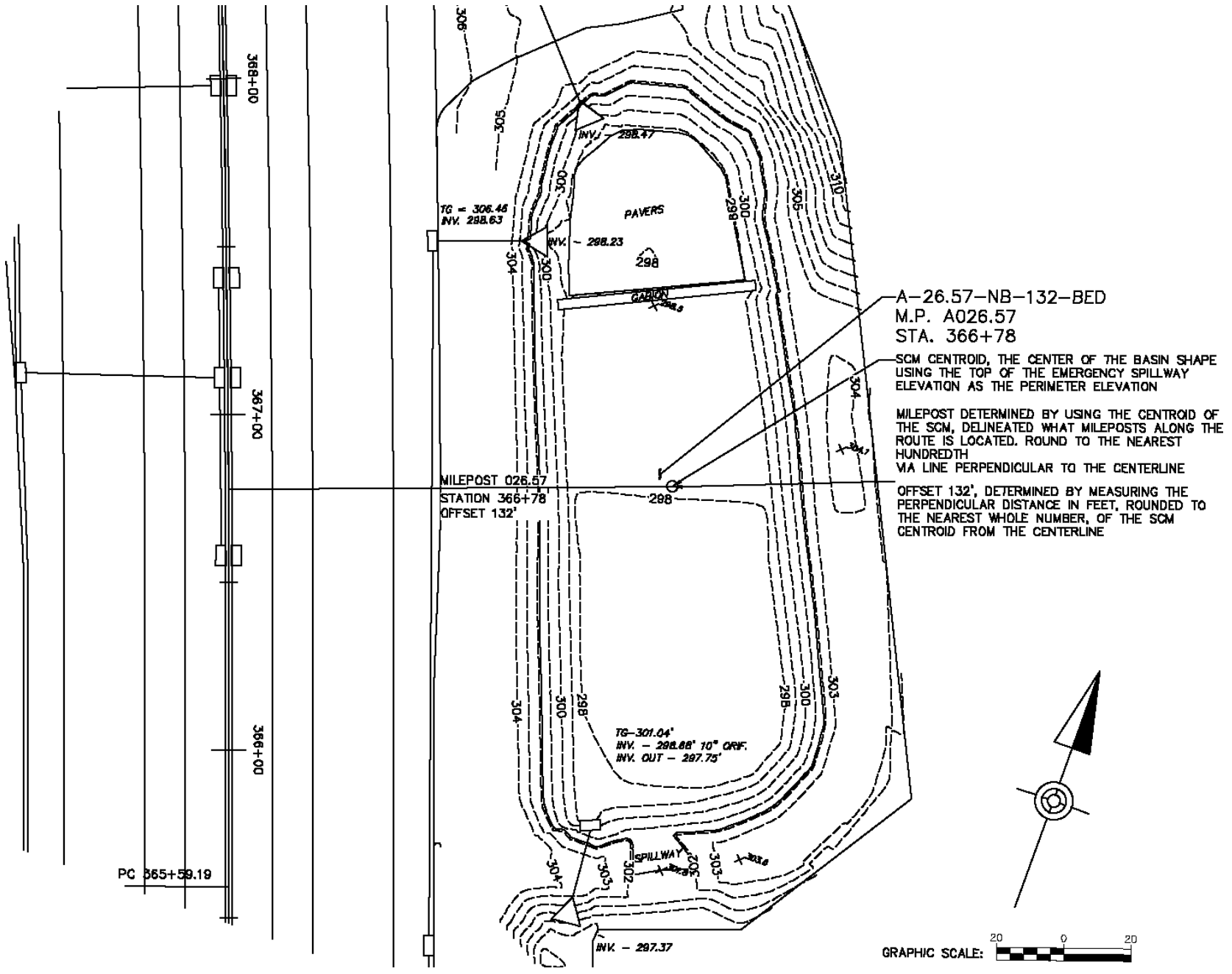
SCM Type: SCMs are classified as one of thirty-six different SCM types, derived from the PA DEP Stormwater Best Management Practices Manual OR PTC's Stormwater Control Measure Operations and Maintenance Manual. The below SCM Types are represented by the following Type Codes:

SCM Type	Type Code
Basin, Dry Detention	BDD
Basin, Dry Extended Detention	BED
Basin, Dry Ultra-Extended Detention	BUD
Basin, Infiltration Detention	BID
Basin, Naturalized Detention	BND
Basin, Wet Detention	BWD
Basin, Other	BOT
Bioretention/Raingarden	BRE
Bioretention/Raingarden with Underdrain	BRU
Constructed Stormwater Filter	CSF
Flow Dispersion, Forest/Buffer	FDF
Flow Dispersion, Vegetated Filter Strip	FDV
Forest Preservation	FPR
Infiltration Berm	IBE
Landscape Restoration Meadow	LRM
Level Spreader Outfall	LSO
Manufactured Treatment Device	MTD
Media Filter Drain	MFD

SCM Type	Type Code
Non-Basin SCM, Other	NBO
Pervious Pavement, Asphalt	PPA
Pervious Pavement, Concrete	PPC
Pervious Pavement, Pavers	PPP
Reforestation/Tree Plantings	RTP
Regenerative Step Pool	RSP
Riparian Buffer Enhancement	RBE
Riparian Buffer Offset	RBO
Soil Amendment Restoration	SAR
Stormwater Wetland	SWE
Stream Restoration	SRE
Stream Stabilization	SST
Subsurface Detention Storage	SDS
Subsurface Infiltration Trench	SIT
Vegetated Filter Strip	VFS
Vegetated Filter Strip, Steep Slope	VSS
Vegetated Swale	VSW
Vegetated Swale with Check Dams	VSC

Example: A-26.57-NB-132-BED

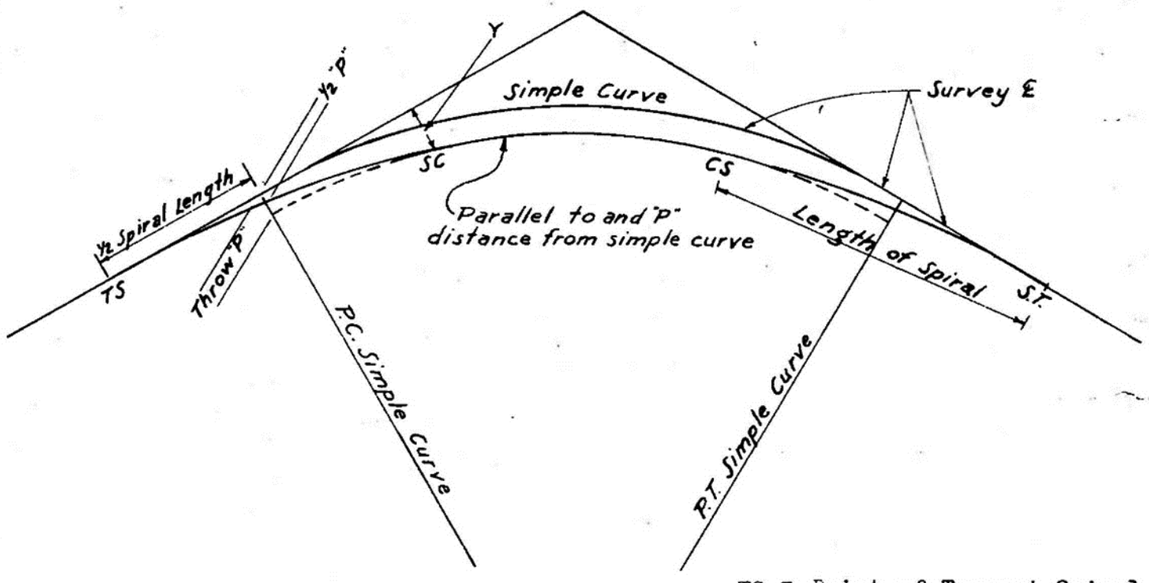
Attribute 1: The SCM is located on the Northeast Extension/I-476 so it gets an **A**.
Attribute 2: The SCM centroid is perpendicular to the centerline at milepost **26.57**.
Attribute 3: The SCM is on the Northbound side of the route so it gets a **NB**.
Attribute 4: The SCM centroid is offset perpendicular from the centerline **132'**.
Attribute 5: The SCM type is a Dry Extended Detention Basin so it gets Type Code **BED**.



Appendix J: Standard Spiraling Method for Simple Curves

PENNSYLVANIA TURNPIKE COMMISSION

STANDARD METHOD FOR SPIRALING SIMPLE CURVES



TS = Point of Tangent Spiral
SC = " " Spiral Curve
CS = " " Curve Spiral
ST = " " Spiral Tangent

Length of Spiral and Throw "P" will be shown for each individual curve in addition to simple curve data.

For distance from survey line to spiraled curve between TS and SC also CS and ST see tabulation for degree of curve and length of spiral. From SC to CS offset distance is "P".

TO DETERMINE OFFSET DISTANCE FROM SURVEY CENTER LINE TO SPIRALED CURVE

Between TS and SC the offset from the tangent to the spiral varies as the length from TS cubed.

In order to determine the offset distance from survey center line to points on a spiral the distance from the tangent to SC (shown as Y on sketch) and the length of spiral are required. It will be noted from the above that Y is 4P. The distance Y may be obtained direct from Allen's tables (shown as X) or from the Bureau of Public Road's table (shown as Yc). Minor variation in the last figure from any of these three sources is the result of degree of refinement in calculation and can be disregarded.

The Bureau's values have been used in the following tables:

Steps in determining offset distance from survey center line to spiraled curve is as follows:

1. Determine "length of spiral" and distance "Y" from drawings or standards.
2. Assume PC or PT of simple curve as center of the spiral.
3. For offset distance from tangent starting from TS.

$$\text{Offset} = \left(\frac{N}{L}\right)^3 \times Y$$

Where L = "length of spiral" and N = distance along tangent from TS.

Note that tables for value of $\left(\frac{N}{L}\right)^3$ for various lengths of spirals are furnished.

From the TS to PC and ST to PT the offset from the tangent is the required information.

4. From PC to SC and PT to CS obtain offset distance from tangent as above and subtract offset from tangent to simple curve i.e.-Offset distance from survey center line to spiraled curve = (Offset from tangent to spiraled curve).-(Offset from tangent to simple curve).
5. From SC to CS the offset remains constant and is equal to "P" (This results in a slight shortening of the radius which is generally advantageous).

In case there are curves other than those included in the following tables, the same method of offsetting is to be used. Care must be used in selecting the length of spiral in that the spiral is of sufficient length to satisfy the condition of approaching centrifugal acceleration and condition of slope on the outside edge of pavement.

Y and P can be found for odd degree of curves by simple interpolation.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FROM SURVEY CENTER LINE

Distance from TS or ST	Degree of Curve / Length of Spiral	2°00' / 200	2°15' / 225	2°30' / 250	3°00' / 250	2°45' / 250	2°45' / 275
10 TS or ST		--	--	--	--	--	--
20		--	--	--	--	--	--
30		.01	.01	.01	.01	.01	.01
40		.02	.02	.02	.02	.02	.02
50		.04	.04	.04	.04	.04	.04
60		.06	.06	.06	.08	.07	.06
70		.10	.10	.10	.12	.11	.10
80		.15	.15	.15	.18	.16	.15
90		.21	.21	.21	.25	.23	.21
100		.29 P.C. or P.T.	.29	.29	.35	.32	.29
110		.37	.39	.39	.46	.43	.39
112.5			P.C. or P.T.				
120		.43	.49	.50	.60	.55	.50
125				P.C. or P.T.	P.C. or P.T.	P.C. or P.T.	
130		.48	.58	.63	.76	.69	.64
137.5							P.C. or P.T.
140		.52	.65	.75	.90	.83	.78
150		.54	.71	.84	1.05	.93	.94
160		.56	.75	.93	1.11	1.01	1.07
170		.57	.78	.98	1.18	1.08	1.19
180		.58	.81	1.03	1.24	1.14	1.27
190		.58	.82	1.06	1.28	1.18	1.34
200		.58 S.C. or C.S.	.82	1.10	1.32	1.21	1.39
210			.82	1.11	1.34	1.23	1.43
220			.83	1.13	1.35	1.24	1.47
225			.83 S.C. or C.S.				
230				1.13	1.35	1.25	1.49
240				1.14	1.36	1.25	1.50
250				1.14 S.C. or C.S.	1.36 S.C. or C.S.	1.25 S.C. or C.S.	1.51
260							1.51
270							1.52
275							1.52 S.C. or C.S.

200' Spiral - 2°00' Curve - P= 0.58
225' Spiral - 2°15' Curve - P= 0.83
250' Spiral - 2°30' Curve - P= 1.14
250' Spiral - 3°00' Curve - P= 1.36
250' Spiral - 2°45' Curve - P= 1.25
275' Spiral - 2°45' Curve - P= 1.52

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 2° 30' CURVE

Distance from TS or ST	Offset from Survey Center Line 300'	250'	200'
0 (TS or ST)	--	--	--
10	--	--	--
20	--	--	--
30	.01	.01	.01
40	.02	.02	.02
50	.03	.04	.05
60	.05	.06	.08
70	.08	.10	.12
80	.12	.15	.19
90	.18	.21	.27
100	.24	.29	.36 (PC or PT)
110	.32	.39	.46
120	.42	.50	.54
125	--	.57 (PC or PT)	--
130	.53	.63	.60
140	.66	.75	.65
150	.82 (PC or PT)	.84	.68
160	.97	.92	.71
170	1.10	.99	.72
180	1.22	1.04	.73
190	1.31	1.07	.73
200	1.39	1.10	.73 (SC or CS)
210	1.46	1.12	
220	1.51	1.13	
230	1.55	1.13	
240	1.58	1.13	
250	1.60	1.13 (SC or CS)	
260	1.62		
270	1.63		
280	1.63		
290	1.63		
300	1.63 (SC or CS)		

300' Spiral - P=1.63 Use where topography is favorable.
250' Spiral - P=1.13
200' Spiral - P=0.73 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 3° CURVE

Distance from TS or ST	Offset from Survey Center Line 350'	300'	200'
0 (TS or ST)	--	--	--
10	--	--	--
20	--	--	--
30	.01	.01	.01
40	.02	.02	.03
50	.03	.04	.05
60	.05	.06	.09
70	.09	.10	.15
80	.13	.15	.22
90	.18	.21	.32
100	.25	.29	.44 (PC or PT)
110	.33	.39	.56
120	.43	.50	.65
130	.55	.64	.72
140	.68	.80	.78
150	.84	.98 (PC or PT)	.82
160	1.02	1.17	.84
170	1.22	1.32	.86
175	1.34 (PC or PT)	--	--
180	1.44	1.46	.86
190	1.65	1.58	.87
200	1.83	1.67	.87 (SC or CS)
210	1.99	1.75	
220	2.12	1.81	
230	2.24	1.86	
240	2.33	1.90	
250	2.42	1.93	
260	2.49	1.94	
270	2.54	1.95	
280	2.58	1.96	
290	2.62	1.96	
300	2.64	1.96 (SC or CS)	
310	2.65		
320	2.66		
330	2.66		
340	2.66		
350	2.67 (SCor CS)		

350' Spiral - P=2.67 Use where topography is favorable.
300' Spiral - P=1.96
200' Spiral - P=0.87 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 3° 30' CURVE

Distance from TS or ST	Offset from Survey Center Line 350'	300'	250'
0 (TS or ST)	.00	.00	.00
10	.00	.00	.00
20	.00	.00	.00
30	.01	.01	.01
40	.02	.02	.03
50	.04	.04	.05
60	.06	.07	.09
70	.10	.12	.14
80	.15	.17	.21
90	.21	.25	.30
100	.29	.34	.41
110	.39	.45	.54
120	.50	.59	.70
125	--	--	.80 (PC or PT)
130	.64	.75	.88
140	.80	.93	1.05
150	.98	1.15 (PC or PT)	1.18
160	1.19	1.36	1.30
170	1.43	1.55	1.38
175	1.56 (PC or PT)	--	--
180	1.68	1.71	1.45
190	1.92	1.84	1.50
200	2.13	1.95	1.54
210	2.32	2.04	1.56
220	2.48	2.12	1.57
230	2.62	2.18	1.58
240	2.73	2.22	1.59
250	2.82	2.25	1.59 (SC or CS)
260	2.90	2.26	
270	2.96	2.28	
280	3.01	2.29	
290	3.05	2.29	
300	3.08	2.29 (SC or CS)	
310	3.10		
320	3.10		
330	3.10		
340	3.11		
350	3.12 (SC or CS)		

350' Spiral - P=3.12 Use where topography is favorable.
300' Spiral - P=2.29
250' Spiral - P=1.59 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 4° CURVE

Distance from TS or ST	Offset from Survey Center Line 350'	300'	250'
0 (TS or ST)	.00	.00	.00
10	.00	.00	.00
20	.00	.00	.00
30	.01	.01	.01
40	.02	.02	.03
50	.04	.05	.06
60	.07	.08	.10
70	.11	.13	.16
80	.17	.20	.24
90	.24	.28	.34
100	.33	.39	.47
110	.44	.52	.62
120	.57	.67	.80
125	--	--	.91 (PC or PT)
130	.73	.85	1.01
140	.91	1.06	1.20
150	1.12	1.31 (PC or PT)	1.35
160	1.36	1.55	1.48
170	1.63	1.76	1.58
175	1.78 (PC or PT)	--	--
180	1.93	1.95	1.65
190	2.20	2.10	1.72
200	2.44	2.22	1.76
210	2.65	2.33	1.79
220	2.83	2.42	1.80
230	2.99	2.48	1.81
240	3.12	2.53	1.81
250	3.23	2.56	1.82 (SC or CS)
260	3.32	2.59	
270	3.39	2.60	
280	3.44	2.61	
290	3.48	2.61	
300	3.51	2.62 (SC or CS)	
310	3.53		
320	3.54		
330	3.55		
340	3.56		
350	3.56 (SC or CS		

350' Spiral - P=3.56 Use where topography is favorable.
300' Spiral - P=2.62
250' Spiral - P=1.82 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 4° 30' CURVE

Distance from TS or ST	Offset from Survey Center Line 400'	350'	300'
10	--	--	--
20	--	--	--
30	.01	.01	.01
40	.02	.02	.03
50	.04	.05	.05
60	.07	.08	.09
70	.11	.13	.15
80	.17	.19	.22
90	.24	.27	.32
100	.33	.37	.44
110	.43	.50	.58
120	.56	.65	.75
130	.72	.82	.96
140	.90	1.03	1.20
150	1.10	1.26	1.47 (PC or PT)
160	1.34	1.53	1.75
170	1.61	1.84	1.99
175	--	2.00 (PC or PT)	--
180	1.91	2.17	2.19
190	2.24	2.48	2.36
200	2.61 (PC or PT)	2.74	2.51
210	2.99	2.98	2.62
220	3.32	3.18	2.72
230	3.62	3.36	2.79
240	3.89	3.51	2.85
250	4.12	3.63	2.89
260	4.33	3.73	2.91
270	4.51	3.81	2.93
280	4.66	3.87	2.94
290	4.79	3.92	2.94
300	4.90	3.95	2.94 (SC or CS)
310	4.98	3.98	
320	5.05	3.99	
330	5.11	4.00	
340	5.15	4.00	
350	5.18	4.01 (SC or CS)	
360	5.20		
370	5.21		
380	5.22		
390	5.22		
400	5.23		

400' Spiral - P=5.23 Use where topography is favorable.
350' Spiral - P=4.01
300' Spiral - P=2.94 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 5° CURVE

Distance from TS or ST	Offset from Survey Center Line 400'	350'	300'
0	.00	.00	.00
10	.00	.00	.00
20	.00	.00	.00
30	.01	.01	.01
40	.02	.03	.03
50	.05	.05	.06
60	.08	.09	.10
70	.12	.14	.17
80	.19	.21	.25
90	.25	.30	.35
100	.36	.41	.48
110	.48	.55	.64
120	.63	.72	.84
130	.80	.91	1.06
140	1.00	1.14	1.33
150	1.22	1.40	1.63 (PC or PT)
160	1.49	1.70	1.94
170	1.78	2.04	2.20
175	--	2.22 (PC or PT)	--
180	2.12	2.41	2.43
190	2.49	2.75	2.62
200	2.90 (PC or PT)	3.05	2.78
210	3.32	3.30	2.91
220	3.69	3.54	3.02
230	4.02	3.73	3.10
240	4.32	3.90	3.16
250	4.58	4.03	3.20
260	4.81	4.14	3.23
270	5.00	4.23	3.25
280	5.17	4.30	3.26
290	5.32	4.35	3.26
300	5.43	4.38	3.27
310	5.53	4.41	
320	5.61	4.43	
330	5.67	4.43	
340	5.71	4.44	
350	5.75	4.45	
360	5.77		
370	5.78		
380	5.79		
390	5.80		
400	5.81		

400' Spiral - P=5.81 Use where topography is favorable.
350' Spiral - P=4.45
300' Spiral - P=3.27 Can be used only where grade is held at center of each lane and superelevation is attained by tipping around this point.

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 5° 30' CURVE

Distance from TS or ST	Offset from Survey Center Line 400'	350'
0	--	--
10	--	--
20	--	--
30	.01	.01
40	.03	.03
50	.05	.06
60	.09	.10
70	.14	.16
80	.20	.23
90	.29	.33
100	.40	.46
110	.53	.61
120	.69	.79
130	.88	1.00
140	1.09	1.25
150	1.35	1.54
160	1.63	1.87
170	1.96	2.24
175	--	2.45 (PC or PT)
180	2.33	2.65
190	2.74	3.02
200	3.19 (PC or PT)	3.35
210	3.64	3.64
220	4.06	3.89
230	4.42	4.10
240	4.75	4.28
250	5.03	4.43
260	5.28	4.55
270	5.50	4.65
280	5.69	4.73
290	5.84	4.78
300	5.97	4.86
310	6.08	4.85
320	6.16	4.87
330	6.23	4.87
340	6.28	4.88
350	6.31	4.88 (SC or CS)
360	6.34	
370	6.35	
380	6.36	
390	6.36	
400	6.36 (SC or CS)	

400' Spiral - P=6.39 Use where topography is favorable.
350' Spiral - P=4.90

TABULATION OFFSET DISTANCE TO SPIRALED CURVE FOR 6° CURVE

Distance from TS or ST	Offset from Survey Center Line 400'	350'
0 (TS or ST)	.00	.00
10	.00	.00
20	.00	.00
30	.01	.01
40	.03	.03
50	.05	.06
60	.09	.11
70	.15	.17
80	.22	.25
90	.32	.36
100	.44	.50
110	.58	.66
120	.75	.86
130	.96	1.09
140	1.19	1.37
150	1.47	1.68
160	1.78	2.04
170	2.14	2.44
175	—	2.67 (PC or PT)
180	2.54	2.89
190	2.98	3.29
200	3.48 (PC or PT)	3.65
210	3.98	3.97
220	4.42	4.24
230	4.82	4.47
240	5.17	4.67
250	5.49	4.83
260	5.76	4.96
270	5.99	5.07
280	6.20	5.15
290	6.37	5.21
300	6.52	5.25
310	6.63	5.28
320	6.71	5.30
330	6.79	5.32
340	6.85	5.33
350	6.88	5.34 (SC or CS)
360	6.91	
370	6.93	
380	6.95	
390	6.96	
400	6.97 (SC or CS)	

400' Spiral - P=6.97 Use where topography is favorable.
350' Spiral - P=5.34

LENGTH OF SPIRAL

VALUES FOR $(\frac{N}{L})^3$ FOR VARIOUS LENGTHS OF SPIRAL

N	200	225	250	275	300	350	400
10	.000125	.000088	.000064	.000048	.000037	.000023	.000016
20	.001000	.000702	.000512	.000384	.000296	.000187	.000125
30	.003375	.002369	.001728	.001299	.001000	.000630	.000422
40	.008000	.005621	.004096	.003080	.002370	.001493	.001000
50	.015625	.010971	.008000	.006008	.004629	.002915	.001953
60	.027000	.018970	.013824	.010388	.008000	.005038	.003375
70	.042875	.030109	.021952	.016484	.012704	.008000	.005359
80	.064000	.044928	.032768	.024617	.018963	.011942	.008000
90	.091125	.064000	.046656	.035062	.027000	.017003	.011391
100	.125000	.087765	.064000	.048070	.037037	.023324	.015625
110	.166375	.116787	.085184	.064000	.049296	.031044	.020797
120	.216000	.151675	.110592	.083110	.064000	.040303	.027000
130	.274625	.192900	.140608	.105622	.081370	.051242	.034328
140	.343000	.240874	.175616	.129827	.101630	.064000	.042875
150	.421875	.296340	.216000	.162325	.125000	.078717	.052734
160	.512000	.359577	.262144	.196934	.151704	.095534	.064000
170	.614125	.431310	.314432	.236258	.181963	.114589	.076766
180	.729000	.512000	.373248	.280368	.216000	.136023	.091125
190	.857375	.602152	.438976	.329796	.254037	.159977	.107172
200	1.000000	.702121	.512000	.384716	.296296	.186589	.125000
210		.813028	.592704	.445244	.343000	.216000	.144703
220		.934810	.681472	.512000	.394370	.248350	.166375
225		1.000000					
230			.778688	.585116	.450630	.283778	.190109
240			.884736	.664653	.512000	.322426	.216000
250			1.000000	.751337	.578704	.364431	.244141
260				.845249	.650963	.409936	.274625
270				.946387	.729000	.459079	.307547
275				1.000000			
280					.813037	.512000	.343000
290					.903296	.568840	.381078
300					1.000000	.629738	.421875
310						.694834	.465484
320						.764268	.512000
330						.838181	.561516
340						.916711	.614125
350						1.000000	.669922
360							.729000
370							.791453
380							.857375
390							.926859
400							1.000000

Appendix K: Pennsylvania Turnpike Drilling Protocols

Pennsylvania Turnpike Drilling Protocols for Open-End Drilling Contracts (2024)

Overview – Contracts will be administered as individual work orders consisting of borings that have been approved, identified on a boring location plan, outlined on the contract specific Engineer's Estimate, and have been staked in the field. Smaller projects such as individual bridge replacement projects are typically completed in one work order, while larger projects such as a total reconstruction project may require several work orders for each phase of the design, e.g., roadway borings, structure borings, pavement cores.

A drilling work order, field view meeting, and official notice to proceed are required prior to the start of any drilling operations.

Objective – Define the roles and responsibilities of key personnel involved with the implementation, execution, and invoicing of new work orders utilizing the open-end drilling contracts established by the Pennsylvania Turnpike Commission (PTC) or those administered by design managers on behalf of the PTC.

Development of a work order:

-The PTC Geotechnical Project Manager will:

1. Once a Subsurface Exploration Planning Submission (SEPS) has been received, consult with the Drilling Program Manager to determine which open-end contract should be utilized for the new work order.
2. Provide the Consultant with a copy of the selected open-end contract and contract specific Engineer's Estimate template.
3. Review all relevant documentation including but not limited to the Schedule of Borings, Engineer's Estimate, and applicable pay items.
4. Provide the Drilling Program Manager with the list of individuals from both the PTC and the consultant that should be invited to the field view meeting.
5. Request the assignment of a PTC Construction Manager if Maintenance and Protection of Traffic (MPT) is being provided by the Drilling Contractor and not PTC maintenance.

-The Drilling Program Manager will:

1. Determine which open-end contract to utilize.
2. Provide the PTC Geotechnical Project Manager with a copy of the selected open-end contract and Engineer's Estimate template.
3. Notify the selected drilling contractor of the upcoming work order.
4. If MPT is required, reach out to the appropriate PTC Maintenance Facility(s) to determine if they are willing and able to provide the MPT for the upcoming work order.

-The Consultant will:

1. Submit a boring location plan, KMZ file of the boring locations, and a schedule of borings utilizing the provided contract specific Engineer's Estimate. The Engineer's Estimate should

include the contract pay items, proposed quantities, and termination criteria. For non-contract items, the Consultant is responsible for providing a special provision. The PTC will negotiate a unit price for the non-contract item(s) with the Drilling Contractor and notify the Consultant of the results.

2. Mark the boring locations in the field using **white** stakes, flagging, and paint prior to the field view meeting. White paint is required by the Pennsylvania One-Call System.
3. Notify the Geotechnical Project Manager once the borings have been marked.
4. Provide the PTC with a list of personnel from the Consultant/subconsultant that should be included in the field view meeting. **The lead inspector must be present at the field view meeting.**

Field View Meeting:

A field view meeting must be held prior to issuing the notice to proceed for all work orders. The purpose of the field view meeting is to provide an overview of the upcoming work order as well as view the proposed boring locations to identify any potential conflicts and/or required changes.

-The Drilling Program Manager will:

1. Schedule the field view meeting upon notice from the PTC Geotechnical Project Manager that the borings have been staked. The field view must include the following attendees:

    - Required: PTC Geotechnical Project Manager
      PTC Drilling Program Manager
      Drilling Contractor Representative
      Design Consultant's Lead Inspector
      PTC Maintenance Foreman or Assistant Foreman (if providing MPT)

    - Optional: PTC Maintenance Foreman or Assistant Foreman (if not providing MPT)
      PTC Design Liaison
      QA Manager and Assigned Staff

2. Create a meeting outline to accompany the meeting invite.
3. Prior to the field view meeting, provide the Consultant with the corresponding lane charts (if applicable), daily worksheet template, chain of custody template, and emergency contact information template.
4. Make a Utility Management Application (UMA) notification prior to the field view meeting to identify any fiber optics and or other PTC utilities within the project limits.
5. Determine the intended work schedule (five (5) eight-hour days, four (4) ten-hour days, or four (4) eight-hour days).
6. Assist the consultant with conducting the field view meeting by outlining the scope of work, identifying any apparent issues, and answering any questions that are proposed.

-The Consultant will:

1. Bring all necessary documentation to the field view meeting including but not limited to, a sign in sheet, copies of the boring location plan, Engineer's Estimate, and the corresponding lane charts.
2. Conduct the field view meeting identifying all pertinent information related to the proposed work order.
3. Take detailed notes during the field view that will be utilized to develop the field view meeting minutes.
4. Identify the lead inspector and provide his/her contact information.

-**The Drilling Contractor will:**

1. Attend the field view meeting.
2. Place a Pennsylvania One-Call prior to the field view meeting to identify any private utilities within the project limits.
3. Identify any issues or concerns regarding the proposed boring locations, boring access, nearby utilities, etc.

Prior to Drilling:

-The Consultant will:

1. Draft and circulate the field view meeting minutes to all parties that attended the field view meeting within three (3) business days after the meeting. If comments are received, make the necessary revisions and send out the finalized document.
2. Provide an updated boring location plan and Engineer's Estimate if changes were noted during the field view meeting.
3. If applicable, provide the property owner information to the PTC and Drilling Contractor for borings located outside the PTC right-of-way.
4. Provide the emergency contact information to the Drilling Program Manager.

-The Drilling Contractor will:

1. Ensure that a Pennsylvania One-Call has been placed.
2. Provide the driller(s) contact information for the emergency contact list to the consultant.
3. Draft and deliver Right of Entry notifications to the applicable property owners if there are borings or boring access outside the PTC right of way.
4. Communicate the need for any additional information or documentation prior to the start of the work order.

-The Drilling Program Manager will:

1. Review and provide comments as necessary on the field view meeting minutes provided by the consultant.
2. After receiving the finalized field view meeting minutes, draft the notice to proceed and negotiated work memorandum documents.

3. Send the notice to proceed, negotiated work memorandum, and finalized field view minutes to the PTC Geotechnical Project Manager for approval. Upon approval, send to his/her supervisor for execution.
4. Coordinate with construction and PTC maintenance to ensure there are no conflicts between the proposed start date and any construction and/or maintenance operations.
5. If PTC maintenance is providing the MPT, submit an SAP notification and notify the District Operations Maintenance Manager, Maintenance Foreman, and Assistant Foreman.
6. When MPT is being provided by the Drilling Contractor, notify the Pennsylvania State Police of the upcoming roadwork. Coordinate trooper assistance if needed and/or required.
7. Coordinate a start date and time with the Drilling Contractor and Consultant.

-**The PTC Geotechnical Project Manager will:**

1. Consult with the Drilling Program Manager regarding any negotiated contract items.
2. Review the field view meeting minutes provided by the consultant and provide comments if necessary.
3. Review and approve the notice to proceed, negotiated work memorandum, and field view meeting minutes.

-Supervisor of the Drilling Program Manager will:

1. Consult with the Drilling Program Manager regarding any negotiated contract items.
2. Review and approve the notice to proceed, negotiated work memorandum, and field view meeting minutes.
3. Issue the notice to proceed.
4. Establish the work order in SAP.

During Drilling:

Once the PTC issues the notice to proceed for a work order, the drilling contractor has ten (10) business days to mobilize the necessary equipment to the project location. The start date is also dependent on the construction activities in the area, roadway conditions, PTC maintenance availability, and weather conditions.

-The Drilling Program Manager will:

1. Coordinate all efforts needed between the drilling contractor, consultant, PTC maintenance, and construction.
2. If MPT is being provided by the Drilling Contractor, submit daily Advanced Traffic Management (ATMS) notifications prior to each work shift.
3. Monitor weather conditions to identify any issues that may restrict drilling during a scheduled work shift.
4. Monitor drilling progress and notify the Geotechnical Project Manager if any issues arise.
5. Review and tabulate the weekly quantities noted on the daily worksheets provided by the Consultant.

-The Consultant will:

1. Possess a copy of the relevant drilling contract and **enforce** the conditions outlined in the contract. If the Drilling Contractor is not abiding by the conditions of the contract or the direction of the lead inspector, inform the contractor of the discrepancies and notify the Drilling Program Manager immediately.
2. Complete daily worksheets to track the project quantities with special consideration of reduced workday hours, nighttime premium hours, and notes to outline the daily work activities. Daily worksheets must be signed by both the inspector and driller at the end of each shift.
3. Submit Daily Lane Closure Reports if the MPT is being provided by the Drilling Contractor. Refer to the "MPT Protocols" section in the drilling contract for all required MPT responsibilities.
4. Communicate any issues or concerns during drilling with the Drilling Program Manager.
5. Review and submit the daily worksheets to the Drilling Program Manager on a weekly basis.
6. Provide the Drilling Program Manager and PTC Geotechnical Project Manager with weekly status updates.
7. If MPT is required for the work order, provide the Drilling Program Manager with **daily** status updates for coordination purposes.
8. Complete the chain of custody form and provide the finalized document to the Drilling Contractor at the end of the work order.

-The Drilling Contractor will:

1. Abide by the conditions outlined in the contract and the direction of the lead inspector.
2. Communicate the objectives for each work shift to both the Lead Inspector and the Drilling Program Manager.
3. Communicate any issues to the Lead Inspector and Drilling Program Manager.
4. Review and sign the inspector's daily worksheet(s) at the end of each shift.
5. Obtain a copy of the completed chain of custody form at the end of the work order for use in sample delivery.

After Drilling:

Upon the completion of the drilling operations, the samples obtained must be delivered to the appropriate core box storage facility and a quantity package and draft invoice must be submitted to the PTC for review and approval. Upon approval, the Drilling Contractor must upload the invoice to the PTC Vendor Portal for final payment.

-The Consultant will:

1. Submit a final quantity tabulation spreadsheet to both the Drilling Program Manager and Drilling Contractor for review.
2. Submit copies of the finalized daily worksheets and inspector's field logs to both the Drilling Program Manager and Drilling Contractor for review.
3. Review any comments submitted by the Drilling Contractor and provide guidance, if requested, to the Drilling Program Manager for response to the comments.

4. Survey the “As Drilled” boring locations, if necessary, and provide the updated boring location plan to the PTC.

-The Drilling Contractor will:

1. Deliver the samples to the appropriate storage facility. The Drilling Contractor must notify the Drilling Program Manager at least three (3) business days prior to delivering the samples.
2. Provide the completed chain of custody form to the Core Box Storage Facility Manager.
3. Review the daily worksheets and final quantity tabulation sheet and provide comments as necessary.
4. Submit a quantity package to the Drilling Program Manager. Include the final daily worksheets, inspector’s logs, driller’s logs, chain of custody form(s), and any receipts from subcontractors for services provided.
5. Upon approval, submit a draft invoice to the Drilling Program Manager for review.
6. Upon receipt of the approved invoice package, upload the invoice package to the PTC Vendor Portal and notify the Drilling Program Manager upon completion.

-Core Box Storage Facility Manager:

1. Meet the Drilling Contractor at the perspective core box storage facility.
2. Inspect the samples being delivered to ensure the labels and packaging are consistent with the guidelines outlined in the contract.
3. Based on the inspection of the samples, accept, or reject the delivery.
4. If accepted, sign the chain of custody form. Scan and send the completed form to the Drilling Program Manager.
5. Log the newly delivered samples into the core box storage database.

-The Drilling Program Manager will:

1. Review the final quantity tabulation submitted by the Consultant and respond to any comments submitted by the Drilling Contractor.
2. Review the quantity package submitted by the Drilling Contractor and provide comments if necessary.
3. Send the final quantity package to the PTC Geotechnical Project Manager and his/her supervisor for approval.
4. Once approved, request the draft invoice from the Drilling Contractor.
5. Review the draft invoice and send to his/her supervisor for approval.
6. Once approved, assemble the final invoice package, and send to the Drilling Contractor with request to upload to the PTC Vendor Portal.
7. Once the payment has been posted, notify his/her supervisor that the work order can be closed in SAP.

-**The PTC Geotechnical Project Manager will:**

1. Review the quantity submission and provided any comments to the Drilling Program Manager.
2. If approved, update the invoice tracking form and notify the Drilling Program Manager.

-The Supervisor of the Drilling Program Manager will:

1. Review the quantity package. If approved update the invoice tracking form and notify the Drilling Program Manager.
2. Review the draft invoice. If approved update the invoice tracking form and notify the Drilling Program Manager.
3. Once uploaded, approve payment of the invoice in the PTC Vendor Portal.
4. Once notified by the Drilling Program Manager, reduce the work order amount if necessary and close the work order in SAP.

Appendix L: Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designers Scope of Work

Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designer Scope of Work

1.0 Introduction

A Conceptual Post Construction Stormwater Management (PCSM) Design phase is being introduced into PTC's preliminary design process to facilitate early identification of right-of-way (ROW) requirements and design timelines associated with meeting regulatory requirements for post construction stormwater management control and permitting. The Conceptual Design phase includes an analysis of PCSM requirements, desktop site characterization, and the identification and prioritization of potential PCSM sites. The Conceptual Design phase also includes early action soils analysis and infiltration testing for areas within existing ROW. This, coupled with the expanded soil analysis and infiltration testing protocols described in Section 3.0, improve data collection and analysis and provide for better stormwater control measure (SCM) selection and design. Another advantage of the design process outlined is that it allows for earlier coordination and communication with the PA DEP Regional Permit Coordination Office (RPCO) and Conservation Districts.

Section 2.0 below provides an outline scope of work for Conceptual Design. Section 3.0 provides protocols for Soil Analysis and Infiltration testing. Section 4.0 describes the Design Field View and Final Soil Characterization and Infiltration Testing Plan and Section 5.0 lists the required Deliverables.

2.0 Conceptual Design

A. Regulation Review

i. Review applicable state and local stormwater regulations.
ii. Define controlling standards and identify which apply (most restrictive of Local Ordinance, Act 167, or Chapter 102).
iii. Review standards with PTC Design Project Manager and PTC Environmental Manager for concurrence.

B. Desktop Site Characterization

i. Gather and review existing information from various sources that relate to SCM design, including but not limited to:
   - Parcel maps for lands adjacent to the transportation corridor;
   - Current and historic topography, as-builts for when the Turnpike was first constructed, land use, cover conditions, and drainage patterns (historic aerial photographs are a good source of historic information);
   - Soils, geology, and groundwater (with particular focus on soil drainage characteristics and depth to limiting layers, specifically reference the USDA Soil Survey(s) for the county(ies) where the project is located);
   - Floodplains;
   - Potable water wells and other water supplies;
   - Tributary waters and Chapter 93 characterization of tributary waters;
   - Local flooding or other drainage issues (sources may include Engineering Roadway Department Design Services, Municipalities, and internet);
   - Other pertinent information to inform stormwater design and build basis for stormwater analysis.

ii. Coordinate with and share information with/from the Environmental Consultant. In particular, it is important to have input from the Wetlands and Watercourse Study.

C. Conceptual Post Construction Stormwater Management (PCSM)

i. Begin the conceptual PCSM analysis using the best available line and grade plans and cross sections.

ii. Identify analysis points, referred to as Discharge Points in NPDES permit documentation. Establish discharge points at all locations where surface runoff leaves the PTC existing or future ROW or permanent drainage easements. Identify each as discharge to a surface water or a non-surface water.

iii. Identify watershed drainage divides (divide to each defined "Surface Water").

iv. Estimate a conservative Limit of Disturbance (LOD) and establish a stormwater management analysis area for volume and water quality analysis, and total tributary drainage areas for peak rate analysis.

v. Define stormwater management requirements for peak rate, volume, and water quality using applicable DEP worksheets and preliminary modeling tools. Conservative estimates of design parameters should be used when complete design information is not available.

vi. Use the analysis above in combination with information garnered from the desktop site characterization to identify potential SCM locations and area needs. Consider site access for construction and maintenance when estimating SCM area needs. Identify all potential locations in and adjacent to the existing and anticipated ROW.

vii. Identify opportunities to perform early field soil and infiltration test analysis to further characterize potential SCM locations. Early field soil analysis and infiltration testing can only be performed within existing ROW or in areas where access can otherwise be secured. Prepare early action soil analysis and infiltration test plan and submit to the PTC Design Project Manager for approval. See *Section E Soil Characterization and Infiltration Testing Plan* below for plan requirements.

viii. Prioritize potential SCM locations based on site characterization constraints, parcel size, soil analysis and infiltration test results, and other limitations such as need for ROW or easement taking and community impacts. Three limitation classes are recommended: few limitations, some limitations, and significant limitations.

ix. Assess stormwater related ROW and/or permanent easement requirements to meet stormwater management requirements.

x. Based on site prioritization and SCM type and size requirements, develop a Conceptual Post Construction Stormwater Management Plan and Letter Report and submit to the PTC Design Project Manager for approval. The Conceptual Post Construction Stormwater Management Plan shall identify SCM type, size, and location, along with any necessary ROW or easement acquisition necessary for SCM construction and access. The Post Construction Stormwater Management Letter Report shall document the analysis process in support of the selected conceptual design. This documentation, as modified through the preliminary and final design process, will serve as a basis for justifying SCM type, size, and location in the NPDES permit documents.

Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designer Scope of Work

D. Early Coordination with DEP RPCO and Conservation Districts

i. After approval of the Conceptual Post Construction Stormwater Management Plan and Letter Report, schedule an initial project coordination pre-application meeting with RPCO and the appropriate CCD to review the conceptual approach. This meeting should be scheduled by the PTC Environmental liaison assigned to the project.

E. Soil Characterization and Infiltration Testing Plan

i. Based on the Conceptual Post Construction Stormwater Management (PCSM) analysis, develop a Soil Characterization and Infiltration Testing Plan (Plan).

ii. The purpose of the Plan is to provide the soil characterization and infiltration testing approach.

iii. The fieldwork for soils observation and interpretation and infiltration testing can begin upon approval of the Soil Characterization and Infiltration Plan.

iv. See *Section 3.0 Soil Analysis and Infiltration* for testing requirements (number, location, etc.).

v. The Plan shall include the following minimum information:

- Mapping
    - Base plan Illustrating existing site physiographic characteristics and identifying the location of each proposed test pit/boring and infiltration test/borehole test
    - Identify access to each testing site
    - Aerial photography illustrating site (optional)
    - Topography
    - Parcel boundary lines and information
    - PTC Right-of-Way
    - Drainage features
    - Streams and wetlands
    - Utility locations
- Identify each test pit or boring location labeled and keyed to a summary table.
- Identify acceptable test methods for each infiltration test (see Section 3.B.vi)
- A summary table that identifies each soil analysis and infiltration test location by plan label identifier and type (for soil analysis, test pit or boring and type; for infiltration tests, infiltrometer or bore hole). Include a column for the depth of sampling or testing and the total test pit or boring depth. A column should also be included for cost.
- Include a note identifying the time period for testing (example Spring, 2022). Note that there may be different dates for testing locations within the same project.
- Identify whether Maintenance and Protection of Traffic (MPT) will be required.

3.0 Soil Analysis and Infiltration

A. Soil Observation and Interpretation - Field Protocol

i. Staffs

Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designer Scope of Work

- An approved Certified Professional Soil Scientist (CPSS) or designee must be on-site to evaluate soil characteristics related to infiltration capacity. Provide a copy of the CPSS certification to the PTC PM.

ii. Scheduling
- In some instances, early concept level testing may be feasible at some locations, such as locations within the ROW.
- Final Soil Observation and Interpretation shall be carried out as a first step in Final Design.

iii. Method
- Test pits shall be used for soil analysis in all instances where the total depth to 2 feet below the infiltration surface is 5 feet or less. Deeper test pits may be used if approved by the PTC Geotechnical liaison for the project. All test pit excavations must follow all applicable OSHA requirements including benching requirements and/or trench box requirements.
- If site restrictions (depth to infiltration surface, access, or utility constraints for example) prohibit the use of surface excavation techniques, subsurface boring techniques may be used for soil analysis.

iv. Continuous split spoon sampling techniques are the preferred method. Direct push methods such as Shelby Tubes can be used but they require laboratory analysis to obtain the necessary soil characteristics. Direct push methods do have the advantage that they do provide an opportunity for assessing soil density and moisture condition. Number of Observations
- The number of test pits and soil analysis borings is dependent on the size of the proposed infiltration basin.
- Twice as many borings are required than test pits.
- The number of test pits or borings should be increased above the minimum values when the Soil Survey indicates there are different soil types in the basin footprint.
- For Test Pits:
  - Basin footprint less than or equal to 8,000 SF: Minimum of 2 test pits
  - Basin footprint larger than 8000 SF: Minimum of 3 test pits or 6 per acre, whichever is greater
- For Soil Analysis Borings (Split Spoon or other):
  - Basin footprint less than or equal to 8,000 SF: 8 borings minimum
  - Basin footprint larger than 8000 SF: 8 borings minimum or 15 per acre, whichever is greater

v. Location/Size
- Test pits or borings should be evenly distributed across the basin area and in each mapped soil type.
- Trenches and test pit widths should be a minimum of 2-1/2 feet wide. Additional width may be necessary to accommodate trench boxes, when required.

- Test pit or boring depth should extend to 3 ft below the bottom of the design infiltration surface. The infiltration surface is the in-situ soil interface (below amended soil elevation).
- When using borings, it is recommended that at least one exploratory boring be advanced to a depth 15 feet below the elevation of the design infiltration surface or to bedrock, whichever is less.

vi. Data Collection

- When possible, soil characterization should be performed visually by the designated field staff. A Soil Log Form (PA DEP or equivalent) shall be completed in the field.
- Soils shall undergo visual identification via methods for soil classification outlined in he NRCS Field Book for Describing and Sampling Soils (latest edition), particularly as related to describing soil layer and horizon designations, texture, color, redoximorphic features, mottles, rock fragments, and structure.
- Soil assessments shall include identification of soil horizons and any zones restricting the movement of water through the soil profile for the entire depth of the test pit or boring.
- At least one soil sample shall be taken at an elevation within one vertical foot of the infiltration interface at the location of any infiltration tests. This sample shall undergo laboratory particle size analysis to determine its USDA textural class. If laboratory testing is performed in accordance with ASTM D2487, percentages of sand, silt, and clay should be adjusted from the USCS Soil Classification system to be compatible with the USDA Textural Classification System.
- The need for soil testing for density should be considered by the professional to facilitate evaluation of site compaction at the infiltration surface after construction.
- Groundwater Interpretation should be to define “regularly occurring seasonal high water” (DEP definition). Soil catena and landscape position should inform this interpretation.
- Deep borings can be used to locate a ground water surface. If a rig is on-site, one soil boring can be advanced to a depth of 15 feet or so below the planned infiltration surface or until bedrock is encountered to aid in interpretation.

B. Infiltration Testing - Field Protocol

i. Staff

- A qualified professional, such as a registered professional engineer, certified professional soils scientist, registered geologist or designee shall oversee all infiltration testing.

ii. Number of Observations

- The number of infiltration tests is dependent on the size of the proposed infiltration basin.
- The number of test pits or boreholes should be increased above the minimum values when the Soil Survey indicates there are different soil types in the basin footprint.
- For Double Ring Infiltrometer Method:

- Minimum of 2 infiltration tests per test pit
- Minimum of 5 infiltration tests per basin for basins sized up to 8,000 SF
- Minimum of 6 infiltration tests per basin or 12 infiltration tests per acre, whichever is greater for basins larger than 8,000 SF

- For Single Ring Infiltrometer, and Cased Borehole Methods:
  - For Basins up to 8,000 SF: 8 infiltration tests per basin
  - For Basins greater than 8,000 SF: 8 infiltration tests per basin or 15 infiltration tests per acre, whichever is greater.
- For Shelby Tube Laboratory Ksat Method:
  - For Basins up to 8,000 SF: 8 infiltration tests per basin
  - For Basins greater than 8,000 SF: 8 infiltration tests per basin or 15 infiltration tests per acre, whichever is greater.

iii. Scheduling
- In some instances, early concept level testing may be feasible at some locations, such as locations within the ROW.
- Infiltration testing is preferred between January and June (wet season).
- The time of year that testing is conducted will need to be considered during data analysis, including the dry season or during winter. More information on data analysis is provided below.
- Field Tests should not be conducted in the rain or within 24 hours of significant rainfall events (>0.5 inches), or when the temperature is below freezing.
- Testing should be discontinued during and immediately following precipitation if the rainfall/runoff entering the hole can bias the results.

iv. Frequency
- Typically, one round of infiltration testing is conducted.
- Retesting may be required if the basin location shifts due to other design issues. Professional judgment should be used to determine if special conditions may warrant retesting (e.g. change of land use, project on-hold, etc.) or as directed by PTC.

v. Location
- Infiltration testing locations should be evenly distributed across the proposed basin bottom.
- The testing location should be re-tested if unforeseen conditions cause the basin to shift resulting in test locations more than 10 feet outside the basin bottom footprint.
- The infiltration test should be within one (1) foot of the infiltration surface elevation (above or below). The infiltration surface is the in-situ soil interface (below amended soil elevation).
- Do not perform an infiltration test if a limiting layer is encountered within 3 feet of the infiltration surface elevation.

vi. Methods
- PTC approved testing methods include, Infiltrometers, Cased Boreholes, and Laboratory Ksat methods. Other methods may be approved upon request. The test

method selected must be approved by the PTC Project Design Manager prior to initiating infiltration testing. Infiltrometers consist of a cylindrical apparatus that is placed at the proposed infiltration surface. The infiltrometer is filled with water and the measured infiltration rate out of the bottom of the infiltrometer is used to estimate the infiltration rate of the soil. Single and double ring infiltrometers may be used but double ring infiltrometers are preferred. The minimum size for a single ring or the inside ring of a double ring is 6 inches. Infiltrometer use is limited to situations where the infiltration surface is 5 feet or less below the ground surface and they are the preferred method at these depths. Infiltrometers are typically used in conjunction with test pit soil analysis. Double ring infiltrometer tests are to be performed in accordance with ASTM D3385. Single ring infiltrometer tests are to be performed in accordance with ASTM D5126.

- Cased Borehole Methods are not limited by the depth to the infiltration surface and are applicable with test elevations deeper than 5 feet. The method involves drilling a borehole and inserting a casing having a minimum diameter of 4 inches. Bentonite is placed in the annular space between the casing and hollow-stem surface to assist in sealing the bottom of the casing. Water is introduced into the borehole, and the rate at which the water level drops is used to establish the infiltration rate. Casing installation for borehole infiltration tests should be performed in accordance with ASTM D6151 (Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling). Borehole infiltration tests should be performed in accordance with ASTM D6391 (Standard Test Method for Field Measurement of Hydraulic Conductivity Using Borehole Infiltration).
- Laboratory Ksat methods are not limited by the depth to the infiltration surface and are applicable with test elevations deeper than 5 feet. This method is not suited for use in in non-cohesive, coarse-grained soils (coarser silts and sands) since soil recovery is difficult under these conditions. The method involves collecting a minimally disturbed soil sample at the proposed infiltration surface using Shelby tubes following procedures outlined in ASTM 1587 (Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes). A Shelby tube with minimum 3-inch diameter shall be used to maximize the cross section for analysis. The undisturbed sample in the Shelby tube is to be delivered to a laboratory and analyzed using a single point Ksat analysis procedure. As an option, a 3-point test could be used to establish the change in Ksat with density. This analysis would be useful if evaluating how the soil will perform if compaction during construction is a consideration.
- Evaluation Procedures for infiltrometer and cased borehole methods include Falling-head and Constant-head.
    - The Falling-head procedure involves monitoring the rate of fall of a column of water.
    - The Constant-head procedure involves introducing water at a rate necessary to maintain a constant head, while measuring the rate of water addition.

- Procedure selection depends on the soil texture. Constant-head methods are preferred for coarser-grained soils and Falling-head methods are preferred for finer-grained soils. Note that most testing is performed using Falling-head methods.

- If a limiting soil layer is found within 3 feet below the infiltration surface, an additional infiltration test should be conducted at an alternate location.
- Infiltration testing should not be conducted in fill conditions since it is not preferable to construct infiltration basins in fill. MRC or lined basins should be used instead. Should no other option be available, and an infiltration basin is needed to be placed in fill, then a soil specification can be used to ensure the fill material is permeable (restrict percentage of clay content).

vii. Data Collection

- Collect infiltration data in accordance with the current version of the Pennsylvania Post Construction Stormwater Management (PCSM) Manual as modified below.
- Measurements should be made using the appropriate time interval (as specified in the PCSM Manual) until a stabilized rate of drop is obtained. A stabilized rate of drop means a difference of ¼ inch or less in the drop between the highest and lowest readings of four consecutive readings. If a stabilized drop is not reached after 12 consecutive readings, an appropriate data adjustment should be made (see Section C.2 below).

C. Infiltration Testing - Data Analysis Protocol

I. Method

- When assessing the average infiltration rate for an SCM, the geometric mean of all infiltration tests should be used to determine the average rate. The geometric mean is an indication of the central tendency of the infiltration test results.
- Outliers (high or low) from test results should be discarded, as determined by best professional judgement.

II. Safety Factors and Data Adjustment

- Safety factors measure the uncertainty associated with measured infiltration rates. Typical Safety Factors are between 2 and 3 but can be up to 5 in extreme conditions.
- For infiltrometer or cased borehole tests, safety factors should be a minimum of 2 in non-karst areas and 3 in karst areas.
- If testing is conducted during a dry period (no rain within 7 or more days) and a stabilized drop is not reached during one or more of the SCM infiltration tests (see Section B.6.b above), the safety factor should be increased by 0.5.
- If testing is conducted in winter, then the test results should be adjusted considering viscosity.
- Site-suitability should be considered when assessing infiltration potential and establishing safety factors. Site Suitability factors should consider the extent of the soil assessment, soil texture, site soil variability, and groundwater.

- Soil assessment includes the extent of testing (# borings/test pits), measurement method, and timing (testing conducted during dry season or winter).
- Soil texture can influence the soils susceptibility to clogging. Finer-grained soils may be more susceptible to clogging than coarser-grained soils.
- Soil variability across a site makes it more difficult to estimate the average properties for the site.
- Depth to seasonal or periodic ground water saturation, including from hillslope interflow should be considered. Consideration should also be given to the potential for ground water mounding.

- Design and construction factors should also be considered. Examples include potential for sedimentation and incidental compaction during construction. SCMs with deeper storage depths tend to have higher sediment loading per unit area and have greater clogging potential than shallower basins.

III. Infiltration Rates

- The minimum and maximum field infiltration rates are 0.2 inches and 10 inches per hour, respectively, or as specified in the PA DEP guidance.
- If the infiltration rate is between 0.2 to 1 inch/hour, managed release concept (MRC) elements should be designed into the stormwater facility.
- Soils with rates in excess of 6.0 inches per hour will require PTC amended soil to reduce the infiltration rate to between 1 and 6 inches per hour.

D. Soil Analysis and Infiltration Testing Report

i. A Soil Analysis and Infiltration Testing Report should be developed to summarize findings.

ii. Identify critical horizons in graphic and/or table format, which are developed from the field form. Develop the critical horizons summary for use by the designer.

iii. Provide a summary of the data collection and analysis, including a map identifying soil analysis and infiltration test locations.

4.0 Design Field View and Final Soil Characterization and Infiltration Testing Plan

A. Design Field View and Final Soil Characterization and Infiltration Testing Plan

i. After approval of the Conceptual Post Construction Stormwater Management Plan and Letter Report by the PTC Design Project Manager and Environmental Manager, advance the PCSM Design to Design Field View and develop the Final Soil Characterization and Infiltration Testing Plan for implementation early in Final Design. See *Section 2.0.E Soil Characterization and Infiltration Testing Plan* above for plan requirements.

5.0 Deliverables include:

A. Conceptual Post Construction Stormwater Management Plan and Letter Report

B. Concept Soil Characterization and Infiltration Testing Plan

C. Concept Soil Characterization and Infiltration Testing Report

Conceptual Post Construction Stormwater Management (PCSM) Design, Soils Analysis, and Infiltration Testing Designer Scope of Work

D. **Design Field View Post Construction Stormwater Management Design Report and Plans**

E. **Final Soil Characterization and Infiltration Testing Plan**