

TSMO

PUBLICATION 852: **TSMO Guidebook, Part II: Design**

JULY 2023

JOSEPH BURNS, SR. TRAFFIC CONTROL SPECIALIST • PLANNING AND FUNDING
STEPHEN MCGINLEY, P.E. • KIMLEY-HORN AND ASSOCIATES, INC.

GUIDING DOCUMENTS

Vision

Strategic Framework



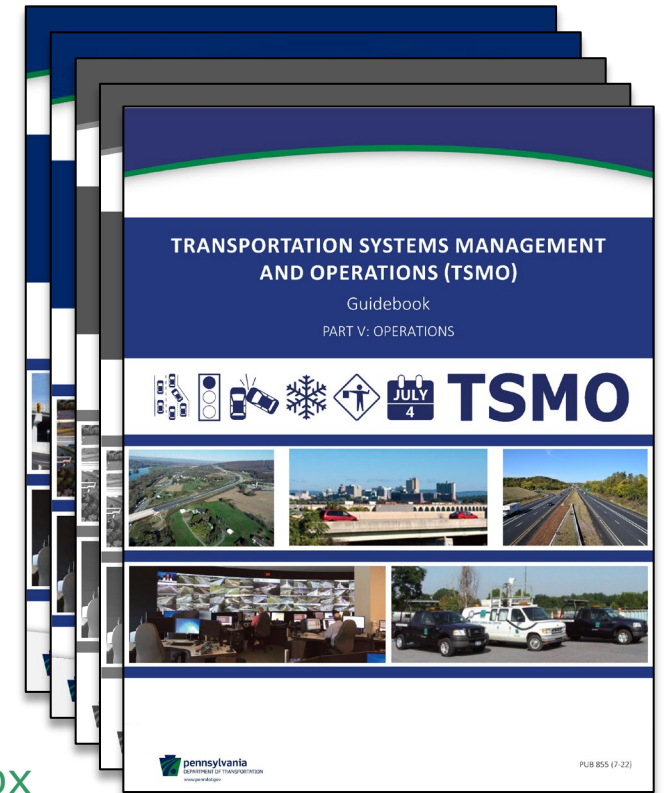
Approach

Program Plan



Policy

Guidebook Series



<https://www.penndot.gov/ProjectAndPrograms/operations/Pages/default.aspx>

www.penndot.gov ( TSMO)



OUTREACH AND COORDINATION

NATIONAL BEST PRACTICES

- MnDOT ITS Design Manual, October 2021
- ADOT ITS Design Guide, March 2019
- GDOT ITS Design Guidelines, November 2020
- UDOT ITS Design Manual, March 2021



Intelligent Transportation Systems (ITS) Design Manual

October 2021

Arizona Department of Transportation

Systems Technology Group

Intelligent Transportation System Design Guide



March 2019

ITS Design Guidelines



11/11/2020
Revision 1.3
Atlanta, GA 30308



UDOT ITS DESIGN MANUAL

2021

ITS Design Manual

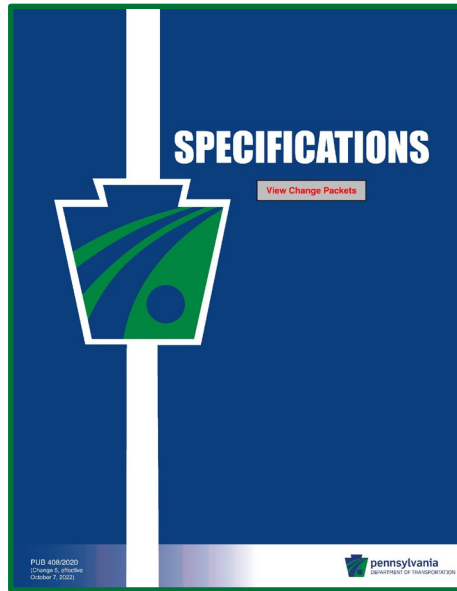


March 2021/v4.1

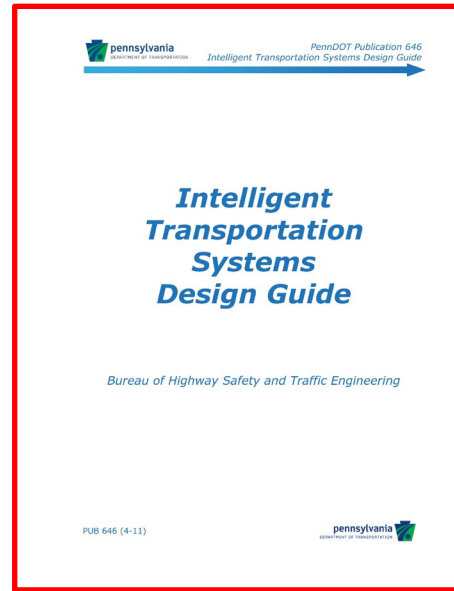


Utah Department of Transportation
3/10/2021

Revising



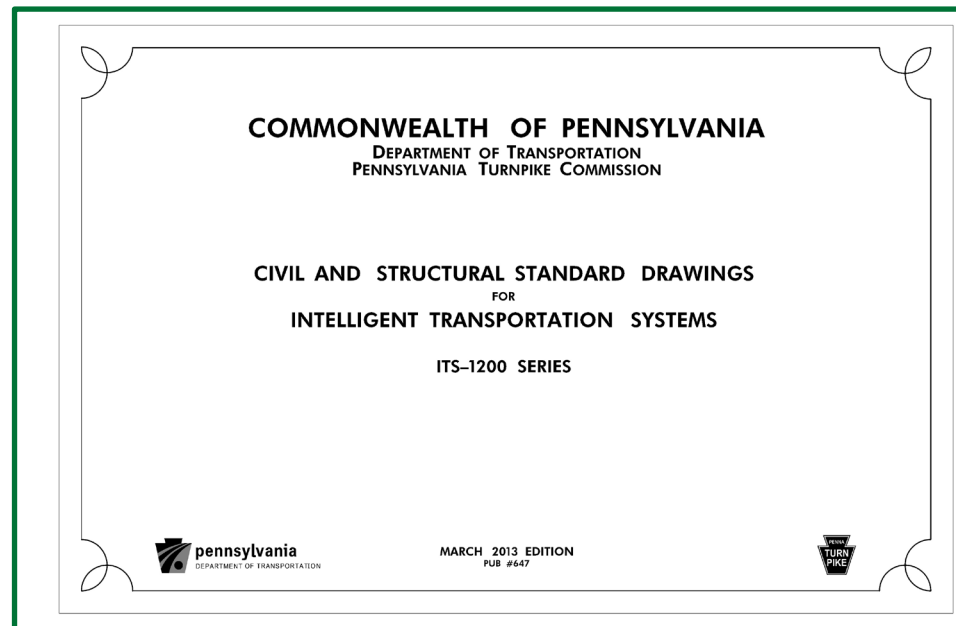
Replaced



Replaced



Revising



DEPARTMENT PUBLICATIONS

- Pub 408 – Specifications
- Pub 646 – ITS Design Guide
- Pub 647 – Civil & Structural Standards
- Pub 697 – ITS Maintenance Standards
- TSMO Design and Integration Guidelines
- Design Manuals (DM-1 thru DM-4)
- SOL 494-16-02 Traffic Signal Remote Communication Policy

STAKEHOLDER AND PEER ENGAGEMENT

- Stakeholder Group
 - Federal Highway Administration
 - Bureau of Design and Delivery
 - Bridge Office
 - Office of Administration – Information Technology (OA/OIT)
 - Engineering Districts
 - Pennsylvania Turnpike Commission
- Regular Meetings/Approvals
 - OA/OIT Coordination Meeting
 - Table of Contents Approval
 - 60% Design Review Meeting Series
 - Pre-Final Design Review Meeting
 - 100% Design Review Meeting

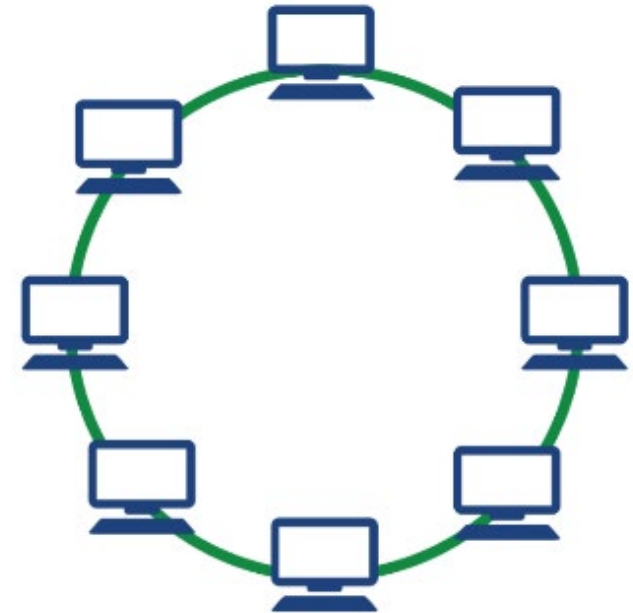
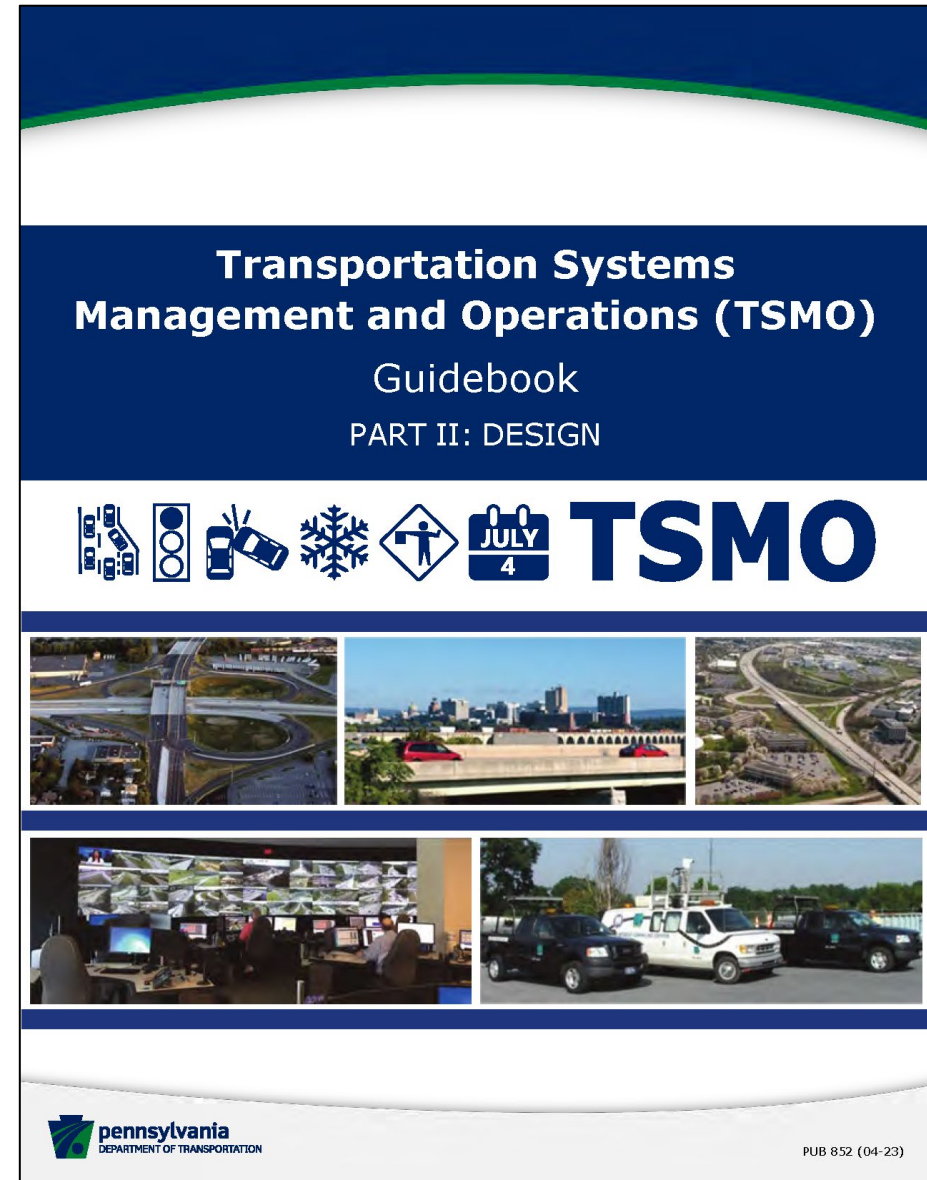


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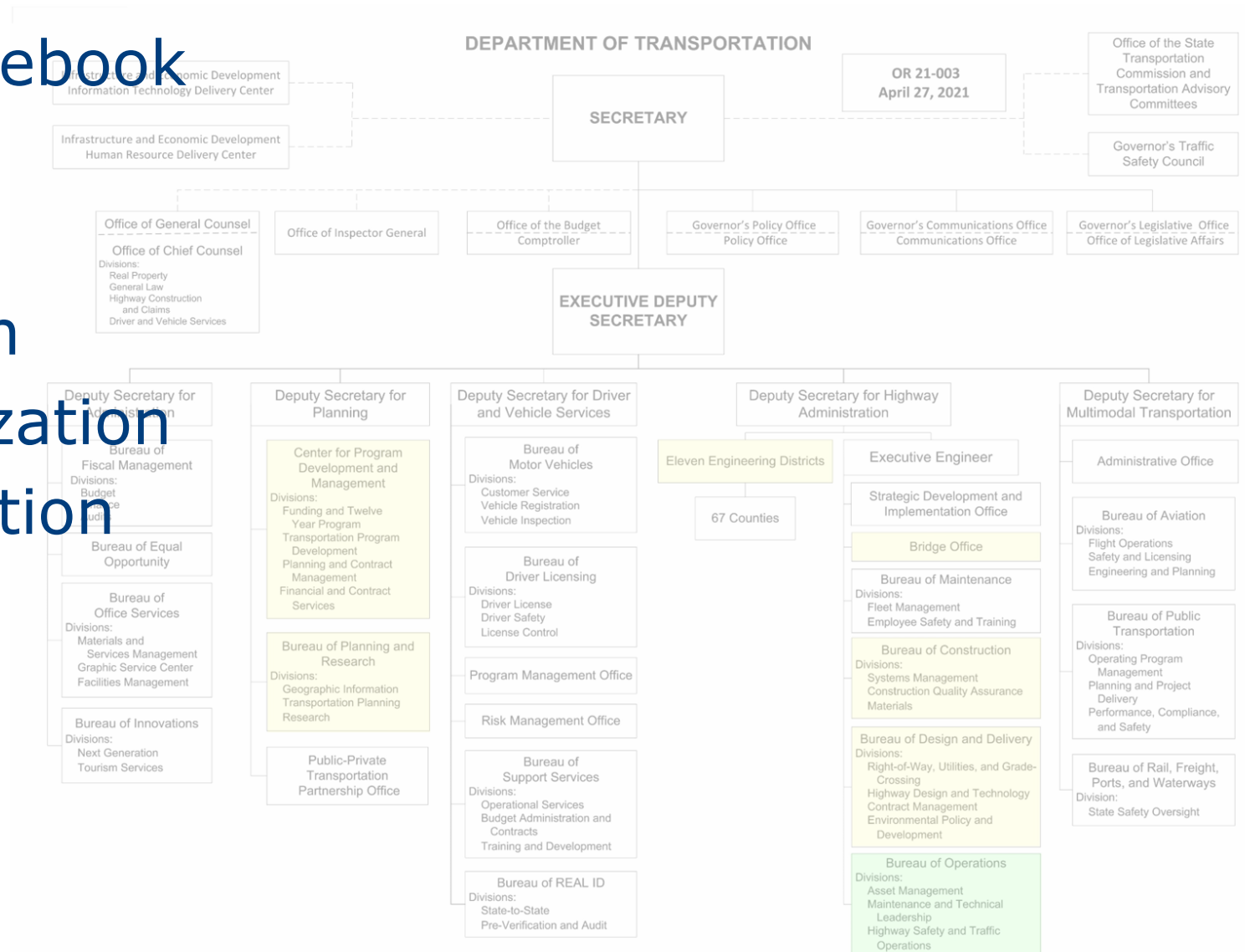
1. Introduction
2. Project Development Process
3. Device and Infra. Design
4. Maintenance Considerations
5. Plan Preparation
6. System Integration



DESIGN MANUAL OVERVIEW

CH. 1: INTRODUCTION

- Purpose of the Guidebook
- Acronyms
- References
- Manual Organization
- Department Organization
- Office of Administration
- Disclaimer



CH. 1: INTRODUCTION

- Bureau of Operations
 - TSMO Units



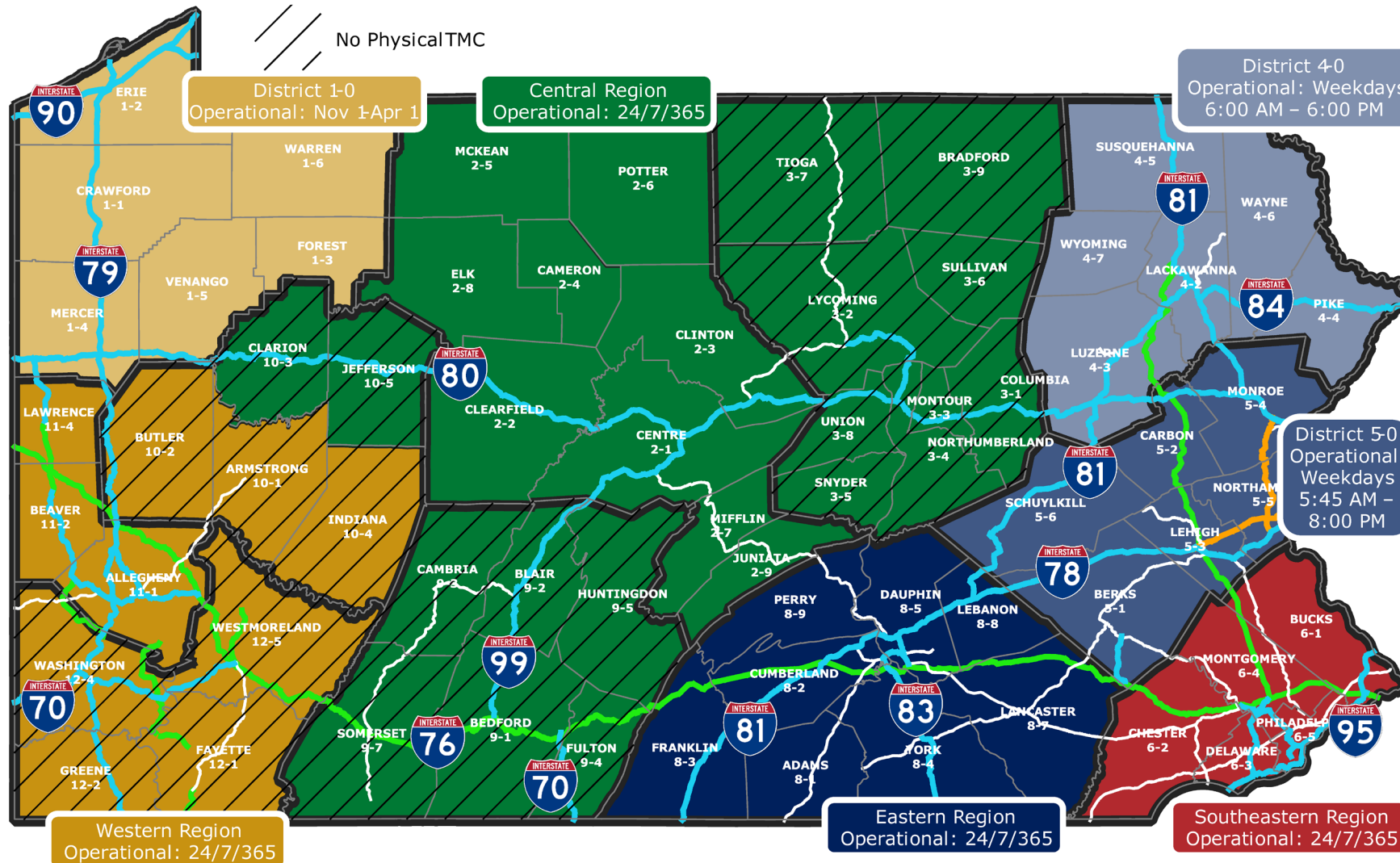
The TSMO – Operations & Performance Section and the TSMO – Arterials & Planning Section are responsible for the programming and maintenance of ITS devices. Each Engineering District is responsible for project delivery.



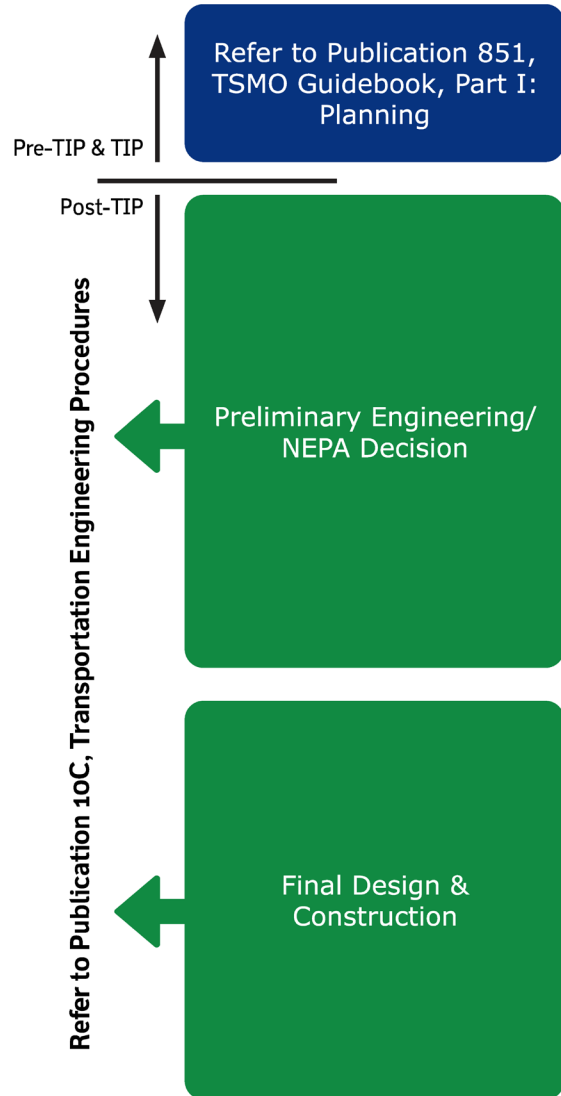
CH. 1: INTRODUCTION

- Operations Regions

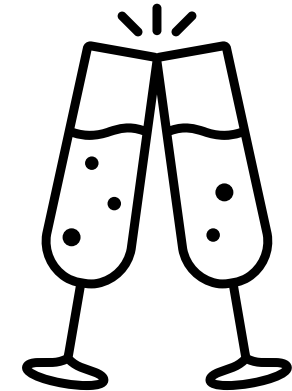
Resource Account:
TSMO@pa.gov



CH. 1: INTRODUCTION



- ★ **Scoping Field View**
 - Submit TE-154 – Traffic Signal/ITS Device Remote Communication Scoping Form to OA/OIT
 - OA/OIT optional attendee at Scoping Field View (based on project complexity)
- ★ **Safety Review (30%)/Systems Engineering**
 - OA/OIT required reviewer/collaborator of the Systems Engineering Report (SER)
 - OA/OIT optional attendee at Safety Review Meeting (based on project complexity)
- ★ **Design Field View (60%)**
 - OA/OIT required reviewer
 - OA/OIT optional attendee at Design Field View Meeting (based on project complexity)
- ★ **Pre-final/Final Design Office Meeting (FDOM) (90%)**
 - OA/OIT required reviewer
 - OA/OIT should be invited to attend FDOM
- ★ **Plans, Specifications & Estimate (PS&E) (100%)**
 - OA/OIT required reviewer
- ★ **System Integration**
 - OA/OIT required collaborator



Resource Account:
FiberReview@pa.gov



CH. 1: INTRODUCTION

7/5/23, 10:25 AM

PennDOT TE-154 Remote Communication Scoping Form

TE-154 (02-23)



TRAFFIC SIGNAL/ITS DEVICE REMOTE COMMUNICATION SCOPING FORM

Purpose: The purpose of this form is to identify the network requirements to support traffic signal and/or ITS field devices.

A - PROJECT INFORMATION			
DISTRICT I-0	COUNTY Crawford	PRIMARY MUNICIPALITY Athens Township	
PROJECT NAME			
PROJECT DESCRIPTION			
DESIGN FIRM/ORGANIZATION	DESIGN CONTACT PERSON	DESIGN CONTACT E-MAIL	DESIGN CONTACT PHONE
PROJECT COMMUNICATION SCOPE ☐ Establish new remote network connection ☐ Add devices to existing remote network connection ☐ Upgrade existing facilities			
B - ATTACHMENTS LISTING			
CHECK THOSE THAT APPLY AND ATTACH TO THIS FORM (REQUIRED FOR ALL PROJECTS) ☒ Network Architecture Diagram* ☒ Field Device Listing* ☐ Photographs ☐ Concept of Operations ☐ Systems Engineering Documents ☐ Other			
C - FIELD DEVICES			
D - CONCEPT OF OPERATIONS			
FUNCTIONAL REQUIREMENTS (CHECK ALL THAT APPLY) ☐ Clock synchronization ☐ Remote device management (database upload/download, etc.) ☐ Remote configuration, monitoring of field equipment status and reporting of equipment malfunctions ☐ Remote device malfunction troubleshooting ☐ Traffic Signal Command and Control (remote selection and implementation of timing plans) ☐ Adaptive traffic signal control technology ☐ High-resolution event log for Automated Traffic Signal Performance Measures (ATSPM) ☐ Changeable Message Sign (CMS) Command and Control ☐ Traffic surveillance (CCTV): ☐ View only ☐ Pan/tilt/zoom control ☐ Connected/Automated Vehicle Applications - Describe ☐ Other:			

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>

1/2

7/5/23, 10:25 AM

PennDOT TE-154 Remote Communication Scoping Form

E - FIELD NETWORK		
EXISTING FIELD NETWORK STATUS ☐ No field network ☐ Serial network ☐ IP-addressable network		FIELD NETWORK OWNERSHIP AND MAINTENANCE ☐ PennDOT ☐ Municipality ☐ Other:
PROPOSED FIELD NETWORK COMMUNICATION METHOD (CHECK ALL THAT APPLY) ☐ Same as existing ☐ Fiber optic cable ☐ Broadband radio ☐ Copper ☐ Other:		
F - BACKHAUL COMMUNICATIONS		
PROPOSED BACKHAUL COMMUNICATION METHOD ☐ Commonwealth-owned fiber ☐ Leased fiber ☐ MPLS ☐ Cellular ☐ Other:		
FIBER REVIEW COMMITTEE MEETING DATE mm/dd/yyyy		
WHERE IS BACKHAUL CONNECTED TO FIELD NETWORK? ☐ PennDOT ITS cabinet ☐ Traffic signal cabinet ☐ Hub cabinet ☐ Other field cabinet ☐ Other field cabinet DESCRIBE CONNECTION LOCATION (TSAMS SIGNAL ID, ITS STATEWIDE ID, INTERSECTION ADDRESS, ETC.)		
BACKHAUL SECURITY (CHECK ONE) ☐ The backhaul connection uses a private, dedicated circuit which is limited to PennDOT traffic		
REMOTE USERS (CHECK ALL THAT APPLY) ☐ PennDOT signal staff ☐ PennDOT TMC staff ☐ Municipal staff ☐ Municipal contractor ☐ Municipal consultant ☐ Municipal police ☐ Signal vendor ☐ Other:		
HOW WILL NON-PENNDOT USERS ACCESS THE SYSTEM? ☐ Office of Administration VPN from remote computer using CWOPA credentials ☐ Other:		
ESTIMATED MONTHLY RECURRING COST	RECURRING COMMUNICATION COSTS TO BE PAID BY: ☐ PennDOT ITS (10576) ☐ PennDOT GLG (11073) ☐ Municipality ☐ Other:	
G - ADDITIONAL INFORMATION		
DESCRIBE ANY ADDITIONAL INFORMATION WHICH MAY IMPACT THE SIZE, LOCATION, OR TYPE OF COMMUNICATIONS REQUIRED FOR THE PROJECT		
H - APPROVALS		
PROJECT SPECIFIC REQUIREMENTS		
DISTRICT TRAFFIC SIGNALS SUPERVISOR RECOMMENDATION (REQUIRED IF SIGNALS INCLUDED)	SIGNATURE	DATE mm/dd/yyyy
TMC MANAGER RECOMMENDATION (REQUIRED IF CONNECTION TO ITS DEVICES IS PROPOSED)	SIGNATURE	DATE mm/dd/yyyy
TSMO ARTERIALS & PLANNING SECTION RECOMMENDATION	SIGNATURE	DATE mm/dd/yyyy
TSMO OPERATIONS & PERFORMANCE SECTION RECOMMENDATION	SIGNATURE	DATE mm/dd/yyyy
SUBMITTED TO CAO/IT DATE mm/dd/yyyy	REMEDY TICKET NUMBER	
FOR CAO/IT USE ONLY		
APPROVED CONNECTION METHOD ☐ Direct connection to private, secure Commonwealth network via state-owned fiber ☐ Direct connection to private, secure Commonwealth network via dedicated circuit		
CORE NETWORK TEAM APPROVAL	SIGNATURE	DATE mm/dd/yyyy

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>

2/2

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>



CH. 1: INTRODUCTION

TE-154 (11-22)



TRAFFIC SIGNAL/ITS DEVICE REMOTE COMMUNICATION SCOPING FORM

Purpose: The purpose of this form is to identify the network requirements to support traffic signal and/or ITS field devices.

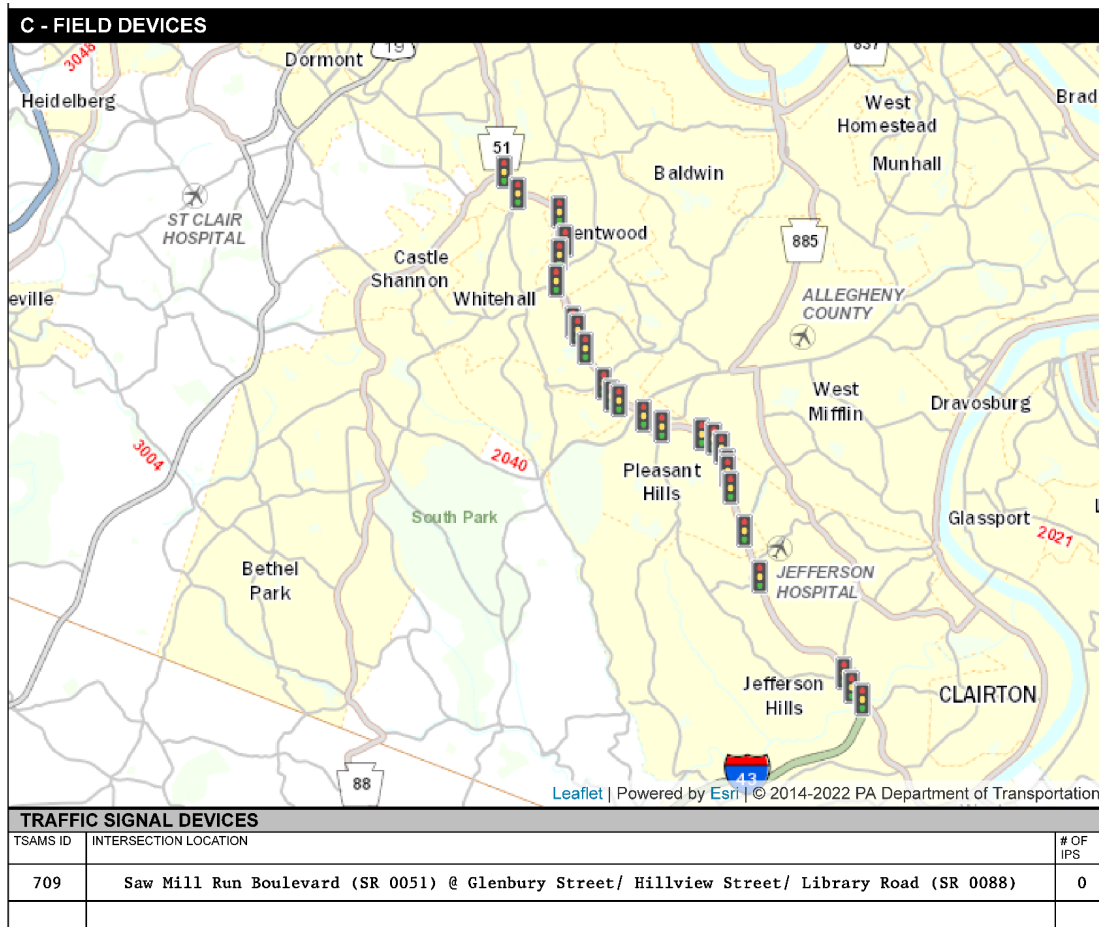
A - PROJECT INFORMATION			
DISTRICT 11-0	COUNTY Allegheny	PRIMARY MUNICIPALITY West Mifflin Borough	
PROJECT NAME SR 51 12A (111571)			
PROJECT DESCRIPTION Roadway Betterment and Signal Upgrade			
DESIGN FIRM/ORGANIZATION PennDOT	DESIGN CONTACT PERSON Dan Fedio	DESIGN CONTACT E-MAIL dafedio@pa.gov	DESIGN CONTACT PHONE 412-429-4983
PROJECT COMMUNICATION SCOPE ☐ Establish new remote network connection ☒ Add devices to existing remote network connection ☐ Upgrade existing facilities			

B - ATTACHMENTS LISTING	
CHECK THOSE THAT APPLY AND ATTACH TO THIS FORM (*REQUIRED FOR ALL PROJECTS)	
☒ Network Architecture Diagram*	☒ Field Device Listing* ☐ Photographs ☐ Concept of Operations
☐ Systems Engineering Documents	☐ Other

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>



CH. 1: INTRODUCTION



The TSAMS ID will be required when completing section C- Field Devices in the TE-154. Therefore, prior to using the Traffic Signal/ITS Device Remote Communication Scoping Form (TE-154), Traffic Signals/ITS Devices must be added in [TSAMS](https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html) as a status of planning.

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>

2847	Clairton Boulevard (SR 0051) @ Stewart Avenue			
868	Clairton Boulevard (SR 0051) @ Greenlee Avenue			
867	Clairton Boulevard (SR 0051) @ Delco Road/ Marylea Avenue			
99	Clairton Boulevard (SR 0051) @ Town Square Way			
98	Clairton Boulevard (SR 0051) @ Brownsville Road			
2843	Clairton Boulevard (SR 0051) @ Glen Elm Drive			
2846	Clairton Boulevard (SR 0051) @ Beall Drive			
2739	Clairton Boulevard (SR 0051) @ Borough Park Drive			
2738	Clairton Boulevard (SR 0051) @ Streets Run Road (SR 2046)			
8728	Clairton Blvd (SR 0051) @ Grace St/ Old Clairton Rd			
8726	Clairton Blvd (SR 0051) @ Irwin Dr			
2778	Clairton Boulevard (SR 0051) @ Old Clairton Road/ Old Lebanon Church Road			
2776	Clairton Boulevard (SR 0051) @ Glenburn Drive			
2775	Clairton Boulevard (SR 0051) @ Belleview Plaza Drive			
2817	Clairton Boulevard (SR 0051) @ Century Three Mall Driveway			
96	Clairton Boulevard (SR 0051) @ Century Three Mall Drive/ Fred Fiore Drive			
2773	Clairton Boulevard (SR 0051) @ Southland Shopping Center Drive North			
2772	Clairton Boulevard (SR 0051) @ Southland Shopping Center Drive South			
2771	Clairton Boulevard (SR 0051) @ East Bruceton Road			
2770	Clairton Boulevard (SR 0051) @ Lewis Run Road (SR 2032)/ Lindsay-Snyder Drive			
966	Clairton Boulevard (SR 0051) @ Coal Valley Road			
965	Clairton Boulevard (SR 0051) @ Jefferson Boulevard			
964	Clairton Boulevard (SR 0051) @ Old Clairton Road			
963	Clairton Boulevard (SR 0051) @ Dick Corporation Drive/ Peters Creek Road			
ITS DEVICES				
DEVICE TYPE	STATEWIDE ID	DISTRICT ID	LOCATION DESCRIPTION	# OF IPS
CAM	THIS IS NOT COR	CM 126	NB at E. Maple Ave. / SR 213	



CH. 1: INTRODUCTION

D - CONCEPT OF OPERATIONS

FUNCTIONAL REQUIREMENTS (CHECK ALL THAT APPLY)

- ☒ Clock synchronization
- ☒ Remote device management (database upload/download, etc.)
- ☒ Remote configuration, monitoring of field equipment status and reporting of equipment malfunctions
- ☒ Remote device malfunction troubleshooting
- ☒ Traffic Signal Command and Control (remote selection and implementation of timing plans)
- ☒ Adaptive traffic signal control technology
- ☐ High-resolution event log for Automated Traffic Signal Performance Measures (ATSPM)
- ☐ Changeable Message Sign (CMS) Command and Control
- ☒ Traffic surveillance (CCTV): ☒ View only ☐ Pan/tilt/zoom control
- ☐ Connected/Automated Vehicle Applications - Describe
- ☐ Other:

E - FIELD NETWORK

EXISTING FIELD NETWORK STATUS

- ☐ No field network ☐ Serial network ☒ IP-addressable network

FIELD NETWORK OWNERSHIP AND MAINTENANCE

- ☐ PennDOT ☐ Municipality ☐ Other:

PROPOSED FIELD NETWORK COMMUNICATION METHOD (CHECK ALL THAT APPLY)

- ☐ Same as existing ☐ Fiber optic cable ☒ Broadband radio ☐ Copper ☐ Other:

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>



CH. 1: INTRODUCTION

F - BACKHAUL COMMUNICATIONS

PROPOSED BACKHAUL COMMUNICATION METHOD

☐ Commonwealth-owned fiber ☐ Leased fiber ☒ MPLS ☐ Cellular ☐ Other:

FIBER REVIEW COMMITTEE MEETING DATE

WHERE IS BACKHAUL CONNECTED TO FIELD NETWORK?

☒ PennDOT ITS cabinet ☐ Traffic signal cabinet ☐ Hub cabinet ☐ Other field cabinet ☐ Other field cabinet

DESCRIBE CONNECTION LOCATION (TSAMS SIGNAL ID, ITS STATEWIDE ID, INTERSECTION, ADDRESS, ETC.)

CCTV is at the intersection of S.R 51 and S.R 88, near TSAMS 709

BACKHAUL SECURITY (CHECK ONE)

☒ The backhaul connection uses a private, dedicated circuit which is limited to PennDOT traffic

REMOTE USERS (CHECK ALL THAT APPLY)

☒ PennDOT signal staff ☐ PennDOT TMC staff ☒ Municipal staff ☒ Municipal contractor ☐ Municipal consultant
☐ Municipal police ☐ Signal vendor ☐ Other:

HOW WILL NON-PENNDOT USERS ACCESS THE SYSTEM?

☒ Office of Administration VPN from remote computer using CWOPA credentials
☐ Other:

ESTIMATED MONTHLY RECURRING COST

RECURRING COMMUNICATION COSTS TO BE PAID BY:

☐ PennDOT ITS (10576) ☒ PennDOT GLG (11073) ☐ Municipality
☐ Other:

G - ADDITIONAL INFORMATION

DESCRIBE ANY ADDITIONAL INFORMATION WHICH MAY IMPACT THE SIZE, LOCATION, OR TYPE OF COMMUNICATIONS REQUIRED FOR THE PROJECT

This project will overlap with two other projects, SR 2040 A22 and SR 2040 A23. SR 2040 A22 will have an Internet drop at Lebanon Rd and SR 2040 A23 will add onto that connection. The northern half of SR 51 from Nurnberger will be able to connect back to the ITS Cameras at S.R 51 and S.R 88. The middle half of SR 51 from Streets Run to Coal Valley will be able to use the Internet drop from SR 2040 A22. The southern half of SR 51 from Jefferson Blvd to Dick Corp will need another Internet drop. See attached location map.

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>



CH. 1: INTRODUCTION

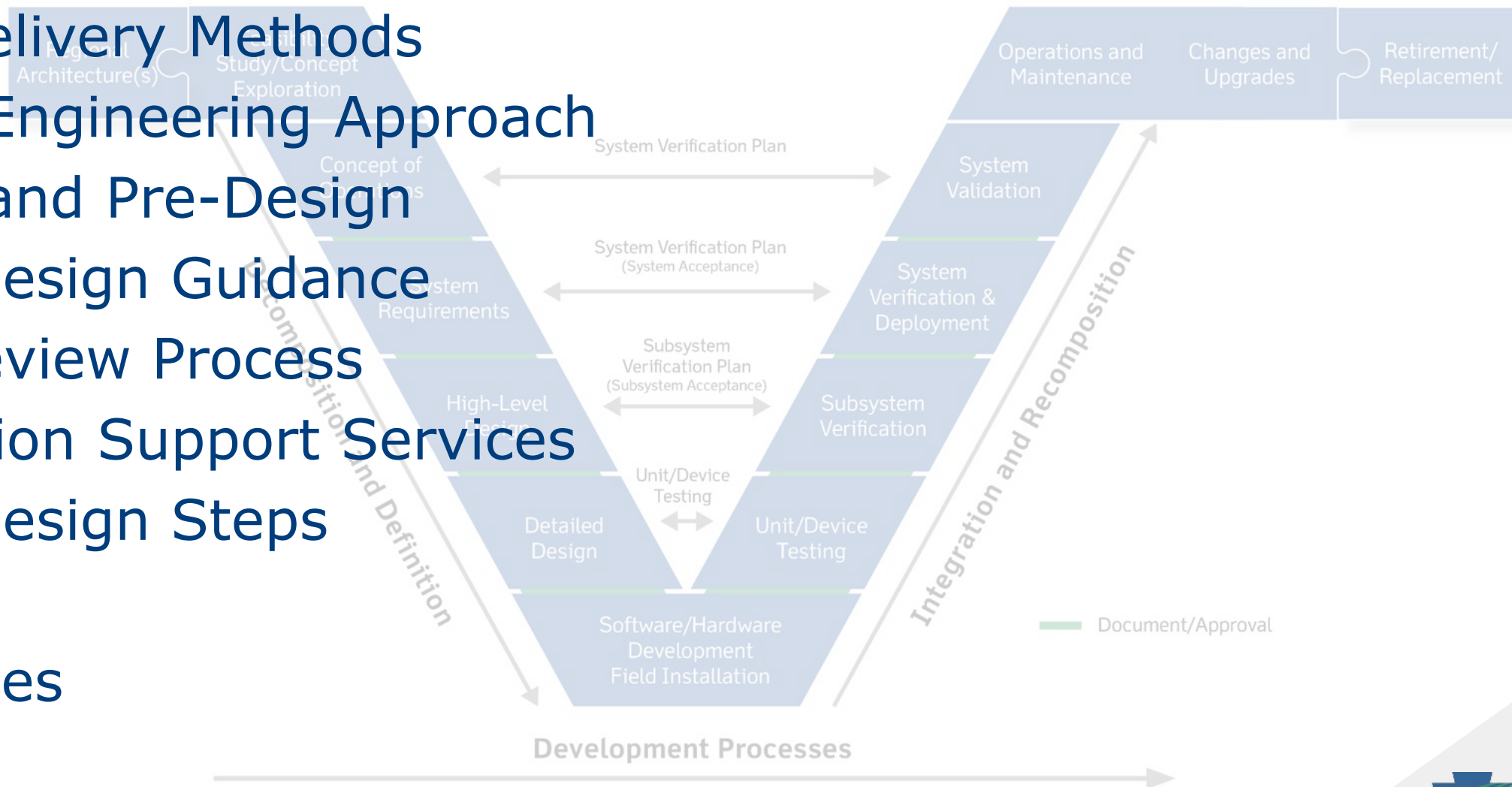
H - APPROVALS		
PROJECT SPECIFIC REQUIREMENTS		
DISTRICT TRAFFIC SIGNALS SUPERVISOR RECOMMENDATION (REQUIRED IF SIGNALS INCLUDED)	SIGNATURE	DATE
TMC MANAGER RECOMMENDATION (REQUIRED IF CONNECTION TO ITS DEVICES IS PROPOSED)	SIGNATURE	DATE
TSMO ARTERIALS & PLANNING SECTION RECOMMENDATION	SIGNATURE	DATE
TSMO OPERATIONS & PERFORMANCE SECTION RECOMMENDATION	SIGNATURE	DATE
SUBMITTED TO OA/OIT DATE	REMEDY TICKET NUMBER	
FOR OA/OIT USE ONLY		
APPROVED CONNECTION METHOD		
☐ Direct connection to private, secure Commonwealth network via state-owned fiber		
☐ Direct connection to private, secure Commonwealth network via dedicated circuit		
CORE NETWORK TEAM APPROVAL	SIGNATURE	DATE

<https://www.dot.state.pa.us/public/Bureaus/BOMO/Portal/Workbooks/TE-154.html>



CH. 2: PROJECT DEVELOPMENT PROCESS

- Project Types
- Project Delivery Methods
- Systems Engineering Approach
- Planning and Pre-Design
- General Design Guidance
- Design Review Process
- Construction Support Services
- General Design Steps
- Durations
- Deliverables



CH. 2: PROJECT DEVELOPMENT PROCESS

- **Systems Engineering Approach**
 - Regional ITS Architecture
 - Regional Operations Plans
- **Planning and Pre-Design**
 - Concept of Operations
 - System/Functional Requirements
 - Device Placement and Justification
- **General Design Guidance**
 - Clear Zone
 - Survey and Core Borings
 - Environmental and Utility Coordination
 - Functionality, Constructability, and Maintainability



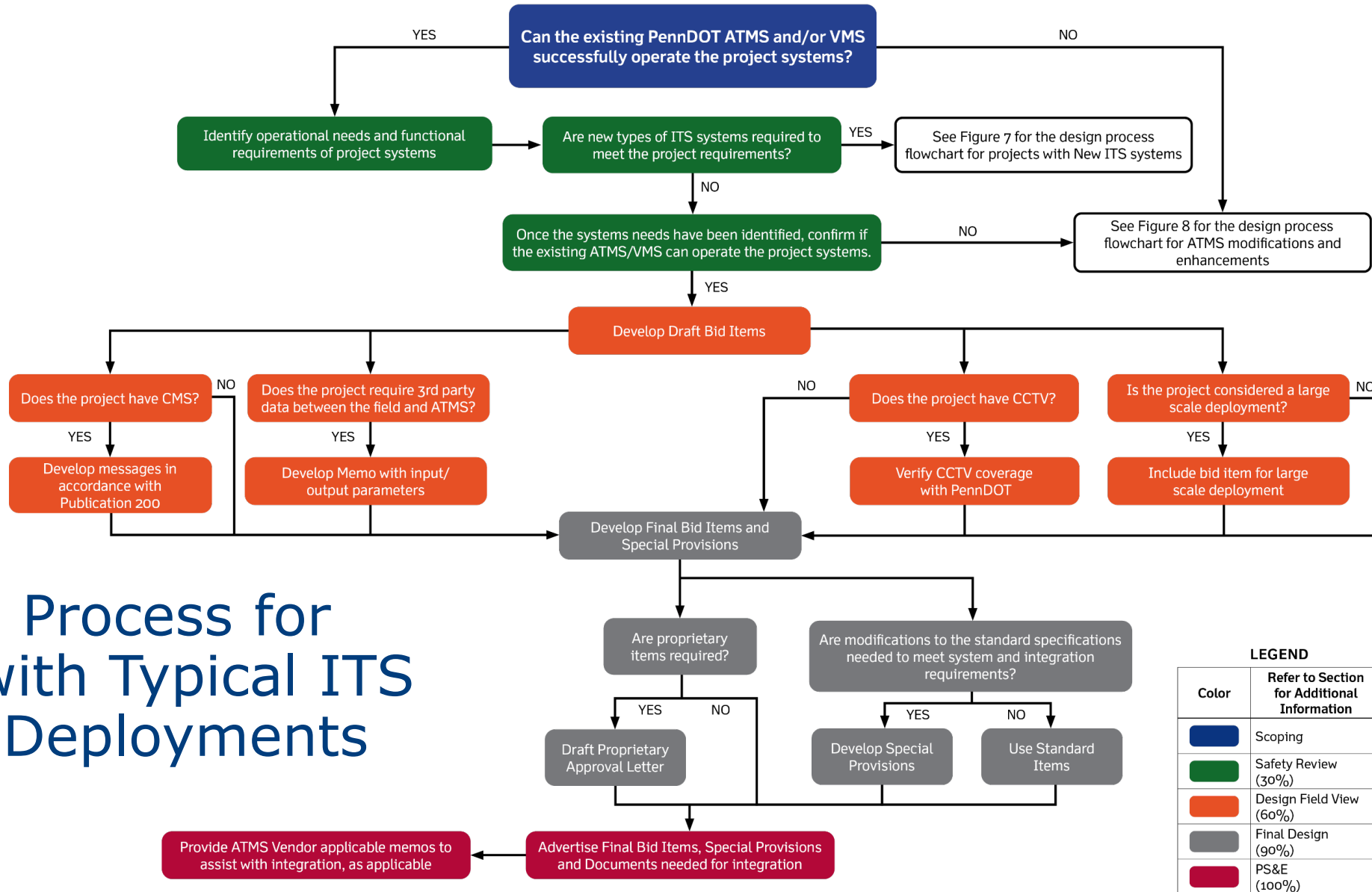
SR 0422, SECTION M1B
SYSTEMS ENGINEERING REPORT

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CH. 2: PROJECT DEVELOPMENT PROCESS



Design Process for Projects with Typical ITS System Deployments



CH. 2: PROJECT DEVELOPMENT PROCESS

- Minor Project

- Consists of only a small number of device installations
- Device types have been deployed previously
- No deviations from design standards are anticipated
- Requires very little coordination between design disciplines and with other projects

- Moderate Project

- Consists of 10 or more ITS device installations.
- May require minor deviations from design standards
- Requires relatively straightforward communications and integration elements
- May or may not be part of a moderately complex roadway or bridge project

- Complex Project

- Consists of many ITS device installations
- Most likely includes new device types and/or systems
- Significant modifications to design standards are anticipated
- Requires communications network and TMC integration design elements
- Device deployments, integration, and testing may be phased
- May or may not be part of a large roadway or bridge project
- May or may not require substantial change to or creation of a new ATMS module



CH. 2: PROJECT DEVELOPMENT PROCESS

ITS Design Timeline

Phase	Minor	Moderate	Complex
Scoping	0-1 Months	1-2 Months	2-4 Months
30% / Safety Review	1 Month	1-2 Months	3-6 Months
60% / DFV	3 Months	3-6 Months	3-12 Months
90% / FDOM (Pre-final)	2 Months	2-3 Months	3-12 Months
100% PS&E	2 Months	2-3 Months	3-6 Months
Total Design Time	8-9 Months	9-16+ Months*	14-40+ Months*

*Phasing for ITS projects that are a component part of roadway and bridge projects may be subject to the submission schedule of the overall roadway/bridge design.



CH. 2: PROJECT DEVELOPMENT PROCESS

PennDOT ITS Design Deliverables

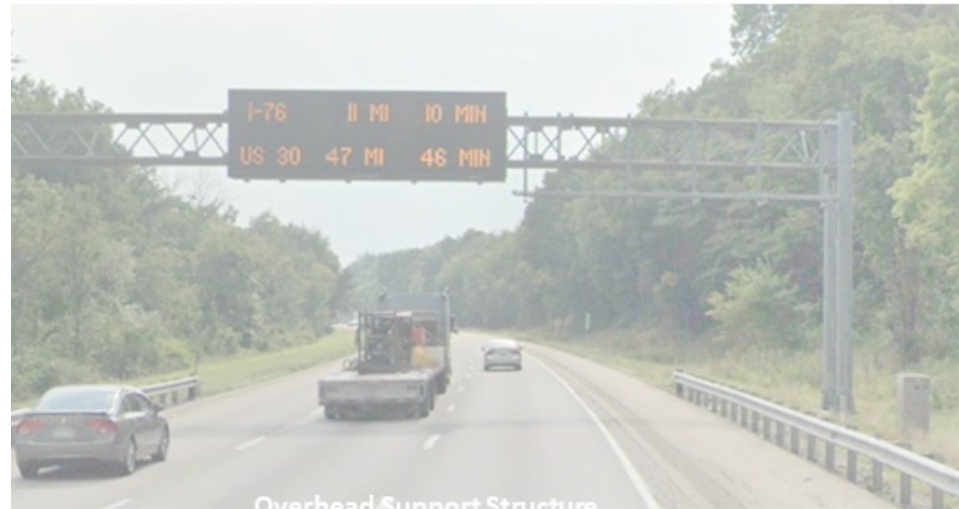
Phase	Deliverables/ Steps	Responsibility	Reviewer	Approval Agency
Scoping	Design Scope/Budget	Designer / PennDOT PM	District ITS staff	District ITS staff, Central Office, FHWA
30% /Safety Review (Systems Engineering Process)	Systems Engineering Report (SER)	Designer	District ITS staff, Central Office, OA/OIT	District ITS staff, Central Office, FHWA, OA/OIT

List of deliverables for all project phases are provided in the Publication.

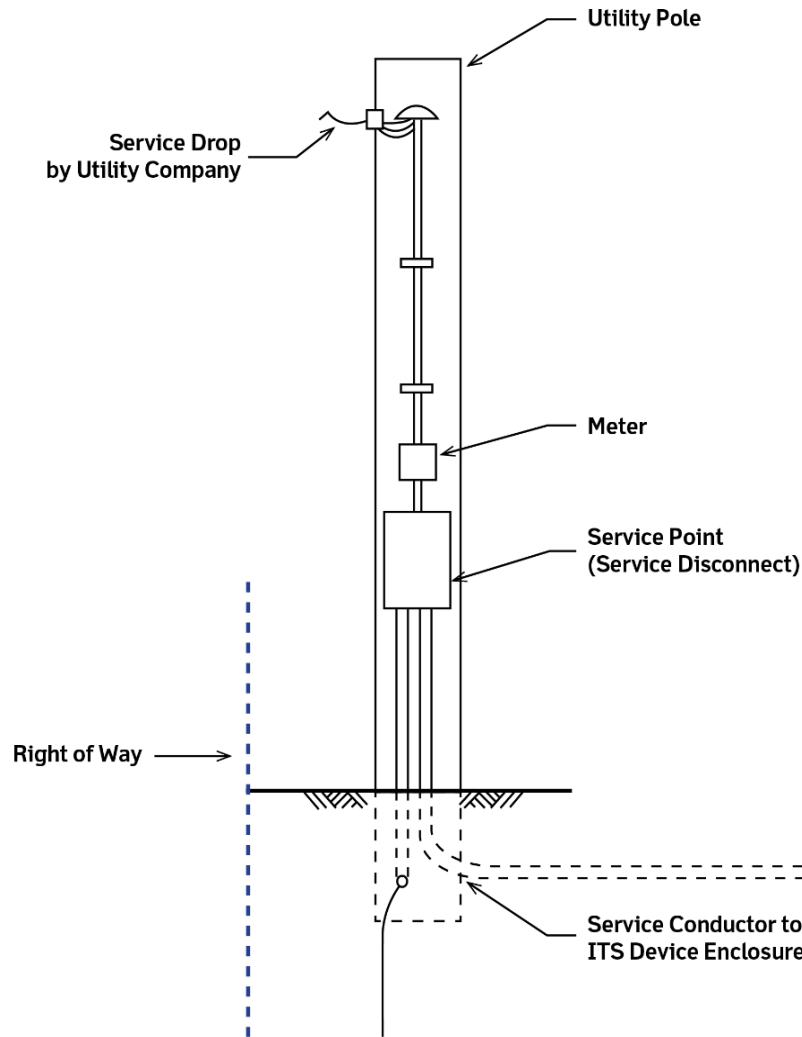


CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

- Power Distribution
- Communications
- Conduit and Junction Boxes
- Equipment Enclosures
- Supporting Infrastructure
- Device Design
- Other and Antiquated Devices and Systems

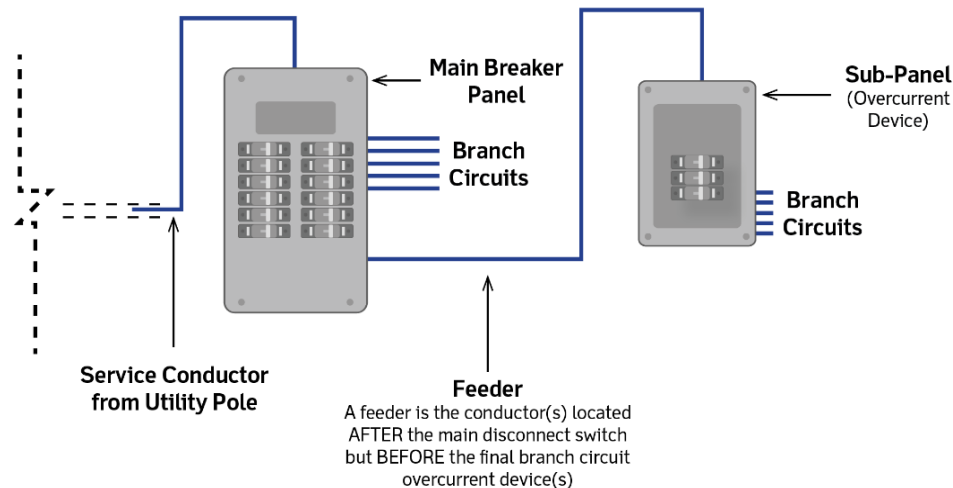


CH. 3: DEVICE AND INFRASTRUCTURE DESIGN



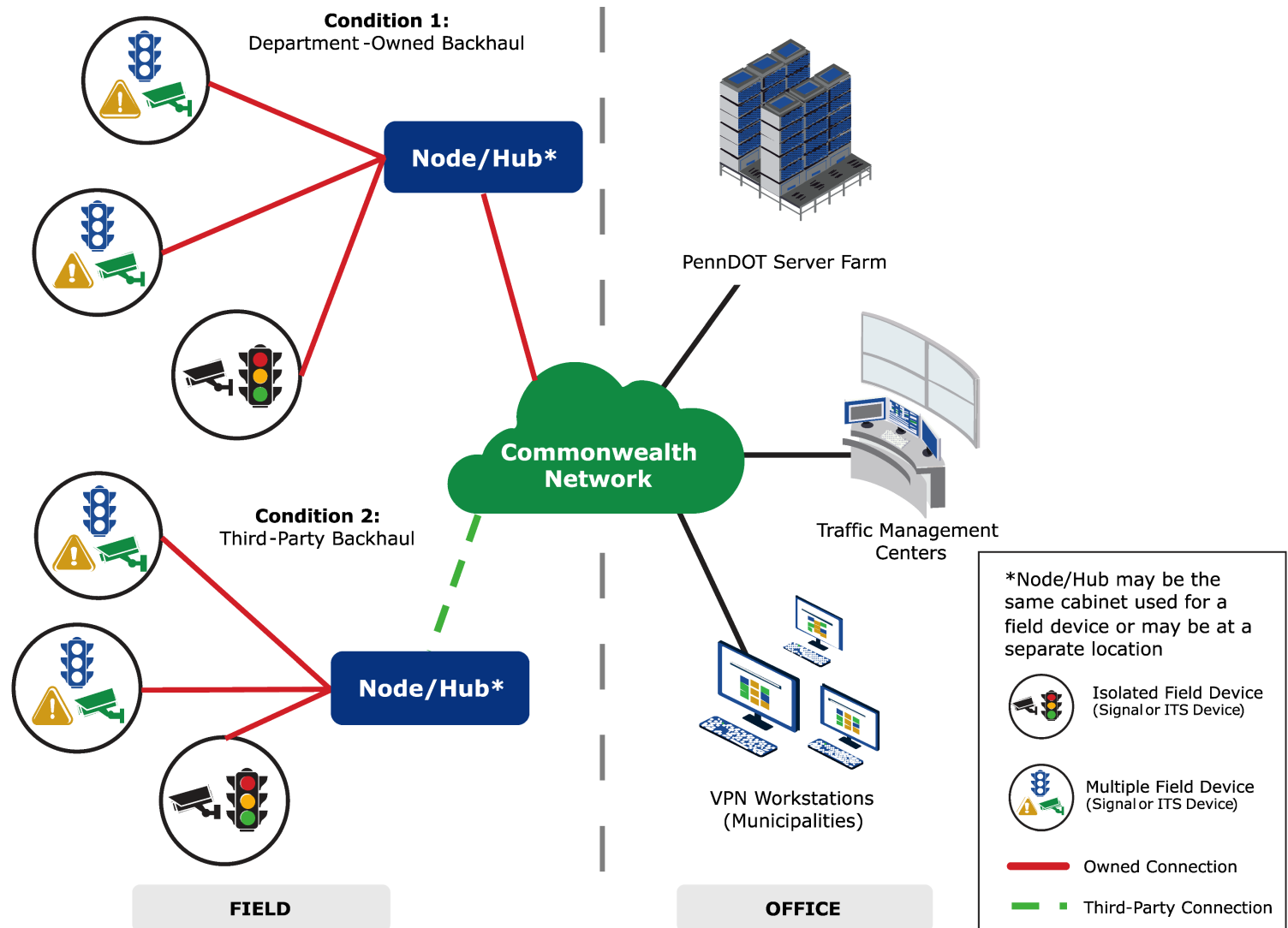
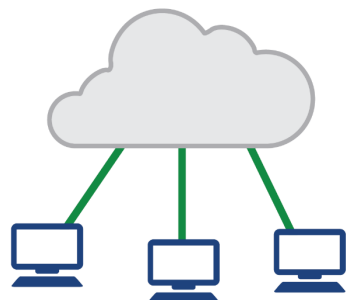
- Power Distribution

- Obtaining Power Service
 - Recommended process
- Circuit Types
- Updated Power Requirements
- Sample Voltage Drop Calculation
- Utility Billing



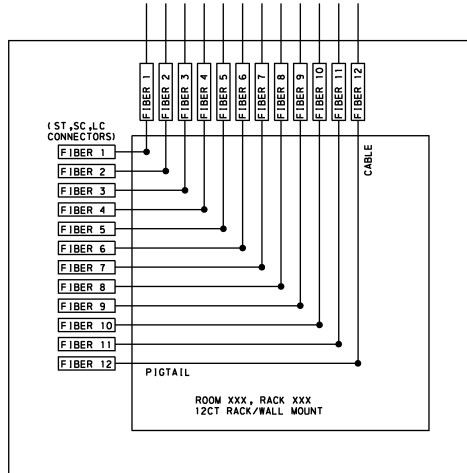
CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

- Communications
 - Network Topology
 - Physical
 - Logistical
 - Technologies
 - Copper
 - Fiber Optic Cable
 - Ethernet
 - Wireless
 - Cellular



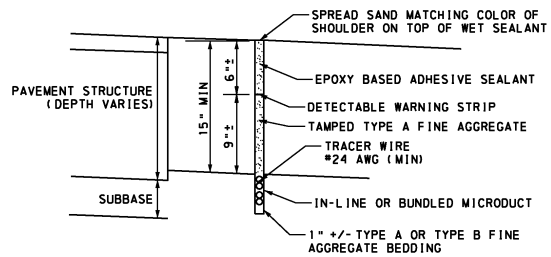
CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

• PennDOT Fiber Standards

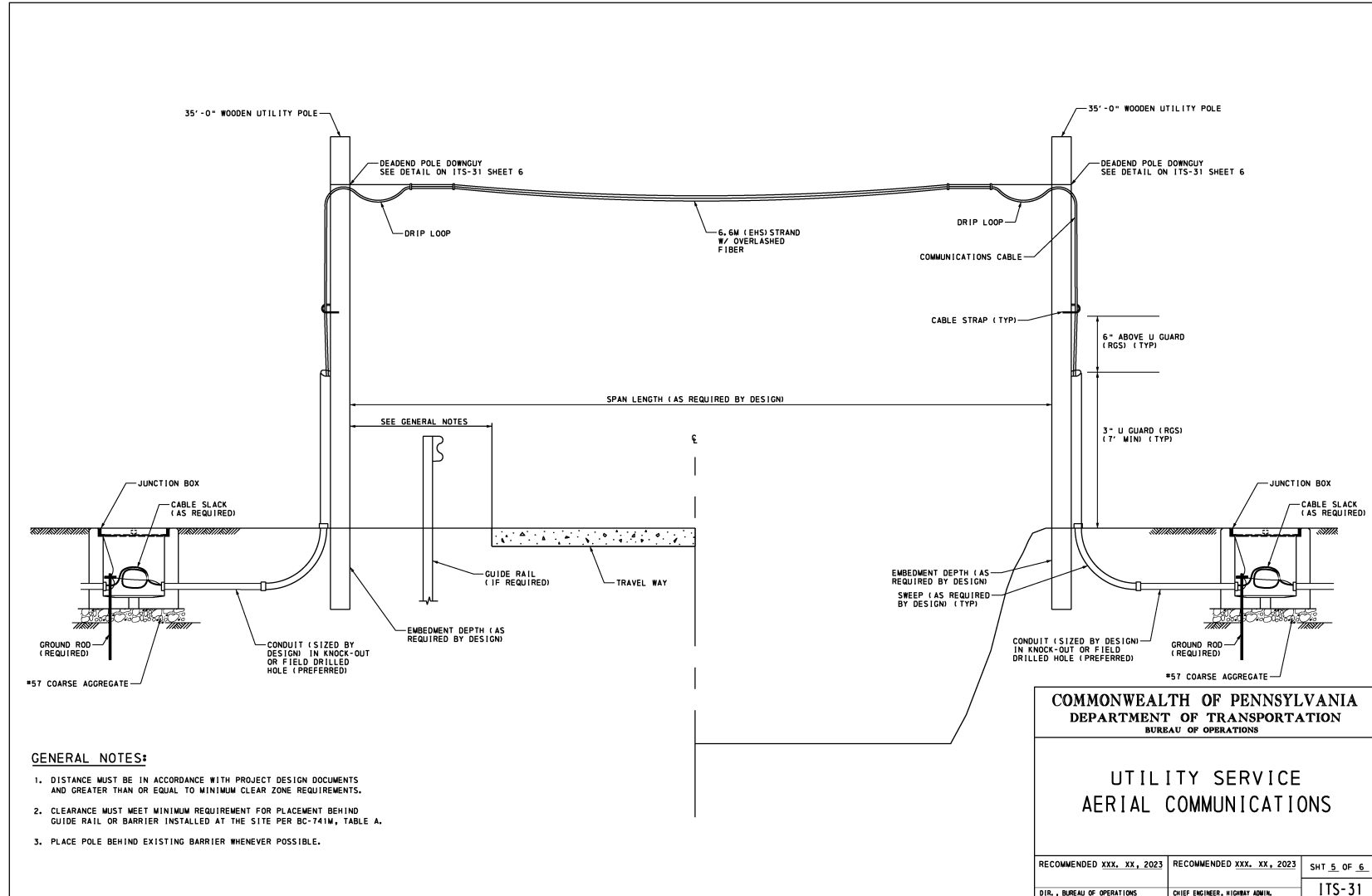


TERMINATION PANEL DETAIL REF#

SAMPLE TERMINATION PANEL



MICRO-TRENCH DETAIL FOR
ROADWAY PAVEMENT AND PAVED SHOULDERS



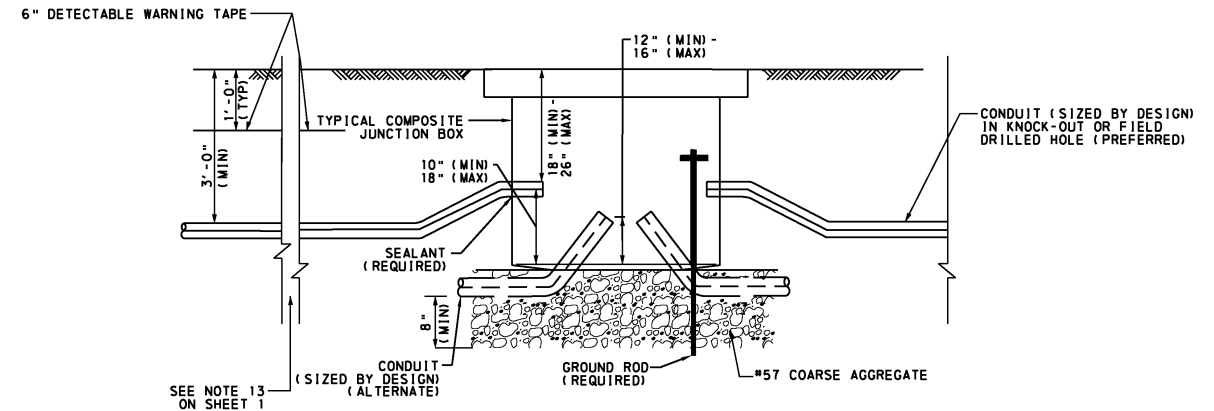
CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

• Conduit and Junction Boxes

– Conduit

- Type
- Fill Ratios
- Dimensions
- Structure Mounted

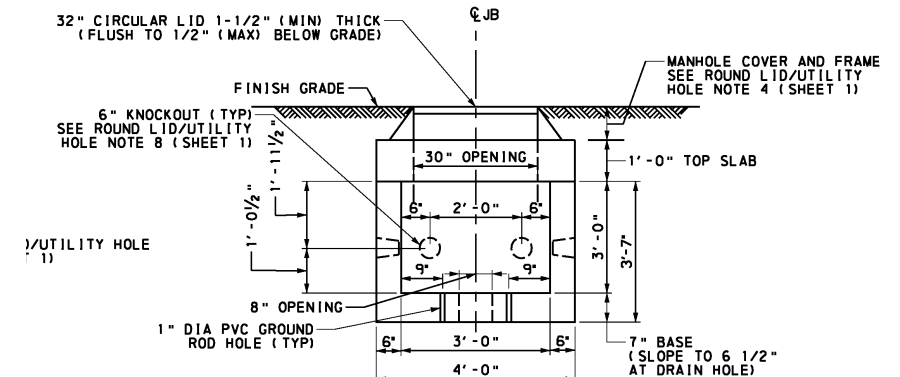
– Junction Boxes



INSTALLATION DETAIL

TABLE 9: TYPICAL CONDUIT DIMENSION FOR POLY VINYL CHLORIDE (PVC) CONDUIT

Trade Size (in)	Inside Diameter (in)	Total Area (sq. in)	40% Area (sq. in)
1/2	0.60	0.28	0.11
3/4	0.80	0.50	0.20
1	1.03	0.83	0.33
1-1/2	1.59	1.98	0.79
2	2.04	3.27	1.31
2-1/2	2.44	4.67	1.87
3	3.03	7.21	2.88
4	3.99	12.50	5.00
5	5.01	19.70	7.88

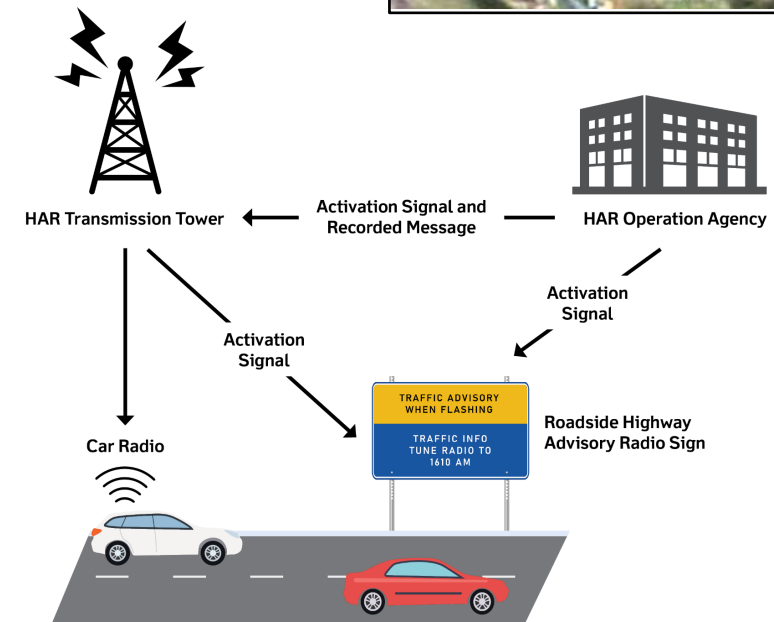
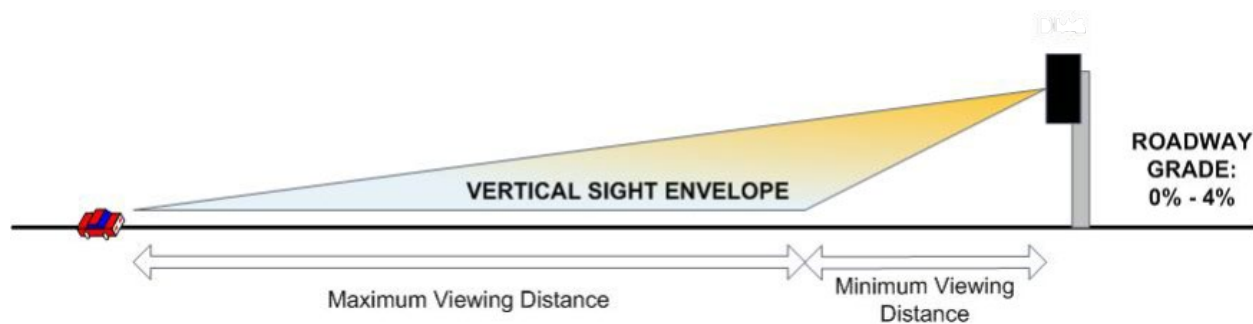


SECTION A-A

ROUND LID JUNCTION BOX DETAILS

CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

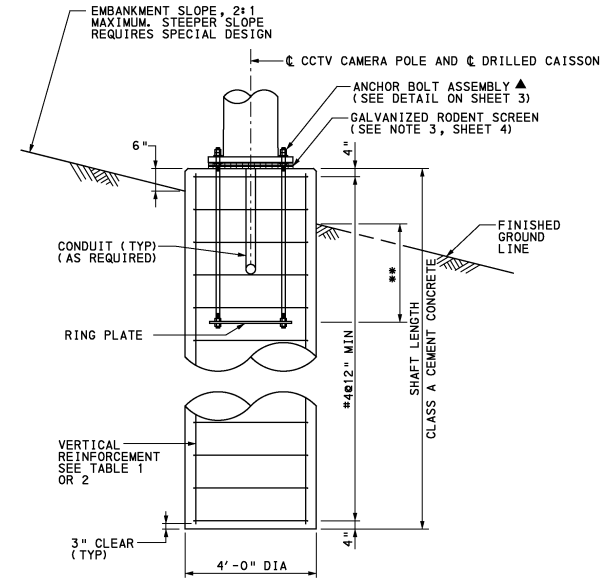
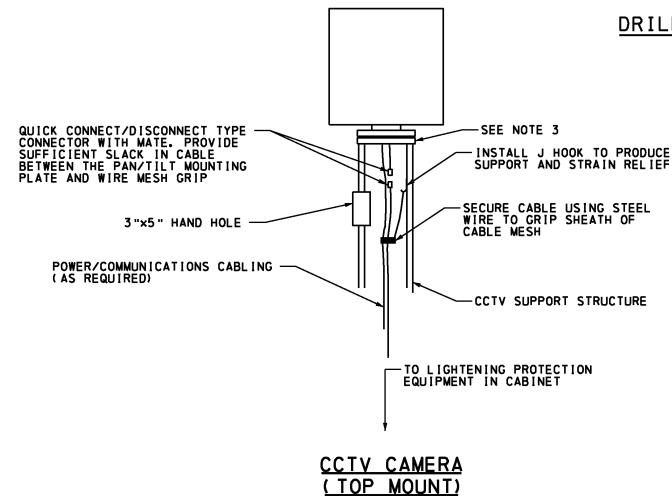
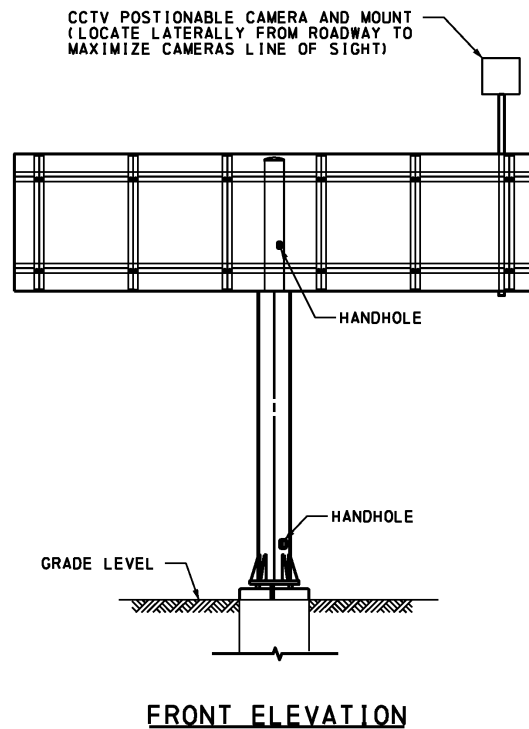
- CCTV Camera
- **Changeable Message Sign**
- Vehicle Detectors
- Ramp Meter Systems
- Other and Antiquated Devices and Systems
 - Highway Advisory Radio
 - Travel Time Systems



CH. 3: DEVICE AND INFRASTRUCTURE DESIGN

• CCTV Camera

- Standard Foundation Designs
- Additional Mounting Details
- External Lowering Device



DRILLED CAISSON ELEVATION
(MAINTAINER PAD NOT SHOWN)

TABLE 1 DRILLED CAISSON DESIGN DATA CAISSON ON LEVEL GROUND				
POLE HEIGHT	SHAFT DIAMETER	SHAFT LENGTH	VERTICAL REINFORCEMENT	
			QUANTITY	SIZE
50	4	14	16	8
70	4	17	16	8

TABLE 2 DRILLED CAISSON DESIGN DATA CAISSON ON 2:1 MAX SLOPE				
POLE HEIGHT	SHAFT DIAMETER	SHAFT LENGTH	VERTICAL REINFORCEMENT	
			QUANTITY	SIZE
50	4	17	16	8
70	4	21	16	8



Ch. 4: MAINTENANCE CONSIDERATIONS

- Philosophy
- Vehicle Access
- Personnel Access
- Work Areas
- Junction Box Lid Access/Storage
- Drainage
- Snow Removal/Storage
- References



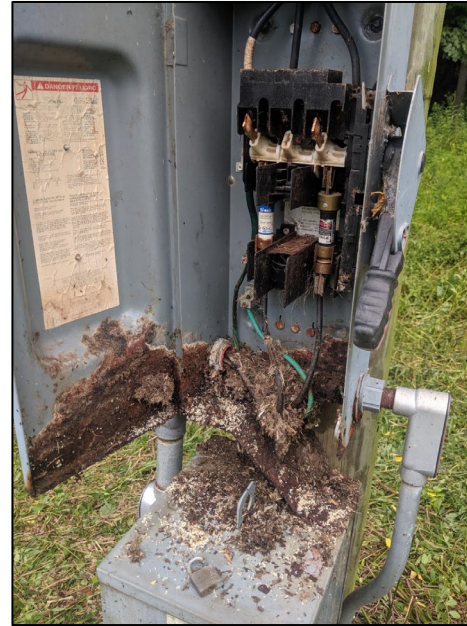
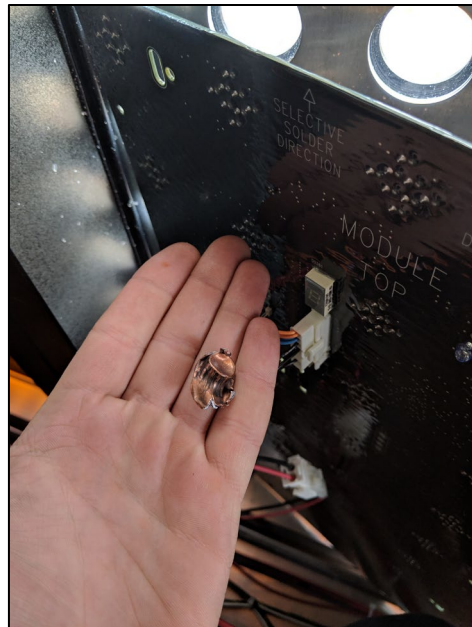
CH. 4: MAINTENANCE CONSIDERATIONS

- Philosophy
 - Safety
 - Efficiency
 - Access
 - Proximity
- Vehicle Access
- Personnel Access
- Work Area



CH. 4: MAINTENANCE CONSIDERATIONS

- Enclosures



CH. 4: MAINTENANCE CONSIDERATIONS

- Safety



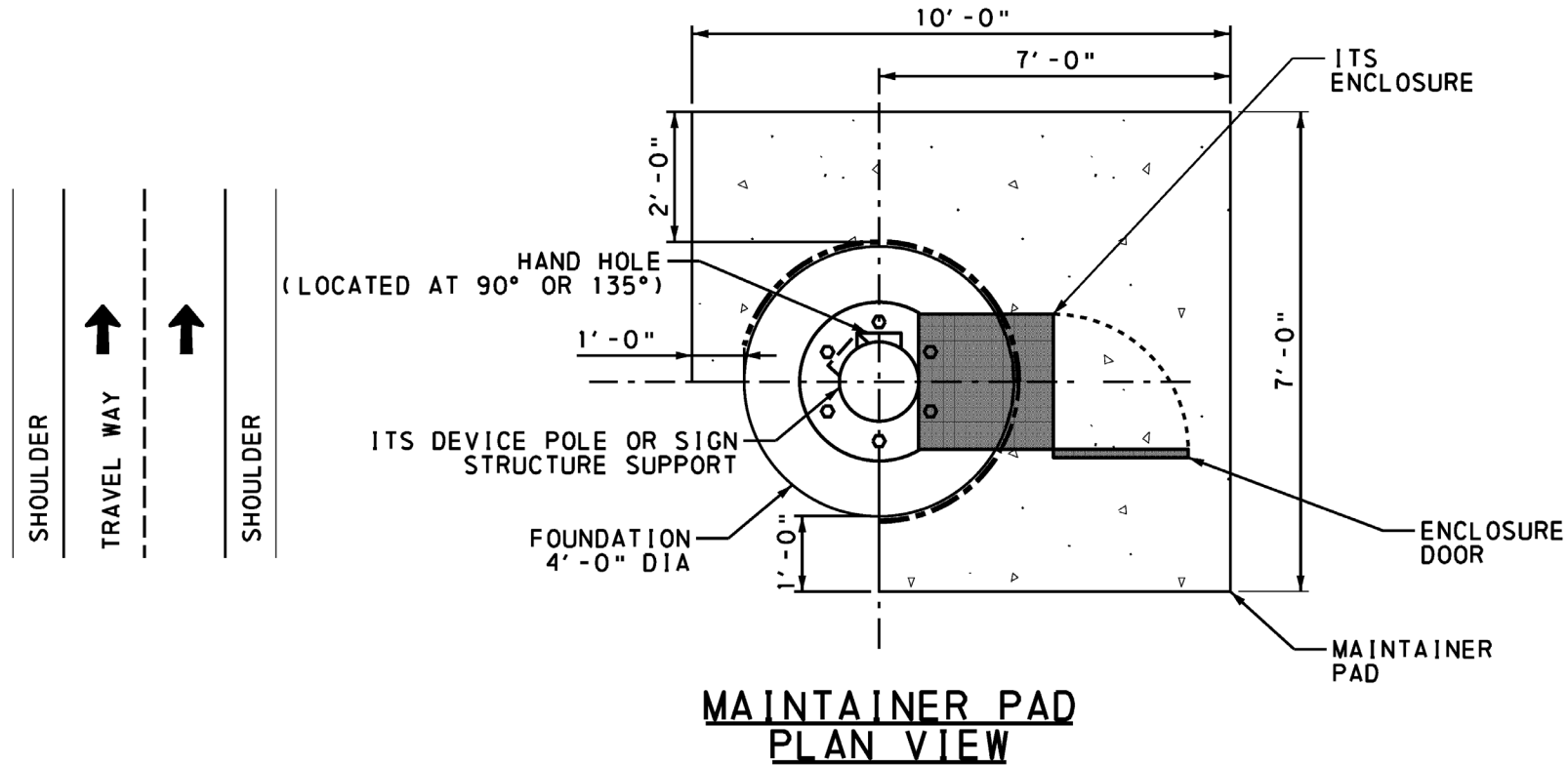
CH. 4: MAINTENANCE CONSIDERATIONS

- Maintainer Pads



CH. 4: MAINTENANCE CONSIDERATIONS

- Maintainer Pads



CH. 4: MAINTENANCE CONSIDERATIONS

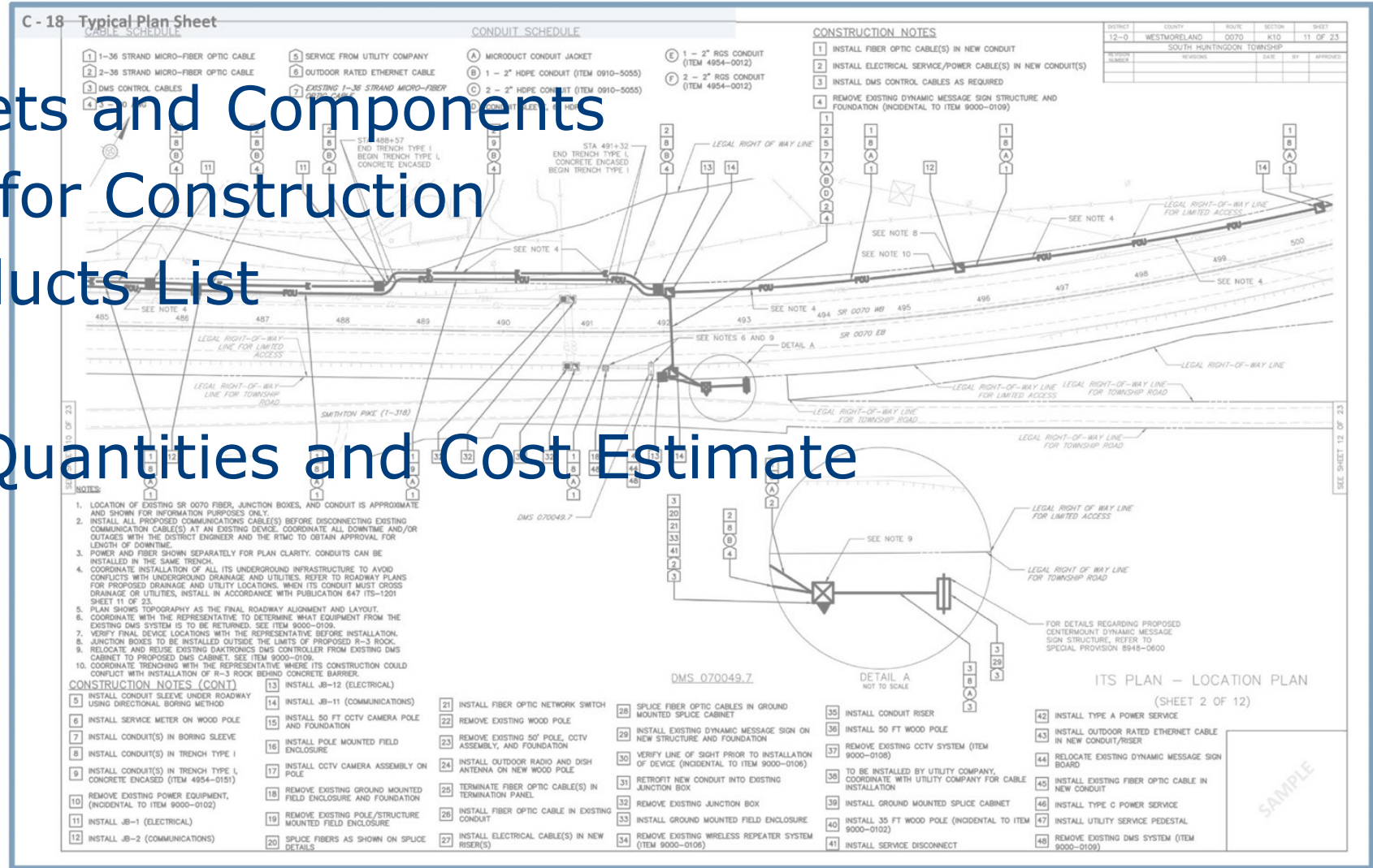
• The FIVE R's of ITS Device Maintenance

REPAIR	A device will be repaired when parts fail, and the maintenance contractor can easily provide those parts at a reasonable cost. As a "rule of thumb," after a component for a device is repaired three times, consideration should be given to retiring the component, or evaluating if the device itself can be efficiently repaired in the future. Begin to compare the repair B/C.
RETROFIT	A retrofitted device will keep the same skeleton/housing and structure, but have the "guts" removed, and replaced with parts that bring the device into compliance with today's standards. Compare the retrofit B/C to the replacement B/C to determine if a device should actually be replaced.
REPLACE	A device should be replaced when it is determined that it can no longer be repaired effectively, when parts are no longer available, or the supporting structure needs to be replaced. A device should also be replaced if the replacement B/C is greater than that of refurbishment. Consider the needs.
RELOCATE	A device should be considered for relocation when the current location no longer provides the maximum amount of coverage , the current location no longer meets standards , or other newer devices in the area / along the corridor provide more information to the motorists or the TMC.
REMOVE	The device should be removed when it is no longer needed to advise motorists of an event, or in the case of equipment such as vehicle detectors, may no longer provide meaningful information to the TMC.



CH. 5: PLAN PREPARATION

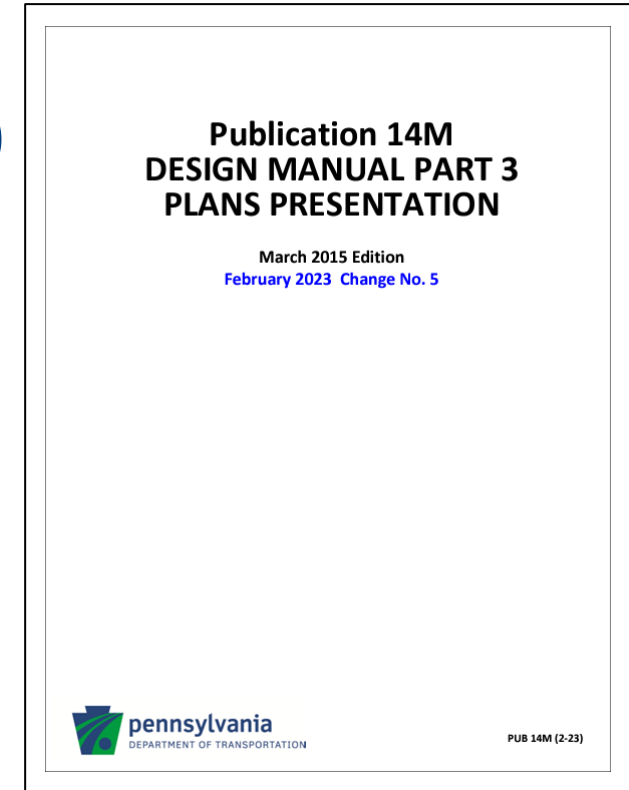
- General
- Typical Plan Sets and Components
- Specifications for Construction
- Approved Products List
- Bid Items
- Tabulation of Quantities and Cost Estimate



CH. 5: PLAN PREPARATION

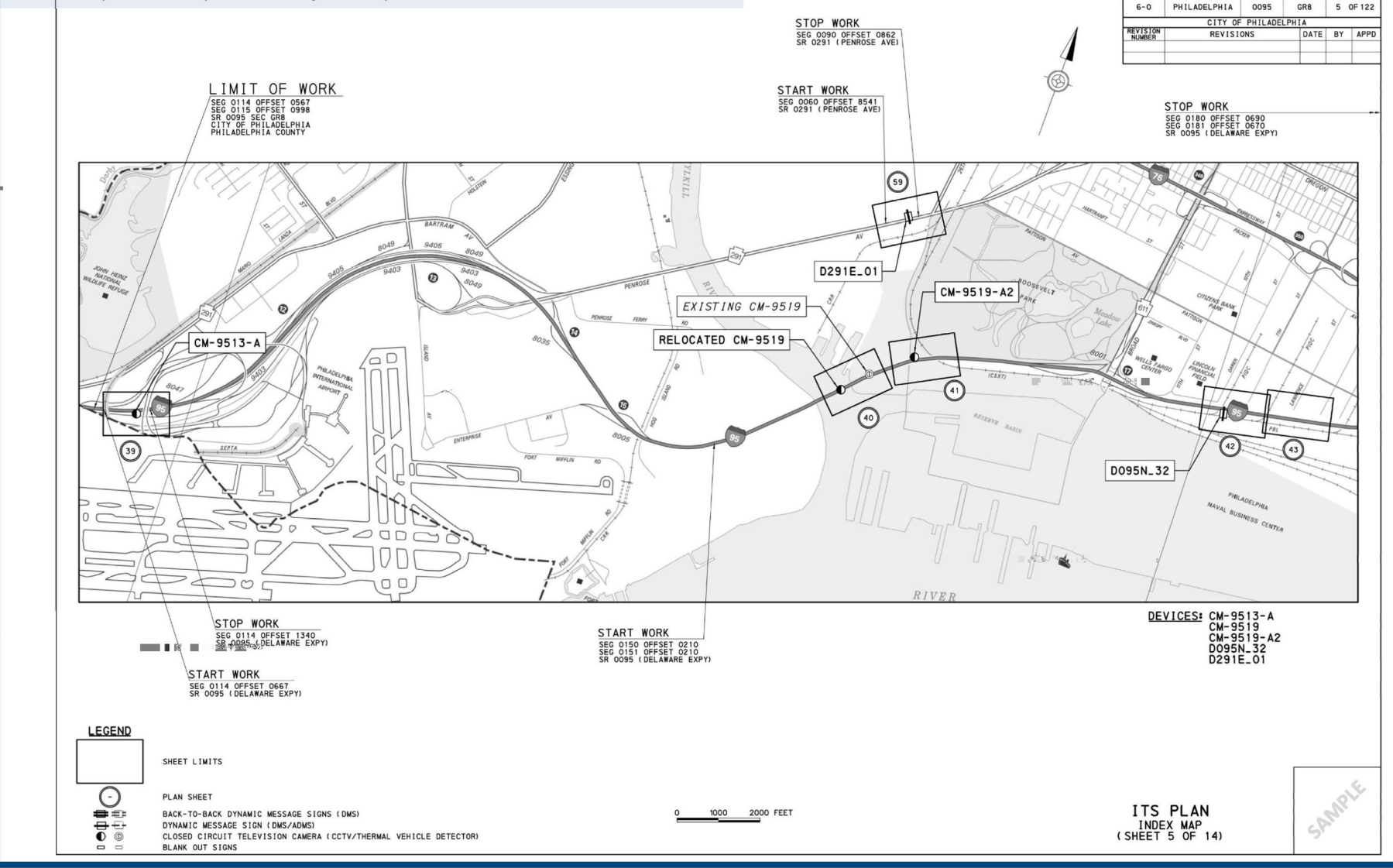
- Title Sheet
- Index Sheet(s)
- Typical Section Sheet(s)
 - General Notes
 - Location Map
 - Tabulation of Overall Length and Construction Length
 - List of All Equalities
 - Earthwork Summary
 - List of Public Utilities
 - Tabulation of Project Coordinates
 - Special Details
 - Typical Sections

- Summary of Quantities Sheet(s)
- Tabulation of Quantities Sheet(s)
- Plan Sheets
- Structure Plan(s)
- Signing Plan(s)
- Final Design
Cross Sections



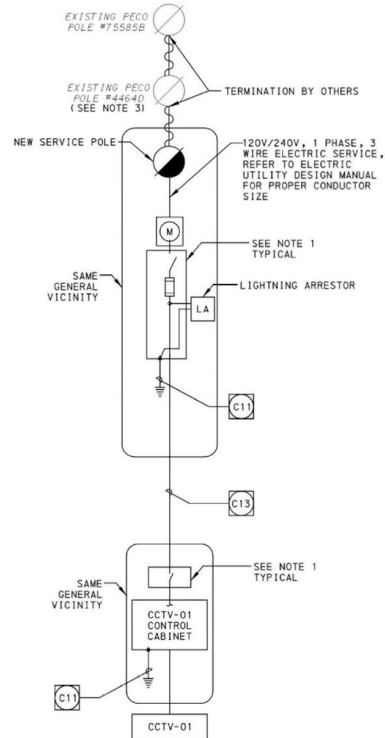
CH. 5: PLAN PREPARATION

D - 2 Sample Index Map with Existing and Proposed Device Labels



CH. 5: PLAN PREPARATION

D - 5 Electrical Schematic(s)/Detail(s) - Device



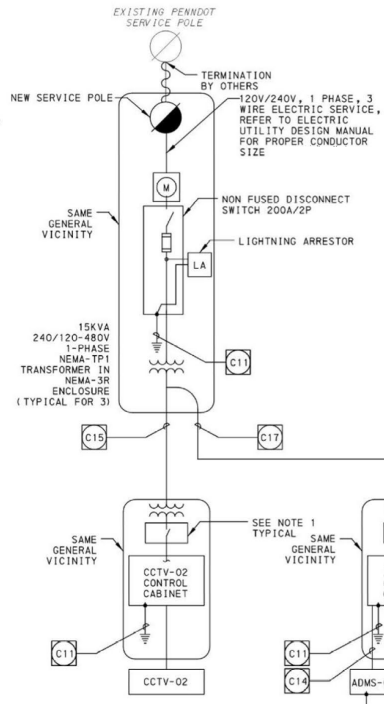
ELECTRIC 1-LINE DIAGRAM
CCTV-01

CABLE LEGEND:

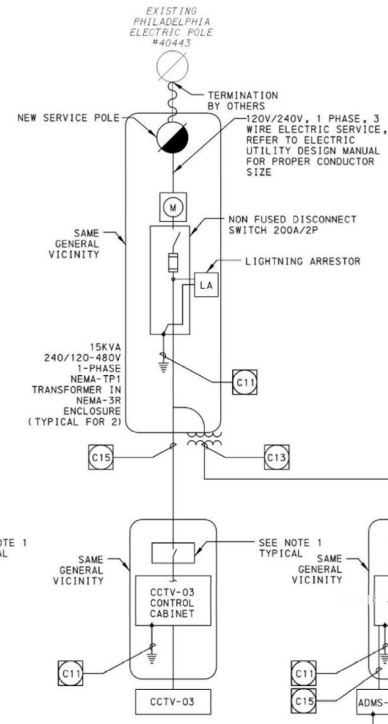
C11	1C 4AWG, BARE COPPER WIRE	C16	3C 8AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT
C12	3C 1AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT	C17	3C 8AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT
C13	3C 2AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT	C18	3C 12AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT
C14	3C 4AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT	C19	3C 1/0AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT
C15	3C 6AWG, +1C 8AWG (Grd), RHW/RHH/USE, 600-VOLT	C20	50-OHM COAXIAL

NOTES:

1. 100A/2P DISCONNECT SWITCH EXCEPT AS NOTED.
2. PROVIDE NEMA3R RATED STEEL ENCLOSURE FOR POWER SWITCH/BREAKER.
3. EXISTING PECO POLE #4464D CURRENTLY DOES NOT HAVE ANY ELECTRICAL CABLES INSTALLED.
4. GROUND CABLES SHOWN IN CABLE LEGEND THAT ARE INSTALLED WITHIN UNDERGROUND CONDUIT MAY BE TYPE THHN/THWN, 600-VOLT CABLE.



ELECTRIC 1-LINE DIAGRAM
CCTV-02, ADMS-01, & TTS-02



ELECTRIC 1-LINE DIAGRAM
CCTV-03, ADMS-02, & TTS-03

ABBREVIATIONS

ADMS	=	ARTERIAL DYNAMIC MESSAGE SIGN
AWG	=	AMERICAN WIRE GAGE
TTS	=	TRAVEL TIME SENSOR
CCTV	=	CLOSED CIRCUIT TV

ITS PLAN
ELECTRICAL DETAILS
(SHEET 1 OF 4)

SAMPLE

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
6-0	PHILADELPHIA	0095	AF2	28 OF 37
		1005	AF2	
		2016	AF2	
CITY OF PHILADELPHIA				
PROJECT	REVISIONS	DATE	BY	



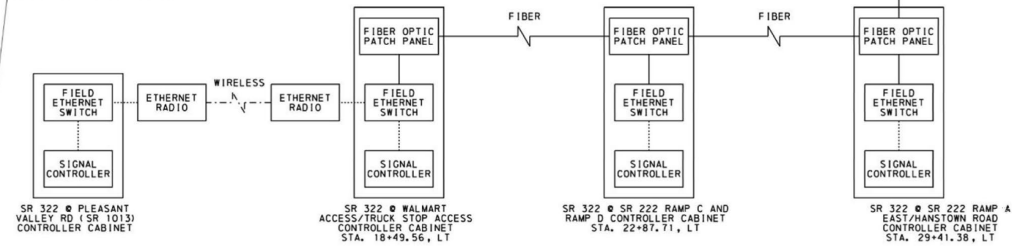
CH. 5: PLAN PREPARATION

D - 7 Communications Schematic(s)/Detail(s) – Field-2-Center (New)

CONSTRUCTION NOTES:

1. SR 322 AT BETHANY ROAD INTERSECTION IN EPHRATA BOROUGH TO BE REMOVED FROM COORDINATED SIGNAL SYSTEM ALONG SR 322. SR 322 AT BETHANY ROAD TO OPERATE ACTUATED, UNCOORDINATED.
2. PROVIDE DEDICATED 2" CONDUIT FOR FIBER OPTIC COMMUNICATION NETWORK.

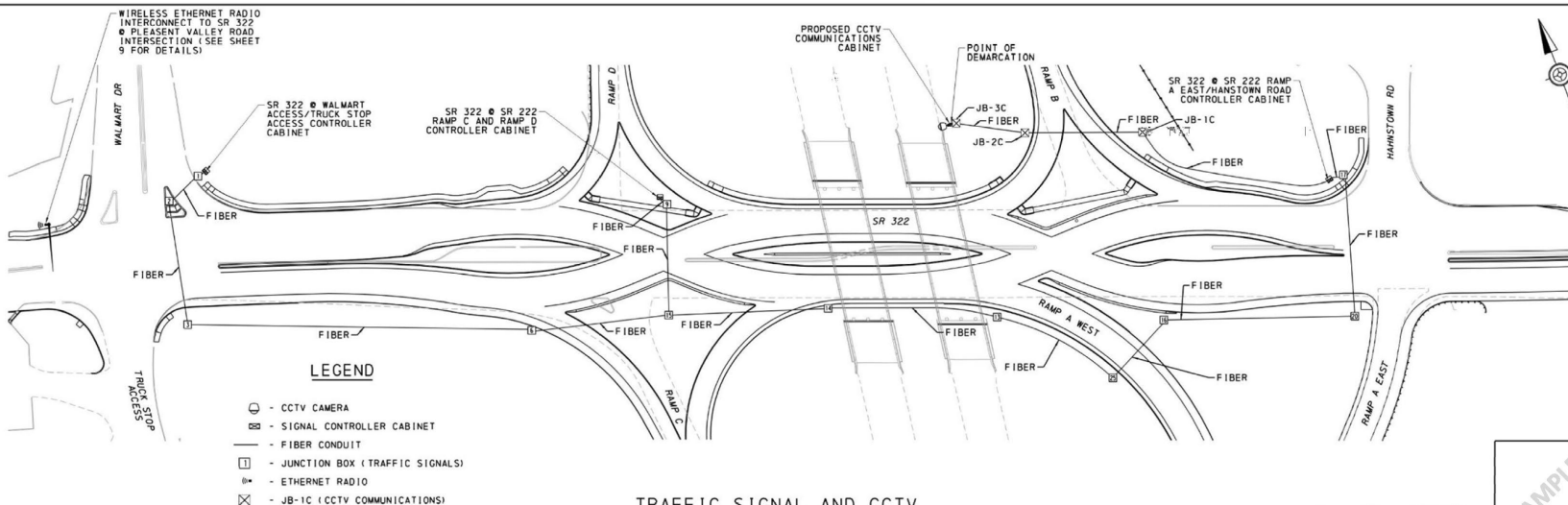
SEE CONSTRUCTION NOTE 1.



Sample: This is not a design standard. Communications to be approved by OA/OIT.

LEGEND

- CCTV CAMERA
- FIBER
- WIRELESS ETHERNET RADIO
- PROVIDER LINE
- ETHERNET CABLE
- ETHERNET RADIO



TRAFFIC SIGNAL AND CCTV COMMUNICATIONS INTERCONNECT DETAIL PLAN

0 50 100 FEET

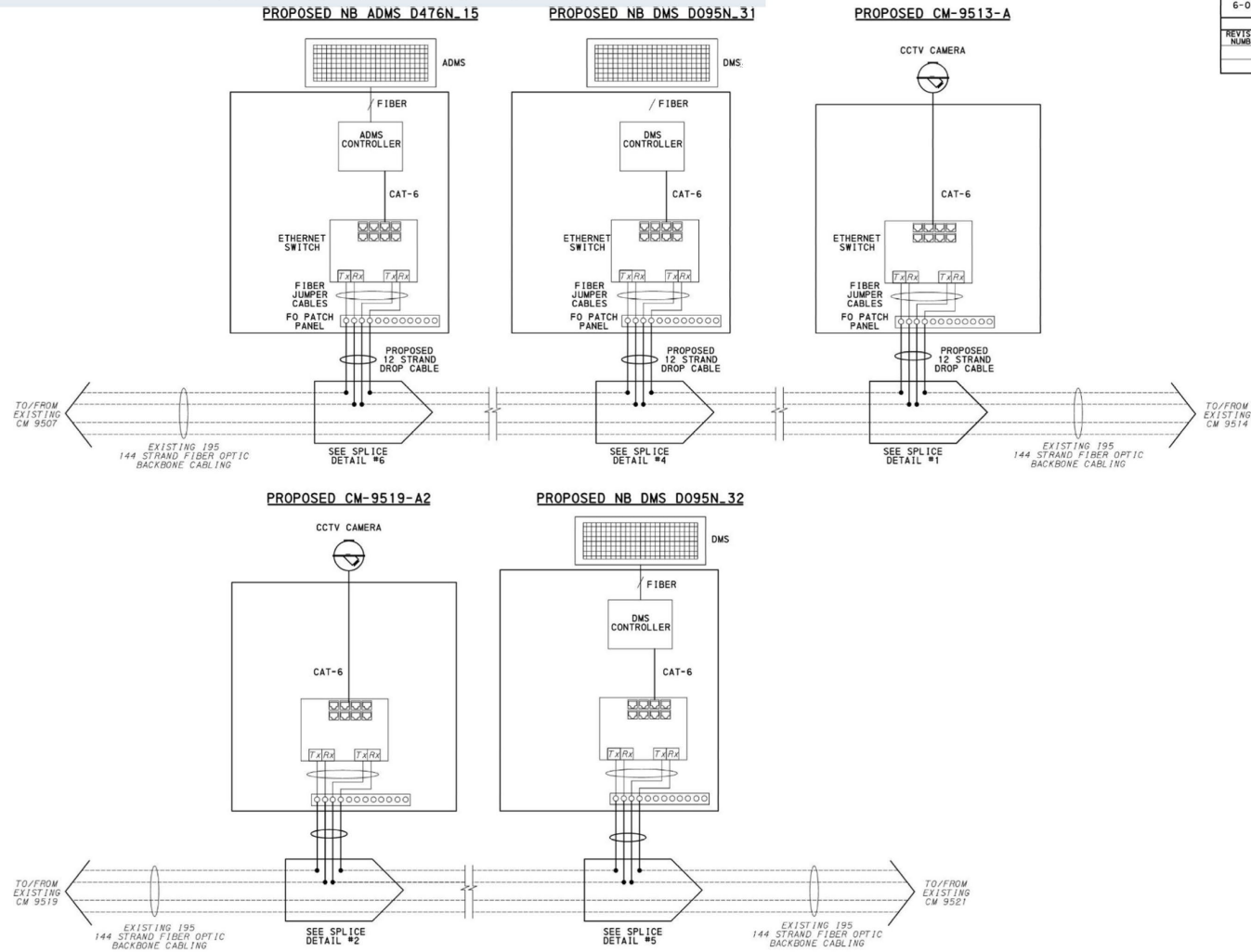
SAMPLE

DISTRICT	COUNTY	ROUTE	SECTION	SHEET
8-0	LANCASTER	0322	036	18 OF 20
EPHRATA/WEST EARL TOWNSHIP				
REVISION NUMBER	REVISIONS	DATE	BY	APPROVED



CH. 5: PLAN PREPARATION

D - 10 Communications Schematic(s)/Detail(s) – Splicing Diagram (also see B-11)



DISTRICT	COUNTY	ROUTE	SECTION	SHEET
6-0	PHILADELPHIA	0095	GR8	98 OF 122
CITY OF PHILADELPHIA				
REVISION NUMBER	REVISION	DATE	BY	APPD

ITS PLAN
SPLICING DETAILS DIAGRAM
COMMUNICATIONS SCHEMATICS
(SHEET 3 OF 10)

SAMPLE

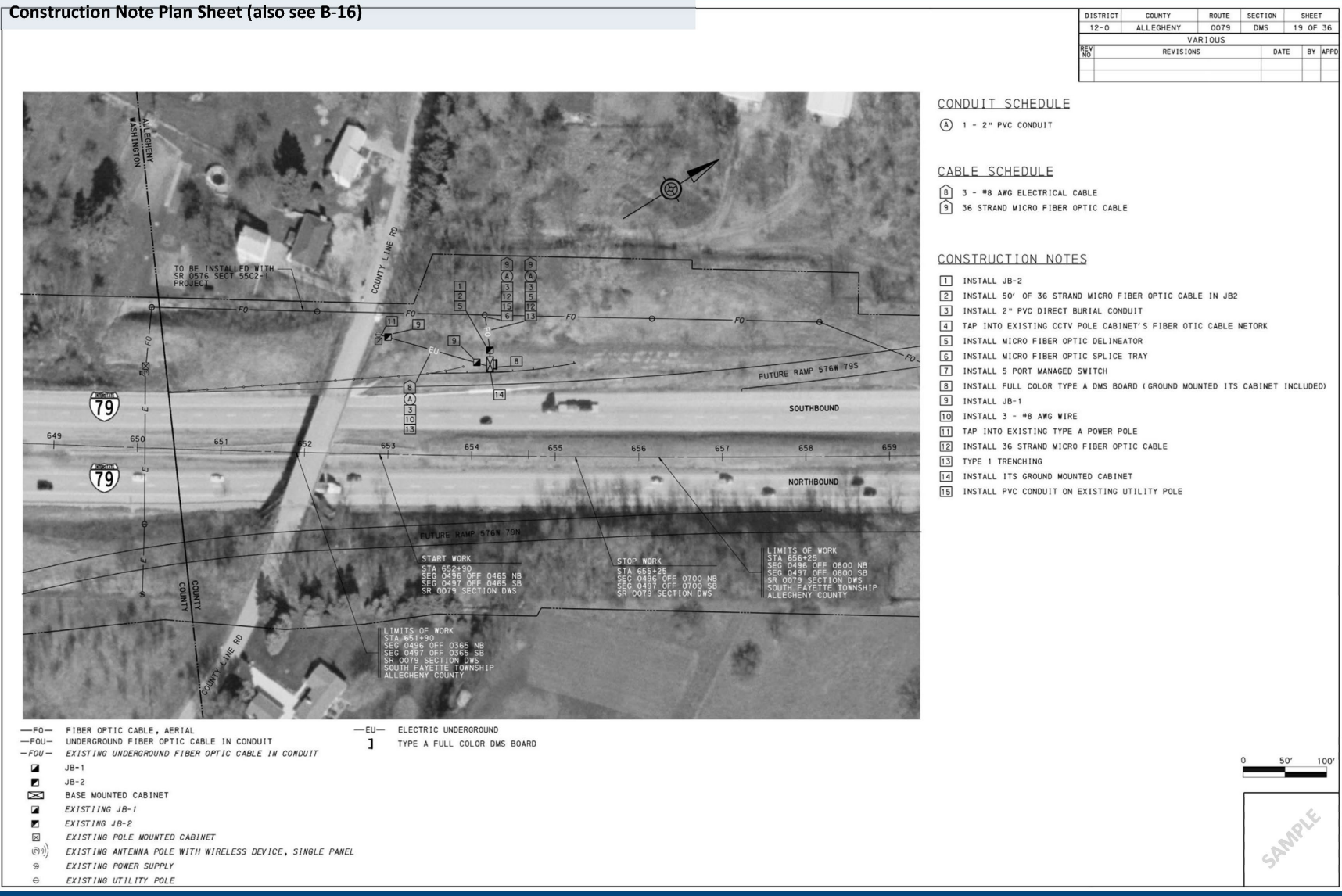


CH. 5: PLAN PREPARATION

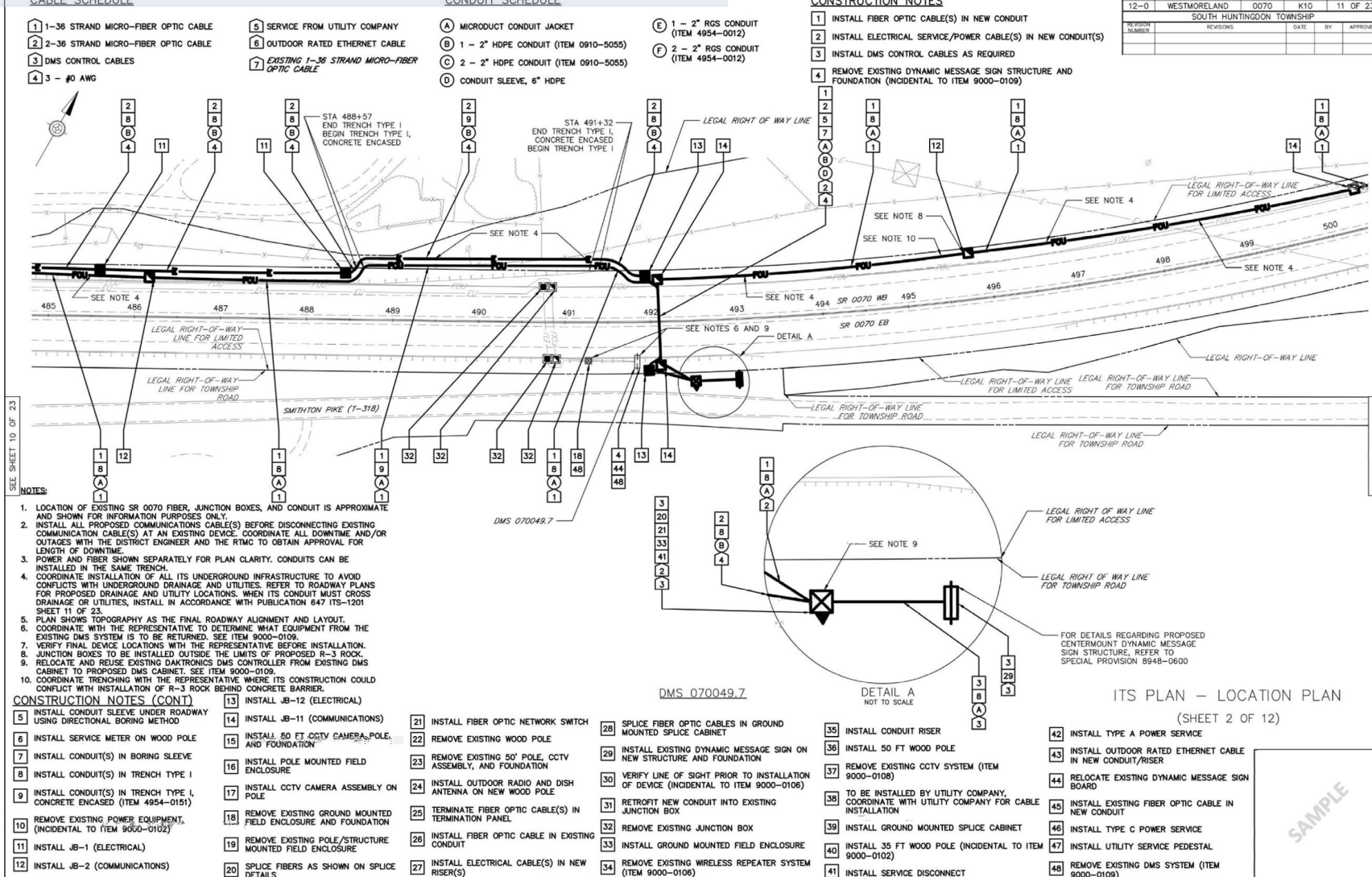
D-15 Construct

1. TOPOGRAPHY, A EXISTING ROAD DEVICES (CM-4) BEEN VERIFIED
 2. LOCATIONS OF CONDUITS AND POWER SHOWN SCALE. INSTALL BOXES BASED APPROVED BY
 3. DO NOT INTER HYDRANT, FIRE
 4. PROVIDE MATE PUBLICATION PROVISIONS WELDING CODE WELDING NOT
 5. THE CONTRACT COORDINATION LOCATE UTILI BEGINNING WORK IN THE CONTRACTOR M COMPLY WITH 1-800-242-17
 6. COMPLY WITH ENTITLED UNDER BEFORE YOU D DAYS NOTICE DAYS IN DESI SYSTEMS, INC
 7. THE CONTRACT RESPONSIBLE OF CONTRACT UNDERGROUND RESPONSIBILITY CONTRACTOR'S
 8. TYPE AND LOC APPURTENANCE INFORMATION DEPARTMENT OF ACCURACY OF STRUCTURES S GUARANTEE TH
 9. ALL NEW UNDER JUNCTION BOX ACCOMPLISHED AT LOW POINT
 10. TRENCH, LAY TRENCHES AT DISTURBED AREA LENGTH THAT
 11. FILTER ALL D FILTER AT TH
 12. COMPLETE ALL ELECTRICAL S LOCAL ELECTR ELECTRICAL S
 13. GROUND WIRE CONTRACTOR'S RUNS WHERE R WIRE IS INCL SUPPLY.
 14. ALL ELECTRIC ARE ESTABLISH STANDARDS SH
 15. ANY DAMAGE TO ITS EQUIPMENT WORK SHALL B
 16. THE CONTRACT AS REQUIRED INSTALLATION
 17. THE CONTRACT DRAWINGS, CO MANUFACTURER AS A PART OF REVIEWED AND
 18. EQUIPMENT LO INTENDED TO EQUIPMENT AN DIMENSIONED LOCATIONS SH SHALL HAVE T
 19. CONTRACTOR W ELECTRICAL C IN THE PLANS SHALL BE SPA UNDERGROUND NATIONAL/LOC
 20. ENSURE JUNCT EASEMENTS, THAT ENSURES
 21. CONSTRUCTION INFRASTRUCTURE SHEETS AND S PAID.
 22. COORDINATE A TERMINATION LOCATIONS W1
- CONTACT: JO
PE
TE

D-17 Construction Note Plan Sheet (also see B-16)



CABLE SCHEDULE



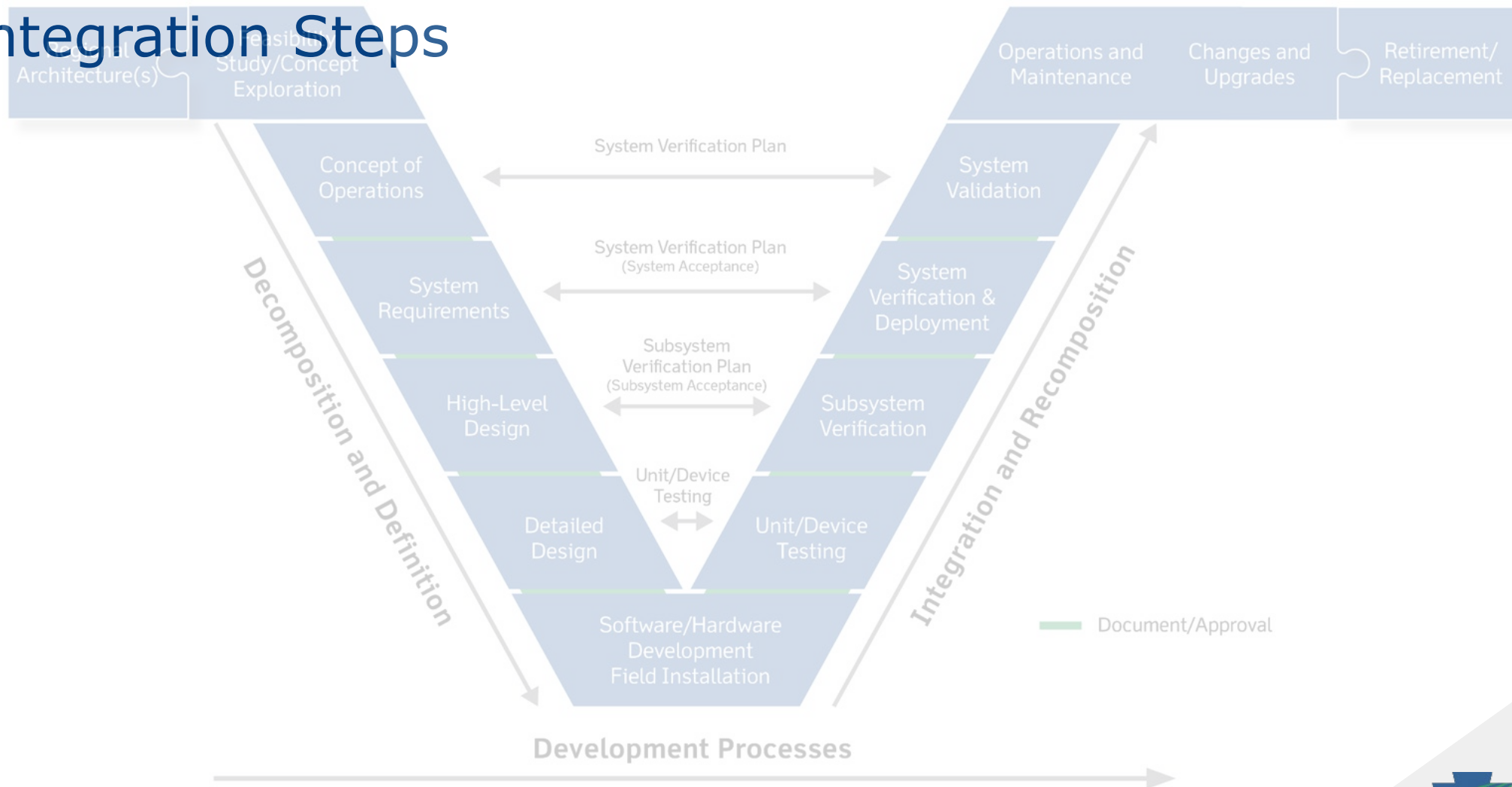
CH. 5: PLAN PREPARATION

- Specifications for Construction
 - Standard Specifications
 - Modified Standard Specifications
 - Special Provisions
- Approved Products List
- Bid Items
- Tabulations of Quantities and Cost Estimate



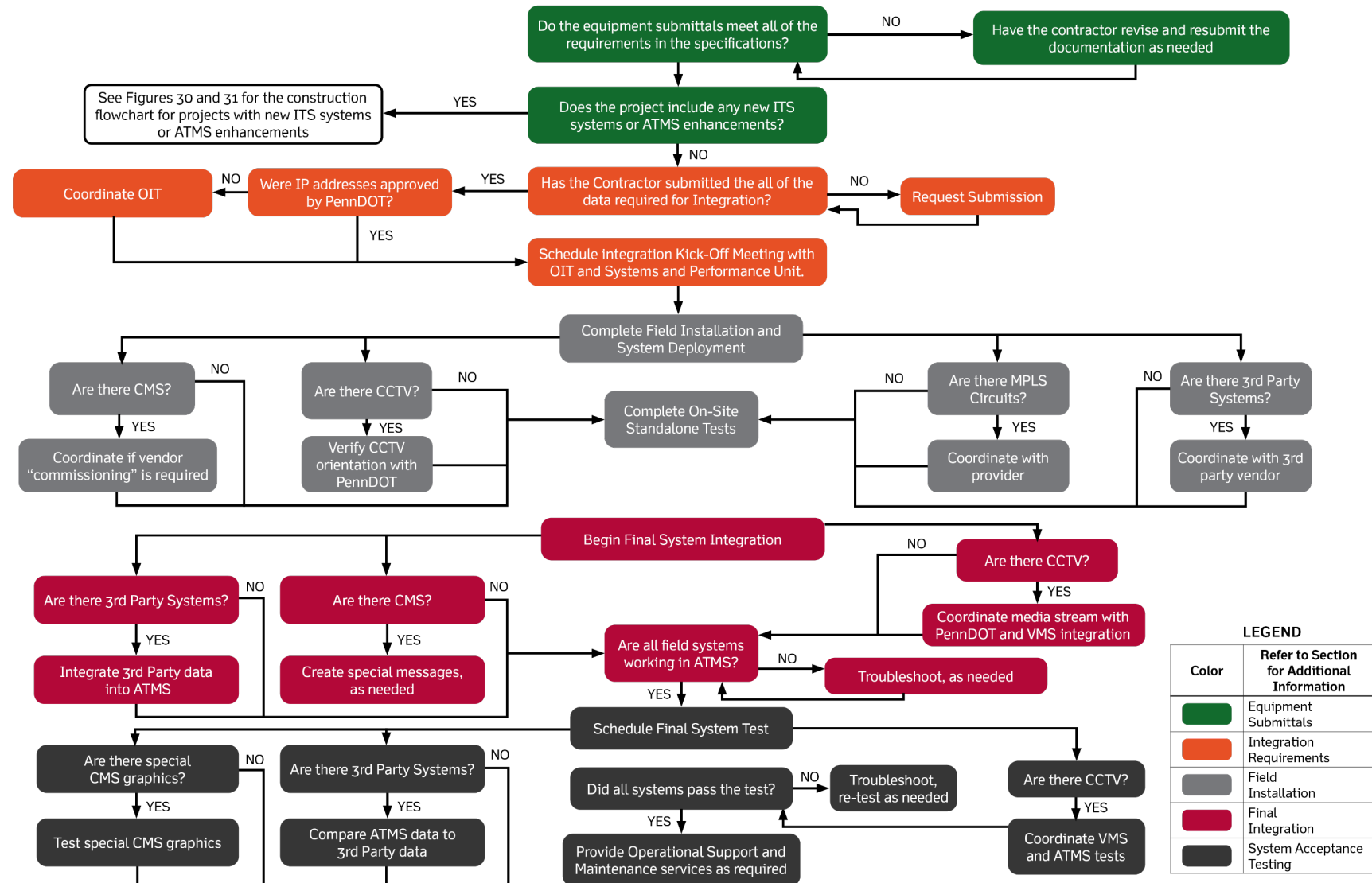
CH. 6: SYSTEM INTEGRATION

- Integrations Process
- General Integration Steps
- Durations



CH. 6: SYSTEM INTEGRATION

Integration Process for Projects with Typical ITS System Deployments



CH. 6: SYSTEM INTEGRATION

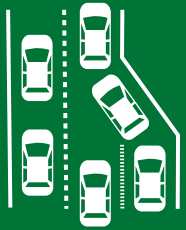
ATMS Modification / Enhancement Timeline

Phase	Minor	Moderate	Complex
Submittal Review	3-5 Months	3-6 Months	6-9 Months
Detailed Software Design	N/A	0-3 Months	3-6 Months
Software Development	N/A	0-6 Months	3-12 Months
User Acceptance Testing	N/A	0-1 Months	1-2 Months
Systems Acceptance Testing	2 Months	1-2 Months	1-3 Months
Operational Testing/Support	5 Months	5-12 Months	12-30 Months*

*Timelines are not aggregate and may overlap. Overall construction duration may be a function of field installation.



QUESTIONS



TSMO

THANK YOU

Joseph R. Burns, Senior Traffic Control Specialist

TSMO Planning & Funding

PA Department of Transportation | BOO

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Kimley-Horn and Associates, Inc.

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