VDOT
Virginia Department of Transportation

Traffic Engineering Design Manual

April 2020

Revision 1
March 2023

Location & Design Division

VDOT GOVERNANCE DOCUMENT

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CHAPTER 1 – INTRODUCTION

1.1 PURPOSE

The Virginia Department of Transportation (VDOT) Traffic Engineering Design Manual (TEDM) presents the information needed to assist engineers and designers prepare traffic signal, lighting, and signing and pavement marking plans to VDOT specifications and standards. This manual is not intended to reproduce the contents of existing design guidance manuals; the goal is to provide the standard design and plan development methodologies required by VDOT in order to produce consistent and high-quality traffic design plans. Statewide uniformity of traffic design plans is intended to improve the overall quality of design plans, create consistency in the information presented and required on plans throughout the Commonwealth of Virginia, and create significant efficiencies in the development and review of VDOT traffic design plans. Consistency of plan development will also aid maintenance staff as they address both preventative and emergency maintenance activities.

1.2 ORGANIZATION AND SCOPE

The TEDM is divided into three main chapters covering the following traffic design areas:

- **Chapter 2 – Traffic Signals** provides guidance on signal equipment components, plan development, and examples related to all intersection-related traffic control signals. The guidance also applies to intersection control beacons, controller actuated warning beacons, pedestrian signals, and temporary traffic control signals. Additionally, the manual provides direction on Signal Justification Reports (SJRs), signal and pedestrian timing development, and left-turn phasing selection policies within the context of the Department's overall traffic signal design process.
- **Chapter 3 – Signing and Pavement Markings** discusses pavement marking materials and sign structure types used in Virginia, plan symbology, and standard legends used to effectively develop a signing and pavement marking plan set. Signing design topics includes typical ground-mounted signs for conventional road and interstate applications, overhead cantilever and span sign structures, and special applications such as isolated mid-block pedestrian crossings or hazard identification warranting unique warning sign or pavement marking treatments. Pavement marking design topics include guidance on marking type selection and application of different line styles.
- **Chapter 4 – Lighting** outlines plan development and equipment of typical lighting systems used on VDOT roadways, including interchange, partial interchange, freeway, roadway, intersection, bridge and underbridge, tunnel, and overhead sign applications. Additionally, guidance on photometric analysis and selection of pole type and luminaire style is provided, based on the Department's latest policies and standards.

Each chapter will provide the designer with a discussion on design elements, standards, and policies applicable to VDOT-maintained facilities, individual plan sheet and plan set requirements, and the VDOT project development process, including design process guidelines for each project milestone. Additionally, appendices will provide the designer with additional resources to aid in producing traffic design plans for the Department.

Note: Standards and guidelines for the engineering design and plan development of Intelligent Transportation Systems (ITS) is not included in this manual. Designers and engineers should refer to VDOT Traffic Operations Division and VDOT Operations Technology Division* for policies and procedures governing ITS design in Virginia.

1.3 PROJECT TYPES

There are several types of projects that warrant traffic engineering design in Virginia. Although each project is initiated and delivered through different processes, the TEDM is intended to be a resource for State, Locality, and consulting engineers in the Commonwealth of Virginia to identify the guidelines to follow for the development of VDOT traffic design plans, as well as provide a set of plan standards for various types of traffic designs. The TEDM guidance shall be used for:

- **VDOT or Locally Administered design-bid-build or design-build projects** where traffic design is part of a larger roadway or transportation plan set;
- **Standalone traffic design projects** issued by District Operations* staff resulting from traffic engineering studies, citizen or local official requests, or maintenance deficiencies; and
- **Developer or permit projects** requiring modifications to adjacent public roadways and access control.

It should also be noted that each VDOT District has specific design or equipment preferences that will need to be confirmed by the designer prior to the start of design work. **However, the format, appearance and information presented on each traffic design plan are hereby required to be uniform.**

1.4 REFERENCES

Users of the TEDM should be completely familiar with the federal and state design requirements found in the latest editions (including any supplements) of the following references in order to fully compliment the guidelines established in this manual:

- FHWA – Manual of Uniform Traffic Control Devices (MUTCD)
- FHWA – Standard Highway Signs
- VDOT – Virginia Supplement to the MUTCD
- VDOT – Traffic Engineering Instructional and Informational Memorandums (IIMs)
- VDOT – Road and Bridge Specifications
- VDOT – Road and Bridge Standards
- VDOT – Road Design Manual (RDM)
- VDOT – CADD Manual
- VDOT – Virginia Standard Highway Signs Book
- VDOT – Guidance for Determination and Documentation of Left-Turn Phasing Mode
- VDOT – Traffic Operations and Safety Analysis Manual (TOSAM)
- VDOT – Virginia Work Area Protection Manual (WAPM)
- AASHTO – A Policy on Geometric Design of Highways and Streets
- AASHTO – Roadside Design Guide
- AASHTO – Roadway Lighting Design Guide
- AASHTO – LRFD Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

- ANSI/IES – Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting (IESNA RP-8)
- NFPA – National Electric Code (NEC)
- ITE – Traffic Control Devices Handbook
- ITE – Traffic Engineering Handbook
- FHWA – Traffic Signal Timing Manual
- US Access Board – Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)
- Code of Virginia – Title 46.2. Motor Vehicles

Disclaimer: The information provided in this manual are current at the date of publishing. The Department will provide updates periodically as VDOT's traffic design standards, policies, and guidelines are changed. Interim guidance may be provided by VDOT Central Office, District, or Regional staff in order to effectively deliver the Department's traffic design program.

CHAPTER 2 – TRAFFIC SIGNAL DESIGN

2.1 INTRODUCTION

This chapter outlines the standards, plan requirements, and design process related to engineering and design of traffic signal control devices at intersections. The designer shall use this manual, from initial project scoping through project plan delivery, to ensure plans are consistently designed on a statewide basis. The nature of VDOT's organizational structure requires that District-specific signal design preferences and policies be verified for each design; however, the guidance established herein serves to provide a uniform roadmap to signal design and plan development in all Districts and localities in the Commonwealth of Virginia.

2.2 VDOT STANDARDS

All of the applicable standards for VDOT signals, unless otherwise noted, can be found in Section 1300 of the latest edition of the *VDOT Road and Bridge Standards* and Sections 238, 512, and Division VII of the *VDOT Road and Bridge Specifications*. Below is a brief classification and description of the equipment utilized for standard VDOT designs.

2.2.1 SIGNAL POLES, MAST ARMS, AND FOUNDATIONS (MP-, PF-, WD- STANDARD DRAWINGS)

- Permanent signal installations and signal rebuilds are constructed using galvanized steel signal pole and mast arms. VDOT uses standard pole types, mast arm lengths, and signal equipment loadings outlined in Section 1300 of the Standards.
- If signalization within work zones cannot be accommodated using existing or proposed permanent mast arms, then temporary signal supports are necessary. Temporary signals at intersections are typically designed using wood-span wire signal poles and guy wires. Portable temporary traffic control signal units may be considered if approved by the District Traffic Engineer.
- Steel strain signal poles and steel chorded signal span structures are rarely used for new designs, but may be considered if roadway geometrics do not permit conventional mast arm pole design.
- Span and mast arms lengths shall comply with the latest version of *Traffic Operations* Division Memorandum IIM-TE-375*, or a design waiver will be required.
- Typically, the Contractor is responsible for test bores and signal pole foundation designs during construction; however, the designer should be cognizant of known issues with poor soil locations or rocky conditions that may impact signal pole foundation constructability. Standard foundation placement above ground and adjacent to pedestrian paths shall be considered during pole placement.
- Breakaway pedestal poles and foundations are used for supplemental signal heads, pedestrian signals, and accessible pedestrian signals and detectors.
- Signal pole luminaire arms used for intersection lighting are clamp-on style and lengths are dictated by lighting analysis or contract documents. Common lengths are between 15 and 24 feet. Refer to Chapter 4 for intersection lighting design requirements.

2.2.2 CONTROLLER CABINETS AND FOUNDATIONS (CF- STANDARD DRAWINGS)

- Advanced Transportation Controller (ATC) cabinet types (based on the latest AASHTO/ITE/NEMA ITS Cabinet Standard) are used for traffic signal designs requiring new cabinets and cabinet replacements. Cabinets and foundation sizes vary by District and traffic signal application.
- Pole-mounted signal cabinets may be used for temporary signal applications. They should not be used for permanent signal locations except where ROW limitations preclude use of pad-mounted cabinets, with District approval.

2.2.3 PEDESTRIAN SIGNAL EQUIPMENT (SP-, PA-, CG- STANDARD DRAWINGS)

- Pedestrian signals have standard bi-modal upraised hand and walking person indications with countdown feature using one- or two- signal head section displays (Standard SP-8 or SP-9, respectively), depending on District preferences. Non-countdown pedestrian signals are rarely used and shall only be specified with District approval.
- Pedestrian signals and detection shall be accessible and in accordance with latest version of *IIM-TE-388*.
- Pedestrian detectors may be mounted on signal poles, pedestal poles, or independent supports, but shall conform to placement criteria established in the MUTCD and US Access Board PROWAG guidance.

2.2.4 CURB RAMPS, LANDINGS, AND SIDEWALKS (CG- STANDARD DRAWINGS – SECTION 200)

- New curb ramps and landings at signalized intersections and pedestrian crossings with existing or proposed sidewalk connectivity shall be designed per VDOT Road Design Manual, MUTCD, and US Access Board PROWAG requirements.
- Existing curb ramps or pedestrian crossings shall be evaluated and upgraded per guidance set forth in *IIM-TE-376* for traffic signals alterations. *IIM-TE-376* defines what activities constitute traffic signal 'alterations'.

2.2.5 JUNCTION BOXES AND CONDUIT SYSTEMS (JB-, ECI- STANDARD DRAWINGS)

- Junction box sizing depends on the number of conduits entering the box; typically, junction boxes adjacent to poles and auxiliary equipment are small or medium, and the junction box adjacent to the signal cabinet is larger.
- If required by District* Operations for signal communications, larger junction boxes shall be utilized for fiber optic splicing to accommodate splice enclosures and mountings.
- Placement of junction boxes within pavement or sidewalk should be avoided where feasible. If a junction box within the travel way cannot be avoided, then the deliberate traffic use series of boxes shall be used.
- Conduit installation is achieved via horizontal directional drilling (boring) or trenching. Boring conduits under roadways and driveways is preferred over open trenching of pavement.

- Spare conduits stubbed out from signal pole and cabinet foundations are required per the standards. Connection of the spare conduits to adjacent junction boxes should be considered and may be required per District preferences.
- Preferred conduit sizes and bored conduit requirements vary by District.

2.2.6 Signal Head and Sign Mountings (SM-, SW-, TA-, SMD- Standards)

- Signal heads typically are federal yellow in color and may be aluminum or polycarbonate material depending on District preferences.
- Vehicular signal heads typically have solid, black backplates. All new traffic signal heads shall have backplates, except that backplate omission can be considered when a project involves additional loads on an existing mast arm, and backplate omission is necessary to accommodate the new loads. VDOT will not consider the use of louvered backplates for load reduction.
- Signal visors may be full-tunnel or cap-style based on District preferences and the alignment of the intersection approaches.
- High-visibility signal backplates (HVSB) are required to be evaluated and implemented per guidance set forth in the latest version of *IIM-TE-378*, and as directed by District staff.
- Mounting brackets for signal head assemblies and signs vary by signal infrastructure type and location (span wire, mast arm, and signal pole - side or top, etc.). Designers shall consider mounting height and location when selecting the appropriate signal head mounting standard.

2.2.7 Electrical Service (SE- Standard Drawings)

- Traffic signals typically operate on 120/240 VAC, single-phase electrical services. Electrical service standard applications vary based on availability of adjacent power sources and District preference.
- When feasible, permanent signal locations should utilize an overhead or underground service to the signal pole adjacent to the traffic signal cabinet or underground service to a standalone pedestal pole.
- Electrical service shall be located on the same corner and within 20 feet of the traffic signal cabinet, or a supplemental service disconnect should be considered.
- Exact location of electrical service grounding electrode junction boxes should be considered in designs with restricted ROW, or when directed by District staff.
- Junction box access may be required for augmented grounding electrodes.
- Intersection lighting may utilize the same electrical service as the traffic signal, but shall be connected to separate breakers to isolate circuitry. The lighting control center (if required) may be mounted on the stand-alone electrical service pole. Refer to Chapter 4 for intersection lighting standards and guidelines.

2.2.8 FLASHING BEACONS

- Flashing beacons used to supplement an advance warning sign of a signalized intersection may use the traffic signals electrical service and controller cabinet for power and flash control, or may use an isolated service and separate flasher cabinet.
- Placement of flashing beacons associated with traffic signals should be based on advance warning sign placement criteria established in the Chapter 2C of the MUTCD.
- Controller-actuated flashing beacons (CAB) system design is subject to intersection geometry, speed limit, and previous crash mitigation solutions, per guidance established in the latest version of *IIM-TE-348 and IIM-TE-394**.
- Refer to Chapter 3 of this manual for guidance on flashing beacons related to unsignalized locations.

2.3 TRAFFIC SIGNAL PLAN REQUIREMENTS

VDOT traffic signal plans shall follow the standards described below and shall utilize the symbology, formatting, and spacing for plan items, as presented in the example plans provided in the Appendix to this chapter and in the VDOT Traffic Engineering Design MicroStation/OpenRoads Designer* Cell Libraries, as defined in the VDOT CADD Manual. In addition, the VDOT CADD Manual provides additional information relative to the file management of CADD files used for traffic signal design, as well as information on drawing scale, levels, symbology, and text and dimension styles*. Please contact CADDsupport@vdot.virginia.gov to obtain the appropriate Microstation/OpenRoads Designer* files and cell libraries.

A majority of text notes, legends, and call-outs are included in the VDOT Traffic Design cell libraries. The text size in the cell libraries is based on 25 scale plans. Cells should be adjusted appropriately based on the proposed scale of the plan.

2.4 TRAFFIC SIGNAL PLAN SET GUIDELINES

There are several different traffic signal design plan packages that may be required by VDOT, depending on the context of design being performed. Below are the most common contexts of design relative to VDOT traffic signal design:

- District Traffic Signal Modification;
- District Traffic Signal Replacement or New Installation; and
- Design for a New Construction Project:
    - As a stand-alone traffic signal design plan package; and
    - As part of a larger design project.

The following descriptions of the typical plan package content and considerations are provided for each design context. It should be noted that this is guidance for typical projects, and that the VDOT project manager may require alterations to the plan package. The designer should verify the requirements of the plan package with the VDOT project manager at the start of each design project.

2.4.1 District Traffic Signal Modifications

These projects are typically considered No Plan projects (as defined in the VDOT *Road Design Manual*) for maintenance, safety, or operations improvements, and therefore may not require detailed (or any) survey information. No Plan projects will typically consist of a single signal plan sheet that is either modified using CADD, or marked up by hand ("redline" plan). The designer shall coordinate with the applicable VDOT District Operations representative to determine the plan sheet standards and plan package requirements. Depending on the level of development of the existing plan sheet or information being used as a base for the modification plan, the plan sheet standards as set forth in this document may not be practical. Additionally, the designer shall coordinate with the appropriate District Structure and Bridge Engineer to ensure that all mast arms and poles will support any additional loading due to the signal modification.

2.4.2 District Traffic Signal Replacements and/or New Installations

For this design context, the plan package requirements will likely vary depending on the VDOT District. The appropriate VDOT District representative shall give specific guidance to the designer on the requirements for each plan package. It is recommended to request a sample plan package from VDOT prior to beginning the design to verify the District's expectations.

- Typically, this type of design has a minimum requirement of a single traffic signal plan sheet.
- These designs will require survey information in order to produce a base plan that will aid in the avoidance of conflicts with existing traffic signal equipment and utilities, and to ensure equipment is placed within ROW.
- Cost estimate using approved VDOT bid item costs from the VDOT District contract.
- These designs may require Title Sheet with General Notes, Traffic Management Plan Sheet or Quantities Summary Sheet.

2.4.3 New Construction Projects

New construction plan projects developed and delivered in accordance with the VDOT Project Development process are the focus of this manual. New construction projects generally range from Minimum Plan projects (e.g., M-501, etc.), which are relatively simple construction projects requiring less than a single construction season, to full Construction Plan projects (e.g., C-501, etc.), which involve large transportation projects of varying complexity and typically one or more seasons of construction duration.

The plan sheets listed below are presented in the proper sequence to produce a traffic signal plan set for new construction projects. Those sheets noted as "For stand-alone projects" are typically not included if the signal design(s) are part of a roadway construction project. Those sheets noted as a "Standard sheet" requires the **designer to reference the VDOT CADD Manual for detailed discussion on the format, data, and sheet numbering.**

a.) Title Sheet (Standard sheet for stand-alone projects)
- This is a Standard Sheet.

b.) Location Map Sheet (Standard sheet stand-alone projects)
- A location map is inserted on a sheet giving enough detail to clearly identify the area and location of the project. This sheet can be combined with the Title Sheet, General Notes Sheet, Plan Index Sheet, or other if information can be consolidated legibly on a single page.

c.) Plan Sheet Index (Standard sheet)
- Generally, this sheet is not used for traffic signal design projects, but this information could be included on the Title Sheet or General Notes Sheet. If there are projects where a number of traffic signal designs are included within the project limits, then a Plan Sheet Index may be appropriate.

d.) ROW Data Sheet (Standard sheet for stand-alone projects)
- For projects that require ROW.

e.) Revision Data Sheet (Standard sheet for stand-alone projects)

f.) General Notes and Legend Sheet
- This sheet typically contains the legend and symbology that are required to be used as well as all general notes.
- If space permits, this sheet should include “Maintenance of Traffic” notes, otherwise a Traffic Management Plan sheet may be required.
- An example of the General Notes and Legend Sheet is provided in the Appendix.

g.) Traffic Management Plan Sheet (Standard sheet for stand-alone projects)
- This sheet may be required if requested by the VDOT District Operations representative or project manager.

h.) Summary Sheet (Standard Sheet)
- An example of the Summary Sheet is provided in the Appendix.

i.) Detail Sheet(s)

Occasionally, additional details may be necessary on the intersection plan sheets to thoroughly illustrate the design intent. These details may include:

- Signal pole location detail (at a larger scale);
- Pedestrian detector and sign orientation details (at a larger scale);
- Pavement markings;
- Intersection signing;
- Pedestrian accommodation details;
- Demolition plan (when appropriate);
- Special foundation or other structural features; and
- Design features specifically related to the intersection, such as:
  - Video Image and Detector Settings Installation Chart;
  - Communication details (splice diagrams, network diagrams, etc.); and
  - CAB details.

j.) Plan Sheet

An example of the required format of a VDOT Traffic Signal Plan Sheet is provided in the Appendix to this chapter. Traffic signal plan sheets shall be developed in MicroStation/OpenRoads Designer* and shall utilize the symbology presented in this chapter and included in the example plan in the Appendix. Plan sheets shall include the following (at a minimum):

- North arrow;
- Scale (typically 1 inch =25 feet, but may use 1 inch =20 feet or 1 inch =10 feet for smaller intersections where additional detail may aid the contractor, if requested by District);
- Speed limits;
- Street names and Route Number and/or Commercial Entrance;
- Regulatory and guide signs (Mast Arm mounted and ground-mounted, as appropriate);
- Intersection geometry (to scale);
- Curb ramps (as required);
- ROW (including easements, if needed); and
- Show only underground and overhead utilities that are in proximity to the traffic signal infrastructure or those utilities that provide the contractor sufficient information to properly bid the traffic signal work.

In addition, plan sheets shall show all graphics and illustrations depicting signal system components, including:

- Pole Locations;
- Controller Cabinet Location;
- Uninterruptible Power Supply Cabinet location;
- Vehicle Signal Heads;
- Pedestrian Signal Heads;
- Vehicle Detectors/Detection Zones;
- Accessible Pedestrian Signals and Detectors (APS and APD);
- Luminaires (as required);
- Conduits;
- Pipe (Conduit) Sleeves;
- Junction Boxes;
- Span Wire Routes, connections, and guy wires (as required);
- Signal Face Identification;
- Controller Phasing Diagram;
- Initial Timing Chart (as required);
- Color Sequence Chart;
- Wiring Information (if required by District);
- Electrical Service Identification and Location;
- Special Equipment, such as Preemption Hardware;
- Communications components (fiber optic cable, wireless antennae, etc.); and
- Plan notes.

2.5 VDOT PROJECT DEVELOPMENT PROCESS FOR TRAFFIC SIGNAL DESIGN

The following describes how the signal design process within a ***new construction project*** aligns with the VDOT Project Development Process. Information pertaining to the Project Development Process can be found on VDOT's website or through the VDOT Project Management Office. The specific plan requirements for each project milestone can be found in checklist format in VDOT's Form *LD-436*.

The VDOT signal design process is a sequence of steps that build on each other to produce a plan set. The following recommended design steps produce a plan set ***specifically as part a new construction project***. It should be noted that ideally, these steps should apply to all designs performed for VDOT traffic signals; however, the requirements for District traffic signal replacements, modifications, and installations may vary depending on the design project and District. The designer should obtain clear guidance on the expected design elements required for these plans from the appropriate VDOT District Operations representatives.

Each project development process stage below guides the designer through various steps necessary to complete a traffic signal design. Design considerations are provided within each step to help aid in a consistent application of design standards. At the end of each project development stage, a list of expected deliverables is outlined. The list of deliverables is representative for typical Type C construction projects. District staff may require additional (or omit) deliverables based on the nature of the design project.

It is expected that after each development process stage, VDOT will coordinate a review of the project deliverables with all appropriate staff. Concurrence or approval on project deliverables should be obtained from the VDOT project manager prior to proceeding to the next stage of development.

2.5.1 SCOPING PHASE

The designer should meet with the applicable VDOT representative (likely the District Traffic Engineer or their designated representative) that will provide final approval of the traffic signal design plan sets to determine any new or area-specific design preferences for the subject intersection. The designer should also request any example District plans that may be relevant to the project scope. The scoping phase includes a number of critical steps to ensure the appropriateness of traffic signal control at a subject intersection, determine the left-turn phasing to be utilized, and validate the lane arrangements. Development of the signal plan set should not begin until these steps are completed.

The signal plans prepared during the scoping phase will result in what is defined in the VDOT Project Development Process as Final Scope/Preliminary Field Inspection (PFI) plans.

2.5.1.1 Perform Pre-Design Activities

Prior to beginning a traffic signal design, the engineer must confirm that the appropriate analyses have been completed. Obtain any approved traffic volume data and/or relevant traffic studies that may provide guidance on the development of signal timings or phasing that will have an impact on the design of the traffic signal equipment. To ensure that unwarranted or unauthorized traffic signals are not installed at an unsignalized location, the designer should verify that a Professional Engineer (PE)-stamped and VDOT-approved SJR has been completed in accordance with the latest version of *IIM-TE-387*. This study is formally approved by the applicable District Traffic Engineer; additional concurrence and approval

is required by the District Engineer/Administrator and State Traffic Engineer for locations on VDOT's Arterial Preservation Network.

Left-turn phasing shall be evaluated for proposed signals or any designs proposing left-turn phasing modifications at existing signals. The designer should verify that a PE-stamped Left-Turn Phasing Evaluation Report (or other approved form of assessment) has been completed in accordance with the latest version of *IIM-TE-362*, VDOT's *Guidance for Determination and Documentation of Left-Turn Phasing Mode* and the *Left-Turn Phase Selection Engineering Assessment Workbook**.

Verify that a PE signed and sealed operational analysis has been completed in the latest version of *IIM-TE-362*, and that the lane arrangements to be accommodated by the traffic signal plan have been confirmed and approved by the District Traffic Engineer. Operational and capacity analyses are performed in accordance with VDOT's latest TOSAM. Finally, ensure compliance with VDOT Access Management Design Criteria.

2.5.1.2 Identify Signal Timing Requirements

Determine the project requirements for signal timing development, if not included as part of the Operational Analysis. At a minimum, the designer should expect to update base or initial signal-timing parameters at the project intersection(s). Coordination of signal timings and other requirements for signal timings will vary based on the project location, number of signals impacted, and VDOT District Operations signal-timing policies and preferences. The designer should verify the exact scope of signal-timing development, signal-timing review process, and submittal requirements (including format) and timeframes.

When required, vehicular change and clearance intervals shall be developed in accordance with the latest version of *IIM-TE-306*, and pedestrian intervals shall be calculated in accordance with the latest establish MUTCD Section 4E criteria and any established District guidance.

2.5.1.3 Identify Pedestrian Accommodation Requirements

The designer should discuss pedestrian needs at project intersections, including any Department pedestrian planning goals; review existing facilities such as curb ramps, sidewalk, and pedestrian signal equipment to identify upgrades; and identify possible pedestrian signal warrants for crossings without existing accommodations. Ultimately, the designer should confirm which legs will require pedestrian signalization and/or marked crossings prior to beginning preliminary design.

2.5.1.4 Identify Traffic Signal ITS, Lighting, and Preemption Requirements

The designer shall coordinate with the appropriate VDOT District Operations representative to identify any ITS (CCTV, system detection, etc.), emergency vehicle preemption, and any other operational requirements that may affect the proposed design.

Railroad preemption must be considered if there is any likelihood of opening or design year queues extending through an at-grade rail crossing. If railroad preemption will be necessary, coordination with the railroad company must be initiated early in the design process to allow ample time for railroad coordination.

Emergency vehicle preemption practices vary greatly by District and are often subject to preestablished agreements between County emergency response officials and VDOT. The designer should verify whether emergency preemption should be included in the project and any coordination that may be required.

Intersection lighting shall be considered at all signalized intersections following the guidelines in Table 2 of the latest version of *IIM-TE-390*. If lighting is determined to be warranted, a photometric design shall be completed ensuring that the proposed lighting meets Department lighting standards. Refer to Chapter 4 of this manual for Lighting design guidelines.

2.5.1.5 Identify Traffic Signal Communications Requirements

Communications shall be established at all VDOT maintained traffic signals. VDOT currently deploys many communication types statewide including, but not limited to, fiber, wireless, cellular, and leased line communications. The designer shall coordinate with the appropriate VDOT District Operations representative to discuss VDOT's latest master communications plan as it relates to the project, and any location specific requirements for establishing communications, including any necessary test plans that may need to be developed for the Contractor to complete during construction. The designer should also coordinate with localities if the signals are maintained by them, and check if the signals are coordinated with other intersections. **All proposed communications shall be approved by District* Operations and comply with VDOT's latest cybersecurity requirements to ensure that all communications will be securely established prior to opening signal for traffic use.**

2.5.1.6 Discuss Third-Party Coordination

Verify District policies with regard to coordinating with external parties such as electrical and communication service providers, railroad companies, and fire and emergency response personnel. Coordination with these representatives can often be time consuming and greatly influence the project delivery schedule.

2.5.1.7 Obtain Survey Information

Obtain the base survey information that is a required element of the traffic signal plan. This will include the location of edge of pavement or curb lines, pavement markings, surface evidence of underground and overhead public and private utilities, any existing VDOT traffic signal equipment if present, and property lines that may impact the design. Overhead line heights should be captured when feasible. Elevation contours may be required at locations with steep slopes that may impact the design. Approach grades for each leg of the intersection may also be needed to develop clearance intervals. Typically, underground and overhead utilities should be identified and located within the public ROW throughout the entirety of the intersection interior, and also within 25 to 50 feet past the point of curvature for each of the intersection curb-radii. As a rule of thumb, it is also suggested to obtain survey information at a minimum of 10 feet beyond the edge of ROW should additional ROW or easement be required as part of the traffic signal design. During the survey phase, approach grades should also be collected for use in calculating clearance intervals. ***NOTE: Survey information may not be required for a District traffic signal replacement, installation, or modification. Confirm needs with the appropriate District representative.***

2.5.1.8 Prepare Survey/Base Plan

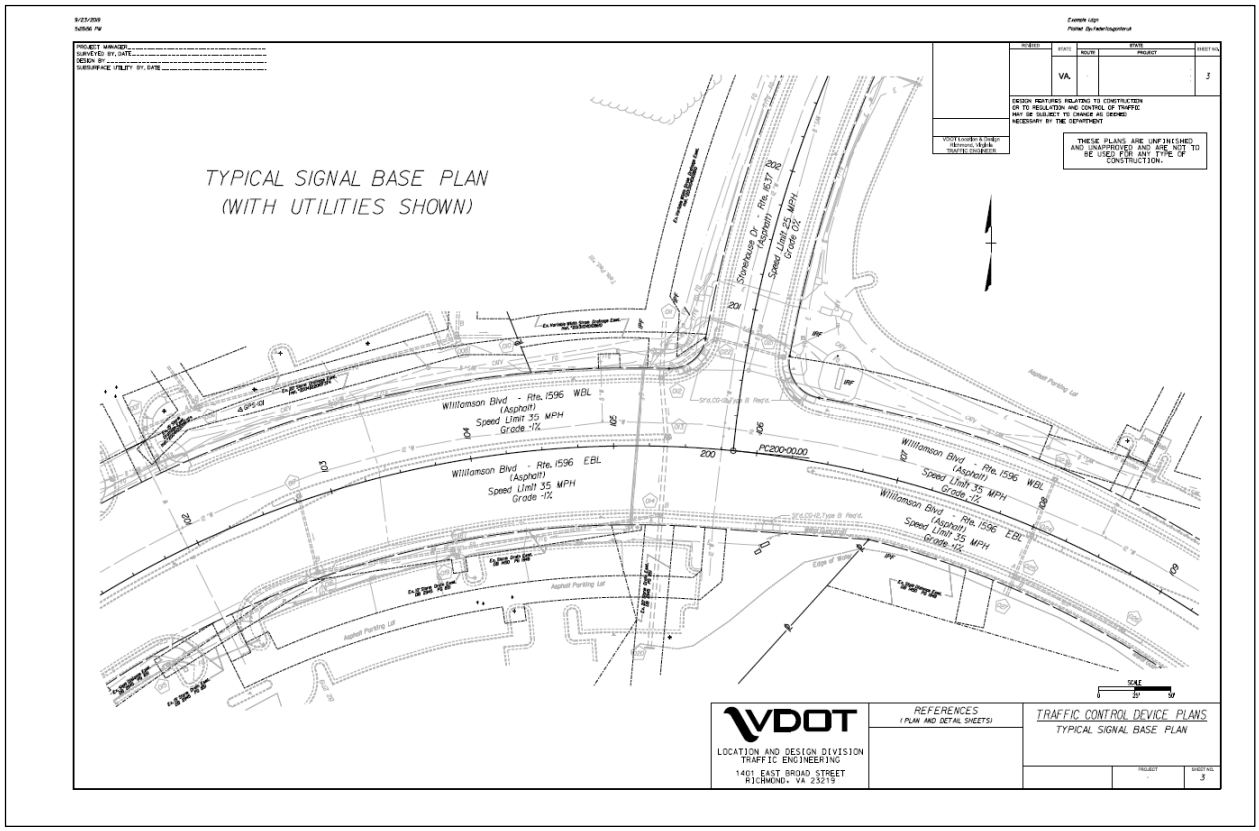
The traffic signal base plan assembles survey and any available project design files and information into a single plan sheet per signalized intersection. The base plan depicts existing survey conditions and proposed roadway improvements from which traffic signal design can be properly scoped, and proposed signal design elements can be evaluated and incorporated into the project design. The preferred level of detail for a typical traffic signal base plan is shown in Figure 2-1. This sheet for a new construction project shall meet the following standards and elements:

- The base plan (and all other signal design plans) shall be prepared using Microstation or OpenRoads Designer* and shall not be post-converted files from any other CADD software such as AutoCAD, unless otherwise approved by the District Traffic Engineer or their designated representative.
- The base map plan sheet should preferably be prepared utilizing the appropriate set of Microstation/OpenRoads Designer* Survey files prepared in accordance with the VDOT CADD Manual Standards. This includes the appropriate uses of file names, official VDOT Microstation/OpenRoads Designer* cells for traffic signal design elements, and Microstation/OpenRoads Designer* level structures, as applicable.
- The base plan should retain the appropriate VDOT survey coordinates within CADD file (if possible).
- For new construction projects, or for projects that require property acquisitions or easements, roadway alignment baselines shall be provided with sufficient data to determine stationing along the main line and intersecting cross street. For stand-alone or District traffic signal projects, the triangulation method (described later in this manual) can also be used to locate signal equipment.
- The base plan should preferably illustrate "finished" roadway elements only. "Finished" roadway elements are defined as the combined existing and proposed curb lines, roadway edge of pavement, sidewalks, drainage, curb ramps, and utilities, etc., as well as, existing and proposed ROW that will be in place when the project is complete. However, depending on CADD file details referenced in the base plan, additional information such as existing curb lines and roadway features that are to be removed, and other pertinent labels and annotations may be shown on the base plan, as appropriate.

At a minimum, the base plan sheet (Figure 2-1) shall include the following:

- North arrow;
- Graphic Scale;
- Speed limits;
- Street names and Route Numbers and/or Commercial Entrance;
- Finished roadway elements (to scale);
- Approach grades as defined in VDOT *IIM-TE-306* for use in calculating clearance intervals;
- All existing and/or proposed underground and overhead utilities in place when project is completed; and
- ROW limits.

Figure 2-1: Traffic Signal Base Plan Sheet



2.5.1.9 Identify Modifications to Existing Signals

For any designs involving modifications to existing signal poles, the designer shall prepare documentation comparing existing and proposed loading, and submit these to the District Structure and Bridge Engineer or his/her designee for approval as early in the design process as possible. The designer should consult with the District representative to confirm documentation requirements. If information is not available on the design parameters used when the signal pole mast arm was originally installed, it may not be feasible to add new loads to the existing mast arm. If the proposed signal pole modifications will result in overloading the mast arm, the designer should consider whether it is feasible to counteract the effects of the overloading by lessening the loads in other ways. Examples could include relocating overhead street name signs as advance signage or to the back side of the near-side mast arm, nudging other loads closer to the column, or (in extreme cases) removing signal head back plates. The controlling factor for mast arm structures is almost always wind load, not dead load. The designer should discuss alternative modification options with the District representative, if necessary, prior to submitting or resubmitting to Structure and Bridge.

For any design involving reusing existing traffic signal cabinets, the designer should ensure that any proposed phasing or other operational changes are compatible with the physical capacity or software compatibility limitations of the existing cabinet or controller to determine if a new cabinet, controller, and/or other equipment is warranted. (e.g., left turn 5-section to flashing yellow arrow head conversions

requiring additional load switches). This information may be obtained from VDOT District Operations staff or a field visit may be necessary to validate the existing equipment. ***Note: VDOT approval is required before opening VDOT-maintained traffic signal cabinets and junction boxes.***

2.5.1.10 Anticipated Scoping Phase Deliverables:

- Operational Analysis;
- Signal Justification Report;
- Left-Turn Phase Evaluation; and
- Approved Project Scope and/or documentation of design requirements.

2.5.2 PRELIMINARY DESIGN PHASE

In this stage, the designer will prepare the preliminary plan sheets required for the specific project. This includes laying out major signal infrastructure components to meet the project's operational needs and verifying ROW and utility clearances are sufficient. It is critical to determine if any traffic signal equipment will require any additional ROW or easements, and if so, coordinate with the project manager to identify the specific limits of the required ROW or easements (construction or permanent). The designer should also notify the Project Manager of any anticipated unavoidable utility conflicts. If required, the designer should complete an airport clearance review for the traffic signal at this stage.

The signal plans prepared during the preliminary design phase will result in what is defined in the VDOT Project Development Process as Public Hearing (PH) plans.

2.5.2.1 Perform an Initial Site Visit and Field Verification

The designer shall perform a field verification of the intersection survey to verify the intersection geometry and to confirm that the traffic signal base plan appears to be accurate.

- It is highly recommended for the designer to take pictures of key observations to verify the survey data of all approaches, and all roadside features in and near VDOT ROW.
- Overhead and underground utilities shown on the survey should be field-verified to the extent feasible to help prevent a potential constructability issue. If necessary, call in a Miss Utility ticket prior to the field visit to verify locations with dense underground utilities.
- This initial field visit can be combined with the initial scoping meeting with the appropriate VDOT District Operations representative.
- The designer should meet with the local VDOT traffic signal technician to discuss the location of the power source and potential signal controller location, and to verify existing equipment and conduit sizes.
- The designer should meet with the VDOT District Operations representative to discuss preemption and communication needs specific to the intersection.
- **Authorization is required by District staff prior to accessing traffic signal cabinets and junction boxes.**

2.5.2.2 Review Geometric Design

The designer should verify:

- Sight distance requirements for the visibility of traffic signal heads are met by referring to the latest version of FHWA's MUTCD.
- For approaches with sight distance constraints, the designer should assess potential countermeasures such as: supplemental signal heads per MUTCD guidance, placement of controller actuated beacons in accordance with the latest version of*IIM-TE-348*, or roadside improvements to improve sight distance such as regrading a minor embankment or selective tree trimming.
- Existing and proposed pavement markings and/or intersection geometry can accommodate the appropriate passenger car/truck/bus turning path as specified by VDOT representatives.
- The effect of geometric design on crosswalk location and crossing length. Corner radii need to be wide enough to accommodate the design vehicle, but large sweeping corner radii can result in excessively long crossing distances and make it more difficult to site mast arms and APS supports. Design vehicles may vary from turning movement to turning movement. Consider right-turn channelization to reduce crossing length, particularly at skewed intersections.

If intersection geometry or signal phasing modifications are being made as part of the signal design project, the designer is required to utilize AUTOTURN Software to check that appropriate turning movements can be made within the intersection, including concurrent left-turn phases, as appropriate. In cases where concurrent opposing left turns are feasible, the designer has the option to show the distance between the dotted extension lines in the plans, so that the minimum distance between them is maintained, as described in Appendix F of the *Road Design Manual*.* If concurrent opposing lefts are not feasible, then alternative signal phasing may need to be considered.

2.5.2.3 Establish Crosswalk, Curb Ramp Locations, and Stop Lines

This step is performed iteratively. Verify all guidelines and preferences with the appropriate VDOT District representative.

- For locations where pedestrians accommodations are being provided, locate crosswalks (both marked and unmarked): Location of crosswalks and their associated curb ramps must be evaluated concurrently and should be placed in accordance with the latest version of *IIM-LD–55 and CG-12 Standard Drawings*. Traffic signal designer should coordinate with the applicable Roadway section designer accordingly.
- In most cases at signalized intersections, crosswalks are marked for all legs where the decision has been made to provide pedestrian accommodations.
- For marked crosswalks: Identify crosswalk type, using one of the crosswalk types found in the PM-Series Standard Drawings. Designer should consult with District Traffic Engineer to verify if high-visibility crosswalks are required for all marked crosswalks, especially those with high volumes of conflicting permissive left- or right-turn movements, and/or marked crosswalks that are expected to see more than occasional use. Refer to the Pavement Marking chapter in this manual for guidance on pavement marking design.
- Identify Crosswalk Width. The crosswalks shall be a minimum of 6 feet in width, but may be wider depending on District or locality preferences and site-specific conditions.

- Coordinate curb ramp locations. Detailed instructions concerning curb ramps are provided in the latest version of VDOT's *Instructional and Informational Memorandum IIM-LD-55* and the MUTCD.
- Locate stop lines. Detailed instructions for establishing stop lines are provided in the MUTCD. Additionally, the designer should seek any additional guidance information that may be utilized by the VDOT District in the placement of stop lines. The designer shall also consider intersection operations and design vehicle turning paths when placing stop bars.

2.5.2.4 Locate Vehicle / Pedestrian Signal Heads and Accessible Pedestrian Signals and Detectors

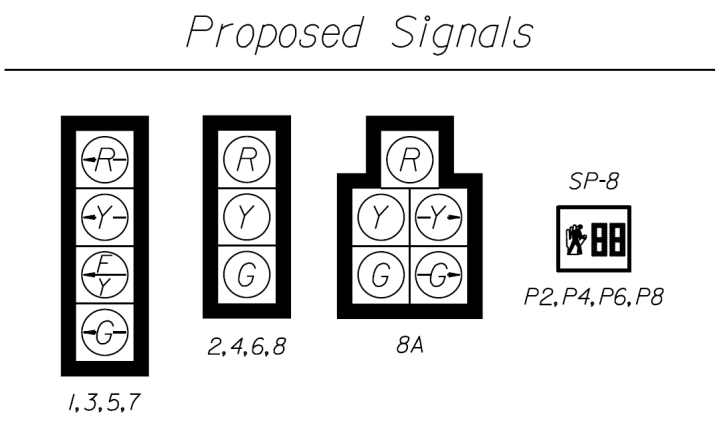
When determining the location of vehicle and pedestrian signal heads and detectors, the designer should take into consideration the proposed signal operations. Lane usage and signal phasing including shared option lanes, exclusive overlap phases, and protected or protected/permissive left-turn phases and through movements determine the selection and placement of signal heads. Signal head placement shall be performed iteratively with signal pole and mast arm placement. The designer should consider the following, at a minimum, when laying out proposed signal heads:

- Reference typical vehicular signal head layouts by left-turn phasing type for various lane arrangements in Chapter 4D of the MUTCD.
- For permissive left-turn signal head selection, consult the latest version of *IIM-TE-381* for flashing yellow arrow requirements.
- Review placement of signals and signs to ensure that existing or planned improvements do not obstruct the visibility to any traffic control device.
- Place vehicle signal heads over receiving lanes, where possible. In the case of horizontal curves, the placement should reinforce proper path choice. Supplemental heads should be considered for curved or skewed approaches, intersections with unusual geometry or sight-distance limitations in concert with the proposed signal phasing at the intersection.
- In addition, verify that the vehicle and pedestrian signal heads meet the most recent requirements of the MUTCD, and conform to the preferences of the VDOT District, if applicable.
- All pedestrian accommodations shall include APSs where required by the latest version of *IIM-TE-388*. APS detectors (which usually consist of pushbuttons) shall be placed to meet all MUTCD requirements for maximum distance from crosswalk. This often precludes placing the APS button on the mast arm; a separate PF-2, PA-3, or PA-4 support is often required. Pedestrian signal heads must also be placed directly in the sight path of a pedestrian waiting to enter the crosswalk.

Develop a Signal Head Detail:

- Signal head labels shall match phase numbering convention identified or otherwise directed by the appropriate VDOT District Operations representative.
- Confirm whether HVSB are required per guidance provided in the latest version *IIM-TE-378*, and verify visor type with District.
- Ensure that the signal operation and signal head details are compatible.

Figure 2-2: Signal Head Detail



2.5.2.5 Locate Signal Poles and Mast Arms

For any Signal Pole Type:

- Designer should give consideration to future maintenance and constructability requirements.
- Typically, poles and arms should be located on the far side of an intersection, perpendicular to the approach it serves, and outside of the median. Alternative placements such as near side or diagonal arms may be appropriate based on intersection geometry, but the designer should consult with the District representative for preferences on pole placement and arm orientation before locating poles and arms.
- Ensure that clear zone and lateral offset guidelines as described in VDOT's *Road Design Manual* and AASHTO's *Roadside Design Guide* are met or an accommodation is made. When necessary, the designer should discuss clear zone or offset feasibility issues with the District representative to properly document any variance or special accommodation.
- Ensure adequate clearance to overhead utilities. Check NESC requirements and contact the local power provider. Typical clearances from overhead primary power lines are a 10-foot minimum in accordance with Virginia's *Overhead High Voltage Line Safety Act*, but may be higher and should be verified with the local power provider.
- Adjacent utility power poles may also carry cable, telephone, or other telecommunication utility lines. The minimum clearances for those cables should be verified with the appropriate utility owner.
- Due to the potential that traffic signal foundations may require significant depths depending on soil type and structural loads (typically to be determined during the pole design by the contractor), the designer shall avoid placement of poles and foundations over any underground utilities. Specific clearances from the different types of utilities can be determined in coordination with the utility provider.

- Ensure crosswalks, curb ramps, and required landing areas of curb ramps are unobstructed for pedestrian use.
- Consider pedestrian signal head locations when locating traffic signal poles in order to minimize use of pedestal poles for pedestrian signal use, if possible.
- Consider planned future widening or improvements when locating poles.
- For constructability purposes, new traffic signal poles and arms should be located on the downstream side of existing pole locations so that the existing signal can remain operational until the new construction is complete, when possible.
- Consider the current MUTCD minimum and maximum distance requirements for signal head placement with respect to the stop line. This rule typically guides the pole location and signal arm orientation required at each intersection.
- Review existing or proposed cross-sections to ensure that mast arms, signal heads, and signs will meet or exceed the minimum vertical clearance above the road, but will not be mounted higher than the maximum allowable height above the road, as per VDOT's *Road and Bridge Standards* and the MUTCD. For unusual locations, a cross-section elevation may be prepared to demonstrate appropriate standard foundation reveal and signal head clearances are met. Typical reveal for signal pole foundations is 12 inches.
- The size of the signal pole and foundations are governed by the most recent VDOT Road and Bridge Standards. Typically, a minimum 4-feet-diameter foundation is assumed during design; however, a greater diameter may be an appropriate assumption for single and dual mast arm poles with significant loading and/or longer arm lengths. Because the actual foundation size is determined during the construction phase, it is recommended to attempt to exceed minimum offsets to underground utilities when locating poles to ensure the planned location is constructible.

For Pedestal Poles:

- Consider pedestrian use when placing pedestal poles that have accessible pedestrian signals and/or detectors, so that they meet the requirements of the latest version of *IIM-TE-388* and any District specific equipment preferences.
- Pedestal poles may be used to support left-turn phase indications in median sections. Consult with the appropriate VDOT District Operations representative to determine District preferences relative to the permitted placement of pedestal poles in the median.

For Mast Arm Poles:

- Determine mast arm length for each pole. Standard mast arm lengths are outlined in VDOT's *Road and Bridge Standards* and limited to lengths presented in the latest version of VDOT's *Structure and Bridge (S&B) IIM-S&B-89** and *IIM-TE-375*. If arm lengths longer than those limits are required for a design, a design waiver will be required to be submitted. A sample design waiver for this issue should be requested to the District.

- Ensure a minimum 1-foot extension of mast arm beyond the last signal head. To account for a potential unexpected field adjustment during construction, a 3 to 4-foot extension is ideal but may not be practical for all sites.

For Combination Poles (signal poles with luminaires) and Other Street Lighting:

- The Lighting Chapter in this document provides further discussion on intersection lighting warrants and requirements.
- Check that entire intersection is lit to acceptable standards.
- Check clearances to overhead utilities and structures.
- Coordinate with representatives of the local utilities that are in proximity to the poles as well as the local VDOT representative regarding design and maintenance standards.

2.5.2.6 Identify Electrical Service Connection, Locate Controller Cabinet, Determine Communications

Coordinate with local power provider and the appropriate VDOT District representative regarding electrical service point and type of service connection to be provided. In addition:

- Document discussions and identify individuals that participate in establishing the service connection location. Include pole number where service is being provided, when possible.
- Identify conduit, cable, riser, and junction boxes, etc. that are required to provide electrical service to the controller cabinet from the electrical service point.
- Refer to the most recent VDOT *Road and Bridge Standards* for electrical service types, Standards SE- series. When selecting the electrical service type, the presence of intersection lighting, auxiliary equipment, and the maintaining jurisdictions maintenance organizational structure shall be considered.
- Ensure that power source wiring and traffic signal system wiring are kept in separate conduit runs and junction boxes.
- An Electrical Service Work Pad shall be provided for all proposed electrical services, unless the safety switch and breaker box are placed such that they will be accessible from a paved sidewalk.

Locate controller cabinet as convenient to the electrical service point as possible, within the parameters of the VDOT electrical service standards (typically 3’ – 20’). In addition:

- Ensure that the controller cabinet location will not be a visibility obstruction for vehicles and pedestrians.
- Ensure grade at proposed cabinet location is adequate and that the controller cabinet is unobstructed for maintenance activities.
- Locate controller cabinet as far from the travel way as possible, where there is a less likely potential for vehicle collision.

- Locate the cabinet so that technicians have the ability to access the lower wiring panels and ensure the cabinet is either not in a possible high water location or is elevated to reduce the possibility of water entering the cabinet. Another possible entrance for water is conduit that is slightly higher than the cabinet foundation. Ensure water has an easy means of draining out of cabinet.
- If possible, locate controller cabinet and orient the cabinet doors to allow technicians to see as many signal heads as possible. Discuss the location with the appropriate VDOT District Operations personnel for specific preferences.
- The designer shall consider the swing of the cabinet doors in locating and orienting the cabinet, and should be noted on the project plans or specifications, if possible.
- Evaluate existing and/or proposed Landscaping. For stand-alone signal projects, evaluate existing landscaping. For signal projects as part of a roadway construction project, evaluate proposed landscaping.

Coordinate with the appropriate VDOT District Operations representative regarding type of communications to be provided based on the latest District Communication Plan. In addition:

- Document discussions and identify individuals that participate in establishing the communications at the project location(s).
- Determine communications type at each signal location (wireless, fiber, cellular, etc.).
- Identify any signal equipment (additional conduit, cable, riser, splice enclosures, junction boxes, etc.) that are required to provide communications to the controller cabinet that may require additional easements or ROW.

2.5.2.7 Develop a Phasing Diagram

- Consult the traffic operations analysis to ensure approved phasing is utilized.
- Phase numbering shall be confirmed with the District representative. In the case of no guidance, typical phasing numbering shall be applied as shown in Figure 2-3. In a coordinated system, phase numbering shall be consistent with the adjacent intersections unless directed otherwise by the District representative.
- Show protected turning and through movements as solid lines.
- Show permissive movements and pedestrian movements as dashed lines.
- Figure 2-4 represents an 8-phase signal operation with protected only left turns and right-turn overlaps.
- Provide a separate preemption phasing chart, if requested by VDOT staff, as shown in Figure 2-5.
- Overlap phases should be called out specifically as OLA, OLB, OLC, etc. and match the red and yellow clearance interval worksheet.

Figure 2-3: Typical NEMA Phase Numbering

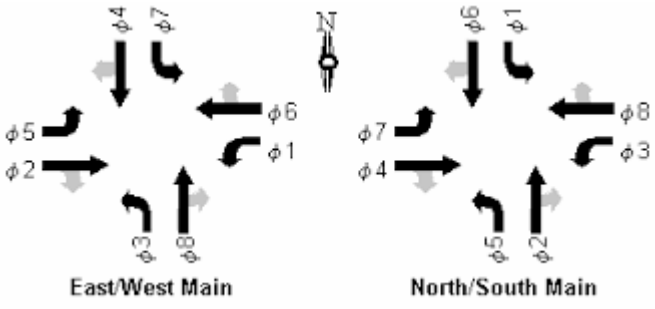


Figure 2-4: Phasing Diagram

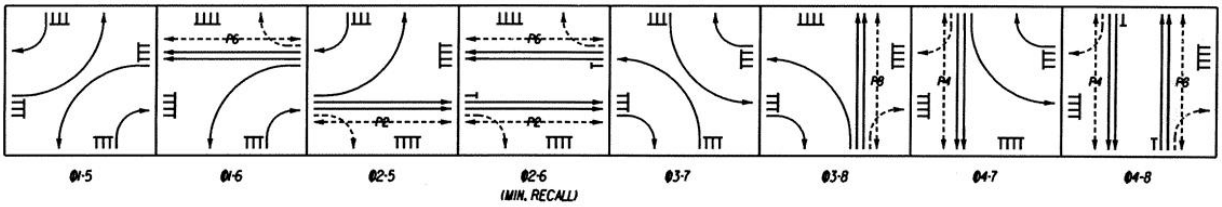
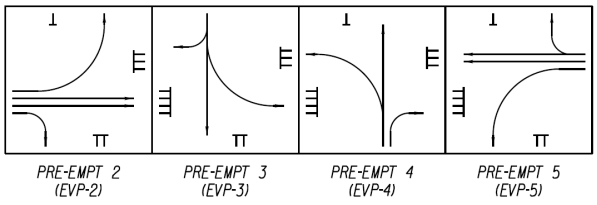


Figure 2-5: Preemption Phasing Diagram



2.5.2.8 Determine Sign Requirements

Consult the MUTCD and the Virginia Supplement to the MUTCD for appropriate sign requirements.

- Show all sign dimensions on the plan sheet such that any signs located on the traffic signal structure can be included in the structural analysis by the contractor.
- A Sign Schedule plan sheet and a Sign Detail plan sheet may be necessary for fabrication of these signs, if requested by VDOT.

Locate and illustrate Overhead Street Name Signs (OSNS).

- Discuss street name blade design criteria with the maintaining agency.
- Street name signs shall be designed in accordance with the latest version of the Virginia Supplement to the MUTCD and *IIM-TE-379*. Street name signs shall be designed in GuidSign and Sign Figure Details shall be provided.

- Ensure that OSNSs do not exceed the maximum width or height established by VDOT standards, and that there is enough room on the mast arm to fit the OSNS. *IIM-TE-379* also gives guidance on when and how the text height can be reduced to reduce the overall sign width.
- Where OSNS signs are not feasible because of constraints such as an unusually long street name, lack of room on the mast arm, or signals with diagonal arms, advance street name signs (D3-2 or D3-V2) should be considered as an alternative.
- In addition to overhead-mounted street name signs, ground-mounted advance street name signs (D3-2 or D3-V2) should be considered per guidance in the Virginia Supplement to the MUTCD. The designer should verify any District preferences related to advance street name signs.

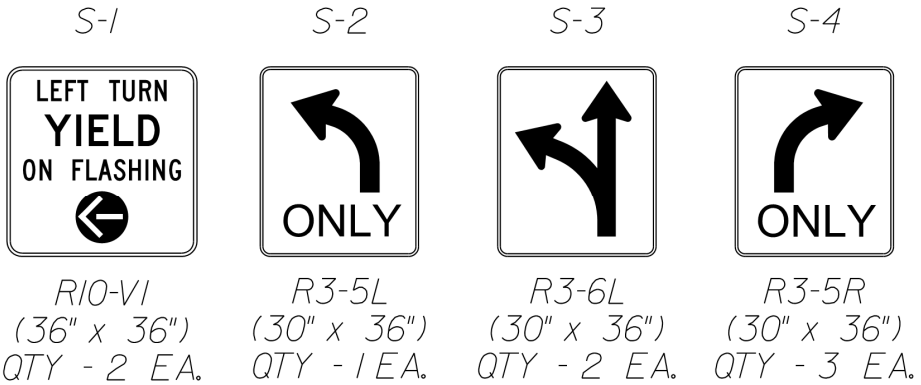
Coordinate with sign and pavement marking designs:

- If the traffic signal design is part of road construction plans, the traffic signal, sign, and pavement marking designs will be in separate plan sheets:
    - Coordinate with the sign and marking plan sheets for continuity of designs.
    - Signs mounted on signal mast arms and pole shall be shown in the signal plan set.
    - Show all ground mounted signs related to signal design in the sign plan set.
    - Signs may be referenced between plan sets if needed for clarity, but it should be made clear that the referenced signs are quantified elsewhere.
- If the traffic signal design is a stand-alone project, perform a field investigation of existing signs to ensure continuity with the traffic signal plan set. Include all signs necessary for the operation of the traffic signal in the traffic signal plan set.

Develop a Sign Detail:

- Assign each sign an identification label signs S-1, S-2, etc.
- Show dimensions and quantities when standard signs dictate.
- Identify applicable signs using MUTCD designations.
- Show dimensions of all signs.
- Perform a preliminary GuidSign layout of overhead street name and other custom signs to obtain dimensions. Refer to Chapter 3 of this manual for sign design requirements.

Figure 2-6: Sign Detail



2.5.2.9 Preliminary Design Cost Estimate

The designer should provide a high-level cost estimate of the signal design elements to ensure project funding is appropriate for the anticipated scope of work. The preliminary cost estimate should be based on standard VDOT items and delivered in a format agreed to by the project manager.

2.5.2.10 Anticipated Preliminary Design Phase Deliverables

- Preliminary Traffic Signal Design Plan showing pole locations, cabinet location, vehicular phasing, signal heads, pedestrian accommodations, proposed stop bar locations and crosswalk pavement markings, signal related signing, and anticipated electrical service type and source;
- Preliminary cost estimate;
- Mast Arm Loading Modification documentation; and
- Temporary Traffic Signalization Layout(s), as required.

2.5.3 DETAILED DESIGN PHASE

In this stage, the designer will refine the preliminary plan sheets, and incorporate additional design details including: locating and designing vehicle detectors, junction boxes and conduit runs, signing and pavement marking requirements, and signal wiring design, as required.

The signal plans prepared during the detailed design phase will result in what is defined in the VDOT Project Development Process as Field Inspection (FI)/Right-of-Way (RW) plans.

2.5.3.1 Locate Vehicle Detectors

Select detector technology. Coordinate with the appropriate VDOT District Operations representatives to identify the desired type of detector technology to be used.

Locate detectors based on detection type, signal operation requirements, and anticipated approach speeds. In general, guidance on advance loop detector or detection zone placement can be obtained from VDOT District Operations representatives, as they are dependent on the signal timing settings used in each District.

If video detection is proposed, the designer should verify proposed video detection zone placement with the manufacturer and/or the VDOT District Operations representative.

2.5.3.2 Locate Junction Boxes and Conduit Runs

In general, junction boxes shall be placed adjacent to major signal equipment infrastructure. The designer should evaluate where junction boxes and conduits can be placed in order to minimize costs and maximize efficiency through the utilization of common trenching.

a.) Locate junction boxes to serve detectors.

b.) Locate intermediate junction boxes.

- Conduit runs should generally not be greater than 200 feet without intermediate junction boxes.

c.) Locate primary junction box.

- It is standard practice to locate a primary junction box (usually a 24 x 36-inch box or larger) closest to the signal controller for convenient access to all cable runs that terminate at the controller.

d.) Locate junction boxes to serve signal and pedestal poles. Combine junction boxes to serve multiple services, if possible.

e.) Locate a junction box for the Electrical Service Connection, if appropriate and requested by VDOT District staff. Refer to VDOT SE- Standards.

f.) Place conduit runs. Minimize total length of conduit used. The three typical methods of conduit installation are: Open Trenching Installation; Jacked Pipe Installation; and Directional Boring Installation. The designer should evaluate the presence of adjacent utilities, available ROW, and type of surface under which the conduit will be installed when selecting conduit installation type. In general, open trenching of pavement surfaces should be avoided, unless precise placement of conduit to avoid adjacent utilities is required (e.g., constrained downtown signalized intersection).

g.) Locate communications box (if required).

- Depending on the proposed communications to the traffic signal cabinet, a supplemental communication service junction box may be required adjacent to the traffic signal cabinet. For fiber optic communications, a 48-inch x 48-inch or larger splice box may be required. Consult with VDOT District Operations staff for traffic signal communications requirements.

h.) Determine junction box sizes and note in plan.

- Refer to VDOT's *Road and Bridge Standards* for VDOT standard junction box sizes and types.
- Coordinate with the appropriate VDOT District Operations representative to determine junction box preferences.
- Refer to the NEC for properly sizing junction boxes.
- Once sized, junction boxes shall be verified for placement within the ROW and utility avoidance.
- Avoid placement of junction boxes with sidewalks and shared-use paths if at all possible.
- Consider conduit sweep and junction box collar requirements when clustering multiple junction boxes adjacent to one another or other signal equipment.

2.5.3.3 Develop Traffic Signal Communications Details

Coordinate with the appropriate VDOT District Operations representative to confirm the type of communications to be provided based on the approach identified in the Preliminary Design Phase.

- Develop communications details such as splicing diagrams, network diagrams, wireless equipment placement, etc. for incorporation into the signal plan set.
- Ensure that communications and traffic signal system wiring are kept in separate conduit runs.
- The designer should verify with District Operations staff if any specific communication test procedures are required to ensure proposed communications are secure once established during construction.

- **In order to ensure the Department's cybersecurity requirements are met, the designer should obtain approval from District* Operations staff for the proposed communication plan to the traffic signal prior to advancing to final design.**

2.5.3.4 Detailed Design Cost Estimate

After the detailed design is complete the designer should generate an itemized cost estimate for the required traffic signal project elements. Estimates for bid-based projects advertisement shall follow the procedures established by the *VDOT Cost Estimation Office Memorandum IIM-CEO-01* and *VDOT Cost Estimating Manual* and should be developed using an approved format as directed by the Project Manager.* The cost estimate should include all items to be furnished and/or installed by the contractor and/or state forces. The cost estimate should also include a contingency factor, CEI, and any third-party costs such as electrical service or communication service provider installation costs. Projects delivered using preestablished VDOT contracts should use contract items, identify work order items, and build the estimate in a format agreed upon by the Contract Administrator (typically in spreadsheet format).

2.5.3.5 Final Field Visit / Design Verification Meeting

A final field visit should be held after all detailed design work is completed. The purpose of the final field visit is to field-verify the final placement of the poles and cabinet, and any other key equipment to be installed at the intersection. It is highly recommended to field-stake the pole and cabinet locations and determine if there are any remaining conflicts with the proposed design. Therefore, it is recommended that underground utilities and VDOT equipment (and property lines, if possible) are marked prior to the final field visit. **Authorization is required by District staff prior to accessing traffic signal cabinets and junction boxes**. Other factors that can be considered during the final field visit are:

- The impact of existing or future grading on the design.
- The visibility of all appropriate signal equipment as well as adjacent property features such as private signs, etc.
- The impact of the signal equipment on nearby property owners.
- Adequacy of ROW for maintenance and construction.
- Electrical service type and location for the proposed signal.
- Communications equipment placement, if any, including line of sight verification needed for wireless communications.
- Any other issues that may affect the design, including resolving any outstanding scoping and initial field visit follow up items and coordination.

2.5.3.6 Anticipated Detailed Design Phase Deliverables

- Detailed Traffic Signal Design Plan, adding conduit system and junction box layout, and proposed vehicle detection system;
- Detailed itemized cost estimate;

- Traffic signal communications preliminary details (splicing diagram, wireless equipment placement, leased line service source identification, etc., if required);
- Special detail sheets specific to each intersection plan (if required), such as:
    - Controller actuated warning beacon (CAB) design details;
    - Pedestrian signal placement and orientation; and
    - Intersection curb ramp, signing and pavement marking details/detail sheets (if required and/or for standalone projects); and
- Refined Temporary Traffic Signalization Plans (if required).

2.5.4 FINAL DESIGN PHASE

This phase includes detailing the equipment of mast arm and other poles, the signal conduit, and cable system; developing intersection specific details, legends, diagrams, charts, and plan notes; and the development of general notes, quantity summaries, and detailed plan sheets.

The signal plans prepared during the final design phase will result in what is defined in the VDOT Project Development Process as Pre-Advertisement Conference (PAC) plans.

2.5.4.1 Develop Signal Wiring

- Confirm the wire size, type, and number of conductors preferred for each type of signal equipment with the District representative.
- If required, prepare a sketch of the proposed wiring/conductor layout (Figure 2-7) of the intersection. The wiring schematic will ensure that all signal components are properly wired.

2.5.4.2 Size Conduits

Determine conduits size based on wiring requirements. The conduit fill chart (Figure 2-8) provides cable and conduit sizing requirements. Follow the requirements listed, below:

- Maximum desirable conductor fill on new conduit installation should be 25%.
- According to NEC requirements, maximum conductor fill for existing and new conduit shall be 40%.
- If pulling new conductors through existing conduit is being considered, verify with the maintaining jurisdiction that pull ropes exist. Also, inquire whether the existing conduit has a history of conductor failures, which would indicate that the conduit is damaged.
- Include spare conduits if requested by VDOT District Operations staff.

Figure 2-7: Example Wiring Diagram

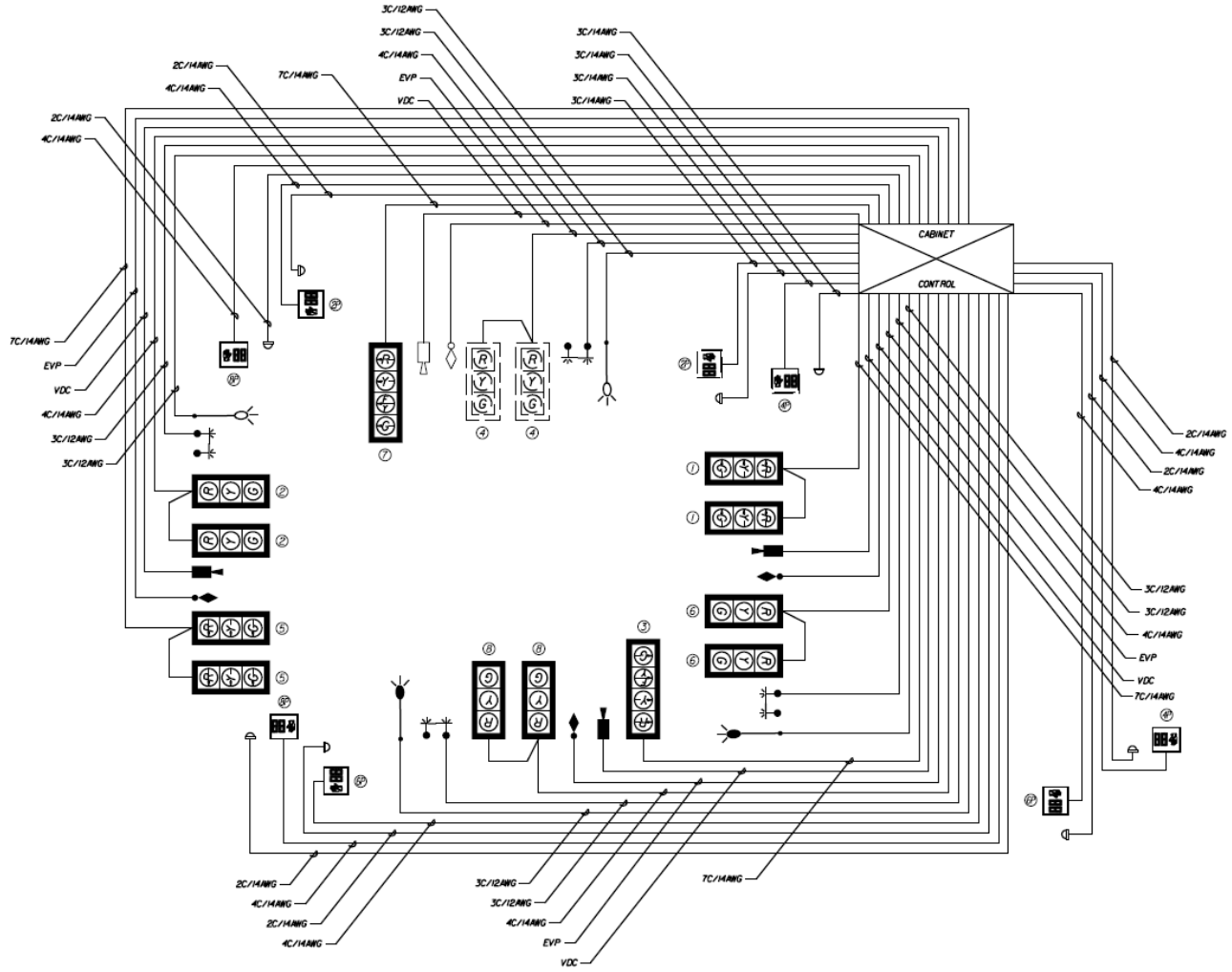


Figure 2-8: Design Guide for Cable and Conduit Sizing*

SIGNAL CABLE			
NON-SHIELDED		SHIELDED	
Size Conductor	Area of Conductors (in^2)	Size Conductor	Area of Conductors (in^2)
14/2	.09	14/2	.13
14/3	.10	14/4	.27
14/4	.12	14/7	.33
14/5	.14	14/12	.46
14/7	.17	19/12 PR.	.31
14/10	.30	19/25 PR.	.52
14/12	.32	19/50 PR.	1.33
8/3	.32	EPDC	.07
12/3	.14	Coaxial (RG6)	.07
16/3	.10	CAT 5E	.056
#8 EGC	.08	CAT 6	.074

ROADWAY LIGHTING CABLE	
Insulated Conductor Cable (AWG) – Type THWN	
Size Conductor	Area of Conductors (in^2)
14	.010
12	.013
10	.022
8	.037
6	.051
4	.083
3	.098
2	.116
1	.157

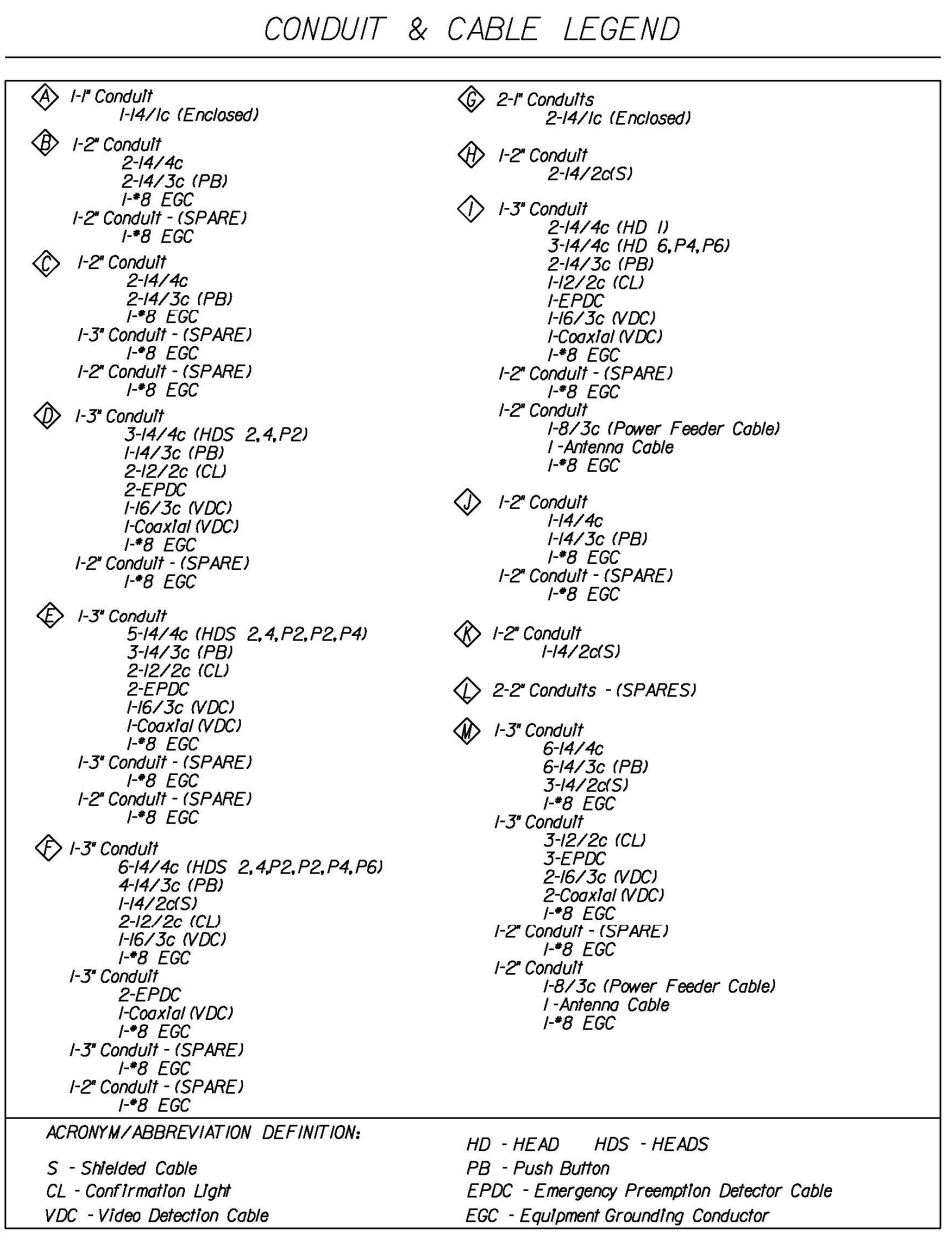
CONDUIT			
PVC Schedule 40 / HDPE			
Size Conduit (in)	Area Conduit (in^2)	25% Area (in^2)	40% Area (in^2)
1"	.83	.2	.33
1.25"	1.45	.36	.58
1.50"	1.98	.49	.79
2"	3.29	.822	1.31
3"	7.26	1.81	2.90
4"	12.55	3.13	5.02
5"	19.76	4.94	7.90
6"	28.56	7.14	11.42

2.5.4.3 Develop Conduit and Cable Legend

- All non-metal conduits are required to have equipment ground conducting (EGC) cables. The most recent VDOT Road and Bridge Standards provide discussions and applications of equipment grounding conductors.

- The wiring and conduit details shall be provided in a Conduit and Cable Legend that is located on the plan sheet that specifically matches the format shown in Figure 2-9 and in the VDOT Sample Plan provided in the Appendix. The information presented shall include the number, type, and size of conduit(s) within each conduit run. The wiring details per conduit run should itemize the number and size/type of cables to be installed within each conduit.

Figure 2-9: Example Conduit and Cable Legend

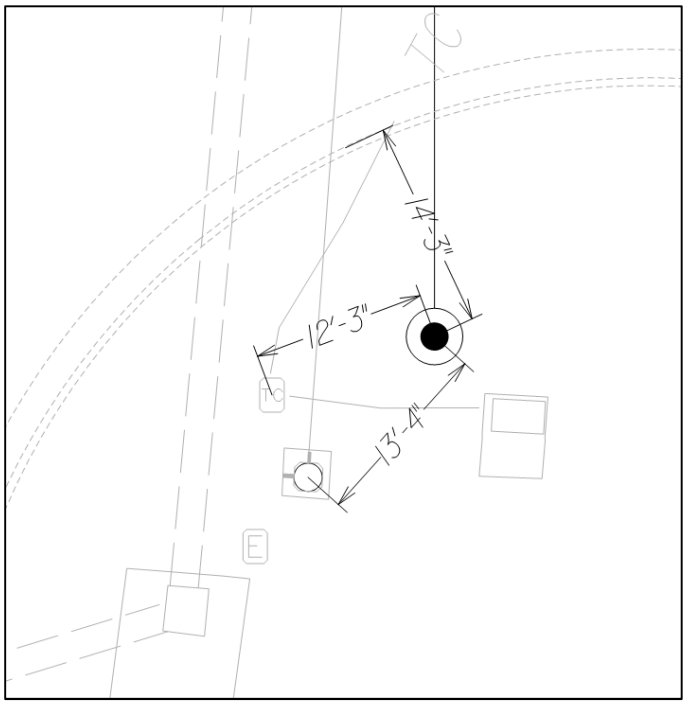


2.5.4.4 Detail Mast Arm and Other Poles

Confirm adequacy of previous signal pole and mast arm placements performed during preliminary design stage.

- Detail pole locations and arm orientation:
  - When signal design is part of road construction project, use station and offset method.
  - When signal design is a stand-alone project:
    - **Option 1:** Establish construction baseline in the same manner as that of a roadway construction project and use station and offset method.
    - **Option 2:** Use triangulation method, where the pole location is fixed by establishing three distances from known objects at the intersection (e.g., fire hydrants, utility poles, etc.). Also include distance from edge of pavement or face of curb (Figure 2-10).
  - Figure 2-12 provides guidance in determining mast arm and luminaire arm orientation.

Figure 2-10: Example of Triangulation Method



- Detail signal heads, signs, and all devices proposed on the mast arm such as emergency preemption devices and video detection cameras, such that the loading of these devices are included in the signal pole structural calculations (Figure 2-11).

Figure 2-11: Mast Arm Detailing

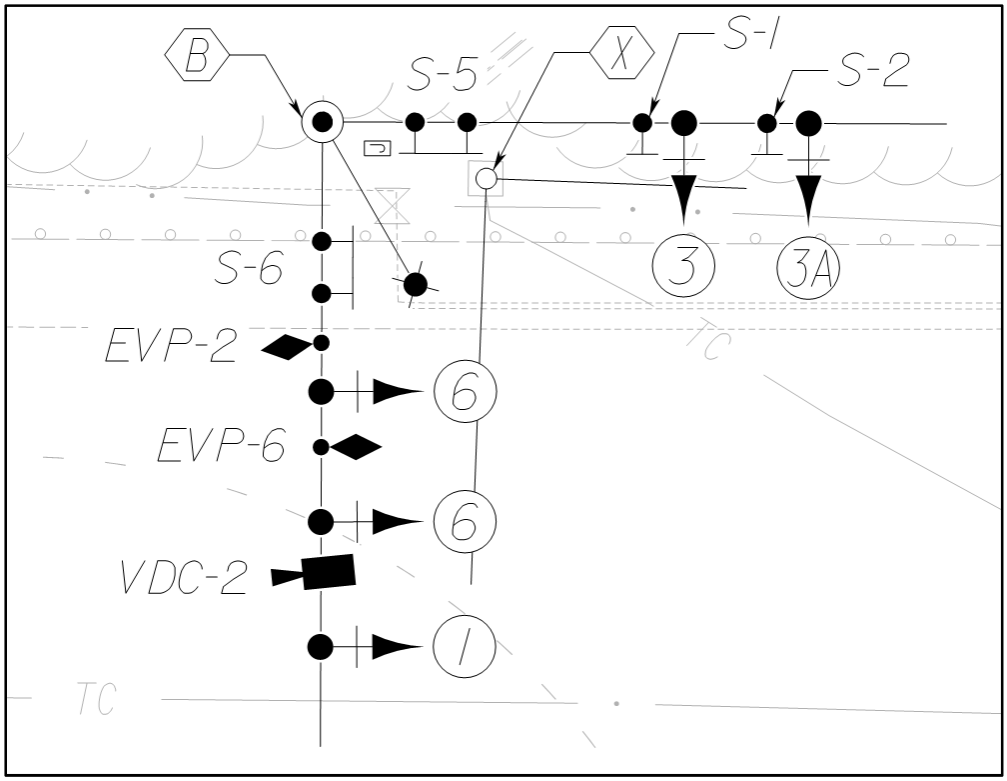
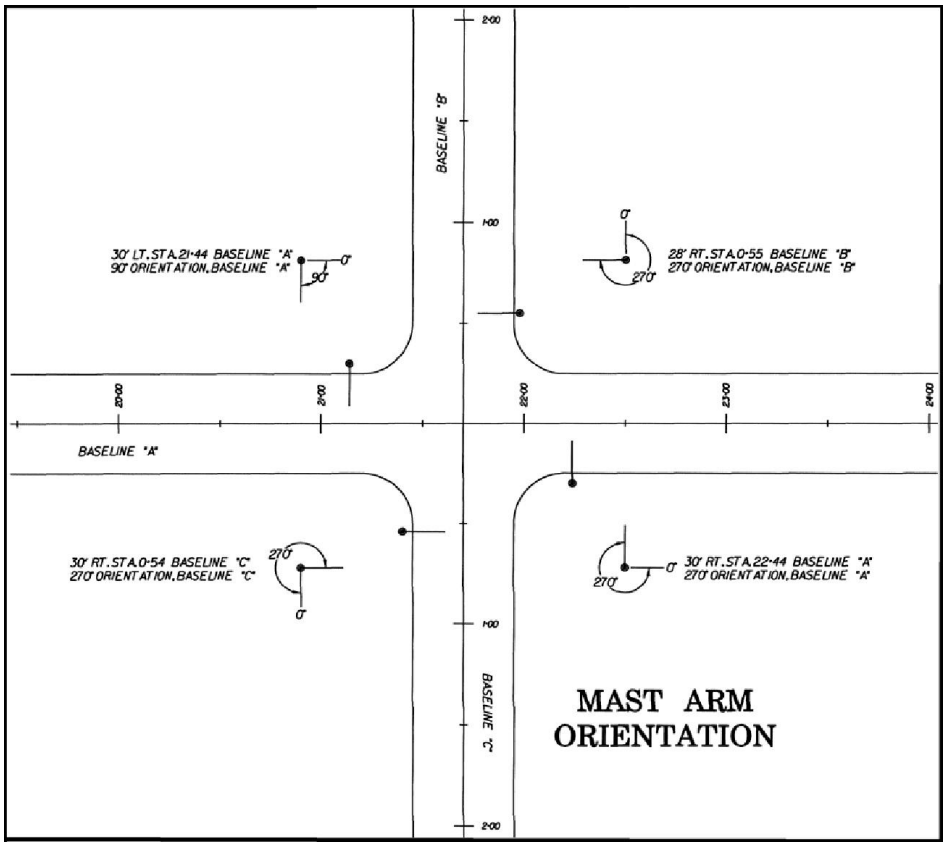


Figure 2-12: Guide to Determine Mast Arm and Luminaire Arm



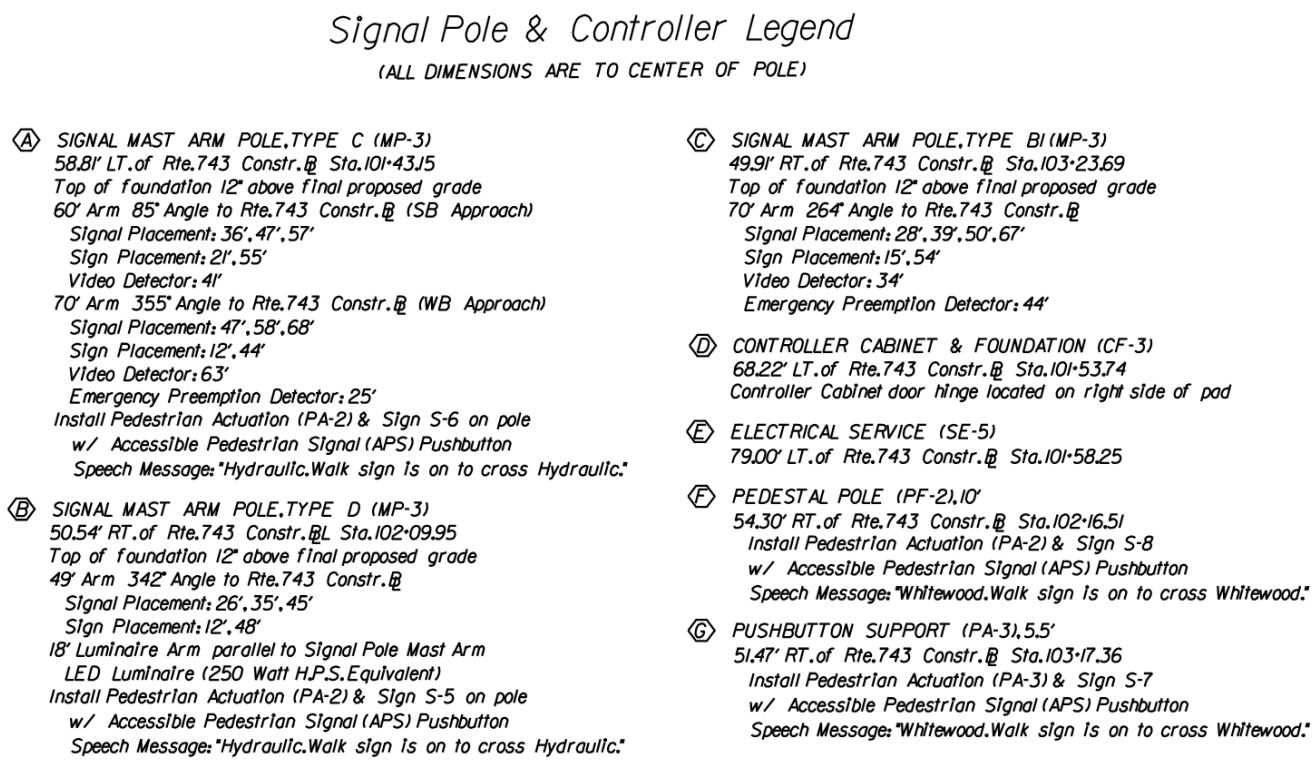
2.5.4.5 Develop Intersection Specific Details, Legends, Diagrams, Charts and Notes

Figure 2-13 through Figure 2-16 are provided as a guide. Specific illustrations, legends, diagrams, charts, and notes must be prepared for the intersection and may not always be in the formats shown below. The design requirements of the intersection will dictate the information and formats to be shown on the plans. The following details, legends, diagrams, charts and notes are depicted in the **General Notes Example Plan** provided in the Appendix.

a.) Develop Final Signal Pole/Structures Detail as shown in Figure 2-13.

- Verify labels on signal and pedestal poles on plan sheets. In order to match the assigned structural numbers, mast arm / strain poles shall be labeled starting with Pole A as the Pole closest to the controller cabinet, then each mast arm/strain pole in consecutive order in a clockwise direction.
- Verify pole types, using VDOT's *Road and Bridge Specifications* or refer to the pole types as described in VDOT District contracts, as applicable.
- Identify pole locations using station and offset method, or show diagrams if triangulation method is used.
- Verify mast arm length and label orientation.
- Identify signal head placement along mast arm (dimensioned from center of pole).
- Identify sign placement along mast arm (dimensioned from center of pole).
- Identify specialty equipment (cameras, preemption equipment, etc. and dimension from center of pole).
- Verify luminaire arm orientation, if required.
- Verify luminaire arm length, orientation, and mounting height, if required.

Figure 2-13: Signal Pole/Structure Details



b.) Develop a Color Sequence Chart as shown in Figure 2-14.

- Identify signal head designations along the left-most column, including pedestrian signal heads.
- Identify all possible phases and phase combinations that are permitted during the operation of the signal.
- Show the signal green face that would be indicated during their respective green phases on the chart.
- Show protected left- and right-turn movements with left and right arrows.
- Show a G to represent a circular green signal face indication.
- Show a FY to represent flashing yellow signal face indication, if required. In cases where a protected/permissive left-turn or right-turn movement (five section head) is used, illustrate in the same cell when two signal faces are illuminated at the same time for the five section head, such as a left-turn arrow and green circle.
- Show the appropriate vehicular/pedestrian signal face indication during Flash operations.
- Show the pedestrian signal face that would be indicated during their respective phases on the chart.

Figure 2-14: Color Sequence Chart

Color Sequence Chart

	SIGNAL	PHASES								COMBINATIONS								FLASH
		1	2	3	4	5	6	7	8	1-5	1-6	2-5	2-6	3-7	3-8	4-7	4-8	
SIGNALS	1	◄G								◄G	◄G	◄FY	◄FY					◄Y
	2		G									G	G					Y
	3			◄G										◄G	◄G	◄FY	◄FY	◄R
	4				G											G	G	R
	5					◄G				◄G	◄FY	◄G	◄FY					◄Y
	6						G				G		G					Y
	7							◄G						◄G	◄FY	◄G	◄FY	◄R
	8								G						G		G	R
	8A	R/G◄							G	R/G◄	R/G◄				G		G	R
	P2	DW	W	DW	DW	DW	DW	DW	DW	DW	DW	W	W	DW	DW	DW	DW	BLANK
	P4	DW	DW	DW	W	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	W	W	BLANK
	P6	DW	DW	DW	DW	DW	W	DW	DW	DW	W	DW	W	DW	DW	DW	DW	BLANK
	P8	DW	DW	DW	DW	DW	DW	DW	W	DW	DW	DW	DW	DW	W	DW	W	BLANK

- EMPTY BOXES DENOTE RED INDICATIONS
- DURING FLASH MODE, THE DISPLAY OF A FLASHING LEFT TURN ARROW SHALL BE FROM THE SIGNAL HEAD SECTION THAT DISPLAYS A SOLID YELLOW INDICATION DURING NORMAL SIGNAL OPERATION.
- FLASHING YELLOW ARROW SIGNAL HEADS SHALL UTILIZE A TYPE I TRANSITION.
- "W" - WALK "DW" - DON'T WALK "FY" - FLASHING YELLOW

c.) Develop Signal Timings, Change and Clearance Interval Timings, and Pedestrian Timings.

- If required by the project scope and District, base initial timings and coordination timings shall be developed and submitted for review at final submission.
- If required, develop initial timing chart to be included on signal plan sheet, as shown in Figure 2-15.
- Determine change and clearance intervals based on the latest version of *IIM-TE-306*.
- At final submission, the design engineer shall provide a completed and PE-stamped copy of the VDOT *Yellow Change & Red Clearance Interval Calculator Worksheet*.
- Calculate and document pedestrian Walk and Flashing Don't Walk intervals per criteria established in Section 4E of the MUTCD and any specific District guidance.

Figure 2-15: Initial Timing Chart

Initial Timing Chart

PHASE	1	2	3	4	5	6	7	8
DIRECTION	SB	NB	WB	EB	NB	SB	EB	WB
MOVEMENT	LEFT	THRU	LEFT	THRU	LEFT	THRU	LEFT	THRU
PHASE ON	X	X	X	X	X	X	X	X
PHASE OFF								
INTERVAL	PHASE TIMINGS							
MIN GREEN	5	20	5	5	5	20	5	5
PASSAGE	2.0	3.5	2.0	2.0	2.0	3.5	2.0	2.0
YELLOW	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
RED	2.9	2.9	4.9	4.9	2.9	2.9	4.9	4.9
MAX 1	15	35	15	15	15	35	15	15
MAX 2								
WALK		7		7				
PED CLEAR		24		30				
MIN GAP	2.0	3.5	2.0	3.0	2.0	3.5	3.0	2.0
TIME BEFORE RED.								
TIME TO REDUCE								
MODE	NON-LOCK	MIN. RECALL	NON-LOCK	NON-LOCK	NON-LOCK	MIN. RECALL	NON-LOCK	NON-LOCK

d.) Determine Quantities.

- The VDOT Specifications provide measurement and payment for most items in a signal project. Specific items not covered under the Specifications are addressed through Special Provisions or Special Provision Copied Notes.
- The pay item on the Summary of Quantities sheet should match exactly the standard VDOT pay items. A current list of standard pay items can be found on the VDOT web site.

The following require special attention in calculating estimated quantities:

- Conduit, Cable, and Trench:

  The Summary of Quantities includes the amount of conduit required for each plan sheet. However, in computing the amount of conduit, cable, and trenching required on a plan sheet, the designer should make some consideration for cable splices and conduit bends around the various drainage structures and other features found along the roadway, i.e., variation of terrain. Similarly, conductor cable will not lie perfectly straight or flat in the conduit. The sum totals of the following items should be increased to compensate for variation encountered during construction. The percentages noted below are sample rules-of-thumb that may be used to accommodate those conditions:

  - Conductor cable: increased 10%;
  - Conduit: increased 5%; and
  - Trench: increased 5%.

- Bored Conduit: Trench Excavation is **not** required in areas where bored conduit is installed.
- The EGC is a separate pay item and is quantified separately from conductor cable.

e.) Develop General, Summary, and Plan Notes.

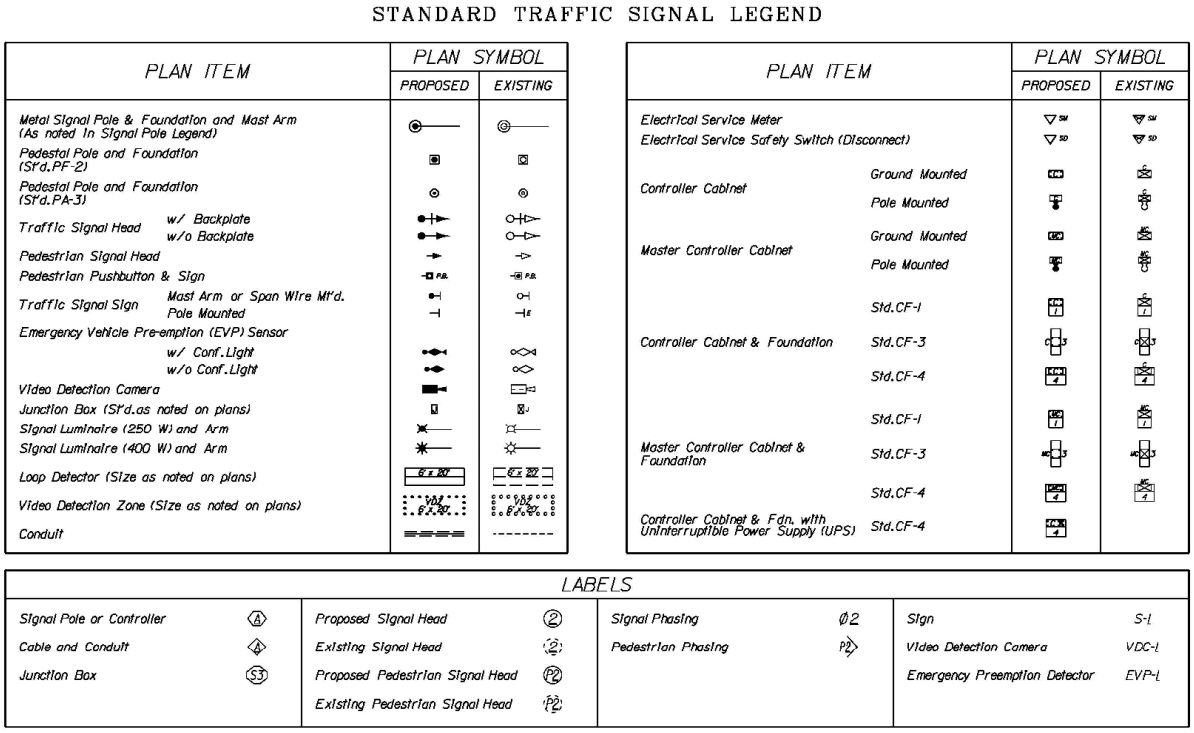
Notes provide clarity and simplification of plans. There are three types of notes typically used on VDOT plans and are defined as follows:

General Notes:

- Traffic Signal Legend and Symbology: The standard required legend is presented in Figure 2-16.
- VDOT contact information.
- Maintaining Jurisdiction contact information and Power Company contact information.
- Maintenance of Traffic notes.
- Special information specific to the overall project.

Several examples of General Notes are shown in the Example Plan provided in the Appendix.

Figure 2-16: Traffic Signal Legend



Summary Notes:

- Place notes related to a specific "Pay Item" that has application to the entire plan set on the Summary of Quantities Sheet. Summary notes typically provide minor detail regarding a "Pay Item" as it applies to the specific project. If a "Pay Item" requires considerable detailing to be included in the pay item, then a special provision may need to be developed. Summary notes are numbered sequentially and circled.
- The circled number is associated with the "Pay Item" by placing it in the appropriate pay item block above the pay item description on the Summary Sheet.

Plan Notes:

- Notes related to the design that is unique to an individual plan sheet. Plan notes are numbered sequentially and shown on the Plan Sheet.

Additional examples of notes that may be included in the plans are provided in the Appendix. The example notes listed above and noted in the Appendix shall be modified in accordance with the specific needs of the traffic signal design.

f.) Develop Other Details, as needed.

- Develop plan notes for required audible messages for Accessible Pedestrian Signals. Refer to the latest version of *IIM-TE-388*.
- NOTE: Some VDOT Districts require the development of an initial timing chart and its inclusion on the traffic signal plan. Coordinate with the appropriate VDOT District Operations staff to determine their requirements.
- Develop special details, signal operation notes, electrical service notes, or special provisions, as required.

2.5.4.6 Final Design Cost Estimate

Refine the detailed design cost estimate based on final design adjustments and additions. Ensure non-standard and/or work order items are included and corresponding special provisions developed.

2.5.4.7 Anticipated Final Design Phase Deliverables

- Final Traffic Signal Design Plan Set;
- Final itemized cost estimate using the appropriate VDOT bid items or preestablished contract items;
- Final Temporary Traffic Signalization Plans;
- Signal analysis deliverables (clearance interval worksheet, etc.);
- Signal timing deliverables; and
- Non-standard item and project specific Special Provisions and Copied Notes.

2.6 PHASES AND DELIVERABLE SUMMARY

Table 2-1 summarizes the deliverables for each task for use as a checklist to ensure all applicable deliverables are completed in the respective phase.

Table 2-1: Deliverables by Phase

Scoping Phase	
Item	**Requirement**
Approved Project Scope and/or documentation of design requirements	Required
Operational Analysis	As needed
Signal Justification Report	As needed
Left-Turn Phase Evaluation	As needed
Preliminary Design Phase	
Item	**Requirement**
Preliminary Traffic Signal Design Plan	Required
Mast Arm Loading Modification documentation	As needed
Temporary Traffic Signalization Layout	As needed
Preliminary Cost Estimate	Required
Detailed Design Phase	
Item	**Requirement**
Revised Signal Plan	Required
Conduit & Wiring System Layout	Required
Traffic signal communications preliminary details	As needed
Refined Temporary Traffic Signalization Plans	As needed
Special detail sheets specific to each intersection plan	As needed
Itemized Cost Estimate	Required
Final Design Phase	
Item	**Requirement**
Final Signal Plans	Required
Final Refined Temporary Traffic Signalization Plans	As needed
Final special detail sheets specific to each intersection	As needed
Signal analysis and timing deliverables (clearance interval worksheet, etc.)	Required
Project specific Special Provisions	As needed
Final Itemized Cost Estimate	Required
Summary of Quantities Sheet	Required

CHAPTER 3 – SIGNING AND PAVEMENT MARKING DESIGN

3.1 INTRODUCTION

This chapter presents the information needed to assist engineers and designers prepare signing and pavement marking plans to VDOT standards. The designer should use this manual as a guide, from initial project scoping through project plan delivery, to ensure plans are consistently designed on a statewide basis. The nature of VDOT's organizational structure requires that District-specific signing design preferences and policies be verified for each design; however, the guidance established herein serves to provide a uniform roadmap to signing and pavement marking design and plan development in all Districts and localities in the Commonwealth of Virginia.

3.2 VDOT STANDARDS

All of the applicable standards for VDOT signs and pavement markings, unless otherwise noted, can be found in Section 1300 of the latest edition of the VDOT *Road and Bridge Standards* and Sections 700, 701, and 704 of the VDOT *Road and Bridge Specifications*. Below is a brief classification and description of the types and standards for pavement markings as well as sign structure equipment utilized for standard VDOT designs.

3.2.1 PAVEMENT MARKINGS TYPES

The following pavement marking types are identified in the VDOT *Road and Bridge Specifications*:

- Type A – Traffic paint (temporary markings and permanent markings on low-volume roads);
- Type B, Class I – thermoplastic pavement marking material;
- Type B, Class II – preformed thermoplastic pavement marking material;
- Type B, Class III* – epoxy-resin pavement marking material;
- Type B, Class IV* – plastic-backed preformed tape;
- Type B, Class VI – patterned (profiled) preformed tape;
- Type B, Class VII* – polyurea pavement markings;
- Type D, Class II^ & III^ – removable tape; and
- Type E^ – non-retroreflective black removable tape.

*Rarely used

^ Temporary pavement markings

The selection of pavement marking material should be based on the latest version of *Traffic Operations Division Memorandum IIM-TE-395* for temporary pavement markings*, the type of pavement, and District preferences.

When pavement markings are atop concrete roads or bridge decks, it is sometimes beneficial to provide black contrast to those markings. Longitudinal markings should include contrast if the speed limit is 45+ mph and the markings are on a concrete road, or a bridge deck of 300 feet or greater in length.

Contrast longitudinal markings are usually achieved with Contrast Type B-VI tape (tape that is preformed with black borders). For skip lines, an alternative method is to stripe skip lines with a 'tiger-tail' alternating white-black pattern using a durable marking material like thermoplastic or polyurea.

3.2.2 PAVEMENT MARKINGS (PM- STANDARD DRAWINGS)

- Standard pavement marking line widths, spacing, and placement are outlined in Section 1300 of the standards.
- At signalized intersections, the need for pedestrian crossing accommodations shall be considered. Marked crosswalks shall be provided where the decision has been made to provide pedestrian crossing accommodations. See Chapter 2 for additional information.
- Crosswalk markings at unsignalized intersections and mid-block crossing shall comply with the latest version of *IIM-TE-384*.
- Crosswalk widths should generally be at least the same width as the pedestrian facility or shared-used path on either side of the roadway, with a minimum of 6 feet per the MUTCD. Wider crosswalks may be used at locations with heavy pedestrian volumes, as determined per District.
- Designer should consult with District Traffic Engineer to verify if high-visibility crosswalks are required for all marked crosswalks, especially those with high volumes of conflicting permissive left- or right-turn movements, and/or marked crosswalks that are expected to see more than occasional use.
- High-visibility longitudinal crosswalk marking patterns should be used instead of standard transverse crosswalk marking patterns only when specified conditions are met as per the latest version of *IIM-TE-384*.
- High-visibility marking patterns, such as longitudinal lines ("continental") or Bar Pair markings, may be used when matching existing adjacent marked crosswalks or when an existing standard crosswalk is upgraded to a high-visibility crosswalk independent of a roadway resurfacing project, where transverse lines should not be reinstalled when the roadway is resurfaced.
- The PM standards also include typical pavement marker location details. Pavement markers shall follow the requirements of the latest version of *IIM-TE-393**.

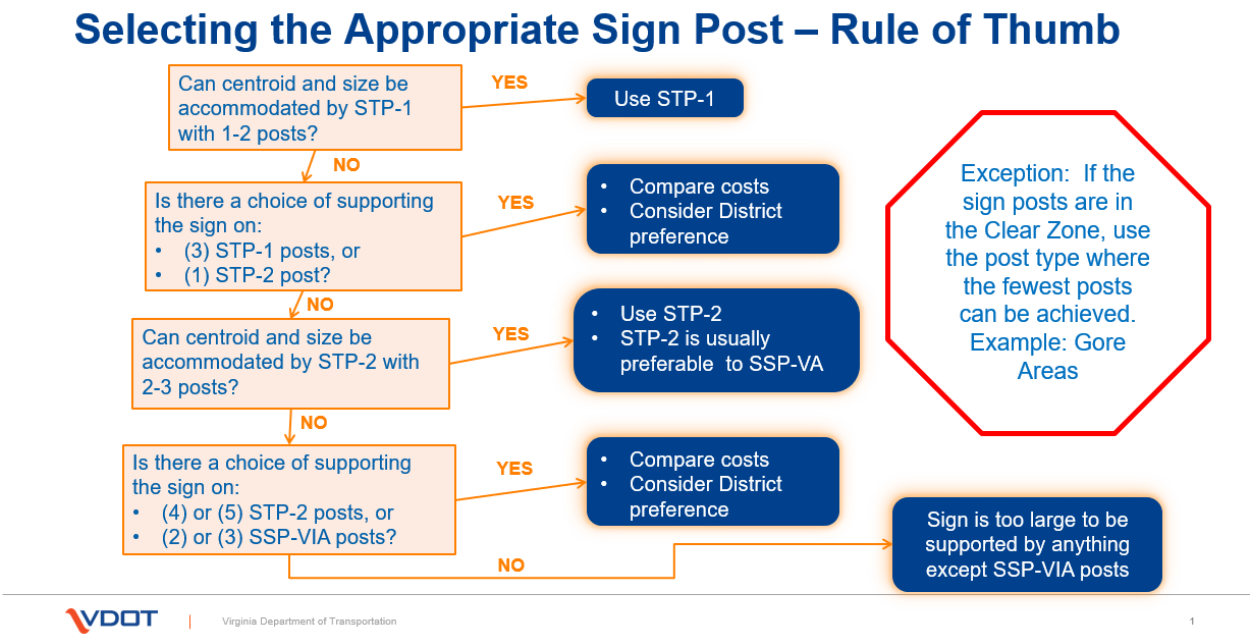
3.2.3 TEMPORARY SIGNS (WSP- STANDARD DRAWINGS):

- Typically, temporary sign installations use wood posts where, for construction purposes, temporary sign installations are in place for a maximum of 36 months.
- Sign widths greater than 48 inches shall require sign bracing conforming to standard Square Tube Post (STP)-1.

3.2.4 SQUARE TUBE POST STRUCTURES (STP- STANDARD DRAWINGS):

- STP structures are generally used to support smaller signs.
- STP posts may be used on either conventional roads or within freeway/limited-access road environments.
- A variety of post sizes are available and the selection is based on the sign size and centroid height, per standard STP-1 and STP-2. See Figure 3-1 for the rule of thumb process for selecting the appropriate sign post.
- STP foundation types are determined based on the post size and District preferences.

Figure 3-1: Sign Post Selection



3.2.5 VA Sign Post Structures (SSP-VA- Standard Drawings):

- The Type VA sign structure is a single I-beam sign post used to support a number of standard size signs as identified in the *Road and Bridge Standards* and are typically used within freeway or limited access road environments.
- Type VA sign structures should not be used unless directed otherwise by the District; STP-1 or STP-2 sign supports should be used instead.

3.2.6 VIA Sign Post Structures (SSP-VIA- Standard Drawings):

- The Type VIA sign structure consists of 2 or 3 I-beam posts and is used to support ground-mounted large format signs that cannot be supported by the other sign structure types.

3.2.7 Overhead Sign Post Structures (OSS-VIA- Standard Drawings):

- The overhead sign structure is used to support all large format signs that are required to be placed overhead. This structure can be a span structure, a cantilever structure, or a butterfly design.
- Per *IIM-TE-375.1*, bridge mounted ancillary structures shall not be used except where allowed as per Part 2 - Chapter 31 of the Manual of the Structure and Bridge Division*.
- Overhead sign lighting is discussed in IIM-TE-380 and in Chapter 4 of this manual.

3.2.8 Sign Panel Design (SPD- Standard Drawings):

- Sign panels shall be aluminum with reflective sheeting.
- Reflective sheeting type shall be as per Section 701 of the Specifications.

3.2.9 DELINEATORS (ED- STANDARD DRAWINGS):

- Delineators can be rigid (ED-series standard drawing) or flexible post delineators as per Section 702 of the specifications.
- The use of edge delineators shall comply with guidance as per Section 3F of the VA Supplement to the MUTCD and as directed by District staff.
- Location and spacing of road edge delineators on interstate ramps are provided based on radius of horizontal curvature.
- Guidance is provided for use, placement and type on interstate roadways, including acceleration and deceleration lanes.

3.2.10 INTEGRATED DIRECTIONAL SIGNING PROGRAM SIGNS:

The Integrated Directional Sign Program (IDSP) is an umbrella program comprised of four unique sign types designed to guide motorists to various essential services, businesses, attractions, tourist destinations, and other points of interest. The IDSP provides interested establishments a single point of contact to apply for signs along state-maintained highways.

Signs currently installed under the IDSP, located within the parameters of the project, shall be maintained by the Contractor in accordance with Section 105.15 (a) of VDOT's Specifications. IDSP Signs include:

- Specific Travel Services (Logo) Signing;
- Tourist-Oriented Directional Signs (TODS);
- Supplemental Guide Signs (SGS); and
- General Motorist Services Signs (GMSS).

SGS may have a green, brown, or blue background:

- Tourist information centers, police, and Department of Motor Vehicles are on blue background signs.
- Destinations that are recreational, historical, or cultural in nature are placed on brown background signs.
- Schools, other government facilities, colleges and universities are placed on green background signs.

3.3 SIGNING AND PAVEMENT MARKING PLAN REQUIREMENTS

VDOT signing and pavement marking plans shall follow the standards described below and shall utilize the symbology, formatting, and spacing for plan items, as presented in the example plans provided in the Appendix to this chapter and in the VDOT Traffic Engineering Design MicroStation/OpenRoads Designer* Cell Libraries, as defined in the VDOT CADD Manual. In addition, the VDOT CADD Manual provides additional information relative to the file management of CADD files used for signing and pavement marking plans, as well as information on drawing scale, levels, symbology, and text and dimension styles*. Please contact CADDsupport@vdot.virginia.gov to obtain the appropriate Microstation/OpenRoads Designer* files and cell libraries.

A majority of text notes, legends, and call-outs are included in the VDOT Traffic Design cell libraries. The text size in the cell libraries is based on 25 scale plans. Cells should be adjusted appropriately based on the proposed scale of the plan.

3.4 SIGNING AND PAVEMENT MARKING PLAN SET GUIDELINES

3.4.1 DISTRICT SIGN AND PAVEMENT MARKING REPLACEMENTS AND/OR NEW INSTALLATIONS

For this design context, the plan package requirements may vary depending on the VDOT District. The appropriate VDOT District representative shall give specific guidance to the designer on the requirements for each plan package. It is recommended to request a sample plan package from VDOT to verify the District's expectations prior to beginning design.

- Typically, this type of design has a minimum requirement of a tabular sign sheet indicating the location, proposed actions and affected signs.
- Cost estimate using approved VDOT bid item costs from the Regional or District contract.

3.4.2 NEW CONSTRUCTION PROJECTS

New construction plan projects developed and delivered in accordance with the VDOT Project Development process are the focus of this manual. New construction projects generally range from Minimum Plan projects (M-501, etc.), which are relatively simple construction projects requiring less than a single construction season, to full Construction Plan projects (C-501, etc.), which involve large transportation projects of varying complexity and typically one or more seasons of construction duration.

The following plan sheets are presented in the proper sequence to produce a signing and pavement marking plan set that would be included in a roadway design plan set for a new construction project. This may or may not be applicable for design projects to be constructed under VDOT District Contracts. It should be noted that all signing/pavement marking plans must be signed and sealed by the responsible Virginia PE, per *IIM-LD-243*.

This is guidance for typical projects, and that the VDOT project manager may require alterations to the plan package. The designer should verify the requirements of the plan package with the VDOT project manager at the start of each design project.

Plan sheets listed below noted as a "Standard Sheet" require the **designer to reference the VDOT CADD Manual for detailed discussion on format, data, and sheet numbering**.

a) Signing and Pavement Marking Plans Index of Sheets, General Notes, and Legends (Standard Sheet)
    - This sheet includes all general notes for both Pavement Markings and Signs (separately).
    - An example of the General Notes Sheet is provided in the Appendix.
    - Legends for the Signing and Pavement marking plans.

b) Summary of Quantities Sheet (Standard Sheet)
    - Summary of Quantities include the pay items required for each plan sheet.

c) Detail Sheets (Standard Sheets)

- There are several standard detail sheets required for signing and pavement marking plans, including:
  - Sign Figure Details; and
  - Sign Schedules.
- Occasionally, additional detail may be necessary on the plan sheets to thoroughly illustrate the design intent. These details may include:
  - Non-Standard Sign Structure Details;
  - Non-Standard Type VA and VIA Sign Structure Details;
  - Overhead (O/H) Sign Structure Elevation Detail Sheets; and
  - Pavement Marking Details (an example of a Pavement Marking Detail Sheet is provided in the Appendix).
  - Additional details may be necessary to clearly illustrate the placement of the pavement markings, pavement markers, object markers or delineation.

d) Plan Sheets: Plan sheets shall include the following (at a minimum):

- North arrow;
- Scale, typically 1 inch =50 feet;
- Stationing;
- Street names and route numbers;
- Intersection or roadway geometry (to scale);
- Curb ramps (as required);
- ROW;
- Show underground and overhead utilities, if applicable; and
- Other roadway features, as necessary.

e) Show all graphics and illustrations depicting signing and pavement marking elements, including:

- Existing and proposed sign placements, including sign removals or replacements and relocations, if applicable;
- Indication of existing and proposed sign orientations;
- Existing sign structure and/or sign panel type;
- Existing sign action and measurement and payment item;
- Proposed sign assembly numbers/sign text numbers;
- Proposed pavement markings, and eradications, if applicable;
- Radii for turn-lane extensions through intersections;
- Spacing requirements for transverse markings;
- Lane-width dimensions;
- Pavement marking legend;
- Pavement markers, if applicable;
- Object markers, if applicable; and
- Delineators, if applicable.

3.5 VDOT PROJECT DEVELOPMENT PROCESS FOR SIGNING AND PAVEMENT MARKING DESIGN

The following describes how the signing and pavement marking design process within a ***new construction project*** aligns with the VDOT Project Development Process. Information pertaining to the Project Development Process can be found on VDOT's website or through the VDOT Project Management Office. The specific plan requirements for each project milestone can be found in checklist format in VDOT's *Form LD-436*.

The VDOT signing and pavement marking design process is a sequence of steps that build on each other to produce a plan set. The following recommended design steps produce a plan set ***specifically as part a new construction project.*** It should be noted that ideally, these steps should apply to all designs performed for VDOT signs and pavement markings; however, the requirements for District signing and pavement marking replacements, modifications, and installations may vary depending on the design project and District. The designer should obtain clear guidance on the expected design elements required for these plans from the appropriate VDOT District Operations representatives.

Each project development process stage below guides the designer through various steps necessary to complete signing and pavement marking design. Design considerations are provided within each step to help aid in consistent application of design standards. At the end of each project development stage, a list of expected deliverables is outlined. The list of deliverables is representative for typical new construction projects. District staff may require additional (or omit) deliverables based on the nature of the design project.

It is expected that after each development process stage, VDOT will coordinate a review of the project deliverables with all appropriate staff. Concurrence or approval on project deliverables should be obtained from the VDOT project manager prior to proceeding to the next stage of development.

3.5.1 SCOPING PHASE

Meet with the applicable VDOT representative (likely the District Traffic Engineer or their designated representative) that will provide final approval of the signing and pavement marking design plan sets to determine any new or area-specific design preferences. The designer should also request any example District plans that may be relevant to the project scope. During this phase, the limits of the survey are to be reviewed to determine if it is sufficient to accommodate the sign and pavement marking design, and if not, schedule/or obtain the appropriate survey information.

While no plans are typically prepared during the scoping phase, the end of this phase corresponds with what is defined in the VDOT *Project Development Process as Final Scope/PFI* plans.

3.5.1.1 Obtain Survey Information

Obtain the base survey information that is a required element of the signing and pavement marking plan.

- Determine if the limits of survey for the subject project will accommodate the signing and pavement marking designs including space for transition areas and work areas of other disciplines. If not, request additional survey.
- Obtain any approved and relevant traffic studies or previous roadway plans that may provide guidance regarding the pavement marking or sign designs.

3.5.1.2 Identify Signing and Pavement Marking Requirements

The signing and pavement marking design parameters and requirements appropriate for the facility should be determined through coordination with the responsible VDOT District representative at the onset of the design. The following issues should be addressed:

- Identification of new ground mounted signs and/or overhead signs;
- Post types;
- Guide sign messages;
- Size and type of letter series;
- Lighting requirements (as per the latest *IIM- TE-380*);
- Luminaire retrieval system and/or catwalk;
- Supplemental signing;
- Logo signing;
- Reuse, Dispose, Salvage existing signs/structures;
- Pavement marking types to be utilized;
- Aesthetic considerations such as ornamental posts, color on the back of the sign panel, galvanized coating of sign structures, crosswalk marking preferences, etc.;
- Pavement marker requirements, if any;
- Location of existing traffic control devices to ensure that proposed signs are not blocking view of the other traffic control devices;
- Available sight distance to and between traffic control devices; and
- Impact to existing IDSP signs or Historical Marker Signs.

3.5.1.3 Anticipated Scoping Phase Deliverables

No deliverables to VDOT at this phase, however preliminary limits of work for additional survey, if necessary, should be identified and expanded upon in the Preliminary Design Phase.

3.5.2 PRELIMINARY DESIGN PHASE

In this stage, the designer will prepare the preliminary plan sheets required for the specific project. This includes laying out major sign infrastructure components to meet the project's operational needs and verifying ROW and utility clearances are sufficient. It is critical to determine if any sign equipment will require any additional ROW or easements, and if so, coordinate with project manager to identify the specific limits of the required ROW or easements (construction or permanent). The designer should also notify the Project Manager of any anticipated unavoidable utility conflicts. If required, complete an airport clearance review for the overhead sign structures at this stage. An airport clearance review is required for all new overhead sign structures or increasing the height of existing structures.

The signing and marking plans prepared during the preliminary design phase will result in what is defined in the VDOT Project Development Process as PH plans.

3.5.2.1 Field Review and Signing and Pavement Marking Inventory

A signing/pavement marking inventory/field review should be performed to document all existing sign data, sign structures, and pavement markings. The limit of the inventory/field review should be extended to include potential transition areas and work areas of other disciplines.

- The sign inventory includes identifying sign messages; locations, color, and size of the sign panels; qualitative evaluation of the condition of the panels; type of posts; overhead sign

structures and span lengths; sign lighting systems; and sign structure walkways. All existing signs shall be identified on the sign inventory.
- Markings inventory should include the general location and type of markings present in the project area, the marking materials (if applicable), and the presence and location of pavement markers.
- Photographs of existing signs and pavement markings should be documented, if possible.

3.5.2.2 Evaluate Utilities and Roadway Geometry

Identify the location of utilities and proposed roadway geometry to determine limits of signing and pavement markings. Ensure all signs (especially large format signs) can be accommodated within existing or proposed ROW. If not, determine any permanent easements or ROW needed to accommodate the signs.

- Utility location plans as well as proposed utility adjustments that may be planned for the near future or during the project development period need to be identified.
- Potential geometric deficiencies relative to providing adequate signing at proper spacing need to be noted and reviewed with the project designers and District representatives.
- It is also necessary to identify, as early as practical, proposed plans for retaining walls, noise walls or any obstacle that could be in conflict with sign structure placement.

A key area that can be overlooked during the early stages of design is the project limits. What may appear to be a good location for the project to terminate for the other design disciplines may not be adequate for traffic control devices. Inadequacies in the transition from the project's cross-section to the existing roadway cross-section will be revealed when the preliminary pavement marking and sign designs are developed at the project limits for the final design configuration, as well as the maintenance of traffic plans. Ensuring proper transitions at the project limits also includes all intersection side streets for primary and secondary road projects. Proper evaluation at the project limits will eliminate the need for obtaining additional ROW at the late stages of design or accepting less than ideal design conditions, since existing signs to be relocated or proposed signs may be located upstream or downstream of the project limits.

3.5.2.3 Determine Appropriate Sign Structure Types & Placement

The designer shall review all relevant technical engineering memorandums for clarification of revised standards including the latest versions of *TE-337* regarding Clearview font for guide signs, *TE-380* regarding Overhead Sign Lighting, and *TE-379* regarding Overhead Street Name Signs for D3-V1 signs that are attached to mast arm or pole. The designer should consider the need for overhead sign placement, in accordance with the MUTCD and guidance provided in this manual, the type of sign structure to be used, and if Overhead Sign Lighting will be required. Standard signs may be modified slightly to change the word message with the approval of the District, if there is no standard sign available that exactly addresses the condition. Any nonstandard uses of symbols, or nonstandard colors, shall be submitted to VDOT Central Office Traffic Engineering Division for review and approval.

Placement of proposed sign posts should not constrict the width of an existing or proposed sidewalk to less than 5 feet.

a.) Structure Type & Span Length Limits:

Span length limits for sign structures are described in *IIM-TE-375*. Designer shall check the latest version of *IIM-TE-375* to verify that span lengths required by the design are appropriate for structure type proposed.

Any deviation from the span limits and supplemental requirements in *IIM-TE-375* will* require a design waiver (*Form SB109*). Please refer to the latest version of *IIM-TE-375* for the design waiver requirements.*

b.) Bridge Parapet Mounts:

Per *IIM-TE-375*, bridge mounted ancillary structures shall not be used except where allowed as per Part 2 - Chapter 31 of the Manual of the Structure and Bridge Division*.

c.) Overhead Sign Structure Determination:

The (MUTCD cites several locations where overhead signing is explicitly required or recommended (MUTCD Section 2A.17, Section 2E, Section 2F, Section 2G). Therefore, it is assumed that signs are generally post-mounted unless one of the specified conditions is met, or unless other constraints or traffic conditions indicate a need for overhead signing. The engineer should refer to the latest *TE-379* for guidance on OSNS of the D3-V1 series signs that are attached to either mast arms or poles. The engineer should also verify there is no additional guidance in the Virginia Supplement to the MUTCD before using this checklist.

The engineer should field evaluate the existing conditions at all proposed sign locations and may consider the following as part of an engineering study to determine if an overhead sign structure should be considered (MUTCD Section 2A.17:3):

- Traffic volume at or near capacity – A higher volume translates to a reduced level of service and an expectation of greater traffic congestion and less freedom for lane changing. Overhead signs permit longer sight lines and longer target visibility for sign legibility.
- Complex interchange design – Multi-lane exit ramps, left exit ramps, cloverleaf configurations, and interchanges with collector-distributor roadways benefit from, and sometimes require, overhead sign placement.
- Three or more lanes in each direction – Multi-lane roadways place some drivers more than 60 lateral feet from post-mounted guide signs with two or more lanes of traffic potentially obscuring important guidance information.
- Restricted sight distance – Post-mounted signs can be obscured by roadway alignment (horizontal curves), geometry (vertical alignment), and roadside objects (overcrossing structures, noise barriers, retaining walls).
- Closely-spaced interchanges – Where interchanges are closely spaced (often in urbanized areas), the available space for post-mounted signs with unobstructed sight lines can be very limiting. It is often necessary to place multiple signs with different messages at one location, which cannot be accomplished with post-mounted signs.

- Multi-lane exits – Research has found that drivers benefit from the additional guidance of lane use arrows on guide signs to indicate proper lane alignment for multi-lane exit ramps, particularly for locations with lane drops (Exit Only) and option lanes (Arrow-per-Lane or diagrammatic signs).
- Large percentage of trucks – As the percentage of trucks increases in the traffic stream, the probability of an adjacent truck obscuring the sight line to a post-mounted sign increases. For roads with high truck percentages (e.g., I-81 and I-77), it can often be difficult to see ground-mount signs. If this criteria is one of the determining factors, butterfly sign structures should be considered as a way to raise the signs to the point where their visibility is no longer obscured by trucks.
- Street lighting background – Street lighting can be both a benefit and a distraction to the viewing of post-mounted signs. The street light poles increase the visual clutter and can obscure the sight lines to post-mounted signs. Lack of street lighting can make signs placed outside the clear zone difficult to read as motor vehicle headlights have a limited angle of incidence.
- High-speed traffic (for non-freeway signing) – As indicated in MUTCD Section 2A.17, overhead signs should be used on expressways and freeways which are typically high speed facilities. Overhead signs provide more target value for drivers to read and understand the message, even at higher speeds. **NOTE:** this should only be considered a criterion when evaluating signing on conventional roads. Since all freeways and interstates are, by default, high-speed, this criterion should not be considered for signs on freeways/interstates.
- Consistency of sign message location through a series of interchanges – Driver expectancy is a key consideration in the design of highway features. If drivers are used to guidance information overhead along a particular roadway segment, utilizing post-mounted guide signs within that segment can be disconcerting and distracting.
- Insufficient space for post-mounted signs – In areas with limited ROWs or roadside features that restrict the available space for post-mounted signs, overhead signs should be considered.
- Junction of two freeways – Freeway-to-freeway interchanges are often complex driving environments with multiple on and off ramps that typically experience the highest traffic volumes, high traffic speeds, and a large percentage of trucks. This combination of factors favors use of overhead signs.
- Left exit ramps – Left exits violate the driver expectancy of exiting to the right. Therefore, the higher target value of overhead signs is critical to provide the drivers with guidance information well in advance of the exit to allow for proper lane alignment and safe lane changing behaviors.

  If the decision is made to place the sign overhead, but the sign message does not necessarily require placement over a particular travel lane, consider using a butterfly instead of a cantilever or full-span truss. Butterfly sign structures are considerably less expensive than other OSS-1 types, both in terms of size of structure and size of foundation.

Locations Where Overhead Sign Structures SHALL Be Used To Mount Highway Signs:

Engineer SHALL use an overhead sign structure if any one of the following conditions applies:

- If a Pull-Through Sign is used (MUTCD Section 2E.12);
- If an Arrow-Per-Lane sign is used (MUTCD Section 2E.21);

- If a Diagrammatic guide sign is used (MUTCD Section 2E.22);
- If an Exit Direction sign contains lanes that are not shown on the Advance Guide signs (MUTCD);
- If the sign is a major guide sign for an interchange lane drop (MUTCD Section 2E.24:2);
- If the sign is an Exit Direction sign for an interchange lane drop (MUTCD Section 2E.36:5);
- If signing a freeway-to-freeway interchange, at the 1 Mile location and at the theoretical gore for each connecting ramp (MUTCD Section 2E.44:5)
- If signing a cloverleaf interchange, for the last Advance Guide sign for the second exit, and the Exit Direction sign for the first exit; and at the Exit Direction sign for the second exit (MUTCD Section 2E.45:3; see also Section 2E.36:13);
- If signing a cloverleaf interchange with collector-distributor roadways, for the guide signs at the exits from the collector-distributor roadway (MUTCD Section 2E.46:3);
- For non-Open-Road ETC lanes, all guide signs at the toll plaza SHALL be overhead (mounted to the toll plaza canopy) to indicate the type of collection or vehicle associated with a particular toll plaza lane (MUTCD Section 2F.16);
- If access to Preferential lanes is restricted to designated locations, Advanced Guide and Preferential Lane Entrance Direction Signs (MUTCD Section 2G.04:7, 2G.11:4, and 2G.12:1); or
- If installing R3-13, R3-14, R3-15, R3-44, or R3-45 series signs (defined as Overhead Preferential Lane regulatory signs) and changeable lane control signal signs (MUTCD Table 2G-1 and Sections 2G.03:10, 2G.05:3, and 2G.07, and Figures 2G-1, 2G-3, and 2G-21 through 2G-24).

<u>Locations Where Overhead Sign Structures SHOULD Be Used to Mount Highway Signs:</u>

If a SHALL condition does not apply, the designer should conduct an engineering study, if required by the District Traffic Engineer, based on the criteria listed below and if any of the following "should" statements presented below apply:

- If the sign is for a multi-exit interchange (Exit Direction for first, Advance Guide sign for second) (MUTCD Section 2E.36:13; see also Section 2E.45:3);
- For an Exit Direction sign, if there is less than 300 feet from the upstream end of the deceleration lane to the theoretical gore (MUTCD Section 2E.36:4);
- If regulatory signs or messages are used to restrict vehicle types or payment types to specific lanes at a toll plaza (MUTCD Section 2F.05:3 and 2F.14:1);
- If some or all toll plaza lanes require a stop, the W9-6 and W9-6a signs (Toll Plaza Warning signs) or plaques at 1 Mile and ½ Mile locations (MUTCD Section 2F.06:2);
- If the toll plaza diverges from a mainline-aligned Open-Road ETC lane, the advance sign at 1 Mile and ½ Mile in advance of the divergence (MUTCD Section 2F.15:2);
- If Preferential Lane regulatory signs are used on freeways and expressways with overhead general-purpose lane guide signs (MUTCD Sections 2G.03 and 2G.17); or
- If egress from preferential lanes is restricted to designated locations, Advance Guide, and Preferential Lane Egress Direction Signs (MUTCD Section 2G.13:5 and 2G.15:3).

Upon completion of an engineering study, an overhead sign structure should be considered if:

- Any two of the Section 2A.17:3 conditions apply, or
- If one of the Section 2A.17:3 conditions and one of the "should" cases from the list above apply.

Locations Where Overhead Sign Structures SHALL NOT Be Used To Mount Highway Signs:

Unless one of the above SHALL conditions apply, use of an overhead sign structure shall not be considered if any one of the following conditions applies:

- If overhead sign supports cannot be installed outside the clear zone or cannot be shielded within the clear zone (MUTCD Section 2A.19:1);
- If overhead sign supports will result in a sidewalk or pedestrian access route width less than 4 feet, or will intrude into a shared-use path (pursuant to MUTCD Section 2A.19:12 and the VDOT Road Design Manual);
- For all Exit Gore signs (MUTCD Section 2E.37.2); or
- For all Specific Service signs (refer to MUTCD Figure 2J-2 and *Virginia's Integrated Directional Signing Program/IDSP Policy*).

3.5.2.4 Prepare Preliminary Signing and Marking Plans

After completion of the existing sign inventory, the existing signs should be shown (dashed) on the proposed construction plans. Based on the determinations regarding sign structure types and locations, proposed signs and sign removals are also illustrated on proposed construction plans sheets, as shown in the example plan provided in the Appendix.

Preliminary pavement marking sketches support the development of the traffic control device designs for signs and traffic signals. It can also reveal geometric discrepancies that may otherwise appear to be properly designed. The sketches only need to illustrate the lane line layout and may not be needed for the entire project.

Preliminary pavement marking sketches and preliminary sign design should be developed concurrently when the road project involves complicated lane configuration design. The lane configurations can become difficult to evaluate without pavement marking sketches, or when a combination of lane changes is being designed within an interchange (e.g., lane drop or exit only lane, acceleration lane, deceleration lane, and lane reduction transition). Preparing the preliminary sign design requires a clear understanding of the lane configurations.

3.5.2.5 Anticipated Preliminary Design Deliverables

- Preliminary Signing plans and Pavement Markings plans with existing signs, proposed removals and proposed installations, including need for overhead signs, as well as location of proposed pavement markings;
- Proposed non-standard signs;
- Identification of any design waiver locations and reasons for need; and
- Identification of additional ROW needed, if applicable.

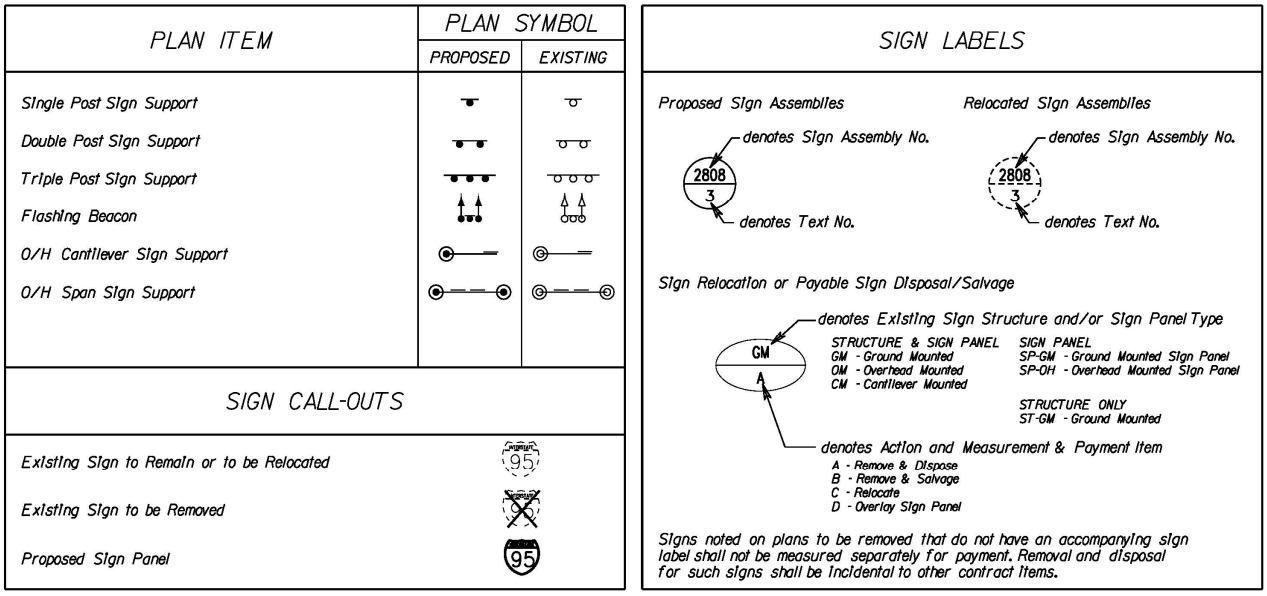
3.5.3 DETAILED DESIGN PHASE

In this stage, the designer will develop signing and pavement marking base plans in CADD. The signing and marking plans prepared during the detailed design phase will result in what is defined in the VDOT Project Development Process as FI/ROW plans.

3.5.3.1 Prepare Signing and Pavement Marking Plan Sheets

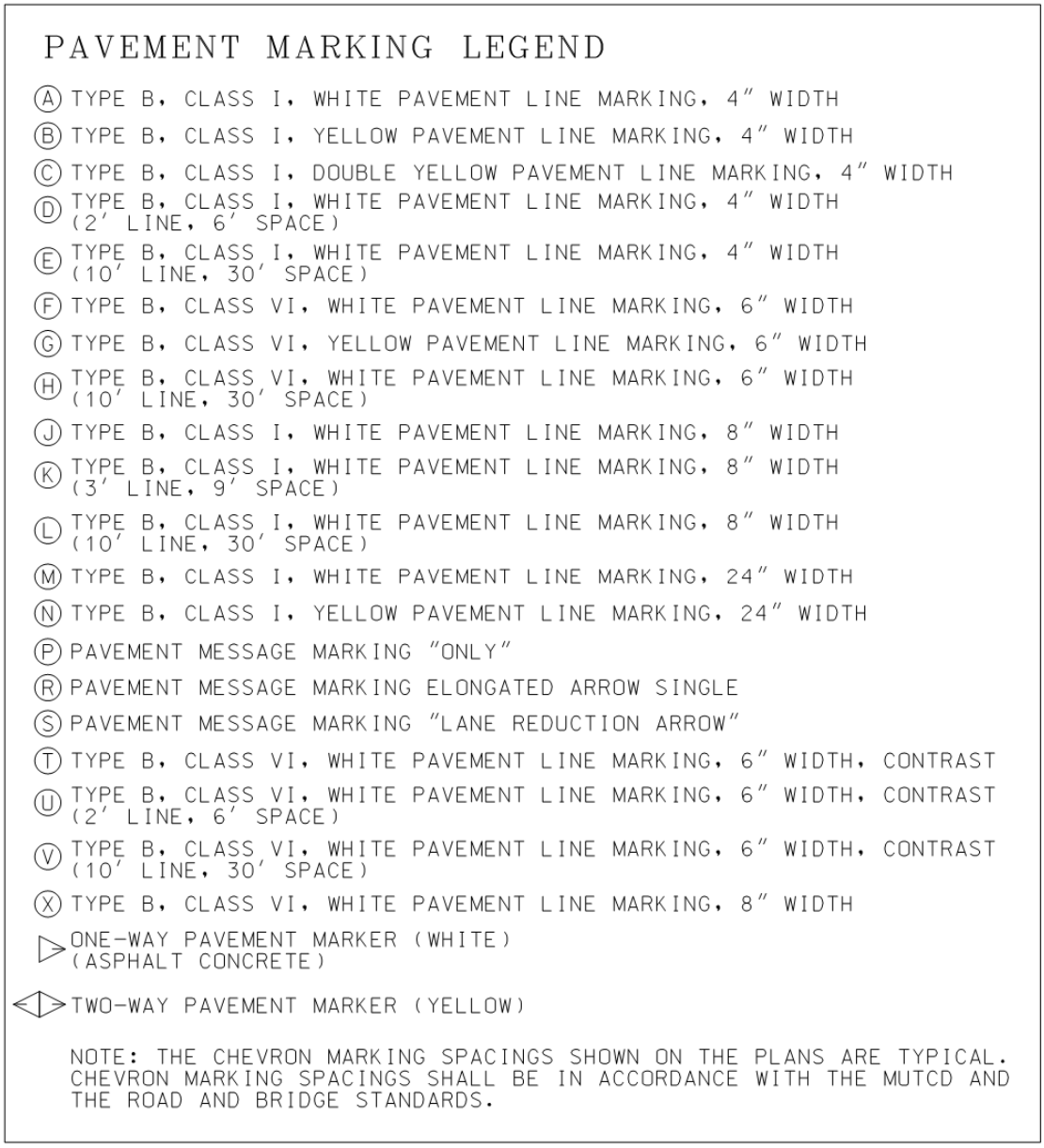
Use the most recent proposed roadway construction plans. The symbology used for sign plans shall match cells included in the VDOT Traffic Engineering Design MicroStation/OpenRoads Designer* Cell Library. An example of VDOT's symbology is shown in Figure 3-2.

Figure 3-2: Standard Sign Legend



Developing pavement markings for roadway alignment requires coordination with the sign design. Pavement markings that identify typical section transitions, such as lane drops or exit only lanes, acceleration lanes, deceleration lanes, and lane reduction transitions, may have to begin well before the change in the typical section. Coordination with the sign design will assist in establishing where and what types of lane lines are necessary. Illustrate the lane line type and identify the width and color on the plan sheet or in the legend. Symbology for labeling pavement markings and markers shall match what is included in the VDOT Traffic Engineering Design MicroStation/OpenRoads Designer* Cell Library. An example of the symbology used is shown in Figure 3-3, Pavement Marking Legend.

Figure 3-3: Pavement Marking Legend



When indicating "standard" proposed signs, use the standard MUTCD sign layouts and/or VDOT sign cell libraries for MicroStation/OpenRoads Designer*. For non-standard proposed signs, use the sign figure details developed by VDOT's approved sign design software.

An example of depicting and labeling existing and proposed signs, and proposed pavement markings on the base plan sheet is included in the Appendix.

All sign labeling should read from left to right and top to bottom. The sign plan sheet should indicate the sign and text numbers, the symbol for location of the structure, and the message to be displayed on the sign. The sign plan sheet also illustrates existing signs with their messages and structures, and identifies what actions are to be taken during construction (i.e., ellipse method).

a.) Existing signs are identified by dashed lines with an ellipse symbol, while sign panels shall be oriented in the appropriate direction that they will be read by traffic. The top half of the ellipse provides information identifying the type of existing sign structure and the bottom half identifies the measurement and payment for the sign. Existing signs to be removed are noted in the bottom half of the ellipse as a pay item.

b.) For those signs to be removed in the roadway grading/widening area, the cost should be incidental to the grading items and should not be paid separately as part of the traffic design estimate. For these signs to be removed as part of the construction, designer should place an X over the face of the sign without any ellipse to differentiate the payment of these signs from the traffic design estimate.

c.) Proposed signs are identified by solid lines with a circle symbol. The top half of the circle identifies the sign number and the bottom half of the circle identifies the text number. Discussion regarding the method of assigning sign and text numbers are presented in following sections of this Chapter.

d.) Signs to be located on the mast arms or poles of traffic signals should be shown on the traffic signal plans and omitted from the signing and pavement marking plans.

e.) Most signs shown on the plan sheet do not typically require detailed location information beyond the distances scaled from the plan, since the location of each sign can easily be scaled from the plan relative to constructed features or property lines. However, in some critical locations, dimensions should be provided between sign posts or panels and nearby features in order to provide the contractor with enough information to match the intent of the sign placement. This may include providing the separation distances between nearby sign posts, the distance of a post from a property line or face of curb, etc. It should be noted that the VDOT *Road Design Manual* provides other critical information to the contractor relative to sign placement such as the minimum allowable distance from edge of sign panel to the face of curb, in rural and urban conditions, etc.

3.5.3.2 Develop Pavement Marking Design

As part of the pavement marking design, it is important to consider the following:

- Gore Markings;
- Crosswalks;
- Intersections (Signalized and Unsignalized);
- School Zones and Railroad Crossings;

- Transverse Markings;
- Dotted lines, stop bars, parking markings, etc.;
- Pavement Marking Messages;
- Bicycle Markings, if any; and
- Pavement Markers, including type and color.

Any pavement marking details not included in the VDOT *Road and Bridge Standards* shall be included in the plan set. Any marked crosswalks shall follow the latest *IIM-TE-384* memo for guidance on use of Pedestrian Crossing Accommodations at Unsignalized Locations*, including the use of high-visibility crosswalks. An engineering study shall be approved by VDOT prior to any installation of marked crosswalks on uncontrolled approaches.

3.5.3.3 Develop the Delineation Layout

Identify if the roadway geometry requires roadside delineators. Illustrate where the delineators are to be located and label them on the pavement marking plans.

3.5.3.4 Detailed Design Cost Estimate

After the detailed design is complete, the designer should generate an itemized cost estimate for the required signing and marking project elements. Estimates for bid-based projects advertisement shall follow the procedures established by the *VDOT Cost Estimation Office Memorandum IIM-CEO-01* and *VDOT Cost Estimating Manual* and should be developed using an approved format as directed by the Project Manager*. The cost estimate should include all items to be furnished and/or installed by the contractor and/or state forces. The cost estimate should also include a contingency factor, CEI, and any third-party costs. Projects delivered using preestablished VDOT contracts should use contract items, identify work order items, and build the estimate in a format agreed upon by the Contract Administrator (typically in spreadsheet format).

3.5.3.5 Anticipated Detailed Design Phase Deliverables

- Signing and Pavement Marking Design Plan Set, including any pavement marking details not included in the VDOT Road and Bridge Standards; and
- Itemized cost estimate.

3.5.4 FINAL DESIGN PHASE

The phase includes preparing all required detail sheets and a sign schedule, as well as development of general notes, quantity summaries, and plan notes.

The signing and pavement marking plans prepared during the final design phase will result in what is defined in the VDOT Project Development Process as Pre-Advertisement Conference (PAC) plans.

3.5.4.1 Prepare Sign Panel Special Detail Sheets

Prepare Sign Panel Special Details, as shown in Figure 3-4 and in the Appendix.

a.) All non-standard MUTCD signs indicated in the Sign Schedule require a Sign Figure Detail. After determining the appropriate letter size, spacing, and margin from the MUTCD, *Standard Highway Signs Manual*, the Virginia Supplement to the MUTCD, or the latest *IIM-TE-379* memo, the values are inserted into VDOT's approved sign design software to generate the detail, as shown in Figure 3-4. The values can be modified by the designer to accommodate sign sizing; deviations from the recommended values should be documented with supporting engineering justification.

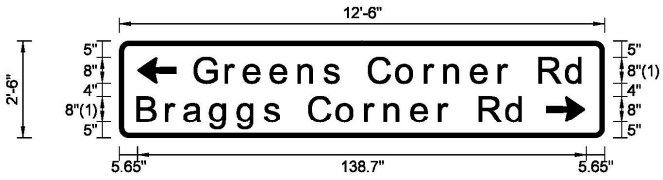
b.) The panel size dimensions from VDOT's approved sign design software need to provide a dimension divisible by six to comply with VDOT Standards.

Sign Figure Detail sheets, designed by VDOT's approved sign design software, provide sign dimensions and letter positions for sign fabrication on all non-standard signs. Up to six Sign Figure Details can be placed on a Sign Panel Special Detail sheet, as long as legibility is maintained.

Non-standard regulatory, warning, or guide signs which use messages, color usage, and/or symbols that are not in the MUTCD or Virginia Supplement to the MUTCD should be submitted to Central Office Traffic Engineering Division for their review.

Figure 3-4: Sign Figure Details

SIGN DETAIL
1:35



SIGN NUMBER	327
WIDTH x HGHT.	12'-6" x 2'-6"
BORDER WIDTH	1.5"
CORNER RADIUS	3"
MOUNTING	Overhead
BACKGROUND	TYPE: Reflective
	COLOR: Green
LEGEND/BORDER	TYPE: Reflective
	COLOR: White/White

SYMBOL	ROT	X	Y	WID	LGTH
ARSHRT	180	5.7	17	8	12
ARSHRT	0	131.9	5	8	12

Dimensions are in inches.tenths

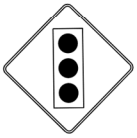
Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)																				LENGTH	SERIES/SIZE
G	r	e	e	n	s		C	o	r	n	e	r		R	d						Clearview-Hwy-5-W
23.7	33.3	39	47.3	55.8	63.8	68.9	77.6	86.1	95	101	109.2	117.8	121.5	130.2	138.6					120.7	86.5
B	r	a	g	g	s		C	o	r	n	e	r		R	d						Clearview-Hwy-5-W
6.2	15	20.4	28.6	37.1	45.3	50.4	59.1	67.7	76.5	82.5	90.8	99.3	103	111.8	120.1					119.7	86.5

3.5.4.2 *Prepare Sign Schedule*

Prepare the Sign Schedule, as shown in Figure 3-5, and in the Appendix, in concurrence with District preferences.

Figure 3-5: Sign Schedule*

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE: W	PANEL SIZE: H	QTY.	SIGN PANEL AREA (s.f.): per ASSEMBLY	SIGN PANEL AREA (s.f.): ALL ASSEM-BLIES	PROP. SIGN STRUCTURE ST'D.	PROP. FD'N. ST'D.	REMARKS
1	401, 406, 507		R1-1	30"	30"	3	6.25	18.75	STP-1 2½" 12 GA.	E	
	629, 630			18"	18"	2	2.25	4.5	STP-1 2" 14 GA.	D	
2	605, 606, 613, 614, 618, 619, 626, 627		R1-2	36"	36"	8	4	32	STP-1 2" 14 GA.	D	
3	404, 509		R2-1	30"	36"	2	7.5	15	STP-1 2½" 12 GA.	E	
4	503, 506, 508, 511, 601, 615, 702, 705, 802, 805, 808, 809		R4-7	24"	30"	12	5	60	STP-1 2" 14 GA.	D	
5	408, 602		W3-3	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	
6	611, 701		W3-2	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	

NOTES:

1) ALL SIGNS SHALL BE ORIENTATED AS SHOWN ON THE PLANS.
2) SIGN COLOR COMBINATIONS SHALL BE IN ACCORDANCE WITH THE FHWA SHS BOOK AND THE 2011 VIRGINIA SHS BOOK OR AS NOTED IN THE PLANS.
3) REFLECTIVE SHEETING SHALL BE TYPE XI, UNLESS OTHERWISE NOTED IN THE REMARKS. ALL REFLECTIVE SHEETING SHALL BE IN ACCORDANCE WITH TABLE VII-1A OF THE 2020 VDOT ROAD AND BRIDGE SPECIFICATIONS.
4) ALL BLACK SHEETING SHALL BE NON-REFLECTIVE.
5) SIGN STRUCTURES SHALL BE INSTALLED PER THE NOTED SIGN ST'D.
6) ALL ST'D. STP-1 STRUCTURES TO BE SINGLE POST UNLESS OTHERWISE NOTED.
7) IF APPLICABLE, SEE SHEET 2D FOR NON-STANDARD TYPE VA AND VIA SIGN STRUCTURE DETAILS.

A Sign Schedule sheet provides detailed information on all signs to be installed on the project. The following paragraphs will discuss the data needed on the Sign Schedule.

a.) Sign Text Number

The sign text number column is determined by numbering the sign text from one through the number of signs, or grouping of signs, as illustrated in the text column. Signs or grouping of signs that are alike should have the same text number.

b.) Sign Assembly Number

The sign assembly number column is determined by numbering the signs on each plan sheet. The VDOT recommended method is to assign sign assembly numbers in a series starting with the number of the plan sheet that the signs appear on. For example, if the signs being numbered are on Plan Sheet (4), then the signs should be numbered 401 through 499. On Plan Sheet (5) they should be numbered starting at 501, etc. Generally, the signs should be numbered in order from left to right, and then top to bottom to make it easier to locate sign placements from the sign schedule.

c.) Standard Number

The standard number column is derived from the MUTCD, *Standard Highway Signs Manual,* or the Virginia Supplement to the MUTCD. If a standard number is not applicable, the word "SPECIAL" is indicated.

d.) Panel Size

The panel size column is determined from VDOT's approved sign design software, *Standard Highway Signs Manual*, MUTCD, or the Virginia supplement to the MUTCD.

e.) Quantity

The quantity column for each sign or grouping of signs for the entire plan set is determined and identified in the Sign Schedule.

f.) Sign Area

The sign area column is the square feet of the sign panel for each sign text number.

g.) Sign Structure Standard

The sign structure standard column identifies the type of structure [i.e., Overhead, STP, Type VA, Type VIA, steel or wood (size and type)].

h.) Remarks

The remarks column, as shown in Figure 3-5, denotes figure references, special directions or intentions that further describe the construction requirement of the signs. Remarks must denote mounting heights for signs that deviate from standard heights noted in STP-1. Examples include Wrong Way, Do Not Enter, and One-Way signs at interchange ramps and chevron signs.

3.5.4.3 Prepare Type VA Sign Structure Detail

Instructions to determine the type and details for Type VA Sign Structures are provided in the latest version of the VDOT *Road and Bridge Standards*. Additionally, support and foundation detail standards are provided under SSP-VA.

a.) In some instances sign size discrepancies will occur. In those instances, the information for support details in the VDOT Road and Bridge Standards, Volume II, Section 1300, will have to be modified based on the sign dimensions: W, H, c, d, post length and TEE Bar number and length. This information will be placed on the Chart for Non-Standard VA Structures, as shown in Figure 3-6 and in the Appendix.

3.5.4.4 Prepare Type VIA Sign Structure Detail

Preparing the Type VIA Sign Structure Detail Sheet, as shown below and in the Appendix, provides sign panel, attachment, and support detail data. This sheet is developed using references charts provided in the VDOT *Road and Bridge Standards, Volume II*, Section 1300. Typical Sign Panel attachment details are determined based on the standard SPD-3, while Alternate Sign Panel Attachment Details are determined based on SPD-7.

Regardless of the attachment method used, the minimum distance between sign posts shall be 8 feet for all VIA Sign Structures.

After determining the type of structure to be used, the designer should refer to VDOT *Road and Bridge Standards, Volume II*, Section 1300, for the Type VIA foundation details. Additionally, foundation detail standards are provided under SSP-VIA. The contract shall not prohibit the Contractor from using SPD-2, SPD-3, or SPD-7 for SSP-VIA sign structures.

Figure 3-6: Type VIA Sign Structure Details

TYPE VIA SIGN STRUCTURE DETAILS

SIGN STRUCTURE TYPE VIA	SIGN PANEL	SIGN PANEL DIMENSIONS W	H	SPD-3 SIGN PANEL ATTACHMENT DETAILS u	u	u	u	ZEE MEMB. SIZE	ZEE MEMB. NO.	TEE BARS NO.	SPD-7 SIGN PANEL ATTACHMENT DETAILS u	u	u	u	STIFFENER MEMB.	STIFFENER SIZE	POST LENGTH NO. 1	POST LENGTH NO. 2	POST LENGTH NO. 3	POST SHAPE	ANCHOR BOLTS DIA.	ANCHOR BOLTS NUMBER REQ'D	EXISTING DIMENSIONS D	EXISTING DIMENSIONS U	BAR P LENGTH	BAR P BAR SIZE NO.	BAR H LENGTH	BAR H BAR SIZE NO.	SUPPORT BASE CONNECTION DATA TABLE A	B	C	D	E	I	Z	W	FUSE AND HINGE PLATE DATA TABLE BOLT SIZE	U	L	d	W2	BOLT KEEPER PLATE DATA TABLE BOLT SIZE	A	B	C	D	E
J MODIFIED (SEE NOTE)	EXIT PANEL	11'	2'-6"	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	A	17'	3'	3'-11"	9'-2"	9"	18"	2	B	D	D	3'-10"	8'-4"	2"	11'-4"	3	LARGE	15'-11"	20'-11"	---	SEE STD. SSP-VIA, TYPE VIA-J FOR THIS INFORMATION.																											
	B	17'	2'-6"	3'-11"	9'-2"	9"	12"	2	B	D	D	3'-10"	3'-4"	7"	11'-4"	2	LARGE																															
C MODIFIED (SEE STD., SSP-VIA FOR FIGURE)		9'	5'	0'-6"	8'-9"	16"	28"	2	B	D	D	0'-6"	8'-0"	0"	1'-3"	5	LARGE	14'-1"	16'-1"	---	SEE STD. SSP-VIA, TYPE VIA-C FOR THIS INFORMATION.																											

* SEE STD. SPD 3 FOR THESE DIMENSIONS.

** SEE STD. SPD-7 FOR THESE DIMENSIONS.

- The VIA sign structure type is determined by matching the height and width of the specific sign panel under consideration to those outlined in the Sign Structure Detail Chart.
- Most sign panel sizes on the project will not have dimensions exactly as shown on the Sign Structure Detail Chart. When the sign panel dimensions vary from the Sign Structure Detail Chart, the following subsections will provide design strategies to be used to modify the sign structure type and determine the data values for the attachment details and supports:

Width Discrepancy

Locate the width of sign panel under consideration within smallest possible range of widths in the Sign Structure Detail Chart.

a.) If the sign panel width is less than midway between the two widths on the chart, select the lower value within the range and use all data values except the "a" and "b" dimensions of the attachment detail.

b.) If the sign panel width is midway or more between the two widths on the chart, select the greater value within the range and use all data values except the "a" and "b" dimensions of the attachment detail.

c.) The attachment detail dimensions for "a" and "b" are determined using the Supplement Sign Panel Post Spacing Chart for Multi-Post VIA Structures, as shown in the following table and in the Appendix. Use the actual sign panel width to determine "a" and "b" dimensions and interpolate, if necessary.

Height Discrepancy

Locate the height of the sign panel under consideration within the smallest possible range of heights in the Sign Structure Detail Chart.

a) If the sign panel height is more than 6 inches greater than the smaller height dimension within the chart range, select the larger height value within the chart range and use all data except the "c" and "d" of the attachment detail and the number of Zee / Tee Bars. Use the Supplement Zee / Tee bar Spacing Chart, as shown in the Figure 3-7 and in the Appendix, as well as the Sign Structure Detail Chart in the VDOT *Road and Bridge Standards, Volume II*, Section 1300 to determine the "c" and "d" dimensions and number of the bars.

b) Calculate the post lengths by subtracting the height of the actual sign panel from the sign panel height obtained from the Sign Structure Detail Chart and then subtract the difference from the post length values from the Sign Structure Detail Chart to get the actual post length.

c) If the sign height is 6 inches or less than the smaller height dimension within the chart range, use the smaller height dimension within the chart range to determine all data except the "c" and "d" post lengths and number of bars. Use the Supplement Zee / Tee bar Spacing Chart (Figure 3-7) and the Sign Structure Detail Chart in the VDOT *Road and Bridge Standards, Volume II*, Section 1300 to determine the "c" and "d" dimensions and number of the bars.

d) Calculate the post lengths by subtracting the height of the actual sign panel from the sign panel height obtained from the Sign Structure Detail Chart and then add the difference back to the post length values from the Sign Structure Detail Chart to get the actual post length.

Figure 3-7: Supplement Zee/Tee Bar Spacing and Sign Panel Post Spacing Chart for 2 Post VIA Structures

SUPPLEMENTAL ZEE/TEE BAR SPACING

(For Sign Heights Not Shown on the VIA Standard)

Sign Height	"C"	"D"	Sign Height	"C"	"D"
3'-0"	9"	1'-6"	11'-0" [1]	18"	4'-0"
3'-6"	12"	1'-6"	11'-0" [2]	12"	3'-0"
4'-6"	14"	2'-2"	11'-6" [1]	18"	4'-3"
5'-0"	16"	2'-4"	11'-6" [2]	15"	3'-0"
5'-6"	15"	3'-0"	12'-6" [3]	12"	3'-6"
6'-6"	15"	4'-0"	13'-0"	18"	3'-4"
7'-0"	12"	2'-6"	13'-6"	18"	3'-6"
7'-6"	12"	2'-9"	14'-6"	18"	3'-10"
8'-6"	15"	3'-0"	15'-0"	18"	3'-0"
9'-6"	18"	3'-3"	15'-6"	15"	3'-3"
10'-6"	18"	3'-9"	16'-6"	18"	3'-4.5"

[1] 3 Bars: Sign Widths 19' Thru 30'-6"

[2] 4 Bars: Sign Widths 12' Thru 18'-6"

[3] 4 Bars: Always

SUPPLEMENTAL

SIGN PANEL POST SPACING CHART FOR

MULTI-POST VIA STRUCTURES (TYPICAL ONLY)

PANEL WIDTH	POST SPACING		PANEL WIDTH	POST SPACING	
	"A"	"B"		"A"	"B"
9'-6"	9"	8'-0"	18'-0"	4'-0"	10'-0"
10'-0"	1'-0"	8'-0"	18'-6"	4'-3"	10'-0"
10'-6"	1'-3"	8'-0"	19'-0"	4'-4"	10'-4"
11'-0"	1'-6"	8'-0"	19'-6"	4'-6"	10'-6"
11'-6"	1'-9"	8'-0"	20'-0"	4'-6"	11'-0"
12'-0"	2'-0"	8'-0"	20'-6"	4'-9"	11'-0"
12'-6"	2'-3"	8'-0"	21'-0"	4'-10"	11'-4"
13'-0"	2'-6"	8'-0"	21'-6"	4'-11"	11'-8"
13'-6"	2'-9"	8'-0"	22'-0"	4'-10"	12'-4"
14'-0"	3'-0"	8'-0"	22'-6"	5'-2"	12'-2"
14'-6"	3'-3"	8'-0"	23'-0"	5'-3"	12'-6"
15'-0"	3'-5"	8'-2"	23'-6"	5'-5"	12'-8"
15-6"	3'-7"	8'-4"	24'-0"	5-4"	13'-4"
16'-0"	3'-6"	9'-0"	24'-6"	5'-8"	13'-2"
16'-6"	3'-9"	9'-0"	25'-0"	5'-9"	13'-6"
17'-0"	3'-11"	9'-2"	25'-6"	5'-10"	13'-10"
17'-6"	4'-0"	9'-6"			

3.5.4.5 Prepare Overhead Sign Structure Elevation Detail Sheet

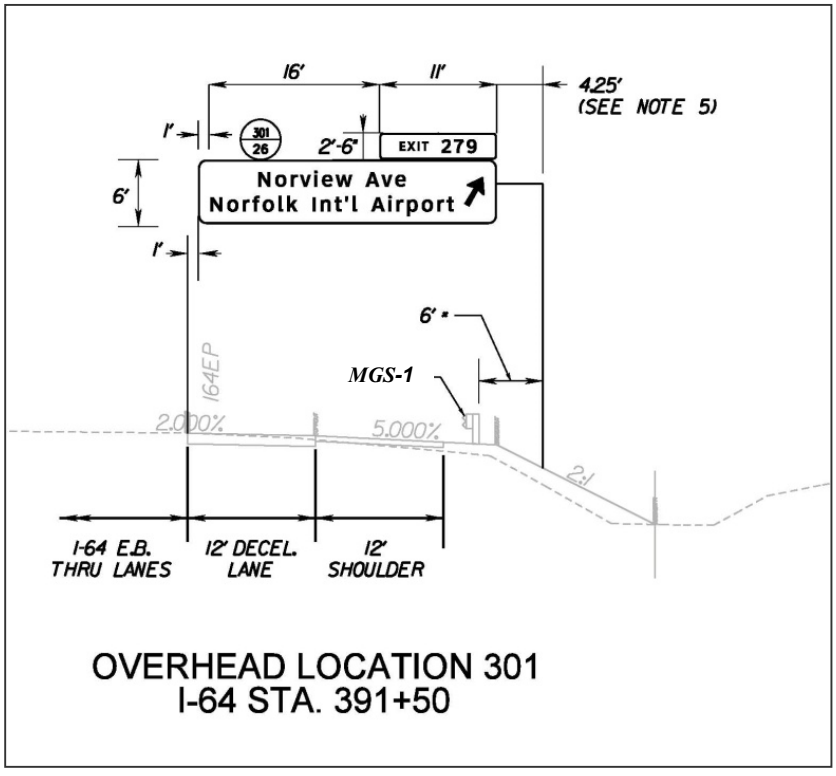
The Overhead Sign Structure Elevation Detail Sheet (see Appendix) provides information and data reflecting the relationship of the overhead signs and structures in relation to the roadway cross section, such as lane widths, shoulders, guardrails, sound walls, etc. It also provides sign support data for the sign panels.

Developing the Overhead Sign Structure Elevation Detail Sheet (Figure 3-8) requires evaluating the sign location and populating the Overhead Sign Support Data Summary Chart. The following instructions will assist in completing the chart:

a.) Illustrate the Sign Structure Dimensions.

b.) Obtain an accurate and current roadway design typical and cross-section of the location to establish placement and location of the sign structure relative to the roadway features. The detail sheet should show the required minimum vertical clearance over the road as per MUTCD, Virginia Supplement to the MUTCD, and OSS Standards.

Figure 3-8: Overhead Sign Structure Elevation Detail Sheet (Enlarged View)



c.) Determine the Sign Panel Data.

Populate the sign panel data in the Overhead Sign Support Data Summary using the Sign Schedule Sheet, (e.g., Text No., Sign No. and the panel size dimensions).

d.) Determine the Sign Panel Attachment Details.

Populate the sign panel attachment detail data in the Overhead Sign Support Data Summary using the instructions previously discussed or if height discrepancies are encountered use the height discrepancy strategy discussed previously with the exception that all bars shall be Zee Type, Size “B”.

e.) Determine the Illuminating Fixtures.

First review the need for overhead sign lighting as per the latest *IIM-TE-380*. The illuminating fixtures information is obtained from the *Illuminating Engineering Society of North America, Recommended Practice for Roadway Sign Lighting*, (*IESNA RP-8*). If *IESNA RP-8* is not available, the chart for sign lighting spacing can be used to provide the lighting information. Additional information discussing sign lighting can be found in Chapter 4 of this manual.

Figure 3-9: Sign Lighting Spacing

Sign Width	Spacing			No. of Lights
8'-0"	4'-0"	*	4'-0"	1
8'-6"	4'-3"	*	4'-3"	1
9'-0"	4'-6"	*	4'-6"	1
9'-6"	4'-9"	*	4'-9"	1
10'-0"	5'-0"	*	5'-0"	1
Maximum sign height 12'-0"				
Luminaire Mounting: 2-ft below sign, 4-ft forward of sign				

Sign Width	Spacing					No. of Lights
10'-6"	3'-0"	*	4'-6"	*	3'-0"	2
11'-0"	3'-0"	*	5'-0"	*	3'-0"	2
11'-6"	3'-0"	*	5'-6"	*	3'-0"	2
12'-0"	3'-0"	*	6'-0"	*	3'-0"	2
12'-6"	3'-3"	*	6'-0"	*	3'-3"	2
13'-0"	3'-6"	*	6'-0"	*	3'-6"	2
13'-6"	3'-6"	*	6'-6"	*	3'-6"	2
14'-0"	3'-6"	*	7'-0"	*	3'-6"	2
14'-6"	3'-6"	*	7'-6"	*	3'-6"	2
15'-0"	3'-6"	*	8'-0"	*	3'-6"	2
15'-6"	3'-9"	*	8'-0"	*	3'-9"	2
16'-0"	4'-0"	*	8'-0"	*	4'-0"	2
16'-6"	4'-3"	*	8'-0"	*	4'-3"	2
17'-0"	4'-3"	*	8'-6"	*	4'-3"	2
17'-6"	4'-3"	*	9'-0"	*	4'-3"	2
18'-0"	4'-6"	*	9'-0"	*	4'-6"	2
18'-6"	4'-9"	*	9'-0"	*	4'-9"	2
19'-0"	4'-9"	*	9'-6"	*	4'-9"	2
19'-6"	4'-9"	*	10'-0"	*	4'-9"	2
20'-0"	5'-0"	*	10'-0"	*	5'-0"	2
For sign height 12'-0" maximum: Luminaire Mounting: 2-ft below sign, 4-ft forward of sign						
For sign height greater than 12': Luminaire Mounting: 2-ft below sign, 6-ft forward of sign						

* Denotes symbol for sign light

Above charts are to be used for 82-Watt, 9532-Lumen, 3000k LED Lur

Sign Lighting Spacing Chart

Sign Width	Spacing							No. of Lights
20'-0"	3'-9"	*	6'-6"	*	6'-6"	*	3'-9"	3
21'-0"	3'-6"	*	7'-0"	*	7'-0"	*	3'-6"	3
21'-6"	3'-9"	*	7'-0"	*	7'-0"	*	3'-9"	3
22'-0"	4'-0"	*	7'-0"	*	7'-0"	*	4'-0"	3
22'-6"	3'-9"	*	7'-6"	*	7'-6"	*	3'-9"	3
23'-0"	4'-0"	*	7'-6"	*	7'-6"	*	4'-0"	3
23'-6"	3'-9"	*	8'-0"	*	8'-0"	*	3'-9"	3
24'-0"	4'-0"	*	8'-0"	*	8'-0"	*	4'-0"	3
24'-6"	4'-3"	*	8'-0"	*	8'-0"	*	4'-3"	3
25'-0"	4'-6"	*	8'-0"	*	8'-0"	*	4'-6"	3
25'-6"	4'-3"	*	8'-6"	*	8'-6"	*	4'-3"	3
26'-0"	4'-6"	*	8'-6"	*	8'-6"	*	4'-6"	3
26'-6"	4'-3"	*	9'-0"	*	9'-0"	*	4'-3"	3
27'-0"	4'-6"	*	9'-0"	*	9'-0"	*	4'-6"	3
27'-6"	4'-9"	*	9'-0"	*	9'-0"	*	4'-9"	3
28'-0"	5'-0"	*	9'-0"	*	9'-0"	*	5'-0"	3
28'-6"	4'-9"	*	9'-6"	*	9'-6"	*	4'-9"	3
29'-0"	4'-6"	*	10'-0"	*	10'-0"	*	4'-6"	3
29'-6"	4'-9"	*	10'-0"	*	10'-0"	*	4'-9"	3
30'-0"	5'-0"	*	10'-0"	*	10'-0"	*	5'-0"	3
For sign height 12'-0" maximum: Luminaire Mounting: 2-ft below sign, 4-ft forward of sign								
For sign height greater than 12': Luminaire Mounting: 2-ft below sign, 6-ft forward of sign								

* Denotes symbol for sign light

Above charts are to be used for 82-Watt, 9532-Lumen, 3000k LED Luminaires

In addition, the following design issues must be evaluated:

- Clear zone requirements, which is available in the VDOT Road Design Manual– Clear Zone Guidelines.
- Guardrail deflection requirements, which is available in the VDOT *Road and Bridge Standards*.
- Conflicting sound walls and utilities (overhead and underground).
- Combined concrete barrier / sign structure foundation design.
- Airport and heliport flight path clear zones.
- Geotechnical issues with soil at candidate location.

Typically the Contractor is responsible for test bores and OSS-1 foundation designs during construction; however, the designer should be cognizant of known issues with poor soil locations or rocky conditions that may impact foundation constructability.

f.) Additional Overhead Sign Structure Considerations

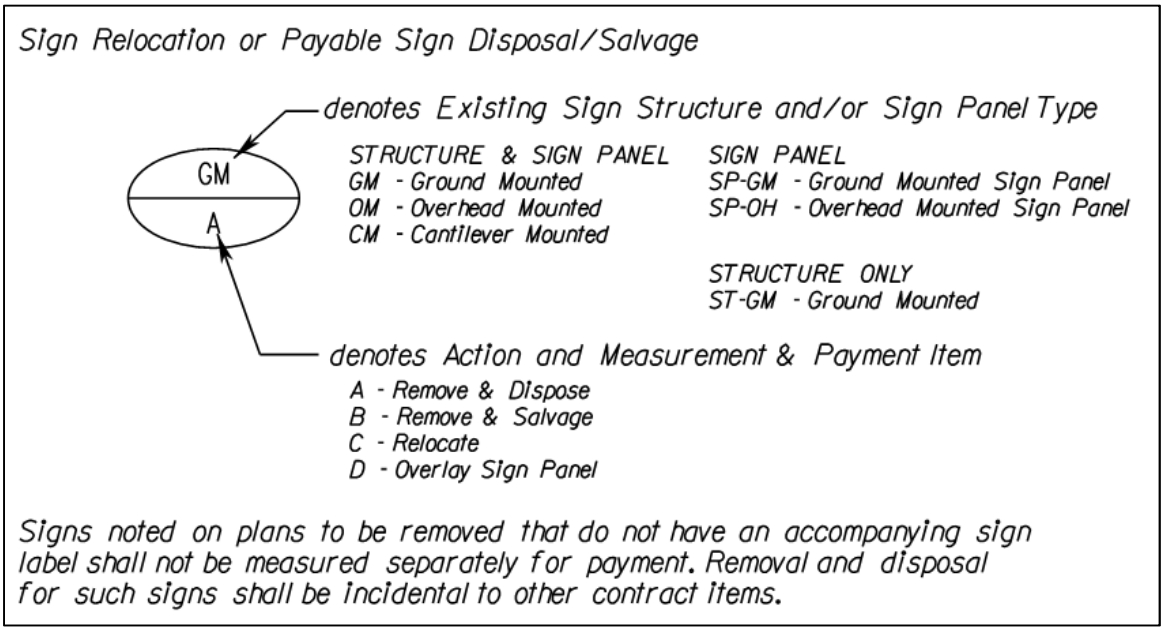
- Cantilever arm lengths should not exceed the maximum allowable length as per *IIM-TE-375*. The edge of the sign panel should extend 1 foot beyond the end of the arm.
- Span sign structures should not exceed the maximum allowable span length as per *IIM-TE-375*.
- Butterfly sign structures – the edge of the sign panel should extend 1 foot beyond the edge of the arm on both sides. The designer should verify that adequate ROW exists for both the sign support and the far edge of the sign.

- When lighting is required on overhead signing it will be necessary to meet with a local power representative to determine the power source routing and identify power pole numbers from which the power would be supplied to the service. On some projects this will be coordinated with the roadway lighting. Others will require obtaining separate power sources and providing the wire routing along with wire sizing and junction box locations. Additional information discussing locating and furnishing the power source locations can be found in Chapter 4 of this manual.
- For span sign structures, the designer should consider the possibility of additional signs being added to the span structure in future years. If so, notes or details should be added to the plans which depict the potential future signs and require the Contractor to design the sign structure to accommodate that future loading.
- If overhead utilities are present within the vicinity of the sign structure, the designer should verify that the structure will not violate the required OSHA/NEC minimum clearance.
- The overhead sign structure must be outside the guardrail's deflection distance as per the latest VDOT *GRIT* manual.
- Coordinate with ITS plans designer to determine whether it is beneficial or necessary to add ITS equipment to the sign structure.

3.5.4.6 Prepare General Notes, Index of Sheets, Sign Legend, and Pavement Marking Legend

General Notes provide general information related to the sign plans and applies throughout the project plan set. An important component of the General Notes is the definition of symbols. The ellipse symbol (Figure 3-10) is used on the plan sheet to provide instruction on the action to be taken for an existing sign and/or sign structure.

Figure 3-10: Ellipse Method for Safety Improvement Items



3.5.4.7 Develop Pavement Marking/Signing Details Sheet

A pavement marking/signing detail sheet is developed to better illustrate the dimensioning and spacing of pavement markings (or signs) in specific areas or locations of the roadway or roadside, if additional detail is needed.

3.5.4.8 Prepare Summary of Quantities Sheet

The Summary of Quantities sheet(s) provides the pay item quantities for the signing and pavement marking plan set and is used for establishing construction cost estimates and bid unit prices.

a.) Quantity takeoffs for all pay items are totaled on each plan sheet and transferred to the Summary of Quantities sheet. The unit for the pay item is the measurement by which the pay item is paid for and is established in the VDOT Road and Bridge Specifications as a Standard pay item. **If the pay item is a Non-Standard pay item, a Special Provision or Special Provision Copied Note is required.** The project quantity total for each pay item is provided at the bottom of each pay item column.

b.) Contracts with more than one project number or funding source should have a separate quantity summary for each project.

3.5.4.9 Final Design Cost Estimate

Refine the detailed design cost estimate based on final design adjustments and additions. Ensure non-standard and/or work order items are included and corresponding special provisions developed.

3.5.4.10 Anticipated Final Design Phase Deliverables

- Final Sign and Pavement Marking Design Plan Set;
- Sign schedule Sheet(s);
- Non-standard item and project specific Special Provisions and Copied Notes;
- Final Non-standard Detail sheets ;
- Design Waivers as identified during Preliminary Design;
- Summary of Quantities Sheet; and
- Final itemized cost estimates either for bid based projects using the appropriate VDOT bid items entered into AASHTO Preconstruction estimating software or other approved format as directed by the Project Manager or for preestablished VDOT contracts using preestablished contract items in a format agreed upon by the Contract Administrator (typically in spreadsheet format).

3.6 PHASES AND DELIVERABLES SUMMARY

The following Table summarizes the deliverables for each task for use as a checklist to ensure all applicable deliverables are completed in the respective phase.

Table 3-1: Deliverables by Phase

Scoping Phase	
Item	**Requirement**
None	--
Preliminary Design Phase	
Item	**Requirement**
Complete Limits of Additional Survey	As needed
Preliminary Signing Plans	Required
Preliminary Pavement Marking Plans	Required
Non-standard Sign Details	As needed
Design Waiver location/needs	As needed
Detailed Design Phase	
Item	**Requirement**
Revised Signing Plans	Required
Revised Pavement Marking Plans	Required
Revised Non-standard Sign Details	As needed
Itemized Cost Estimate	Required
Final Design Phase	
Item	**Requirement**
Final Signing Plans	Required
Final Pavement Marking Plans	Required
Final Non-standard Sign Details	Required
Design Waivers	As needed
Final Itemized Cost Estimate	Required
Summary of Quantities Sheet	Required
Sign Schedule Sheet(s)	Required

CHAPTER 4 – LIGHTING DESIGN STANDARDS AND GUIDELINES

4.1 INTRODUCTION

This chapter outlines the standards, plan requirements, and design process related to engineering and design of lighting systems for intersections, interchanges, and roadway systems. VDOT's current polices related to roadway lighting and overhead sign lighting are addressed in *Traffic Operations Division Memorandum IIM-TE-390* and *IIM-TE-380*, respectively.

Virginia's law regarding the installation of outdoor light fixtures, Virginia Code §2.2-1111 was signed into law, effective July 1, 2003. The law provides strict requirements on the procurement of light fixtures.

Any roadway lighting designed, installed or funded under the auspices of the Department must be in accordance with this legislation. This includes, but is not limited to, construction projects, lighting installed by permit, and intersection lighting (including that installed by District Signal Contracts), etc. Typically, the Central Office L&D Division, Traffic Operations Division* Section designs or reviews designs of others to ensure the lighting designs are appropriate.

For VDOT traffic signal projects with proposed intersection lighting, if a standard design does not apply to a specific intersection configuration, VDOT Central Office L&D Division, Traffic Operations Division* Section will review or provide lighting designs for those locations to ensure compliance. VDOT policy requires that lighting be considered at traffic signals with marked crosswalks*.

Additionally, maintenance personnel should strive to select replacement fixtures that are as similar as possible to the existing luminaires. When replacing HPS with LED fixtures, the District should select the fixture closest in equivalence to the wattage of the existing HPS.

4.2 VDOT STANDARDS

All of the applicable standards for VDOT lighting devices, unless otherwise noted, can be found in Section 1300 of the latest edition of the VDOT *Road and Bridge Standards* and Sections 238, 512, and Division 7 of the VDOT *Road and Bridge Specifications*. Below is a brief classification and description of the equipment utilized for standard VDOT designs.

4.2.1 LIGHT POLES (LP- STANDARD DRAWINGS)

4.2.1.1 Pole Standard LP-1

Used for Conventional (Cobra Head) or Shoebox Luminaires. The most common structure used is the 30-foot to 50-foot pole with a luminaire arm. The luminaire arm typically places the luminaire directly over the edge of the travel lane. This pole type is recommended to be used for parking lots or rest areas. Consult with the District regarding the LP-1 preference before beginning detailed lighting design*.

4.2.1.2 Pole Standard LP-2

Used for Offset or Shoebox Luminaires. The offset pole is typically a 30-foot to 50-foot pole with a luminaire. New offset luminaires are mounted with a 0-degree tilt, or pointing straight down, with single or double tenon. This pole type is recommended to be used for freeways.

4.2.1.3 Pole Standard LP-3

Used for High Mast Luminaires. High mast lighting implies an area type of lighting with 3 to 12 LED luminaires mounted on poles (also referred to as towers), at heights varying from approximately 60 feet to 150 feet. The total lighting output shall be sufficient to satisfy current* IES RP-8 criteria. At these mounting heights, high-output luminaires develop a uniform light distribution. The luminaire assembly is hoisted to the top of the tower by a winch located in the base of the pole. Although the VDOT *Road and Bridge Standards* only note standard pole lengths from 60 to 140 feet, other lengths are available from several manufacturers. This pole type is recommended to be used for interchanges.

4.2.1.4 Transformer Bases

Conventional and offset lighting poles are typically mounted to the concrete foundation anchor bolts using a transformer base. The transformer base provides a convenient splice point for the electrical system and can provide an economical alternative to placing a junction box at the base of each pole.

4.2.1.5 Post-Top & Decorative Lighting

Post-top lighting for paths and sidewalks it typically maintained by non-VDOT entities. Under certain circumstances covered by DPM 9-4, VDOT will install conduits and junction boxes in conjunction with VDOT projects, with the permittee responsible for installation of poles and luminaires.

VDOT will not install decorative light poles or decorative fixtures without an agreement for those poles and/or fixtures to be maintained by others.

4.2.2 VDOT Lighting Pole Foundations (LF- Standard Drawings)

4.2.2.1 Conventional and Offset Lighting Standard Pole Foundation (LF-1)

The **VDOT Standard LF-1 Type A Foundation** provides support for the LP-1 and LP-2 lighting standards. This foundation is cast-in-place, typically* 8-feet deep with a 30-inch diameter. It is also known as a "drilled shaft" foundation.

The design engineer cannot assume that this foundation will work in every case. The engineer sealing the lighting plan must recognize soil characteristics and finished grade, along with the light pole loading, to provide a foundation suitable to support the light pole. In areas with marshy soil or shifting sands, or in areas that have very shallow hard rock formations, the lighting designer should consider specifying a special design pole foundation. The Department must approve non-standard foundations.

4.2.2.2 High Mast Lighting Pole Foundation

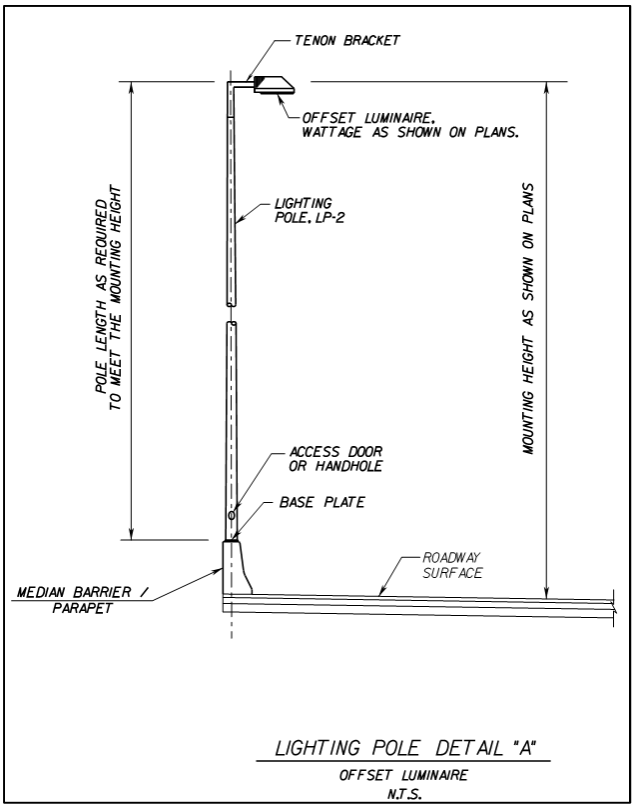
High mast lighting pole foundations are designed by the contractor using *Standard Drawing PF-8* and *IIM-TE-382*, using test bore information obtained by the contractor.

4.2.2.3 Bridge Mount Lighting Pole Foundation

The VDOT Standard Bridge Conduit System includes a light pole foundation suitable to support a 40-foot cobrahead lighting pole with a 6-foot luminaire arm. Bridge lighting should be closely coordinated with

the structural designer and project manager. Figure 4-1 clarifies the pole length requirements for installation on a bridge parapet.

Figure 4-1: Bridge Mount Pole Detail



4.2.3 VDOT Electrical Service (SE- Standard Drawings)

VDOT roadway lighting systems are typically powered by a 277/480-Volt, 3-phase configuration Y-connection at electrical service. The luminaires are powered at 277-Volt line-to-neutral.

Roadway lighting installed on traffic signal combination poles operate on 120/240-Volt, single-phase power. Luminaires can be powered by either 120-Volt line-to-neutral or 240-Volt line-to-line.

Remote sign lights also operate on 120/240-Volt, single-phase power.

The following is a description of the standard electrical services and lighting control centers used by VDOT for roadway lighting. Drawings are in VDOT *Road and Bridge Standards*, Section 1300.

Type A or Type B configurations are chosen depending on the service entrance, e.g., overhead or underground.

4.2.3.1 Electrical Service SE-9 Type A and B

- The SE-9 is the primary VDOT standard for electrical service for roadway lighting, used for distribution of 277/480-Volt, 3-phase power system.
- **The Type A** system is intended for those installations where many circuits are required; e.g., 6 or more branch circuits. The lighting control center is housed in a separate enclosure with an

associated concrete foundation. This configuration is used for the majority of the VDOT lighting control centers.

- **The Type B** system provides a lighting control center cabinet mounted to the same metal frame as the fused safety switch and meter base. This configuration should be considered when only a few circuits (less than 6 branch circuits) are required and the loads are small.
- Some situations may require the roadway lighting system to share an electrical service with the ITS system. In this case, a separate Lighting Control Center (CCW-1) and a separate concrete foundation (CF-2) is required along with a modified SE-9 with two fused safety switches and step-down transformer(s). Separate grounding is also required for each fused safety switch.

4.2.3.2 Other Electrical Service SE- 1, 2, 3, 4, 5, 6, 7, 8, 10, 11

These Electrical Service standards are used on 120/240-Volt, single-phase power systems. Some lighting systems may be located where 3-phase power is not available, or the systems may have very low power requirements and can operate on 120/240-Volt, single-phase power. See detail drawings in VDOT *Road and Bridge Standards*, Section 1300.

Example:
The **SE-6** Electrical Service includes a meter base and a fused safety switch with an associated ground mounted cabinet that is more suitable to a large system which requires plenty of room for circuits and contactors.

The **SE-7 and SE-8** Electrical Service includes a meter base, a fused safety switch, conduit, grounding equipment, and a wood pole for mounting the hardware.

The SE-8 also provides for the installation of a small lighting control cabinet and photocell. This system might be used in powering several overhead signs, an underbridge lighting system, or a small parking lot.

The **SE-10** and **SE-11** Electrical Services are designed with two (2) meter bases and safety switches to accommodate flexibility in order to separate street lighting and traffic signal services.

4.2.3.3 Electrical Service Grounding Electrodes

A pictorial description of the Electrical Service Grounding Electrode is provided in each of the electrical service standard drawings. The requirements for Electrical Service Grounding Electrodes are detailed in the VDOT Road and Bridge Specifications, Section 700.05, VDOT Road and Bridge Standards for SE-series standard drawings*, and VDOT Standard Lighting Control Centers (CCW- Standard Drawings).

The lighting plans must identify the rating of the contactors and circuit breakers to be installed. The contactors, controlled by the photocell, provide the on-off switching of the lighting system at dusk and dawn. It is not uncommon to oversize them. For example, most VDOT roadway lighting contactors are rated 60 amps per pole, but are operating circuits carrying only 15 amps to 35 amps. Circuit breakers are single pole and normally sized at 125% of normal operating current.

VDOT standard **CCW-1 Type D, or Type H** Control Center is required on roadway lighting projects involving the distribution of a 3-phase, 277/480-Volt power system for Y configuration.

VDOT standard **CCW-1 Type C, or Type G** Control Center is required on roadway lighting projects involving the distribution of single-phase, 120/240-Volt power system.

VDOT standard **CCW-1 Type E** (single-phase) and **Type F** (three-phase) control centers include a time clock along with the photocell. These systems may be useful in parking lots where the number of energized light fixtures can be reduced late at night or in the early morning hours.

4.2.4 JUNCTION BOXES AND CONDUIT SYSTEMS (JB-, ECI- STANDARD DRAWINGS)

VDOT specifications recognize all NEC conduit trade sizes. However, the following items have become the preferred standards:

- Minimum 2-inch PVC Schedule-40 conduit is used for all buried conduit runs.
- Metal conduit is preferred for all exposed conduit runs.
- 2-inch conduit is typically the smallest size used throughout a roadway electrical system, except as branch conduits for underbridge lighting and sign lighting.
- 1 and ¾ inches metal conduit works best for an underbridge lighting system.
- 3- or 4-inch conduit sizes are frequently specified when the NEC conduit fill requirements demand a size larger than 2 inches.
- Placing multiple conduits in the same trench is preferred.
- When running conductors under a bridge, the bridge abutment can provide a suitable mounting location for the exposed conduit.
- The EGC is paid for separately from the cost of the conductor cables.
- Metal conduit does not require an EGC; however, the metal conduit shall be bonded in accordance with NEC. Also, since it is not unusual for exposed metal conduit to separate when mounted on a bridge structure, the lighting designer may specify installation of an EGC in metal conduit installed with an underbridge lighting system.
- Liquid Tight Flexible Metal Conduit (type LFMC) should be used where conduit transitions from underground to a bridge structure. The flexible conduit will compensate for vibration and shifting of the bridge structure. However, the NEC requires an EGC be included where the length of the flexible metal conduit exceeds 6 feet.

4.2.4.1 Transformer Bases Versus Junction Boxes

The transformer base provides a convenient splice point for the electrical system and can provide an economical alternative to placing a junction box at the base of each pole.

The requirement to install a transformer base with a light pole does not necessarily imply the use of a breakaway base. The breakaway base can be installed with or without a transformer base.

4.2.4.2 Conductor Cable

The conductor cable and equipment grounding conductor shall be copper. The VDOT Road and Bridge Specifications, Section 238 for conductor cable run in conduit requires the use of THWN. The following should be applied to each roadway lighting plan:

- The minimum cable size used in any main conduit run for a roadway lighting plan should be a #8 AWG. This procedure is required due to the high tensile strength needed to complete a long conduit pull. For short distances (i.e., from base of the pole or structure to the fixture), or where cable flexibility is an issue, #10 AWG may be used if found suitable to accommodate the current draw.
- The maximum cable size should be #000 AWG (also known as #3/0). Larger sizes can be difficult to pull.
- The VDOT Road and Bridge Specifications, Section 705.04 requires all luminaires to be supplied with conductors (typically #10 or #12 AWG) from the base of the pole to the luminaire.
- The EGC installed in any non-metal conduit should be the same size as the largest phase/power conductor unless otherwise specified on the plans. In most cases, this procedure is required to meet NEC requirements for sizing the EGC for voltage drop.

4.3 STANDARD LIGHTING SYSTEMS UTILIZED BY VDOT

VDOT *IIM-TE-390* contains VDOT's current policies related to roadway lighting systems. VDOT's default position is not to provide roadway lighting unless warranted*. When lighting has been determined to be warranted for inclusion in a project, the following standard lighting systems are typically utilized.

VDOT lighting systems are generally designed for state-maintained roadways. The systems typically include poles, luminaires, conduit, wire, and lighting control centers. The systems are frequently designed as complete, stand-alone systems that are maintained by state forces.

Typical VDOT roadway lighting projects include the following types:

- **Partial Interchange Lighting** is the lighting of ramp terminals and on/off ramps found along a freeway or interstate roadway.
- **Complete Interchange Lighting** places lights in the merging traffic and gore areas in the same locations as partial interchange lighting. In addition, lighting is placed along the ramps and on the crossroad between the ramp terminals. This configuration may not include lighting the mainline running through the interchange. Complete interchange lighting can only be installed with concurrence from the State Traffic Operations* Engineer.
- **Continuous Freeway Lighting** includes complete interchange lighting and includes lighting between interchanges along the mainline. Continuous lighting can include a number of interchanges and is usually provided in urban areas. Continuous freeway lighting can only be installed with concurrence from the State Traffic Operations* Engineer.

Each of the above typical roadway designs is discussed in detail in both the AASHTO and FHWA lighting warrant sections.

4.3.1 LIGHTING ON BRIDGES

The roadway on a bridge is normally treated the same as other parts of the roadway. If there is no lighting on the adjacent roadway, there is normally no need for lighting on the bridge. An exception is a very long bridge, which may be lighted even though the roadway is not lighted at other locations. In this situation, the lighting designer should consider placing roadway lighting in advance of the bridge to allow the driver's eyes to transition into the brighter roadway on the bridge.

Where lights are to be installed on a bridge, the lighting designer should submit the proposed lighting standard locations to VDOT Structure and Bridge Division for review and approval. VDOT may then suggest alternate pole locations for the lighting designer to review and determine compatibility with the lighting criteria. This iterative procedure applies to any bridge structure requiring lighting.

The **transition zone** is discussed in general terms in *IESNA RP-8* under the Roadway and Interchange section and the Tunnel Lighting section. As described in RP-8, the driver's eyes need about one (1) second to adjust to changes in light levels. The length of the transition zone is based on the wet pavement safe-stopping distance.

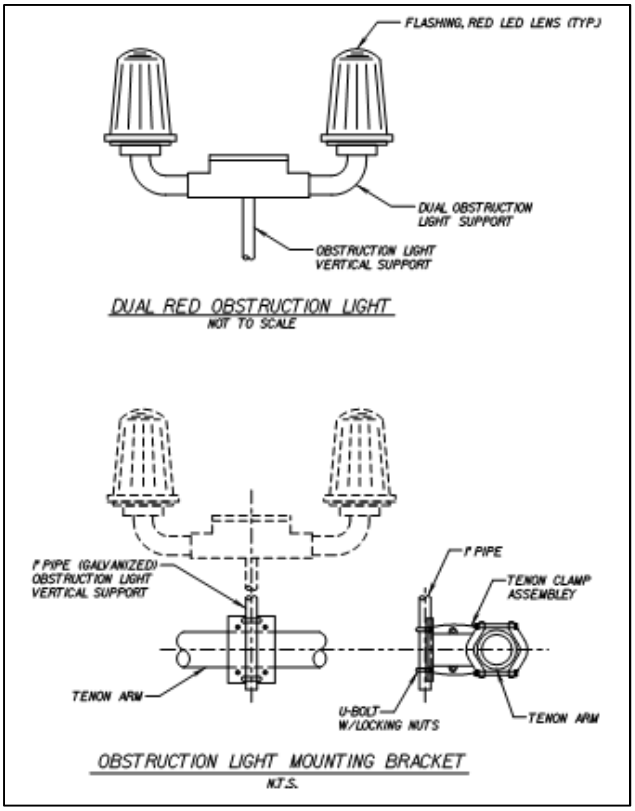
As a rule of thumb and based on the recommendations described in Tunnel Lighting section of *RP-8-18*, a transition zone can be created in advance of the bridge by increasing the pole spacing such that the illumination in the transition zone is 1/3 the light level on the bridge. Many times, the transition zone can be created using the same type and wattage luminaire installed on the bridge.

The installation of navigation and air obstruction lights can occasionally be an integral part of bridge and lighting design. The VDOT Structure and Bridge Division may ask the lighting designer to coordinate electrical service points for the roadway lighting and navigational/air obstruction lighting. The Federal Aviation Administration (FAA), Coast Guard, and Corps of Engineer circulars should be consulted for more detailed recommendations of the placement of lights.

4.3.2 LIGHTING NEAR AIRPORTS

Flight path "**slopes**" extend from various points relative to airport runways. These **slopes** define the clear zones for the top of light poles. If the designer does not recognize changing elevations around the airport, the top of the light poles can easily extend up and into the flight path clear zone. The lighting designer shall contact the FAA representative or airfield safety officer to review the placement of light standards. Local and military regulations may be more stringent than FAA standards. In some situations, the FAA or military installation may require the installation of obstruction lighting. Figure 4-2 shows example details for these lights secured to the lifting ring of a high mast light pole.

Figure 4-2: Obstruction Lights Secured to High Mast Towers



4.3.3 UNDERPASS LIGHTING

Where the AASHTO Guide indicates that underpass lighting is desirable, the luminaires are typically mounted on the bridge abutment, or on the pier caps. Figure 4-3 shows an example underpass lighting detail sheet.

Note: *In all cases, VDOT Structure and Bridge Division must be consulted to approve placement of any item on a bridge or tunnel structure.*

Where the bridge abutment or pier cap is more than about 10 feet from the edge of the paved shoulder, pendant luminaires can be secured to the bottom of the bridge. This option, when compared to mounting locations further away from the roadway, can improve light level uniformity, reduce the number of required luminaires, and discourage vandalism. However, the designer must recognize the maintenance of traffic needs for this configuration. That is, if the luminaire is suspended directly above the shoulder, a shoulder closure operation would be needed to make any repairs to the light fixture. A better alternative would be to suspend the luminaire at a point beyond the shoulder.

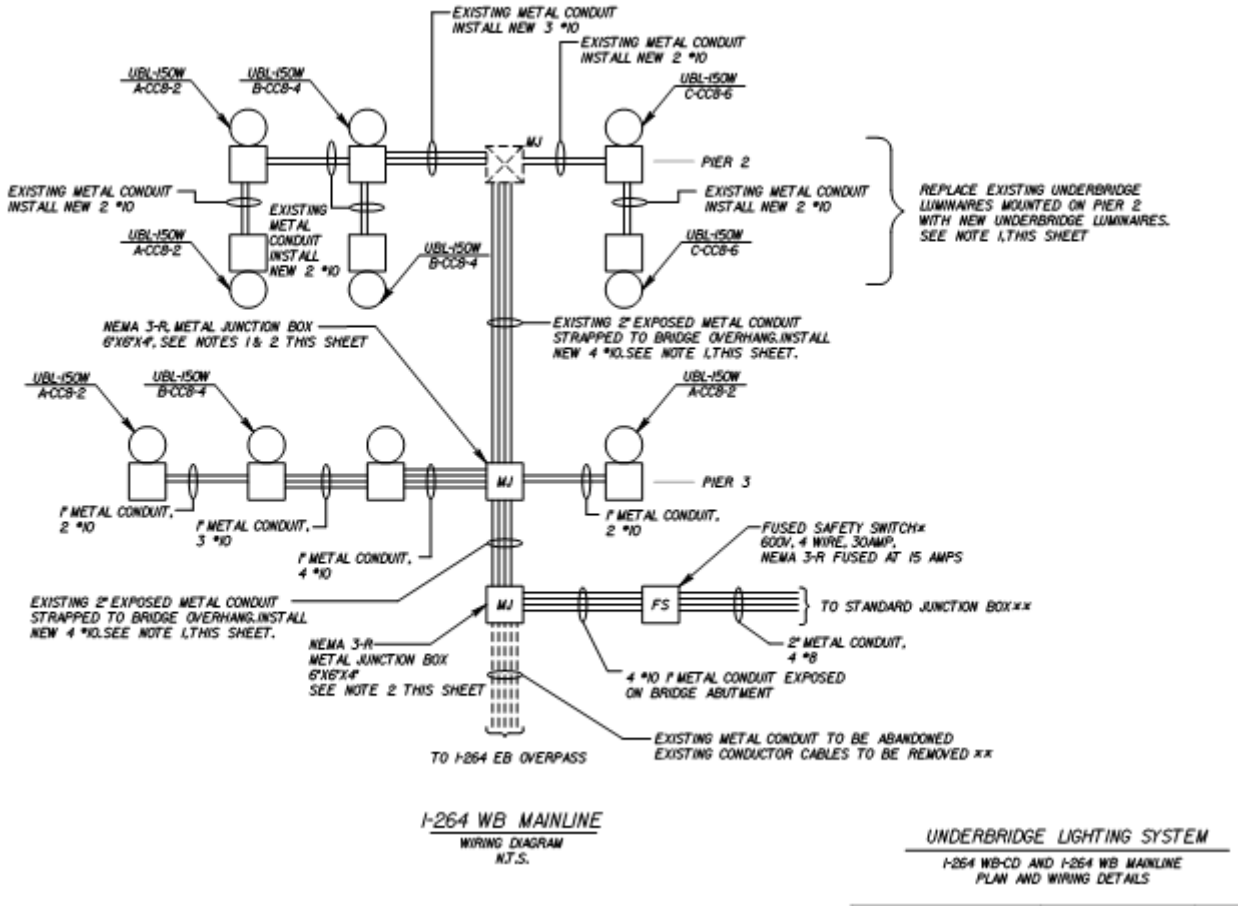
Underpass luminaires have also been secured to the bridge girders; however, this arrangement must be reviewed by VDOT Structure and Bridge Division.

AASHTO recommends that the lighting level duplicate the lighting values on the adjacent roadway. However, due to the luminaire mounting height it is typically necessary to provide higher light levels in

order to achieve the required uniformity. **Thus, it is not unusual for the underpass light level to be twice that of the adjoining roadway.**

Note: *An underpass is differentiated from a tunnel by its length and physical configuration. Specifically, an underpass does not substantially limit a driver's ability to see objects ahead (see RP-8 Tunnel Lighting section). Furthermore, due to its limited length and relative height, and underpass requires no supplemental daytime lighting (see AASHTO Roadway Lighting Design Guide). That is, underpass luminaires are energized only during nighttime periods. Supplemental lighting during daytime periods is not required.*

Figure 4-3: Underpass Lighting Detail



4.3.4 TUNNEL LIGHTING

A tunnel is defined as a structure over a roadway that restricts the normal daytime illumination, such that the driver's visibility is substantially reduced. Unlike an interstate roadway underpass, vehicular tunnels greatly reduce visibility either due to their length or due to the reduced size of the tunnel portal. Vehicular tunnels are classified by AASHTO as:

- **Long Tunnel:** Having a length greater than the minimum wet pavement stopping sight distance. Distances are then established delineating the Entrance Zone, Transition Zone, and Interior Zone. AASHTO recommendations provide the lighting designer with illumination levels in these zones that effectively taper the lighting levels, allowing the driver's eyes to adapt to the reduced lighting

within the interior of the tunnel. The length of each transition zone is based on the design speed of the roadway and the minimum safe-stopping distance.

- **Short Tunnel:** Having a length of less than the minimum wet pavement stopping sight distance. Lighting levels are not typically tapered because the driver's eyes never have a chance to adapt to the darkness. The AASHTO guideline treat short tunnels as underpasses.

The *IESNA RP-8* recommendations provide a range of **luminance** values based on portal design and tunnel orientation. Recent advancements in the AGI32 lighting design software allow the designer to consider reflectance of the tile walls within a tunnel and calculate the resultant luminance of the tunnel's roadway surface.

*The designer should note that separate lighting criteria are provided for divided tunnels and undivided (bi-directional traffic) tunnels in RP-8. Also, RP-8 provides conversion factors for use of **illuminance** in the design of lighting in curved tunnels.*

4.3.5 LIGHTING FOR OTHER STREETS AND HIGHWAYS

Lighting levels and uniformity ratios for local streets and urban arterial roadways are contained in *IESNA RP-8* and are shown in **luminance** values. However, the lighting designer should fully understand the unique requirements of the municipality and pay close attention to the lighting levels at intersections.

4.3.6 LIGHTING AT INTERSECTIONS OR OTHER ISOLATED TRAFFIC CONFLICT AREAS

IIM-TE-390 summarizes VDOT's current policies on intersection and isolated traffic conflict area lighting. Luminaires should be placed on or near prominent decision points. Intersection lighting should be considered if crosswalks are present at the intersection. Intersection lighting should be designed to illuminate the pedestrian with positive rather than negative contrast.

When intersection lighting is provided at a signalized intersection, the lighting should be provided from a luminaire bracket arm attached to the signal pole to avoid excessive poles at an intersection. Additional light poles may be necessary when the intersection has channelization or complex turning lanes.

Luminaires on traffic signal poles (also known as Combination Signal Poles) may be powered from the traffic signal service point and will require a photocell for day/night control. Additionally, luminaires on Combination Signal Poles may be powered from a local power company feeder. In this situation, the feeder is routed into a fused safety switch located on one of the signal poles. Branch circuits are then run from the fused safety switch to each luminaire/signal pole. At locations where the crosswalk placement is such that a luminaire from a Combination Signal Pole would not provide adequate illumination, consider whether a light pole could be used in lieu of a pedestal pole near the crosswalk and support the luminaire and required APS and pedestrian signal equipment.

The level of illumination of a signalized intersection is dictated by the area classification of the roadway. Suggested levels of illumination are given in the *IESNA RP-8*, Intersections, Roundabouts and Crosswalk.

Lighting at isolated intersections or other traffic conflict areas serve to alert the driver approaching the conflict area. These situations are discussed in detail in the *IESNA RP-8*, Intersections, Roundabouts and Crosswalk and At-Grade Railway Crossings. Intersections, such as a remote fire station entrance, have no continuous roadway lighting leading to them. The lighting designer should try to taper the lighting levels

leading up to and away from the brighter intersection. Providing too much illumination, without tapering the lighting near this intersection, will cause excessive glare, and will reduce the contrast between the traffic signal and the background lighting. Effectively, the driver will require more time to notice a changing traffic signal.

4.3.7 SIGN LIGHTING

The designer should reference *IIM-TE-380* to determine when an overhead sign should be lighted. Ultimate authority on whether structures shall or shall not be lighted rests with the District Traffic Engineer and/or the District administration.

The number of luminaires installed on a sign structure must be determined before the design engineer can develop the electrical plan for the lighting system. The **illumination** criteria for sign structure lighting is found in the *IESNA RP-8*. The average illumination level varies based on the ambient lighting, i.e., in rural areas where there is no roadway lighting, the amount of illumination is low compared to the illumination level in an urban area.

Currently, VDOT installs maximum 85-watt, 3000k LED sign luminaires. VDOT has developed a chart showing the number of luminaires needed to achieve the required illumination. The chart is in Chapter 3, Signing and Pavement Marking Design Standards.

Luminaires on overhead sign structures are mounted a minimum of 1 foot below the lower edge of the sign but are typically mounted 2 feet below the lower edge of the sign, and 4 feet in front of the sign. However, on signs taller than 12 feet, the luminaires are mounted 6 feet in front of the sign.

Additional information on sign lighting, including the sign lighting mounting chart, can be found in Chapter 3, Signing and Pavement Marking Design Standards.

4.4 LIGHTING PLAN REQUIREMENTS

VDOT lighting plans shall follow the standards described below and shall utilize the symbology, formatting, and spacing for plan items, as presented in the example plans provided in the Appendix to this chapter and in the VDOT Traffic Engineering Design MicroStation/OpenRoads Designer* Cell Libraries, as defined in the VDOT CADD Manual. In addition, the VDOT CADD Manual provides additional information relative to the file management of CADD files used for lighting plans, as well as information on drawing scale, levels, symbology, and text and dimension styles*. Please contact CADDsupport@vdot.virginia.gov to obtain the appropriate Microstation/OpenRoads Designer* files and cell libraries.

A majority of text notes, legends, and call-outs are included in the VDOT Traffic Design cell libraries. The text size in the cell libraries is based on 25 scale plans. Cells should be adjusted appropriately based on the proposed scale of the plan.

Efforts should be made to show items, such as junction boxes and luminaire arms, at scale on the plan sheets such that they represent the actual size of the structure. For example, junction boxes shown at scale may clearly indicate a physical conflict with a drainage structure. However, in other instances, it can be practical to show items, such as underbridge luminaires, larger than actual size for clarity on the sheet.

Based on the nature of the project, plans will be developed either as stand-alone lighting plans or as part of a complete set of roadway construction plans. The advertisement and construction of a lighting plan varies under these circumstances.

4.4.1 DISTRICT STAND-ALONE TRAFFIC ENGINEERING LIGHTING PLANS

Stand-alone lighting projects are constructed separately from a complete roadway construction project. These may be delivered through a separate advertise construction contract or as task order through an on-call contract (District Signal or ITS Contract, for example). They may also be developed as part of an area improvement project. The designer should confirm plan requirements for standalone lighting plans, particularly those to be installed under an on-call contract, with the appropriate District Traffic Engineering or Operations staff and adjust the plan contents to match the requirements for the specific delivery method.

Once the scope of the District stand-alone project is understood, developing the project's survey will typically be the lighting designer's first task. Refer to *Section 4.5.4.2* for a discussion on survey and alignment procedures commonly used in roadway lighting plans.

4.4.2 ROADWAY CONSTRUCTION PLANS WITH LIGHTING

New construction plan projects developed and delivered in accordance with the VDOT Project Development process are the focus of this manual. New construction projects generally range from Minimum Plan projects (M-501, etc.), which are relatively simple construction projects requiring less than a single construction season, to full Construction Plan projects (C-501, etc.), which involve large transportation projects of varying complexity and typically one or more seasons of construction duration.

The following plan sheets are presented in the proper sequence to produce a lighting plan set for roadway construction projects. Those sheets noted as, "For stand-alone projects" are typically not included if the lighting design(s) are part of a roadway construction project. Those sheets noted as a "Standard sheet" requires the **designer to reference the VDOT CADD Manual for detailed discussion on the format, data and sheet numbering.**

a.) Title Sheet (Standard Sheet for stand-alone projects)

- The Title Sheet for stand-alone lighting plans must meet all the requirements of a standard VDOT Title Sheet with the following exceptions:
    - Stand-alone lighting projects do not typically include acquisition of ROW. The ROW Signature blocks may not be needed and can be removed from the Title Sheet.
    - The Index of Sheets is typically a short list. This list can be added to the upper-left corner of the Title Sheet.

b.) Location Map (Standard Sheet for stand-alone projects)

- A location map is inserted on a sheet giving enough detail to clearly identify the area and location of the project. This sheet can be combined with the Title Sheet, General Notes Sheet, Plan Index Sheet, or other if information can be consolidated legibly on a single page.
- For roadway construction projects, the Location Map may be added at the discretion of the Traffic Engineer / L&D Manager or the lighting designer.

c.) Plan Sheet Index (Standard sheet)

- The Plan Sheet Index provides an overview of all the plan sheets in the project. It allows a quick reference to specific items within the overall project. The sheet can be helpful in identifying specific elements of the lighting plan relative the entire project. On most roadway lighting projects, the Plan Sheet Index can be incorporated onto the Title Sheet. However, large projects may require a separate Plan Sheet Index for clarity.
- The Plan Sheet Index should include the location of the lighting control centers. On smaller projects, the Plan Sheet Index may include light pole symbols, such as high mast light poles.
- On roadway construction projects, the roadway lighting plans will typically follow the roadway construction plan sheet numbering. However, in some cases, the roadway lighting portion of the construction project may not require every roadway construction plan sheet. In this case, the roadway lighting plan sheets may be renumbered. The Plan Sheet Index will then provide a reference to the overall construction project.

d.) Revision Data Sheet (Standard sheet for stand-alone projects)

- This sheet is included with the final plan set but is left blank except for the project numbers and sheet number.

e.) General Notes and Legend Sheet

- The General Notes should include the required lighting criteria (e.g., average illumination, uniformity, etc.) for the project.
- An example of the General Notes and Legend Sheet is provided in the Appendix.

f.) Alignment Data Sheets, Survey Alignment Coordinate Data Sheets, and Benchmarks.

g.) Traffic Management Plan Sheet (Standard sheet for stand-alone projects)

- The maintenance of traffic may be simple and can be included in the contract documents. Other projects may require a plan sheet to describe the lane closure times, detour requirements, and other Work Area Protection items.

h.) Roadside Development Sheet (Standard Sheet for stand-alone projects)

- When required, and as directed by the project manager.

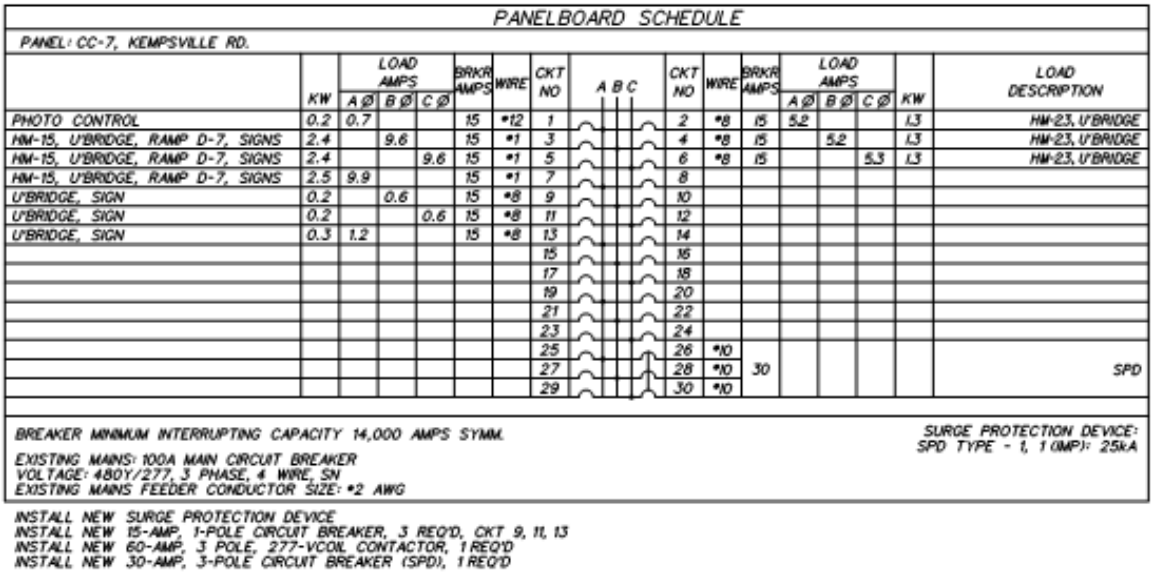
i.) Summary of Quantities

j.) Detail sheets

Items that are found in the VDOT *Road and Bridge Standards* should not be shown in the lighting plans unless required for clarification or modification. Typical details found in each lighting plan set include:

- Panelboard schedule
    - The lighting system designer must include the circuit breaker size and interrupting rating, and contactor rating and type (e.g., 60-amp, 3-pole, 277-Volt coil). Figure 4-4 shows examples of panelboard details where modifications to the control center are required.

Figure 4-4: Panelboard Detail



PANELBOARD SCHEDULE

PANEL: CC-7, KEMPSVILLE RD.

	KW	LOAD AMPS A Ø	LOAD AMPS B Ø	LOAD AMPS C Ø	BRKR AMPS	WIRE	CKT NO	A B C	CKT NO	WIRE	BRKR AMPS	LOAD AMPS A Ø	LOAD AMPS B Ø	LOAD AMPS C Ø	KW	LOAD DESCRIPTION
PHOTO CONTROL	0.2	0.7			15	#12	1		2	#8	15	5.2			1.3	HW-23, U'BRIDGE
HW-15, U'BRIDGE, RAMP D-7, SIGNS	2.4		9.6		15	#1	3		4	#8	15		5.2		1.3	HW-23, U'BRIDGE
HW-15, U'BRIDGE, RAMP D-7, SIGNS	2.4			9.6	15	#1	5		6	#8	15			5.3	1.3	HW-23, U'BRIDGE
HW-15, U'BRIDGE, RAMP D-7, SIGNS	2.5	9.9			15	#1	7		8							
U'BRIDGE, SIGN	0.2		0.6		15	#8	9		10							
U'BRIDGE, SIGN	0.2			0.6	15	#8	11		12							
U'BRIDGE, SIGN	0.3	1.2			15	#8	13		14							
							15		16							
							17		18							
							19		20							
							21		22							
							23		24							
							25		26	#10						
							27		28	#10	30					SPD
							29		30	#10						

BREAKER MINIMUM INTERRUPTING CAPACITY 14,000 AMPS SYMM.

EXISTING MAINS: 100A MAIN CIRCUIT BREAKER
VOLTAGE: 480Y/277, 3 PHASE, 4 WIRE, SN
EXISTING MAINS FEEDER CONDUCTOR SIZE: #2 AWG

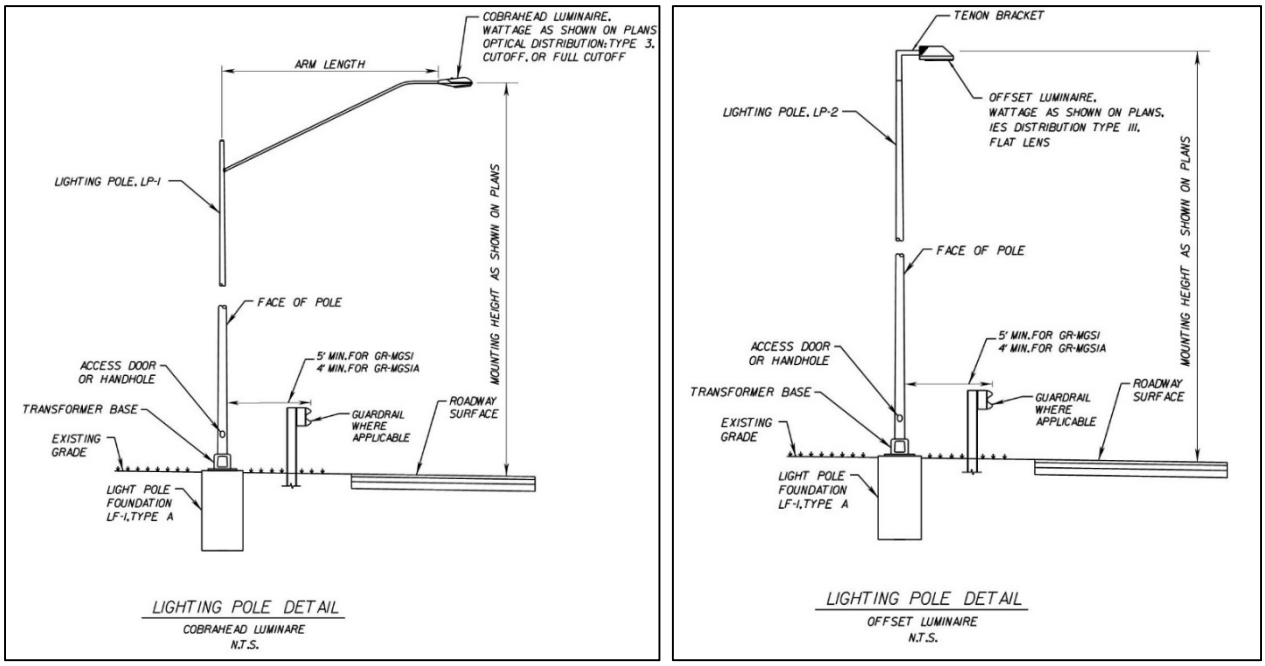
SURGE PROTECTION DEVICE:
SPD TYPE - 1, 1 (MP): 25kA

INSTALL NEW SURGE PROTECTION DEVICE
INSTALL NEW 15-AMP, 1-POLE CIRCUIT BREAKER, 3 REQ'D, CKT 9, 11, 13
INSTALL NEW 60-AMP, 3 POLE, 277-VCOIL CONTACTOR, 1 REQ'D
INSTALL NEW 30-AMP, 3-POLE CIRCUIT BREAKER (SPD), 1 REQ'D

PANEL BOARD DETAIL MODIFY EXISTING CONTROL CENTER, CC-7

- Luminaire Details
    - This detail sheet should include a diagram of the luminaire and iso-footcandle curves if required for clarification. Luminaire details should not reference specific manufacturers or otherwise preclude the use of similar fixtures with similar output levels and lighting patterns.
- Typical Pole Details
    - This detail sheet may be required for clarification of pole installation, such as pole placement relative to guardrail or edge of shoulder. Figure 4-5 shows key elements that should be included in the plan details (e.g., the minimum distance behind required behind guardrail).

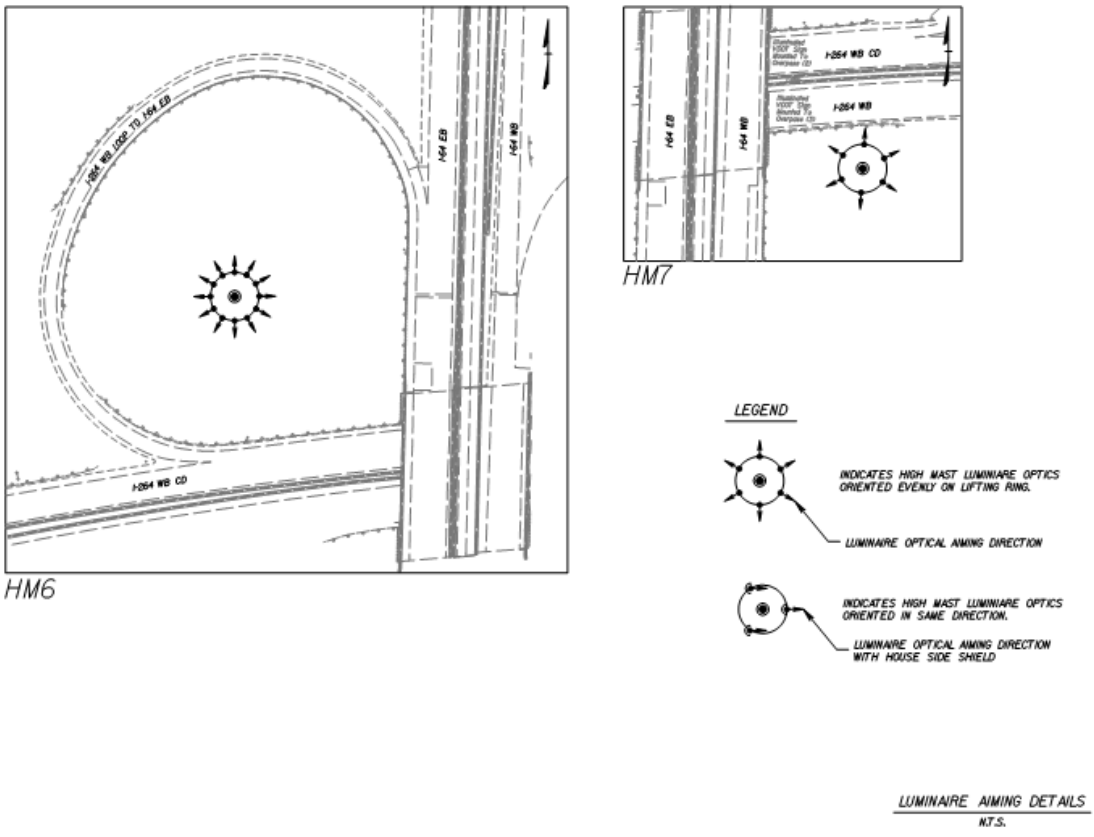
Figure 4-5: Conventional and Offset Lighting Poles (LP-1 and LP-2)



LP-1 LP-2

- Under bridge lighting systems
    - Enlarged plan view of the bridge structure showing luminaire placement and luminaire circuiting (e.g., wattage – control center # - circuit #), conduit routing, conduit size and type (e.g., Metal, LFMC), junction box placement, and junction box size and type (e.g., metal - NEMA 3R, NEMA 4X).
    - Elevated or section views of the piers or abutments showing luminaire, conduit, and junction box placement.
    - Electrical schematic showing the conductor cable routing, splice points, circuiting, and phasing.
- Special conduit attachments to bridge structures
- Other Detail Sheets
    - These sheets may include specially modified items required for the project, such as a modified electrical service or a special design pole foundation.
    - Figure 4-6 shows aiming diagrams for high mast lighting.

Figure 4-6: High Mast Lighting Aiming Details



k.) Plan Sheets

An example of the required format of a VDOT Lighting Plan Sheet is provided in the Appendix.

- Sheet numbers begin at "3" for standalone projects.
- Plan Sheet Number Series will be obtained from the construction Traffic Engineer / L&D Manager for roadway construction projects.
- The plan sheet scale should match the roadway construction plans.
- Each plan sheet should clearly identify the required pay items and include:
    - A layout of the roadway and graphical representation of the lighting standard locations, control centers, overhead sign structures, and conduit runs.
    - Call-outs with cable/conduit quantities and sizes.
    - Luminaire call-outs with wattage, Correlated Color Temperature, circuit assignments, service panels, mounting height, bracket arm length, and in special situations, luminaire tilt angle.
    - Lighting standard call-outs with pole locations (station and offset), pole number, and pole type.
    - Junction box type (station and offset is optional).

4.5 VDOT PROJECT DEVELOPMENT PROCESS FOR LIGHTING DESIGN

The following describes how the lighting design process within a ***new construction project*** aligns with the VDOT Project Development Process. Information pertaining to the Project Development Process can be found on VDOT's website or through the VDOT Project Management Office. The specific plan requirements for each project milestone can be found in checklist format in VDOT's *Form LD-436*.

4.5.1 SCOPING PHASE:

Meet with the applicable VDOT representative (likely the District Traffic Engineer or their designated representative and Central Office L&D staff) that will provide final approval of the lighting design plan sets to determine any new or area-specific design preferences. The designer should also request any example plans that may be relevant to the project scope. The scoping phase includes a number of critical steps to ensure the appropriateness of lighting in the project scope as well as collecting the appropriate base information. Development of the lighting plan set should not begin until these steps are completed.

The lighting plans prepared during the scoping phase will result in what is defined in the VDOT *Project Development Process as Final Scope/PFI* plans.

4.5.1.1 Perform Lighting Warrants

If requested by a VDOT Traffic Engineer / L&D Manager, the engineer shall perform lighting warrants. If not requested, the designer shall confirm that a lighting warrant assessment has been completed and concurrence that lighting should be included in the overall project design has been granted by the District Traffic Engineer.

The *Traffic Operations Division Instructional & Informational Memorandum (IIM)*, ***IIM-TE-390*** *Light Emitting Diode (LED) Exterior Lighting* provides guidance on when and where lighting should be installed:

> *VDOT's default position is "no lighting", particularly for continuous freeway and street lighting. Where roadway lighting is to be provided, VDOT's philosophy is "nodes, not roads" – meaning that it may be appropriate to provide partial interchange lighting or intersection/ crosswalk/ roundabout lighting if there is strong safety justification.*

The primary purpose of warrants is to assist administrators and designers in evaluating locations for lighting needs and selecting locations for installing lighting. Warrants give conditions that should be satisfied to justify the installation of lighting. Meeting these warrants does not obligate the State or other agencies to provide lighting or participate in its cost. Conversely, local knowledge in addition to the information reflected in the warrants, such as roadway geometry, ambient lighting, sight distance, signing, crash rates, or frequent occurrences of fog, ice, or snow may influence the decision to install lighting. The design stage can begin once the decision has been made to install new lighting.

Warrants for freeways are covered by the AASHTO *Roadway Lighting Guide*. The roadway lighting systems described in this reference are **Continuous Freeway Lighting**, **Complete Interchange Lighting** and **Partial Interchange Lighting**.

Warranting conditions on street and highways other than freeways are also addressed in the AASHTO guide; however, the guide recommends referencing FHWA's *Lighting Handbook and the Transportation Association of Canada (TAC).* The FHWA handbook notes that:

> *[The warrant system] is based on the Transportation Association of Canada (TAC) Guide for the Design of Roadway Lighting (27) which was based on the 1978 Roadway Lighting Handbook published by the U.S. Department of Transportation.*
>
> *The warrant system is based on factors grouped into geometric, operational, environmental, and crash factors. For each factor a numeric rating (R) from 1 to 5 corresponding to the defined criterion is defined. Each criterion is assigned a weight (W) to indicate its relative importance.*

VDOT policy requires that lighting be considered at traffic signals with marked crosswalks. If lighting is recommended for a project, the designer will proceed to the following steps.

4.5.1.2 Discuss Third Party Coordination

Verify District policies with regard to coordinating with external parties such as electrical providers. Coordination with these representatives can often be time consuming and greatly influence the project delivery schedule. The designer and should also work with VDOT to determine if an FAA airport clearance review will be required for the project.

4.5.1.3 Obtain Survey Information

Obtain the base survey information that is a required element of the lighting plan. This will include the location of edge of pavement or curb lines; pavement markings; surface evidence of underground and overhead public and private utilities; any existing VDOT lighting or traffic signal equipment, if present; and property lines that may impact the design. Overhead line heights should be captured when feasible. Elevation contours may be required at locations with steep slopes that may impact the design. As a rule of thumb, it is also suggested to obtain survey information at a minimum of 10 feet beyond the edge of ROW should additional ROW or easement be required as part of the lighting design. ***NOTE: Survey information may not be required for a District lighting system replacement, installation or modification. Confirm needs with the appropriate District representative.***

4.5.1.4 Determine Reuse of Existing Lighting System Equipment

For projects where existing lighting is present, the project may involve complete replacement of the lighting system or modifications/additions to the existing system.

- In most situations, a field review of the site will be the only way to verify the type of roadway lighting currently utilized on the site.
- The engineer should collect all as-built plans of the site.
- The lighting engineer should make every attempt to understand the layout of existing lighting systems and Traffic Management Systems.

Once the lighting designer has a good understanding of the existing lighting system, the District Traffic Engineer must be contacted to determine those items that should be maintained, removed, replaced, modified, or abandoned. VDOT *Road and Bridge Specifications*, Section 510 provides procedures for working with existing lighting systems.

4.5.1.5 Prepare Survey/Base Plan

The lighting base plan assembles survey and any available project design files and information into a single file. The base plan depicts existing survey conditions and proposed roadway improvements from which lighting design can be properly scoped, and proposed lighting design elements can be evaluated and incorporated into the project design. The level of detail for a typical lighting base plan when prepared from a roadway construction plan is shown below and in the Appendix.

- Prepare base map in accordance with the VDOT CADD Manual Standards.
- Retain coordinates within CADD file (if possible).
- Show the locations of underground and overhead utilities.
- Show elements of the existing survey that will impact the installation of light pole foundations and conduit trenching as well as "Finished" roadway elements.
- Perform a field site visit and review plan/profile drawings to ensure that roadway geometry is appropriate for the installation of the lighting system.

"Finished" roadway elements are defined as the combined existing and proposed curb lines, roadway edge of pavement, sidewalks, drainage, curb ramps, etc., as well as existing and proposed ROW that will be in place when the project is complete.

The base plan sheet includes the following (at a minimum):

- North arrow;
- Graphic Scale;
- Street names;
- Finished roadway elements (to scale); and
- All existing and proposed underground and overhead utilities in place when project is completed.

Existing curb lines and roadway features that are to be removed or relocated during construction may need to be shown on the lighting plans to ensure the contractor understands any potential conflicts.

Example:

The Contractor should clearly understand that the plan requires installation of light poles and conduit in an area that was once an asphalt parking lot but is now planned to be a grassy landscaped area.

4.5.1.6 Anticipated Scoping Phase Deliverables:

- Approved Lighting Warrant Evaluation; and
- Approved Project Scope and/or documentation of design requirements.

4.5.2 PRELIMINARY DESIGN PHASE:

In this stage, the designer will prepare the preliminary plan sheets required for the specific project. This includes laying out major lighting components and verifying ROW and utility clearances are sufficient. It is critical to determine if any lighting equipment will require any additional ROW or easements, and if so, coordinate with project manager to identify the specific limits of the required ROW or easements. The

designer should also notify the Project Manager of any anticipated unavoidable utility conflicts. If required, complete an airport clearance review for the lighting at this stage.

The lighting plans prepared during the preliminary design phase will result in what is defined in the VDOT Project Development Process as PH plans.

4.5.2.1 Select Pole and Luminaire Types

The designer should review lighting options with the District Traffic Engineer, Project Manager, and local VDOT personnel prior to the initial selection of light poles and luminaire equipment.

The following items should be considered when selecting poles and luminaires:

Conventional or Cobrahead Pole

- The most common equipment used is the 30-foot to 50-foot pole with a luminaire and luminaire arm.
- The luminaire arm typically places the luminaire directly over the edge of the travel lane.
- Maintenance of these luminaires will almost certainly require a shoulder closure, and in many cases will require a lane closure.
- Generally, this type of pole allows greater spacing between luminaires than the offset style pole.

Offset

- The offset pole is typically a 30-foot to 50-foot pole with a luminaire mounted to the top without a bracket arm. A shore tenon is used to secure the luminaire to the pole.
- Positioning the luminaire beyond the shoulder reduces need for a lane closure to perform maintenance.

Decorative Lighting

- Decorative poles and acorn style luminaires, are non-standard to VDOT and requires modification of the Specifications for completion of the contract documents.
- VDOT will only install this lighting type with an agreement that the lightings will be maintained by others.

High Mast Luminaire and Pole Combination

- High mast lighting provides area lighting using 3 to 12 LED luminaires. The luminaires vary from 250 watts to 500 watts, mounted on a single pole (also referred to as a tower). The pole heights vary from approximately 60 feet to 140 feet.
- At these mounting heights, high-output luminaires develop a uniform light distribution.
- High mast lighting is used principally where continuous lighting is desirable, such as:
    - Interchange lighting;
    - Lighting of toll plazas;
    - Rest areas and parking areas;
    - General area lighting; and

- Continuous lighting on highways having wide cross-sections and many traffic lanes.

- This type of lighting system is **not** desirable where there is residential impact from spill light. House-side shields installed on the luminaires may be required to reduce the impacts of the lighting on nearby residential areas.
- The system is desirable where maintenance of conventional lighting units may be a hazard to the traveling public and maintenance personnel.
- High mast lighting typically provides reduced glare levels when compared to conventional or offset lighting.
- Several roadways can usually be illuminated from a single high mast tower.
- High mast lighting provides the motorist with an exceptionally wide field of vision.
- Performance of the system under adverse weather conditions is generally acceptable.
- The cost of a single high mast lighting tower and luminaire assembly is higher than that of a conventional or offset lighting standard. As a rule of thumb, the light that is provided by one high mast tower should replace 6 to 8 conventional lighting standards.
- The high mast tower cannot be fitted with a breakaway base and thus must be located outside the clear zone or protected from traffic by guardrail or barrier service.
- High mast lighting standards must be located such that they are accessible to a crane for maintenance crews in the event the luminaire ring becomes hung at the top of the tower.

4.5.2.2 Conduct Lighting Analysis

VDOT requires all roadway lighting designs to meet the lighting criteria as discussed in the current IESNA publication, *Recommended Practices for Roadway Lighting (RP-8-18)*. The AGI32 lighting design software or other approved lighting design software shall be utilized to determining the levels required for the final roadway light plan.

The **Luminance Design Method** is used for straight roadways. The **Horizontal Illuminance Design Method** may be used for design along curved sections of roadways where luminance can be difficult to calculate. For determining the horizontal illuminance level needed to meet the luminance lighting criterion, the following equivalent may be used, assuming an R2 or R3 pavement:

1 cd/m^2 = 1.4 fc (15 Lux as noted in IESNA RP-8)

Example:

Roadway Classification	**Average Luminance L_{avg} (cd/m^2)**	**Average Illuminance (fc)**
Freeway Class A	0.6	0.8
Freeway Class B	0.4	0.6
Expressway	1.0	1.4

a.) Lighting Levels

The design must be appropriate for the site and must provide the level and uniformity of light suggested in the current IESNA publication, *Recommended Practices for Roadway Lighting (RP-8)*. The recommended design values represent the **minimum maintained average lighting level**. Facilities may be designed with higher average lighting levels but must provide the required uniformity. In all cases, the VDOT Traffic Engineering / L&D Manager must approve higher lighting levels.

b.) Lamp and Luminaire Depreciation Factors

The lighting system designer must consider the luminaire maintenance factor, or light loss factor (LLF) in determining the light output for a luminaire. The LLF is based on the Lamp Lumen Depreciation (LLD) and the Luminaire Dirt Depreciation (LDD) over the life of the fixture. The following factors are used for roadway light fixtures:

- LLD: 0.90
- LDD: 0.95

Specifically: The LLF for a conventional luminaire is:

LLF = 0.90(LLD) x 0.95(LDD) = 0.855 (~0.86)

For further information, see the FHWA *Roadway Lighting Handbook*.

c.) Light Trespass

The lighting design should not exceed the Maximum Initial Vertical Illuminance spill light at the ROW as described in *IIM-TE-390*. The allowable illumination level varies on the type of adjacent property, e.g., residential, commercial, etc.

The calculated illumination level is modeled in AGI32 using the Obtrusive Light – Illuminance/Intensity calculation. The calculation is made along the ROW line. The AGI32 Help file provides step-by-step instructions on creating the calculation grid. See, Vertical Illuminance Calculation – LEED Light Trespass, Special Application – Calculating the potential for light trespass, per LEED version 4.

The key issues involved with determining the light trespass level are:

- "Initial vertical illuminance" is used in the calculation. That is, the luminaire LLF should be 1.0. As such, each luminaire must be redefined with LLF set to 1.0. It may be helpful to create a separate AGI32 file for this calculation.
- "Maximum Illumination" level is used to determine if the design meets the VDOT requirements for the environment. For example, the maximum allowable illumination at the ROW for an adjacent apartment complex is 0.3 fc.

4.5.2.3 Place Poles

Pole placement is an engineering decision which should be based upon geometry, character of the roadway, lighting design calculation analysis from Section 4.5.2.2, physical features, environment, available maintenance, economics, aesthetics, and overall lighting objectives. The physical roadside conditions may require adjustment of the spacing determined during the conceptual lighting design. The following points should be considered in every lighting design:

- VDOT requires all roadway lighting design calculations to meet the lighting criteria as discussed in the current IESNA publication, *Recommended Practices for Roadway Lighting (RP-8)*.
- The lighting designer should plan a site visit early in the design process. Terrain features may alter the choice of lighting equipment and the routing of conduit.
- Site considerations affecting pole placement include the presence of noise walls, retaining walls, existing guardrail, rock, narrow roadside clearances, power lines, nearby airports, traffic signals, and nearby residential neighborhoods.
- The placement of light poles near power lines requires the lighting designer to coordinate with the local power company. In many cases, light poles cannot be placed within 10 feet of a distribution line and 25 feet of a transmission line as measured in any direction.
- Poles should be placed behind noise walls only if the site permits access for maintenance. The location of required doors should be noted and brought to the attention of the Project Manager.
- The lighting designer should recognize that pole foundations placed directly behind a retaining wall might conflict with the tiebacks associated with the wall.
- Poles should also be placed outside the roadway clear zone whenever possible, as discussed later in this Chapter and located to minimize knockdowns. If placement outside the clear zone is not feasible, then poles shall be installed with breakaway bases.
- When placed behind guardrail, poles shall be placed at a distance that will allow clearance for guardrail deflection upon impact. Guardrail deflection requirements can be found in Appendix I of the VDOT *Road Design Manual*.
- Pole and luminaire placement should be uniform. Inconsistencies in the luminaire positioning over the roadway, and the distance from the shoulder to the base of the pole, can be a source of distraction to the driver.
- Where intersection lighting is being provided at a signalized intersection, whenever possible the lights should be co-located with the traffic signal mast arm.
- Stand-alone light poles may be used where necessary to provide effective illumination of the crosswalks. If so, then the stand-alone light poles should ideally be placed so they can double as supports for the pedestrian signal head and/or Accessible Pedestrian Signal equipment.
- It is not unusual for luminaires mounted on signal poles to be powered from a separate source. In this case, the lighting designer should coordinate with the signal designer for the location of junction boxes and signal conduits, and the position of the luminaires and bracket arms.
- Light pole placement should consider maintenance issues. Bucket trucks must be nearly level to operate and are limited in the height and distance from the roadway that the bucket can reach. Different types of trucks may have different working ranges. The lighting designer should verify

with the VDOT District Maintenance section as to the availability and attributes of their bucket trucks.

- Luminaires should be placed no closer than 50 feet in front of a sign and/or no closer than 15 feet behind the sign.

Clear Zone and Breakaway Base Considerations

Clear zone requirements can be found in Appendix A of the VDOT *Road Design Manual*. Poles should always be placed outside the clear zone. Poles placed within the clear zone should be fitted with a breakaway base.

Where poles are placed behind guardrail, they must be located outside the deflection zone of the guardrail and should **not** be fitted with a breakaway base. The guardrail deflection zone can be found in Appendix I of the VDOT *Road and Bridge Standards* under the Guardrail Installation Criteria.

The following are several points to consider in the placement of light poles:

- The clear zone requirements vary with design speed, Average Daily Traffic (ADT), and the grade of the paved and unpaved shoulder.
- It is imperative that the lighting designer does not place a lighting standard in the clear zone at the gore of an interstate/freeway exit ramp, since the pole will be prone to collision. Elimination of this lighting standard will greatly reduce visibility at this critical location. The lighting designer must review the clear zone requirements as discussed in the VDOT *Road Design Manual*.
- The transformer base may be configured with an AASHTO approved breakaway system or constructed of frangible material. See VDOT *Road and Bridge Specifications*, Section 229 and Section 700.
- As an alternative, a breakaway base may be provided with a set of couplings and a skirt having only 4 inches of clearance from the top of the concrete foundation.
- A lighting pole located outside the clear zone or beyond the deflection zone of the guardrail should not be fitted with a breakaway base.
- Limited ROW or terrain restriction may prevent the placement of lighting standards outside the deflection zone of standard guardrail. In this situation, the lighting plans may require strengthening the guardrail to reduce the depth of the deflection zone. In no case should the light pole be placed within the deflection zone of the guardrail.
- When all alternatives have been exhausted, and placement of the lighting standard results in a location within the guardrail deflection zone, concrete barrier service should replace the guardrail.
- Transformer bases shall be labeled as breakaway or non-breakaway on the plans.

Median Barrier Lighting Considerations

Median barrier lighting is an option in areas of limited ROW. The lighting system can be powered from a single conduit, versus two conduit runs placed along both edges of the roadway.

Both conventional and offset lighting standards can be mounted on median barriers utilizing a twin arm mounting system. This lighting configuration provides several benefits, but may not be the most appropriate alternative for every situation:

- The median barrier technique of mounting lighting poles reduces the number of poles and conduit runs and has the added benefit of utilizing the house-side light from the luminaire. However, without the presence of trees or a sound wall along the outside shoulder, spill light may affect residential communities adjacent to the roadway.
- Maintaining the lighting system requires placing service vehicles on the inside shoulder directly adjacent to the fast lane. Median barrier mounted lights should not be used in high volume areas without a 10-foot minimum inside shoulder.
- Vehicles stopped in the breakdown lane on the outside shoulder may receive only the minimum amount of illumination.
- Coordination with the median barrier designer shall be made to ensure the pole foundation dimensions and bolt circle configuration match the attributes of the proposed lighting pole. For example, the top, flat surface of a standard double-faced median barrier is 7 and 3/4 inches wide. However, a light pole anchor bolt circle is 12 inches. Also, there should be at least 3 inches of concrete cover over the 1-inch-diameter anchor bolts. These dimensions will require the top surface of the median barrier to at least 24.5 inches wide to accommodate the anchor bolts and light pole base plate.
- The lighting designer must recognize the dimensions of the pole foundation blister and location of the shy-line as described by the VDOT *Standard Median Barrier (MB-7D)*. For example, if the top surface of the median barrier is widened to 24.5 inches to accommodate the light pole anchor bolts, the width at the base of a standard median barrier must be tapered from 23 and 5/8 inches to 33 and 3/4 inches. If the median barrier at the light pole encroaches into the shy line of a roadway with a design speed of 60 mph, the flare rate of the taper for a should be 26:1. For this example, the taper from the standard median barrier width will begin 26.4 feet in advance of the widened median barrier at the light pole.
- The lighting design must consider the location of drainage structures under the median barrier.
- The beginning and ending of a median barrier typically require a section of wall that tapers in height. Lighting standards should not be placed on this section of the wall.
- The lighting designer must ensure that the median barrier design provides for a junction chamber of sufficient size to accommodate the conduit and conductor cables at the base of each pole.

Example:
A junction chamber (d = 6 inches x h = 12 inches x l = 18 inches) at the base of the pole, embedded in the median barrier, would provide a pull box for a 2-inch conduit with five #2 AWG cables (3-phase conductors, 1-neutral, and 1-ground). This chamber would also provide a splice point for the 1-inch conduit coming down from the pole base, and the four #10 AWG wires delivering power to the luminaires and grounding for the pole (2-phase conductors, 1-neutral, and 1-ground).

- At locations where dual mount lighting standards provide illumination to roadways of differing elevations, the mounting height for both luminaires should be measured from the roadway with

the higher elevation. The lighting designer should provide a detail of this lighting standard in the plans to clarify the placement of the luminaires relative to the roadway.

4.5.2.4 Field Visit and Determine the Power Source

A **field visit** with the power company representative should be organized shortly after completing the system characterization. The lighting designer should provide the power company representative with an estimated transformer (kVA) power requirement.

The lighting designer must meet and discuss the source of power prior to completing the layout of the lighting system.

Every service feed provided by the local power company must be coordinated with a field representative. The lighting designer should never assume that power is readily available and easily accessible.

- **Grid Maps.** Prior to meeting the power company representative, the lighting designer should request grid maps indicating the location of primary electrical feeders that are local to the proposed facility. Reviewing these maps will enable the designer to develop a conceptual conduit layout plan.
- **Primary Power**. During a field visit, the designer should try to identify potential sources of primary power. The typical primary power delivered by the local power company is 13,900 Volt or 19,500 Volt. The power company will step down this primary power through a transformer to provide secondary power at the voltage required for the lighting system.

  Overhead 3-phase primary power can be recognized as three small wires running at the top of wooden utility poles. The lighting designer should take the time to notice these lines during the field reconnaissance and note the pole numbers for later reference.

- **Easements and ROW.** The lighting designer cannot assume that a property owner will allow the power company to cross privately-owned land to deliver power to the VDOT ROW.
- **Locate primary power directly adjacent to the VDOT ROW if possible.** The power company will typically place transformers at the top of the utility pole, step down the voltage, and run the secondary power to the meter base on the VDOT electrical service.
- The distance from the source of primary power should be kept as short as possible to minimize losses due to voltage drop.
- Secondary 277/480-Y Volt three-phase power is never run in excess of 2,000 feet from the transformer to the meter base.
- Secondary 120/240 Volt single-phase power is never run more than 700 feet from the transformer to the meter base.

  If these distances are exceeded, primary power must be pulled to the VDOT electrical service and a step-down transformer placed near the meter base.

4.5.2.5 Preliminary Design Cost Estimate

The designer should provide a high-level cost estimate of the lighting design elements to ensure project funding is appropriate for the anticipated scope of work. The preliminary cost estimate should be based on standard VDOT items and delivered in a format agreed to by the project manager.

4.5.2.6 Anticipated Preliminary Design Phase Deliverables:

- Preliminary Lighting Design Plan showing pole locations, anticipated electrical service type and source, and photometric analysis calculations; and
- Preliminary cost estimate.

4.5.3 DETAILED DESIGN PHASE:

In this stage, the designer will refine the preliminary plan sheets, and incorporate additional design details, including: laying out the conduit and wiring system, calculating voltage drops, determining wiring size, conduit size, and junction boxes**.**

The lighting plans prepared during the detailed design phase will result in what is defined in the VDOT Project Development Process as Field Inspection (FI) / ROW plans.

4.5.3.1 Place Electrical Service and Lighting Control Center

The lighting designer must recognize the following issues when selecting a location for the electrical service and control center cabinet:

- **Clear-Zone.** The structure must be placed well outside the clear-zone or located behind guardrail or barrier service.
- **Accessibility.** In many VDOT districts, the local power company meter reader is not permitted to stop on an interstate roadway to read the meter. Thus, the meter must be located within the VDOT ROW, but easily accessible from a side street. Furthermore, the control center must be accessible to the VDOT electrician.

Example:
A lighting control center located behind a noise wall should be accessible either through a door in the wall, or a local street behind the wall, or within walking distance of the end of the wall.

In another example, where the VDOT electrical service is located directly adjacent to the ROW fence, the fence should be routed around the electrical service such that the power company representative and VDOT electrician can access the equipment without any physical restriction.

4.5.3.2 Layout the Conduit and Wiring System

The conduit and wiring systems are best prepared by plotting the lighting plan on a large-scale plot. The designer should incorporate the following procedures into the lighting plan:

- Conduits and junction boxes on plan sheets are diagrammatic and actual conduits and junction boxes shall conform to the field and ROW conditions.
- Junction boxes are placed on either side of conduit road crossings.
- A junction box should be placed at the base of each overhead sign structure.
- On long, uninterrupted conduit runs, a junction box should be placed every 250 feet to ease in pulling the wire.

- Junction boxes should be placed at the base of each light pole where #0 AWG (also known as #1/0) wires or larger are used to feed power to the pole. For wire sizes #1 or smaller, a transformer base may be used to splice the luminaire wires to the branch conductors.
- Conduit used in roadway lighting is typically no smaller than 2 inches. Exposed conduit used for under bridge lighting systems should be 1 inch or smaller.
- On projects that require the VDOT contractor to install conduit from the local power company service drop to the VDOT meter base and control center, the lighting designer should verify the required conduit size and number with the power company representative.
- Conduit size is based on the NEC 40% fill rule for roadway lighting system.

4.5.3.3 Calculate Voltage Drop, Wire Size, Conduit Size and Junction Box Size

Voltage drop calculations must be performed for the entire roadway lighting system. The designer should incorporate the following procedures into the lighting plan:

- VDOT does not require a specific wire size to be used in roadway lighting systems; however, due to issues with tensile strength, #8 conductor cable is the minimum suggested wire size in any buried conduit runs.
- Wire sizes over #000 (also known as #3/0) are discouraged, but not prohibited. They are difficult to pull and splice over the long distances associated with roadway lighting projects.
- The NEC requires total voltage drop in the branch circuits from the panelboard not to exceed 3%. An exception to the NEC allows for the combined voltage drop of the electrical system (branch circuit and feeders) not to exceed 5%.
- #10 or #12 AWG wire is installed from the base of all lighting standards to the luminaires. This size wire is also installed in high mast lighting standards that may be as much as 150 feet in height. This wire is incidental to the cost of the luminaire per VDOT *Road and Bridge Specifications*, Section 705, and not included in the summary of quantities or cost estimate.
- The pole wire is spliced to the branch circuit in the base of the pole with breakaway fuse. Sufficient space must be allowed in the pole base to make the splice. The NEC provides guidance on volume requirements and junction box sizing.
- When operating at voltages higher than 240 Volts, consider providing separate poles to accommodate lighting (instead of routing the luminaire wires through traffic signal poles) for maintenance and signal technician safety purposes.
- Luminaires on overhead sign structures are powered by #10 or #12 AWG wire installed from the fused safety switch to the luminaire. This wire will rise at least 20’ and may reach as far as 60 feet across the roadway. The cost of this wire is incidental to the sign lighting system.
- The panelboard schedule is created and included in the final plan set. Circuit breaker and contactor sizes are chosen in accordance with NEC requirements and specified on the plans.
- Circuit breakers are intended to protect the conductor cables and contactors. However, NEC requirements state that the circuit breaker ratings not exceed 125% of the normal operating load, except to round up to the nearest commercially available breaker size.
- Contactors switch the lights on and off at dusk and dawn in conjunction with the photoelectric cell. On 3-phase control centers, contactors are normally 3-pole with a 277-Volt coil. They must

have a rating that exceeds the circuit breaker protecting it. Due to the cost of replacing contactors, it is usually best to require a rating far in excess of the normal load. Using the previous example, it is typical to install a 3-pole contactor rated at 60-amps per pole.

4.5.3.4 Detailed Design Cost Estimate

After the detailed design is complete the designer should generate an itemized cost estimate for the required lighting project elements. Estimates for bid-based projects advertisement shall follow the procedures established by the *VDOT Cost Estimation Office Memorandum IIM-CEO-01* and *VDOT Cost Estimating Manual* and should be developed using an approved format as directed by the Project Manager*. The cost estimate should include all items to be furnished and installed by the contractor and/or state forces. The cost estimate should also include a contingency factor, CEI, and any third-party costs such as electrical service or communication service provider installation costs. Projects delivered using preestablished VDOT contracts should use contract items, identify work order items, and build the estimate in a format agreed upon by the Contract Administrator (typically in spreadsheet format).

4.5.3.5 Anticipated Detailed Design Phase Deliverables:

- Detailed Lighting Design Plan, adding conduit system and junction box layout, and proposed wiring system; and
- Detailed itemized cost estimate.

4.5.4 FINAL DESIGN PHASE:

This phase includes preparing the plan package, developing specific details, legends, diagrams, charts, and notes. Also develop general, quantity summaries, and plan notes.

The lighting plans prepared during the final design phase will result in what is defined in the VDOT Project Development Process as PAC plans.

4.5.4.1 Apply Lighting Symbols & Plan Call-Outs

After the development of the entire roadway lighting plan described in Section 4.5.1 through 4.5.3, the various roadway lighting symbols are added to the plan sheets. Call-outs are placed on the plan sheet indicating each required pay item to be installed by the contractor. These call-outs and symbols must exactly match the pay item description in the Specifications. A sample plan that includes call-outs is included in the Appendix.

Luminaire Call-outs

Each luminaire call-out should include an annotation indicating its source of power. For a 3-phase lighting system, this note should reference the phase, control center, and circuit from which it is fed.

Conventional luminaire call-outs must include a reference to wattage, luminaire arm length, and mounting height. If wattage is not the same for all luminaires, the maximum wattage and minimum lumens should be stated in the General Notes*.

Offset luminaire call-outs must include a reference to wattage and mounting height*.

High mast luminaire assembly call-outs must include a reference to wattage and number of luminaires on the assembly. The pole length is frequently included in the luminaire call-out for clarity; however, this annotation may be redundant to the "Pole Type" associated with the pole call-out. If a high mast luminaire must be installed with its optics oriented at a specific bearing, an arrow must be added to the symbol to indicate the luminaire's aiming direction.

Pole Call-outs

The pole call-out provides the contractor with a pole location, pole number, pole type, and if the pole is to be equipped with a breakaway base.

- The pole location usually references a survey baseline as explained earlier in this document.
- The pole type refers to the lighting standard pay item and pole length.
- The base of each pole symbol must be placed on the plan sheet at its required location and oriented to match the required aiming direction.

Example:
An LP-1 pole intended to be placed at a specific station and offset should be shown on the plan sheet with the pole base at the required point relative to the baseline. The symbol should then be oriented such that the LP-1 bracket arm and luminaire are aimed in the direction that provides the best illumination of the roadway. Many times, this orientation results in placing the bracket arm and luminaire perpendicular to the edge of the curb.

Conduit Call-outs

The conduit call-outs must include the size of the conduit (proposed or existing) and/or pipe sleeve, and the number/size of conductor cables. Additional information may be included to clarify circuit connections. For example, the call-out might include an annotation regarding any special requirements such as "Metal," "Conduit mounted to bridge abutment," etc.

Circuit Details

Some plan sheets may require a more detailed description of the electrical circuitry involved with construction. These details may involve complicated splicing at a junction box. An example of a circuit detail is shown in the Appendix.

4.5.4.2 Lighting System Survey and Alignment

The conditions of a specific project may require a lighting design that is not constructed in conjunction with a roadway construction project. In some cases, the roadway construction project may be nearing completion, and the lighting project may simply utilize the survey and as-built roadway plans. In other situations, the lighting designer may need to acquire full aerial mapping and survey to complete the lighting plan. In either case, a stand-alone lighting project must include a complete set of survey and alignment plan sheets.

Survey and Alignment Based on Roadway Construction Plans

Projects that are constructed during or immediately following a roadway construction project may utilize the roadway construction baselines to establish the light pole locations. This system is used in the example plan sheet presented in the Appendix. For example, a lighting standard is frequently located with a station and offset such as:

STA. 103+15, 35' LT.
RT-460 CONST. B_L

If the lighting plans are not included in the complete set of roadway construction plans, the roadway lighting plan set is considered a stand-alone project and should utilize:

- The Survey including existing and proposed roadway alignment;
- The Proposed Alignment Data Sheets; and
- Benchmarks.

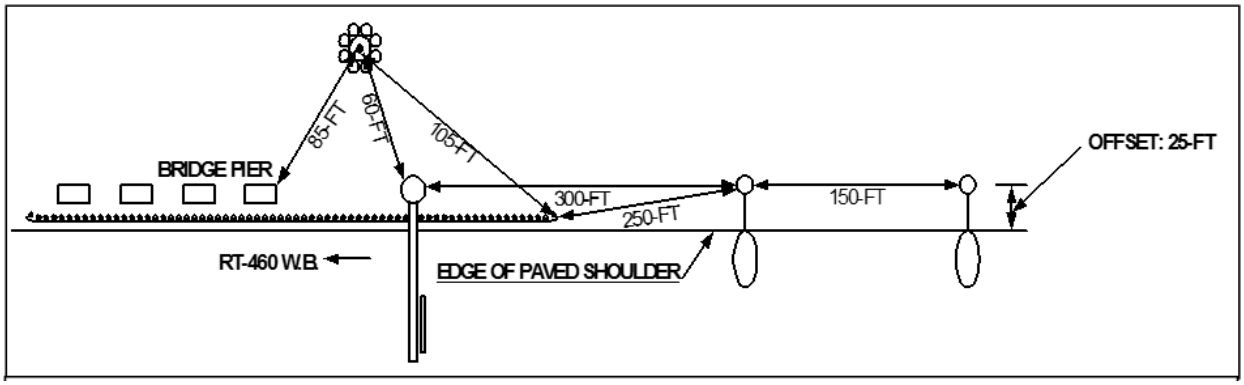
Stand-Alone Roadway Lighting Projects

Stand-alone lighting projects that require a complete new set of aerial mappings and survey can establish the location of the proposed lighting standards in several ways:

a.) **Option 1:** A construction baseline can be established in the same manner as that of a roadway construction project.

b.) **Option 2:** Lighting standard locations may also be established using a set of swing ties. Three swing-ties should be established for every standard as shown in Figure 4-7.

Figure 4-7: Pole Locations Using Swing Ties

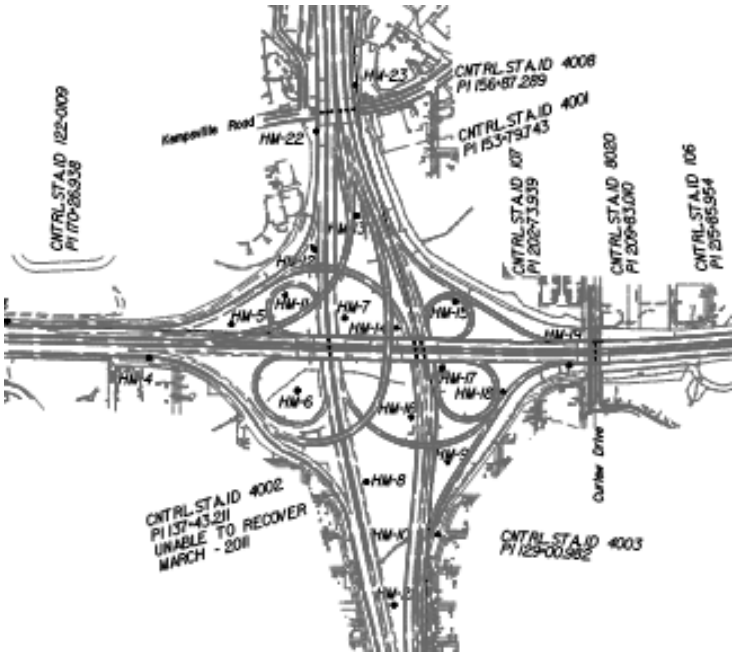


Option 3: The lighting designer may elect to locate the lighting standards using a coordinate system referenced to the VDOT Project Coordinate System. This system provides the construction surveyor the ability to use a GPS instrument to locate the proposed pole locations and deliver to VDOT the final as-staked (as-built) pole locations. These pole coordinates may be used to develop a pole inventory in a GIS format.This method is advantageous in cases where the cost of maintenance of traffic to establish baselines may be prohibitive. Also, it may be impractical to expect a surveyor to rely on survey points separated by difficult topography, such as densely wooded ramp systems or high median barriers. Figure 4-8 shows an example detail sheet where

the poles are numbered on the plan and a table is shown referencing the pole numbers to northings and eastings.

Figure 4-8: Pole Locations Coordinate System

POLE NUMBER	NORTHING	EASTING
HW-1	198884.386	3954864.453
HW-2	198136.015	3954846.180
HW-3	197176.980	3955044.524
HW-4	196186.472	3954787.844
HW-5	195610.446	3955021.375
HW-6	195150.122	3954559.483
HW-7	194820.549	3955065.883
HW-8	194568.050	3953921.820
HW-9	194100.493	3954058.916
HW-10	194170.799	3953554.448
HW-11	195233.979	3955225.829
HW-12	195030.145	3955541.367
HW-13	194736.145	3955780.028
HW-14	194457.080	3954998.198
HW-15	194048.267	3955177.161
HW-16	194354.932	3954371.518
HW-17	194143.187	3954716.779
HW-18	193714.051	3954554.308
HW-19	193250.136	3954735.898
HW-20	194182.321	3952218.040
HW-21	194475.659	3953063.548
HW-22	195018.892	3956369.937
HW-23	194745.409	3956692.852
CH-1	194435.945	3952079.174
CH-2	194492.327	3952282.564
CH-3	194538.122	3952475.885



4.5.4.3 Determining Quantities

The VDOT Specifications provide measurement and payment for most items in a roadway lighting project. Specific items not covered under the Specifications are addressed through Special Provisions or Special Provision Copied Notes.

The pay item on the Summary of Quantities sheet should match exactly the standard VDOT pay items. A current list of standard pay items can be found on the VDOT web site.

The following section describes items that require special attention in calculating estimated quantities.

Conduit, Cable, and Trench

The Summary of Quantities includes the amount of conduit required for each plan sheet. However, in computing the amount of conduit, cable, and trenching required on a plan sheet, the lighting designer should make some consideration for cable splices and conduit bends around the various drainage structures and other features found along the roadway, i.e., variation of terrain. Similarly, conductor cable will not lie perfectly straight or flat in the conduit. The sum totals of the following items should be increased to compensate for variation encountered during construction. The percentages noted below are sample rules-of-thumb that may be used to accommodate those conditions:

- Conductor cable: increased 10%;
- Conduit: increased 5%; and
- Trench: increased 5%.

Bored Conduit

Trench Excavation is **not** required in areas where Jacked Pipe Sleeve or Bored Conduit is installed.

Pipe Sleeve

The current Specifications and Standards do not cover Pipe Sleeve. A modification to the VDOT Specification must be included in the contract documents in those cases where Pipe Sleeve is required on a lighting plan. The Summary of Quantities should include trenching (ECI-1) wherever Pipe Sleeve is required.

Equipment Grounding Connector (EGC)

The EGC is separate pay item and is quantified separately from conductor cable.

4.5.4.4 Final Design Cost Estimate

Refine the final design cost estimate based on final design adjustments and additions. Ensure non-standard and/or work order items are included and corresponding special provisions developed.

4.5.4.5 Anticipated Final Design Phase Deliverables

- Final Lighting Design Plan Set;
- Final itemized cost estimate using the appropriate VDOT bid items or preestablished contract items; and
- Non-standard item and project specific Special Provisions and Copied Notes.

4.6 PHASES AND DELIVERABLES SUMMARY

The following Table summarizes the deliverables for each task for use as a checklist to ensure all applicable deliverables are completed in the respective phase.

Table 4-1: Deliverables by Phase

Scoping Phase	
Item	**Requirement**
Lighting Warrant Evaluation	Required
Preliminary Design Phase	
Item	**Requirement**
Complete Limits of Additional Survey	As needed
Preliminary Lighting Plan & Photometric Analysis	Required
Preliminary Cost Estimate	Required
Detailed Design Phase	
Item	**Requirement**
Revised Lighting Plan	Required
Conduit & Wiring System Layout	Required
Voltage Drop Calculations	Required
Itemized Cost Estimate	Required
Final Design Phase	
Item	**Requirement**
Final Lighting Plans	Required
Non-Standard Plan Details	Required
Final Itemized Cost Estimate	Required
Summary of Quantities Sheet	Required

Virginia Department of Transportation

Traffic Engineering Design Manual

Appendix A:
VDOT Traffic Signal Design Plans

April 2020

Revision 1
March 2023

Location & Design Division

VDOT GOVERNANCE DOCUMENT

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	IH5

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

TEMPORARY SIGNAL LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Wood Signal Pole & Foundation and Mast Arm (As noted In Signal Pole Legend)		
Pedestal Pole and Foundation (St'd.PF-2)		
Pedestal Pole and Foundation (St'd.PA-3)		
Traffic Signal Head w/ Backplate		
Traffic Signal Head w/o Backplate		
Pedestrian Signal Head		
Pedestrian Pushbutton & Sign	P.B.	P.B.
Traffic Signal Sign Mast Arm or Span Wire Mt'd.		
Traffic Signal Sign Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor		
w/ Conf.Light		
w/o Conf.Light		
Video Detection Camera - Type III 360		
Junction Box (St'd.as noted on plans)	J	J
Signal Luminaire (250 W) and Arm		
Signal Luminaire (400 W) and Arm		
Loop Detector (Size as noted on plans)	6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)	VDZ 6' x 20'	VDZ 6' x 20'
Conduit		

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted	C	C
	Pole Mounted	C	C
Master Controller Cabinet	Ground Mounted	MC	MC
	Pole Mounted	MC	MC
Controller Cabinet & Foundation	Std.CF-1	C 1	C 1
	Std.CF-3	C 3	C 3
	Std.CF-4	C 4	C 4
Master Controller Cabinet & Foundation	Std.CF-1	MC 1	MC 1
	Std.CF-3	MC 3	MC 3
	Std.CF-4	MC 4	MC 4
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2
Junction Box	S3	Proposed Pedestrian Signal Head	P2	Sign	S-1
		Existing Pedestrian Signal Head	P2	Video Detection Camera	VDC-1
				Emergency Preemption Detector	EVP-1

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD
OLD TOWNE ROAD DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	IH5

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

(A) WOOD SIGNAL POLE (WD-2)
Pole A to Pole B
Install Signal Cabinet and Controller on Wood Signal Pole
Install Electrical Service Type SE-3 Type A on Wood Signal Pole

(B) WOOD SIGNAL POLE (WD-2)
Pole B to Pole C

(C) WOOD SIGNAL POLE (WD-2)
Pole C to Pole D

(D) WOOD SIGNAL POLE (WD-2)
Pole D to Pole A

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	IH6

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

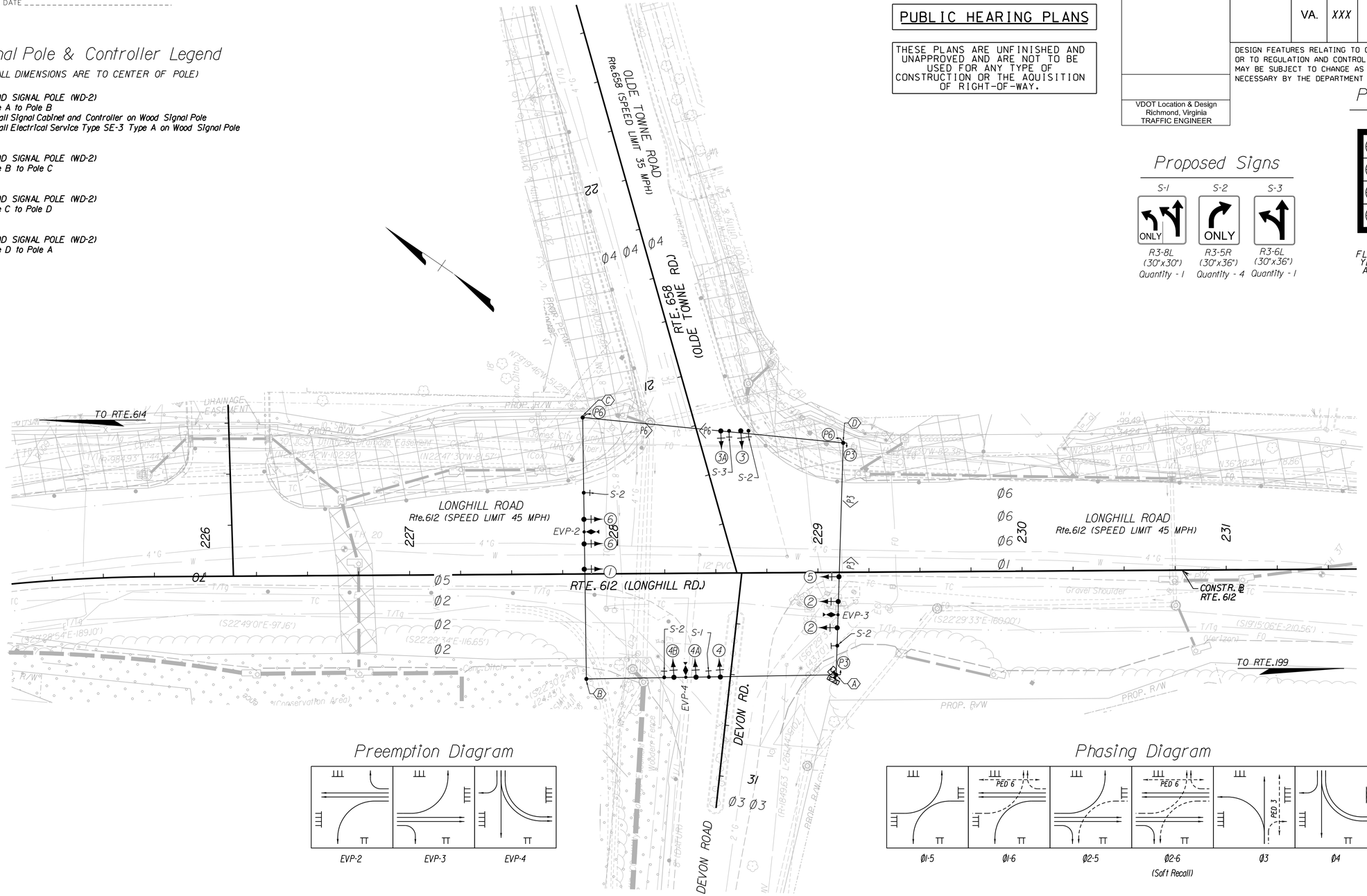
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

Proposed Signs

S-1: R3-8L (30"x30") Quantity - 1
S-2: R3-5R (30"x36") Quantity - 4
S-3: R3-6L (30"x36") Quantity - 1

Proposed Signals

1,5 FLASHING YELLOW ARROW
2,3,6
4
4B
3A,4A
SP-9
P3, P6



Preemption Diagram

Phasing Diagram

SPEED LIMITS	
Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

MOT Plan Sheets	IJIB(5)

TRAFFIC CONTROL DEVICE PLANS

TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	IH6

PROJECT MANAGER_____
SURVEYED BY _____
DESIGN SUPERVISED BY_____
DESIGNED BY _____

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(1)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

STANDARD TRAFFIC SIGNAL LEGEND

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Metal Signal Pole & Foundation and Mast Arm (As noted in Signal Pole Legend)			
Pedestal Pole and Foundation (Std.PF-2)			
Pedestal Pole and Foundation (Std.PA-3)			
Traffic Signal Head	w/ Backplate		
	w/o Backplate		
Pedestrian Signal Head			
Pedestrian Pushbutton & Sign		P.B.	P.B.
Traffic Signal Sign	Mast Arm or Span Wire Mt'd.		
	Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor			
	w/ Conf.Light		
	w/o Conf.Light		
Video Detection Camera			
Video Detection Camera - Type III 360			
Junction Box (Std.as noted on plans)			J
Roadway Luminaire			
Loop Detector (Size as noted on plans)		6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)		VDZ 6' x 20'	VDZ 6' x 20'
Conduit			
Wireless Antenna			

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted		
	Pole Mounted		
Master Controller Cabinet	Ground Mounted	MC	MC
	Pole Mounted	MC	MC
Controller Cabinet & Foundation	Std.CF-1	1	1
	Std.CF-3	C 3	C 3
	Std.CF-4	4	4
	Std.CF-5	5	C 5
Master Controller Cabinet & Foundation	Std.CF-1	MC 1	MC 1
	Std.CF-3	MC 3	MC 3
	Std.CF-4	MC 4	MC 4
	Std.CF-5	MC 5	MC 5
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2	Sign	S-1
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2	Video Detection Camera	VDC-1
Junction Box	S3	Proposed Pedestrian Signal Head	P2			Emergency Preemption Detector	EVP-1
		Existing Pedestrian Signal Head	P2				

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LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

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TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL
INDEX OF SHEETS, GENERAL NOTES & LEGENDS

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(1)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

(1) CONTROLLER CABINET & FOUNDATION (CF-5)

(A) MAST ARM POLE MP-3,TYPE E1
60' Arm 270° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,270° Angle to Constr.℄

(B) MAST ARM POLE MP-3,TYPE D
49' Arm 0° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,267° Angle to Constr.℄

(C) MAST ARM POLE MP-3,TYPE E1
65' Arm 90° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,91° Angle to Constr.℄

(D) MAST ARM POLE TYPE MP-3,TYPE D
30' Arm 180° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,88° Angle to Constr.℄

(E) PEDESTAL POLE (PF-2),10'

(F) PEDESTRIAN ACTUATION (PA-3)

(G) PEDESTAL POLE (PF-2),10'

(H) PEDESTRIAN ACTUATION (PA-3)

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(3)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

Proposed Signs

S-1 R3-8L (30"x30") Quantity - 1

S-2 R3-5R (30"x36") Quantity - 4

S-3 R3-6L (30"x36") Quantity - 1

S-4 Longhill Rd (FIGURE 1) (SHEET NO.12(2A)1) (78"x18") Quantity - 2

S-5 ← Olde Towne Rd / Devon Rd → (FIGURE 2) (SHEET NO.12(2A)1) (126"x30") Quantity - 1

S-6 ← Devon Rd / Olde Towne Rd → (FIGURE 3) (SHEET NO.12(2A)1) (126"x30") Quantity - 1

Proposed Signals

1,5 FLASHING YELLOW ARROW

2,3,6

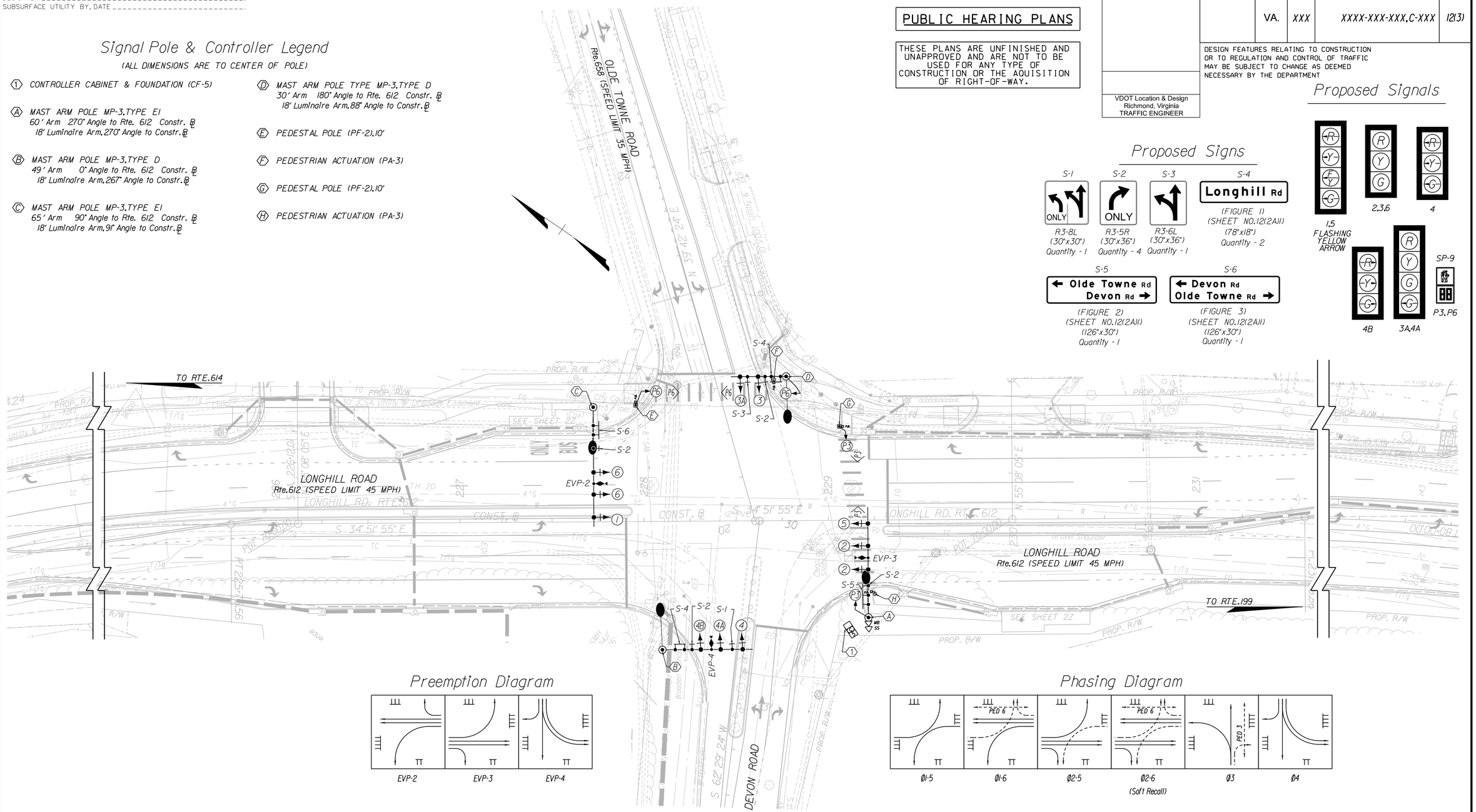
4

4B

3A,4A

SP-9

P3, P6



Preemption Diagram

Phasing Diagram

SPEED LIMITS	
Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

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LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheets	4,5
Signing and Pavement Marking Plan Sheets	II(4),II(5)

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(3)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	IH5

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

RW PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

TEMPORARY SIGNAL LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Wood Signal Pole & Foundation and Mast Arm (As noted In Signal Pole Legend)		
Pedestal Pole and Foundation (St'd.PF-2)		
Pedestal Pole and Foundation (St'd.PA-3)		
Traffic Signal Head w/ Backplate		
Traffic Signal Head w/o Backplate		
Pedestrian Signal Head		
Pedestrian Pushbutton & Sign	P.B.	P.B.
Traffic Signal Sign Mast Arm or Span Wire Mt'd.		
Traffic Signal Sign Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor		
w/ Conf.Light		
w/o Conf.Light		
Video Detection Camera - Type III 360		
Junction Box (St'd.as noted on plans)	J	J
Signal Luminaire (250 W) and Arm		
Signal Luminaire (400 W) and Arm		
Loop Detector (Size as noted on plans)	6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)	VDZ 6' x 20'	VDZ 6' x 20'
Conduit		

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted	C	C
Controller Cabinet	Pole Mounted	C	C
Master Controller Cabinet	Ground Mounted	MC	MC
Master Controller Cabinet	Pole Mounted	MC	MC
Controller Cabinet & Foundation	Std.CF-1	C 1	C 1
Controller Cabinet & Foundation	Std.CF-3	C 3	C 3
Controller Cabinet & Foundation	Std.CF-4	C 4	C 4
Master Controller Cabinet & Foundation	Std.CF-1	MC 1	MC 1
Master Controller Cabinet & Foundation	Std.CF-3	MC 3	MC 3
Master Controller Cabinet & Foundation	Std.CF-4	MC 4	MC 4
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2
Junction Box	S3	Proposed Pedestrian Signal Head	P2		
		Existing Pedestrian Signal Head	P2		

Sign	S-1	
Video Detection Camera	VDC-1	
Emergency Preemption Detector	EVP-1	

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD
OLD TOWNE ROAD DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	IH5

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

(A) WOOD SIGNAL POLE (WD-2)
Pole A to Pole B
Install Signal Cabinet and Controller on Wood Signal Pole
Install Electrical Service Type SE-3 Type A on Wood Signal Pole

(B) WOOD SIGNAL POLE (WD-2)
Pole B to Pole C
Install Video Detection Camera - Type III 360 on Wood Signal Pole

(C) WOOD SIGNAL POLE (WD-2)
Pole C to Pole D

(D) WOOD SIGNAL POLE (WD-2)
Pole D to Pole A

RW PLANS

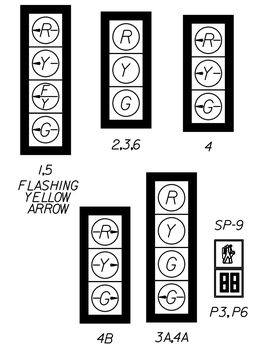
THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

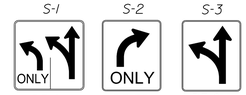
REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	IH6

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

Proposed Signals



Proposed Signs



Pavement Marking Legend

(A) Existing 24" Stop Bar

Preemption Diagram

Phasing Diagram

SPEED LIMITS

Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

MOT Plan Sheets	IJIB(5)

TRAFFIC CONTROL DEVICE PLANS
TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	IH6

PROJECT MANAGER _____
SURVEYED BY _____
DESIGN SUPERVISED BY _____
DESIGNED BY _____

RW PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(1)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

STANDARD TRAFFIC SIGNAL LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Metal Signal Pole & Foundation and Mast Arm (As noted in Signal Pole Legend)		
Pedestal Pole and Foundation (Std.PF-2)		
Pedestal Pole and Foundation (Std.PA-3)		
Traffic Signal Head — w/ Backplate		
Traffic Signal Head — w/o Backplate		
Pedestrian Signal Head		
Pedestrian Pushbutton & Sign	P.B.	P.B.
Traffic Signal Sign — Mast Arm or Span Wire Mt'd.		
Traffic Signal Sign — Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor		
w/ Conf.Light		
w/o Conf.Light		
Video Detection Camera		
Video Detection Camera - Type III 360		
Junction Box (Std.as noted on plans)	J	J
Roadway Luminaire		
Loop Detector (Size as noted on plans)	6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)	VDZ 6' x 20'	VDZ 6' x 20'
Conduit		
Wireless Antenna		

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted	CC	CC
Controller Cabinet	Pole Mounted	CC	CC
Master Controller Cabinet	Ground Mounted	MC	MC
Master Controller Cabinet	Pole Mounted	MC	MC
Controller Cabinet & Foundation	Std.CF-1	CC 1	CC 1
Controller Cabinet & Foundation	Std.CF-3	CC 3	CC 3
Controller Cabinet & Foundation	Std.CF-4	CC 4	CC 4
Controller Cabinet & Foundation	Std.CF-5	CC 5	CC 5
Master Controller Cabinet & Foundation	Std.CF-1	MC 1	MC 1
Master Controller Cabinet & Foundation	Std.CF-3	MC 3	MC 3
Master Controller Cabinet & Foundation	Std.CF-4	MC 4	MC 4
Master Controller Cabinet & Foundation	Std.CF-5	MC 5	MC 5
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2
Junction Box	S3	Proposed Pedestrian Signal Head	P2		
		Existing Pedestrian Signal Head	P2		

Sign	S-1		
Video Detection Camera	VDC-1		
Emergency Preemption Detector	EVP-1		

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL
INDEX OF SHEETS, GENERAL NOTES & LEGENDS

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(1)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(3)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

RW PLANS

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Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

① CONTROLLER CABINET & FOUNDATION (CF-5)

Ⓐ MAST ARM POLE MP-3,TYPE E1
60' Arm 270° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,270° Angle to Constr.℄

Ⓑ MAST ARM POLE MP-3,TYPE D
49' Arm 0° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,267° Angle to Constr.℄

Ⓒ MAST ARM POLE MP-3,TYPE E1
65' Arm 90° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,91° Angle to Constr.℄

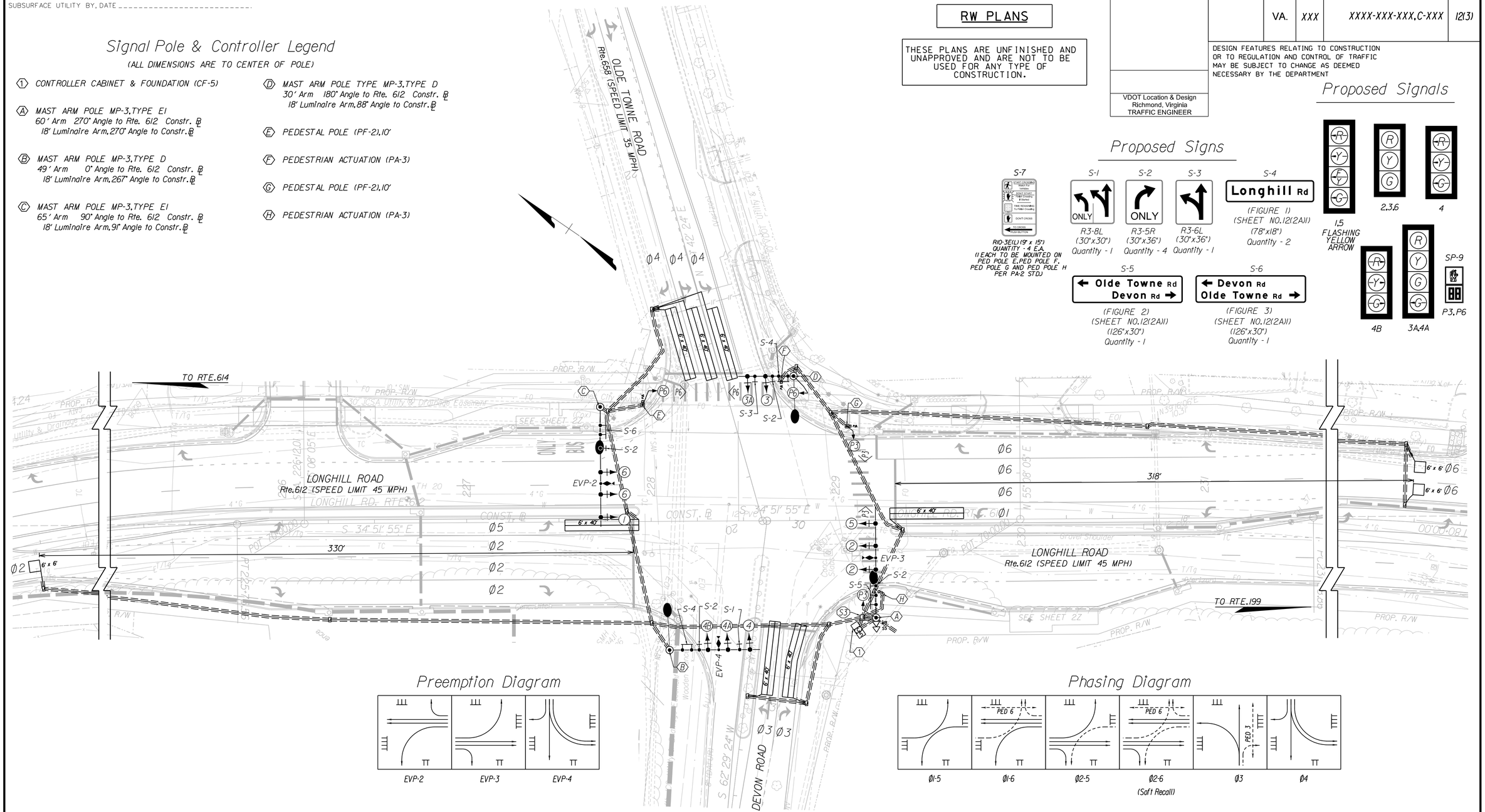
Ⓓ MAST ARM POLE TYPE MP-3,TYPE D
30' Arm 180° Angle to Rte. 612 Constr. ℄
18' Luminaire Arm,88° Angle to Constr.℄

Ⓔ PEDESTAL POLE (PF-2),10'

Ⓕ PEDESTRIAN ACTUATION (PA-3)

Ⓖ PEDESTAL POLE (PF-2),10'

Ⓗ PEDESTRIAN ACTUATION (PA-3)



Proposed Signs

S-7
R10-3E(L) (9" x 15")
QUANTITY - 4 EA.
(1 EACH TO BE MOUNTED ON PED POLE E, PED POLE F, PED POLE G AND PED POLE H PER PA-2 STD.)

S-1
R3-8L (30"x30")
Quantity - 1

S-2
R3-5R (30"x36")
Quantity - 4

S-3
R3-6L (30"x36")
Quantity - 1

S-4
Longhill Rd
(FIGURE 1) (SHEET NO.12(2A)1) (78"x18")
Quantity - 2

S-5
← Olde Towne Rd
Devon Rd →
(FIGURE 2) (SHEET NO.12(2A)1) (126"x30")
Quantity - 1

S-6
← Devon Rd
Olde Towne Rd →
(FIGURE 3) (SHEET NO.12(2A)1) (126"x30")
Quantity - 1

Proposed Signals

1,5 FLASHING YELLOW ARROW

2,3,6

4

4B

3A,4A

SP-9

P3, P6

Preemption Diagram

Phasing Diagram

JUNCTION BOX LEGEND

All Junction Boxes shall conform to St'd.JB-S2 unless otherwise noted on the plans.

(S3) Denotes St'd.JB-S3

SPEED LIMITS

Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheets	4,5
Signing and Pavement Marking Plan Sheets	11(4),11(5)

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(3)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	IH5

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

INDEX OF SHEETS

GENERAL NOTES FOR TEMPORARY SIGNALS

1. THE CONTRACTOR SHALL KEEP EACH TRAFFIC SIGNAL IN THE PROJECT LIMITS OPERATIONAL AT ALL TIMES DURING CONSTRUCTION THROUGH THE USE OF THE EXISTING SIGNAL, THE TEMPORARY SIGNAL, THE PERMANENT SIGNAL OR ANY COMBINATION THEREOF. THE CONTRACTOR SHALL FURNISH, INSTALL, MAINTAIN, RELOCATE, AND REMOVE EXISTING, TEMPORARY, AND PROPOSED TRAFFIC SIGNAL EQUIPMENT AND ALL NECESSARY HARDWARE AS NEEDED THROUGHOUT THE DURATION OF CONSTRUCTION AND IN CONFORMANCE WITH THE APPLICABLE SPECIFICATIONS.
2. THE TEMPORARY SIGNALIZATION PLANS INCLUDED IN THE PROJECT PLAN ASSEMBLY SHALL BE FOLLOWED UNLESS THE CONTRACTOR SUBMITS ALTERNATE TEMPORARY SIGNALIZATION PLANS TO THE ENGINEER. ALL ALTERNATE TEMPORARY SIGNALIZATION PLANS SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPLEMENTATION.

   THESE TEMPORARY SIGNALIZATION PLANS HAVE BEEN DESIGNED FOR THE SEQUENCE OF CONSTRUCTION (S.O.C.)/MAINTENANCE OF TRAFFIC (M.O.T.) SCHEME CONTAINED IN THE PROJECT PLAN ASSEMBLY. THE CONTRACTOR SHALL INCLUDE REVISED TEMPORARY SIGNALIZATION PLANS WITH ALL ALTERNATE S.O.C./M.O.T. SUBMISSIONS. ALL ALTERNATE TEMPORARY SIGNALIZATION PLANS SHALL BE APPROVED BY THE ENGINEER PRIOR TO IMPLEMENTATION.
3. THE CONTRACTOR SHALL RELOCATE THE EXISTING AND TEMPORARY TRAFFIC SIGNAL HEADS AND APPURTENANCES (WOOD POLES, SPAN WIRE, SIGNS, DETECTORS, ETC.) AND REVISE THE SIGNAL PHASING AND TIMING AS MANY TIMES AS DEEMED NECESSARY DURING CONSTRUCTION TO MAINTAIN AND PROTECT TRAFFIC AS SHOWN ON THE PLANS OR AS PROPOSED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER.
4. ALL TEMPORARY TRAFFIC SIGNAL WORK SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH THE PLANS, THE VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT) ROAD & BRIDGE SPECIFICATIONS DATED 2007, VDOT ROAD & BRIDGE STANDARDS DATED 2008, THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, 2003 EDITION (MUTCD), THE VIRGINIA SUPPLEMENT TO THE MUTCD, THE 2002 NATIONAL ELECTRICAL CODE, SPECIAL PROVISION COPIED NOTES AND SPECIAL PROVISIONS AT THE TIME OF THIS ADVERTISEMENT.
5. AT LEAST 3 WORKING DAYS PRIOR TO BEGINNING WORK, THE CONTRACTOR SHALL CONTACT "MISS UTILITY OF VIRGINIA" (1-800-552-7001) IN ORDER TO DETERMINE THE EXTENT AND LOCATION OF ALL UNDERGROUND UTILITIES WITHIN THE PROJECT LIMITS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING OR REPLACING, AT HIS OWN EXPENSE ANY EXISTING UTILITIES, PAVEMENT, CONCRETE ITEMS, PIPES, ETC., THAT ARE DAMAGED DURING CONSTRUCTION.
6. TRAFFIC SIGNAL HEADS NOT IN USE AND OVERHEAD TRAFFIC SIGNAL SIGNS NOT APPLICABLE TO THE CURRENT TRAFFIC PATTERN SHALL BE COVERED IN ACCORDANCE WITH SECTION 703.03(C) UNLESS OTHERWISE NOTED. THE CONTRACTOR SHALL INSTALL AND MAINTAIN THE COVERS ON THE DEVICES UNTIL SUCH DEVICES ARE REMOVED OR RESTORED TO OPERATION.
7. WOOD POLES TO BE INSTALLED IN ACCORDANCE WITH VDOT ST'D WD-2. WOOD POLE SIZE AND CLASS SHALL BE DETERMINED BY THE CONTRACTOR.
8. A CONTINUOUS WIRE (NO SPLICES) SHALL BE RUN BETWEEN THE CONTROLLER CABINET AND THE TERMINAL IN THE FIRST SIGNAL HEAD. JUMPERS BETWEEN THE SIGNAL HEAD OF SIMILAR PHASES ARE PERMITTED BUT SHALL HAVE NO SPLICES.
9. ALL TEMPORARY TRAFFIC SIGNAL HEADS SHALL BE 12 INCH LED SECTIONS WITH TUNNEL VISORS ON ALL INDICATIONS. INSTALLATION SHALL BE IN ACCORDANCE WITH VDOT ST'Ds. SIGNAL HEAD SECTION MATERIAL SHALL CONFORM TO SECTION 703.02(e) FOR THE APPLICABLE TYPE OF INSTALLATION.
10. ALL UNUSED WIRES IN THE SIGNAL HEADS SHALL BE CAPPED INDIVIDUALLY WITH CRIMP TYPE CAPS.
11. THROUGHOUT THE DURATION OF CONSTRUCTION, THE CONTRACTOR SHALL PROVIDE DETECTION ON THE EXISTING, TEMPORARY, AND/OR NEW ROADWAY ALIGNMENT FOR ALL INTERSECTION APPROACHES OR AS SHOWN ON THE PLANS. THE CONTRACTOR SHALL FURNISH, INSTALL, MAINTAIN, RELOCATE AND REVISE THE NECESSARY EQUIPMENT TO PROVIDE VEHICLE DETECTION DURING EACH STAGE/PHASE OF CONSTRUCTION. DURING CONSTRUCTION, IF A DETECTOR BECOMES NON-OPERATIONAL, THE ASSOCIATED PHASE SHALL BE PUT ON MAX RECALL AND THE CONTRACTOR SHALL PROVIDE DETECTION WITHIN 24 HOURS. VIDEO DETECTION IS SHOWN HEREIN, BUT THE TYPE OF DETECTION USED SHALL BE AT THE CONTRACTOR'S DISCRETION. DETECTION FOR TRAVEL LANES SHOWN IS APPROXIMATE. ALL DETECTION ZONES SHALL BE COORDINATED AND APPROVED BY THE ENGINEER.
12. THE CONTRACTOR SHALL LABEL ALL SPARE WIRES IN THE CONTROLLER CABINET, IN ACCORDANCE WITH SECTION 700.04(g) OF THE ROAD AND BRIDGE SPECIFICATIONS.
13. THE CONTRACTOR SHALL BE RESPONSIBLE TO RETURN ALL DISTURBED AREAS, LANDSCAPING (TREES, SHRUBS, FLOWERS, ETC.) AND FENCING TO THEIR ORIGINAL STATE AT THE COMPLETION OF ALL WORK. DISTURBED AREAS SHALL BE SEEDED IN ACCORDANCE WITH SECTION 603 AND SECTION 605 OF THE SPECIFICATIONS, AND ALL COST FOR THIS ITEM SHALL BE INCLUDED IN THE PRICE BID FOR OTHER ITEMS. NO SEPARATE MEASUREMENT WILL BE MADE.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE SIGNAL CABLE SLACK TO ACCOMMODATE ALL SIGNAL HEAD RELOCATIONS DURING CONSTRUCTION.
15. THE CONTRACTOR SHALL MONITOR TRAFFIC CONDITIONS DURING TEMPORARY SIGNALIZATION AND SHALL ADJUST THE GREEN INDICATION TIMINGS AS NECESSARY TO MINIMIZE DELAY AND QUEUING. THE CONTRACTOR SHALL ALSO ADJUST SIGNAL TIMINGS AS DIRECTED BY THE ENGINEER.
16. YELLOW AND ALL RED CLEARANCE INTERVAL TIMINGS SHALL BE CALCULATED AND IMPLEMENTED FOR EACH PHASE OF CONSTRUCTION. ALL YELLOW AND ALL RED CLEARANCE INTERVAL TIMINGS SHALL ADHERE TO THE METHODOLOGY IN TRAFFIC ENGINEERING MEMORANDUM "306 (TE-306) AND SHALL BE SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE COMMONWEALTH OF VIRGINIA. THE CONTRACTOR SHALL SUBMIT THE SEALED CLEARANCE INTERVAL TIMING CALCULATIONS TO THE NNRO SIGNAL TIMINGS ENGINEERS FOR REVIEW A MINIMUM OF TWO (2) WEEKS PRIOR TO IMPLEMENTATION.
17. PAVEMENT MARKINGS ARE SHOWN ON THE SIGNAL PLANS FOR REPRESENTATIONAL PURPOSES ONLY. ACTUAL PAVEMENT MARKINKS SHALL BE IN ACCORDANCE WITH THE TEMPORARY SIGNING AND PAVEMENT MARKING PLANS.
18. ALL SIGNAL EQUIPMENT SHALL BE REMOVED FROM THE EXISTING SIGNAL INSTALLATION. THE CONTROLLER CABINET, THE UPS CABINET AND ALL CONTENTS THEREIN SHALL BE SALVAGED AND RETURNED TO THE VIRGINIA DEPARTMENT OF TRANSPORTATION. PLEASE CONTACT DAVID PERREIRA AT 804-840-7872 FORTY EIGHT (48) HOURS IN ADVANCE TO COORDINATE THE DELIVERY OF THE CABINETS.
   ALL OTHER EQUIPMENT SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR IN ACCORDANCE WITH R & B SPECIFICATIONS 510.

TEMPORARY SIGNAL LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Wood Signal Pole & Foundation and Mast Arm (As noted in Signal Pole Legend)		
Pedestal Pole and Foundation (St'd. PF-2)		
Pedestal Pole and Foundation (St'd. PA-3)		
Traffic Signal Head w/ Backplate		
Traffic Signal Head w/o Backplate		
Pedestrian Signal Head		
Pedestrian Pushbutton & Sign	P.B.	P.B.
Traffic Signal Sign Mast Arm or Span Wire Mt'd.		
Traffic Signal Sign Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor		
w/ Conf. Light		
w/o Conf. Light		
Video Detection Camera - Type III 360		
Junction Box (St'd. as noted on plans)	J	J
Signal Luminaire (250 W) and Arm		
Signal Luminaire (400 W) and Arm		
Loop Detector (Size as noted on plans)	6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)	VDZ 6' x 20'	VDZ 6' x 20'
Conduit		

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted		
Controller Cabinet	Pole Mounted		
Master Controller Cabinet	Ground Mounted	MC	MC
Master Controller Cabinet	Pole Mounted	MC	MC
Controller Cabinet & Foundation	Std. CF-1	CC 1	CC 1
Controller Cabinet & Foundation	Std. CF-3	CC 3	CC 3
Controller Cabinet & Foundation	Std. CF-4	CC 4	CC 4
Master Controller Cabinet & Foundation	Std. CF-1	MC 1	MC 1
Master Controller Cabinet & Foundation	Std. CF-3	MC 3	MC 3
Master Controller Cabinet & Foundation	Std. CF-4	MC 4	MC 4
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2
Junction Box	S3	Proposed Pedestrian Signal Head	P2		
		Existing Pedestrian Signal Head	P2		

Sign	S-1		
Video Detection Camera	VDC-1		
Emergency Preemption Detector	EVP-1		

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	IH5

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

PAC PLANS

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Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

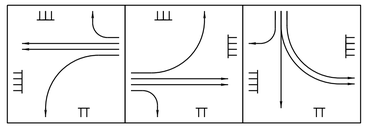
(A) WOOD SIGNAL POLE (WD-2)
50' RT of Longhill Rd Constr.℄ Sta.229 + 9
Pole A to Pole B
Signal Placement: 57', 69', 80'
Sign Placement: 61', 85'
Preemption Placement: 75'
Install Signal Cabinet and Controller on Wood Signal Pole
Install Electrical Service Type SE-3 Type A on Wood Signal Pole

(B) WOOD SIGNAL POLE (WD-2)
51' RT of Longhill Rd.Constr.℄ Sta.227 + 86
Pole B to Pole C
Signal Placement: 54', 66', 78'
Sign Placement: 90'
Preemption Placement: 71'
Install Video Detection Camera - Type III 360 on Wood Signal Pole

(C) WOOD SIGNAL POLE (WD-2)
77' LT of Longhill Rd.Constr.℄ Sta.227 + 85
Pole C to Pole D
Signal Placement: 68', 78'
Sign Placement: 73', 83'

(D) WOOD SIGNAL POLE (WD-2)
63' LT of Ramp A Constr.℄ Sta.229 + 13
Pole D to Pole A
Signal Placement: 66', 78', 90'
Sign Placement: 100'
Preemption Placement: 85'

Preemption Diagram



Color Sequence Chart

SIGNALS	SIGNAL	PHASES 1	2	3	4	5	6	COMBINATIONS 1-5	1-6	2-5	2-6	FLASH
	1	→G	→FY					→G	→G	→FY	→FY	Y*
	2		G							G	G	Y
	3			G								
	3A			G / →G								
	4				→G							
	4A				G / →G							
	4B				G→							
	5					→G	→FY	→G	→FY	→G	→FY	Y*
	6						G		G		G	Y
	P3	DW	DW	W	DW	DW	DW	DW	DW	DW	DW	BLANK
	P6	DW	DW	DW	DW	DW	W	DW	W	DW	W	BLANK

Empty box denotes RED indication (Red ball or red arrow as appropriate)

When operating, the FY indication shall operate in a flashing mode.

*The Y arrow signal face (second from the top) shall flash during FLASH operation. The FY arrow signal face (third from the top) shall be blank during FLASH operation.

DW denotes DON'T WALK indication.

W denotes WALK indication.

Note: Reference signal heads and pole placements shown are for phase IB. Signal heads and pole placements shall require adjustments throughout each phase of construction to align with the lane arrangements/locations used.

Video detection cameras shall be used to maintain all existing stop bar and extension detection zones.

All existing pedestrian signals and pushbuttons must be maintained throughout construction utilizing existing, proposed, or temporary equipment.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX, C-XXX	IH6

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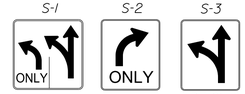
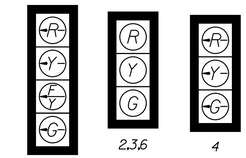
VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

Proposed Signs



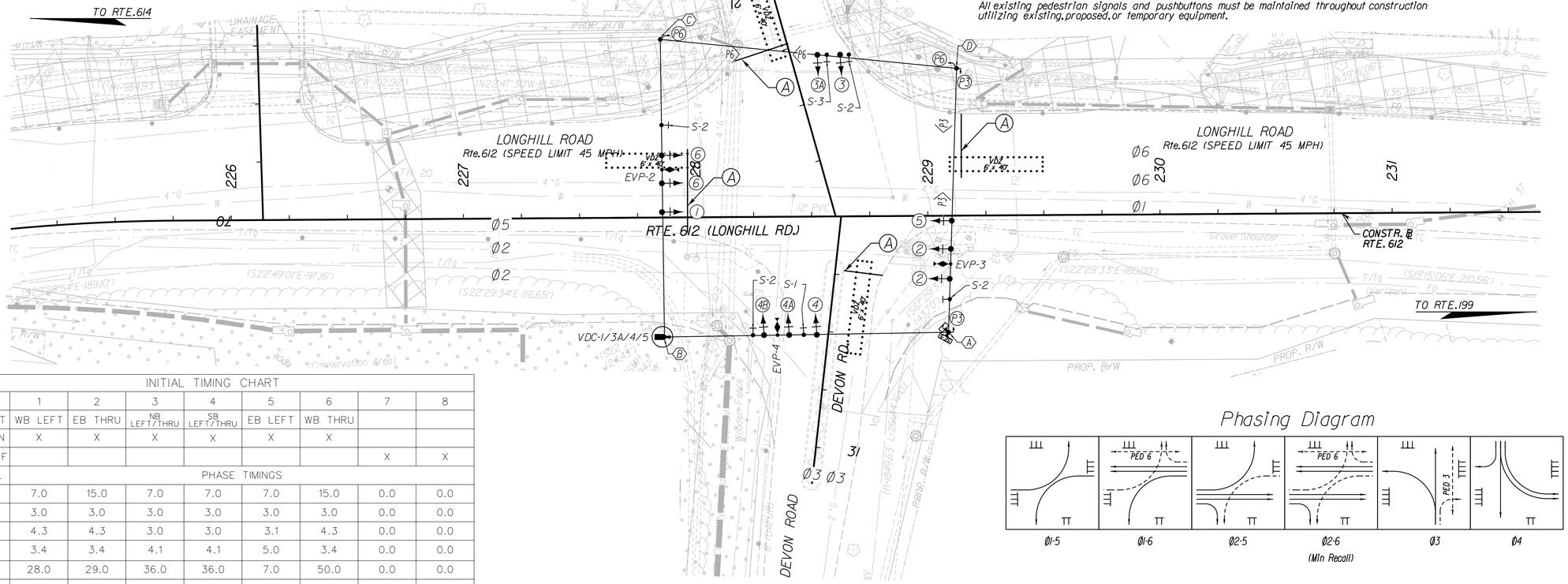
R3-8L (30"x30") Quantity - 1
R3-5R (30"x36") Quantity - 4
R3-6L (30"x36") Quantity - 1

Proposed Signals



Pavement Marking Legend

(A) Existing 24" Stop Bar



Phasing Diagram

INITIAL TIMING CHART

PHASE	1	2	3	4	5	6	7	8
MOVEMENT	WB LEFT	EB THRU	NB LEFT/THRU	SB LEFT/THRU	EB LEFT	WB THRU		
PHASE ON	X	X	X	X	X	X		
PHASE OFF							X	X
INTERVAL	PHASE TIMINGS							
MIN GR	7.0	15.0	7.0	7.0	7.0	15.0	0.0	0.0
PASSAGE	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
AMBER	4.3	4.3	3.0	3.0	3.1	4.3	0.0	0.0
RED	3.4	3.4	4.1	4.1	5.0	3.4	0.0	0.0
MAX 1	28.0	29.0	36.0	36.0	7.0	50.0	0.0	0.0
MAX 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN GAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIME BEFORE REDUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIME TO REDUCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEADING PED WALK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PED WALK	0.0	0.0	7.0	0.0	0.0	7.0	0.0	0.0
PED CLEARANCE	0.0	0.0	20.0	0.0	0.0	12.0	0.0	0.0
MODE	NON-LOCK	MIN RECALL	NON-LOCK	NON-LOCK	NON-LOCK	MIN RECALL	--	--

SPEED LIMITS

Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

MOT Plan Sheets — IJIB(5)

TRAFFIC CONTROL DEVICE PLANS
TEMPORARY TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	IH6

PROJECT MANAGER _____
SURVEYED BY _____
DESIGN SUPERVISED BY _____
DESIGNED BY _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(1)1

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

GENERAL NOTES - TRAFFIC SIGNALS

1. The following items shall be in accordance with standards listed below:

Signal Pole Foundation	PF-8
Conduit Installation	ECI-I or Bored
Signal Head Hangers	SM-3
Sign Hanger	SMD-2
Junction Box	JB-S2, JB-S3
Controller Cabinet Foundation	CF-5
Electrical Service	SE-3

2. Traffic signal foundation depths and above ground foundation projection/reveal (if needed) shall be determined by the Contractor in accordance with PF-8 standards after the signal pole soil test bores are completed. Signal poles and foundations shall be in accordance with Special Provisions including maximum loading conditions. The pole supplier shall provide foundations designs and shop drawings that are signed sealed by a Professional Engineer. The top of all signal pole foundations shall be installed 4" above the highest point of the roadway pavement in which the mast is extending over, to allow for required signal head to pavement distances per the MUTCD.

3. Signal pole foundations may be field adjusted within the designated corners no more than 2' in any direction from the plan locations, provided that the revised foundation locations:

Remain out of the clear zone and pavement sections.
Remain within the right of way or proposed easement.
Does not conflict with utilities.
Does not limit sight distance.
Does not affect drainage.
Allow the signal heads to be adjusted with the same alignment with the designated travel lanes as shown on the plans, and is in accordance with the PF-8 Concrete Foundation Standard detail referenced to the installation.

4. The Contractor shall verify mast arm lengths and signal head lane coverage prior to the installation of signal pole foundations.

5. All poles shall be field staked by the Contractor and inspected by the Engineer and Contractor per Section 700 prior to installation of foundations.

6. Traffic signal heads and mast arm signs may be field adjusted no more than 2' in either direction on the mast arms, provided they remain within the designated travel lane assignments. If further adjustment is needed, the Project Inspector shall contact (TBD) at (XXX) XXX-XXXX.

7. All unused wires in the signal heads shall be capped individually using crimp type caps.

8. The Controller Cabinet & CF-5 foundation may be relocated within the designated corner provided it remains within the right of way or proposed easement, outside of the clear zone and pavement sections, does not conflict with utilities, does not limit sight distance, and is in accordance with the Electric Service Standard detail referenced to the installation.

9. Junction boxes may be relocated in the field as necessary provided they remain within the right of way, do not conflict with utilities and remain outside the pavement section.

10. The placement of 6' x 40' loops shown on the plans shall be 2' in front of stop bars and all 6' x 6' loops shall be installed at the distances specified on the plans.

11. The electric service connection and service line locations may be field adjusted as necessary provided all equipment remains within the right of way or proposed easement, does not conflict with utilities and remains outside of the pavement sections.

12. All underground and overhead utilities shown on these plans are approximate only and may not be complete. At least 72 hours prior to beginning signal work, the Contractor shall contact "Miss Utility of Virginia" at 1-800-552-7001 in order to determine the extent, location, and identify all of the utilities within the work area. At least 5 full working days prior to beginning signal work, the Contractor shall contact (TBD) at (XXX) XXX-XXXX in order to determine the extent and location of all underground signal equipment owned by VDOT with the project limits. If the Contractor perceives a conflict between utilities and the proposed traffic signal equipment, the Contractor shall notify the Engineer immediately so that the conflict may be reviewed. The Contractor shall be responsible for repairing or replacing, at their own expense, any existing utilities, pavement, concrete items, etc. that are damaged or disturbed during construction.

13. Conduit systems shall be bonded in accordance with Section 700 of the Road and Bridge Specifications.

14. Pavement Markings shown on the signal plans are for representation only. Actual Pavement Markings shall be in accordance with the Pavement Marking Plans.

15. All equipment is to be installed within the existing or proposed R/W or easement.

16. The Contractor shall notify (TBD) at (XXX) XXX-XXXX, at least 48 hours prior to removal of existing controller cabinet and equipment.

17. All underground and overhead utilities shown on these plans are approximate only and may not be complete.

18. The contractor will provide signal timings. The contractor shall contact (TBD) at (XXX) XXX-XXXX at least two weeks in advance of signal timing implementation.

19. The contractor shall coordinate all signal timings, including red and yellow clearance intervals with (TBD) at (XXX) XXX-XXXX.

20. The Contractor shall maintain signal communications at all times.

21. Temporary signals shall only utilize video detection for vehicle detection.

22. Traffic Signal equipment removed from service shall remain the property of VDOT. The Contractor shall contact (TBD) at (XXX) XXX-XXXX at least two weeks prior to removal and delivery of the signal equipment to coordinate salvaging and disposal.

23. If the Contractor perceives a conflict between utilities and the proposed traffic signal equipment, the Contractor shall notify the Engineer immediately so that the conflict may be reviewed. The Contractor shall be responsible for repairing or replacing, at their own expense, any existing utilities, pavement, concrete items, pipes, etc. that are damaged during construction.

24. All traffic signal and signing work and adjustments to proposed signals shall be constructed in accordance with the Plans, and the latest editions of the Virginia Department of Transportation (VDOT) Road & Bridge Specifications dated 2016, VDOT Road & Bridge Standards dated 2016, the Manual on Uniform Traffic Control Devices, 2009 Edition (MUTCD), the 2011 Virginia Supplement to the MUTCD, the 2002 National Electrical Code, Special Provision Copied Notes and Special Provisions at the time of advertisement.

25. Emergency preemption detectors and confirmation lights shall be located as shown on the plans, however, may be field adjusted as necessary to provide optimal detection capabilities. Wiring shall be adjusted as necessary if the detector and light locations are modified.

26. Accessible Pedestrian Signals and Detectors shall be used. Pushbuttons shall be located a maximum of 10" from the pedestrian travelway (sidewalk). Extender Arms may be used for pushbuttons as noted on the plans or as required to meet the 10" requirement.

27. The Contractor shall obtain approval from District/Regional Operations representative prior to opening signal for traffic use to ensure that all communications comply with VDOT's latest cyber security requirements.

28. All proposed communications shall comply with the latest VITA ITRM Standard SEC501 - Information Security Standard, and be approved by District/Regional Operations representative prior to opening signal for traffic use.

STANDARD TRAFFIC SIGNAL LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Metal Signal Pole & Foundation and Mast Arm (As noted in Signal Pole Legend)		
Pedestal Pole and Foundation (St'd. PF-2)		
Pedestal Pole and Foundation (St'd. PA-3)		
Traffic Signal Head w/ Backplate		
Traffic Signal Head w/o Backplate		
Pedestrian Signal Head		
Pedestrian Pushbutton & Sign	P.B.	P.B.
Traffic Signal Sign Mast Arm or Span Wire Mt'd.		
Traffic Signal Sign Pole Mounted		
Emergency Vehicle Pre-emption (EVP) Sensor		
w/ Conf. Light		
w/o Conf. Light		
Video Detection Camera		
Video Detection Camera - Type III 360		
Junction Box (St'd. as noted on plans)		
Roadway Luminaire		
Loop Detector (Size as noted on plans)	6' x 20'	6' x 20'
Video Detection Zone (Size as noted on plans)	VDZ 6' x 40'	VDZ 6' x 40'
Conduit		
Wireless Antenna		

PLAN ITEM		PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Electrical Service Meter		SM	SM
Electrical Service Safety Switch (Disconnect)		SD	SD
Controller Cabinet	Ground Mounted	CC	CC
Controller Cabinet	Pole Mounted	CP	CP
Master Controller Cabinet	Ground Mounted	MC	MC
Master Controller Cabinet	Pole Mounted	MP	MP
Controller Cabinet & Foundation	Std. CF-1	CC 1	C 1
Controller Cabinet & Foundation	Std. CF-3	C 3	C 3
Controller Cabinet & Foundation	Std. CF-4	CC 4	C 4
Controller Cabinet & Foundation	Std. CF-5	CC 5	C 5
Master Controller Cabinet & Foundation	Std. CF-1	MC 1	MC 1
Master Controller Cabinet & Foundation	Std. CF-3	MC 3	MC 3
Master Controller Cabinet & Foundation	Std. CF-4	MC 4	MC 4
Master Controller Cabinet & Foundation	Std. CF-5	MC 5	MC 5
Uninterruptible Power Supply Cabinet		UPS	UPS

LABELS

Signal Pole or Controller	A	Proposed Signal Head	2	Signal Phasing	Ø2	Sign	S-1
Cable and Conduit	A	Existing Signal Head	2	Pedestrian Phasing	P2	Video Detection Camera	VDC-1
Junction Box	S3	Proposed Pedestrian Signal Head	P2			Emergency Preemption Detector	EVP-1
		Existing Pedestrian Signal Head	P2				

INDEX OF SHEETS

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
TRAFFIC SIGNAL
INDEX OF SHEETS, GENERAL NOTES & LEGENDS (SHEET 1 of 2)
JAMES CITY COUNTY

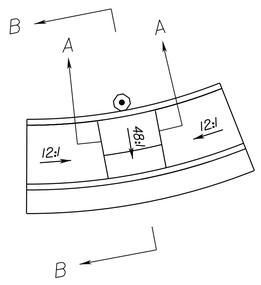
PROJECT	SHEET NO.
XXXX-XXX-XXX	12(1)1

PROJECT MANAGER _____
SURVEYED BY _____
DESIGN SUPERVISED BY _____
DESIGNED BY _____

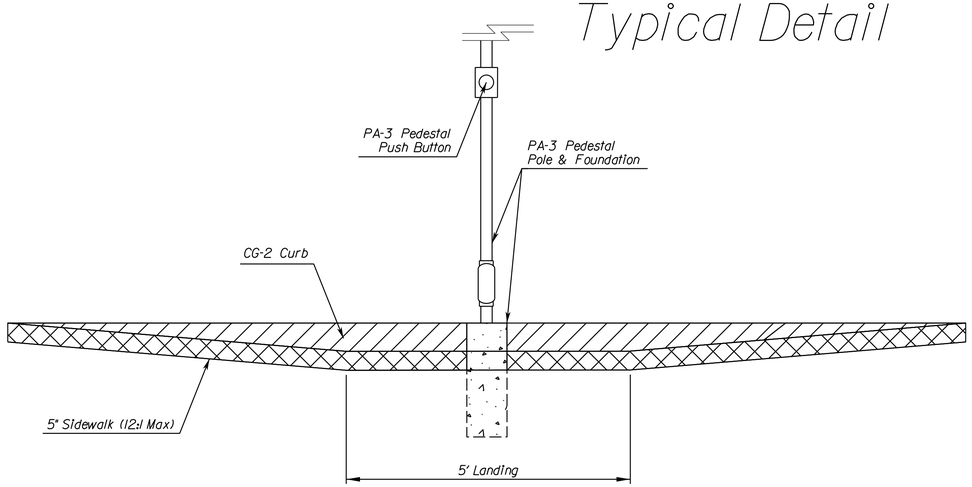
REVISED	STATE	STATE		SHEET NO.
		ROUTE	PROJECT	
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(1)2

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

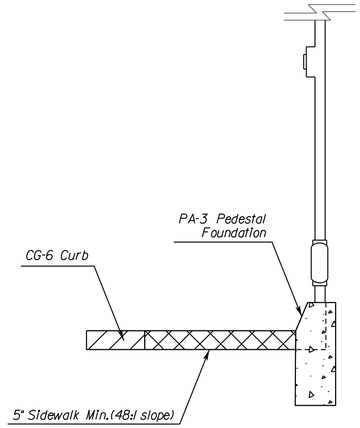
Pole Foundation Built Into Curb Typical Detail



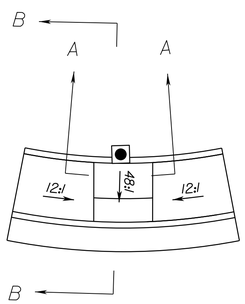
PA-3 DETAIL
(N.T.S.)



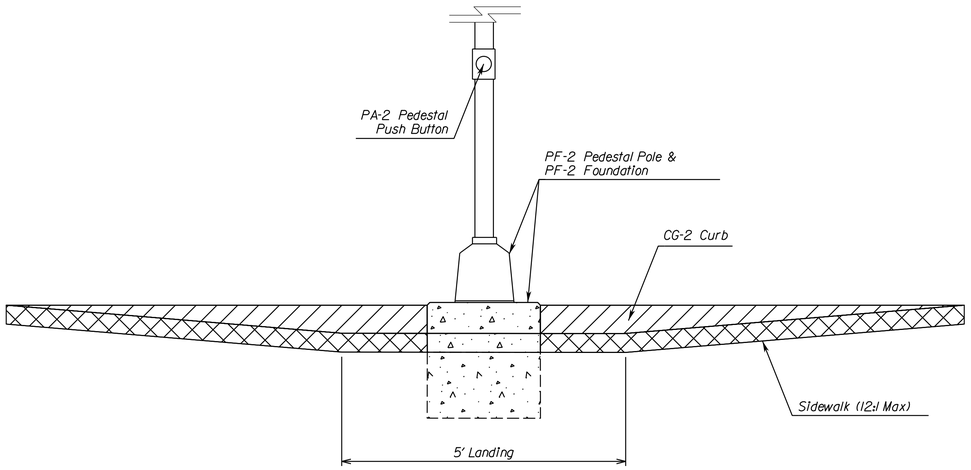
SECTION A-A
(N.T.S.)



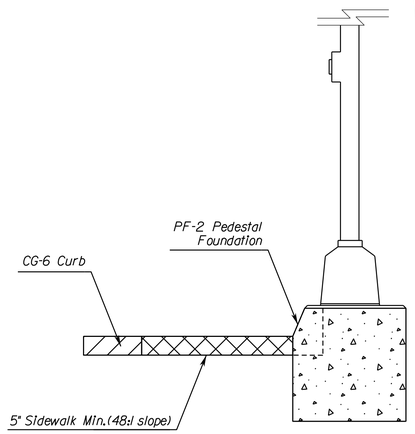
SECTION B-B
(N.T.S.)



PA-2 AND PF-2 DETAIL
(N.T.S.)



SECTION A-A
(N.T.S.)

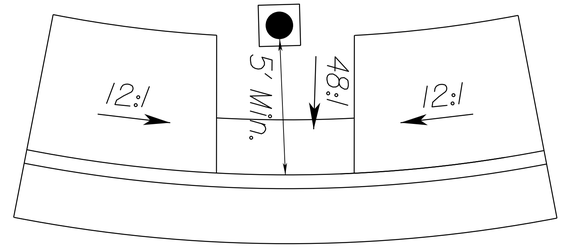


SECTION B-B
(N.T.S.)

NOTE:

Signs and Pushbuttons must be rotated parallel to the associated crosswalk.

Pole Foundation Flush Installation Typical Detail



All installation details shall be per St'd PF-2, except that the 5' Min. distance may be measured to the pole.

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL
INDEX OF SHEETS, GENERAL NOTES & LEGENDS (Sheet 2 of 2)
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(1)2

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(2)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

SUMMARY OF QUANTITIES

Int. No.	Intersection	Sheet No.	TCD Discipline	Summary Notes	Sign Panel (S.F.)	ATC Cabinet - 5-Door Configuration (EA.)	Electrical Service SE-3, Type B (EA.)	Traffic Signal Head Section 12" LED (EA.)	Accessible Pedestrian System Pushbutton Stations (EA.)	Pedestrian Actuation PA-3 (EA.)	Pedestal Pole PF-2, 10' (EA.)	Concrete Foundation Signal Pole PF-8 (C.Y.)	Concrete Foundation PF-2 (EA.)	Concrete Foundation CF-5 (EA.)	Signal Pole MP-3, Type D (EA.)	Signal Pole MP-3, Type E1 (EA.)	Mast Arm 30' (EA.)	Mast Arm 49' (EA.)	Mast Arm 60' (EA.)	Mast Arm 65' (EA.)	EVP Detection System 3-Way (L.F.)	EVP Detector Cable (L.F.)	Loop Detector Amplifier (EA.)	8/3 Conductor Cable (L.F.)	14/2 Conductor Cable (L.F.)	14/4 Conductor Cable (L.F.)	14/7 Conductor Cable (L.F.)	14/1 Enclosed Conductor Cable (L.F.)	14/2 Conductor Cable Shielded (L.F.)	Hanger Assembly SM-3, One Way (L.F.)	Hanger Assembly SMB-2, One Way (L.F.)	Hanger Assembly SMB-3, One Way (L.F.)	Mounting Extender (EA.)	Loop Sawcut 3/8" (L.F.)	Loop Sawcut 7/8" (L.F.)	Remove Existing Pole (EA.)	Remove Existing Foundation (EA.)	Remove Existing Signal Head (EA.)	Remove Existing Controller (EA.)	Remove Existing Manhole/Junction Box (EA.)	Remove Existing Emergency Preemption Detectors (EA.)	Uninterruptible Power Supply Type I (EA.)	Uninterruptible Power Supply Battery Pack (EA.)	Uninterruptible Power Supply Cabinet Detached (EA.)	Modify Signal (EA.)	
			TCD Discipline		SIGNALS																																												
			Summary Notes		⊗			①		②																																							
			Item Description		Sign Panel	ATC Cabinet - 5-Door Configuration	Electrical Service SE-3, Type B	Traffic Signal Head Section 12" LED	Accessible Pedestrian System Pushbutton Stations	Pedestrian Actuation PA-3	Pedestal Pole PF-2, 10'	Concrete Foundation Signal Pole PF-8	Concrete Foundation PF-2	Concrete Foundation CF-5	Signal Pole MP-3, Type D	Signal Pole MP-3, Type E1	Mast Arm 30'	Mast Arm 49'	Mast Arm 60'	Mast Arm 65'	EVP Detection System 3-Way	EVP Detector Cable	Loop Detector Amplifier	8/3 Conductor Cable	14/2 Conductor Cable	14/4 Conductor Cable	14/7 Conductor Cable	14/1 Enclosed Conductor Cable	14/2 Conductor Cable Shielded	Hanger Assembly SM-3, One Way	Hanger Assembly SMB-2, One Way	Hanger Assembly SMB-3, One Way	Mounting Extender	Loop Sawcut 3/8"	Loop Sawcut 7/8"	Remove Existing Pole	Remove Existing Foundation	Remove Existing Signal Head	Remove Existing Controller	Remove Existing Manhole/Junction Box	Remove Existing Emergency Preemption Detectors	Uninterruptible Power Supply Type I	Uninterruptible Power Supply Battery Pack	Uninterruptible Power Supply Cabinet Detached	Modify Signal	
			Unit		S.F.	EA.	EA.	EA.	EA.	EA.	EA.	C.Y.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	L.F.	L.F.	EA.	L.F.	L.F.	L.F.	L.F.	L.F.	L.F.	L.F.	L.F.	L.F.	EA.	L.F.	L.F.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	
1	Rte. 612 (Longhill Road) & Old Towne Road/Devon Road	12(3)			116	1	1	37	4	2	2	44	2	1	2	2	1	1	1	1	1	690	10	30	800	1,870	500	3,160	6,640	11	2	2	2	1,050	140	4	5	14	1	12	3	1	1	1	1	
	TOTAL				116	1	1	37	4	2	2	44	2	1	2	2	1	1	1	1	1	690	10	30	800	1,870	500	3,160	6,640	11	2	2	2	1,050	140	4	5	14	1	12	3	1	1	1	1	

Int. No.	Intersection	Sheet No.	TCD Discipline	Summary Notes	Luminaire Arm 18' (EA.)	8 Conductor Cable (L.F.)	Conductor Cable No.8 EGC (L.F.)	Junction Box JB-S2 (EA.)	Junction Box JB-S3 (EA.)	Electrical Service Grounding Electrode (10') (EA.)	1" PVC Conduit (L.F.)	Bored Conduit 2" (L.F.)	Bored Conduit 3" (L.F.)	2" PVC Conduit (L.F.)	3" PVC Conduit (L.F.)	Trench Excavation EC1-1 (L.F.)	Test Bore (EA.)	McCain ATC 2070 controller with D-4 firmware (EA.)	Pedestrian Signal Head SP-9 (EA.)
			TCD Discipline		SIGNALS														
			Summary Notes																
			Item Description		Luminaire Arm 18'	8 Conductor Cable	Conductor Cable No.8 EGC	Junction Box JB-S2	Junction Box JB-S3	Electrical Service Grounding Electrode (10')	1" PVC Conduit	Bored Conduit 2"	Bored Conduit 3"	2" PVC Conduit	3" PVC Conduit	Trench Excavation EC1-1	Test Bore	McCain ATC 2070 controller with D-4 firmware	Pedestrian Signal Head SP-9
			Unit		EA.	L.F.	L.F.	EA.	EA.	EA.	L.F.	L.F.	L.F.	L.F.	L.F.	L.F.	EA.	EA.	EA.
1	Rte. 612 (Longhill Road) & Old Towne Road/Devon Road	12(3)			4	1,610	2,470	15	1	5	70	610	730	1,260	110	1,430	4	1	4
	TOTAL				4	1,610	2,470	15	1	5	70	610	730	1,260	110	1,430	4	1	4

SUMMARY NOTES

⊗ Denotes item to be paid for on the basis of Plan Quantity in accordance with current Road & Bridge Specifications.

① Signal heads shall be polycarbonate. Included in the cost of this item are the retroreflective backplates and cap visors.

② The pay item for "Pedestrian Actuation PA-3" does not include the pushbutton or sign. The pushbutton and sign will be paid for under pay item "Accessible Pedestrian System Pushbutton Stations".

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

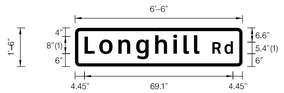
TRAFFIC CONTROL DEVICE PLANS
TRAFFIC SIGNAL
SUMMARY OF QUANTITIES
LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(2)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

FIGURE 1

SIGN DETAIL



SIGN NUMBER	S-4
WIDTH x HGHT.	6'-6" x 1'-6"
BORDER WIDTH	1.5"
BORDER INSET	0"
PANEL RADIUS	2.25" plus 0"
MOUNTING	Overhead
BACKGROUND	TYPE: Reflective
	COLOR: BlackWhite
LEGEND/BORDER	TYPE: Reflective
	COLOR: White

SYMBOL	ROT	X	Y	WID	HT

Dimensions are in inches.tenths

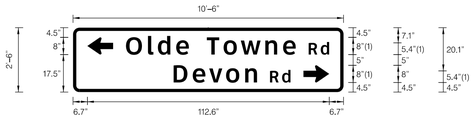
Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)

L	o	n	g	h	i	l	l	R	d												LENGTH	SERIES/SIZE
4.4	11.3	20.2	28.5	37.3	45.8	50.5	55.4	64	69.6												69.1	ClearviewHwy-5-W 86,5,5,4/4.4

FIGURE 2

SIGN DETAIL



SIGN NUMBER	S-5
WIDTH x HGHT.	10'-6" x 2'-6"
BORDER WIDTH	1.5"
BORDER INSET	0"
PANEL RADIUS	3" plus 0"
MOUNTING	Overhead
BACKGROUND	TYPE: Reflective
	COLOR: Green
LEGEND/BORDER	TYPE: Reflective
	COLOR: White

SYMBOL	ROT	X	Y	WID	HT
AR_Type D	90	6.7	17.5	8	12
AR_Type D	270	107.3	4.5	8	12

Dimensions are in inches.tenths

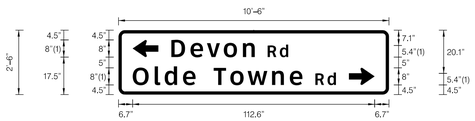
Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)

O	l	d	e		T	o	w	n	e	R	d										LENGTH	SERIES/SIZE
24.7	34.9	39.5	48.1	54	62.4	70.1	78.2	89.6	97.9	109.8	115.4										94.6	ClearviewHwy-5-W 86,5,5,4/4.4
D	e	v	o	n	R	d																ClearviewHwy-5-W
46.8	55.8	63.4	71.3	80.2	91.7	97.4															54.5	86,5,5,4/4.4

FIGURE 3

SIGN DETAIL



SIGN NUMBER	S-6
WIDTH x HGHT.	10'-6" x 2'-6"
BORDER WIDTH	1.5"
BORDER INSET	0"
PANEL RADIUS	3" plus 0"
MOUNTING	Overhead
BACKGROUND	TYPE: Reflective
	COLOR: BlackWhite
LEGEND/BORDER	TYPE: Reflective
	COLOR: White

SYMBOL	ROT	X	Y	WID	HT
AR_Type D	90	6.6	17.5	8	12
AR_Type D	270	107.3	4.5	8	12

Dimensions are in inches.tenths

Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)

D	e	v	o	n	R	d															LENGTH	SERIES/SIZE
24.6	33.5	41.2	49	57.9	69.5	75.2															54.5	ClearviewHwy-5-W 86,5,5,4/4.4
O	l	d	e		T	o	w	n	e	R	d											ClearviewHwy-5-W
6.6	16.9	21.5	30	35.9	44.3	52.1	60.1	71.5	79.8	91.7	97.4										94.6	86,5,5,4/4.4

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(2A)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

PAC PLANS

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VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL SIGN FIGURE DETAILS

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(2A)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(3)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

Signal Pole & Controller Legend

(ALL DIMENSIONS ARE TO CENTER OF POLE)

① CONTROLLER CABINET & FOUNDATION (CF-5)

Ⓐ MAST ARM POLE MP-3,TYPE E1
52.9' RT. of Rte. 612 Constr. ℄ Sta. 229+22
Top of foundation 12" above proposed grade.
60' Arm 270° Angle to Rte. 612 Constr. ℄
Signal Placement: 26',39',51'
Sign Placement: 10',17.5'
Emergency Preemption Detector: 32.5'
18' Luminaire Arm,270° Angle to Constr.℄

Ⓑ MAST ARM POLE MP-3,TYPE D
70.0' RT. of Rte. 612 Constr. ℄ Sta. 228+10
Top of foundation 12" above proposed grade.
49' Arm 0° Angle to Rte. 612 Constr. ℄
Signal Placement: 21',31.5',43.5'
Sign Placement: 9.5',16',38'
Emergency Preemption Detector: 26.5'
18' Luminaire Arm,267° Angle to Constr.℄

Ⓒ MAST ARM POLE MP-3,TYPE E1
62.3' LT. of Rte. 612 Constr. ℄ Sta. 227+73
Top of foundation 12" above proposed grade.
65' Arm 90° Angle to Rte. 612 Constr. ℄
Signal Placement: 35.5',47.5',60'
Sign Placement: 13',22.5'
Emergency Preemption Detector: 41.5'
18' Luminaire Arm,91° Angle to Constr.℄

Ⓓ MAST ARM POLE TYPE MP-3,TYPE D
78.4' LT. of Rte. 612 Constr. ℄ Sta. 228+77
Top of foundation 12" above proposed grade.
30' Arm 180° Angle to Rte. 612 Constr. ℄
Signal Placement: 15.5',25'
Sign Placement: 5.5',11.5',21'
18' Luminaire Arm,88° Angle to Constr.℄

Ⓔ PEDESTAL POLE (PF-2),10'
63.2' LT. of Rte. 612 Constr. ℄ Sta. 227+96
Extender Arm Required for pushbutton.

Ⓕ PEDESTRIAN ACTUATION (PA-3)
76.8' LT. of Rte. 612 Constr. ℄ Sta. 228+71

Ⓖ PEDESTAL POLE (PF-2),10'
51.0' LT. of Rte. 612 Constr. ℄ Sta. 229+06
Extender Arm required for pushbutton.

Ⓗ PEDESTRIAN ACTUATION (PA-3)
40.1' RT. of Rte. 612 Constr. ℄ Sta. 229+25

NOTE: Luminaires on combination signal poles shall be equivalent to 250w LED (26,000 Lumens) installed at a mounting height of 28.5' from the finished roadway surface to the center of the luminaire.

Proposed Signs

S-1 R3-8L (30"x30") Quantity - 1

S-2 R3-5R (30"x36") Quantity - 4

S-3 R3-6L (30"x36") Quantity - 1

S-4 Longhill Rd (FIGURE 1) (SHEET NO.12(2A)1) (78"x18") Quantity - 2

S-5 ← Olde Towne Rd / Devon Rd → (FIGURE 2) (SHEET NO.12(2A)1) (126"x30") Quantity - 1

S-6 ← Devon Rd / Olde Towne Rd → (FIGURE 3) (SHEET NO.12(2A)1) (126"x30") Quantity - 1

S-7 R10-3E(L) (9" x 15") QUANTITY - 4 EA. (1 EACH TO BE MOUNTED ON PED POLE E,PED POLE F, PED POLE G AND PED POLE H PER PA-2 STD.)

Proposed Signals

1.5 FLASHING YELLOW ARROW

2,3,6

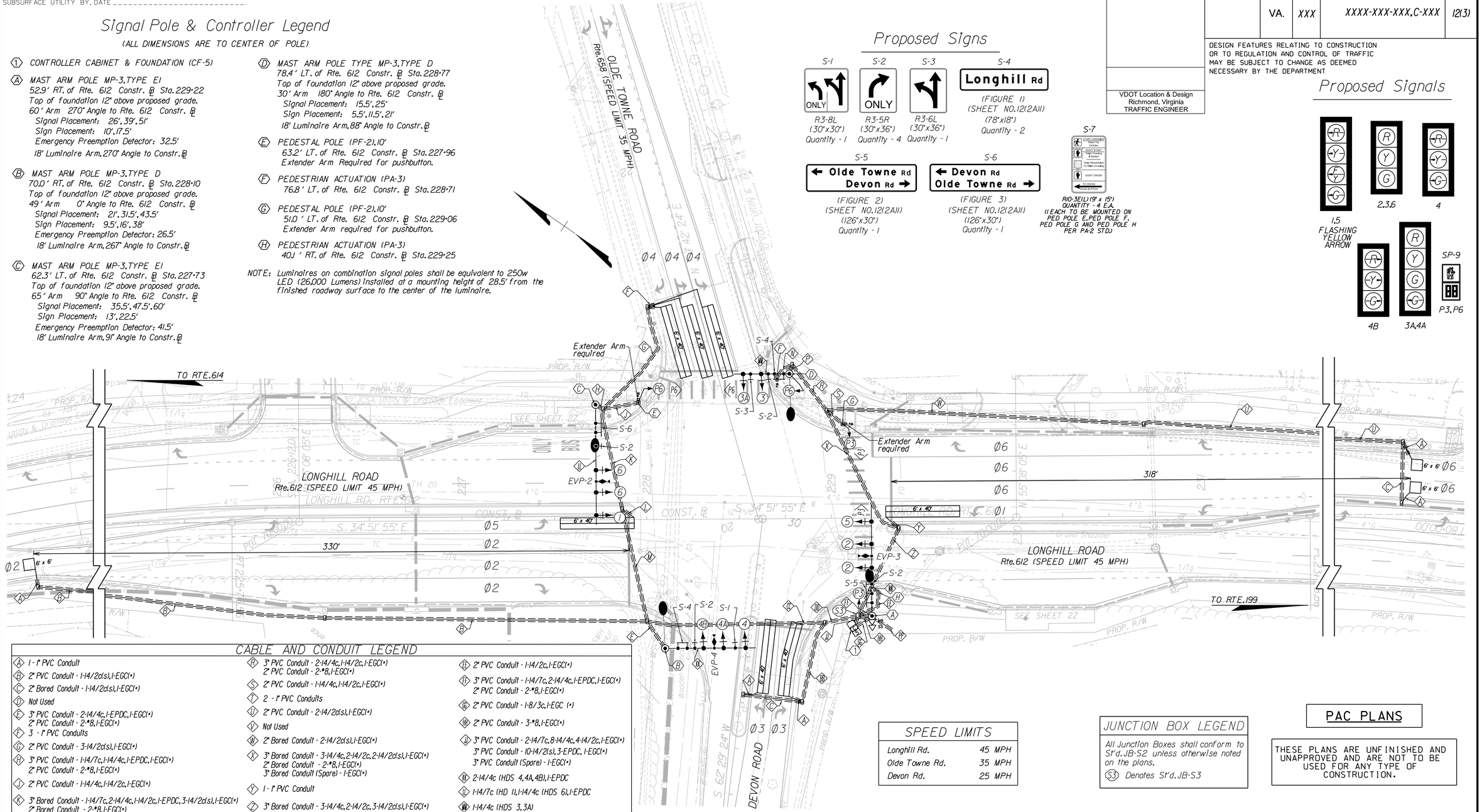
4

4B

3A,4A

SP-9

P3,P6



CABLE AND CONDUIT LEGEND

Ⓐ 1 - 1" PVC Conduit
Ⓑ 2" PVC Conduit - 1-14/2c(s),1-EGC(*)
Ⓒ 2" Bored Conduit - 1-14/2c(s),1-EGC(*)
Ⓓ Not Used
Ⓔ 3" PVC Conduit - 2-14/4c,1-EPDC,1-EGC(*)
2" PVC Conduit - 2-#8,1-EGC(*)
Ⓕ 3 - 1" PVC Conduits
Ⓖ 2" PVC Conduit - 3-14/2c(s),1-EGC(*)
Ⓗ 3" PVC Conduit - 1-14/7c,1-14/4c,1-EPDC,1-EGC(*)
2" PVC Conduit - 2-#8,1-EGC(*)
Ⓙ 2" PVC Conduit - 1-14/4c,1-14/2c,1-EGC(*)
Ⓚ 3" Bored Conduit - 1-14/7c,2-14/4c,1-14/2c,1-EPDC,3-14/2c(s),1-EGC(*)
2" Bored Conduit - 2-#8,1-EGC(*)
3" Bored Conduit (Spare) - 1-EGC(*)
Ⓛ 1 - 1" PVC Conduit
Ⓜ 3" Bored Conduit - 1-14/7c,2-14/4c,1-14/2c,1-EPDC,4-14/2c(s),1-EGC(*)
2" Bored Conduit - 2-#8,1-EGC(*)
3" Bored Conduit (Spare) - 1-EGC(*)
Ⓝ 2" PVC Conduit - 1-14/2c,1-EGC(*)
Ⓟ 3" PVC Conduit - 2-14/4c,1-EGC(*)
2" PVC Conduit - 2-#8,1-EGC(*)
Ⓡ 3" PVC Conduit - 2-14/4c,1-14/2c,1-EGC(*)
2" PVC Conduit - 2-#8,1-EGC(*)
Ⓢ 2" PVC Conduit - 1-14/4c,1-14/2c,1-EGC(*)
Ⓣ 2 - 1" PVC Conduits
Ⓤ 2" PVC Conduit - 2-14/2c(s),1-EGC(*)
Ⓥ Not Used
Ⓦ 2" Bored Conduit - 2-14/2c(s),1-EGC(*)
Ⓧ 3" Bored Conduit - 3-14/4c,2-14/2c,2-14/2c(s),1-EGC(*)
2" Bored Conduit - 2-#8,1-EGC(*)
3" Bored Conduit (Spare) - 1-EGC(*)
Ⓨ 1 - 1" PVC Conduit
Ⓩ 3" Bored Conduit - 3-14/4c,2-14/2c,3-14/2c(s),1-EGC(*)
2" Bored Conduit - 2-#8,1-EGC(*)
3" Bored Conduit (Spare) - 1-EGC(*)
Ⓐ Not Used
Ⓑ 2" PVC Conduit - 2-14/2c(s),1-EGC(*)
Ⓒ 3" PVC Conduit - 1-14/7c,4-14/4c,1-14/2c,2-EPDC,5-14/2c(s),1-EGC(*)
2" Bored Conduit - 3-#8,1-EGC(*)
3" Bored Conduit (Spare) - 1-EGC(*)
Ⓓ 3" PVC Conduit - 1-14/7c,4-14/4c,1-14/2c,2-EPDC,7-14/2c(s),1-EGC(*)
2" PVC Conduit - 3-#8,1-EGC(*)
Ⓔ 2" PVC Conduit - 1-14/2c,1-EGC(*)
Ⓕ 3" PVC Conduit - 1-14/7c,2-14/4c,1-EPDC,1-EGC(*)
2" PVC Conduit - 2-#8,1-EGC(*)
Ⓖ 2" PVC Conduit - 1-8/3c,1-EGC (*)
Ⓗ 2" PVC Conduit - 3-#8,1-EGC(*)
Ⓙ 3" PVC Conduit - 2-14/7c,8-14/4c,4-14/2c,1-EGC(*)
3" PVC Conduit - 10-14/2(s),3-EPDC,1-EGC(*)
3" PVC Conduit (Spare) - 1-EGC(*)
Ⓚ 2-14/4c (HDS 4,4A,4B),1-EPDC
Ⓛ 1-14/7c (HD 1),1-14/4c (HDS 6),1-EPDC
Ⓜ 1-14/4c (HDS 3,3A)
Ⓝ 1-14/7c (HD 5),1-14/4c (HDS 2),1-EPDC
Ⓟ 3" PVC Conduit - For Electrical Service

EGC - Equipment Grounding Cable
* If required for a Bonded System
2-#8 - Used for each Intersection Luminaire
EPDC - Emergency Preemption Detector Cable
(s) - Shielded Cable

SPEED LIMITS

Longhill Rd.	45 MPH
Olde Towne Rd.	35 MPH
Devon Rd.	25 MPH

JUNCTION BOX LEGEND

All Junction Boxes shall conform to St'd.JB-S2 unless otherwise noted on the plans.

(S3) Denotes St'd.JB-S3

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheets	4,5
Signing and Pavement Marking Plan Sheets	11(4),11(5)

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(3)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12(3A)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

INITIAL TIMING CHART

PHASE	1	2	3	4	5	6	7	8
MOVEMENT	WB LEFT	EB THRU	NB LEFT/THRU	SB LEFT/THRU	EB LEFT	WB THRU		
PHASE ON	X	X	X	X	X	X		
PHASE OFF							X	X
INTERVAL	PHASE TIMINGS							
MIN GR	7.0	15.0	7.0	7.0	7.0	15.0	0.0	0.0
PASSAGE	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0
AMBER	4.3	4.3	3.0	3.0	3.1	4.3	0.0	0.0
RED	3.4	3.4	4.1	4.1	5.0	3.4	0.0	0.0
MAX 1	28.0	29.0	36.0	36.0	7.0	50.0	0.0	0.0
MAX 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIN GAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIME BEFORE REDUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIME TO REDUCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LEADING PED WALK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PED WALK	0.0	0.0	7.0	0.0	0.0	7.0	0.0	0.0
PED CLEARANCE	0.0	0.0	20.0	0.0	0.0	12.0	0.0	0.0
MODE	NON-LOCK	MIN RECALL	NON-LOCK	NON-LOCK	NON-LOCK	MIN RECALL	--	--

Color Sequence Chart

SIGNALS	SIGNAL	PHASES 1	2	3	4	5	6	COMBINATIONS 1-5	1-6	2-5	2-6	FLASH
	1	→G	→FY					→G	→G	→FY	→FY	Y*
	2		G							G	G	Y
	3			G								
	3A			G →G								
	4				→G							
	4A				G →G							
	4B				G←							
	5					→G	→FY	→G	→FY	→G	→FY	Y*
	6						G		G		G	Y
	P3	DW	DW	W	DW	DW	DW	DW	DW	DW	DW	BLANK
	P6	DW	DW	DW	DW	DW	W	DW	W	DW	W	BLANK

Empty box denotes RED indication (Red ball or red arrow as appropriate)
When operating, the FY indication shall operate in a flashing mode.

*The Y arrow signal face (second from the top) shall flash during FLASH operation. The FY arrow signal face (third from the top) shall be blank during FLASH operation.

DW denotes DON'T WALK indication.

W denotes WALK indication.

APS AUDIBLE INDICATION TABLE

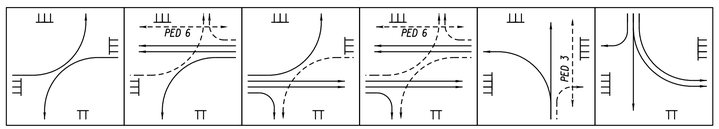
PUSHBUTTON (QUAD.)	SPEECH PB INFORMATION MESSAGE	AUDIBLE WALK INDICATION
P3 (SE) P3 (NE)	WAIT TO CROSS LONGHILL AT OLD TOWNE	PERCUSSIVE TONE
P6 (NE) P6 (NW)	WAIT TO CROSS OLD TOWNE AT LONGHILL	PERCUSSIVE TONE

NOTE: ALL OTHER TONES AND BEACONING ASSOCIATED WITH APS SHALL BE IN ACCORDANCE WITH THE SPECIAL PROVISIONS IN THE CONTRACT DOCUMENTS.

PAC PLANS

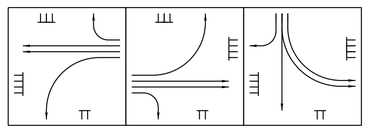
THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

Phasing Diagram



Ø1-5 Ø1-6 Ø2-5 Ø2-6 Ø3 Ø4
(Min Recall)

Preemption Diagram



EVP-2 EVP-3 EVP-4

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheets	4,5
Signing and Pavement Marking Plan Sheets	11(4), 11(5)

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL PLAN

LONGHILL ROAD &
OLD TOWNE ROAD/DEVON ROAD
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	12(3A)

VDOT
Virginia Department of Transportation

Traffic Engineering Design Manual

Appendix B:
VDOT Signing & Pavement Marking Design Plans

April 2020

Revision 1
March 2023

Location & Design Division

VDOT GOVERNANCE DOCUMENT

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

(SHEETS II(3), II(7) AND II(8) NOT INCLUDED IN THIS EXAMPLE)

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(1)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

STANDARD SIGN LEGEND

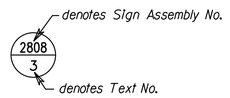
PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Single Post Sign Support		
Double Post Sign Support		
Triple Post Sign Support		
Flashing Beacon		
O/H Cantilever Sign Support		
O/H Span Sign Support		

SIGN CALL-OUTS

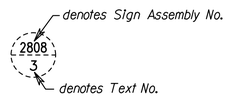
Existing Sign to Remain or to be Relocated	
Existing Sign to be Removed	
Proposed Sign Panel	

SIGN LABELS

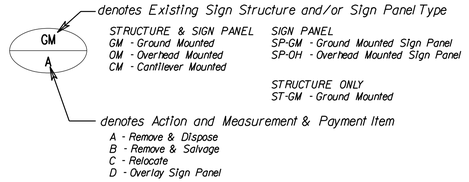
Proposed Sign Assemblies



Relocated Sign Assemblies



Sign Relocation or Payable Sign Disposal/Salvage



Signs noted on plans to be removed that do not have an accompanying sign label shall not be measured separately for payment. Removal and disposal for such signs shall be incidental to other contract items.

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS
INDEX OF SHEETS, GENERAL NOTES & LEGENDS

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	II(1)

3/20/2020
9:38:31 AM

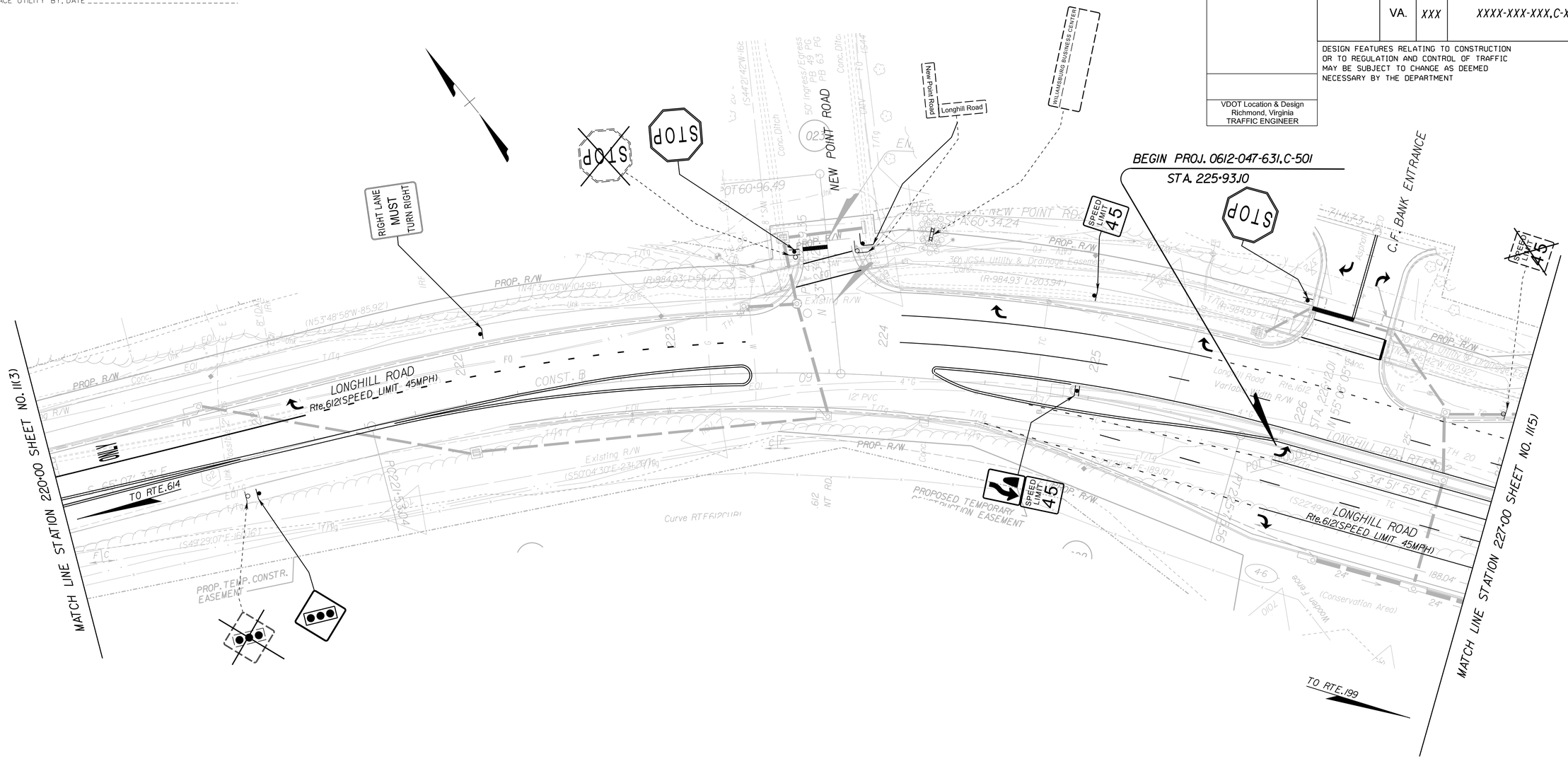
t10092111104.dgn
Plotted By: FedericoGontaruk

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(4)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER



PUBLIC HEARING PLANS

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VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	4

TRAFFIC CONTROL DEVICE PLANS
SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(4)

3/20/2020
9:40:07 AM

t10092111105\.dgn
Plotted By: FedericoGontaruk

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

PUBLIC HEARING PLANS

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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(5)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

MATCH LINE SHEET NO. II(5C) STA. 22+25

MATCH LINE STATION 227+00 SHEET NO. II(4)

MATCH LINE STATION 234+00 SHEET NO. II(6)

Exist. Sign relocated from left of Sta. 231+44 (This Sheet)

Exist. Sign to be relocated left of Sta. 227+14 (This Sheet) Removal of existing structure to be paid for under other items.

LONGHILL ROAD
Rte. 612 (SPEED LIMIT 45MPH)
TO RTE. 614

LONGHILL ROAD
Rte. 612 (SPEED LIMIT 45MPH)

TO RTE. 199

DEVON ROAD

Longhill Road
Olde Towne Road

Longhill Road
Devon Road

Sediment Forebay

Bio-Retention Filter I

6" Perforated Pipe

SEE SHEET 22

SEE SHEET 23

PROP. R/W

Existing R/W

Variable Width R/W

TURNING VEHICLES

PATH NARROWS

BUSS SIGN

SPEED LIMIT 45

SLOW CHILDREN

SIGNAL AHEAD

SIDE OF THE ROAD

REFERENCES (PLAN AND DETAIL SHEETS)	
Roadway Plan Sheet	5
Traffic Signal Plan Sheet	12(3)

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(5)

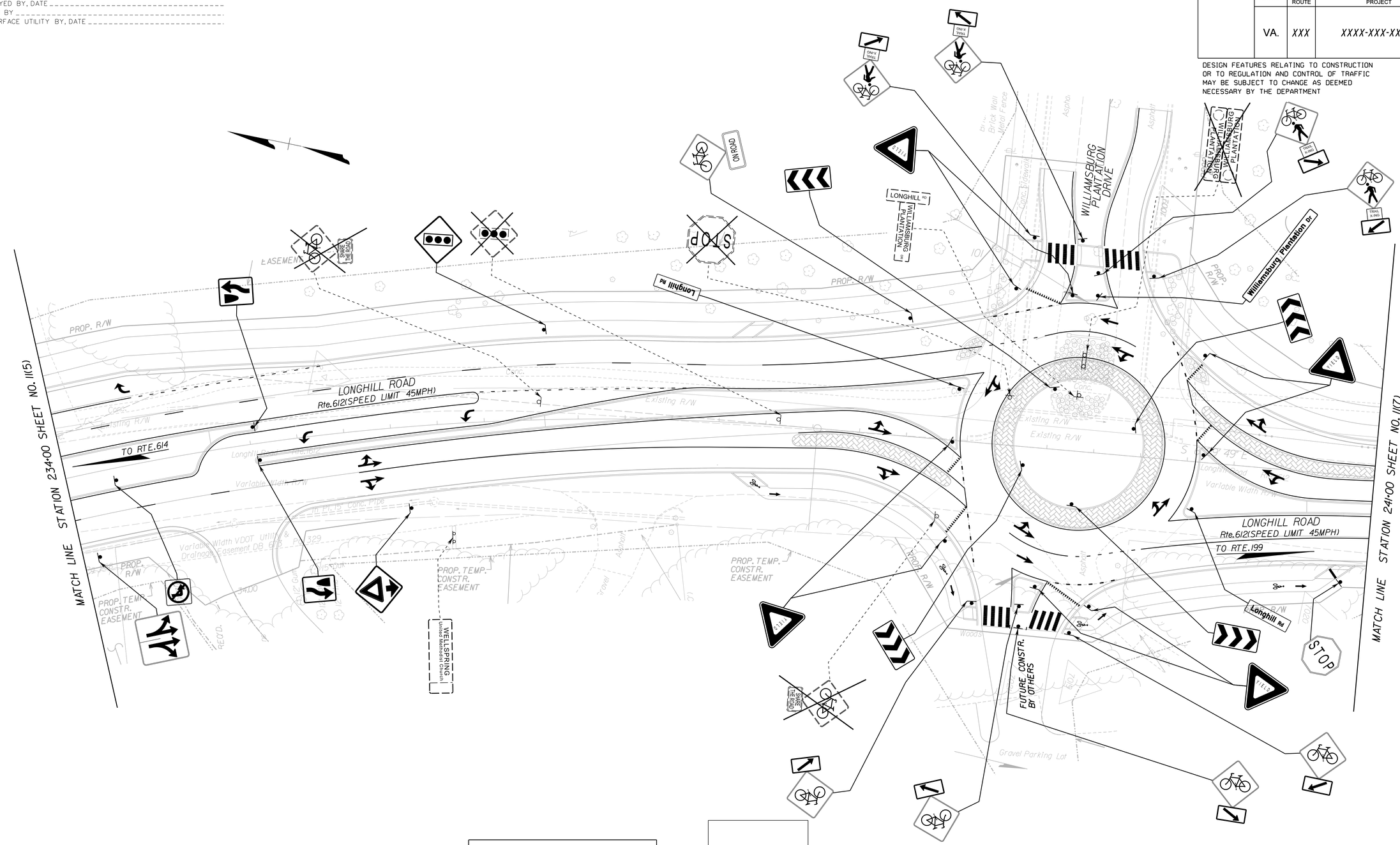
3/20/2020
9:55:39 AM

t10092111106.dgn
Plotted By: FedericoGontaruk

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(6)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT



PUBLIC HEARING PLANS

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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	6

TRAFFIC CONTROL DEVICE PLANS
SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(6)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

(SHEETS II(3), II(7) AND II(8) NOT INCLUDED IN THIS EXAMPLE)

RW PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(1)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

STANDARD SIGN LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Single Post Sign Support		
Double Post Sign Support		
Triple Post Sign Support		
Flashing Beacon		
O/H Cantilever Sign Support		
O/H Span Sign Support		

SIGN CALL-OUTS

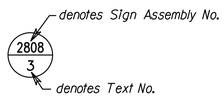
Existing Sign to Remain or to be Relocated

Existing Sign to be Removed

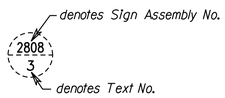
Proposed Sign Panel

SIGN LABELS

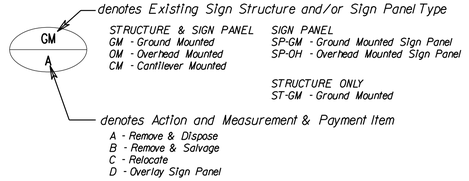
Proposed Sign Assemblies



Relocated Sign Assemblies



Sign Relocation or Payable Sign Disposal/Salvage



Signs noted on plans to be removed that do not have an accompanying sign label shall not be measured separately for payment. Removal and disposal for such signs shall be incidental to other contract items.

PAVEMENT MARKING LEGEND

(A) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH

(B) TYPE B,CLASS I,YELLOW PAVEMENT LINE MARKING,4" WIDTH

(C) TYPE B,CLASS I,DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH

(D) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (2' LINE,6' SPACE)

(E) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (10' LINE,30' SPACE)

(F) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH

(G) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (2' LINE,6' SPACE)

(H) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (3' LINE,9' SPACE)

(J) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,24" WIDTH

(K) PAVEMENT MESSAGE MARKING (BUS) TYPE B,CLASS II

(L) PAVEMENT SYMBOL MARKING (TRIPLE TURN ARROW) TYPE B,CLASS II

(M) PAVEMENT SYMBOL MARKING (YIELD 1' X 1.5') TYPE B,CLASS II

(N) PAVEMENT SYMBOL MARKING (THRU ARROW) TYPE B,CLASS II

(P) PAVEMENT SYMBOL MARKING (SINGLE TURN ARROW) TYPE B,CLASS II

(R) PAVEMENT SYMBOL MARKING (DOUBLE TURN ARROW THRU/LT OR RT) TYPE B,CLASS II

(S) PAVEMENT MESSAGE MARKING (ONLY) TYPE B,CLASS II

(T) PAVEMENT SYMBOL MARKING,(BICYCLIST THRU ARROW) TYPE B,CLASS II

(U) PAVEMENT SYMBOL MARKING,(HELMETED BICYCLIST) TYPE B,CLASS II

(V) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,6" WIDTH

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS
INDEX OF SHEETS, GENERAL NOTES & LEGENDS

JAMES CITY COUNTY

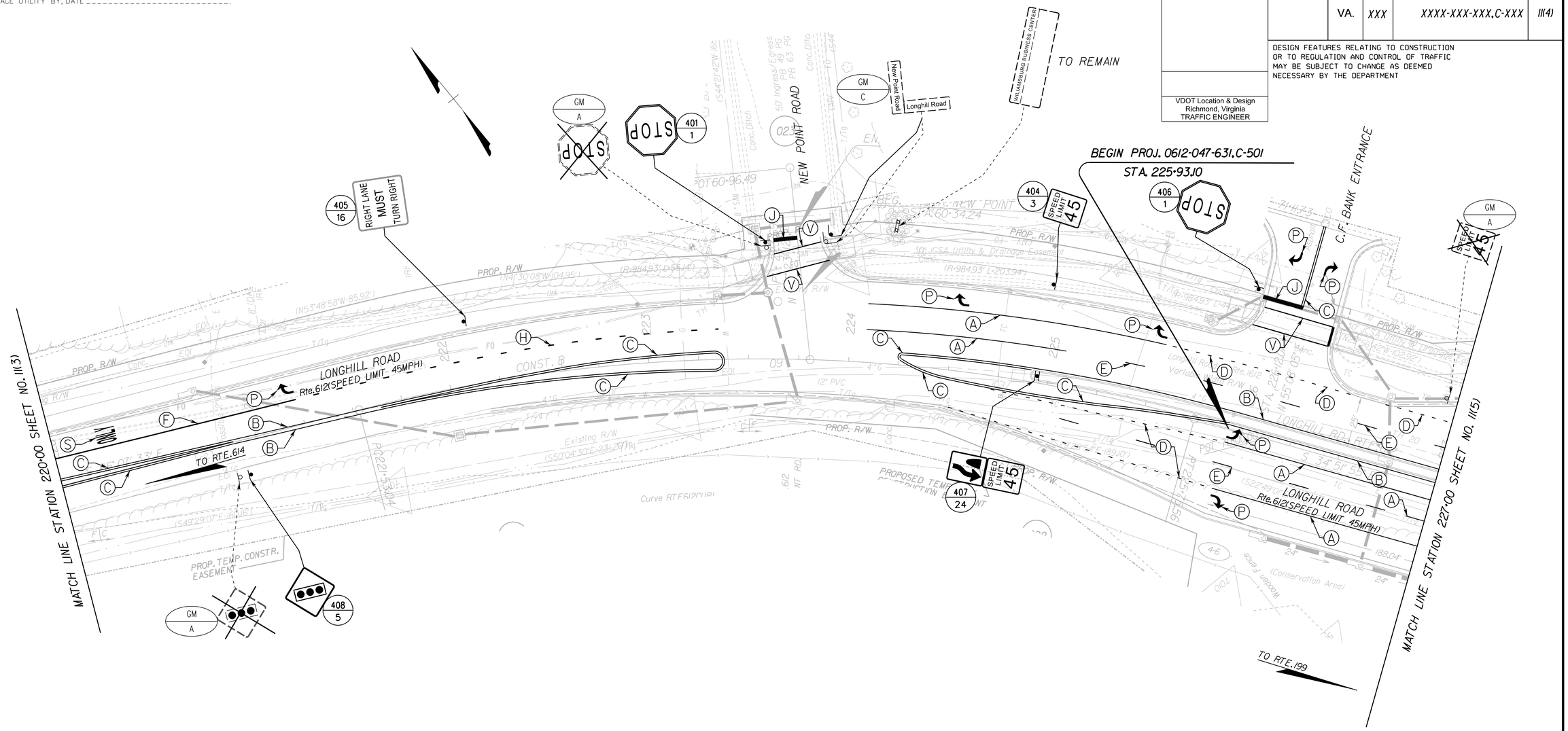
PROJECT	SHEET NO.
XXXX-XXX-XXX	II(1)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(4)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER



PAVEMENT MARKING LEGEND

- (A) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH
- (B) TYPE B,CLASS I,YELLOW PAVEMENT LINE MARKING,4" WIDTH
- (C) TYPE B,CLASS I,DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (D) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (2' LINE,6' SPACE)
- (E) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (10' LINE,30' SPACE)
- (F) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH
- (G) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (2' LINE,6' SPACE)
- (H) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (3' LINE,9' SPACE)
- (J) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,24" WIDTH
- (K) PAVEMENT MESSAGE MARKING (BUS) TYPE B,CLASS II
- (L) PAVEMENT SYMBOL MARKING (TRIPLE TURN ARROW) TYPE B,CLASS II
- (M) PAVEMENT SYMBOL MARKING (YIELD 1' X 1.5') TYPE B,CLASS II
- (N) PAVEMENT SYMBOL MARKING (THRU ARROW) TYPE B,CLASS II
- (P) PAVEMENT SYMBOL MARKING (SINGLE TURN ARROW) TYPE B,CLASS II
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RW PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	4

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(4)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

RW PLANS

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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(5)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

MATCH LINE SHEET NO. II(5C) STA. 22+25

TO REMAIN

Fenris Colony 15

OLDE TOWNE ROAD

512 21 — TURNING VEHICLES

502 15 — GM A — Longhill Road

503 4

501 18 — BUS SIGN — Exist. Sign relocated from left of Sta. 231+44 (This Sheet)

LONGHILL ROAD
Rte. 612 (SPEED LIMIT 45MPH)

TO RTE. 614

MATCH LINE STATION 227+00 SHEET NO. II(4)

Sediment Forebay

Bio-Retention Filter I

6" Perforated Pipe

DEVON ROAD

Devon Road — Longhill Road — GM C

511 4

505 19

GM A

513 21 — TURNING VEHICLES

514 20 — PATH NARROWS

Exist. Sign to be relocated left of Sta. 227+14 (This Sheet) Removal of existing structure to be paid for under other items.

SP-GM C — BUS SIGN — 510 18

SPEED LIMIT 45 — GM A

SPEED LIMIT 45 — 509 3

507 1

506 4

515 20 — PATH NARROWS

504 22

516 7

508 4

TO RTE. 199

MATCH LINE STATION 234+00 SHEET NO. II(6)

END PAVEMENT MARKINGS

PAVEMENT MARKING LEGEND

- (A) TYPE B, CLASS I, WHITE PAVEMENT LINE MARKING, 4" WIDTH
- (B) TYPE B, CLASS I, YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (C) TYPE B, CLASS I, DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (D) TYPE B, CLASS I, WHITE PAVEMENT LINE MARKING, 4" WIDTH (2' LINE, 6' SPACE)
- (E) TYPE B, CLASS I, WHITE PAVEMENT LINE MARKING, 4" WIDTH (10' LINE, 30' SPACE)
- (F) TYPE B, CLASS I, WHITE PAVEMENT LINE MARKING, 8" WIDTH
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VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	5
Traffic Signal Plan Sheet	12(3)

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(5)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(6)

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RW PLANS

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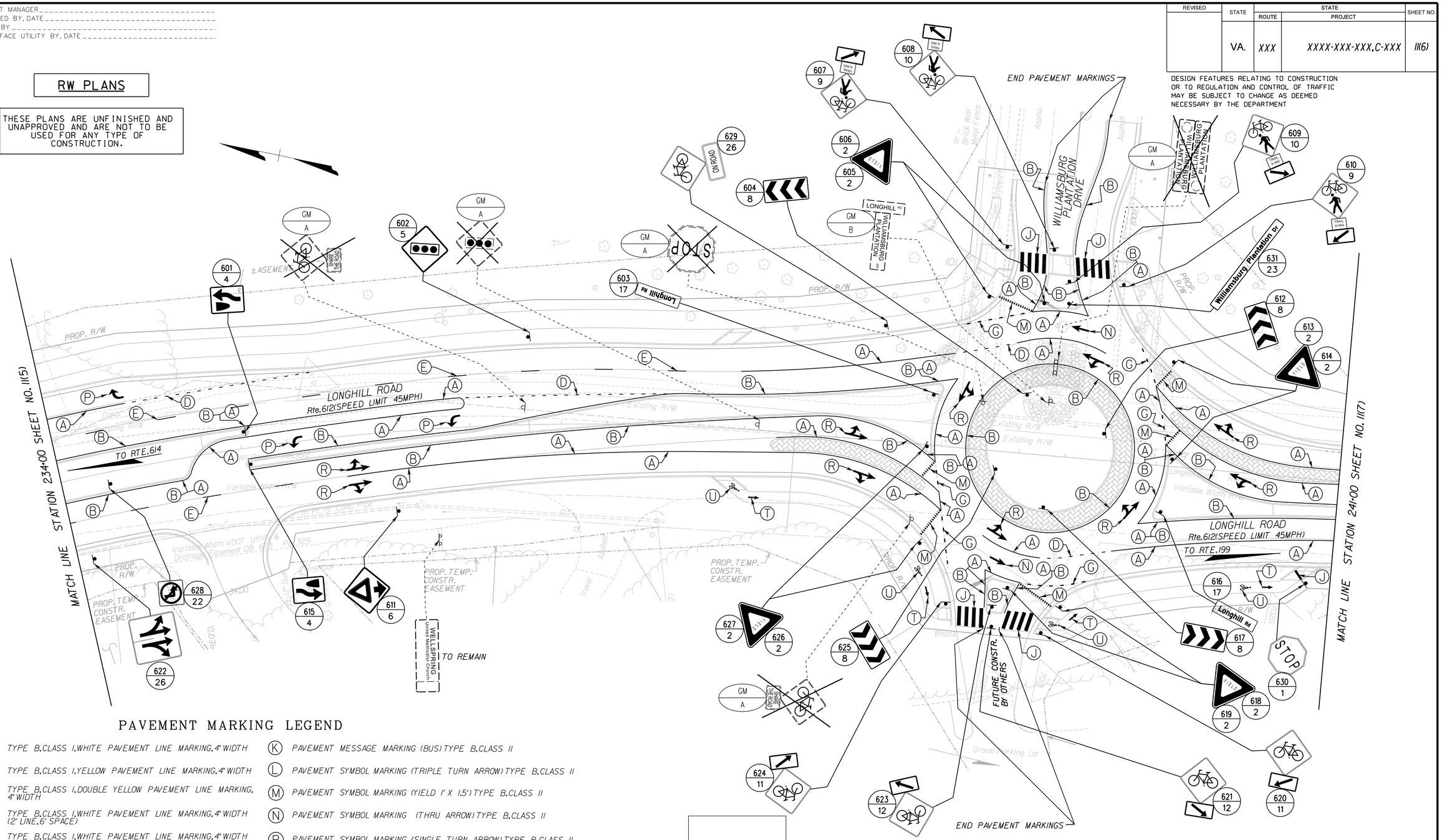

PAVEMENT MARKING LEGEND

- (A) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH
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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	6

TRAFFIC CONTROL DEVICE PLANS
SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(6)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(1)

PAC PLANS

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DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

INDEX OF SHEETS

GENERAL NOTES - SIGNING

1. All existing signs are to remain unless otherwise noted.

2. Signs are to be installed within R/W or easement.

3. The locations of all underground and overhead utilities shown on these plans are approximate only and may not be accurate. At least 72 hours prior to beginning signing work, the Contractor shall contact "Miss Utility of Virginia" at 1-800-552-7001 in order to determine the extent and location of all underground utilities within the project limits.
If the Contractor perceives a conflict between utilities and the proposed traffic signing equipment, the Contractor shall notify the Engineer immediately so that the conflict may be reviewed.

4. Sign panel design for signs mounted on Square Tube Posts shall conform to St'd. STP-1. The Contractor shall verify the design of all sign panel assembly types not shown in this St'd. with the Engineer.

GENERAL NOTES - PAVEMENT MARKING

1. All existing conflicting pavement markings shall be eradicated.

2. Stop bars are to be installed a minimum of 4' and a maximum of 30' in advance of the nearest edge of the intersecting roadway or as directed by the Engineer.

3. All proposed pavement markings shall tie into the existing markings at the limit of the proposed pavement markings.

4. Pavement markings on existing pavement are to remain unless noted otherwise on the plans. Existing pavement markings shown outside the limits of the new markings are approximate and shown for reference only.

5. All new pavement marking arrows included in project are noted on plans. All other arrows shown on the plans are existing (hollow arrows) or denote the direction of travel.

6. All turn lane arrows, turn lane skip/solid lines and stop bars shall be located per St'd. PM-3.

7. Stop bars shall be no closer than 4' from crosswalks. Stop bars on shared use paths shall not be placed over tactile strips.

8. The width of crosswalks shall be 10' and shall be in accordance with The Road and Bridge Std's. PM-3 for Crosswalk Markings.

STANDARD SIGN LEGEND

PLAN ITEM	PLAN SYMBOL: PROPOSED	PLAN SYMBOL: EXISTING
Single Post Sign Support		
Double Post Sign Support		
Triple Post Sign Support		
Flashing Beacon		
O/H Cantilever Sign Support		
O/H Span Sign Support		

SIGN CALL-OUTS

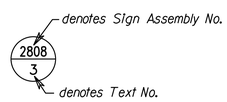
Existing Sign to Remain or to be Relocated

Existing Sign to be Removed

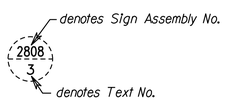
Proposed Sign Panel

SIGN LABELS

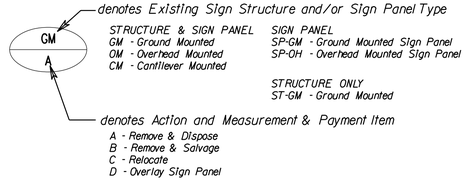
Proposed Sign Assemblies



Relocated Sign Assemblies



Sign Relocation or Payable Sign Disposal/Salvage



Signs noted on plans to be removed that do not have an accompanying sign label shall not be measured separately for payment. Removal and disposal for such signs shall be incidental to other contract items.

PAVEMENT MARKING LEGEND

(A) TYPE B, CLASS I, WHITE PAVEMENT LINE MARKING, 4" WIDTH

(B) TYPE B, CLASS I, YELLOW PAVEMENT LINE MARKING, 4" WIDTH

(C) TYPE B, CLASS I, DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH

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VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS
INDEX OF SHEETS, GENERAL NOTES & LEGENDS

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	II(1)

3/1/2023
3:08:14 PM

t10092111102\.dgn
Plotted By: federicogontaruk

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(2)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

SUMMARY OF QUANTITIES

TCD Discipline	SIGNING														PAVEMENT MARKINGS																						
Summary Notes	⊗								①																		②										
Item Description / UNIT / SHEET NO.	Sign Panel	Sign Post STP-I, 2",14 GAUGE	Sign Post STP-I, 2 3/16",10 GAUGE	Sign Post STP-I, 2 1/2",10 GAUGE	Sign Post STP-I, 2 1/2",12 GAUGE	Concrete Foundation STP-I,Type C	Concrete Foundation STP-I,TYPE D	Concrete Foundation STP-I,TYPE E	Relocate Existing Ground Mounted Sign Panel	Relocate Existing Ground Mounted Sign Structure & Sign Panel	Remove & Salvage Existing Ground Mounted Sign Structure & Sign Panel	Remove & Dispose Existing Ground Mounted Sign Structure & Sign Panel			Type B,Class I,Pavement Line Marking 4"	Type B,Class I,Pavement Line Marking 6"	Type B,Class I,Pavement Line Marking 8"	Type B,Class I,Pavement Line Marking 24"	Eradication of Existing Linear Pavement Markings	Pavement Message Marking "ONLY" Type B,Class II	Pavement Symbol Marking, Single Turn Arrow, Type B,Class II	Pavement Symbol Marking (Double Turn Arrow Thru/Lt or Rt) Type B,Class II	Pavement Symbol Marking, Triple Turn Arrow, Type B,Class II	Pavement Symbol Marking, (Yield 1' x 1.5') Type B,Class II	Pavement Symbol Marking, (Bicyclist Thru Arrow) Type B,Class II	Pavement Symbol Marking, (Helmeted Bicyclist) Type B,Class II	Pavement Message,8" Character Type B,Class II										
	S.F.	LF.	LF.	LF.	LF.	EA.	EA.	EA.	EA.	EA.	EA.	EA.			LF.	LF.	LF.	LF.	LF.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.										
II(3)	14.5	12	--	--	30	--	1	2	--	--	--	--			980	--	345	--	100	1	2	--	--	--	--	--	--										
II(4)	45	--	--	13	65	1	--	5	--	1	--	--			3,085	140	195	60	--	1	7	--	--	--	--	--	--										
II(5)	71	136	--	--	52	--	11	4	2	1	--	--			4,345	--	--	440	--	1	12	4	--	--	--	--	3										
II(5c)	--	--	--	--	--	--	--	--	--	--	--	--			1,195	--	--	--	~	--	1	1	--	--	--	--	--										
II(6)	188.25	195	24	60	166	4	15	13	--	--	1	--			3,660	--	60	195	~	--	5	10	--	80	4	4	--										
II(7)	45	49	--	--	52	--	4	4	--	--	--	--			3,190	--	--	35	—	--	5	4	--	--	--	--	--										
II(8)	49	95	--	--	37	--	8	3	2	--	--	1			2,900	--	--	440	100	1	7	1	1	--	--	--	3										
TOTAL	413	487	24	73	402	5	39	31	4	2	1	1			19,355	140	600	1,170	200	4	39	20	1	80	4	4	6										

SUMMARY NOTES

⊗ Denotes item to be paid for on the basis of Plan Quantity in accordance with current Road & Bridge Specifications.

① Relocate Existing Ground Mounted Sign Panel shall include all required Sign Bracing and Mounting Hardware.

② This Pay Item refers to the Pavement Message Marking "BUS".

PAC PLANS

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VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 E. BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
SIGNING & PAVEMENT MARKINGS
SUMMARY OF QUANTITIES

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	II(2)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(2A)

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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

FIGURE 1

SIGN DETAIL

SIGN NUMBER	603, 616
WIDTH x HGHT.	4'-0" x 1'-0"
BORDER WIDTH	0.5"
BORDER INSET	0"
PANEL RADIUS	1.5"
MOUNTING	Ground
BACKGROUND	TYPE: Reflective
	COLOR: Green
LEGEND/BORDER	TYPE: Reflective
	COLOR: White/White

SYMBOL	ROT	X	Y	WID	HT

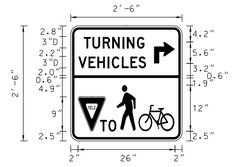
Dimensions are in inches.tenths

Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)																								LENGTH	SERIES/SIZE
L	o	n	g	h	i	l	l	R	d																D 2000
4.9	9.2	13.8	18.3	23.1	27.7	29.9	32.1	37.5	40.7															38.1	64.5,4/3

FIGURE 2

SIGN DETAIL



SIGN NUMBER	512, 513, 801, 810
WIDTH x HGHT.	2'-6" x 2'-6"
BORDER WIDTH	0.63"
BORDER INSET	0.38"
PANEL RADIUS	1.88" plus 0.38"
MOUNTING	Ground
BACKGROUND	TYPE: Reflective
	COLOR: Black/White
LEGEND/BORDER	TYPE: Reflective
	COLOR: Black/Black

SYMBOL	ROT	X	Y	WID	HT
AR90R1	0	22.5	20.2	5.6	5.7
Pedestrain	0	12.4	2.5	5.2	12
Bicycle	0	18.3	2.5	9.6	6.9

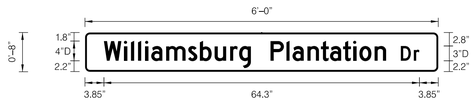
Dimensions are in inches.tenths

Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)																								LENGTH	SERIES/SIZE
T	U	R	N	I	N	G																			D 2000
3.6	5.9	8.6	11.2	13.9	15.1	17.8																		16.3	3
V	E	H	I	C	L	E	S																		D 2000
2.1	4.8	7.2	9.9	11.1	13.8	16.1	18.2																	18.2	3
T	O																								D 2000
7.9	10.2																							4.4	3

FIGURE 3

SIGN DETAIL



SIGN NUMBER	631
WIDTH x HGHT.	6'-0" x 0'-8"
BORDER WIDTH	0.38"
BORDER INSET	0"
PANEL RADIUS	1"
MOUNTING	Ground
BACKGROUND	TYPE: Reflective
	COLOR: Green
LEGEND/BORDER	TYPE: Reflective
	COLOR: White/White

SYMBOL	ROT	X	Y	WID	HT

Dimensions are in inches.tenths

Letter locations are panel edge to lower left corner

LETTER POSITIONS (X)																											SERIES/SIZE
W	i	l	l	i	a	m	s	b	u	r	g		P	l	a	n	t	a	t	i	o	D 2000				
3.9	7.9	9.4	10.8	12.3	13.5	16.5	21	23.4	26.4	29.6	31.4	33.8	37.8	41.1	42.3	45.3	48.1	49.9	52.6	54.7	55.9	4/3,32.3				
n	D	r																			LENGTH						
59	64.4	67																			64.3						

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RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS
SIGN FIGURE DETAILS

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	II(2A)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

SIGN SCHEDULE

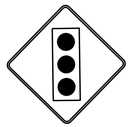
PAC PLANS

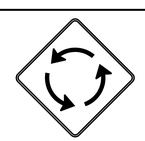
THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	1112B11

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE W	PANEL SIZE H	QTY.	SIGN PANEL AREA (s.f.) per ASSEMBLY	SIGN PANEL AREA (s.f.) ALL ASSEM-BLIES	PROP. SIGN STRUCTURE ST'D.	PROP. FD'N. ST'D.	REMARKS
1	401, 406, 507		R1-1	30"	30"	3	6.25	18.75	STP-1 2½" 12 GA.	E	
	629, 630			18"	18"	2	2.25	4.5	STP-1 2" 14 GA.	D	
2	605, 606, 613, 614, 618, 619, 626, 627		R1-2	36"	36"	8	4	32	STP-1 2" 14 GA.	D	
3	404, 509		R2-1	30"	36"	2	7.5	15	STP-1 2½" 12 GA.	E	
4	503, 506, 508, 511, 601, 615, 702, 705, 802, 805, 808, 809		R4-7	24"	30"	12	5	60	STP-1 2" 14 GA.	D	
5	408, 602		W3-3	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	
6	611, 701		W3-2	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE W	PANEL SIZE H	QTY.	SIGN PANEL AREA (s.f.) per ASSEMBLY	SIGN PANEL AREA (s.f.) ALL ASSEM-BLIES	PROP. SIGN STRUCTURE ST'D.	PROP. FD'N. ST'D.	REMARKS
7	516, 703		W2-6	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	
8	604, 612, 617, 625		R6-4A	48"	24"	4	8	32	STP-1 2½" 12 GA.	E	
9	607, 610		W11-15	30"	30"	2	6.25	22.5	STP-1 2½" & 2 3/16" 10 GA.	C	
			W11-15P	24"	18"	2	3				
			W16-7PL	24"	12"	2	2				
10	608, 609		W11-15	30"	30"	2	6.25	22.5	STP-1 2½" & 2 3/16" 10 GA.	C	
			W11-15P	24"	18"	2	3				
			W16-7PR	24"	12"	2	2				
11	620, 624		W11-1	24"	24"	2	4	12	STP-1 2½" 12 GA.	E	
			W16-7PL	24"	12"	2	2				

NOTES:

1) ALL SIGNS SHALL BE ORIENTATED AS SHOWN ON THE PLANS.
2) SIGN COLOR COMBINATIONS SHALL BE IN ACCORDANCE WITH THE FHWA SHS BOOK AND THE 2011 VIRGINIA SHS BOOK OR AS NOTED IN THE PLANS.
3) REFLECTIVE SHEETING SHALL BE TYPE XI, UNLESS OTHERWISE NOTED IN THE REMARKS. ALL REFLECTIVE SHEETING SHALL BE IN ACCORDANCE WITH TABLE VII-1A OF THE 2020 VDOT ROAD AND BRIDGE SPECIFICATIONS.
4) ALL BLACK SHEETING SHALL BE NON-REFLECTIVE.
5) SIGN STRUCTURES SHALL BE INSTALLED PER THE NOTED SIGN ST'D.
6) ALL ST'D. STP-1 STRUCTURES TO BE SINGLE POST UNLESS OTHERWISE NOTED.
7) IF APPLICABLE, SEE SHEET 2D FOR NON-STANDARD TYPE VA AND VIA SIGN STRUCTURE DETAILS.

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
SIGNING AND PAVEMENT MARKINGS
SIGN SCHEDULE

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	1112B11

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

SIGN SCHEDULE

PAC PLANS

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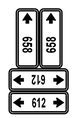
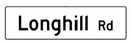
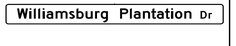
VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	11(2B)12

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE W	PANEL SIZE H	QTY.	SIGN PANEL AREA (s.f.) per ASSEMBLY	SIGN PANEL AREA (s.f.) ALL ASSEM-BLIES	PROP. SIGN STRUCTURE ST'D.	PROP. F'D'N. ST'D.	REMARKS
12	621,623		W11-1	24"	24"	2	4	12	STP-1 2½" 12 GA.	E	
			W16-7PR	24"	12"	2	2				
13	807		R3-17	24"	18"	1	3	4.33	STP-1 2" 14 GA.	D	
			R3-17BP	24"	8"	1	1.33				
14	803,804		M1-V3aB	24"	9"	4	1.5	6	STP-1 2" 14 GA.	D	(See Note 8)
15	502		M1-V3aR	24"	9"	1	1.5	6	STP-1 2" 14 GA.	D	(See Note 8)
			M1-V3aL	24"	9"	1	1.5				
			M1-V3aB	24"	9"	2	3				(See Note 8)
16	301,405		R3-7R	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	
17	603,616		D3-1	48"	12"	2	4	8	STP-1 2" 14 GA.	D	(See Figure 1)

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE W	PANEL SIZE H	QTY.	SIGN PANEL AREA (s.f.) per ASSEMBLY	SIGN PANEL AREA (s.f.) ALL ASSEM-BLIES	PROP. SIGN STRUCTURE ST'D.	PROP. F'D'N. ST'D.	REMARKS
18	501,510,704,806		EXIST.	-	-	4	-	-	STP-1 2" 14 GA.	D	
		NOT USED									
20	302,514,515		W5-4a	18"	18"	3	2.25	6.75	STP-1 2" 14 GA.	D	
21	512,513,801,810		R10-15R (Mod)	30"	30"	4	6.25	25	STP-1 2½" 12 GA.	E	(See Figure 2)
22	504,505,628,706		R3-2	24"	24"	3	4	12	STP-1 2" 14 GA.	D	
23	631		D3-1	72"	8"	1	4	4	STP-1 2" 14 GA.	D	(See Figure 3)
24	407		R2-1 R4-7	30" 24"	36" 30"	1 1	7.5 5	7.5 5	STP-1 2½" 10 GA.	C	

NOTES:

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7) IF APPLICABLE, SEE SHEET 2D FOR NON-STANDARD TYPE VA AND VIA SIGN STRUCTURE DETAILS.
8) SIGN PANELS SHALL BE MOUNTED BACK TO BACK AND BRACED PER ST'D. STP-1.

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
SIGNING AND PAVEMENT MARKINGS
SIGN SCHEDULE

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	11(2B)12

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

SIGN SCHEDULE

PAC PLANS

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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	11(2B)3

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

TEXT NO.	SIGN ASSEMBLY NO(s).	TEXT	SIGN ASSEMBLY COMPONENTS: MUTCD ST'D.	PANEL SIZE W	PANEL SIZE H	QTY.	SIGN PANEL AREA (s.f.) per ASSEMBLY	SIGN PANEL AREA (s.f.) ALL ASSEMBLIES	PROP. SIGN STRUCTURE ST'D.	PROP. F'D'N. ST'D.	REMARKS
25	303.629.708.811		W11-1	24"	24"	4	4	24	STP-1 2½" 12 GA.	E	
			W11-VP2	24"	12"	4	2				
26	622.707		R3-8 (Mod.)	30"	30"	2	6.25	12.5	STP-1 2½" 12 GA.	E	

NOTES:

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VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
SIGNING AND PAVEMENT MARKINGS
SIGN SCHEDULE
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	11(2B)3

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(4)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

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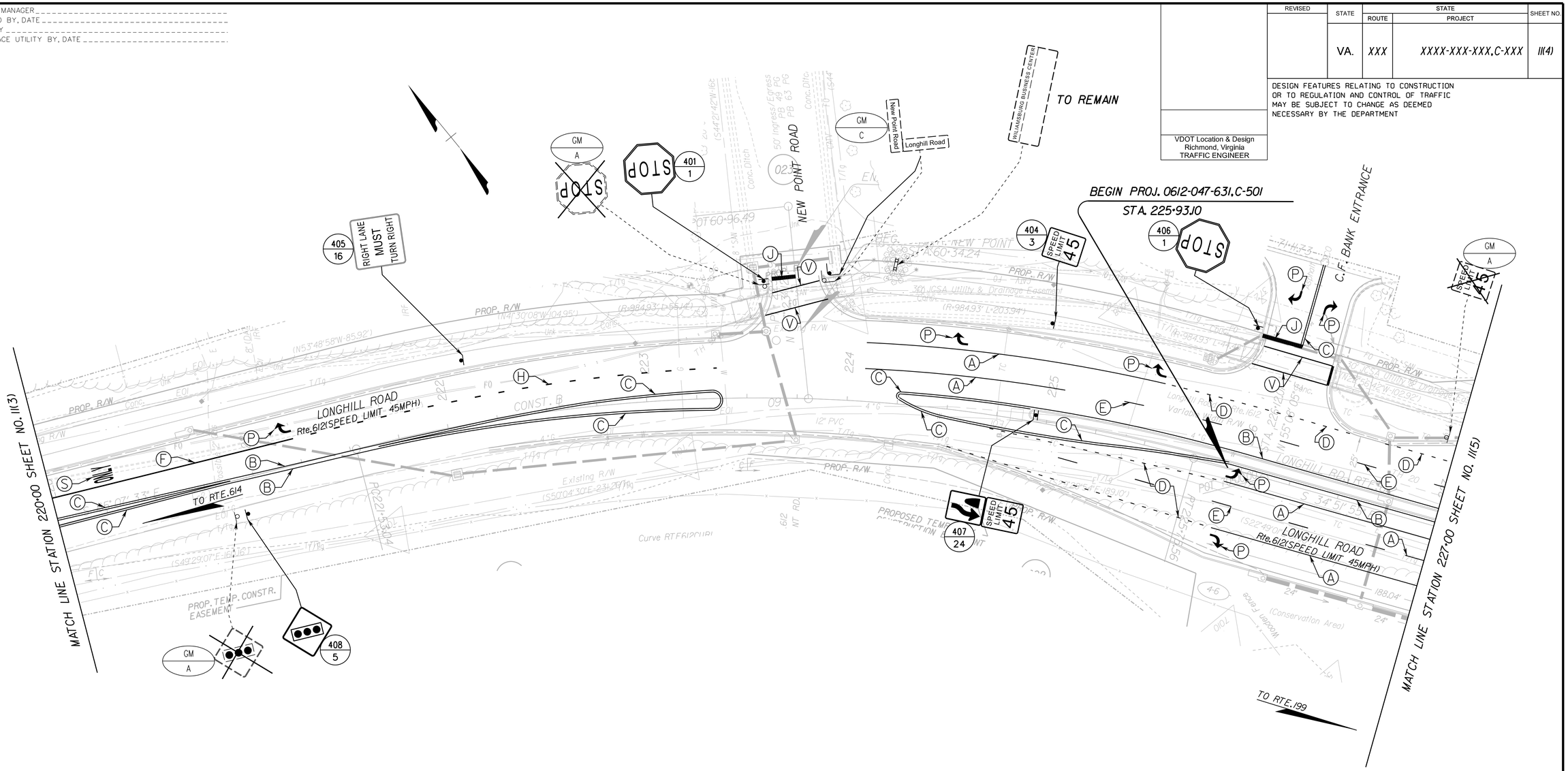

PAVEMENT MARKING LEGEND

- (A) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH
- (B) TYPE B,CLASS I,YELLOW PAVEMENT LINE MARKING,4" WIDTH
- (C) TYPE B,CLASS I,DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (D) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (2' LINE,6' SPACE)
- (E) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (10' LINE,30' SPACE)
- (F) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH
- (G) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (2' LINE,6' SPACE)
- (H) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (3' LINE,9' SPACE)
- (J) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,24" WIDTH
- (K) PAVEMENT MESSAGE MARKING (BUS) TYPE B,CLASS II
- (L) PAVEMENT SYMBOL MARKING (TRIPLE TURN ARROW) TYPE B,CLASS II
- (M) PAVEMENT SYMBOL MARKING (YIELD 1' X 1.5') TYPE B,CLASS II
- (N) PAVEMENT SYMBOL MARKING (THRU ARROW) TYPE B,CLASS II
- (P) PAVEMENT SYMBOL MARKING (SINGLE TURN ARROW) TYPE B,CLASS II
- (R) PAVEMENT SYMBOL MARKING (DOUBLE TURN ARROW THRU/LT OR RT) TYPE B,CLASS II
- (S) PAVEMENT MESSAGE MARKING (ONLY) TYPE B,CLASS II
- (T) PAVEMENT SYMBOL MARKING,(BICYCLIST THRU ARROW) TYPE B,CLASS II
- (U) PAVEMENT SYMBOL MARKING,(HELMETED BICYCLIST) TYPE B,CLASS II
- (V) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,6" WIDTH

PAC PLANS

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VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	4

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(4)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(5)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

PAC PLANS

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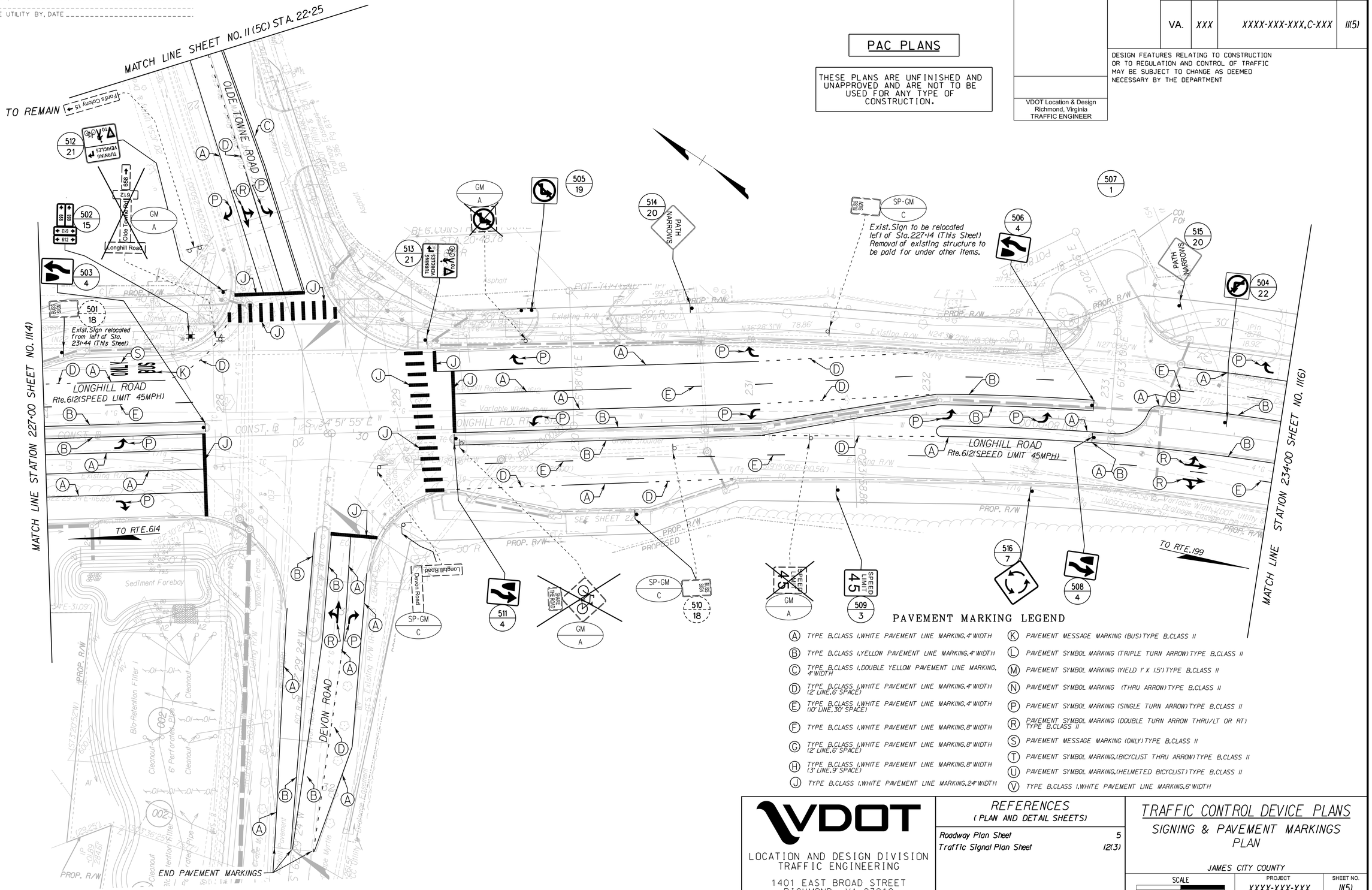

PAVEMENT MARKING LEGEND

- (A) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH
- (B) TYPE B.CLASS I,YELLOW PAVEMENT LINE MARKING,4" WIDTH
- (C) TYPE B.CLASS I,DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (D) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (2' LINE,6' SPACE)
- (E) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (10' LINE,30' SPACE)
- (F) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH
- (G) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (2' LINE,6' SPACE)
- (H) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (3' LINE,9' SPACE)
- (J) TYPE B.CLASS I,WHITE PAVEMENT LINE MARKING,24" WIDTH
- (K) PAVEMENT MESSAGE MARKING (BUS) TYPE B,CLASS II
- (L) PAVEMENT SYMBOL MARKING (TRIPLE TURN ARROW) TYPE B,CLASS II
- (M) PAVEMENT SYMBOL MARKING (YIELD 1' X 1.5') TYPE B,CLASS II
- (N) PAVEMENT SYMBOL MARKING (THRU ARROW) TYPE B,CLASS II
- (P) PAVEMENT SYMBOL MARKING (SINGLE TURN ARROW) TYPE B,CLASS II
- (R) PAVEMENT SYMBOL MARKING (DOUBLE TURN ARROW THRU/LT OR RT) TYPE B,CLASS II
- (S) PAVEMENT MESSAGE MARKING (ONLY) TYPE B,CLASS II
- (T) PAVEMENT SYMBOL MARKING,(BICYCLIST THRU ARROW) TYPE B,CLASS II
- (U) PAVEMENT SYMBOL MARKING,(HELMETED BICYCLIST) TYPE B,CLASS II
- (V) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,6" WIDTH

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING

1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	5
Traffic Signal Plan Sheet	12(3)

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(5)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	II(6)

PAC PLANS

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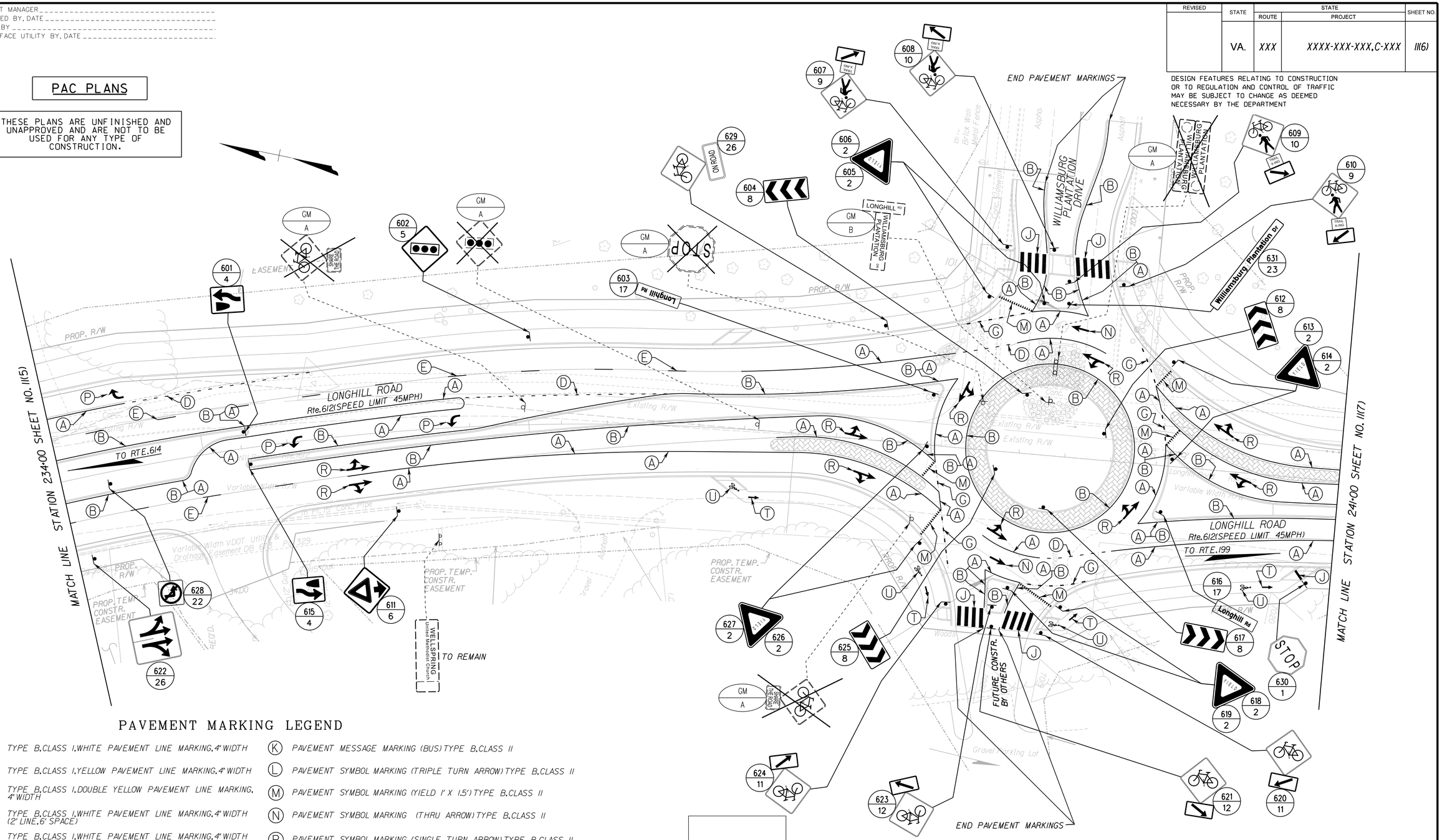

PAVEMENT MARKING LEGEND

- (A) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH
- (B) TYPE B,CLASS I,YELLOW PAVEMENT LINE MARKING,4" WIDTH
- (C) TYPE B,CLASS I,DOUBLE YELLOW PAVEMENT LINE MARKING, 4" WIDTH
- (D) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (2' LINE,6' SPACE)
- (E) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,4" WIDTH (10' LINE,30' SPACE)
- (F) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH
- (G) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (2' LINE,6' SPACE)
- (H) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,8" WIDTH (3' LINE,9' SPACE)
- (J) TYPE B,CLASS I,WHITE PAVEMENT LINE MARKING,24" WIDTH
- (K) PAVEMENT MESSAGE MARKING (BUS) TYPE B,CLASS II
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- (M) PAVEMENT SYMBOL MARKING (YIELD 1' X 1.5') TYPE B,CLASS II
- (N) PAVEMENT SYMBOL MARKING (THRU ARROW) TYPE B,CLASS II
- (P) PAVEMENT SYMBOL MARKING (SINGLE TURN ARROW) TYPE B,CLASS II
- (R) PAVEMENT SYMBOL MARKING (DOUBLE TURN ARROW THRU/LT OR RT) TYPE B,CLASS II
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VDOT Location & Design
Richmond, Virginia
TRAFFIC ENGINEER

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet	6

TRAFFIC CONTROL DEVICE PLANS

SIGNING & PAVEMENT MARKINGS PLAN

JAMES CITY COUNTY

SCALE	PROJECT	SHEET NO.
0 25' 50'	XXXX-XXX-XXX	II(6)

VDOT
Virginia Department of Transportation

Traffic Engineering Design Manual

Appendix C:
VDOT Lighting Design Plans

April 2020

Revision 1
March 2023

Location & Design Division

VDOT GOVERNANCE DOCUMENT

3/20/2020
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Plotted By: FedericoGontaruk

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(1)

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.

STANDARD LIGHTING LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Roadway Luminaire	●	
Signal Luminaire	✱	
Decorative Luminaire	✱	

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Light Pole	•	
Light Pole Foundation	○	
Breakaway Base (LP-1 & LP-2)	□	
Lighting Control Center, Type	CCW-1A	
Junction Box (JB-S1 Unless Otherwise Noted)	J	
Electrical Service	SE-6	
Conduit	▬▬▬	
Luminaire Arm	———	
LABELS		
Cable and Conduit	A	

LIGHTING LABELS

Proposed Lighting Cobrahead

Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 150W- 18'- 30' ← Denotes Luminaire Type, Wattage, Arm Length, Mounting Height,

Proposed Lighting Decorative

Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 52W- 16' ← Denotes Luminaire Type, Wattage, Mounting Height,

Luminaire Circuiting

CCI-6/8
CONTROL CENTER ← CIRCUIT

VDOT
CENTRAL REGION OPERATIONS
TRAFFIC ENGINEERING
2430 PINE FOREST DRIVE
COLONIAL HEIGHTS, VA 23 34

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL MODIFICATION

INDEX OF SHEETS, GENERAL NOTES & LEGEND

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(1)

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Plotted By: Federico.Gontaruk

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

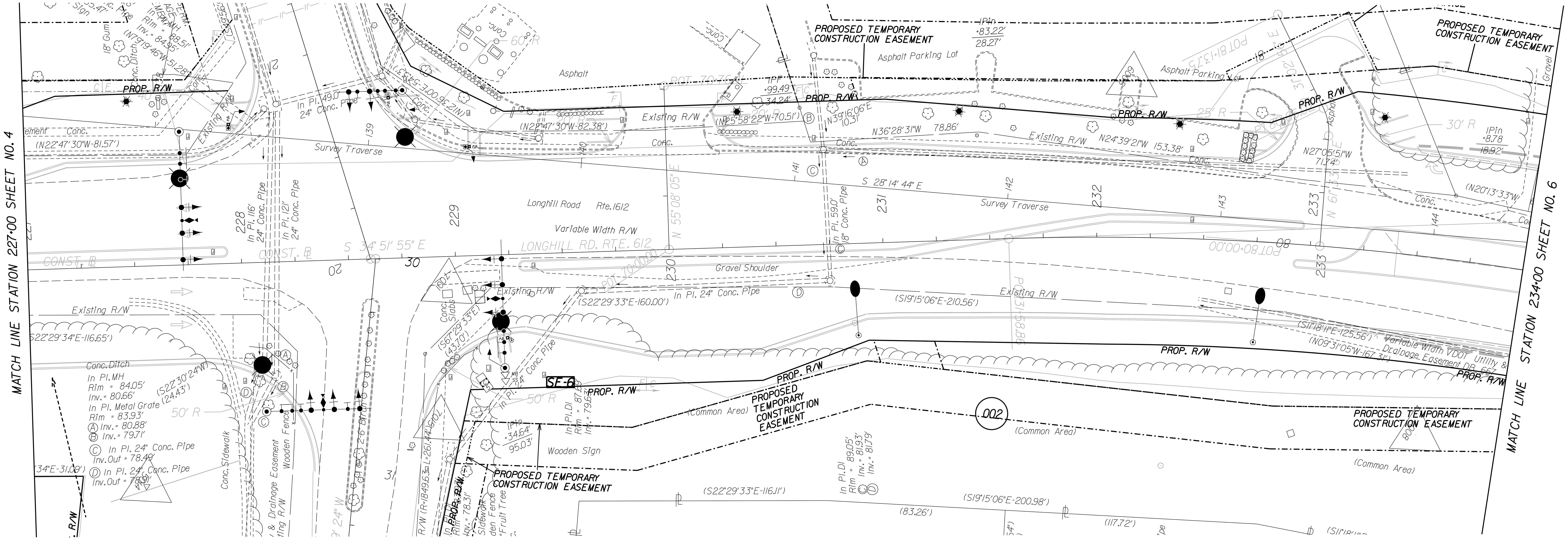
REVISED	STATE	ROUTE	PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(5)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

PUBLIC HEARING PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION OR THE AQUISITION OF RIGHT-OF-WAY.



VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet(s)	5
Traffic Signal Plan Sheet(s)	12(5)

TRAFFIC CONTROL DEVICE PLANS
LIGHTING PLAN

LONGHILL ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT XXXX-XXX-XXX
SHEET NO. 13(5)

3/20/2020
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Plotted By: FedericoGontaruk

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

REVISED	STATE	STATE		SHEET NO.
		ROUTE	PROJECT	
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(1)

STANDARD LIGHTING LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Roadway Luminaire	●	
Signal Luminaire	✱	
Decorative Luminaire	✱	

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Light Pole	•	
Light Pole Foundation	○	
Breakaway Base (LP-1 & LP-2)	□	
Lighting Control Center, Type	CCW-1A	
Junction Box (JB-S1 Unless Otherwise Noted)	J	
Electrical Service	SE-6	
Conduit	▬ ▬ ▬	
Luminaire Arm	———	
LABELS		
Cable and Conduit	A	

LIGHTING LABELS

Proposed Lighting Cobrahead

Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 150W- 18'- 30'
← Denotes Luminaire Type, Wattage, Arm Length, Mounting Height.

Proposed Lighting Decorative

Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 52W- 16'
← Denotes Luminaire Type, Wattage, Mounting Height.

Luminaire Circuiting

CCI-6/8
CONTROL CENTER ← CIRCUIT

RW PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT
CENTRAL REGION OPERATIONS
TRAFFIC ENGINEERING
2430 PINE FOREST DRIVE
COLONIAL HEIGHTS, VA 23 34

TRAFFIC CONTROL DEVICE PLANS

TRAFFIC SIGNAL MODIFICATION

INDEX OF SHEETS, GENERAL NOTES & LEGEND

JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(1)

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(5)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

RW PLANS

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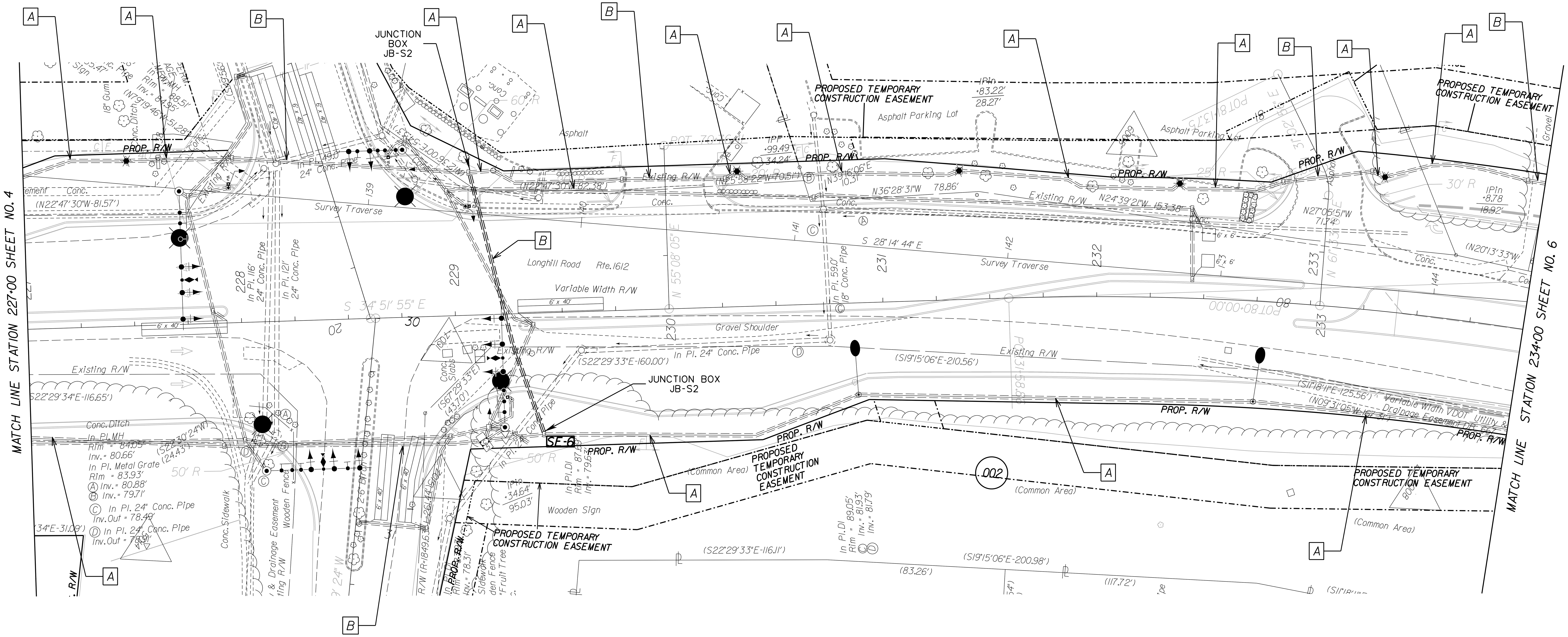

A 2'' PVC CONDUIT

B BORED CONDUIT 3''

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet(s)	5
Traffic Signal Plan Sheet(s)	12(5)

TRAFFIC CONTROL DEVICE PLANS
LIGHTING PLAN

LONGHILL ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(5)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(1)

GENERAL NOTES - LIGHTING

INDEX OF SHEETS

1. The following items and operations shall conform to the standard listed below:

   Lighting Pole Foundation LF-1
   Lighting Pole LP-1, LP-2
   Conduit Installation ..... EC1-1 or Bored
   Junction Box JB-S2, JB-S3
   Control Center CCW-1
   Electrical Service SE-6

2. Lighting Pole foundation depths and above ground foundation projection/reveal (if needed) shall be determined by the Contractor in accordance with the current Road & Bridge Standards. Lighting poles and foundations shall be in accordance with the current Road & Bridge Standards. The pole supplier shall provide a bolt template for the foundation, which shall be centered utilizing the LF-1 foundation.

3. Lighting pole foundations may be field adjusted no more than 2' in any direction from the plan locations, provided that the revised foundation locations:
   Remain out of the clear zone and pavement sections.
   Remain within the right of way or propose easement.
   Does not conflict with utilities.
   Does not conflict with vehicle or pedestrians travel way.
   Does not limit sight distance.
   Does not affect drainage.
   Allow the lighting pole foundations to be adjusted with the same alignment with the designated location shown on the plans, and is in accordance with the LF-1 Lighting Pole Foundation Installation Details. If further adjustment is needed, the Project Inspector shall contact the Design Engineer on the plans. All modifications to the lighting pole placement more than 2' shall be approved by the engineer and shown on the as-built plans. All poles shall be field staked by the Contractor and inspected by the Engineer and Contractor per the specifications prior to installation of foundations.

4. The Lighting Control Center and CF-2 foundation may be relocated within the designated area provided it remains within the right of way or proposed easement, outside of the clear zone and pavement sections, does not conflict with utilities, does not limit sight distance, and is in accordance with the Electric Service Standard detail referenced to the installation.

5. Junction boxes may be relocated in the field as necessary provided they remain within the right of way, do not conflict with utilities and remain outside the pavement section.

6. The electric service connection and service line locations may be field adjusted as necessary provided all equipment remains within the right of way or proposed easement, does not conflict with utilities and remains outside the pavement sections.

7. All underground and overhead utilities shown on these plans are approximate only and may not be complete. At least 72 hours prior to beginning lighting work, the Contractor shall contact "Miss Utility of Virginia" at 1-800-552-7001 in order to determine the extent, location, and identify all of the utilities within the work area. If the Contractor perceives a conflict between utilities and the proposed lighting equipment, the Contractor shall notify the Engineer immediately so that the conflict may be reviewed. The Contractor shall be responsible for repairing or replacing at their own expense, any existing utilities, pavement, concrete items, etc. that are damaged or disturbed during construction.

8. Conduits and junction boxes shown on these plans are diagrammatic and actual conduit runs and junction boxes shall be modified as field conditions warrant. All modifications to the conduit runs shall be approved by the engineer and shown on the as-built plans. Conduit systems shall be bonded in accordance with Section 700 of the Road & Bridge Specifications.

9. All equipment is to be installed within the existing or proposed R/W or easement.

10. All roadway lighting standards shall include breakaway base unless otherwise noted on the plans.

11. The contractor shall field verify existing overhead power lines locations and stay at least 25 feet away from transmission lines and 10 feet away from power lines. If there is any conflict with overhead lines, the contractor shall notify the engineer immediately.

12. The contractor is responsible for determining proper pole length needed at each location in order to attain proper luminaire mounting height specified at each location in relation to the roadway prior to placing any order. The pole type has been determined from survey information. Actual pole length shall be determined from field measurement.

13. The contractor shall coordinate electrical service drop locations with the local power company and engineer prior to ordering any cabinets or installing any conduits and junction boxes.

STANDARD LIGHTING LEGEND

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING	PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Roadway Luminaire	●		Light Pole	•	
Signal Luminaire	✱		Light Pole Foundation	○	
Decorative Luminaire	✱		Breakaway Base (LP-1 & LP-2)	□	
			Lighting Control Center, Type	CCW-1A	
			Junction Box (JB-S1 Unless Otherwise Noted)	J	
			Electrical Service	SE-6	
			Conduit	═══	
			Luminaire Arm	———	
			LABELS		
			Cable and Conduit	A	

LIGHTING LABELS

Proposed Lighting Cobrahead
Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 150W - 18' - 30'
Denotes Luminaire Type, Wattage, Arm Length, Mounting Height.

Proposed Lighting Decorative
Denotes Location of Light Pole in reference to Baseline → Station, Offset Const. ℄
Type, 52W - 16'
Denotes Luminaire Type, Wattage, Mounting Height.

Luminaire Circuiting
CCI-6/8
CONTROL CENTER — CIRCUIT

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT
CENTRAL REGION OPERATIONS
TRAFFIC ENGINEERING
2430 PINE FOREST DRIVE
COLONIAL HEIGHTS, VA 23 34

TRAFFIC CONTROL DEVICE PLANS
TRAFFIC SIGNAL MODIFICATION
INDEX OF SHEETS, GENERAL NOTES & LEGEND
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(1)

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Plotted By: federicogontaruk

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(2)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

SUMMARY OF QUANTITIES

TCD Discipline	LIGHTING																		
Summary Notes	5											1		2 & 4	3 & 4	3 & 4			
Item Description	Electrical Service SE-6	Electrical Service Grounding Electrode (10')	Concrete Foundation CF-2	Control Center CCW-1, Type C	Conductor Cable No.6 (EGC)	6 Conductor Cable	Concrete Foundation LF-1, Type A	Lighting Pole LP-2, Type E	Luminaire Arm, 18'	Junction Box JB-S1	Junction Box JB-S2	Decorative Concrete Foundation	Decorative Light Pole	Luminaire Decorative LED 52 Watt	Cobrahead Luminaire LED 210 Watt	Signal Pole Luminaire LED 210 Watt	2" PVC Conduit	Bored Conduit 3"	Trench Excavation EC1-1
UNIT	EA.	EA.	EA.	EA.	L.F.	L.F.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	EA.	L.F.	L.F.	L.F.
SHEET NO.																			
13(3)					1,760	880	3	3	3			4	4	4	3		840		840
13(4)					2,950	1,475	5	5	5	4		7	7	7	5		1,410	115	1,410
13(5)	1	5	1	1	3,585	1,795	2	2	2	7	2	6	6	6	2	4	1,575	535	1,575
13(6)	1	5	1	1	3,650	1,825	6	6	6	6	2	8	8	8	6		1,155	400	1,155
13(7)					2,860	1,430	4	4	4	2		6	6	6	4		1,365	115	1,365
13(8)					2,200	1,100	3	3	3	4		3	3	3	3	4	525	230	525
TOTAL	2	10	2	2	17,005	8,505	23	23	23	23	4	34	34	34	23	8	6,870	1,395	6,870

NOTES

1. Decorative concrete foundation shall be designed and furnished by the pole manufacturer.
2. Decorative Luminaire shall be type ASYM distribution with CCT of 3000K.
3. Roadway Luminaire shall be type III distribution with CCT of 3000K.
4. See plan sheet 13(2A) for details on decorative pole / Luminaire.
5. The Contractor is resposible to coordinate with the local utilities for the best service drop locations. The distance from the source of primary power shall be kept as short as possible to minimize losses due to voltage drop. The Contractor is resposible for locating all existing utilities and lighting systems before proceeding with the work.

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
ROADWAY LIGHTING
SUMMARY OF QUANTITIES
JAMES CITY COUNTY

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(2)

PROJECT MANAGER _____
SURVEYED BY, DATE _____
DESIGN BY _____
SUBSURFACE UTILITY BY, DATE _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(2A)

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

ELECTRICAL SERVICE

SERVICE LOCATION NO	STANDARD	TYPE	VOLTAGE	SAFETY S ITC			CONTROL CENTER IRING CC	
				VOLTAGE	AMPERAGE	FUSE AMPERAGE	CONTACTOR AMPERAGE	TYPE
1 & 2	SE-6	A	240/120	240	100	60	30	C

PANEL BOARD SCHEDULE CC1

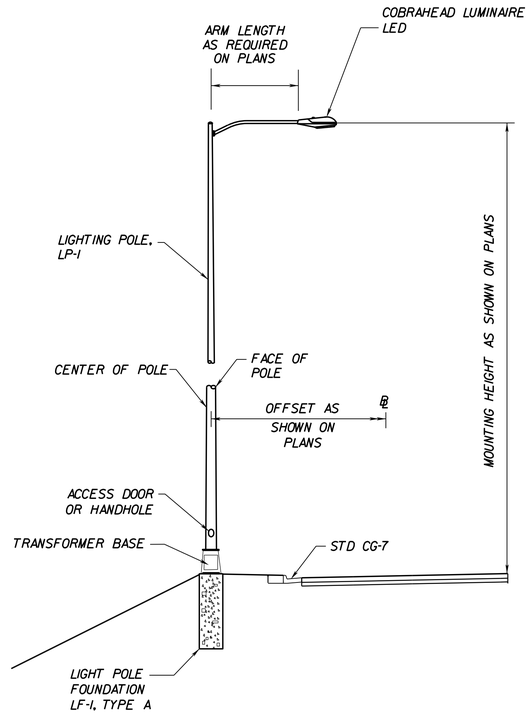
LOAD DESCRIPTION	WIRE SIZE	AMPERAGE BRKR. AMPS	AMPERAGE LOAD AMPS	AMPERAGE CIRCUIT NUMBER	SOLID NEUTRAL L1 L2 SN	AMPERAGE CIRCUIT NUMBER	AMPERAGE LOAD AMPS	AMPERAGE BRKR. AMPS	WIRE SIZE	LOAD DESCRIPTION
PHOTOCELL	12	15	1.7	1		2	10.7	15	6	ROADWAY LIGHTING
GFCI REC	12	20	10.0	3		4	10.7		6	
VENTILATION	12	15	0.3	5		6	4.3	15	6	ROADWAY LIGHTING
SPACE	-	-	-	7		8	4.3		6	
SPACE	-	-	-	9		10	-	30	8	SPD TYPE 1
SPACE	-	-	-	11		12	-		8	

CONTACTORS: 30-AMP, 2-POLE, 120-V COIL, 2 REQ'D
PANELBOARD: 100 AMP MCB
VOLTAGE: 120/240V, 1-PHASE, 3-WIRE, SN
MAINS FEEDER CONDUCTOR SIZE: 2 AWG
MAIN CIRCUIT BREAKER: 100-AMP, 2-POLE, MIN. INTERRUPTING CAPACITY 10,000 AMPS SYMM

PANEL BOARD SCHEDULE CC2

LOAD DESCRIPTION	WIRE SIZE	AMPERAGE BRKR. AMPS	AMPERAGE LOAD AMPS	AMPERAGE CIRCUIT NUMBER	SOLID NEUTRAL L1 L2 SN	AMPERAGE CIRCUIT NUMBER	AMPERAGE LOAD AMPS	AMPERAGE BRKR. AMPS	WIRE SIZE	LOAD DESCRIPTION
PHOTOCELL	12	15	1.7	1		2	12.7	20	6	ROADWAY LIGHTING
GFCI REC	12	20	10.0	3		4	12.7		6	
VENTILATION	12	15	0.3	5		6	3.9	15	6	DECORATIVE LIGHTING
SPACE	-	-	-	7		8	3.9		6	
SPACE	-	-	-	9		10	-	30	8	SPD TYPE 1
SPACE	-	-	-	11		12	-		8	

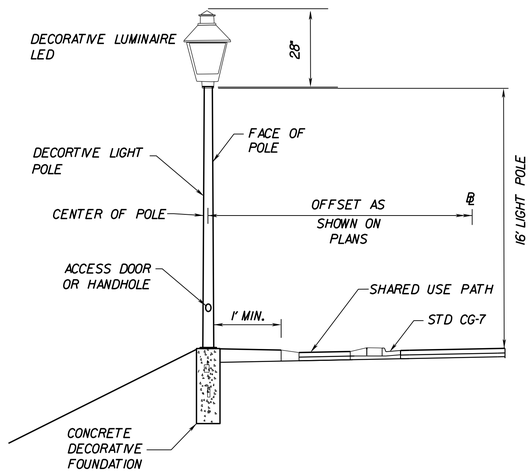
CONTACTORS: 30-AMP, 2-POLE, 120-V COIL, 2 REQ'D
PANELBOARD: 100 AMP MCB
VOLTAGE: 120/240V, 1-PHASE, 3-WIRE, SN
MAINS FEEDER CONDUCTOR SIZE: 2 AWG
MAIN CIRCUIT BREAKER: 100-AMP, 2-POLE, MIN. INTERRUPTING CAPACITY 10,000 AMPS SYMM



LIGHTING POLE LOCATION DETAIL "A"

NOT TO SCALE

ROADWAY LIGHTING

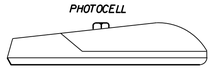


LIGHTING POLE LOCATION DETAIL "B"

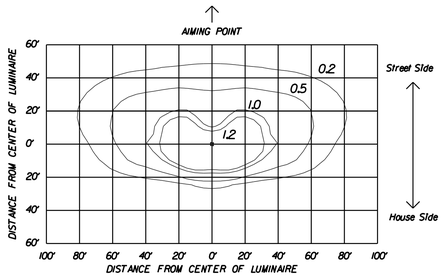
NOT TO SCALE

SHARED USE PATH

DECORATIVE POLE SHALL INCLUDE STRUCTURAL REVIEW AND PE SEAL BY AN ENGINEER.
DECORATIVE LIGHT POLE-16' POLE HEIGHT, ROUND TAPERED STEEL ROADWAY LIGHTING POLE SHAFT CONFORMS TO ASTM A1011 GRADE 50 OR ASTM A240 GRADE 201LN STANDARDS AND FORMED WITH A CONSTANT LINEAR TAPER. FEATURES (SET/4) ANCHOR BOLTS WITH TWO GALVANIZED HEXAGONAL NUTS PER ASTM A563 GRADE DH WITH EACH BOLT, 2 FLAT WASHERS PER ASTM F436 FULLY GALVANIZED, ANCHOR STYLE BASE PLATE, REINFORCED HANDHOLE WITH REMOVABLE COVER, GROUND LUG, 2-3/8" OR 3" O.D. TENON, HOT DIP GALVANIZED FINISH THROUGHOUT AND PAINTED USING MILLERBOND WET COAT PAINT PROCESS (PAINTED BLACK AND SHALL BE Fed ID FS 27038).



COBRAHEAD LUMINAIRE

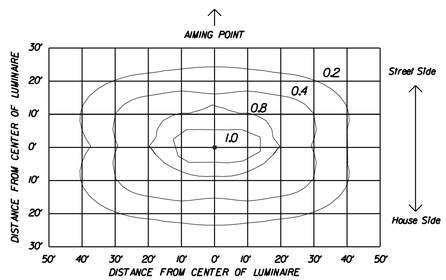


ISOFOOTCANDLE DIAGRAM
MAX 210-WATT LED ROADWAY LUMINAIRE
MIN 20,000 LUMENS, CCT 3000K
40-FT MOUNTING HEIGHT
COBRAHEAD LUMINAIRE

N.T.S.

ISOFOOT CANDLE DIAGRAM REPRESENTS THE LUMINAIRE ILLUMINATION PATTERN WITH A LIGHT LOSS FACTOR OF 0.85.

DECORATIVE LUMINAIRE



ISOFOOTCANDLE DIAGRAM
MAX 52-WATT LED ROADWAY LUMINAIRE
MIN 4,900 LUMENS, CCT 3000K
16-FT MOUNTING HEIGHT
DECORATIVE LUMINAIRE

N.T.S.

ISOFOOT CANDLE DIAGRAM REPRESENTS THE LUMINAIRE ILLUMINATION PATTERN WITH A LIGHT LOSS FACTOR OF 0.85.

LUMINAIRE SHALL DISPLAY THE OLD FASHIONED TRADITIONAL LANTERN TYPE POST TOP LIGHTING

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

VDOT

LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 E. BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS

LIGHTING & PANELBOARD SCHEDULE DETAILS

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(2A)

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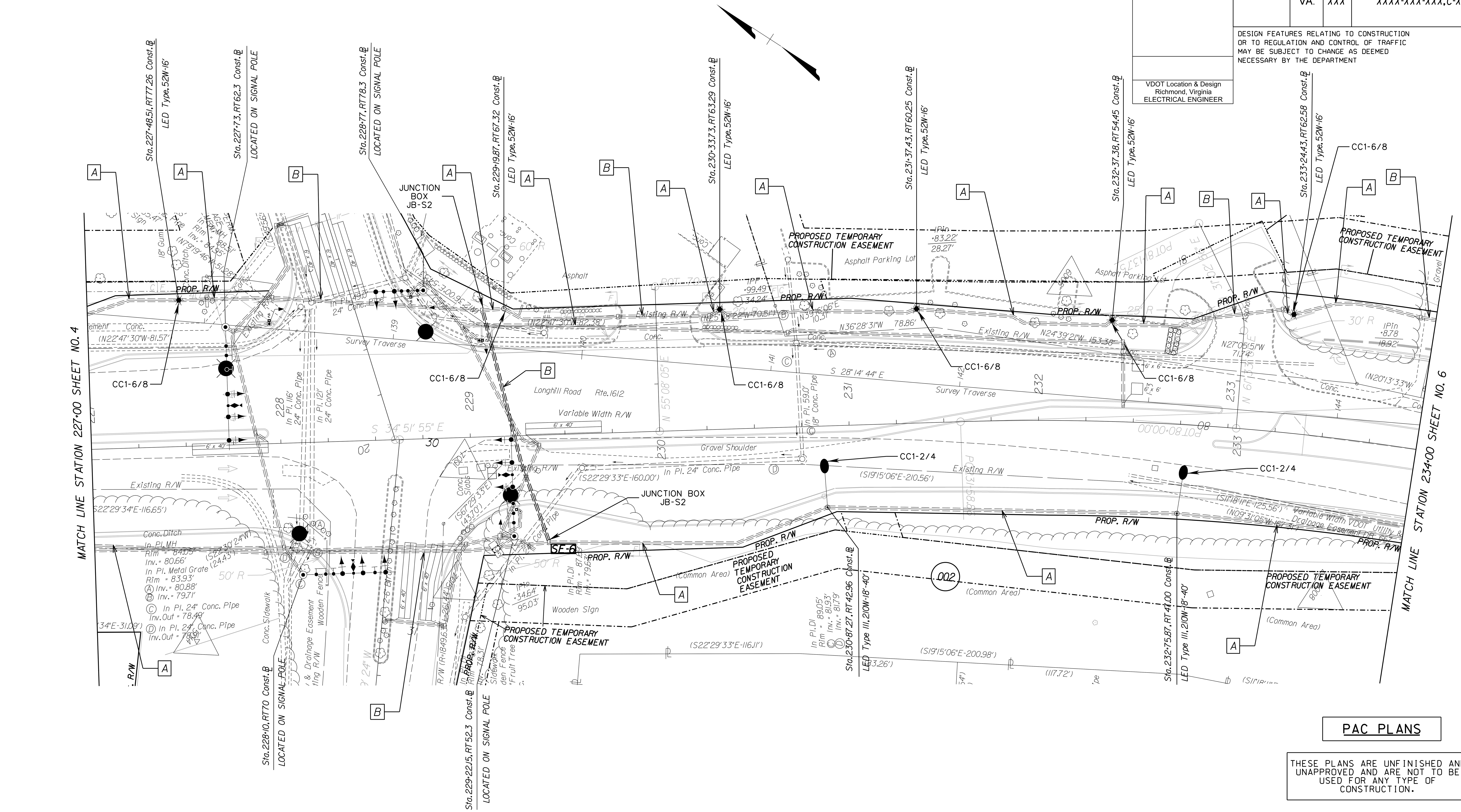
Plotted By: Federico.Gontaruk

PROJECT MANAGER
SURVEYED BY, DATE
DESIGN BY
SUBSURFACE UTILITY BY, DATE

REVISED	STATE	ROUTE	PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	13(5)

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT



PAC PLANS

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A	2" PVC CONDUIT 2 #6 + 1 #6 EGC
B	BORED CONDUIT 3" 2 #6 + 1 #6 EGC

VDOT
LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 EAST BROAD STREET
RICHMOND, VA 23219

REFERENCES
(PLAN AND DETAIL SHEETS)

Roadway Plan Sheet(s)	5
Traffic Signal Plan Sheet(s)	12(5)

TRAFFIC CONTROL DEVICE PLANS
LIGHTING PLAN

LONGHILL ROAD
JAMES CITY COUNTY

SCALE 0 25' 50'

PROJECT	SHEET NO.
XXXX-XXX-XXX	13(5)

PROJECT MANAGER _____
SURVEYED BY _____
DESIGN SUPERVISED BY _____
DESIGNED BY _____

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2B

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

GENERAL NOTES - LIGHTING

1. The following items and operations shall conform to the standard listed below:

   Lighting Pole Foundation..... PF-8,LF-1
   Lighting Pole..... LP-2 or LP-3 Poles
   Conduit Installation..... EC1-1 or Bored
   Junction Box..... JB-S3
   Control Center..... CCW-1,Type G or H
   Electrical Service..... SE-8 or SE-9

2. Lighting Pole foundation depths and above ground foundation projection/reveal (if needed) shall be determined by the Contractor in accordance with the current Road & Bridge Standards. Lighting poles and foundations shall be in accordance with the current Road & Bridge Standards. The pole supplier shall provide a bolt template for the foundation, which shall be centered utilizing the PF-8 foundation.

3. Lighting pole foundations may be field adjusted no more than 10' in any direction from the plan locations, provided that the revised foundation locations:
   Remain out of the clear zone and pavement sections.
   Remain within the right of way or propose easement.
   Does not conflict with vehicle or pedestrians travel way.
   Does not affect drainage. Does not conflict with utilities.
   Allow the lighting pole foundations to be adjusted with the same alignment with the designated location shown on the plans, and is in accordance with the PF-8 Lighting Pole Foundation Installation Details. If further adjustment is needed, the Project Inspector shall contact the Design Engineer on the plans. All modifications to the lighting pole placement more than 10 feet shall be approved

4. The Contractor shall furnish and install an Equipment Grounding Conductor (EGC) in all non-metallic conduit in accordance with Section 700 of the Specifications. The EGC size shall be the same size as the largest conductor indicated on the plans for each conduit run.

5. Junction boxes may be relocated in the field as necessary provided they remain within the right of way, do not conflict with utilities and remain outside the pavement section.

6. The electric service connection and service line locations may be field adjusted as necessary provided all equipment remains within the right of way or proposed easement, does not conflict with utilities and remains outside the pavement sections.

7. All underground and overhead utilities shown on these plans are approximate only and may not be complete. At least 72 hours prior to beginning lighting work, the Contractor shall contact "Miss Utility of Virginia" at 1-800-552-7001 in order to determine the extent, location, and identify all of the utilities within the work area. If the Contractor perceives a conflict between utilities and the proposed lighting equipment, the Contractor shall notify the Engineer immediately so that the conflict may be reviewed. The Contractor shall be responsible for repairing or replacing at their own expense, any existing utilities, pavement, concrete items, etc. that are damaged or disturbed during construction.

8. All Conduits and Junction Boxes shown on these plans are diagrammatic and actual conduit runs and Junction Boxes shall be modified as field conditions warrant.
   All modification to the conduit runs and Junction Boxes shall be approved by the engineer and shown on the As- Built plans. Conduit systems shall be bonded in accordance with Section 700 of the Road and Bridge Specifications.

9. All equipment is to be installed within the existing or proposed R/W or easement.

10. The Contractor shall maintain the integrity of the existing roadway lighting systems until such time that the new roadway lighting system is made active.

11. The contractor is responsible for determining proper pole length needed at each location in order to attain proper luminaire mounting height specified at each location in relation to the roadway. The pole type has been determined from survey information. Actual pole length shall be determined from field measurement

12. Conduits shall be installed with large radius offsets (55*32 minimum radius) to bypass drainage inlets, manholes, and other obstructions.

13. The Contractor shall coordinate electrical service location drops with the engineer and the local power company for determining suitable locations. These locations are diagrammatic and actual locations shall be field verifyied. Contact VDOT lighting and maintenance prior to energizing or de-energizing any electrical services.

14. The luminaires supplied for this project shall produce an average illuminance of approximately 0.6 to 0.9 foot-candles, with no point on the roadway surface below 0.2 foot-candle and a minimum to average uniformity ratio of 3:1 or better when calculated using max 500W LED with min 56000 lumen or using max 310W LED min 30,000 lumen and using a light-loss factor (LLF) of 0.85.

15. All luminaires assembly shall be pointed to street side.

16. The Breakaway Transformer Base is required for each LP-2 light poles.
    If the pole is install bebind the Guardrll shall be Non-Breakway Transformer Base and shall meet the Deflection Zone.

17. All Lighting poles shall be field staked by the Contractor and inspected by the Engineer prior to installation of foundations.

18. All Luminaires shall be 3000K unless otherwise specified on the plans.

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

Standard Lighting Legend

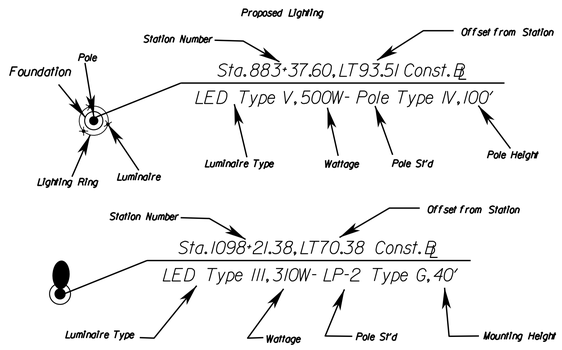
PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Highmast - 2 Luminaire		
Highmast - 3 Luminaire		
Highmast - 4 Luminaire		
Highmast - 6 Luminaire		
Highmast - 8 Luminaire		
Roadway Luminaire		
Signal Luminaire		
Decorative Luminaire		
Underbridge Luminaire		

PLAN ITEM	PLAN SYMBOL PROPOSED	PLAN SYMBOL EXISTING
Light Pole	●	◌
Light Pole Foundation	○	◌
Breakaway Base (LP-1 & LP-2)	□	⬚
Lighting Control Center, Type	CCW-1A	CCW-1E
Junction Box	J	☒J
Electrical Service	SE-9	SE-E
Conduit & Cable	═══	- - - - -
Luminaire Arm	———	— — —

LABELS

Cable and Conduit	A
High Mast	HM

LIGHTING LABELS



LOCATION AND DESIGN DIVISION
TRAFFIC ENGINEERING
1401 E. BROAD STREET
RICHMOND, VA 23219

TRAFFIC CONTROL DEVICE PLANS
LIGHTING PLAN
GENERAL NOTES & LEGEND

PROJECT	SHEET NO.
XXXX-XXX-XXX	2B

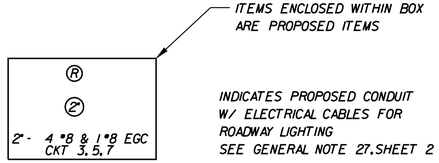
REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2C

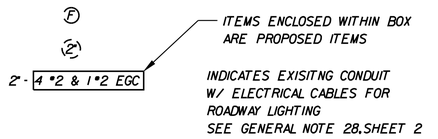
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

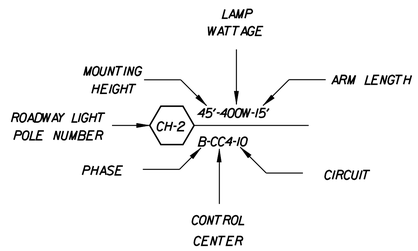
VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

ROADWAY LIGHTING LEGEND

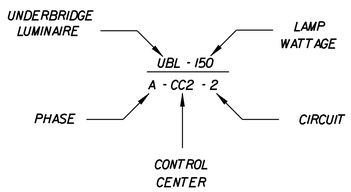
PROPOSED	EXISTING	DESCRIPTION
		UNDERBRIDGE LIGHTING FIXTURE
R		EXISTING UNDERBRIDGE LIGHTING FIXTURE TO BE REPLACED
		CONDUIT
		EXPOSED CONDUIT
J	J	JUNCTION BOX (PROPOSED STD. JB-S2 UNLESS OTHERWISE SHOWN)
MJ	MJ	METAL JUNCTION BOX, 6"x6"x4" (OR AS SHOWN ON PLANS)
CC	CC	CONTROL CENTER
		ELECTRICAL SERVICE POINT
H	C	CONDUIT IDENTIFIER
FS		FUSED SAFETY SWITCH
		HIGHMAST LIGHT POLE
		ROADWAY LIGHT POLE
		CHAIN LINK GATE



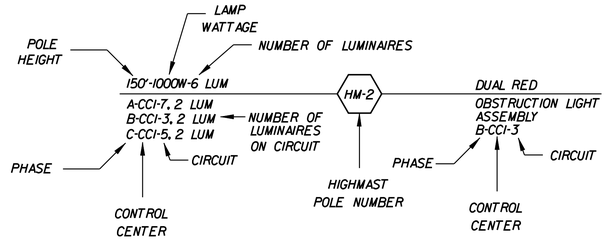




ROADWAY LIGHTING



UNDERBRIDGE LIGHTING



HIGHMAST LIGHTING

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

LEGEND

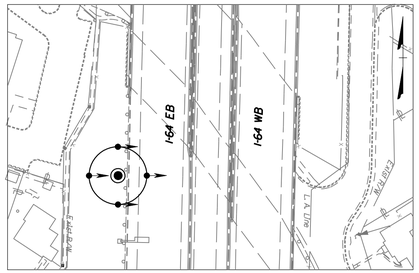
	PROJECT	SHEET NO.
	XXXX-XXX-XXX	2C

9:59:26 AM

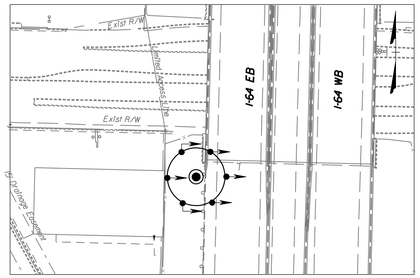
REVISED	STATE	STATE		SHEET NO.
		ROUTE	PROJECT	
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2D

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

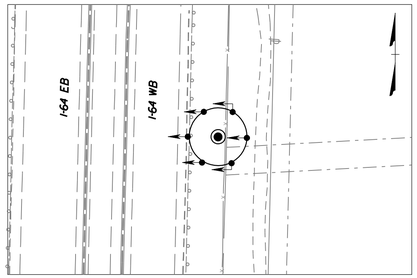
VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER



HM1



HM2



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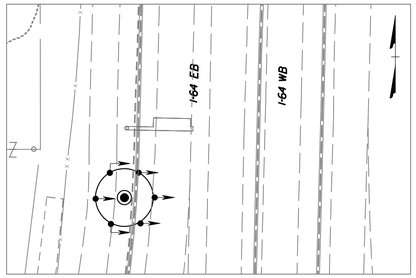

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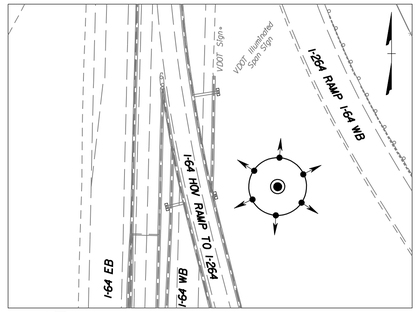

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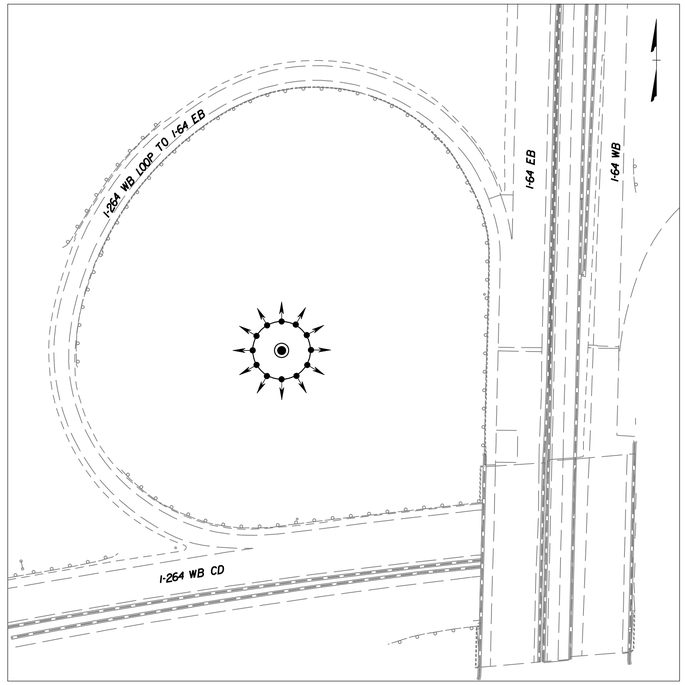
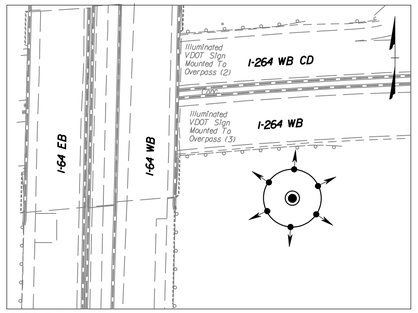
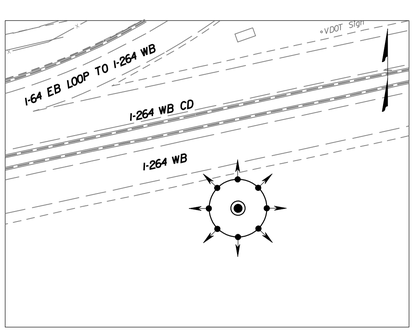


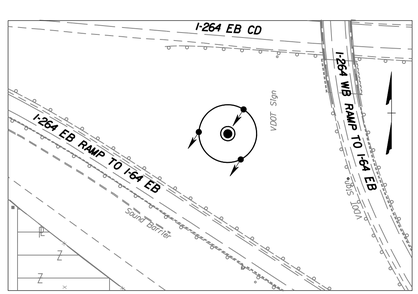
HM6



HM7

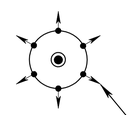


HM8



HM9

LEGEND



INDICATES HIGH MAST LUMINIARE OPTICS ORIENTED EVENLY ON LIFTING RING.

LUMINAIRE OPTICAL AIMING DIRECTION

INDICATES HIGH MAST LUMINIARE OPTICS ORIENTED IN SAME DIRECTION.

LUMINAIRE OPTICAL AIMING DIRECTION WITH HOUSE SIDE SHIELD

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

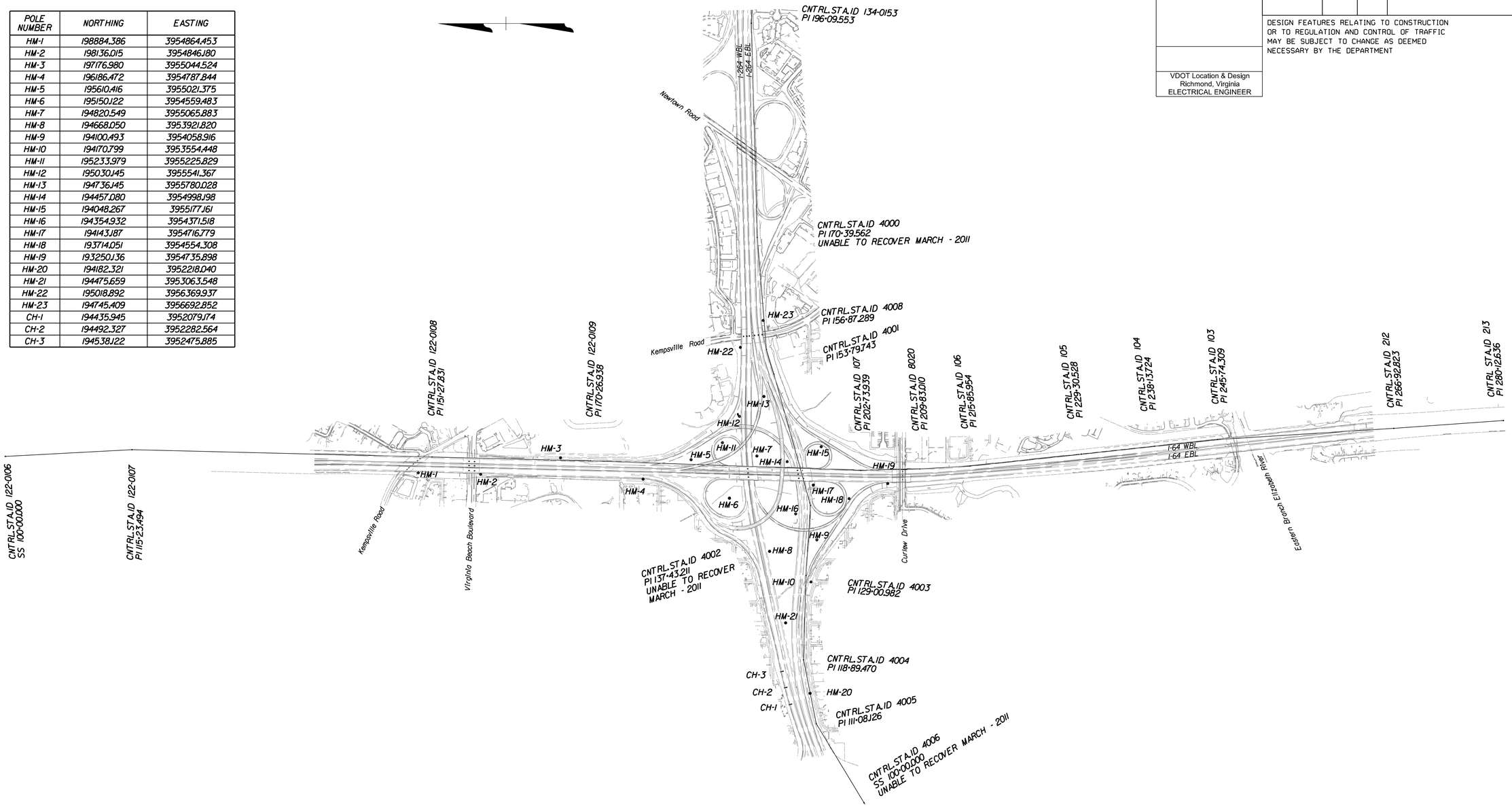
LUMINAIRE AIMING DETAILS

N.T.S.

	PROJECT	SHEET NO.
	XXXX-XXX-XXX	2D

$TIME$STAMP$

POLE NUMBER	NORTHING	EASTING
HM-1	198884.386	3954864.453
HM-2	198136.015	3954846.180
HM-3	197176.980	3955044.524
HM-4	196186.472	3954787.844
HM-5	195610.416	3955021.375
HM-6	195150.122	3954559.483
HM-7	194820.549	3955065.883
HM-8	194668.050	3953921.820
HM-9	194100.493	3954058.916
HM-10	194170.799	3953554.448
HM-11	195233.979	3955225.829
HM-12	195030.145	3955541.367
HM-13	194736.145	3955780.028
HM-14	194457.080	3954998.198
HM-15	194048.267	3955177.161
HM-16	194354.932	3954371.518
HM-17	194143.187	3954716.779
HM-18	193714.051	3954554.308
HM-19	193250.136	3954735.898
HM-20	194182.321	3952218.040
HM-21	194475.659	3953063.548
HM-22	195018.892	3956369.937
HM-23	194745.409	3956692.852
CH-1	194435.945	3952079.174
CH-2	194492.327	3952282.564
CH-3	194538.122	3952475.885



PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

LIGHT POLE COORDINATE TABLE

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2E

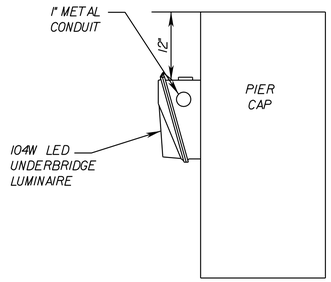
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

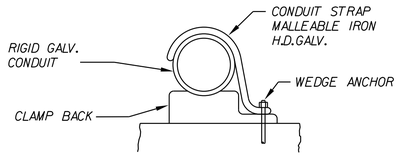
	PROJECT	SHEET NO.
	XXXX-XXX-XXX	2E

$TIME$STAMP$

PROJECT MANAGER _____
SURVEYED BY _____
DESIGN SUPERVISED BY _____
DESIGNED BY _____

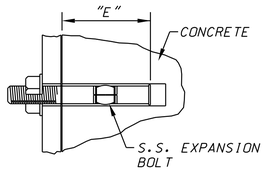


TYPICAL SECTION THROUGH PIER CAP
NOT TO SCALE



CONDUIT STRAP & BACK
NOT TO SCALE

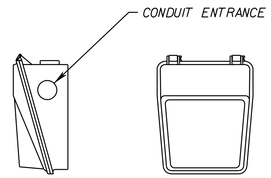
WEDGE ANCHOR SPECS		
SIZE	MIN. "E"	PULLOUT lb
1/4"	1 1/2"	2600
3/8"	2"	5000
1/2"	2 1/2"	6300
5/8"	3"	8300



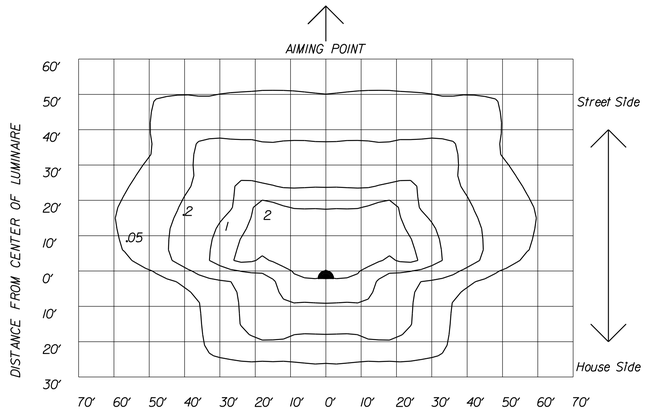
WEDGE ANCHOR
NOT TO SCALE

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.



UNDERBRIDGE LUMINAIRE 104W LED
IES TYPE III OR IV, MEDIUM, NON-CUTOFF
8375 LUMENS
NOT TO SCALE



ISOFOOTCANDLE DIAGRAM *
104-WATT LED UNDERBRIDGE LUMINAIRE
15-FT MOUNTING HEIGHT
N.T.S.

UNDERBRIDGE WALLPACK

* ISOFOOT CANDLE DIAGRAMS REPRESENT THE LUMINAIRE ILLUMINATION PATTERN WITH A LIGHT LOSS FACTOR OF 1.00.

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2F

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

UNDERBRIDGE LIGHTING SYSTEM
MOUNTING DETAILS AND LUMINAIRE SPECIFICATIONS

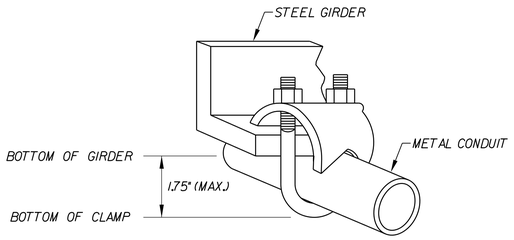
	PROJECT	SHEET NO.
	XXXX-XXX-XXX	2F

PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	2G

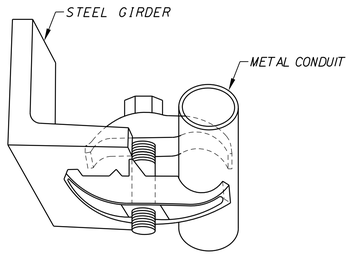
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER



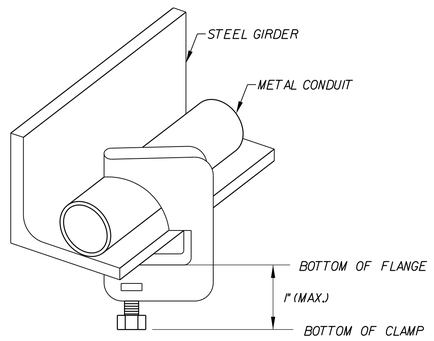
NOMINAL CONDUIT SIZE: ¾"
MATERIAL: MALLEABLE IRON. ELECTRO GALVANIZED FINISH INCLUDING THREADS

GIRDER CONDUIT CLAMP (OPTION 1)
NOT TO SCALE



NOMINAL CONDUIT SIZE: ¾"
MATERIAL: MALLEABLE IRON. ELECTRO GALVANIZED FINISH INCLUDING THREADS

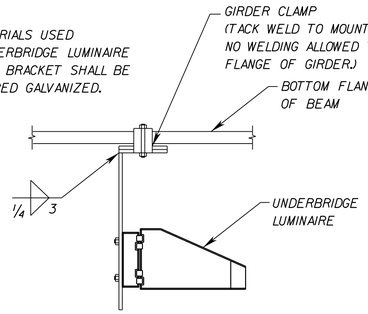
GIRDER CONDUIT CLAMP (OPTION 2)
NOT TO SCALE



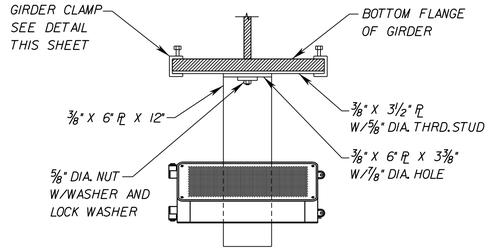
NOMINAL CONDUIT SIZE: ¾"
MATERIAL: ⅛" STEEL. GALV-KROM FINISH INCLUDING THREADS

GIRDER CONDUIT CLAMP (OPTION 3)
NOT TO SCALE

ALL MATERIALS USED FOR UNDERBRIDGE LUMINAIRE MOUNTING BRACKET SHALL BE HOT DIPPED GALVANIZED.

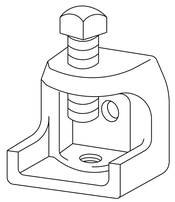


SIDE VIEW



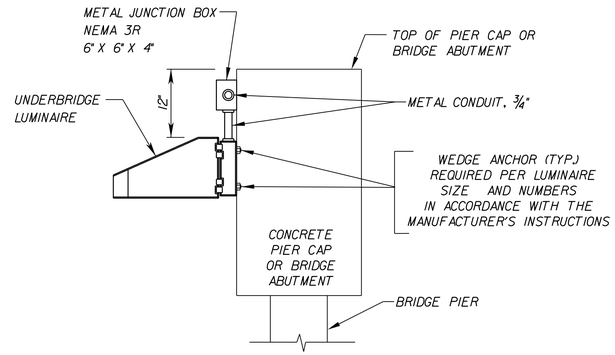
FRONT VIEW

GIRDER MOUNT LUMINAIRE DETAIL
NOT TO SCALE



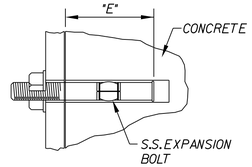
BASE DIMENSIONS: 2" X 2"
JAW OPENING: 2" MIN.
MATERIAL: MALLEABLE IRON. ELCTROPLATED FINISH INCLUDING THREADS
LOAD RATING: 1300LBS. MIN.

GIRDER CLAMP FOR LUMINAIRE ASSEMBLY
NOT TO SCALE

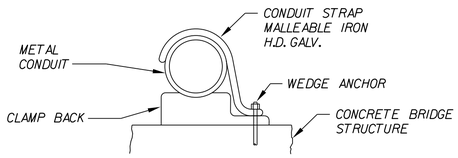


SURFACE MOUNT LUMINAIRE DETAIL
NOT TO SCALE

WEDGE ANCHOR SPECS		
SIZE	MIN. "E"	PULLOUT lb
¼"	1½"	2600
⅜"	2"	5000
½"	2½"	6300
⅝"	3"	8300



WEDGE ANCHOR
NOT TO SCALE



TYPICAL CONDUIT STRAP & BACK
NOT TO SCALE

NOTE:
THE CONTRACTOR SHALL USE EXTREME CARE TO AVOID DAMAGING REINFORCEMENT BARS WHEN DRILLING INTO EXISTING CONCRETE BRIDGE AND RETAINING WALL STRUCTURES. A REBAR BAR LOCATOR SHALL BE USED TO LOCATE AND MARK REINFORCEMENT BARS PRIOR TO DRILLING.

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

TRAFFIC CONTROL DEVICE PLANS

ELECTRICAL
UNDERBRIDGE LIGHTING SYSTEM DETAILS

PROJECT	SHEET NO.
XXXX-XXX-XXX	2G

REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	5

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

A — 2 — R

B — 2 — 2-#8 CKT 3,5,7, 1-#8 EGC

C — 2 — R — 2- 4-#00 CKT 3,5,7, 1-#00 EGC

D — 2 — 2-4-#2 CKT 2,4,6, 1-#2 EGC

E — 2 — R — 2- 4-#2 & 1-#2 EGC

F — 2 — 2-4-#2 & 1-#2 EGC

G — 2 — 2-4-#4 & 1-#4 EGC

H — 2 — R — 2- 4-#4 & 1-#4 EGC

J — 2 — 2-4-#8 & 1-#8 EGC

K — 2 — R — 2- 4-#8 & 1-#8 EGC

L — 2 — 2- 4-#8 & 1-#8 EGC
CKT 2,4 LUM.
CKT 4,3 LUM.
CKT 6,3 LUM.

DUAL RED OBSTRUCTION LIGHT ASSEMBLY C-CC8-11 — HM-5 — 150'-1000W-6LUM A-CC8-13, 2 LUM B-CC8-9, 2 LUM C-CC8-11, 2 LUM

150'-1000W-6LUM A-CC8-2, 2 LUM B-CC8-4, 2 LUM C-CC8-6, 2 LUM — HM-7 — DUAL RED OBSTRUCTION LIGHT ASSEMBLY C-CC8-6

DUAL RED OBSTRUCTION LIGHT ASSEMBLY C-CC4-5 — HM-6 — 150'-1000W-12LUM A-CC4-7, 4 LUM B-CC4-3, 4 LUM C-CC4-5, 4 LUM

Match Line Sheet 4

Match Line Sheet 7

Match Line Sheet 8 Station 23+00.00

Match Line Sheet 6

I-264 RAMP TO I-64 WB

I-64 HOV RAMP TO I-264

I-64 WB

I-64 HOV

I-64 EB

I-64 EB RAMP TO I-264 WB

I-264 WB LOOP TO I-64 EB

I-264 WB CD

I-264 WB

I-264 WB RAMP TO I-64 EB

REPLACE EXIST. SIGN LIGHTING
LOCATION 4 (S)
10-LUMINAIRES
4 FUSED SAFETY SWITCHES

UNDERBRIDGE LIGHTING SYSTEM
I-264 WB-CD
SEE DETAIL SHEET 11 & 12

EXISTING CONDUIT AND CONDUCTORS TO I-264 EB OVERPASS

UNDERBRIDGE LIGHTING SYSTEM
I-264 WB MAINLINE
SEE DETAIL SHEET 11 & 12

TEST BORE: 3 REQ'D

PAC PLANS

THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.

(1) SPLICE NEW CONDUIT TO EXISTING CONDUIT
(2) SPLICE NEW JUNCTION BOX INTO EXISTING CONDUIT
(R) REMOVE EXISTING CONDUCTOR CABLE

(S) SIGN STRUCTURE NUMBER LOC.4
STRUCTURE # 0640354
STRUCTURE # 0640353
STRUCTURE # 0640352
STRUCTURE # 064031I
STRUCTURE # 064031O

ROADWAY LIGHTING PLAN

SCALE 0 50' 100'

PROJECT	SHEET NO.
XXXX-XXX-XXX	5

$TIME$ST AMP$

PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

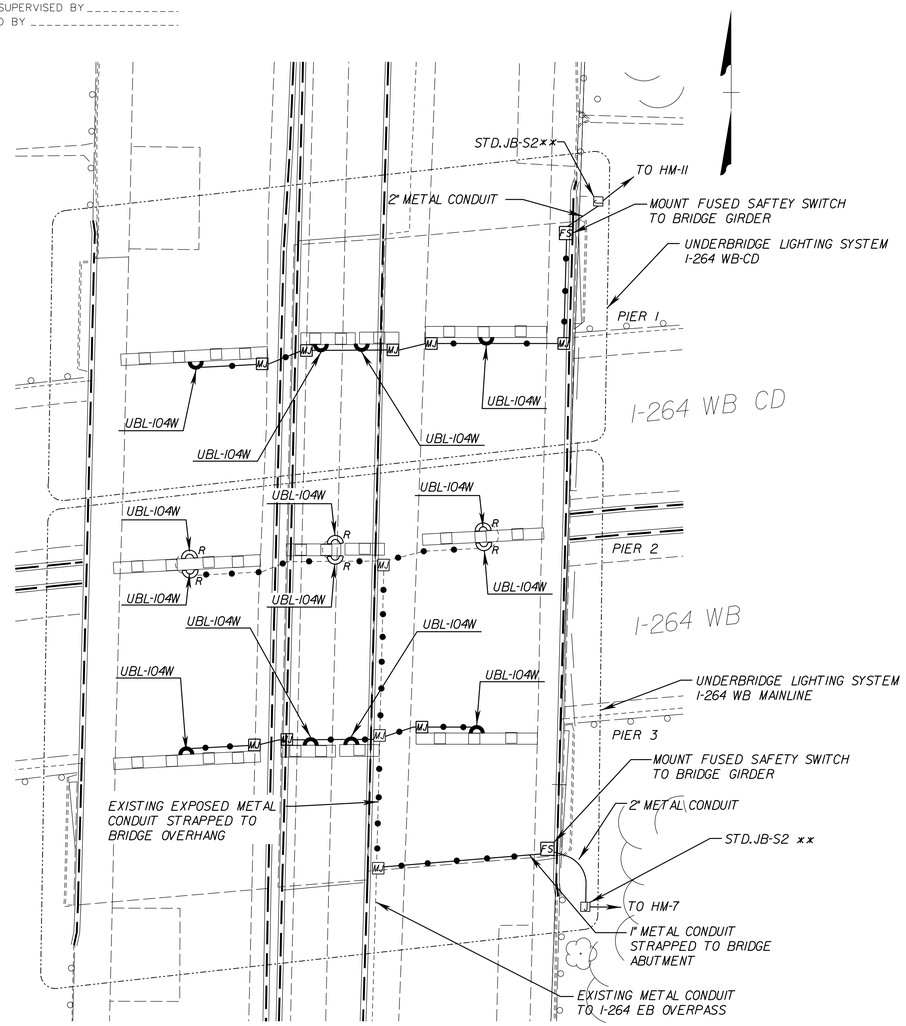
REVISED	STATE	STATE ROUTE	STATE PROJECT	SHEET NO.
	VA.	XXX	XXXX-XXX-XXX,C-XXX	11

DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

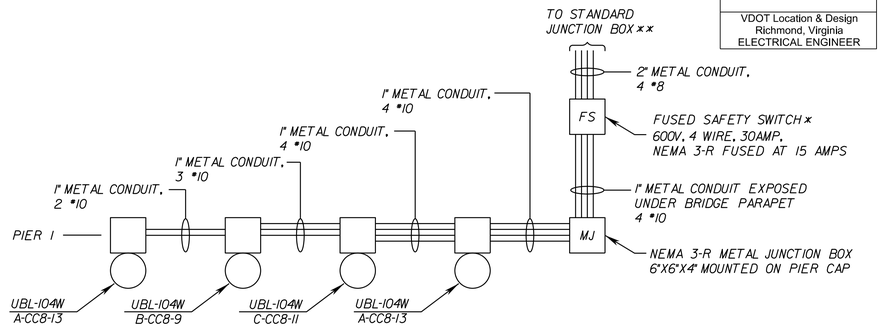
VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER

PAC PLANS

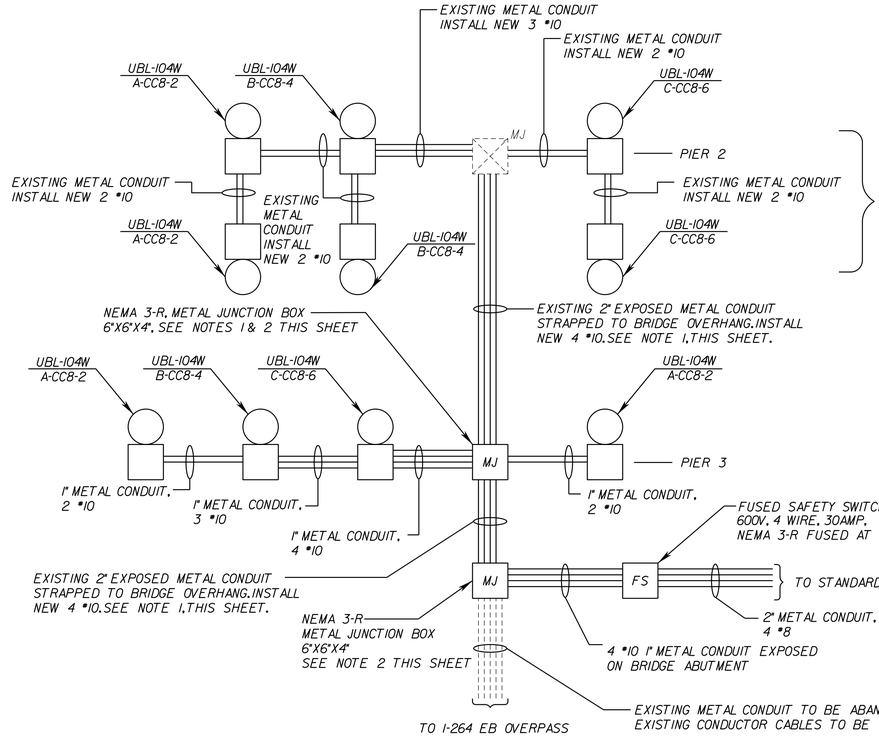
THESE PLANS ARE UNFINISHED AND UNAPPROVED AND ARE NOT TO BE USED FOR ANY TYPE OF CONSTRUCTION.



I-264 WB-CD AND I-264 WB MAINLINE
PLAN VIEW
N.T.S.



I-264 WB-CD
WIRING DIAGRAM
N.T.S.



I-264 WB MAINLINE
WIRING DIAGRAM
N.T.S.

NOTES:

* FUSED SAFETY SWITCH AND METAL CONDUIT SHALL BE ELECTRICALLY BONDED TO THE ROADWAY LIGHTING SYSTEM IN THE STANDARD JUNCTION BOX TO PROVIDE A FULLY GROUNDED UNDERBRIDGE LIGHTING SYSTEM.

** NOT INCLUDED IN UNDERBRIDGE LIGHTING SYSTEM PAY ITEM.

1. REPLACE EXISTING RIGID GALVANIZED STEEL CONDUIT AND FLEXIBLE METAL CONDUIT AS REQUIRED TO PROVIDE A FULLY FUNCTIONAL UNDERBRIDGE LIGHTING SYSTEM.
2. SPLICE NEW METAL JUNCTION BOX INTO EXISTING CONDUIT.
3. FLEXIBLE METAL CONDUIT SHALL BE TYPE LFMC.
4. SEE SHEET 2F FOR UNDERBRIDGE LIGHTING SYSTEM MOUNTING DETAILS AND LUMINAIRE SPECIFICATIONS.

UNDERBRIDGE LIGHTING SYSTEM

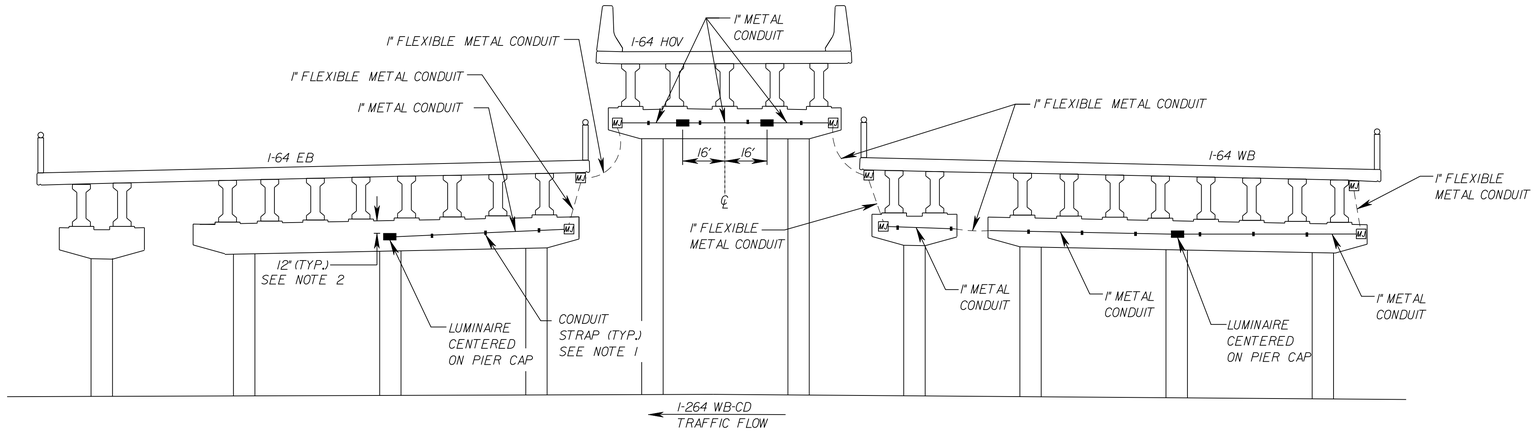
I-264 WB-CD AND I-264 WB MAINLINE
PLAN AND WIRING DETAILS

	PROJECT	SHEET NO.
	XXXX-XXX-XXX	11

REVISED	STATE	STATE		SHEET NO.
		ROUTE	PROJECT	
	VA.	XXX	XXXX-XXX-XXX,C-XXX	12

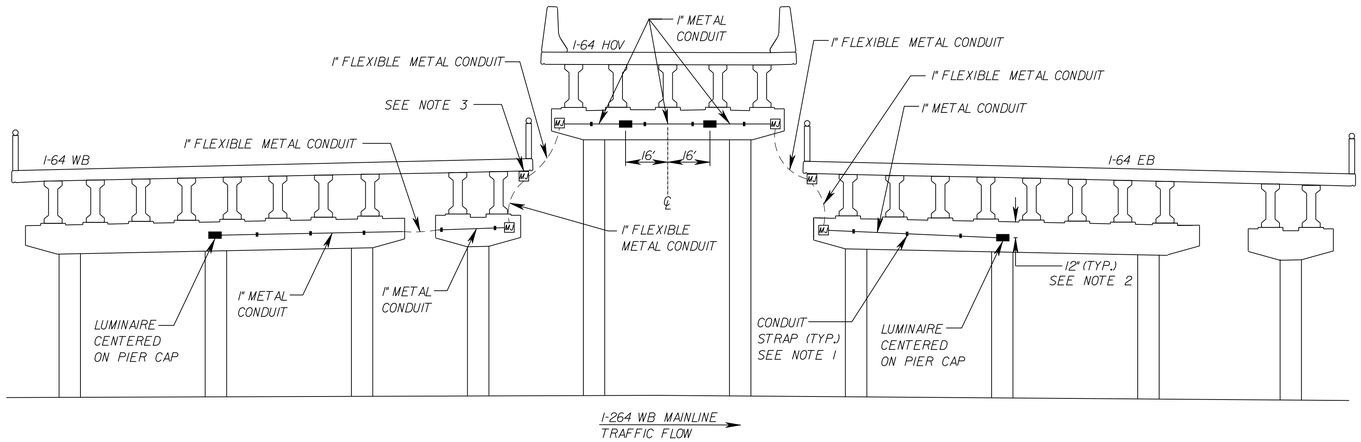
DESIGN FEATURES RELATING TO CONSTRUCTION OR TO REGULATION AND CONTROL OF TRAFFIC MAY BE SUBJECT TO CHANGE AS DEEMED NECESSARY BY THE DEPARTMENT

VDOT Location & Design
Richmond, Virginia
ELECTRICAL ENGINEER



I-264 WB-CD, PIER 1

ELEVATION DETAIL
N.T.S.



I-264 WB MAINLINE, PIER 3

ELEVATION DETAIL
N.T.S.

NOTES:
1. CONDUIT SHALL BE STRAPPED 10' C-C AND WITHIN 1' OF THE CONDUIT TERMINI.
2. UNDERBRIDGE LUMINAIRES SHALL BE INSTALLED 12" FROM TOP OF PIER CAP.
3. SPLICE INTO EXISTING CONDUIT. INSTALL NEW 6"x6"x4" METAL JUNCTION BOX.
4. FLEXIBLE METAL CONDUIT SHALL BE TYPE LMFC.
5. SEE SHEET 2F FOR UNDERBRIDGE LIGHTING SYSTEM MOUNTING DETAILS AND LUMINAIRE SPECIFICATIONS.

PAC PLANS

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UNDERBRIDGE LIGHTING SYSTEM

I-264 WB-CD AND I-264 WB MAINLINE ELEVATION DETAILS

	PROJECT	SHEET NO.
	XXXX-XXX-XXX	12

$PLOTSTAMP$