



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

J. ERIC BOYETTE
SECRETARY

January 12, 2022

Addendum No. 2

RE: Contract # C204553

WBS # 40237.3.3

STATE FUNDED

Pender County (R-3300B)

NC-417 (HAMPSTEAD BYPASS) FROM SOUTH OF NC-210 TO NORTH OF SR-1563 (SLOOP POINT LOOP RD)

January 18, 2022 Letting

To Whom It May Concern:

Reference is made to the plans and proposal form furnished to you on this project.

The following revisions have been made to the Roadway plans.

Sheet No.	Revision
2A-1 thru 2A-8	Note added to Typical Sections: "SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS".

Please void the above listed Sheets in your plans and staple the revised Sheets thereto.

The following revisions have been made to the proposal.

Page No.	Revision
Proposal Cover	Note added that reads "Includes Addendum No. 2 Dated 1-12-2022".
Table of Contents	Project Special Provision entitled INTERMEDIATE CONTRACT TIME 6 AND LIQUIDATED DAMAGES was added. Page numbers updated.
G-3 thru G-4	Project Special Provision entitled INTERMEDIATE CONTRACT TIME 6 AND LIQUIDATED DAMAGES added.
G-6	Project Special Provision entitled SPECIALTY ITEMS was revised to add line numbers 429-430.
TS-1 thru TS-4	Updated pages to show "Metal Pole Removal" in "Contents".

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
CONTRACT STANDARDS AND DEVELOPMENT
1591 MAIL SERVICE CENTER
RALEIGH, NC 27699-1591

Telephone: (919) 707-6900
Fax: (919) 250-4127
Customer Service: 1-877-368-4968

Location:
1020 BIRCH RIDGE DR.
RALEIGH, NC 27610

Website: www.ncdot.gov

Page No.	Revision
TS-45 thru TS-122, TS-123 (New)	The Unit Project Special Provision entitled SIGNALS AND INTELLIGENT TRANSPORTATION SYSTEMS was revised. "Metal Pole Removals" section was added to provision.

Please void the above listed existing Pages in your proposal and staple the revised Pages thereto.

Staple New Page TS-123 after revised TS-122 in your proposal.

On the item sheets the following pay item revisions have been made:


<u>Item</u>	<u>Description</u>	<u>Old Quantity</u>	<u>New Quantity</u>
0429-7960000000-N- SP	METAL POLE FOUNDATION REMOVAL	NEW ITEM	4 EA
0430-7972000000-N- SP	METAL POLE REMOVAL	NEW ITEM	4 EA

The Contractor's bid must include these pay item revisions.

The electronic bidding file has been updated to reflect these revisions. Please download the Addendum File and follow the instructions for applying the addendum. Bid Express will not accept your bid unless the addendum has been applied.

The contract will be prepared accordingly.

Sincerely,

DocuSigned by:

 F81B6038A47A442...

Ronald E. Davenport, Jr., PE
 State Contract Officer

RED/cms
 Attachments

cc: Mr. Lamar Sylvester, PE
 Mr. D. Chad Kimes, PE
 Mr. Boyd Tharrington, PE
 Mr. Jon Weathersbee, PE
 Mr. Ken Kennedy, PE
 Project File (2)

Mr. Forrest Dungan, PE
 Ms. Jaci Kincaid
 Ms. Lori Strickland
 Mr. Mike Gwyn
 Ms. Penny Higgins
 Mr. Kyle Kempf

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH, N.C.

PROPOSAL

INCLUDES ADDENDUM No. 2 DATED 1-12-2022

DATE AND TIME OF BID OPENING: **JANUARY 18, 2022 AT 2:00 PM**

CONTRACT ID C204553
WBS 40237.3.3

FEDERAL-AID NO. STATE FUNDED

COUNTY PENDER

T.I.P. NO. R-3300B

MILES 6.916

ROUTE NO. NC 417

LOCATION NC-417 (HAMPSTEAD BYPASS) FROM SOUTH OF NC-210 TO NORTH OF SR-1563 (SLOOP POINT LOOP RD).

TYPE OF WORK GRADING, DRAINAGE, PAVING, SIGNALS, AND STRUCTURES.

NOTICE:

ALL BIDDERS SHALL COMPLY WITH ALL APPLICABLE LAWS REGULATING THE PRACTICE OF GENERAL CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA WHICH REQUIRES THE BIDDER TO BE LICENSED BY THE N.C. LICENSING BOARD FOR CONTRACTORS WHEN BIDDING ON ANY NON-FEDERAL AID PROJECT WHERE THE BID IS \$30,000 OR MORE, EXCEPT FOR CERTAIN SPECIALTY WORK AS DETERMINED BY THE LICENSING BOARD. BIDDERS SHALL ALSO COMPLY WITH ALL OTHER APPLICABLE LAWS REGULATING THE PRACTICES OF ELECTRICAL, PLUMBING, HEATING AND AIR CONDITIONING AND REFRIGERATION CONTRACTING AS CONTAINED IN CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA. NOTWITHSTANDING THESE LIMITATIONS ON BIDDING, THE BIDDER WHO IS AWARDED ANY FEDERAL - AID FUNDED PROJECT SHALL COMPLY WITH CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA FOR LICENSING REQUIREMENTS WITHIN 60 CALENDAR DAYS OF BID OPENING.

BIDS WILL BE RECEIVED AS SHOWN BELOW:

THIS IS A ROADWAY & STRUCTURE PROPOSAL

5% BID BOND OR BID DEPOSIT REQUIRED

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PROPOSAL ITEM SHEET

ITEM SHEET(S) (TAN SHEETS)

The time of availability for this intermediate contract work shall be the time the Contractor begins to install all traffic control devices for lane closures according to the time restrictions listed herein.

The completion time for this intermediate contract work shall be the time the Contractor is required to complete the removal of all traffic control devices for lane closures according to the time restrictions stated above and place traffic in the existing traffic pattern.

Liquidated Damages for **Intermediate Contract Time Number 2** for the above lane narrowing, lane closure, holiday and special event time restrictions for US 17 are **One Thousand Two Hundred Fifty Dollars (\$ 1,250.00)** per fifteen (15) minute time period.

Liquidated Damages for **Intermediate Contract Time Number 3** for the above lane narrowing, lane closure, holiday and special event time restrictions for NC 210 and/or Hoover Road are **Five Hundred Dollars (\$ 500.00)** per hour.

INTERMEDIATE CONTRACT TIME NUMBER 4 AND LIQUIDATED DAMAGES:

(2-20-07) (Rev. 6-18-13)

108

SP1 G14 H

The Contractor shall complete the work required of **Area 5, Phase I, Steps #2B thru #3B** as shown on Sheet **TMP-3B** and shall place and maintain traffic on same.

The date of availability for this intermediate contract time is the date the Contractor elects to begin the work.

The completion date for this intermediate contract time is the date which is **One Hundred Five (105)** consecutive calendar days after and including the date of availability.

The liquidated damages are **One Thousand Dollars (\$ 1,000.00)** per calendar day.

INTERMEDIATE CONTRACT TIME NUMBER 5 AND LIQUIDATED DAMAGES:

(2-20-07) (Rev. 6-18-13)

108

SP1 G14 G

The Contractor shall complete the work required of **Area 5, Phase 2, Step #1A** as shown on Sheet **TMP-3C** and shall place and maintain traffic on same.

The time of availability for this intermediate contract time is the **Friday at 6:00 PM** that the Contractor begins the work.

The completion time for this intermediate contract time is the following **Monday at 6:00 AM**, which is **sixty (60)** consecutive hours after the time of availability

The liquidated damages are **Five Hundred Dollars (\$ 500.00)** per hour.

INTERMEDIATE CONTRACT TIME NUMBER 6 AND LIQUIDATED DAMAGES:

(6-18-13)

108

SP1 G14 L

The Contractor shall complete **all** work required of the **Pay Item: Field Office** as described in the **Field Office (Contractor Designed) Special Provision, and shall provide the final Certificate of Occupancy.**

The date of availability for this intermediate contract time is **February 28, 2022.**

The completion date for this intermediate contract time is **November 30, 2022.**

The liquidated damages are **Two Hundred Dollars (\$ 200.00)** per calendar day.

PERMANENT VEGETATION ESTABLISHMENT:

(2-16-12) (Rev. 10-15-13)

104

SP1 G16

Establish a permanent stand of the vegetation mixture shown in the contract. During the period between initial vegetation planting and final project acceptance, perform all work necessary to establish permanent vegetation on all erodible areas within the project limits, as well as, in borrow and waste pits. This work shall include erosion control device maintenance and installation, repair seeding and mulching, supplemental seeding and mulching, mowing, and fertilizer topdressing, as directed. All work shall be performed in accordance with the applicable section of the *2018 Standard Specifications*. All work required for initial vegetation planting shall be performed as a part of the work necessary for the completion and acceptance of the Intermediate Contract Time (ICT). Between the time of ICT and Final Project acceptance, or otherwise referred to as the vegetation establishment period, the Department will be responsible for preparing the required National Pollutant Discharge Elimination System (NPDES) inspection records.

Once the Engineer has determined that the permanent vegetation establishment requirement has been achieved at an 80% vegetation density (the amount of established vegetation per given area to stabilize the soil) and no erodible areas exist within the project limits, the Contractor will be notified to remove the remaining erosion control devices that are no longer needed. The Contractor will be responsible for, and shall correct any areas disturbed by operations performed in permanent vegetation establishment and the removal of temporary erosion control measures, whether occurring prior to or after placing traffic on the project.

Payment for *Response for Erosion Control, Seeding and Mulching, Repair Seeding, Supplemental Seeding, Mowing, Fertilizer Topdressing, Silt Excavation, and Stone for Erosion Control* will be made at contract unit prices for the affected items. Work required that is not represented by contract line items will be paid in accordance with Articles 104-7 or 104-3 of the *2018 Standard Specifications*. No additional compensation will be made for maintenance and removal of temporary erosion control items.

CONSTRUCTION MORATORIUM (Bats):

(1-19-16)

SP1 G18C

No tree cutting will be allowed when **temperature is 40 degrees or less.**

SPECIALTY ITEMS:

(7-1-95)(Rev. 7-20-21)

108-6

SP1 G37

Items listed below will be the specialty items for this contract (see Article 108-6 of the 2018 *Standard Specifications*).

Line #	Description
134-151	Guardrail
152-157	Fencing
161-189	Signing
207-212, 221-223	Long-Life Pavement Markings
213	Removable Tape
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231-270, 424	Utility Construction
271-307, 309, 425-426	Erosion Control
308	Reforestation
310-366, 429-430	Signals/ITS System

AWARD OF CONTRACT:

Revise the 2018 *Standard Specifications* as follows:

Page 1-23, Subarticle 103-4 (A) General, first paragraph, replace the 3rd and 4th sentences with the following:

Where award is to be made, the notice of award will be issued within 60 days after the opening of bids or upon issuance of any necessary debt instrument, whichever is later, but not to exceed 120 days; except with the consent of the lowest responsible bidder the decision to award the contract to such bidder may be delayed for as long a time as may be agreed upon by the Department and such bidder. In the absence of such agreement, the lowest responsible bidder may withdraw his bid at the expiration of 120 days without penalty if no notice of award has been issued.

FUEL PRICE ADJUSTMENT:

(11-15-05) (Rev. 7-20-21)

109-8

SP1 G43

Revise the 2018 *Standard Specifications* as follows:

Page 1-87, Article 109-8, Fuel Price Adjustments, add the following:

The base index price for DIESEL #2 FUEL is \$ **2.6786** per gallon. Where any of the following are included as pay items in the contract, they will be eligible for fuel price adjustment.

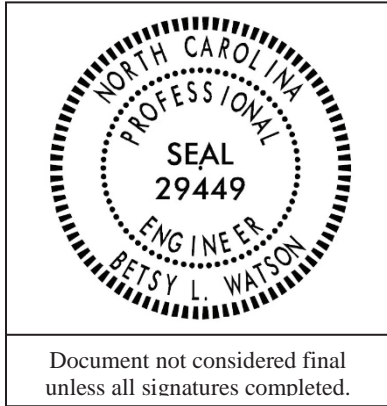
The pay items and the fuel factor used in calculating adjustments to be made will be as follows:

Description	Units	Fuel Usage Factor Diesel
Unclassified Excavation	Gal/CY	0.29
Borrow Excavation	Gal/CY	0.29
Class IV Subgrade Stabilization	Gal/Ton	0.55
Aggregate Base Course	Gal/Ton	0.55
Sub-Ballast	Gal/Ton	0.55

R-3300B

TS-1

Pender County



**Signals and Intelligent Transportation Systems
Project Special Provisions
(Version 18.3)**

11-Jan-22

DocuSigned by:
Betsy L. Watson
35E67BB34F8743F...

1/11/2022

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<http://www.ncdot.gov/doh/preconstruct/highway/geotech/formdet/misc/MetalPole.pdf>

If assistance is needed, contact the Engineer.

4. Non-Standard Foundation Design:

Design non-standard foundations based upon site-specific soil test information collected in accordance with Section 2 (Soil Test) above. Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges*. Use the computer software LPILE version-6.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Use the computer software gINT V8i or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide a drilled pier foundation for each pole with a length and diameter that result in a horizontal lateral movement of less than 1 inch at the top of the pier and a horizontal rotational movement of less than 1 inch at the edge of the pier. Contact the Engineer for pole loading diagrams for standard poles to be used for non-standard foundation designs. Submit any non-standard foundation designs including drawings, calculations, and soil boring logs to the Engineer for review and approval before construction.

C. Drilled Pier Construction

Construct drilled pier foundation and Install anchor rod assemblies in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* Standard Special Provision SP09-R005 located at:

<https://connect.ncdot.gov/resources/Specifications/Pages/2018-Specifications-and-Special-Provisions.aspx>

5.6. METAL POLE REMOVALS

A. Description:

Remove and dispose of existing metal support poles, and remove and dispose of existing foundations, associated anchor bolts, electrical wires and connections.

B. Construction Methods:

1. Foundations:

Remove and promptly dispose of the metal support pole foundations including reinforcing steel, electrical wires, and anchor bolts to a minimum depth of 2 feet below the finished ground elevation. At the Contractor's option, remove the complete foundation.

2. Metal Poles:

Consult Division Traffic Services regarding ownership of poles. If the Division chooses to maintain these structures in their inventory for future use, permanently mark the pole with the signal inventory number, asset inventory number or some identifying information that identifies where the pole came from

Remove the metal support poles, and promptly transport the metal support poles from the project. Use methods to remove the metal support poles and attached equipment that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no additional cost to the Department.

Transport and properly dispose of the materials.

Backfill and compact disturbed areas to match the finished ground elevation. Seed unpaved areas.

Use methods to remove the foundations that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no cost to the Department.

5.7. CUSTOM DESIGN OF TRAFFIC SIGNAL SUPPORTS

A. General

Design traffic signal supports with foundations consisting of metal poles with mast arms.

The lengths of the metal signal poles shown on the plans are estimated from available data for bid purposes. Determine the actual length of each pole from field measurements and adjusted cross-sections. Furnish the revised pole heights to the Engineer. Use all other dimensional requirements shown on the plans.

Ensure each pole includes an identification tag with information and location positions as defined on Metal Pole Standard Drawing Sheets M2, M3 and M4. All pole shaft tags must include the NCDOT Inventory number followed by the pole number shown on the traffic signal or ITS (non-signalized locations) plan.

Design all traffic signal support structures using the following 6th Edition AASHTO specifications:

- Design for a 50-year service life as recommended by Table 3.8.3-2.
- Use the wind pressure map developed from 3-second gust speeds, as provided in Article 3.8.
- Ensure signal support structures include natural wind gust loading and truck-induced gust loading in the fatigue design, as provided for in Articles 11.7.1.2 and 11.7.1.3, respectively. Designs need not consider periodic galloping forces.
- Assume the natural wind gust speed in North Carolina is 11.2 mph. For natural wind fatigue stress calculations, utilize a drag coefficient (C_d) computed for 11.2 mph wind velocity and not the basic wind speed velocity.
- Design for Category II fatigue, as provided for in Article 11.6, unless otherwise specified.
- Calculate all stresses using applicable equations from Section 5. The Maximum allowable stress ratios for all signal support designs are 0.9.
- Conform to article 10.4.2 and 11.8 for all deflection requirements.

Ensure that the design permits cables to be installed inside poles and mast arms.

Unless otherwise specified by special loading criteria, the computed surface area for ice load on signal heads is:

- 3-section, 12-inch, Surface area: 26.0 ft² (17.0 ft² without back plate)
- 4-section, 12-inch, Surface area: 32.0 ft² (21.0 ft² without back plate)
- 5-section, 12-inch, Surface area: 42.0 ft² (29.0 ft² without back plate)

The ice loading for signal heads defined above includes the additional surface area that back plates will induce. Special loading criteria may be specified in instances where back plates will not

be installed on signal heads. Refer to the Loading Schedule on each Metal Pole Loading Diagram for revised signal head surface areas. The pole designer should revise ice loads accordingly in this instance. Careful examination of the plans when this is specified is important as this may impact sizing of the metal support structure and foundation design which could affect proposed bid quotes. All maximum stress ratios of 0.9 still apply.

Assume the combined minimum weight of a messenger cable bundle (including messenger cable, signal cable and detector lead-in cables) is 1.3 lbs/ft. Assume the combined minimum diameter of this cable bundle is 1.3 inches.

Ensure that designs provide a removable pole cap with stainless steel attachment screws for each pole top and mast arm end.

B. Metal Poles

Submit design drawings for approval including pre-approved QPL pole drawings. Show all the necessary details and calculations for the metal poles including the foundation and connections. Include NCDOT inventory number on design drawings. Include as part of the design calculations the ASTM specification numbers for the materials to be used. Provide the types and sizes of welds on the design drawings. Include a Bill of Materials on design drawings. Ensure design drawings and calculations are signed, dated, and sealed by the responsible professional engineer licensed in the state of North Carolina. Immediately bring to the attention of the Engineer any structural deficiency that becomes apparent in any assembly or member of any assembly as a result of the design requirements imposed by these specifications, the plans, or the typical drawings. Said Professional Engineer is wholly responsible for the design of all poles and arms. Review and acceptance of these designs by the Department does not relieve the said Professional Engineer of his responsibility. **Do not fabricate the assemblies until receipt of the Department's approval of the design drawings.**

For mast arm poles, provide designs with provisions for pole plates and associated gussets and fittings for mast arm attachment. As part of each mast arm attachment, provide a grommeted 2" diameter hole on the shaft side of the connection to allow passage of the signal cables from the pole to the arm.

Where ice is present, assume wind loads as shown in Figure 3.9.4.2-3 of the 6th Edition AASHTO Specification for Group III loading.

For each strain pole, provide two messenger cable clamps and associated hardware to attach the messenger support cable. Ensure that the diameter of the clamps is appropriately designed to be adjustable from 1'-6" inches below the top, down to 6'-6" below the top of the pole. Do not attach more than one messenger support cable to a messenger cable clamp.

Provide a grounding lug(s) in the approximate vicinity of the messenger cable clamp for bonding and grounding messenger cable. Lugs must accept #4 or #6 AWG wire to bond messenger cables to the pole in order to provide an effective ground fault circuit path. Refer to Metal Pole Standard Drawing Sheet M6 for construction details.

Design tapers for all pole shafts that begin at the base with diameters that decrease uniformly at the rate of 0.14 inch per foot of length.

Design a base plate on each pole. The minimum base plate thickness for all poles is determined by the following criteria:

Case 1 Circular or rectangular solid base plate with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/3 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt is $M = (P \times D_1) / 2$, where

M = bending moment at the critical section of the base plate induced by one anchor bolt

P = anchoring force of each anchor bolt

D_1 = horizontal distance between the anchor bolt center and the outer face of the upright, or the difference between the bolt circle radius and the outside radius of the upright

Locate the critical section at the face of the anchor bolt and perpendicular to the bolt circle radius. The overlapped part of two adjacent critical sections is considered ineffective.

Case 2 Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/3 of the upright diameter.

The magnitude of bending moment induced by the anchoring force of each anchor bolt is $M = P \times D_2$,

where P = anchoring force of each anchor bolt

D_2 = horizontal distance between the face of the upright and the face of the anchor bolt nut

Locate the critical section at the face of the anchor bolt top nut and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections is considered ineffective.

If the base plate thickness calculated for Case 2 is less than Case 1, use the thickness calculated for Case 1.

The following additional owner requirements apply concerning pole base plates.

- Ensure that whichever case governs as defined above, the anchor bolt diameter is set to match the base plate thickness. If the minimum diameter required for the anchor bolt exceeds the thickness required for the base plate, set the base plate thickness equal to the required bolt diameter.
- For dual mast arm supports, or for single mast arm supports 50' or greater, use a minimum 8 bolt orientation with 2" diameter anchor bolts, and a 2" thick base plate.
- For all metal poles with mast arms, use a full penetration groove weld with a backing ring to connect the pole upright component to the base. Refer to Metal Pole Standard Drawing Sheet M4.

Ensure that designs have anchor bolt holes with a diameter 1/4 inch larger than the anchor bolt diameters in the base plate.

Ensure that the anchor bolts have the required diameters, lengths, and positions, and will develop strengths comparable to their respective poles.

Provide designs with a 6 x 12-inch hand hole with a reinforcing frame for each pole.

Provide designs with a terminal compartment with cover and screws in each pole that encompasses the hand hole and contains provisions for a 12-terminal barrier type terminal block.

For each pole, provide designs with provisions for a 1/2-inch minimum thread diameter, coarse thread stud and nut for grounding which will accommodate a #6 AWG ground wire. Ensure the lug is electrically bonded to the pole and is conveniently located inside the pole at the hand hole.

When required, design couplings on the pole for mounting pedestrian pushbuttons at a height of 42 inches above the bottom of the base. Provide mounting points consisting of 1-1/2 inch internally threaded half-couplings that comply with the NEC that are mounted within the poles. Ensure the couplings are essentially flush with the outside surfaces of the poles and are installed before any required galvanizing. Provide a threaded plug for each half coupling. Ensure that the surface of the plug is essentially flush with the outer end of the mounting point when installed and has a recessed hole to accommodate a standard wrench.

C. Mast Arms

Design all arm plates and necessary attachment hardware, including bolts and brackets as required by the plans.

Design for grommets holes on the arms to accommodate the cables for the signals if specified.

Design arms with weatherproof connections for attaching to the shaft of the pole.

Always use a full penetration groove weld with a backing ring to connect the mast arm to the pole. Refer to Metal Pole Standard Drawing Sheet M5.

Capacity of tapped flange plate must be sufficient to develop the full capacity of the connecting bolts. In all cases the flange plate of both arm and shaft must be at least as thick as the arm connecting bolts are in diameter.

1. Foundations:

Remove and promptly dispose of the metal signal pole foundations including reinforcing steel, electrical wires, and anchor bolts to a minimum depth of two feet below the finished ground elevation. At the Contractor's option, remove the complete foundation.

2. Metal Poles:

Assume ownership of the metal signal poles, remove the metal signal poles, and promptly transport the metal signal poles from the project. Use methods to remove the metal signal poles and attached traffic signal equipment that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no additional cost to the Department.

Transport and properly dispose of the materials.

Backfill and compact disturbed areas to match the finished ground elevation. Seed unpaved areas.

Use methods to remove the foundations that will not result in damage to other portions of the project or facility. Repair damages that are a result of the Contractor's actions at no cost to the Department.

5.8. POLE NUMBERING SYSTEM

A. New Poles

Attach an identification tag to each pole shaft and mast arm section as shown on Metal Pole Standard Drawing Sheet M2 “Typical Fabrication Details Common To All Metal Poles”.

5.9. MEASUREMENT AND PAYMENT

Actual number of metal poles with single mast arms furnished, installed, and accepted.

Actual number of metal poles with dual mast arms furnished, installed, and accepted.

Actual number of soil tests with SPT borings drilled furnished and accepted.

Actual volume of concrete poured in cubic yards of drilled pier foundation furnished, installed and accepted.

Actual number of designs for mast arms with metal poles furnished and accepted.

Actual number of metal signal pole foundations removed and disposed.

Actual number of metal signal poles removed and disposed.

No measurement will be made for foundation designs prepared with metal pole designs, as these will be considered incidental to designing signal support structures.

Payment will be made under:

Pay Item	Pay Unit
Metal Pole with Single Mast Arm	Each
Metal Pole with Dual Mast Arm.....	Each
Soil Test	Each
Drilled Pier Foundation.....	Cubic Yard
Mast Arm with Metal Pole Design	Each
Metal Pole Foundation Removal	Each
Metal Pole Removal.....	Each

6. ETHERNET EDGE SWITCH

Furnish and install a managed Ethernet edge switch as specified below that is fully compatible, interoperable, and completely interchangeable and functional within the existing City or Division traffic signal system communications network.

6.1. DESCRIPTION

A. Ethernet Edge Switch

Furnish and install a hardened, field Ethernet edge switch (hereafter “edge switch”) for traffic signal controllers as specified below. Ensure that the edge switch provides wire-speed, fast Ethernet connectivity at transmission rates of 100 megabits per second from each remote ITS device location to the routing switches.

Contact the City or Division to arrange for the programming of the new Field Ethernet Switches with the necessary network configuration data, including but not limited to, the Project IP Address, Default Gateway, Subnet Mask and VLAN ID information. Provide a minimum five (5) days working notice to allow the City or Division to program the new devices.

B. Network Management

Ensure that the edge switch is fully compatible with the City's or Division's existing Network Management Software.

6.2. MATERIALS**A. General**

Ensure that the edge switch is fully compatible and interoperable with the trunk Ethernet network interface and that the edge switch supports half and full duplex Ethernet communications.

Furnish an edge switch that provide 99.999% error-free operation, and that complies with the Electronic Industries Alliance (EIA) Ethernet data communication requirements using single-mode fiber-optic transmission medium and copper transmission medium. Ensure that the edge switch has a minimum mean time between failures (MTBF) of 10 years, or 87,600 hours, as calculated using the Bellcore/Telcordia SR-332 standard for reliability prediction.

B. Compatibility Acceptance

The Engineer has the authority to require the Contractor to submit a sample Field Ethernet Switch and Field Ethernet Transceiver along with all supporting documentation, software and testing procedures to allow a compatibility acceptance test be performed prior to approving the proposed Field Ethernet Switch and Field Ethernet Transceiver for deployment. **The Compatibility Acceptance testing will ensure that the proposed device is 100% compatible and interoperable with the existing City Signal System network, monitoring software and Traffic Operations Center network hardware.** Allow fifteen (15) working days for the Compatibility Acceptance Testing to be performed

C. Standards

Ensure that the edge switch complies with all applicable IEEE networking standards for Ethernet communications, including but not limited to:

- IEEE 802.1D standard for media access control (MAC) bridges used with the Spanning Tree Protocol (STP);
- IEEE 802.1Q standard for port-based virtual local area networks (VLANs);
- IEEE 802.1P standard for Quality of Service (QoS);
- IEEE 802.1w standard for MAC bridges used with the Rapid Spanning Tree Protocol (RSTP);
- IEEE 802.1s standard for MAC bridges used with the Multiple Spanning Tree Protocol;
- IEEE 802.1x standard for port based network access control, including RADIUS;
- IEEE 802.3 standard for local area network (LAN) and metropolitan area network (MAN) access and physical layer specifications;
- IEEE 802.3u supplement standard regarding 100 Base TX/100 Base FX;
- IEEE 802.3x standard regarding flow control with full duplex operation; and
- IFC 2236 regarding IGMP v2 compliance.
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)

- IEEE 802.3ad Ethernet Link Aggregation
- IEEE 802.3i for 10BASE-T (10 Mbit/s over Fiber-Optic)
- IEEE 802.3ab for 1000BASE-T (1Gbit/s over Ethernet)
- IEEE 802.3z for 1000BASE-X (1 Gbit/s Ethernet over Fiber-Optic)

D. Functional

Ensure that the edge switch supports all Layer 2 management features and certain Layer 3 features related to multicast data transmission and routing. These features shall include, but not be limited to:

- An STP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1D standard.
- An RSTP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1w standard.
- An Ethernet edge switch that is a port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and has a minimum 4-kilobit VLAN address table (254 simultaneous).
- A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 megabits per second and 148,800 packets per second for 100 megabits per second.
- A minimum 4-kilobit MAC address table.
- Support of Traffic Class Expediting and Dynamic Multicast Filtering.
- Support of, at a minimum, snooping of Version 2 & 3 of the Internet Group Management Protocol (IGMP).
- Support of remote and local setup and management via telnet or secure Web-based GUI and command line interfaces.
- Support of the Simple Network Management Protocol version 3 (SNMPv3). Verify that the Ethernet edge switch can be accessed using the resident EIA-232 management port, a telecommunication network, or the Trivial File Transfer Protocol (TFTP).
- Port security through controlling access by the users. Ensure that the Ethernet edge switch has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network.
- Support of remote monitoring (RMON-1 & RMON-2) of the Ethernet agent.
- Support of the TFTP and SNMP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

E. Physical Features

Ports: Provide 10/100/1000 Mbps auto-negotiating ports (RJ-45) copper Fast Ethernet ports for all edge switches. Provide auto-negotiation circuitry that will automatically negotiate the highest possible data rate and duplex operation possible with attached devices supporting the IEEE 802.3 Clause 28 auto-negotiation standard.

Optical Ports: Ensure that all fiber-optic link ports operate at 1310 or 1550 nanometers in single mode. Provide Type LC connectors for the optical ports, as specified in the Plans or by the Engineer. Do not use mechanical transfer registered jack (MTRJ) type connectors.

Provide an edge switch having a minimum of two optical 100/1000 Base X ports capable of transmitting data at 100/1000 megabits per second. Ensure that each optical port consists of a pair of fibers; one fiber will transmit (TX) data and one fiber will receive (RX) data. Ensure that the optical ports have an optical power budget of at least 15 dB.

Copper Ports: Provide an edge switch that includes a minimum of four copper ports. Provide Type RJ-45 copper ports and that auto-negotiate speed (i.e., 10/100/1000 Base) and duplex (i.e., full or half). Ensure that all 10/100/1000 Base TX ports meet the specifications detailed in this section and are compliant with the IEEE 802.3 standard pinouts. Ensure that all Category 5E unshielded twisted pair/shielded twisted pair network cables are compliant with the EIA/TIA-568-B standard.

Port Security: Ensure that the edge switch supports/complies with the following (remotely) minimum requirements:

- Ability to configure static MAC addresses access;
- Ability to disable automatic address learning per ports; know hereafter as Secure Port. Secure Ports only forward; and
- Trap and alarm upon any unauthorized MAC address and shutdown for programmable duration. Port shutdown requires administrator to manually reset the port before communications are allowed.

F. Management Capabilities

Ensure that the edge switch supports all Layer 2 management features and certain Layer 3 features related to multicast data transmission and routing. These features shall include, but not be limited to:

- An STP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1 D standards;
- An RSTP healing/convergence rate that meets or exceeds specifications published in the IEEE 802.1w standard;
- An Ethernet edge switch that is a port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and has a minimum 4-kilobit VLAN address table (254 simultaneous);
- A forwarding/filtering rate that is a minimum of 14,880 packets per second for 10 megabits per second, 148,800 packets per second for 100 megabits per second and 1,488,000 packets per second for 1000 megabits per second;
- A minimum 4-kilobit MAC address table;
- Support of Traffic Class Expediting and Dynamic Multicast Filtering.
- Support of, at a minimum, snooping of Version 2 & 3 of the Internet Group Management Protocol (IGMP);

- Support of remote and local setup and management via telnet or secure Web-based GUI and command line interfaces; and
- Support of the Simple Network Management Protocol (SNMP). Verify that the Ethernet edge switch can be accessed using the resident EIA-232 management port, a telecommunication network, or the Trivial File Transfer Protocol (TFTP).

Network Capabilities: Provide an edge switch that supports/complies with the following minimum requirements:

- Provide full implementation of IGMPv2 snooping (RFC 2236);
- Provide full implementation of SNMPv1, SNMPv2c, and/or SNMPv3;
- Provide support for the following RMON–I groups, at a minimum:
 - Part 1: Statistics
 - Part 2: History
 - Part 3: Alarm
 - Part 9: Event
- Provide support for the following RMON–2 groups, at a minimum:
 - Part 13: Address Map
 - Part 16: Layer Host
 - Part 17: Layer Matrix
 - Part 18: User History
- Capable of mirroring any port to any other port within the switch;
- Meet the IEEE 802.1Q (VLAN) standard per port for up to four VLANs;
- Meet the IEEE 802.3ad (Port Trunking) standard for a minimum of two groups of four ports;
- Password manageable;
- Telnet/CLI;
- HTTP (Embedded Web Server) with Secure Sockets Layer (SSL); and
- Full implementation of RFC 783 (TFTP) to allow remote firmware upgrades.

Network Security: Provide an edge switch that supports/complies with the following (remotely) minimum network security requirements:

- Multi-level user passwords;
- RADIUS centralized password management (IEEE 802.1X);
- SNMPv3 encrypted authentication and access security;
- Port security through controlling access by the users: ensure that the Ethernet edge switch has the capability to generate an alarm and shut down ports when an unauthorized user accesses the network;
- Support of remote monitoring (RMON-1&2) of the Ethernet agent; and
- Support of the TFTP and SNTF. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

G. Electrical Specifications

Ensure that the edge switch operates, and power is supplied with 115 volts of alternating current (VAC). Ensure that the edge switch has a minimum operating input of 110 VAC and a maximum operating input of 130 VAC. Ensure that if the device requires operating voltages other than 120 VAC, supply the required voltage converter. Ensure that the maximum power consumption does not exceed 50 watts. Ensure that the edge switch has diagnostic light emitting diodes (LEDs), including link, TX, RX, speed (for Category 5E ports only), and power LEDs.

H. Environmental Specifications

Ensure that the edge switch performs all of the required functions during and after being subjected to an ambient operating temperature range of -30 degrees to 165 degrees Fahrenheit as defined in the environmental requirements section of the NEMA TS 2 standard, with a noncondensing humidity of 0 to 95%.

Provide certification that the device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard. Provide certification that the device meets the vibration and shock resistance requirements of Sections 2.1.9 and 2.1.10, respectively, of the NEMA TS 2 standard. Ensure that the edge switch is protected from rain, dust, corrosive elements, and typical conditions found in a roadside environment.

The edge switch shall meet or exceed the following environmental standards:

- IEEE 1613 (electric utility substations)
- IEC 61850-3 (electric utility substations)
- IEEE 61800-3 (variable speed drive systems)
- IEC 61000-6-2 (generic industrial)
- EMF – FCC Part 15 CISPR (EN5502) Class A

I. Ethernet Patch Cable

Furnish a factory pre-terminated/pre-connectorized Ethernet patch cable with each edge switch. Furnish Ethernet patch cables meeting the following physical requirements:

- Five (5)-foot length
- Category 5e or better
- Factory-installed RJ-45 connectors on both ends
- Molded anti-snag hoods over connectors
- Gold plated connectors

Furnish Fast Ethernet patch cords meeting the following minimum performance requirements:

- TIA/EIA-568-B-5, Additional Transmission Performance Specifications for 4-pair 100 Ω Enhanced Category 5 Cabling
- Frequency Range: 1-100 MHz
- Near-End Crosstalk (NEXT): 30.1 dB
- Power-sum NEXT: 27.1 dB
- Attenuation to Crosstalk Ratio (ACR): 6.1 dB
- Power-sum ACR: 3.1 dB
- Return Loss: 10dB
- Propagation Delay: 548 nsec

6.3. CONSTRUCTION METHODS

A. General

Ensure that the edge switch is UL listed.

Verify that network/field/data patch cords meet all ANSI/EIA/TIA requirements for Category 5E and Category 6 four-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.

Contact the Signal Shop a minimum of 5 days prior to installation for the most current edge switch IP Address, VLAN, subnet mask, default gateway and configuration files.

B. Edge Switch

Mount the edge switch inside each field cabinet by securely fastening the edge switch to the upper end of the right rear vertical rail of the equipment rack using manufacturer-recommended or Engineer-approved attachment methods, attachment hardware and fasteners.

Ensure that the edge switch is mounted securely in the cabinet and is fully accessible by field technicians without blocking access to other equipment. Verify that fiber-optic jumpers consist of a length of cable that has connectors on both ends, primarily used for interconnecting termination or patching facilities and/or equipment.

6.4. MEASUREMENT AND PAYMENT

Ethernet edge switch will be measured and paid as the actual number of Ethernet edge switches furnished, installed, and accepted.

No separate measurement will be made for Ethernet patch cable, power cord, mounting hardware, nuts, bolts, brackets, or edge switch programming as these will be considered incidental to furnishing and installing the edge switch.

Payment will be made under:

Pay Item	Pay Unit
Ethernet Edge Switch.....	Each

7. DMS ELECTRICAL SERVICE

7.1. DESCRIPTION

Install new electrical service equipment as shown in the Plans. The first item of work on this project is the installation of all electrical service pedestals, poles, and meter base/disconnect combination panels to expedite the power service connections. Comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the Standard Specifications, the Project Special Provisions, and all local ordinances. All work involving electrical service shall be coordinated with the appropriate utility company and the Engineer.

Obtain the maximum available ground fault current from the utility company. Print this information on a durable label and adhere to the dead front of the disconnect.

R-3300B**TS-57****Pender County****7.2. MATERIALS****A. Meter Base/Disconnect Combination Panel**

Furnish and install new meter base/disconnect combination panels as shown in the Plans. Provide meter base/disconnect combination panels that have a minimum of eight (8) spaces in the disconnect. Furnish a double pole 100A circuit breaker at the DMS-1 & DMS-2 and at the DMS-3 & DMS-4 locations. Furnish each with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure meter base/ disconnect combination panel is listed as meeting UL Standard UL-67 and marked as being suitable for use as service equipment. Ensure circuit breakers are listed as meeting UL-489 and ensure circuit breakers comply with the calculated maximum available ground fault current provided by the power company. Fabricate the enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 8 through number 3/0 AWG.

Furnish NEMA Type 3R combinational panels rated 100 Ampere minimum for overhead services and 200 Ampere minimum for underground services that meet the requirements of the local utility. Provide meter base with sockets' ampere rating based on sockets being wired with a minimum of 167 degrees F insulated wire. Furnish 4 terminal, 600-volt, single phase, 3-wire meter bases that comply with the following:

- Line, Load, and Neutral Terminals accept 4/0 AWG and smaller Copper/Aluminum wire
- With or without horn bypass
- Made of galvanized steel
- Listed as meeting UL Standard US-414
- Overhead or underground service entrance specified.

Furnish 1.5" watertight hub for threaded rigid conduit with meter base.

At the main service disconnect, furnish and install UL-approved lightning arrestors that meet the following requirements:

Type of design	Silicon Oxide Varistor
Voltage	120/240 Single Phase, 3 wire
Maximum current	100,000 amps
Maximum energy	3000 joules per pole
Maximum number of surges	Unlimited
Response time one milliamp test	5 nanoseconds
Response time to clamp 10,000 amps	10 nanoseconds
Response time to clamp 50,000 amps	25 nanoseconds

R-3300B**TS-58****Pender County**

Leak current at double the rated voltage	None
Ground wire	Separate

B. Equipment Cabinet Disconnect

Provide new equipment cabinet disconnects at the locations shown in the Plans. Furnish double pole 50A circuit breakers at DMS locations. Furnish panels that have a minimum of four (4) spaces in the disconnect. Furnish circuit breakers with a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure meter base/ disconnect combination panel is listed as meeting UL Standard UL-67 and marked as being suitable for use as service equipment. Ensure circuit breakers are listed as meeting UL-489. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 8 through number 3/0 AWG.

C. Grounding System

Furnish 5/8"x10' copper clad steel grounding electrodes (ground rods) and #4 AWG solid bare copper conductors for grounding system installations. Secure the copper conductor to the ground rod with an irreversible compression coupling using a ratcheting compression tool. Comply with the NEC, Standard Specifications, these Project Special Provisions, and the Plans.

D. Wood Pedestal

Furnish 6" x 6" wood pedestals for electrical service equipment as shown in the Plans.

7.3. CONSTRUCTION METHODS**A. General**

Coordinate with the Engineer and the utility company to de-energize an existing service temporarily prior to starting any modifications.

Permanently label cables at all access points using nylon tags labeled with permanent ink. Ensure each cable has a unique identifier. Label cables immediately upon installation. Use component name and labeling scheme approved by the Engineer.

B. Meter Base/Disconnect Combination Panel

Install meter base/disconnect combination panels with lightning arrestors as called for in the Plans. At all new DMS locations, route the feeder conductors from the meter base/disconnect to the DMS equipment cabinet in conduit. Provide rigid galvanized conduit for above ground and PVC or HDPE for below ground installations.

C. Electrical Service Disconnect

Install equipment cabinet disconnects and circuit breakers as called for in the Plans. Install THWN stranded copper feeder conductors as shown in Plans between the electrical service disconnect and the equipment cabinet disconnect. Route the conductors from the equipment cabinet disconnect to the equipment cabinet in rigid galvanized steel conduit. Bond the equipment cabinet

disconnect in accordance with the NEC. Ensure that the grounding system complies with the grounding requirements of these Project Special Provisions, the Standard Specifications and the Plans.

D. Grounding System

Install ground rods as indicated in the Plans. Connect the #4 AWG grounding conductor to ground rods using an exothermic welding process. Test the system to ensure a ground resistance of 20-ohms or less is achieved. Drive additional ground rods as necessary or as directed by the Engineer to achieve the proper ground resistance.

7.4. MEASUREMENT AND PAYMENT

DMS Electrical Service will be measured and paid as the actual number of complete and functional DMS electrical service locations furnished, installed, tested, and accepted.

No measurement will be for meter base/disconnect combination panels, equipment cabinet disconnects, circuit breakers, copper service entrance conductors, copper feeder conductors, grounding electrodes, grounding conductors, risers, conduits from disconnect to cabinet, wood pedestals, and any additional material necessary for the installation of the new DMS electrical service as they will be considered incidental to furnishing and installing the new DMS electrical service.

Payment will be made under:

Pay Item	Pay Unit
DMS Electrical Service.....	Each

8. DYNAMIC MESSAGE SIGN (DMS)

8.1. DESCRIPTION

Furnish and install two (2) DMS mounted back to back on a single support structure.

DMSs used on the State Highway System shall be preapproved on the current NCDOT ITS & Signals 2018 Qualified Products List (QPL) by the date of installation. DMSs not preapproved will not be allowed for use on the project. To ensure compatibility with the existing DMS Control Software deployed in the State, furnish NTCIP compliant DMSs that are fully compatible with Daktronics, Inc. Vanguard V4 software (also referred to hereinafter as the “Control Software”).

Furnish and install DMSs compliant with UL standards 48, 50, and 879.

Add and configure the new DMSs in the system using the Control Software and computer system. Furnish, install, test, integrate and make fully operational the new DMSs at locations shown in the Plans.

Contact the Engineer to confirm all DMS locations prior to beginning construction.

Furnish operating DMS systems consisting of, but not limited to, the following:

- Front Access DMS
 - Full Matrix, Full Color, 96 pixels high by 208 pixels wide front access LED DMS
 - Pedestal type DMS support structures and mounting hardware

- DMS controllers, Uninterruptible Power Supplies (UPS), cabinets and accessories with interconnect and power cabling and conduit
- Branch circuit conductors and related equipment
- All other equipment and incidentals required for furnishing, installing, and testing the DMS system and system components

Use only UL listed and approved electronic and electrical components in the DMS system.

8.2. MATERIALS

A. Environmental Requirements

Construct the DMS and DMS controller cabinets so the equipment within is protected against moisture, dust, corrosion, and vandalism.

Design the DMS system to comply with the requirements of Section 2.1 (Environmental and Operating Standards) of NEMA TS 4-2005.

B. Full Matrix Led Dynamic Message Sign (DMS)

Construct the DMS to display at least three lines of text that, when installed, are clearly visible and legible to a person with 20/20 corrected vision from a distance of 900 feet in advance of the DMS at an eye height of 3.5 feet along the axis.

When displaying three lines, each line must display at least 8 equally spaced and equally sized alphanumeric individual characters. Each character must be at least 18 inches in height and composed from a luminous dot matrix. Provide an entire LED matrix that is a minimum of 98 pixels high and 208 pixels wide.

1. DMS Enclosure

Comply with the requirements of Section 3 (Sign Mechanical Construction) of NEMA TS 4-2005 as it applies to front access enclosures. The following requirements complement TS 4-2005:

- Construct the DMS with a metal front-access enclosure excluding the face. Construct the enclosure of welded aluminum type 6061-T6, 5052-H38, 5052-H34, or of an Engineer approved alternate at least 1/8-inch thick. Perform all welding of aluminum and aluminum alloys in accordance with the latest edition of AWS D1.2, Structural Welding Code - Aluminum. Continuously weld the seams using Gas Metal Arc Welding (GMAW).
- Provide all exterior and interior DMS enclosure surfaces with natural, mill-finish aluminum. Remove all grind marks and discoloration from the surfaces.
- Provide corrosion resistant nuts, bolts, washers, and other mounting and bonding parts and components used on the exterior of the DMS enclosure and ensure they are sealed against water intrusion.
- Provide one access door for each 10 to 15-pixel wide section of the sign enclosure. Vertically hinge the doors and design to swing out from the face to provide access to the enclosure interior. Extend each door the full height of the display matrix.

- Provide a retaining latch mechanism for each door to hold the door open at a 90-degree angle.
- Each door will form the face panel for a section of the sign. Mount the LED modules to the door such that they can be removed from the door when in the open position. Other sign components can be located inside the sign enclosure and be accessible through the door opening.
- Provide for each door a minimum of two (2) screw-type captive latches to lock them in the closed position and pull the door tight and compress a gasket located around the perimeter of each door. Install the gasket around the doors to prevent water from entering the cabinet.
- Do not place a manufacturer name, logo, or other information on the front face of the DMS or shield visible to the motorist.
- Provide power supply monitoring circuitry to detect power failure in the DMS and to automatically report this fault to the Control Software. This requirement is in addition to reporting power failure at the controller cabinet.
- Do not paint the stainless-steel bolts on the Z-bar assemblies used for mounting the enclosure.

2. DMS Interior Environment Control

Install a minimum of one (1) temperature sensor that is mounted near the top of the DMS interior. The sensor(s) will measure the temperature of the air in the enclosure over a minimum range of -40°F to +176°F. Ensure the DMS controller will continuously monitor the internal temperature sensor output and report to the DMS control software upon request.

Design the DMS with systems for enclosure ventilation, face panel fog and frost prevention, and safe over-temperature shutdown.

Design the DMS ventilation system to be thermostatically controlled and to keep the internal DMS air temperature lower than +140°F, when the outdoor ambient temperature is +115°F or less.

The ventilation system will consist of two or more air intake ports located near the bottom of the DMS rear wall. Cover each intake port with a filter that removes airborne particles measuring 500 microns in diameter and larger. Mount one or more ball bearing-type fans at each intake port. These fans will positively pressure the DMS enclosure.

Design the fans and air filters to be removable and replaceable from inside the DMS housing. To ease serviceability, mount the fans no more than four (4) feet from the floor of the DMS enclosure.

Provide each ventilation fan with a sensor to monitor its rotational speed, measured in revolutions per minute and report this speed to the sign controller upon request.

The ventilation system will move air across the rear of the LED modules in a manner such that heat is dissipated from the LED's. Design the airflow system to move air from the bottom of the enclosure towards the top to work with natural convection to move heat away from the modules.

Install each exhaust port near the top of the rear DMS wall. Provide one exhaust port for each air intake port. Screen all exhaust port openings to prevent the entrance of insects and small animals.

Cover each air intake and exhaust port with an aluminum hood attached to the rear wall of the DMS. Thoroughly seal all intakes and exhaust hoods to prevent water from entering the DMS.

Provide a thermostat near the top of the DMS interior to control the activation of the ventilation system.

The DMS shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal enclosure air temperature exceeds a maximum threshold temperature. The threshold temperature shall be configurable and shall have a default factory setting of 140°F.

3. Front Panel

Protect the DMS face with contiguous, weather-tight, removable panels. These panels must be a polycarbonate material that is ultraviolet protected, have an antireflection coating, and are a minimum of 1/8- inch thick.

Furnish polycarbonate panels with the following characteristics:

- Tensile Strength, Ultimate: 10,000 PSI
- Tensile Strength, Yield: 9,300 PSI
- Tensile Strain at Break: 125%
- Tensile Modulus: 330,000 PSI
- Flexural Modulus: 330,000 PSI
- Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 PSI at 270F and 66 PSI at 288F
- Coefficient of Thermal Expansion: 3.9×10^{-5} in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

For substitutes, submit one 12" x 12" sample of the proposed material together with a description of the material attributes to the Engineer for review and approval. Install a .09" aluminum mask on the front of the panel (facing the motorists) that contains a circular opening for each LED pixel. Prime and coat the front side of the aluminum mask, which faces the viewing motorists, with automotive-grade flat black acrylic enamel paint or an approved equivalent. Guarantee all painted surfaces provide a minimum outdoor service life of 20 years.

Design the panels so they will not warp nor reduce the legibility of the characters. Differential expansion of the DMS housing and the front panel must not cause damage to any

DMS component or allow openings for moisture or dust. Glare from sunlight, roadway lighting, commercial lighting, or vehicle headlights must not reduce the legibility or visibility of the DMS. Install the panels so that a maintenance person can easily remove or open them for cleaning.

4. Display Modules

Manufacture each display module with a standard number of pixels, not to exceed an array of 9 x 5, which can be easily removed. Assemble the modules onto the DMS assemblies contiguously to form a continuous matrix to display the required number of lines, characters, and character height.

Design display modules that are interchangeable and replaceable without using special tools. Provide plug-in type power and communication cables to connect to a display module.

Construct each display module as a rectangular array of 5 horizontal pixels by 7 to 9 vertical pixels. Provide the module with an equal vertical and horizontal pitch between pixels, and columns that are perpendicular to the rows (i.e., no slant). Design each module to display:

- All upper- and lower-case letters.
- All punctuation marks.
- All numerals 0 to 9.
- Special user-created characters.

Display upper-case letters and numerals over the complete height of the module. Optimize the LED grouping and mounting angle within a pixel for maximum readability.

Furnish two (2) spare display modules per each DMS installed for emergency restoration.

5. Discrete LEDs

Provide discrete LEDs with a nominal viewing cone of 30 degrees with a half-power angle of 15 degrees measured from the longitudinal axis of the LED. Make certain, the viewing cone tolerances are as specified in the LED manufacturer's product specifications and do not exceed +/- 3 degrees half-power viewing angle of 30 degrees.

Provide LEDs that are untinted, non-diffused, high output solid state lamps utilizing indium gallium aluminum phosphide (InGaAlP) technology. No substitutions will be allowed. Provide T1 3/4, 0.2-inch size LEDs that emit a true amber color at a wavelength of 590 ± 5 nm.

Provide LEDs with a MTBF (Mean Time Before Failure) of at least 100,000 hours of permanent use at an operating point of 140° F or below at a specific forward current of 20mA. Discrete LED failure is defined as the point at which the LED's luminous intensity has degraded to 50% or less of its original level.

Obtain the LEDs used in the display from a single LED manufacturer that have a single part number. Obtain them from batches sorted for luminous output, where the highest luminosity LED is not more than fifty percent more luminous than the lowest luminosity LED when the LEDs are driven at the same forward current. Do not use more than two successive and overlapping batches in the LED display. Document the procedure to be used to comply with this requirement as part of the material submittal.

Individually mount the LEDs on circuit boards that are at least 1/16" thick FR-4 fiberglass, flat black printed circuit board in a manner that promotes cooling. Protect all exposed metal on

both sides of the LED pixel board (except the power connector) from water and humidity exposure by a thorough application of acrylic conformal coating. Design the boards so bench level repairs to individual pixels, including discrete LED replacement and conformal coating repair is possible.

Operate the LED display at a low internal DC voltage not to exceed 24 Volts.

Design the LED display operating range to be -20° F to $+140^{\circ}$ F at 95% relative humidity, non-condensing.

Supply the LED manufacturer's technical specification sheet with the material submittals.

6. LED Power Supplies

Power the LED Display by means of multiple regulated switching DC power supplies that operate from 120 volts AC input power and have an output of 48 volts DC or less. Wire the supplies in a redundant parallel configuration that uses multiple power supplies per display. Provide the supplies with current sharing capability that allows equal amounts of current to their portion of the LED display. Provide power supplies rated such that if one supply fails the remaining supplies will be able to operate their portion of the display under full load conditions (i.e. all pixels on at maximum brightness) and at a temperature of 140° F.

Provide power supplies to operate within a minimum input voltage range of $+90$ to $+135$ volts AC and within a temperature range of -22° F to 140° F. Power supply output at 140° F must not deteriorate to less than 65% of its specified output at 70° F. Provide power supplies that are overload protected by means of circuit breakers, that have an efficiency rating of at least 75%, a power factor rating of at least .95, and are UL listed. Provide all power supplies from the same manufacturer and with the same model number. Design the power driver circuitry to minimize power consumption.

Design the field controller to monitor the operational status (normal or failed) of each individual power supply and be able to display this information on the Client Computer screen.

7. LED Pixels

A pixel is defined as the smallest programmable portion of a display module that consists of a cluster of closely spaced discrete LEDs. Design each pixel to be a maximum of 2 inches in diameter.

Construct the pixels with two strings of LEDs. It is the manufacturer's responsibility to determine the number of LEDs in each string to produce the candela requirement as stated herein.

Ensure each pixel produces a luminous intensity of 40 Cd when driven with an LED drive current of 20 mA per string.

Power the LEDs in each pixel in strings. Use a redundant design so that the failure of an LED in one string does not affect the operation of any other string within the pixel. Provide the sign controller with the ability to detect the failure of any LED string and identify which LED string has failed. Submit a complete schematic of the LED power and driver circuits with the material submittals.

8. Character Display

Design display modules to be easily removable without the use of tools. Position cooling fans so they do not prevent removal of an LED pixel board or driver board.

Use continuous current to drive the LEDs at the maximum brightness level. Design the light levels to be adjustable for each DMS / controller so the Engineer may set levels to match the luminance requirements at each installation site.

Design the controller to automatically detect failed LED strings or drivers and initiate a report of the event to the Control Software. Design the controller to be able to read the internal temperature of the DMS enclosure and the ambient temperature outside the DMS enclosure and report these to the Control Software.

9. Display Capabilities

Design the DMS with at least the following message displays:

- Static display
- Flashing display with Dynamic flash rates
- At least two alternating Static and / or Flashing sequences (multi-page messages)

10. DMS Mini Controller

Furnish and install a mini controller inside the DMS that is interconnected with the main controller using a fiber optic cable, CAT-5 cable, or an approved alternate. The mini controller will enable a technician to perform all functions available from the main controller. Provide the mini controller with an LCD/keypad interface. Size the LCD display screen to allow preview of an entire one-page message on one screen. Provide a 4 X 4 keypad.

Alternatively, install an EIA/TIA-232E port inside the DMS enclosure to enable a maintenance technician to communicate with the DMS main controller and obtain access to and perform all functions of the main controller using a laptop computer.

C. DMS Enclosure Structure Mounting

Mount the DMS enclosure and interconnect system securely to the supporting structures. Design the DMS enclosure supports and structure to allow full access to the DMS enclosure inspection door.

Furnish and install U-bolt connections of hanger beams to overhead assembly truss chords with a double nut at each end of the U-bolt. Bring the double nuts tight against each other by the use of two wrenches.

Submit plans for the DMS enclosure, structure, mounting description and calculations to the Engineer for approval. Have such calculations and drawings approved by a Professional Engineer registered in the state of North Carolina, and bear his signature, seal, and date of acceptance.

Provide removable lifting eyes or the equivalent on the DMS enclosure rated for its total weight to facilitate handling and mounting the DMS enclosure.

Design the DMS structure to conform to the applicable requirements of the *Standard Specifications for Structural Supports for Highway Signs, Luminaires*, and the section titled “DMS Assemblies” of these Project Special Provisions.

D. DMS / DMS Controller Interconnect

Furnish and install all necessary cabling, conduit, and terminal blocks to connect the DMS and the DMS controller. Use approved manufacturer's specifications and the Plans for cable and conduit types and sizes. Use fiber optic cable to interconnect sign and controller. Install fiber optic interconnect centers in the sign enclosure and cabinet to securely install and terminate the fiber optic cable. Submit material submittal cut sheets for the interconnect center.

E. DMS Controller and Cabinet

Furnish and install one DMS controller with accessories per DMS in a protective cabinet. Mount the controller cabinet on the DMS support structure. Install cabinet so that the height from the ground to the middle of the cabinet is 4 feet. Ensure a minimum of 3 feet level working surface under each cabinet that provides maintenance technicians with a safe working environment.

Provide the DMS controller as a software-oriented microprocessor and with resident software stored in non-volatile memory. The Control Software, controller and communications must comply with the NTCIP Standards identified in these Project Special Provisions. Provide sufficient non-volatile memory to allow storage of at least 500 multi-page messages and a test pattern program.

Furnish the controller cabinet with, but not limited to, the following:

- Power supply and distribution assemblies
- Power line filtering hybrid surge protectors
- Radio Interference Suppressor
- Communications surge protection devices
- Industrial-Grade UPS system and local disconnect
- Microprocessor-based controller
- Display driver and control system (unless integral to the DMS)
- Industrial-grade telephone line surge and lightning protector
- Serial interface port for local laptop computer
- Local user interface
- Interior lighting and duplex receptacle
- Adjustable shelves as required for components
- Temperature control system
- All interconnect harnesses, connectors, and terminal blocks
- All necessary installation and mounting hardware

Furnish the DMS controller and associated equipment completely housed in a NEMA 3R cabinet made from 5052-H32 sheet aluminum at least 1/8" thick. Use natural aluminum cabinets. Perform all welding of aluminum and aluminum alloys in accordance with the latest edition of AWS D1.2, Structural Welding Code - Aluminum. Continuously weld the seams using Gas Metal Arc Welding (GMAW).

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Slant the cabinet roof away from the front of the cabinet to prevent water from collecting on it.

Do not place a manufacturer name, logo, or other information on the faces of the controller cabinet visible to the motorist.

Provide cabinets capable of housing the components and sized to fit space requirement. Design the cabinet layout for ease of maintenance and operation, with all components easily accessible. Submit a cabinet layout plan for approval by the Engineer.

Locate louvered vents with filters in the cabinet to direct airflow over the controller and auxiliary equipment, and in a manner that prevents rain from entering the cabinet. Fit the inside of the cabinet, directly behind the vents, with a replaceable, standard-size, commercially available air filter of sufficient size to cover the entire vented area.

Provide a torsionally rigid door with a continuous stainless-steel hinge on the side that permits complete access to the cabinet interior. Provide a gasket as a permanent and weather resistant seal at the cabinet door and at the edges of the fan / exhaust openings. Use a non-absorbent gasket material that will maintain its resiliency after long-term exposure to the outdoor environment. Construct the doors so that they fit firmly and evenly against the gasket material when closed. Provide the cabinet door with louvered vents and air filters near the bottom as described in the paragraph above.

The cabinet shall contain a full-height standard EIA 19-inch rack. The rack shall be secured within the cabinet by mounts at the top and bottom.

The rack shall contain a minimum of one (1) pullout drawer. The drawer shall be suitable for storing manuals and small tools, such as screwdrivers. The drawer shall be able to latch in the out position to function as a laptop/utility shelf.

Provide a convenient location on the inside of the door to store the cabinet wiring diagrams and other related cabinet drawings. Provide a Corbin #2 main door lock made of non-ferrous or stainless-steel material. Key all locks on the project alike, and provide 10 keys to the Engineer. In addition, design the handle to permit padlocking.

Provide the interior of the cabinet with ample space for housing the controller and all associated equipment and wiring; use no more than 75% of the useable space in the cabinet. Provide ample space in the bottom of the cabinet for the entrance and exit of all power, communications, and grounding conductors and conduit.

Arrange the equipment so as to permit easy installation of the cabling through the conduit so that they will not interfere with the operation, inspection, or maintenance of the unit. Provide adjustable metal shelves, brackets, or other support for the controller unit and auxiliary equipment. Leave a 3-inch minimum clearance from the bottom of the cabinet to all equipment, terminals, and bus bars.

Provide power supply monitoring circuitry to detect power failure and to automatically report the occurrence to the Control Software.

Install two 15-watt fluorescent light strips with shields, one in the top of the cabinet and the other under the bottom shelf. Design both lights to automatically turn on when the cabinet door is opened and turn off when the door closes.

Mount and wire a 120V ($\pm 10\%$) GFCI duplex receptacle of the 3-wire grounding type in the cabinet in a location that presents no electrical hazard when used by service personnel for the operation of power tools and work lights.

No cabinet resident equipment may utilize the GFCI receptacle. Furnish one spare non-GFCI receptacle for future equipment.

Mount a bug-proof and weatherproof thermostatically controlled fan and safety shield in the top of the cabinet. Size the fan to provide at least for two air exchanges per minute. Fuse the fan at 125% of the capacity of the motor. The magnetic field of the fan motor must not affect the performance of the control equipment. Use a fan thermostat that is manually adjustable to turn on between 80°F and 160°F with a differential of not more than 10°F between automatic turn-on and turn-off. Mount it in an easily accessible location, but not within 6 inches of the fan.

Install additional fans and/or heaters as needed to maintain the temperature inside the cabinet within the operating temperature range of the equipment within the cabinet as recommended by equipment manufacturer(s).

1. Wiring

The requirements stated herein apply wherever electrical wiring is needed for any DMS system assemblies and subassemblies such as controller cabinet, DMS enclosure, electrical panel boards and etc.

Neatly arrange and secure the wiring inside the cabinet. Where cable wires are clamped to the walls of the control cabinet, provide clamps made of nylon, metal, plastic with rubber or neoprene protectors, or similar. Lace and jacket all harnesses, or tie them with nylon tie wraps spaced at 6 inches maximum to prevent separation of the individual conductors.

Individually and uniquely label all conductors. Ensure all conductor labels are clearly visible without moving the conductor. Connect all terminal conductors to the terminal strip in right angles. Remove excess conductor before termination of the conductor. Mold the conductor in such a fashion as to retain its relative position to the terminal strip if removed from the strip. Do not run a conductor across a work surface with the exception of connecting to that work surface. No conductor bundles can be support by fasteners that support work surfaces. Install all connectors, devices and conductors in accordance to manufactures guidelines. Comply with the latest NEC guideline in effect during installation. No conductor or conductor bundle may hang loose or create a snag hazard. Protect all conductors from damage. Ensure all solder joints are completed using industry accepted practices and will not fail due to vibration or movement. Protect lamps and control boards from damage.

No splicing will be allowed for feeder conductors and communication cables from the equipment cabinet to the DMS enclosure.

Insulate all conductors and live terminals so they are not hazardous to maintenance personnel.

Route and bundle all wiring containing line voltage AC and / or shield it from all low voltage control circuits. Install safety covers to prevent accidental contact with all live AC terminals located inside the cabinet.

Use industry standard, keyed-type connectors with a retaining feature for connections to the controller.

Label all equipment and equipment controls clearly.

Supply each cabinet with one complete set of wiring diagrams that identify the color-coding or wire tagging used in all connections. Furnish a water-resistant packet adequate for storing wiring diagrams, operating instructions, and maintenance manuals with each cabinet.

2. Power Supply and Circuit Protection

Design the DMS and controller for use on a system with a line voltage of $120V \pm 10\%$ at a frequency of $60 \text{ Hz} + 3 \text{ Hz}$. Under normal operation, do not allow the voltage drop between no load and full load of the DMS and its controller to exceed 3% of the nominal voltage.

Blackout, brownout, line noise, chronic over-voltage, sag, spike, surge, and transient effects are considered typical AC voltage defects. Protect the DMS system equipment so that these defects do not damage the DMS equipment or interrupt their operation. Equip all cabinets with devices to protect the equipment in the cabinet from damage due to lightning and external circuit power and current surges.

3. Circuit Breakers

Protect the DMS controller, accessories, and cabinet utilities with thermal magnetic circuit breakers. Provide the controller cabinet with a main circuit breaker sized according to the NEC. Use appropriately sized branch circuit breakers to protect the controller and accessories and for servicing DMS equipment and cabinet utilities.

4. Surge Suppressor

Install and clearly label filtering hybrid power line surge protectors on the load side of the branch circuit breakers in a manner that permits easy servicing. Ground and electrically bond the surge protector to the cabinet within 2 inches.

Provide power line surge protector that meets the following requirements:

Peak surge current occurrences	20 minimum
Peak surge current for an 8 x 20 microsecond waveshape	50,000 amperes
Energy Absorption	> 500 Joules
Clamp voltage	240 volts
Response time	<1 nanosecond
Minimum current for filtered output	15 amperes for 120VAC*
Temperature range	-40°F to +158°F

*Capable of handling the continuous current to the equipment

5. Radio Interference Suppressor

Provide each controller cabinet with sufficient electrical and electronic noise suppression to enable all equipment in it to function properly. Provide one or more radio interference suppressors (RIS) connected between the stages of the power line surge suppressor that minimize interference generated in the cabinet in both the broadcast and the aircraft frequencies. Each RIS must provide a minimum attenuation of 50 decibels over a frequency range of 200 KHz to 75 MHz. Clearly label the suppressor(s) and size them at least at the rated current of the main circuit breaker but not less than 50 amperes.

Provide RIS that are hermetically sealed in a substantial metal case which is filled with a suitable insulating compound and have nickel-plated 10/24 brass stud terminals of sufficient external length to provide space to connect #8 AWG wires. Mount them so that the studs cannot

be turned in the case. Properly insulate ungrounded terminals from each other, and maintain a surface linkage distance of not less than ¼” between any exposed current conductor and any other metallic parts. The terminals must have an insulation factor of 100-200 MΩ, dependent on external circuit conditions. Use RIS designed for 120 VAC \pm 10%, 60Hz, and which meet the standards of UL and the Radio Manufacturers Association.

6. Communications Surge Protector

Equip the cabinet with properly labeled hybrid data line surge protectors that meet the following general requirements:

Surge current occurrences at 2000 ampere, 8 x 20 microsecond waveform	> 80
Surge current occurrences at 400 ampere, 10x700 microsecond waveform	> 80
Peak surge current for 8 x 20 microsecond waveform	10,000 A (2500 A/line)
Peak surge current for 10x700 microsecond waveform	500 A/line
Response time	< 1 nanosecond
Series resistance	< 15 Ω
Average capacitance	1500 pF
Temperature range	-10°F to 150°F
Clamp Voltage	As required to match equipment in application

7. Lightning Arrester

Protect the system with an UL-approved lightning arrester installed at the main service disconnect that meets the following requirements:

Type of design	Silicon Oxide Varistor
Voltage	120/240 Single phase, 3 wires
Maximum current	100,000 amps
Maximum energy	3000 joules per pole
Maximum number of surges	Unlimited

Response time one milliamp test	5 nanoseconds
Response time to clamp 10,000 amps	10 nanoseconds
Response time to clamp 50,000 amps	25 nanoseconds
Leak current at double the rated voltage	None
Ground Wire	Separate

8. Uninterruptible Power Supply (UPS)

Provide the cabinet with an industrial grade power conditioning UPS unit to supply continuous power to operate the equipment connected to it if the primary power fails. The UPS must detect a power failure and provide backup power within 20 milliseconds. Transition to the UPS source from primary power must not cause loss of data or damage to the equipment being supplied with backup power. Provide an UPS with at least three outlets for supplying conditioned AC voltage to the DMS controller. Provide a unit to meet the following requirements:

- Input Voltage Range: 120VAC +12%, -25%
- Power Rating: 1000 VA, 700 Watts
- Input Frequency: 45 to 65 Hz
- Input Current: 7.2A
- Output Voltage: 120VAC +/- 3%
- Output Frequency: 50/60 +/-1 Hz
- Output Current: 8.3A
- Output Crest Factor Ratio: @50% Load Up to 4.8:1
@75% Load Up to 3.2:1
@100% Load Up to 2.4:1
- Output THD: 3% Max. (Linear)
5% Max. (Non-Linear)
- Output Overload: 110% for 10 min; 200% for 0.05 sec.
- Output Dynamic Response: +/- 4% for 100% Step Load Change
0.5 ms Recovery Time.
- Output Efficiency @ 100% Load: 90% (Normal Mode)
- Operating Temperature: -40 °F to +165 °F
- Humidity: 0% to 95% Non-condensing
- Remote Monitoring Interface: RS-232
- Protection: Input/Output Short Circuit

Input/Output Overload

Excessive Battery Discharge

- Specifications: UL1778, FCC Class A, IEEE 587

Provide the UPS unit capable of supplying 30 minutes of continuous backup power to the equipment connected to it when the equipment is operating at full load.

9. Controller Communications Interface

Provide the controller with the following interface ports:

- An EIA/TIA-232E port for remote communication using NTCIP
- An 10/100 Ethernet port for remote communication using NTCIP
- An EIA/TIA-232E port for onsite access using a laptop
- An EIA/TIA-232E auxiliary port for communication with a field device such as a UPS
- Fiber Optic ports for communication with the sign
- RJ45 ports for communication with the sign using CAT-5 cable
- RJ45 ports for communication with mini controller located inside the sign enclosure

10. Controller Local User Interface

Provide the controller with a Local User Interface (LUI) for at least the following functions:

- On / Off Switch: controls power to the controller.
- Control Mode Switch: for setting the controller operation mode to either remote or local mode.
- LCD Display and Keypad: Allow user to navigate through the controller menu for configuration (display, communications parameter, etc) running diagnostics, viewing peripherals status, message creation, message preview, message activation, and etc. Furnish an LCD display with a minimum size of 240x64 dots with LED back light.

11. Controller Address

Assign each DMS controller a unique address. Preface all commands from the Control Software with a particular DMS controller address. The DMS controller compares its address with the address transmitted; if the addresses match, then the controller processes the accompanying data.

12. Controller Functions

Design the DMS controller to continuously control and monitor the DMS independent of the Control Software. Design the controller to display a message on the sign sent by the Control Software, a message stored in the sign controller memory, or a message created on-site by an operator using the controller keypad.

Provide the DMS controller with a watchdog timer to detect controller failures and to reset the microprocessor, and with a battery backed-up clock to maintain an accurate time and date

reference. Set the clock through an external command from the Control Software or the Local User Interface.

13. DMS Controller Memory

Furnish each DMS controller with non-volatile memory. Use the non-volatile memory to store and reprogram at least one test pattern sequence and 500 messages containing a minimum of two pages of 45 characters per page. The Control Software can upload messages into and download messages from each controller's non-volatile memory remotely.

Messages uploaded and stored in the controller's non-volatile memory may be erased and edited using the Control Software and the controller. New messages may be uploaded to and stored in the controller's non-volatile memory using the Control Software and the controller.

F. Photo-Electric Sensors

Install three photoelectric sensors with ½ inch minimum diameter photosensitive lens inside the DMS enclosure. Use sensors that will operate normally despite continual exposure to direct sunlight. Place the sensors so they are accessible and field adjustable. Point one sensor north or bottom of the sign. Place the other two, one on the back wall and one on the front wall of the sign enclosure. Alternate designs maybe accepted, provided the sensor assemblies are accessible and serviceable from inside the sign enclosure.

Provide controls so that the Engineer can field adjust the following:

- The light level emitted by the pixels elements in each Light Level Mode.
- The ambient light level at which each Light Level Mode is activated.

G. Equipment List

Provide a general description of all equipment and all information necessary to describe the basic use or function of the major system components. Include a general "block diagram" presentation. Include tabular charts listing auxiliary equipment, if any is required. Include the nomenclature, physical and electrical characteristics, and functions of the auxiliary equipment unless such information is contained in an associated manual; in this case include a reference to the location of the information. Include an itemized list of equipment costs.

Include a table itemizing the estimated average and maximum power consumption for each major piece of equipment.

H. Physical Description

Provide a detailed physical description of size, weight, center of gravity, special mounting requirements, electrical connections, and all other pertinent information necessary for proper installation and operation of the equipment.

I. Parts List

Provide a parts list that contains all information needed to describe the characteristics of the individual parts, as required for identification. Include a list of all equipment within a group and a list of all assemblies, sub-assemblies, and replacement parts of all units. Arrange this data in a table, in alpha-numerical order of the schematic reference symbols, which gives the associated description, manufacturer's name, and part number, as well as alternate manufacturers and part numbers. Provide a table of contents or other appropriate grouping to identify major components, assemblies, etc.

J. Character Set Submittal

Submit an engineering drawing of the DMS character set including 26 upper case and lower case letters, 10 numerals, an asterisk (*), a dash, a plus sign (+), a designated lane diamond, a slash, an ampersand, and arrows at 0, 45, 90, 135, 180, 225, 270, and 315 degrees.

K. Wiring Diagrams

Provide a wiring diagram for each DMS and each controller cabinet, as well as interconnection wiring diagrams for the system as a whole.

Provide complete and detailed schematic diagrams to component level for all DMS assemblies and subassemblies such as driver boards, control boards, DMS controller, power supplies, and etc. Ensure that each schematic enables an electronics technician to successfully identify any component on a board or assemblies and trace its incoming and outgoing signals.

L. Routine of Operation

Describe the operational routine, from necessary preparations for placing the equipment into operation to securing the equipment after operation. Show appropriate illustrations with the sequence of operations presented in tabular form wherever applicable. Include in this section a total list of the test instruments, aids and tools required to perform necessary measurements and measurement techniques for each component, as well as set-up, test, and calibration procedures.

M. Maintenance Procedures

Specify the recommended preventative maintenance procedures and checks at pre-operation, monthly, quarterly, semi-annual, annual, and "as required" periods to assure equipment operates reliably. List specifications (including tolerances) for all electrical, mechanical, and other applicable measurements and / or adjustments.

N. Repair Procedures

Include in this section all data and step-by-step procedures necessary to isolate and repair failures or malfunctions, assuming the maintenance technicians are capable of analytical reasoning using the information provided in the section titled "Wiring Diagrams and Theory of Operation."

Describe accuracy, limits, and tolerances for all electrical, physical, or other applicable measurements. Include instructions for disassemblies, overhaul, and re-assemblies, with shop specifications and performance requirements.

Give detailed instructions only where failure to follow special procedures would result in damage to equipment, improper operation, danger to operating or maintenance personnel, etc. Include such instructions and specifications only for maintenance that specialized technicians and engineers in a modern electromechanical shop would perform. Describe special test set-up, component fabrication, and the use of special tools, jigs, and test equipment.

O. Field Trial

At the request of the Engineer, supply a three-character demonstration module with characters of the size and type specified for the project, an appropriate control device and power supply to allow character display within 30 working days of the request. Perform a field trial on this module at a time and location selected by the Engineer.

This trial will allow the Engineer or his selected representatives to test the readability of the DMS at the maximum distance required for specified character size. Test the module with the sun directly above the DMS, and near the horizon in front of and behind the DMS (washout and back-lit conditions).

8.3. CONSTRUCTION METHODS

A. Description

This article establishes practices and procedures and gives minimum standards and requirements for the installation of Dynamic Message Sign systems, auxiliary equipment and the construction of related structures.

Provide electrical equipment described in this specification that conforms to the standards of NEMA, UL, or Electronic Industries Association (EIA), wherever applicable. Provide connections between controllers and electric utilities that conform to NEC standards. Express wire sizes according to the American Wire Gauge (AWG).

Provide stainless steel screws, nuts, and locking washers in all external locations. Do not use self-tapping screws unless specifically approved by the Engineer. Use parts made of corrosion-resistant materials, such as plastic, stainless steel, brass, or aluminum. Use construction materials that resist fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.

B. Layout

The Engineer will establish the actual location of each Dynamic Message Sign assemblies. It is the Contractor's responsibility to ensure proper elevation, offset, and orientation of all DMS assemblies. The location of service poles as well as conduit lengths shown in the Plans, are approximate based on available project data. Make actual field measurements to place conduit and equipment at the required location.

C. Construction Submittal

When the work is complete, submit "as built" plans, inventory sheets, and any other data required by the Engineer to show the details of actual construction and installation and any modifications made during installation.

The "as built" plans will show: the DMS, controller, and service pole locations; DMS enclosure and controller cabinet wiring layouts; and wire and conduit routing. Show all underground conduits and cables dimensioned from fixed objects.

Include detailed drawings that identify the routing of all conductors in the system by cable type, color code, and function. Clearly label all equipment in the DMS system, controller cabinet, and DMS enclosure.

D. Conduit

Install the conduit system in accordance with section 1715 of Standard Specification and NEC requirements for an approved watertight raceway.

Make bends in the conduit so as not to damage it or change its internal diameter. Install watertight and continuous conduit with as few couplings as standard lengths permit.

Clean conduit before, during, and after installation. Install conduit in such a manner that temperature changes will not cause elongation or contraction that might damage the system.

Attach the conduit system to and install along the structural components of the DMS structure assemblies with beam clamps or stainless-steel strapping. Install strapping according to the strapping manufacturer's recommendations. Do not use welding or drilling to fasten conduit to structural components. Space the fasteners at no more than 4 feet for conduit 1.5 inches and larger or 6 feet for conduit smaller than 1.25 inches. Place fasteners no more than 3 feet from the center of bends, fittings, boxes, switches, and devices.

Flexible conduit will only be allowed when the conduits transition from the horizontal structure segment to the horizontal truss segment and from the horizontal truss segment to the rear entrance of the DMS when installing the DMS communications and feeder cables. The maximum length of flexible conduit allowed at each transition will be 5 feet.

Locate underground conduit as shown in the Plans in a manner consistent with these Project Special Provisions.

Do not exceed the appropriate fill ratio on all cable installed in conduit as specified in the NEC.

E. Wiring Methods

Do not pull permanent wire through a conduit system until the system is complete and has been cleaned.

Color-code all conductors per the NEC. Use approved marking tape, paint, sleeves or continuous colored conductors for No.8 AWG and larger. Do not mark a white conductor in the cable assemblies any other color.

Bury underground circuits at the depth shown in the Plans and surround it with at least 3 inches of sand or earth back-fill free of rocks and debris. Compact backfill in 6-inch layers. Do not splice underground circuits unless specifically noted in the Plans.

F. Equipment and Cabinet Mounting

Mount equipment securely at the locations shown in the Plans, in conformance with the dimensions shown. Install fasteners as recommended by the manufacturer and space them evenly. Use all mounting holes and attachment points for attaching DMS enclosures and controller cabinets to the structures.

Drill holes for expansion anchors of the size recommended by the manufacturer of the anchors and thoroughly clean them of all debris.

Provide one key-operated, pin tumbler, dead bolt padlock, with brass or bronze shackle and case, conforming to Military Specification MIL-P-17802E (Grade I, Class 2, Size 2, Style A) for each electrical panel and switch on the project. Key all padlocks alike, and provide 10 keys to the Engineer.

Provide cabinets with all mounting plates, anchor bolts, and any other necessary mounting hardware in accordance with these Project Special Provisions and the Plans.

Seal all unused conduit installed in cabinets at both ends to prevent water and dirt from entering the conduit and cabinet with approved sealing material.

Install a ground bushing attached inside the cabinet on all metal conduits entering the cabinet. Connect these ground bushings to the cabinet ground bus.

G. Work Site Clean-Up

Clean the site of all debris, excess excavation, waste packing material, wire, etc. Clean and clear the work site at the end of each workday. Do not throw waste material in storm drains or sewers.

8.4. MEASUREMENT AND PAYMENT

DMS will be measured and paid as the actual number of 98 X 108 front access DMS furnished, installed, and accepted. Each DMS consists of an LED Dynamic Message Sign, spare display modules communications equipment, strapping hardware, controller, UPS, controller cabinet, conduit, fittings, couplings, sweeps, conduit bodies, wire, flexible conduit, power conductors and communications cable between the controller cabinet and the DMS enclosure, connectors, circuit protection equipment, photo-electric sensors, tools, materials, all related testing, cost of labor, cost of transportation, incidentals, and all other equipment necessary to furnish and install the DMS system.

Payment will be made under:

Pay Item	Pay Unit
DMS.....	Each

9. NTCIP REQUIREMENTS

This section defines the detailed NTCIP requirements for the DMSs covered by these Project Special Provisions and Plans.

9.1. REFERENCES

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards.

Implement the most recent version of the standard including any and all Approved or Recommended Amendments to these standards for each NTCIP Component covered by these project specifications.

Table 1: NTCIP Standards

Abbreviated Number	Full Number	Title
NTCIP 1101	NTCIP 1101:1997	<i>Simple Transportation Management Framework</i>
NTCIP 1201	NTCIP 1201:1997	<i>Global Object Definitions</i>
NTCIP 1203	NTCIP 1203:1997	<i>Object Definitions for Dynamic Message Signs</i>
NTCIP 2001	NTCIP 2001:1997	<i>Class B Profile</i>
NTCIP 2101	NTCIP 2101	<i>SP-PMPP/232 Subnet Profile for PMPP over RS-232</i>
NTCIP 2102	NTCIP 2102	<i>SP-PMPP/FSK Subnet Profile for PMPP over FSK Modem</i>
NTCIP 2103	NTCIP 2103	<i>SP-PPP/232 Subnetwork Profile for PPP over RS232 (Dial Up)</i>
NTCIP 2104	NTCIP 2104	<i>SP-Ethernet Subnet Profile for Ethernet</i>
NTCIP 2201	NTCIP 2201	<i>TP-Null Transport Profile</i>
NTCIP 2202	NTCIP 2202	<i>TP-Internet Internet Transport Profile (TCP/IP and UDP/IP)</i>
NTCIP 2301	NTCIP 2301	<i>AP-STMF AP for Simple Transportation Management Framework</i>

A. General Requirements

1. Subnet Level

Ensure each serial port on each NTCIP Component supports NTCIP 2103 over a dial-up connection with a contractor provided external modem with data rates of 28.8 kbps, 19.2 kbps, 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. Enable the NTCIP Component to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT - Command Set
- MNP5
- MNP10
- V.42bis

Ensure each serial port on each NTCIP Component supports NTCIP 2103 over a null-modem connection with data rates of 19.2 kbps, 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps.

Ensure each serial port on each NTCIP Component supports NTCIP 2101 with data rates of 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps.

Ensure NTCIP components support NTCIP 2102 and NTCIP 2104.

NTCIP Components may support additional Subnet Profiles at the manufacturer's option. At any one time, make certain only one Subnet Profile is active on a given serial port of the NTCIP Component. Ensure the NTCIP Component can be configured to allow the field technician to activate the desired Subnet Profile and provide a visual indication of the currently selected Subnet Profile.

2. Transport Level

Ensure each NTCIP Component complies with NTCIP 2201 and 2202.

NTCIP Components may support additional Transport Profiles at the manufacturer's option. Ensure Response datagrams use the same Transport Profile used in the request. Ensure each NTCIP Component supports the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

3. Application Level

Ensure each NTCIP Component complies with NTCIP 1101 and 2301 and meets the requirements for Conformance Level 1 (NOTE - See Amendment to standard).

Ensure each NTCIP Component supports SNMP traps. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Ensure Responses use the same Application Profile used by the request. Ensure each NTCIP Component supports the receipt of Application data packets at any time allowed by the subject standards.

4. Information Level

Guarantee each NTCIP Component provides Full, Standardized Object Range Support of all objects required by these Special Provisions unless otherwise indicated below. Make certain the maximum Response Time for any object or group of objects is 200 milliseconds.

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Design the DMS to support all mandatory objects of all mandatory Conformance Groups as defined in NTCIP 1201 and NTCIP 1203. Table 2 indicates the modified object requirements for these mandatory objects.

Table 2: Modified Object Ranges for Mandatory Objects

Object	Reference	Project Requirement
ModuleTableEntry	NTCIP 1201 Clause 2.2.3	Contains at least one row with moduleType equal to 3 (software). The moduleMake specifies the name of the manufacturer, the moduleModel specifies the manufacturer's name of the component and the modelVersion indicates the model version number of the component.
MaxGroupAddresses	NTCIP 1201 Clause 2.7.1	At least 1
CommunityNamesMax	NTCIP 1201 Clause 2.8.2	At least 3
DmsNumPermanentMsg	NTCIP 1203 Clause 2.6.1.1.1.1	At least 1*
DmsMaxChangeableMsg	NTCIP 1203 Clause 2.6.1.1.1.3	At least 21
DmsFreeChangeableMemory	NTCIP 1203 Clause 2.6.1.1.1.4	At least 20 when no messages are stored.
DmsMessageMultiString	NTCIP 1203 Clause 2.6.1.1.1.8.3	The DMS supports any valid MULTI string containing any subset of those MULTI tags listed in Table 4
DmsControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Support at least the following modes: Local External central CentralOverride

* Ensure the Permanent Messages display the content shown in Table 3.

Ensure the sign blanks if a command to display a message contains an invalid Message CRC value for the desired message.

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Table 3: Content of Permanent Messages

Perm. Msg. Num.	<u>Description</u>
1	Permanent Message #1 blanks the display (i.e., consist of and empty MULTI string). It has a run-time priority of one (1).

Table 4: Required MULTI Tags

Code	Feature
f1	field 1 - time (12hr)
f2	field 2 - time (24hr)
f8	field 8 – day of month
f9	field 9 – month
f10	field 10 - 2 digit year
f11	field 11 - 4 digit year
fl (and /fl)	flashing text on a line by line basis with flash rates controllable in 0.5 second increments.
fo	Font
jl2	Justification – line – left
jl3	Justification – line – center
jl4	Justification – line – right
jl5	Justification – line – full
jp2	Justification – page – top
jp3	Justification – page – middle
jp4	Justification – page – bottom
Mv	moving text
Nl	new line
Np	new page, up to 2 instances in a message (i.e., up to 3 pages/frames in a message counting first page)
Pt	page times controllable in 0.5 second increments.

The NTCIP Component implements all mandatory and optional objects of the following optional conformance groups with FSORS.

5. Test Heading
a. Time Management

As defined in NTCIP 1201

b. Timebase Event Schedule

As defined in NTCIP 1201. The following list indicates the modified object requirements for this conformance group.

Table 5: Modified Object Ranges for the Timebase Event Schedule Conformance Group

Object	Reference	Project Requirement
MaxTimeBaseScheduleEntries	NTCIP 1201 Clause 2.4.3.1	At least 28
maxDayPlans	NTCIP 1201 Clause 2.4.4.1	At least 14
maxDayPlanEvents	NTCIP 1201 Clause 2.4.4.2	At least 10

c. Report

As defined in NTCIP 1201. The following list indicates the modified object requirements for this conformance group.

Table 6: Modified Object Ranges for the Report Conformance Group

Object	Reference	Project Requirement
maxEventLogConfigs	NTCIP 1201 Clause 2.5.1	At least 50
eventConfigurationMode	NTCIP 1201 Clause 2.4.3.1	The NTCIP Component supports the following Event Configuration Modes: onChange greaterThanValue smallerThanValue
MaxEventLogSize	NTCIP 1201 Clause 2.5.3	At least 200
MaxEventClasses	NTCIP 1201 Clause 2.5.5	At least 16

d. PMPP**e. Font Configuration**

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 7: Modified Object Ranges for the Font Configuration Conformance Group

Object	Reference	Project Requirement
NumFonts	NTCIP 1203 Clause 2.4.1.1.1.1	At least 4*
MaxFontCharacters	NTCIP 1203 Clause 2.4.1.1.1.3	At least 127**

*Upon delivery, the first font is a standard 18” font. The second font is a double-stroke 18” font. The third font is a 28” font. The fourth font is empty.

**Upon delivery, the first three font sets are configured in accordance with the ASCII character set for the following characters:

- “A” thru “Z”- All upper-case letters.
- “0” thru “9”- All decimal digits.
- Space (i.e., ASCII code 0x20).
- Punctuation marks shown in brackets [. , ! ? - ‘ ’ “ ” / ()]
- Special characters shown in brackets [# & * + < >]

f. DMS Configuration

As defined in NTCIP 1203.

g. MULTI Configuration

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 8: Modified Object Ranges for the MULTI Configuration Conformance Group

Object	Reference	Project Requirement
DefaultBackgroundColor	NTCIP 1203 Clause 2.5.1.1.1.1	The DMS supports the following background colors: black
DefaultForegroundColor	NTCIP 1203 Clause 2.5.1.1.1.2	The DMS supports the following foreground colors: amber
DefaultJustificationLine	NTCIP 1203 Clause 2.5.1.1.1.6	The DMS supports the following forms of line justification: left center right full
defaultJustificationPage	NTCIP 1203 Clause 2.5.1.1.1.7	The DMS supports the following forms of page justification: top middle bottom
defaultPageOnTime	NTCIP 1203 Clause 2.5.1.1.1.8	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
defaultPageOffTime	NTCIP 1203 Clause 2.5.1.1.1.9	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
defaultCharacterSet	NTCIP 1203 Clause 2.5.1.1.1.10	The DMS supports the following character sets: eightBit

- h. Default Message Control** as defined in NTCIP 1203
- i. Pixel Service Control** as defined in NTCIP 1203
- j. MULTI Error Control** as defined in NTCIP 1203
- k. Illumination/Brightness Control**

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 9: Modified Object Ranges for the Illumination/Brightness Control Conformance Group

Object	Reference	Project Requirement
dmsIllumControl	NTCIP 1203 Clause 2.8.1.1.1.1	The DMS supports the following illumination control modes: photocell timer manual
dmsIllumNumBrightLevels	NTCIP 1203 Clause 2.8.1.1.1.4	At least 16

- l. Auxiliary I/O**
- m. Scheduling**

As defined in NTCIP 1203. The following list indicates the modified object requirements for this conformance group.

Table 10: Modified Object Ranges for the Scheduling Conformance Group

Object	Reference	Project Requirement
NumActionTableEntries	NTCIP 1203 Clause 2.9.1.1.1.1	At least 21

- n. Sign Status** as defined in NTCIP 1203
- o. Status Error** as defined in NTCIP 1203
- p. Pixel Error Status** as defined in NTCIP 1203
- q. Fan Error Status** as defined in NTCIP 1203
- r. Power Status** as defined in NTCIP 1203
- s. Temperature Status** as defined in NTCIP 1203

Install necessary hardware for the support of items q, r, and s above.

Table 11: Some Optional Object Requirements

Object	Reference	Project Requirement
DefaultFlashOn	NTCIP 1203 Clause 2.5.1.1.1.3	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
DefaultFlashOff	NTCIP 1203 Clause 2.5.1.1.1.4	The DMS supports the full range of these objects with step sizes no larger than 0.5 seconds
DmsMultiOtherErrorDescription	NTCIP 1203 Clause 2.7.1.1.1.20	If the vendor implements any vendor-specific MULTI tags, the DMS shall provide meaningful error messages within this object whenever one of these tags generates an error.

6. Documentation

Supply software with full documentation, including a CD-ROM containing ASCII versions of the following MIB files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a manufacturer specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. Name this file identical to the standard MIB Module, except that it will have the extension ".man".
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

Allow the use of any and all of this documentation by any party authorized by the Department for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

B. NTCIP Acceptance Testing

Test the NTCIP requirements outlined above by a third-party testing firm. Submit to the Engineer for approval a portfolio of the selected firm. Include the name, address, and a history of the selected firm in performing NTCIP testing along with references. Also provide a contact person's name and phone number. Submit detailed NTCIP testing plans and procedures, including a

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list of hardware and software, to the Engineer for review and approval 10 days in advance of a scheduled testing date. Develop test documents based on the NTCIP requirements of these Project Special Provisions. The acceptance test will use the NTCIP Exerciser, and/or other authorized testing tools and will follow the guidelines established in the ENTERPRISE Test Procedures. Conduct the test in North Carolina on the installed system in the presence of the Engineer. Document and certify the results of the test by the firm conducting the test and submit the Engineer for review and approval. In case of failures, remedy the problem and have the firm retest in North Carolina. Continue process until all failures are resolved. The Department reserves the right to enhance these tests as deemed appropriate to ensure device compliance.

9.2. MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered by this section.

Payment for this work will be covered in the applicable sections of these Project Special Provisions at the contract unit price for "DMS" and will be full compensation for all work listed above.

10. DMS ASSEMBLIES

10.1. DESCRIPTION

This section includes all design, fabrication, furnishing, and erection of the DMS assemblies, and attachment of the DMS enclosures to the structures in accordance with the requirements of these Project Special Provisions and the Plans. Fabricate the supporting DMS assemblies from tubular steel. Furnish pedestal type DMS assemblies as shown in the Plans. Cantilevered and monotube (horizontal truss) DMS structures will not be allowed.

For the two (2) DMS mounted back to back, provide one pedestal structure with a minimum of 20 feet clearance from the high point of the road to the bottom of the DMS enclosure. DMS assemblies must allow for field adjustment with shims (horizontal & vertical tilting) +/- 3 degrees of the DMS enclosure to ensure optimum legibility from all travel lanes.

For DMS assemblies, design the new DMS assemblies (including footings) and submit shop drawings for approval. A Professional Engineer that is registered in the state of North Carolina will prepare such computations and drawings. These must bear his signature, seal, and date of acceptance.

For future CCTV camera location, install extension pole at the dual-sided DMS location shown in the plans.

The provisions of Section 900 of the Standard Specifications apply to all work covered by this section.

It is the Contractor's responsibility to provide DMS S-dimension elevation drawings for the DMS locations to the Engineer for approval.

10.2. MATERIALS

Use materials that meet the following requirements of the Standard Specifications:

Structural Steel	Section 1072
Overhead Sign Structures	Section 1096

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Signing Materials
 Organic-Zinc Repair Paint
 Reinforcing Steel
 Direct Tension Indicators

Section 1092
 Article 1080-9
 Sub-article 1070
 Sections 440 and 1072

10.3. CONSTRUCTION METHODS

A. General

Fabricate the new DMS assemblies in accordance with the details shown in the approved shop drawings and the requirements of these Project Special Provisions.

No welding, cutting, or drilling in any manner will be permitted in the field, unless approved by the Engineer.

Drill bolt holes and slots to finished size. Holes may also be punched to finished size, provided the diameter of the punched holes are at least twice the thickness of the metal being punched. Flame cutting of bolt holes and slots is not permitted.

Erect DMS in accordance with the requirements indicated on the Plans and in these Project Special Provisions. Field drill two holes per connection in the Z bars for attaching the DMS to the structure. Use two bolts at each connection. Provide two (2) U-bolts at each U-bolt connection such as 1) each truss chord to sign hanger, or 2) each truss chord to platform support. Provide two (2) U-bolts at each U-bolts connection where ends of truss chords are supported. Minimum diameter of all U-bolts is to be ½ inch.

Use two coats of a zinc-rich paint to touch up minor scars on all galvanized materials. See Standard Specifications for Roads and Structures Section 1076-6.

For high strength bolted connections, provide direct tension indicator washer.

B. Shop Drawing

Submit to the Engineer for approval a complete design for the DMS assemblies (including footings), DMS assembly hardware, and brackets for supporting the DMS. Base the design on the line drawings and correct wind speed in accordance with the latest edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 6th Edition, 2013" with the latest interim revisions.

The manufacturer of the DMS assembly must ensure that design of the assembly is compatible with the DMS for mounting and attachment.

Submit six copies of complete detailed shop drawings and one copy of the design computations for the DMS assembly to the Engineer for approval prior to fabrication. Show in the shop drawings complete design and fabrication details including foundations, provisions for attaching the DMS to supporting structures, applicable material specifications, and any other information necessary for procuring and replacing any part of the complete DMS assembly.

Allow a minimum of 40 working days for shop drawing approval after the Engineer receives them. If revised drawings are necessary, allow appropriate additional time for review and approval of final shop drawings.

Approval of shop drawings by the Engineer will not relieve the Contractor of his responsibility for the correctness of drawings, or for the fit of all shop and field connections and anchors.

C. Design and Fabrication

1. Dynamic Message Sign Assembly

- Design must be in accordance with the Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition, 2013, and the latest Interim Revisions.
- The wind pressure map that is developed from the 3-second gust speeds, as provided in Article 3.8, shall be used.
- The natural wind gust speed in North Carolina shall be assumed to be 5 meters per second or 11.6 mph for inland areas, and 7 meters per second or 15.7 mph for coastal areas. The coastal area shall be defined as any area within 2 miles from the waterfront facing the ocean or sound and all area where the design basic wind speed is above 120 mph, as shown in Figure 3-2.
- The fatigue importance category used in the design, for each type of structure, as provided for in Article 11.6, Fatigue Importance Factors, shall be Category II unless otherwise shown on the contract plans.
- Wind drag coefficient for Dynamic Message Sign enclosures shall be 1.7.

The following Specification interpretations or criteria shall be used in the design of overhead sign assemblies:

- For design of supporting upright posts or columns, the effective length factor for columns “K”, as provided for in Appendix B, Section B.5, shall be taken as the following, unless otherwise approved by the Engineer:
 - Case 1 For a single upright post of span type overhead sign structure, the effective column length factor, “K”, shall be taken as 2.0.
 - Case 2 For twin post truss-type upright post with the post connected to one chord of a horizontal truss, the effective column length factor for that column shall be taken as 2.0.
 - Case 3 For twin post truss-type upright post with the post connected to two truss chords of a horizontal tri-chord or box truss, the effective column length factor for that column shall be taken as 1.65.
- For twin post truss-type upright post, the unbraced length shall be from the chord to post connection to the top of base plate.
- For twin post truss-type upright post that is subject to axial compression, bending moment, shear, and torsion the post shall satisfy Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals Equations 5-17, 5-18 and 5-19. To reduce the effects of secondary bending, in lieu of Equation 5-18, the following equation may be used:

$$\frac{f_a}{F_a} + \frac{f_b}{\left(1 - \frac{0.6f_a}{F_e}\right)F_b} + \left(\frac{f_v}{F_v}\right)^2 \leq 1.0$$

Where

fa = Computed axial compression stress at base of post

- The base plate thickness for all uprights and poles shall be a minimum of 2" but not less than that determined by the following criteria and design.

Case 1 Circular or rectangular solid base plates with the upright pole welded to the top surface of base plate with full penetration butt weld, and where no stiffeners are provided. A base plate with a small center hole, which is less than 1/5 of the upright diameter, and located concentrically with the upright pole, may be considered as a solid base plate.

The magnitude of bending moment in the base plate, induced by the anchoring force of each anchor bolt shall be calculated using equation $M = (P \times D_1) / 2$.

Case 2 Circular or rectangular base plate with the upright pole socketed into and attached to the base plate with two lines of fillet weld, and where no stiffeners are provided, or any base plate with a center hole that is larger in diameter than 1/5 of the upright diameter.

The magnitude of bending moment induced by the anchoring force of each anchor bolt shall be calculated using equation $M = P \times D_2$.

- M, bending moment at the critical section of the base plate induced by one anchor bolt
- P, anchoring force of each anchor bolt
- D₁, horizontal distance between the center of the anchor bolt and the outer face of the upright, or the difference between the radius of the bolt circle and the outside radius of the upright
- D₂, horizontal distance between the face of the upright and the face of the anchor bolt nut

- The critical section shall be located at the face of the anchor bolt and perpendicular to the radius of the bolt circle. The overlapped part of two adjacent critical sections shall be considered ineffective.
- The thickness of base plate of Case 1 shall not be less than that calculated based on formula for Case 2.
- Uprights, foundations, and trusses shall be designed in accordance with the DMS Foundation Special Provision for the effects of torsion. Torsion shall be considered from dead load

eccentricity of these attachments, as well as for attachments such as walkway platforms, supporting brackets, etc., that add to the torsion in the assembly. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

- Uprights, foundations, and trusses shall be designed for the proposed sign wind area and future wind areas. The design shall consider the effect of torsion induced by the eccentric force location of the center of wind force above (or below) the center of the supporting truss. Truss vertical and horizontal truss diagonals in particular and any other assembly members shall be appropriately sized for these loads.

Fabricate the supporting structures using tubular members of either aluminum or steel, using only one type of material throughout the project.

Horizontal components of the supporting structures for overhead DMS must be of a truss design to support the DMS. Truss centerline must coincide with centerline of the DMS design area shown on the structure line drawing. Provide permanent camber in addition to dead load camber in accordance with the "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals." Indicate on the shop drawings the amount of camber provided and the method employed in the fabrication of the support to obtain the camber.

For all U-bolt connections of hanger beams to overhead assembly truss chords, provide all U-bolts with a flat washer, a lock washer and double nuts at each end of the U-bolts. All double nuts that are on any U-bolt shall be the same thickness and weight. When assembled, the double nuts shall be brought tight against each other by the use of two wrenches.

Fabricate attachment assemblies for the mounting DMS in a manner that allows easy removal of each sign independently.

2. CCTV Camera Extension Pole

At the locations shown in the plans, design the DMS assembly with provisions to allow for the attachment of a CCTV camera assembly. Design the CCTV camera extension pole to provide an attachment height of 45 feet above finished grade. Design the maximum deflection at the top of the CCTV supporting member for 30 mph, non-gusting wind with no more than 1 inch in any direction. The ultimate design load for the CCTV camera extension pole shall be AASHTO 2002 50 year wind speed for the area plus 50 lbs camera deadload. Design the CCTV camera extension pole as an integral part of the DMS assembly and submit the design along with the structural calculation for review and approval by the Engineer.

10.4. MEASUREMENT AND PAYMENT

DMS will be measured and paid as the actual number of dynamic message sign assemblies furnished, installed, and accepted. Payment includes all design, fabrication, construction, transportation, and attachment of the complete dynamic message sign assemblies for the independent attachment of two (2) signs, supporting structure, hardware, direct tension indicators, preparing and furnishing shop drawings, additional documentation, incidentals, and all other equipment and features necessary to furnish the system described above.

CCTV Camera Extension Pole will be measured and paid as the actual number of CCTV camera extension poles furnished, installed and accepted. Payment includes design, fabrication, and hardware as described above.

Payment will be made under:

Pay Item	Pay Unit
DMS Structure	Each
CCTV Camera Extension Pole	Each

11. SOIL TEST FOR DMS FOUNDATION

11.1. DESCRIPTION

Perform a soil test for each DMS foundation location according to the requirements described below.

It is assumed that all foundation designs will be drilled pier foundations unless site-specific soil test information does not allow for a drilled pier foundation design. If an alternative foundation design is required, notify the Engineer immediately. Prior approval from the Engineer is required to receive additional compensation for an alternate foundation design.

Design all custom foundations to carry the maximum capacity of each DMS structure.

When poor soil conditions are encountered, which could create an excessively large foundation design, consideration may be given to allowing an exemption to the maximum capacity design. The contractor must gain approval from the Engineer before reducing a foundation’s capacity. Where poor soil is known to be present, it is advisable that the contractor receive approval for foundation designs before releasing poles for fabrication.

11.2. SOIL TEST

A. General

Drilled piers are reinforced concrete sections, cast in place against in situ, undisturbed material. Drilled piers are of straight shaft type and vertical.

The contractor-selected pole fabricator is responsible for determining if the addition of wing walls is necessary for the supporting foundations.

B. Soil Test

Perform a soil test at each proposed DMS pedestal location. Complete all required fill placement and excavation at each pedestal location to finished grade before drilling each boring. Soil tests performed that are not in compliance with this requirement may be rejected and will not be paid. Drill one boring to a depth of 26 feet within a 25-foot radius of each proposed foundation.

Perform standard penetration tests (SPT) in accordance with ASTM D 1586 at depths of 1, 2.5, 5, 7.5, 10, 15, 20 and 26 feet. Discontinue the boring if one of the following occurs:

- A total of 100 blows have been applied in any 2 consecutive 6-in. intervals
- A total of 50 blows have been applied with < 3-in. penetration

Submit completed boring logs collected in accordance with these Project Special Provisions DMS load information to the contractor-selected pedestal fabricator to assist in the pedestal and foundation design.

Describe each DMS pedestal location along the project corridor in a manner that is easily discernible to both the contractor’s designer and NCDOT reviewers. If a DMS pedestal is at an intersection, label the boring the “Intersection of (*Route or SR #*), (*Street Name*) and (*Route or SR #*), (*Street Name*), _____ County. Label borings with “B- *N, S, E, W, NE, NW, SE or SW*” corresponding to the quadrant location within the intersection.

Pedestal numbers should be made available to the geotechnical drilling Contractor. Include pedestal numbers in the boring label if they are available. If they are not available, ensure the boring labels can be cross-referenced to corresponding pedestal numbers or pedestal locations.

For each boring, submit a legible (handwritten or typed) boring log signed and sealed by a licensed Geologist or Professional Engineer registered in North Carolina. Include on each boring the SPT blow counts and N-values at each depth, depth of the boring, and a general description of the soil types encountered.

Borings that can’t be easily related to their specific pedestal location will be returned to the contractor for clarification, or if approved by the Engineer, the foundation may be designed using the worst-case soil condition obtained as part of this project.

11.3. MEASUREMENT AND PAYMENT

Soil test for DMS foundation will be measured and paid as the actual number of Soil Tests with SPT borings drilled, furnished and accepted.

Payment will be made under:

Pay Item	Pay Unit
Soil Test for DMS Foundation.....	Each

12. FOUNDATIONS AND ANCHOR ROD ASSEMBLIES FOR METAL POLES

12.1. DESCRIPTION

Foundations for metal poles include foundations for signals, cameras, overhead and dynamic message signs (DMS) and high mount and light standards supported by metal poles or upright trusses. Foundations consist of footings with pedestals and drilled piers with or without grade beams or wings. Anchor rod assemblies consist of anchor rods (also called anchor bolts) with nuts and washers on the exposed ends of rods and nuts and a plate or washers on the other ends of rods embedded in the foundation.

Construct concrete foundations with the required resistances and dimensions and install anchor rod assemblies in accordance with the contract and accepted submittals. Construct drilled piers consisting of cast-in-place reinforced concrete cylindrical sections in excavated holes. Provide temporary casings or polymer slurry as needed to stabilize drilled pier excavations. Use a prequalified Drilled Pier Contractor to construct drilled piers for metal poles. Define “excavation” and “hole” as a drilled pier excavation and “pier” as a drilled pier.

This provision does not apply to foundations for signal pedestals; see Section 1743 of the *2018 Standard Specifications* and Standard Drawing No. 1743.01 of the *2018 Roadway Standard Drawings*.

12.2. MATERIALS

Refer to the *2018 Standard Specifications*.

Item	Section
Conduit	1091-3
Grout, Type 2	1003
Polymer Slurry	411-2(B)
Portland Cement Concrete	1000
Reinforcing Steel	1070
Rollers and Chairs	411-2(C)
Temporary Casings	411-2(A)

Provide Type 3 material certifications in accordance with Article 106-3 of the *2018 Standard Specifications* for conduit, rollers, chairs and anchor rod assemblies. Store steel materials on blocking at least 12" above the ground and protect it at all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials. Load, transport, unload and store foundation and anchor rod assembly materials so materials are kept clean and free of damage. Damaged or deformed materials will be rejected.

Use conduit type in accordance with the contract. Use Class A concrete for footings and pedestals, Class Drilled Pier concrete for drilled piers and Class AA concrete for grade beams and wings including portions of drilled piers above bottom of wings elevations. Corrugated temporary casings may be accepted at the discretion of the Engineer. A list of approved polymer slurry products is available from:

connect.ncdot.gov/resources/Geological/Pages/Products.aspx

Provide anchor rod assemblies in accordance with the contract consisting of the following:

- A. Straight anchor rods,
- B. Heavy hex top and leveling nuts and flat washers on exposed ends of rods, and
- C. Nuts and either flat plates or washers on the other ends of anchor rods embedded in foundations.

Do not use lock washers. Use steel anchor rods, nuts and washers that meet ASTM F1554 for Grade 55 rods and Grade A nuts. Use steel plates and washers embedded in concrete with a nominal thickness of at least 1/4". Galvanize anchor rods and exposed nuts and washers in accordance with Article 1076-4 of the *2018 Standard Specifications*. It is not necessary to galvanize nuts, plates and washers embedded in concrete.

12.3. CONSTRUCTION METHODS

Install the required size and number of conduits in foundations in accordance with the plans and accepted submittals. Construct top of piers, footings, pedestals, grade beams and wings flat, level

and within 1" of elevations shown in the plans or approved by the Engineer. Provide an Ordinary Surface finish in accordance with Subarticle 825-6(B) of the *2018 Standard Specifications* for portions of foundations exposed above finished grade. Do not remove anchor bolt templates or pedestal or grade beam forms or erect metal poles or upright trusses onto foundations until concrete attains a compressive strength of at least 3,000 psi.

A. Drilled Piers

Before starting drilled pier construction, hold a predrill meeting to discuss the installation, monitoring and inspection of the drilled piers. Schedule this meeting after the Drilled Pier Contractor has mobilized to the site. The Resident or Division Traffic Engineer, Contractor and Drilled Pier Contractor Superintendent will attend this predrill meeting.

Do not excavate holes, install piles or allow equipment wheel loads or vibrations within 20 ft of completed piers until 16 hours after Drilled Pier concrete reaches initial set.

Check for correct drilled pier alignment and location before beginning drilling. Check plumbness of holes frequently during drilling.

Construct drilled piers with the minimum required diameters shown in the plans. Install piers with tip elevations no higher than shown in the plans or approved by the Engineer.

Excavate holes with equipment of the sizes required to construct drilled piers. Depending on the subsurface conditions encountered, drilling through rock and boulders may be required. Do not use blasting for drilled pier excavations.

Contain and dispose of drilling spoils and waste concrete as directed and in accordance with Section 802 of the *2018 Standard Specifications*. Drilling spoils consist of all materials and fluids removed from excavations.

If unstable, caving or sloughing materials are anticipated or encountered, stabilize holes with temporary casings and/or polymer slurry. Do not use telescoping temporary casings. If it becomes necessary to replace a temporary casing during drilling, backfill the excavation, insert a larger casing around the casing to be replaced or stabilize the excavation with polymer slurry before removing the temporary casing.

If temporary casings become stuck or the Contractor proposes leaving casings in place, temporary casings should be installed against undisturbed material. Unless otherwise approved, do not leave temporary casings in place for mast arm poles and cantilever signs. The Engineer will determine if casings may remain in place. If the Contractor proposes leaving temporary casings in place, do not begin drilling until a casing installation method is approved.

Use polymer slurry and additives to stabilize holes in accordance with the slurry manufacturer's recommendations. Provide mixing water and equipment suitable for polymer slurry. Maintain the required polymer slurry at all times except for sand content.

Define a "sample set" as slurry samples collected from mid-height and within 2 ft of the bottom of holes. Take sample sets from excavations to test polymer slurry immediately after filling holes with slurry, at least every 4 hours thereafter and immediately before placing concrete. Do not place Drilled Pier concrete until both slurry samples from an excavation meet the required polymer slurry properties. If any slurry test results do not meet the requirements, the Engineer may suspend drilling until both samples from a sample set meet the required slurry properties.

Remove soft and loose material from bottom of holes using augers to the satisfaction of the Engineer. Assemble rebar cages and place cages and Drilled Pier concrete in accordance with Subarticle 411-4(E) of the 2018 *Standard Specifications* except for the following:

- 1) Inspections for tip resistance and bottom cleanliness are not required,
- 2) Temporary casings may remain in place if approved, and
- 3) Concrete placement may be paused near the top of pier elevations for anchor rod assembly installation and conduit placement or
- 4) If applicable, concrete placement may be stopped at bottom of grade beam or wings elevations for grade beam or wing construction.

If wet placement of concrete is anticipated or encountered, do not place Drilled Pier concrete until a concrete placement procedure is approved. If applicable, temporary casings and fluids may be removed when concrete placement is paused or stopped in accordance with the exceptions above provided holes are stable. Remove contaminated concrete from exposed Drilled Pier concrete after removing casings and fluids. If holes are unstable, do not remove temporary casings until a procedure for placing anchor rod assemblies and conduit or constructing grade beams or wings is approved.

Use collars to extend drilled piers above finished grade. Remove collars after Drilled Pier concrete sets and round top edges of piers.

If drilled piers are questionable, pile integrity testing (PIT) and further investigation may be required in accordance with Article 411-5 of the 2018 *Standard Specifications*. A drilled pier will be considered defective in accordance with Subarticle 411-5(D) of the 2018 *Standard Specifications* and drilled pier acceptance is based in part on the criteria in Article 411-6 of the 2018 *Standard Specifications* except for the top of pier tolerances in Subarticle 411-6(C) of the 2018 *Standard Specifications*.

If a drilled pier is under further investigation, do not grout core holes, backfill around the pier or perform any work on the drilled pier until the Engineer accepts the pier. If the drilled pier is accepted, dewater and grout core holes and backfill around the pier with approved material to finished grade. If the Engineer determines a pier is unacceptable, remediation is required in accordance with Article 411-6 of the 2018 *Standard Specifications*. No extension of completion date or time will be allowed for remediation of unacceptable drilled piers or post repair testing.

Permanently embed a plate in or mark top of piers with the pier diameter and depth, size and number of vertical reinforcing bars and the minimum compressive strength of the concrete mix at 28 days.

B. Footings, Pedestals, Grade Beams and Wings

Excavate as necessary for footings, grade beams and wings in accordance with the plans, accepted submittals and Section 410 of the 2018 *Standard Specifications*. If unstable, caving or sloughing materials are anticipated or encountered, shore foundation excavations as needed with an approved method. Notify the Engineer when foundation excavation is complete. Do not place concrete or reinforcing steel until excavation dimensions and foundation material are approved.

Construct cast-in-place reinforced concrete footings, pedestals, grade beams and wings with the dimensions shown in the plans and in accordance with Section 825 of the 2018 *Standard Specifications*. Use forms to construct portions of pedestals and grade beams protruding above

finished grade. Provide a chamfer with a 3/4" horizontal width for pedestal and grade beam edges exposed above finished grade. Backfill and fill in accordance with Article 410-8 of the *2018 Standard Specifications*. Proper compaction around footings and wings is critical for foundations to resist uplift and torsion forces.

C. Anchor Rod Assemblies

Size anchor rods for design and the required projection above top of foundations. Determine required anchor rod projections from nut, washer and base plate thicknesses, the protrusion of 3 to 5 anchor rod threads above top nuts after tightening and the distance of one nut thickness between top of foundations and bottom of leveling nuts.

Protect anchor rod threads from damage during storage and installation of anchor rod assemblies. Before placing anchor rods in foundations, turn nuts onto and off rods past leveling nut locations. Turn nuts with the effort of one workman using an ordinary wrench without a cheater bar. Report any thread damage to the Engineer that requires extra effort to turn nuts.

Arrange anchor rods symmetrically about center of base plate locations as shown in the plans. Set anchor rod elevations based on required projections above top of foundations. Securely brace and hold rods in the correct position, orientation and alignment with a steel template. Do not weld to reinforcing steel, temporary casings or anchor rods.

Install top and leveling (bottom) nuts, washers and the base plate for each anchor rod assembly in accordance with the following procedure:

- 1) Turn leveling nuts onto anchor rods to a distance of one nut thickness between the top of foundation and bottom of leveling nuts. Place washers over anchor rods on top of leveling nuts.
- 2) Determine if nuts are level using a flat rigid template on top of washers. If necessary, lower leveling nuts to level the template in all directions or if applicable, lower nuts to tilt the template so the metal pole or upright truss will lean as shown in the plans. If leveling nuts and washers are not in full contact with the template, replace washers with galvanized beveled washers.
- 3) Verify the distance between the foundation and leveling nuts is no more than one nut thickness.
- 4) Place base plate with metal pole or upright truss over anchor rods on top of washers. High mount luminaires may be attached before erecting metal poles but do not attach cables, mast arms or trusses to metal poles or upright trusses at this time.
- 5) Place washers over anchor rods on top of base plate. Lubricate top nut bearing surfaces and exposed anchor rod threads above washers with beeswax, paraffin or other approved lubricant.
- 6) Turn top nuts onto anchor rods. If nuts are not in full contact with washers or washers are not in full contact with the base plate, replace washers with galvanized beveled washers.
- 7) Tighten top nuts to snug-tight with the full effort of one workman using a 12" wrench. Do not tighten any nut all at once. Turn top nuts in increments. Follow a star pattern cycling through each nut at least twice.

- 8) Repeat (7) for leveling nuts.
- 9) Replace washers above and below the base plate with galvanized beveled washers if the slope of any base plate face exceeds 1:20 (5%), any washer is not in firm contact with the base plate or any nut is not in firm contact with a washer. If any washers are replaced, repeat (7) and (8).
- 10) With top and leveling nuts snug-tight, mark each top nut on a corner at the intersection of 2 flats and a corresponding reference mark on the base plate. Mark top nuts and base plate with ink or paint that is not water-soluble. Use the turn-of-nut method for pretensioning. Do not pretension any nut all at once. Turn top nuts in increments for a total turn that meets the following nut rotation requirements:

NUT ROTATION REQUIREMENTS (Turn-of-Nut Pretensioning Method)	
Anchor Rod Diameter, inch	Requirement
$\leq 1 \frac{1}{2}$	1/3 turn (2 flats)
$> 1 \frac{1}{2}$	1/6 turn (1 flat)

Follow a star pattern cycling through each top nut at least twice.

- 11) Ensure nuts, washers and base plate are in firm contact with each other for each anchor rod. Cables, mast arms and trusses may now be attached to metal poles and upright trusses.
- 12) Between 4 and 14 days after pretensioning top nuts, use a torque wrench calibrated within the last 12 months to check nuts in the presence of the Engineer. Completely erect mast arm poles and cantilever signs and attach any hardware before checking top nuts for these structures. Check that top nuts meet the following torque requirements:

TORQUE REQUIREMENTS	
Anchor Rod Diameter, inch	Requirement, ft-lb
7/8	180
1	270
1 1/8	380
1 1/4	420
$\geq 1 \frac{1}{2}$	600

If necessary, retighten top nuts in the presence of the Engineer with a calibrated torque wrench to within ± 10 ft-lb of the required torque. Do not overtighten top nuts.

- 13) Do not grout under base plate.

12.4. MEASUREMENT AND PAYMENT

Foundations and anchor rod assemblies for metal poles and upright trusses will be measured and paid for elsewhere in the contract.

No payment will be made for temporary casings that remain in drilled pier excavations. No payment will be made for PIT. No payment will be made for further investigation of defective piers. Further investigation of piers that are not defective will be paid as extra work in accordance with Article 104-7 of the *2018 Standard Specifications*. No payment will be made for remediation of unacceptable drilled piers or post repair testing.

13. OVERHEAD AND DYNAMIC MESSAGE SIGN FOUNDATIONS

13.1. DESCRIPTION

Sign foundations include foundations for overhead and dynamic message signs (DMS) supported by metal poles or upright trusses. Sign foundations consist of footings with pedestals or drilled piers with or without grade beams or wings, conduit and anchor rod assemblies. Construct sign foundations in accordance with the contract and accepted submittals. Define “cantilever sign” as an overhead cantilever sign support in accordance with Figure 1-1 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

13.2. MATERIALS

Use sign foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

A. Assumed Subsurface Conditions

Assume the following soil parameters and groundwater elevation for sign foundations unless these subsurface conditions are not applicable to sign locations:

- A. Unit weight (γ) = 120 lb/cf,
- B. Friction angle (ϕ) = 30°,
- C. Cohesion (c) = 0 lb/sf, and
- D. Groundwater 7 ft below finished grade.

A subsurface investigation is required if the Engineer determines these assumed subsurface conditions do not apply to a sign location and the sign cannot be moved. Subsurface conditions requiring a subsurface investigation include but are not limited to weathered or hard rock, boulders, very soft or loose soil, muck or shallow groundwater. No extension of completion date or time will be allowed for subsurface investigations.

B. Subsurface Investigations

Use a prequalified geotechnical consultant to perform one standard penetration test (SPT) boring in accordance with ASTM D1586 at each sign location requiring a subsurface investigation. Rough grade sign locations to within 2 ft of finished grade before beginning drilling. Drill borings to 2 drilled pier diameters below anticipated pier tip elevations or refusal, whichever is higher.

Use the computer software gINT version 8.0 or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide boring logs sealed by a geologist or engineer licensed in the state of North Carolina.

C. Sign Foundation Designs

Design sign foundations for the wind zone and clearances shown in the plans and the slope of finished grade at each sign location. Use the assumed soil parameters and groundwater elevation

above for sign foundation designs unless a subsurface investigation is required. For sign locations requiring a subsurface investigation, design sign foundations for the subsurface conditions at each sign location. Design footings, pedestals, drilled piers, grade beams and wings in accordance with the 6th Edition of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. In some instances, conflicts with drainage structures may dictate sign foundation types.

Design footings in accordance with Section 4.4 of the *AASHTO Standard Specifications for Highway Bridges*. Do not use an allowable bearing pressure of more than 3,000 lb/sf for footings.

Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges* except reduce ultimate side resistance by 25% for uplift. Use the computer software LPILE version 5.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Provide drilled pier designs with a horizontal deflection of less than 1" at top of piers. For cantilever signs with single drilled pier foundations supporting metal poles, use wings to resist torsion forces. Provide drilled pier designs with a factor of safety of at least 2.0 for torsion.

For drilled pier sign foundations supporting upright trusses, use dual drilled piers connected with a grade beam having a moment of inertia approximately equal to that of either pier. The Broms' method is acceptable to analyze drilled piers with grade beams instead of LPILE. Use a safety factor of at least 3.5 for the Broms' design method in accordance with C13.6.1.1 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Submit boring logs, if any, working drawings and design calculations for acceptance in accordance with Article 105-2 of the *2018 Standard Specifications*. Submit working drawings showing plan views, required foundation dimensions and elevations and typical sections with reinforcement, conduit and anchor rod assembly details. Include all boring logs, design calculations and LPILE output for sign foundation design submittals. Have sign foundations designed, detailed and sealed by an engineer licensed in the state of North Carolina.

13.3. CONSTRUCTION METHODS

Construct footings, pedestals, drilled piers, grade beams and wings and install anchor rod assemblies for sign foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

13.4. MEASUREMENT AND PAYMENT

Overhead Footings will be measured and paid in cubic yards. Sign foundations will be measured as the cubic yards of foundation concrete for footings, pedestals, drilled piers, grade beams and wings shown on the accepted submittals. The contract unit price for *Overhead Footings* will be full compensation for providing labor, tools, equipment and foundation materials, stabilizing or shoring excavations and supplying concrete, reinforcing steel, conduit, anchor rod assemblies and any incidentals necessary to construct sign foundations. Subsurface investigations required by the Engineer will be paid as extra work in accordance with Article 104-7 of the *2018 Standard Specifications*.

Payment will be made under:

Pay Item	Pay Unit
Overhead Footings	Cubic Yards

14. REMOVAL AND DISPOSAL OF EXISTING DMS COMPONENTS

14.1. DESCRIPTION

Remove and dispose of one (1) existing DMS and one (1) existing DMS structure shown in the Plan.

Perform the work required by this section in accordance with Section 907 of the Standard Specifications.

Contractor to provide the Engineer a two week notice before anticipated removal of the sign to allow Division Traffic personnel adequate time to salvage all usable parts from the sign enclosure and the equipment cabinet.

14.2. REMOVAL AND DISPOSAL OF EXISTING DMS

Remove and dispose of the one existing DMS. Remove and dispose of all other DMS power and communication cables.

Comply with Section 907-2(C) of the Standard Specifications.

14.3. REMOVE AND DISPOSAL OF DMS STRUCTURE AND FOUNDATIONS

Remove and dispose of the existing full-span overhead structure as shown in the Plans. Remove and dispose of all conduits attached to structures. Ensure conduits are removed to 24-inches below finished grade. Comply with Section 907-2(C) of the Standard Specifications. Remove and dispose of the existing foundations.

14.4. REMOVE AND DISPOSAL OF EXISTING ELECTRICAL SERVICE

Remove and dispose of existing electrical service as shown in the Plans. Coordinate with the utility company to de-energize the service and remove the meter. Remove and dispose of the existing meter base, service disconnect equipment, feeder conductors and conduits. Comply with Section 907-2(C) of the Standard Specification.

14.5. MEASUREMENT AND PAYMENT

Disposal of Existing DMS will be measured and paid as the actual number of DMSs and cabinets remove and disposed according with Section 14.2 above.

Disposal of Existing DMS Structure and Foundations will be measured and paid as the actual number of DMS structures and foundations removed and disposed according with Section 14.3 above.

Disposal of Existing Electrical Service will be measured and paid as the actual number of electrical services removed and disposed according with Section 14.4 above.

Payment will be made under:

Pay Item	Pay Unit
Disposal of Existing DMS	Each
Disposal of Existing DMS Structure and Foundations	Each
Disposal of Existing Electrical Service.....	Each

15. DIGITAL CCTV FIELD EQUIPMENT

15.1. DESCRIPTION

Furnish and install High Definition (1080p) CCTV field equipment described in these Project Special Provisions. Furnish equipment that is compatible, interoperable, and completely interchangeable with existing equipment currently in use by the Division. Ensure that the equipment is fully compatible with all features of the existing video management software currently in use by the Division.

This unit also includes all associated hardware, including stainless steel banding with screw clamps for attaching the pole adapter bracket to the pole and a 1.5-inch NTP external thread pipe adapter for attaching the dome camera to the camera mounting arm.

Straight, liquid tight, aluminum, strain relief cable connectors shall be provided to seal the cable opening in the camera mounting arm and pole. The connectors shall have a ¾" N.P.T. hub and shall accommodate a cord diameter of 0.125" to 0.25".

Also provided are aluminum or stainless steel washers and locknuts to secure the connectors and seal the openings. This unit covers drilling a hole in the aluminum pole to accommodate the cable connector. The hole will be drilled 2' from the top of the pole in line with the camera mounting position. An access hole will be provided in the pole for securing the connector with a locknut.

The patch cable between a new or existing switch and the PoE midspan, will be a 3' long shielded, outdoor-rated CAT5e cable pre-terminated with male RJ45 gold-plated connectors with snagless boots, eight (8) 24 AWG conductors and tested to a minimum of 350 MHz.

15.2. MATERIAL

A. General

Furnish and install a new CCTV camera assembly at the location shown on the Plans. This assembly consists of the following:

1. Dome CCTV camera that contains in a single enclosed unit the following:

CCTV color digital signal processing camera unit with zoom lens, filter, control circuit, and accessories

2. Motorized pan, tilt, and zoom

All necessary cable, connectors, and incidental hardware to make a complete and operable system

Built-in video encoder capable of H.264/MPEG-4 compression for video-over-IP transmission.

Lightning arrestors installed in-line between the CCTV camera and the equipment cabinet components.

A NEMA Type 4 enclosure constructed of aluminum with a clear acrylic dome or approved equal Camera Unit housing.

B. Camera and Lens

Cameras

Furnish new Complementary Metal-Oxide-Semiconductor (CMOS) sensor-equipped color cameras. Furnish cameras that meet the following minimum requirements:

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Video format:	NTSC compatible resolution, user selectable up to a maximum of 1920x1080 (1080p),
Focus:	Automatic with manual override, Electronic Image Stabilization (EIS),
White balance:	Automatic through the lens with manual override,
Shutter:	Electronic shutter with manual control from 1/2 of a second to 1/30,000th of a second,
Overexposure protection:	The camera must have built-in circuitry or a protection device to prevent any damage to the camera when pointed at strong light sources, including the sun,
Sensitivity:	0.6 lux at 90% scene reflectance
Input/Output Connection:	Single 10BASE-T/100BASE-T compatible outdoor-rated Cat5e cable for video, control, and Power over Ethernet; IP66-rated RJ45 connector,
Power:	High Power over Ethernet (High PoE), 74W max

Zoom Lens

Furnish each camera with a motorized zoom lens that is integrated in a high-performance dome system, or approved equivalent, with automatic iris control and manual override. Furnish lenses that meet the following optical specifications:

Aperture	f/1.6 – f/2.9,
Focal length:.....	4.45 mm (wide) and 89 mm (tele.), minimum,
Horizontal viewing angle:.....	55.4° (wide) and 2.9° (tele), minimum,
Zoom	30X optical, 12X digital, minimum
Preset positioning:.....	64 Presets, minimum.

The lens must be capable of both automatic and remote manual control iris and focus override operation. The lens must be equipped for remote control of zoom and focus, including automatic movement to any of the preset zoom and focus positions. Mechanical or electrical means must be provided to protect the motors from overrunning in extreme positions. The operating voltages of the lens must be compatible with the outputs of the camera control.

- Edge Storage: SD/SDHC/SDXC slot supporting up to 64GB memory card

F. Ethernet Cable

Provide, at a minimum, Category 5 Enhanced (5e) Ethernet cable that complies with ANSI/TIA-568-B-5 standards for four-pair shielded twisted copper for Ethernet communications. The cable shall meet all of the mechanical requirements of ANSI/ECEA S-80-576. The Ethernet cable must be rated for medium-power, network-powered broadband communications circuits and must be Type BMU network-powered broadband communications medium-power cable.

Provide 4-pair twisted copper Ethernet cable and connectors rated for an ambient operating temperature range of -30° F to 165° F. The cable shall be shielded, outdoor-rated, and have a UV-resistant jacket. The void between the insulated copper pairs and the polyethylene outer jacket shall be injected with a water-resistant flooding compound.

G. Control Receiver/Driver

Provide each new camera unit with a control receiver/driver that is integral to the CCTV dome assembly. The control receiver/driver will receive serial asynchronous data initiated from a camera control unit, decode the command data, perform error checking, and drive the pan/tilt unit, camera controls, and motorized lens. As a minimum, the control receiver/drivers must provide the following functions:

- Zoom in/out
- Automatic focus with manual override
- Tilt up/down
- Automatic iris with manual override
- Pan right/left
- Minimum 64 preset positions for pan, tilt, and zoom

In addition, each control receiver/driver must accept status information from the pan/tilt unit and motorized lens for preset positioning of those components. The control receiver/driver will relay pan, tilt, zoom, and focus positions from the field to the remote camera control unit. The control receiver/driver must accept “goto” preset commands from the camera control unit, decode the command data, perform error checking, and drive the pan/tilt and motorized zoom lens to the correct preset position. The preset commands from the camera control unit will consist of unique values for the desired pan, tilt, zoom, and focus positions.

H. CCTV Camera Attachment to Pole

At locations shown in the Signal Communication Plans where new CCTV cameras are to be installed on new metal CCTV poles, and proposed DMS support structure for DMS-03 and DMS-04, furnish an attachment assembly for each CCTV camera unit. Submit shop drawings for review and approval by the Engineer prior to installation.

Furnish CCTV attachments that allow for the removal and replacement of the CCTV enclosure as well as providing a weatherproof, weather tight, seal that does not allow moisture to enter the enclosure.

Furnish a CCTV Camera Attachment Assembly that is able to withstand wind loading at the maximum wind speed and gust factor called for in these Special Provisions and can support a minimum camera unit dead load of 45 pounds (20.4 kg).

I. Surge Suppression

Protect all equipment at the top of the pole with grounded metal oxide varistors connecting each power conductor to ground.

15.3. CONSTRUCTION METHOD

A. General

Mount the digital CCTV camera unit at 35 feet above ground level on the new CCTV metal poles (40'). For CCTV camera to be mounted on the DMS extension pole attached to proposed DMS support structure for DMS-03 and DMS-04, provide an attachment height of 45 feet above finished grade (Reference: *DMS Assemblies* section of these Project Special Provisions).

Mount the CCTV camera unit such that a minimum 5 feet of clearance is maintained between the camera and the top of the pole.

Mount CCTV camera on the side of pole nearest intended field of view. Avoid occluding the view with the pole.

B. Electrical and Mechanical Requirements

Install Power over Ethernet (PoE) injector in new signal cabinet, and run an outdoor-rated Cat5e Ethernet cable through the existing conduit and up the pole to the CCTV assembly as shown in the Signal Communications Plans. Take all precautions necessary to ensure the Ethernet cable is not damaged during storage and installation. Do not step on the cable nor run over the cable with vehicles or equipment. Do not pull the cable over or around obstructions or along the ground. Install the cables according to the latest version of the manufacturer's cable installation procedures and the industry-accepted installation standards, codes, and practices, or as directed by the Engineer.

Ground all equipment as called for in the Standard Specifications, these Special Provisions, and the Plans.

Install surge protectors on all ungrounded conductors entering the CCTV enclosure. House the protectors in a small, ventilated weatherproof cabinet attached near the CCTV attachment point in a manner approved by the Engineer.

Furnish all tools, equipment, materials, supplies, and hardware necessary to install a fully operational CCTV camera system as depicted in the plans.

15.4. MEASUREMENT AND PAYMENT

Digital CCTV Camera Assembly will be measured and paid as the actual number of Digital CCTV Camera Assemblies furnished, installed, integrated, and accepted. No separate measurement will be made for necessary cabling, PoE cable, connectors, CCTV camera attachment assemblies, conduit, condulets, grounding equipment, surge protectors, CCTV control software, or any other equipment or labor required to install the CCTV assembly.

Payment will be made under:

Pay Item	Pay Unit
Digital CCTV Camera Assembly	Each

16. FIELD EQUIPMENT CABINET

16.1. DESCRIPTION

Furnish 336 pole mounted cabinets to house the CCTV (Analog and/or Digital) control and communications equipment. The cabinets must consist of a cabinet housing, 19-inch EIA mounting cage, and power distribution assembly (PDA #3 as described in the CALTRANS TSCES).

The cabinet housing must conform to sections 6.2.2 (Housing Construction), 6.2.3 (Door Latches and Locks), 6.2.4 (Housing Ventilation), and 6.2.5 (Hinges and Door Catches) of the CALTRANS TSCES. Do not equip the cabinet housings with a police panel.

The cabinet cage must conform to section 6.3 of the CALTRANS TSCES.

Terminal blocks on the PDA #3 Assembly have internal wiring for the Model 200 switch pack sockets. Do not use terminal blocks on PDA #3 as power terminals for cabinet devices. Do not furnish cabinet with "Input Panels" described in section 6.4.7.1 of the TSCES. Do furnish cabinet with "Service Panels" as described in section 6.4.7.1 of the TSCES and as depicted on drawing TSCES-9 in the TSCES. Use service panel #2.

Furnish terminal blocks for power for cabinet CCTV and communications devices as needed to accommodate the number of devices in the cabinet.

Do not furnish cabinets with C1, C5, or C6 harness, input file, output file, monitor units, model 208 unit, model 430 unit, or switch packs.

Furnish all conduits, shelving, mounting adapters, and other equipment as necessary to route cabling, mount equipment, and terminate conduit in equipment cabinet.

16.2. MATERIAL

A. Shelf Drawer

Provide a pull out, hinged-top drawer, having sliding tracks, with lockout and quick disconnect feature in the equipment cabinet. Furnish a pullout drawer that extends a minimum of 14 inches that is capable of being lifted to gain access to the interior of the drawer. Minimum interior dimensions of the drawer are to be 1 inch high, 13 inches deep, and 16 inches wide. Provide drawers capable of supporting a 40-pound device or component when fully extended.

B. Cabinet Light

Each cabinet must include two (2) fluorescent lighting fixtures (one front, one back) mounted horizontally inside the top portion of the cabinet. The fixtures must include a cool white lamp, and must be operated by normal power factor UL-listed ballast. A door-actuated switch must be installed to turn on the applicable cabinet light when the front door or back door is opened. The lights must be mounted not to interfere with the upper door stay.

C. Surge Protection for System Equipment

Each cabinet must be provided with devices to protect the CCTV and communications equipment from electrical surges and over voltages as described below.

1. Main AC Power Input

Each cabinet must be provided with a hybrid-type, power line surge protection device mounted inside the power distribution assembly. The protector must be installed between the applied line voltage and earth ground. The surge protector must be capable of reducing the effect of lightning transient voltages applied to the AC line. The protector must be mounted inside the Power Distribution Assembly housing facing the rear of the cabinet. The protector must include the following features and functions:

- Maximum AC line voltage: 140 VAC.
- Twenty pulses of peak current, each of which must rise in 8 microseconds and fall in 20 microseconds to ½ the peak: 20000 Amperes.
- The protector must be provided with the following terminals:
 - Main Line (AC Line first stage terminal).
 - Main Neutral (AC Neutral input terminal).
 - Equipment Line Out (AC line second state output terminal, 19 amps).
 - Equipment Neutral Out (Neutral terminal to protected equipment).
 - GND (Earth connection).
- The Main AC line in and the Equipment Line out terminals must be separated by a 200 Microhenry (minimum) inductor rated to handle 10 AMP AC Service.
- The first stage clamp must be between Main Line and Ground terminals.
- The second stage clamp must be between Equipment Line Out and Equipment Neutral.
- The protector for the first and second stage clamp must have an MOV or similar solid state device rated at 20 KA and must be of a completely solid state design (i.e., no gas discharge tubes allowed).
- The Main Neutral and Equipment Neutral Out must be connected together internally and must have an MOV similar solid state device or gas discharge tube rated at 20 KA between Main Neutral and Ground terminals.
- Peak Clamp Voltage: 350 volts at 20 KA. (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together).
- Voltage must never exceed 350 volts.
- The Protector must be epoxy-encapsulated in a flame-retardant material.
- Continuous service current: 10 Amps at 120 VAC RMS.
- The Equipment Line Out must provide power to cabinet CCTV and communications equipment and to the 24V power supply.

2. Ground Bus

Provide a neutral bus that is not connected to the earth ground or the logic ground anywhere within the cabinet. Ensure that the earth ground bus and the neutral ground bus each have ten compression type terminals, each of which can accommodate wires ranging from number 14 through number 4 AWG.

3. Uninterruptible Power Supply (UPS)

Furnish and install one rack mounted UPS in each new cabinet that meet the following minimum specifications:

Output

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Output Power Capacity	480 Watts / 750 VA
Max Configurable Power	480 Watts / 750 VA
Nominal Output Voltage	120V
Output Voltage Distortion	Less than 5% at full load
Output Frequency (sync to mains)	57 - 63 Hz for 60 Hz nominal
Crest Factor	up to 5:1
Waveform Type	Sine wave
Output Connections	(4) NEMA 5-15R

Input

Nominal Input Voltage	120V
Input Frequency	50/60 Hz +/- 3 Hz (auto sensing)
Input Connections	NEMA 5-15P
Cord Length	6 feet
Input voltage range for main operations	82 - 144V
Input voltage adjustable range for mains operation	75 -154 V

Battery Type

Maintenance-free sealed Lead-Acid battery with suspended electrolyte, leak-proof.

Typical recharge time	2 hours
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Communications & Management

Interface Port(s)	DB-9 RS-232, USB
Control panel	LED status display with load and battery bar-graphs

Surge Protection and Filtering

Surge energy rating	480 Joules
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Environmental

Operating Environment	32 - 104 °F
Operating Relative Humidity	0 - 95%
Storage Temperature	5 - 113 °F
Storage Relative Humidity	0 - 95%

Conformance

Regulatory Approvals	FCC Part 15 Class A, UL 1778
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16.3. CONSTRUCTION METHODS

For each equipment cabinet installation, use stainless steel banding or other method approved by the Engineer to fasten cabinet to pole. Install equipment cabinets so that the height to the middle of the enclosure is 4 feet from ground level. No risers shall enter the top or sides of the equipment cabinet.

Install all conduits, condulets, and attachments to equipment cabinets in a manner that preserves the minimum bending radius of cables and creates water proof connections and seals.

Install a UPS in each cabinet and power all CCTV cameras from the UPS.

16.4. MEASUREMENT AND PAYMENT

Field Equipment Cabinet will be measured and paid as the actual number of equipment cabinets furnished, installed and accepted.

No payment will be made for the UPS, cabling, connectors, cabinet attachment assemblies, conduit, condulets, risers, grounding equipment, surge protectors, or any other equipment or labor required to install the equipment cabinet and integrate the cabinet with the CCTV camera equipment.

Payment will be made under:

Pay Item	Pay Unit
Field Equipment Cabinet	Each

17. ELECTRICAL SERVICE (CCTV CABINETS)

17.1. DESCRIPTION

At locations called out in the Plans, install a new electrical service for the new CCTV Camera (Analog and/or Digital) consisting of a new meter and service disconnect, service entrance conductors, and feeder conductors, grounding, conduits and risers, etc.

Comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the *Standard Specifications*, these Project Special Provisions, and all local ordinances. Coordinate all work involving electrical service with the appropriate utility company and the Engineer.

17.2. MATERIALS

A. Electrical Service

Provide material, equipment and hardware under this section that is pre-approved on the 2018 ITS and Signals QPL by the date of equipment installation.

Provide all materials necessary to form a complete electrical service assembly as shown in the Plans. Furnish new external electrical service disconnects, meter bases, and required grounding. Install new electrical service feeder conductors and conduits between the disconnects and the equipment cabinets as required.

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Provide all electrical service disconnects with a space/expansion slots, covered by a knockout or removable blank cover, designed to allow the future installation of at least one additional circuit breaker.

Provide inverse time circuit breaker with at least 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure.

For overhead services furnish 3-wire stranded #3 AWG copper service entrance conductors with THWN rating for supplying power to the meter base/disconnects. Provide conductors with black, red, and white insulation that are intended for power circuits at 600 V or less and comply with the following:

- Listed as meeting UL Standard UL-83
- Meets ASTM B-3 and B-8 or B-787 standards.

Furnish 3-wire stranded copper feeder conductors with THWN rating for supplying power to the equipment cabinets. Provide conductors with black, white, and green insulation that are intended for power circuits at 600 V or less and comply with the following:

- Listed as meeting UL Standard UL-83
- Meets ASTM B-3 and B-8 or B-787 standards.

As indicated below, provide the following:

CCTV Camera Cabinet:

- 1 single-pole 15A breaker
- 1 spare slot/space (minimum)
- 3-wire stranded #12 AWG copper feeder conductors with THWN rating

Furnish 1” rigid galvanized conduit between the disconnect and the equipment cabinets as required. For underground runs greater than 10 feet in length, the Contractor may transition from 1” rigid galvanized conduit to 1” PVC conduit for the remainder of the underground run beyond the initial 10 feet. Furnish Schedule 40 PVC female adapters to connect the PVC conduit to the threaded end of the rigid galvanized conduit. The interior surface of one end of the PVC female adapter shall be compatibly threaded to connect it to the threaded end of the rigid metallic riser without the aid of additional fittings, hardware or adhesives. The opposite end of the adapter shall be non-threaded to permit a slip fit, glued connection to the underground PVC conduit.

Ensure service disconnects are listed as meeting UL Standard UL-489 and marked as being suitable for use as service equipment. Fabricate enclosure from galvanized steel. Provide ground bus and neutral bus with a minimum of four terminals with minimum wire capacity range of number 8 through number 2/0 AWG.

Furnish NEMA Type 3R meter base rated 100A minimum for overhead service and 200A minimum for underground service and that meets the requirements of the local utility. Provide meter base with ampere rating of meter sockets based on sockets being wired with insulated wire rated at least 167°F. With each meter base, provide a blank meter socket cover made from UV stabilized polycarbonate or metal and that is either clear or gray in color to prevent access to interior of meter base until meter is installed by the local power company.

Furnish 4 terminal, 600 volt, single phase, 3 wire meter base that complies with the following:

- Line, Load, and Neutral Terminals accept #8 to 2/0 AWG copper/aluminum wire;
- Ringed or Ringless Type, with or without bypass;

- Made of galvanized steel;
- Listed as meeting UL Standard UL-414; and
- Overhead or underground service entrance as specified.

Provide electrical service enclosures, meter bases, disconnect panels, combination panel enclosures and pedestals with electrostatically applied dry powder paint finish with minimum thickness of 2.4 mils and that is light gray in color. All exterior surfaces must be powder coated steel.

Furnish 1" watertight hub (i.e., meter socket hub) for threaded rigid galvanized conduit with meter base.

If meter base and electrical service disconnect are supplied in the same enclosure (i.e., combination panel), ensure assembly is marked as being suitable for use as service equipment. Ensure combination meter and disconnect mounted in a pedestal for underground service is listed as meeting UL Standard UL-231. Otherwise, ensure combination meter and disconnect is listed as meeting UL Standard UL-67. Provide combination panels with pedestals of sufficient length to attain a minimum embedment depth of 24 inches below grade when installed per the manufacturer's instructions.

Provide a grounding electrode system at all new electrical services. Provide underground marker tape above ground grounding electrodes and buried ground wire. Provide all grounding electrodes and ground wire necessary to ensure that grounding system, whether existing or new, complies with all grounding requirements of these Project Special Provisions.

B. CCTV Cabinet Disconnect

Furnish new CCTV cabinet disconnect with a 15A circuit breaker at the locations shown in the Plans. Provide CCTV cabinet disconnects that have spaces (slots) for at least two breakers (one occupied by the 15A breaker + one future breaker) and a minimum of 10,000 RMS symmetrical amperes short circuit current rating in a lockable NEMA 3R enclosure. Ensure equipment cabinet disconnects are listed as meeting UL Standard UL-489 and marked as being suitable for use as service disconnects. Fabricate enclosure from galvanized steel and electrostatically apply dry powder paint finish, light gray in color, to yield a minimum thickness of 2.4 mils. All exterior surfaces must be powder coated steel. Provide ground bus and neutral bus with a minimum of four terminals and a minimum wire capacity range of number 8 through number 2 AWG.

C. Grounding Electrodes (Ground Rods)

Furnish 5/8"x10' copper clad steel grounding electrodes (ground rods), #4 AWG solid bare copper conductors, to make the grounding system installations. Secure the Copper conductor to the ground rod using an irreversible compression coupling using a ratcheting compression tool. Comply with the NEC, the *Standard Specifications*, these Project Special Provisions and the Plans.

17.3. CONSTRUCTION METHODS

A. General

All work involving electrical service shall be coordinated with the appropriate electric utility company. Coordinate with the utility company to ascertain the feasibility of installing electrical service at each location before performing any work. Obtain all required local permits before beginning work.

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Run feeder conductors separately from all other conductors in a 1-inch rigid galvanized conduit. Do not allow feeder conductors to share conduits with any other conductors or cables. Do not route unfused electrical feeder conductors inside of metal poles. Permanently label conductors at all access points using nylon tags labeled with permanent ink. Ensure each conductor has a unique identifier. Label conductors immediately upon installation. Use component name and labeling scheme approved by the Engineer.

Use rigid galvanized conduit for all underground conduit runs 10 feet or less in length. For underground runs greater than 10 feet in length, the Contractor may transition from 1" rigid galvanized conduit to 1" PVC conduit for the remainder of the run beyond the initial 10 feet using an approved PVC female adapter. Apply thread seal tape to the threads of the rigid galvanized conduit before screwing the PVC adapter onto the threaded male end of the conduit. Connect the threaded female end of the PVC adapter to the threaded end of the rigid galvanized conduit, then connect the not threaded end of the adapter to the PVC conduit using a slip fit, glued connection.

Direct bury pedestals that support combination panel at a minimum embedment depth of 24 inches below grade.

Upon completion of electrical service installation and backfilling of all excavations, restore the disturbed ground to its original condition as determined and approved by the Engineer. For paved areas, replace removed or damaged pavement with in kind materials, matching the elevation, color, texture/finish and general appearance of the surrounding pavement in accordance with the "Equipment Cabinet Foundation" section of these Project Special Provisions. For unpaved areas, backfill excavations with removed material, tamp the backfilled material and rake smooth the top 1½ inches. Finish unpaved areas flush with surrounding natural ground and to match the original contour of the ground. Seed with same type of grass as surrounding area and mulch the newly seeded area. If unpaved area was not grassed, replace the original ground cover in kind as directed by the Engineer.

Complete repairs to and restoration of all ground (paved and unpaved) disturbed for construction within five consecutive calendar days following initial removal. If the Contractor fails to repair and restore the ground in accordance with these Project Special Provisions within the time frame specified, the Department reserves the right to make the necessary repairs, and all expenses incurred by the Department in making the repairs and restoring the ground will be deducted from payment due the Contractor.

Install meter socket covers on new meter bases to block access to the wiring inside until the meter is attached to the meter base by the power company. Use only approved meter socket covers that comply with these Project Special Provisions; do not use cardboard, paper, plywood, sheet plastic, tape, etc. to cover the meter socket opening. Do not leave a meter socket uncovered.

Provide all necessary stainless steel banding hardware and clamps for securely attaching service disconnects, meter bases, combination panels and service conduits and risers to metal poles.

B. New Electrical Service for CCTV

At locations identified in the Plans, install new electrical service for a CCTV cabinet in accordance with the details shown in the Plans. Install a new electrical service comprised of an external service disconnect and a meter base with meter socket cover housed in a combination panel. After installation of the meter base with meter socket cover, the local power company will remove the socket cover and transfer the existing meter or install a new meter and make any necessary connections to the power lines.

Unless the Plans indicate otherwise, have the power company route the service drop underground to combination panel, even where source power lines are overhead.

C. Grounding of Electrical Services

In addition to NEC requirements, test grounding electrode resistance for a maximum of 20 ohms. Furnish and install additional ground rods to grounding electrode system as necessary to meet test requirements. Furnish 5/8” x 10’ copper clad steel grounding electrode system (ground rods), #4 AWG solid bare copper conductors, and a irreversible compression coupling for grounding system installations. Comply with NEC, the *Standard Specifications*, these Project Special Provisions and the Plans.

Follow test equipment’s procedures for measuring grounding electrode resistance. When using clamp-type ground resistance meters, readings of less than 1 ohm typically indicate a ground loop. Rework bonding and grounding circuits as necessary to remove ground loop circuits and retest. If a ground loop cannot be identified and removed to allow the proper use of a clamp-type ground resistance meter, use the three-point test method.

Submit a completed Inductive Loop & Grounding Test Form available on the Department’s website at:

<https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx>

Install a length of marker tape 6 to 12 inches below finished grade directly over grounding electrodes and conductors.

17.4. MEASUREMENT AND PAYMENT

CCTV Electrical Service will be measured and paid for as the actual number of complete, functional CCTV electrical service locations furnished, installed and tested.

No measurement will be made of risers with weatherheads for CCTV electrical service as they will be considered incidental to furnishing and installing a new CCTV electrical service.

No measurement will be made of short risers (i.e., from disconnect to underground conduit and from underground conduit to bottom of cabinet), meter bases, meter socket covers, service disconnects, additional circuit breakers in new service disconnects where required, underground conduit between service risers and disconnects/meters, conduit for feeder conductors between the service disconnect and the equipment cabinet, PVC female adapters, acquisition of service fees, service entrance conductors, feeder conductors, ground wire, grounding electrodes rods and any remaining hardware and conduit to connect the electrical service to the CCTV equipment cabinet as they will be considered incidental to furnishing and installing new electrical service.

No measurement will be made of restoration of unpaved ground surfaces with like materials, including but not limited to backfill, graded stone, seeding and mulching, as this work will be considered incidental to installation of a new electrical service.

Payment will be made under:

Pay Item	Pay Unit
CCTV Electrical Service	Each

18. TESTING (CCTV)

18.1. DESCRIPTION

Once all hardware for the new CCTV camera assemblies has been installed, test the new cameras locally to ensure functionality. Perform these tests in the presence of the Engineer or a designated representative. After successfully testing the new cameras, integrate into their respective system(s) or the NCDOT STOC.

Perform a System Operational Test, which fully exercises all functions of the new cameras. Submit a test plan a minimum of fifteen (15) days prior to the scheduled start of the test to the Engineer for review and approval. The Engineer will review the test plans and reply within fifteen (15) working-days from the receipt of the test plan.

A. CCTV Camera Field Test

1. Verify that each CCTV camera can be controlled locally at the camera site. The test should exercise all camera functionality as noted below:
 - Pan 360 degrees left and right
 - Tilt 180 degrees up and down
 - Zoom In / Zoom Out
 - Focus near / Focus far
 - Auto-focus
 - Iris open / Iris close
 - Auto-iris
 - Record and run presets
2. The Contractor should supply a Laptop or PDA loaded with the appropriate CCTV control software and a portable color monitor for use during this test.
3. In addition, the field test will include inspection of the cabinets, electrical service, grounding system, wire & cabling, and all other components installed at each CCTV site.

B. System Integration Test

Upon successfully completion of the CCTV Camera Field Test, test to ensure that the new cameras have been successfully integrated into their respected system(s) (i.e. Closed Loop System, Centrac, NCDOT STOC Center). Make arrangement with the control centers to ensure that communications links for the CCTV Field devices are operational and functioning as designed. As a minimum, ensure that the same tests as conducted during the CCTV Field Test Requirements can be accomplished from the Control Centers.

C. 30-Day Observation Period

Upon completion of all project work, the successful completion of the System Operational Test and the correction of all known deficiencies, including minor installation items, a 30-day Observation Period will commence. This Observation Period will consist of a 30-day period of normal operation without any failures. The purpose of this period is to ensure that all components of the system function in accordance with these Project Special Provisions over an extended length of time.

Respond to system or component failures (or reported failures) that occur during the 30-day Observation Period within 24 hours. Correct said failures within 48 hours. Failures that cannot be corrected within 48 hours will suspend the timing of the 30-day Observation Period beginning at the time when the failure occurred. After the cause of such failures has been corrected, timing of the 30-day Observation Period will resume. Failures that necessitate a redesign of any major component will terminate the Observation Period. Once the components have been redesigned or replaced, the 30-Day Observation Period will be restarted from zero. Failures in any of the components exceeding a total of three (3) occurrences will terminate the 30-day Observation Period. Once the failures have been corrected, the 30-day Observation Period will be restarted from zero.

All documentation must be completed prior to the end of the 30-day Observation Period. The 30-day Observation Period will not be considered part of the contract time. Final acceptance will occur upon the successful completion of the 30-day Observation Period and after all documentation requirements have been fully satisfied.

The system major components are:

- CCTV Camera Assembly

18.2. MEASUREMENT AND PAYMENT

There will be no direct payment for work covered in this section. Payment at contract unit prices for the various items in the contract will be full compensation for all work covered in this section.

19. CCTV METAL POLES

19.1. CCTV METAL POLES

A. General

Furnish and install a new 40' tapered CCTV metal pole, grounding system, and all necessary hardware. The work covered by this special provision includes requirements for the design, fabrication, and installation of custom designed CCTV metal poles and associated foundations.

Comply with applicable sections of the *2018 STANDARD SPECIFICATIONS FOR ROADS & STRUCTURES*, hereinafter referred to as the *Standard Specifications*. Provide designs of completed assemblies with hardware that equals or exceeds AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* 6th Edition, 2013 (hereafter called AASHTO), including the latest interim specifications. Provide assemblies with a round or near-round (18 sides or more) cross-section, or a multi sided cross section with no less than six sides. The sides may be straight, convex, or concave.

After fabrication, hot-dip galvanize steel poles, and all parts used in the assembly in accordance with section 1076 of the *Standard Specification*. Design structural assemblies with weep holes large enough and properly located to drain molten zinc during galvanization process. Galvanize structures to meet or exceed AASHTO M 111. Provide galvanizing on hardware that meets or exceeds ASTM Standard A-153. Ensure that threaded material is brushed and re-tapped as necessary after galvanizing. Perform repair of damaged galvanizing that complies with the following:

Repair of Galvanizing.....Article 1076-6

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Standard Drawings for Metal Poles are available that supplement these project special provisions. These drawings are located on the Department's website:

<https://connect.ncdot.gov/resources/safety/Pages/ITS-Design-Resources.aspx>

Comply with article 1098-1B "General Requirements" of the *Standard Specifications* for submittal requirements. Furnish shop drawings for approval. Provide the copies of detailed shop drawings for each type of structure as summarized below. Ensure that shop drawings include material specifications for each component and identify welds by type and size on the drawing details, not in table format. Do not release structures for fabrication until shop drawings have been approved by NCDOT. Provide an itemized bill of materials for all structural components and associated connecting hardware on the drawings.

Comply with article 1098-1A "General Requirements" of the *Standard Specifications* for Qualified Products List (QPL) submittals. All shop drawings must include project location description, CCTV Asset inventory number(s), and a project number or work order number on the drawings.

Mark final pole locations and receive approval from the Engineer before initiating bore samples and designing foundations.

Summary of information required for metal pole review submittal:

Item	Hardcopy Submittal	Electronic Submittal	Comments / Special Instructions
Sealed, Approved ITS Plan/Loading Diagram	1	1	All structure design information needs to reflect the latest approved ITS plans
Custom Pole Shop Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media Show NCDOT inventory number(s) in or above the title block
Structure Calculations	1 set	1 set	
Custom Foundation Drawings	4 sets	1 set	Submit drawings on 11" x 17" format media.
Foundation Calculations	1	1	Submit L Pile calculations per Section 11.4 of this Project Special Provision.
Soil Boring Logs and Report	1	1	Report should include a location plan and a soil classification report including soil capacity, water level, hammer efficiency, soil bearing pressure, soil density, etc. for each pole.

NOTE – All shop drawings and custom foundation design drawings must be sealed by a professional Engineer licensed in the state of North Carolina. All geotechnical information must be sealed by either a Professional Engineer or geologist licensed in the state of North Carolina. Include a title block and revision block on the shop drawings and foundation designs showing the NCDOT inventory number.

Shop drawings and foundation drawings may be submitted together or separately for approval. However, shop drawings must be approved before foundations can be reviewed. Foundation designs

will be returned without review if the associated shop drawing has not been approved. Incomplete submittals will be returned without review.

19.2. MATERIALS

Fabricate CCTV metal pole from coil or plate steel to meet the requirements of ASTM A 595 Grade A tubes. For structural steel shapes, plates and bars use A572 Gr 50 min or ASTM A709 Gr 50 min.. Provide poles that are round in cross section or multisided tubular shapes and have a uniform linear taper of 0.14 in/ft. Construct shafts from one piece of single ply plate or coil so there are no circumferential weld splices. Galvanize in accordance with AASHTO M 111 and/or ASTM A 123 or an approved equivalent.

Ensure that allowable pole deflection does not exceed that allowed per 6th Edition AASHTO. Ensure that maximum deflection at the top of the pole does not exceed 2.0 percent of the pole height.

Use the submerged arc process or other NCDOT previously approved process suitable for poles to continuously weld pole shafts along their entire length. The longitudinal seam weld will be finished flush to the outside contour of the base metal. Ensure shafts have no circumferential welds except at the lower end joining the shaft to the pole base. In the event that a circumferential weld is necessary, prior approval is required from the Engineer and NCDOT Materials and Test Unit. Provide welding that conforms to Article 1072-20 of the *Standard Specifications*, except that no field welding on any part of the pole will be permitted unless approved by a qualified engineer.

Refer to Metal Pole Standard Drawing Sheets M2 through M5 for fabrication details. Fabricate anchor bases from plate steel meeting, as a minimum, the requirements of ASTM A 36M or cast steel meeting the requirements of ASTM A 27M Grade 485-250, AASHTO M270 Gr 36 or an approved equivalent. Conform to the applicable bolt pattern and orientation as shown on Metal Pole Standard Drawing Sheet M2.

Ensure all hardware is galvanized steel or stainless steel. The Contractor is responsible for ensuring that the designer/fabricator specifies connecting hardware and/or materials that do not create a dissimilar metal corrosive reaction.

Unless otherwise required by the design, ensure each anchor rod is 2" diameter and 60" length. Provide 10" minimum thread projection at the top of the rod, and 8" minimum at the bottom of the rod. Use anchor rod assembly and drilled pier foundation materials that meet the *Foundations and Anchor Rod Assemblies for Metal Poles* provision.

For each structural bolt and other steel hardware, hot dip galvanizing shall conform to the requirements of AASHTO M 232 (ASTM A 153). Ensure end caps for poles are constructed of cast aluminum conforming to Aluminum Alloy 356.0F.

Provide a circular anchor bolt lock plate that will be secured to the anchor bolts at the embedded end with 2 washers and 2 nuts. Provide a base plate template that matches the bolt circle diameter of the anchor bolt lock plate. Construct plates and templates from ¼" minimum thick steel with a minimum width of 4". Galvanizing is not required.

Provide 4 heavy hex nuts and 4 flat washers for each anchor bolt. For nuts, use AASHTO M291 grade 2H, DH, or DH3 or equivalent material. For flat washers, use AASHTO M293 or equivalent material.

Provide a 2-inch hole equipped with an associated coupling and weatherhead approximately 5 feet below the top of the pole to accommodate passage of CCTV cables from inside the pole to the CCTV camera.

Provide a 2-inch hole equipped with an associated coupling and conduit fittings/bodies approximately 18 inches above the base of the pole accommodate passage of CCTV cables from the CCTV cabinet to the inside of the pole. Refer to Metal Pole Standard Drawing Sheet M3 for fabrication details.

Have poles permanently stamped above the base hand hole with the identification tag details as shown on Metal Pole Standard Drawing Sheet M2.

For each pole, provide a 1/2-inch minimum thread diameter, coarse thread stud and nut for grounding which will accommodate #4 AWG ground wire. Ensure that the lug is electrically bonded to the pole and is conveniently located inside the pole at the hand hole.

Provide a removable pole cap with stainless steel attachment screws for the top of each pole. Ensure that the cap is cast aluminum conforming to Aluminum Association Alloy 356.0F. Furnish cap attached to the pole with a sturdy chain or cable approved by the Engineer. Ensure that the chain or cable is long enough to permit the cap to hang clear of the pole-top opening when the cap is removed.

19.3. CONSTRUCTION METHODS

Install anchor rod assemblies in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision (SP09-R005) located on the Department's 2018 Standard Specifications and Provisions website:

<https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx>

Erect CCTV metal poles only after concrete has attained a minimum allowable compressive strength of 3000 psi. Final approval of foundation is contingent upon concrete achieving a compressive strength of 4,500 psi strength as required by *Foundations and Anchor Rod Assemblies for Metal Poles* provision. Connect poles to grounding electrodes and bond them to the electrical service grounding electrodes.

For holes in the poles used to accommodate cables, install grommets before wiring pole or arm. Do not cut or split grommets.

Attach the hand hole covers to the pole by a sturdy chain or cable. Ensure the chain or cable is long enough to permit the cover to hang clear of the opening when the cover is removed, and is strong enough to prevent vandalism. Ensure the chain or cable will not interfere with service to the cables in the pole.

Attach cap to pole with a sturdy chain or cable. Ensure the chain or cable is long enough to permit the cap to hang clear of the opening when the cap is removed.

Perform repair of damaged galvanizing that complies with the *Standard Specifications*, Article 1076-7 "Repair of Galvanizing."

Install galvanized wire mesh around the perimeter of the base plate to cover the gap between the base plate and top of foundation for debris and pest control.

Install a 1/4" thick plate for concrete foundation tag to include: concrete grade, depth, diameter, and reinforcement sizes of the installed foundation.

Install CCTV metal poles, hardware, and fittings as shown on the manufacturer's installation drawings. Install poles so that when the pole is fully loaded it is within .5 degrees of vertical.

19.4. DRILLED PIER FOUNDATIONS FOR METAL POLES

Analysis procedures and formulas shall be based on AASHTO, ACI code and per FHWA Manuals. Design methods based on engineering publications or research papers needs to have prior approval from NCDOT. The Department reserves the right to accept or disapprove any method used for the analysis.

Use a Factor of Safety of 1.33 for torsion and 2.0 for bending for the foundation design.

Foundation design for lateral load shall not exceed 1" lateral deflection at top of foundation.

Design all custom foundations to carry the maximum capacity of each metal pole.

When poor soil conditions are encountered which could create an excessively large foundation design, consideration may be given to allowing an exemption to the maximum capacity design. The contractor must gain approval from the engineer before reducing a foundation's capacity. On projects where poor soil is known to be present, it is advisable that the contractor gain foundation approval before releasing poles for fabrication.

A. Description

Design, furnish and install foundations for CCTV metal poles with all necessary hardware in accordance with the plans and specifications.

Design all CCTV pole foundations using actual soil conditions at each pole location. Perform soil test in accordance with article "B" Soil Test and Foundation Determination of this special provision.

B. Soil Test and Foundation Determination

Drilled piers are reinforced concrete sections, cast-in-place against in situ, undisturbed soil. Drilled piers are of straight shaft type and vertical.

Some drilled piers for supporting metal poles may require wing walls to resist torsional rotation. Based upon this provision and the results of the required soil test, a drilled pier length requirement may be determined and constructed in accordance with the plans.

Soil Test:

Perform a soil test at each proposed metal pole location. Complete all required fill placement and excavation at each signal pole location to finished grade before drilling each boring. Soil tests performed that are not in compliance with this requirement may be rejected and will not be paid. Drill one boring to a depth of 26 feet within a 25-foot radius of each proposed foundation.

Perform standard penetration tests (SPT) in accordance with ASTM D 1586 at depths of 1, 2.5, 5, 7.5, 10, 15, 20 and 26 feet. Discontinue the boring if one of the following occurs:

- A total of 100 blows have been applied in any 2 consecutive 6-in. intervals.
- A total of 50 blows have been applied with < 3-in. penetration.

Describe each CCTV pole location along the project corridor in a manner that is easily discernible to both the contractor's designer and NCDOT reviewers. If a CCTV pole is at an intersection, label the boring the "Intersection of (Route or SR #), (Street Name) and (Route or SR #),

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(Street Name), _____ County, Signal Inventory No. _____”. Label borings with “B- N, S, E, W, NE, NW, SE or SW” corresponding to the quadrant location within the intersection.

If the CCTV pole location is located between intersections, provide a coordinate location and offset, or milepost number and offset. Pole numbers should be made available to the geotechnical drilling Contractor. Include pole numbers in the boring label if they are available. If they are not available, ensure the boring labels can be cross-referenced to corresponding pole numbers or pole locations. For each boring, submit a legible (hand written or typed) boring log signed and sealed by a licensed Geologist or Professional Engineer registered in North Carolina. Include on each boring the SPT blow counts and N-values at each depth, depth of the boring, and a general description of the soil types encountered.

Borings that can't be easily related to their specific pole location will be returned to the contractor for clarification, or if approved by the engineer, the foundation may be designed using the worst-case soil condition obtained as part of this project.

i. Standard Foundation Determination:

Use the following method for determining the Design N-value:

$$N_{AVG} = \frac{(N@1' + N@2.5' + \dots + N@Deepest \text{ Boring Depth})}{\text{Total Number of N-values}}$$

$$Y = (N@1')^2 + (N@2.5')^2 + \dots + (N@Deepest \text{ Boring Depth})^2$$

$$Z = (N@1' + N@2.5' + \dots + N@Deepest \text{ Boring Depth})$$

$$N_{STD \text{ DEV}} = \left[\frac{(\text{Total Number of N-values} \times Y) - Z^2}{(\text{Total Number of N-values}) \times (\text{Total Number of N-values} - 1)} \right]^{0.5}$$

Design N-value equals lesser of the following two conditions:

$$N_{AVG} - (N_{STD \text{ DEV}} \times 0.45)$$

Or

$$\text{Average of First Four N-Values} = \frac{(N@1' + N@2.5' + N@5' + N@7.5')}{4}$$

Note: If less than 4 N-values are obtained because of criteria listed in Section 2 above, use average of N-values collected for second condition. Do not include the N-value at the deepest boring depth for above calculations if the boring is discontinued at or before the required boring depth because of criteria listed in Section 2 above. Use N-value of zero for weight of hammer or weight of rod. If N-value is greater than 50, reduce N-value to 50 for calculations.

Submit completed boring logs collected in accordance with Section 2 (Soil Test) above along with pole loading diagrams from the plans to the contractor-selected pole fabricator to assist in the pole and foundation design.

If one of the following occurs, contact the Engineer.

- The Design N-value is less than 4.
- The drilled pier length, “L”, is greater than the depth of the corresponding boring.

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Foundation designs are based on level ground around the traffic signal pole. If the slope around the edge of the drilled pier is steeper than 8:1 (H:V) or the proposed foundation will be less than 10 feet from the top of an embankment slope, the Contractor is responsible for providing slope information to the foundation designer and to the Engineer, so it can be considered in the design.

If assistance is needed, contact the Engineer.

C. Non-Standard Foundation Design

Design non-standard foundations based upon site-specific soil test information collected in accordance with Section 2 (Soil Test) above. Design drilled piers for side resistance only in accordance with Section 4.6 of the *AASHTO Standard Specifications for Highway Bridges*. Use the computer software LPILE version 5.0 or later manufactured by Ensoft, Inc. to analyze drilled piers. Use the computer software gINT version 8.0 or later manufactured by Bentley Systems, Inc. with the current NCDOT gINT library and data template to produce SPT boring logs. Provide a drilled pier foundation for each pole with a length and diameter that result in a horizontal lateral movement of less than 1 inch at the top of the pier and a horizontal rotational movement of less than 1 inch at the edge of the pier. Submit and gain approval of foundation designs including drawings, calculations, and soil boring before construction. Foundations installed without prior approval may be rejected.

D. Drilled Pier Construction

Construct drilled pier foundations in accordance with the *Foundations and Anchor Rod Assemblies for Metal Poles* provision (SP09 R005). This provision may be located at:

<https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx>

19.5. MEASUREMENT AND PAYMENT

Actual number of CCTV Metal Poles (40') furnished, installed and accepted.

Actual number of Soil Tests with SPT borings performed furnished and accepted.

Actual volume of concrete poured in cubic yards of Drilled Pier Foundation furnished, installed, and accepted.

No measurement will be made for CCTV Metal Pole designs and foundation designs, as these will be considered incidental to CCTV Metal Poles and Drilled Pier Foundations.

Payment will be made under:

Pay Item	Pay Unit
CCTV Metal Pole (40')	Each
Soil Test for CCTV Pole.....	Each
Drilled Pier Foundation for CCTV Pole	Cubic Yards

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
ROADWAY ITEMS						
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	0000400000-N	801	CONSTRUCTION SURVEYING	Lump Sum	L.S.	
0003	0000900000-N	SP	GENERIC MISCELLANEOUS ITEM FIELD OFFICE	Lump Sum	L.S.	
0004	0001000000-E	200	CLEARING & GRUBBING .. ACRE(S)	Lump Sum	L.S.	
0005	0008000000-E	200	SUPPLEMENTARY CLEARING & GRUB- BING	5 ACR		
0006	0015000000-N	205	SEALING ABANDONED WELLS	5 EA		
0007	0022000000-E	225	UNCLASSIFIED EXCAVATION	104,500 CY		
0008	0028000000-N	SP	TYPE I STANDARD APPROACH FILL STATION ***** (30+17.11 -Y31-)	Lump Sum	L.S.	
0009	0028000000-N	SP	TYPE I STANDARD APPROACH FILL STATION ***** (658+69.17 -L1- LT)	Lump Sum	L.S.	
0010	0028000000-N	SP	TYPE I STANDARD APPROACH FILL STATION ***** (658+69.17 -L1- RT)	Lump Sum	L.S.	
0011	0030000000-N	SP	TYPE II MODIFIED APPROACH FILL, STATION ***** (39+82.39 -Y30-)	Lump Sum	L.S.	
0012	0036000000-E	225	UNDERCUT EXCAVATION	168,000 CY		
0013	0084000000-E	SP	WICK DRAINS	743,000 LF		
0014	0106000000-E	230	BORROW EXCAVATION	4,405,300 CY		
0015	0127000000-N	235	EMBANKMENT SETTLEMENT GAUGES	26 EA		
0016	0134000000-E	240	DRAINAGE DITCH EXCAVATION	37,600 CY		
0017	0156000000-E	250	REMOVAL OF EXISTING ASPHALT PAVEMENT	80,460 SY		
0018	0177000000-E	250	BREAKING OF EXISTING ASPHALT PAVEMENT	12,700 SY		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0019	0192000000-N	260	PROOF ROLLING	90 HR		
0020	0194000000-E	265	SELECT GRANULAR MATERIAL, CLASS III	56,800 CY		
0021	0196000000-E	270	GEOTEXTILE FOR SOIL STABILIZA- TION	68,800 SY		
0022	0199000000-E	SP	TEMPORARY SHORING	13,210 SF		
0023	0223000000-E	275	ROCK PLATING	2,400 SY		
0024	0248000000-N	SP	GENERIC GRADING ITEM MODIFIED TYPE A BRIDGE AP- PROACH FILL, STATION 25+28.04 -Y32-	Lump Sum	L.S.	
0025	0248000000-N	SP	GENERIC GRADING ITEM PLACEMENT OF NATIVE MATERIAL	Lump Sum	L.S.	
0026	0255000000-E	SP	GENERIC GRADING ITEM HAULING AND DISPOSAL OF PETRO- LEUM CONTAMINATED SOIL	50 TON		
0027	0318000000-E	300	FOUNDATION CONDITIONING MATE- RIAL, MINOR STRUCTURES	4,910 TON		
0028	0320000000-E	300	FOUNDATION CONDITIONING GEO- TEXTILE	15,440 SY		
0029	0335000000-E	305	*** DRAINAGE PIPE (60")	184 LF		
0030	0335200000-E	305	15" DRAINAGE PIPE	3,416 LF		
0031	0335300000-E	305	18" DRAINAGE PIPE	992 LF		
0032	0335400000-E	305	24" DRAINAGE PIPE	612 LF		
0033	0335500000-E	305	30" DRAINAGE PIPE	432 LF		
0034	0335600000-E	305	36" DRAINAGE PIPE	324 LF		
0035	0335700000-E	305	42" DRAINAGE PIPE	60 LF		
0036	0335800000-E	305	48" DRAINAGE PIPE	108 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0037	0335850000-E	305	*** DRAINAGE PIPE ELBOWS (15")	82 EA		
0038	0335850000-E	305	*** DRAINAGE PIPE ELBOWS (18")	8 EA		
0039	0335850000-E	305	*** DRAINAGE PIPE ELBOWS (24")	2 EA		
0040	0335850000-E	305	*** DRAINAGE PIPE ELBOWS (30")	2 EA		
0041	0343000000-E	310	15" SIDE DRAIN PIPE	392 LF		
0042	0344000000-E	310	18" SIDE DRAIN PIPE	96 LF		
0043	0345000000-E	310	24" SIDE DRAIN PIPE	136 LF		
0044	0354000000-E	310	**** RC PIPE CULVERTS, CLASS ***** (18", V)	48 LF		
0045	0354000000-E	310	**** RC PIPE CULVERTS, CLASS ***** (30", V)	96 LF		
0046	0354000000-E	310	**** RC PIPE CULVERTS, CLASS ***** (36", V)	320 LF		
0047	0354000000-E	310	**** RC PIPE CULVERTS, CLASS ***** (42", V)	464 LF		
0048	0366000000-E	310	15" RC PIPE CULVERTS, CLASS III	7,752 LF		
0049	0372000000-E	310	18" RC PIPE CULVERTS, CLASS III	2,588 LF		
0050	0378000000-E	310	24" RC PIPE CULVERTS, CLASS III	1,960 LF		
0051	0384000000-E	310	30" RC PIPE CULVERTS, CLASS III	1,164 LF		
0052	0390000000-E	310	36" RC PIPE CULVERTS, CLASS III	4,644 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0053	0396000000-E	310	42" RC PIPE CULVERTS, CLASS III	800 LF		
0054	0402000000-E	310	48" RC PIPE CULVERTS, CLASS III	1,200 LF		
0055	0408000000-E	310	54" RC PIPE CULVERTS, CLASS III	1,128 LF		
0056	0448000000-E	310	***** RC PIPE CULVERTS, CLASS IV (48")	112 LF		
0057	0448000000-E	310	***** RC PIPE CULVERTS, CLASS IV (66")	232 LF		
0058	0448000000-E	310	***** RC PIPE CULVERTS, CLASS IV (78")	428 LF		
0059	0448200000-E	310	15" RC PIPE CULVERTS, CLASS IV	8,424 LF		
0060	0448300000-E	310	18" RC PIPE CULVERTS, CLASS IV	1,954 LF		
0061	0448400000-E	310	24" RC PIPE CULVERTS, CLASS IV	564 LF		
0062	0448500000-E	310	30" RC PIPE CULVERTS, CLASS IV	876 LF		
0063	0448600000-E	310	36" RC PIPE CULVERTS, CLASS IV	3,352 LF		
0064	0448700000-E	310	42" RC PIPE CULVERTS, CLASS IV	1,000 LF		
0065	0546000000-E	310	*** CAA PIPE CULVERTS, ***** THICK (48", 0.109")	340 LF		
0066	0973100000-E	330	*** WELDED STEEL PIPE, ***** THICK, GRADE B IN SOIL (54", 0.750")	60 LF		
0067	0973300000-E	330	*** WELDED STEEL PIPE, ***** THICK, GRADE B NOT IN SOIL (54", 0.750")	60 LF		
0068	0992000000-E	SP	GENERIC PIPE ITEM 30" PIPE ENDWALL WITH LOAD-CARRYING GRATE	5 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0069	0992000000-E	SP	GENERIC PIPE ITEM 36" PIPE ENDWALL WITH LOAD- CARRYING GRATE	28 EA		
0070	0992000000-E	SP	GENERIC PIPE ITEM 42" PIPE ENDWALL WITH LOAD- CARRYING GRATE	2 EA		
0071	0992000000-E	SP	GENERIC PIPE ITEM 48" PIPE ENDWALL WITH LOAD- CARRYING GRATE	2 EA		
0072	0992000000-E	SP	GENERIC PIPE ITEM 54" PIPE ENDWALL WITH LOAD- CARRYING GRATE	1 EA		
0073	0992000000-E	SP	GENERIC PIPE ITEM 6" VALVE	1 EA		
0074	0995000000-E	340	PIPE REMOVAL	13,207 LF		
0075	1000000000-E	462	6" SLOPE PROTECTION	675 SY		
0076	1011000000-N	500	FINE GRADING	Lump Sum	L.S.	
0077	1099500000-E	505	SHALLOW UNDERCUT	1,100 CY		
0078	1099700000-E	505	CLASS IV SUBGRADE STABILIZA- TION	2,050 TON		
0079	1111000000-E	SP	CLASS IV AGGREGATE STABILIZA- TION	12,170 TON		
0080	1121000000-E	520	AGGREGATE BASE COURSE	157,800 TON		
0081	1220000000-E	545	INCIDENTAL STONE BASE	10,000 TON		
0082	1275000000-E	600	PRIME COAT	19,109 GAL		
0083	1297000000-E	607	MILLING ASPHALT PAVEMENT, **** DEPTH (1-1/2")	1,590 SY		
0084	1330000000-E	607	INCIDENTAL MILLING	2,000 SY		
0085	1491000000-E	610	ASPHALT CONC BASE COURSE, TYPE B25.0C	101,660 TON		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0086	1503000000-E	610	ASPHALT CONC INTERMEDIATE COURSE, TYPE I19.0C	92,280 TON		
0087	1519000000-E	610	ASPHALT CONC SURFACE COURSE, TYPE S9.5B	18,990 TON		
0088	1523000000-E	610	ASPHALT CONC SURFACE COURSE, TYPE S9.5C	73,460 TON		
0089	1575000000-E	620	ASPHALT BINDER FOR PLANT MIX	14,685 TON		
0090	1693000000-E	654	ASPHALT PLANT MIX, PAVEMENT REPAIR	800 TON		
0091	1840000000-E	665	MILLED RUMBLE STRIPS (ASPHALT CONCRETE)	118,100 LF		
0092	2022000000-E	815	SUBDRAIN EXCAVATION	3,159 CY		
0093	2026000000-E	815	GEOTEXTILE FOR SUBSURFACE DRAINS	9,400 SY		
0094	2036000000-E	815	SUBDRAIN COARSE AGGREGATE	1,580 CY		
0095	2044000000-E	815	6" PERFORATED SUBDRAIN PIPE	9,400 LF		
0096	2070000000-N	815	SUBDRAIN PIPE OUTLET	19 EA		
0097	2077000000-E	815	6" OUTLET PIPE	114 LF		
0098	2209000000-E	838	ENDWALLS	115.6 CY		
0099	2220000000-E	838	REINFORCED ENDWALLS	52.7 CY		
0100	2253000000-E	840	PIPE COLLARS	7.44 CY		
0101	2275000000-E	SP	FLOWABLE FILL	26 CY		
0102	2286000000-N	840	MASONRY DRAINAGE STRUCTURES	352 EA		
0103	2297000000-E	840	MASONRY DRAINAGE STRUCTURES	8.3 CY		
0104	2308000000-E	840	MASONRY DRAINAGE STRUCTURES	171 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0105	2352000000-N	840	FRAME WITH GRATE, STD 840.**** (840.20)	8 EA		
0106	2354000000-N	840	FRAME WITH GRATE, STD 840.22	21 EA		
0107	2364000000-N	840	FRAME WITH TWO GRATES, STD 840.16	30 EA		
0108	2364200000-N	840	FRAME WITH TWO GRATES, STD 840.20	84 EA		
0109	2365000000-N	840	FRAME WITH TWO GRATES, STD 840.22	85 EA		
0110	2366000000-N	840	FRAME WITH TWO GRATES, STD 840.24	4 EA		
0111	2367000000-N	840	FRAME WITH TWO GRATES, STD 840.29	5 EA		
0112	2374000000-N	840	FRAME WITH GRATE & HOOD, STD 840.03, TYPE ** (E)	24 EA		
0113	2374000000-N	840	FRAME WITH GRATE & HOOD, STD 840.03, TYPE ** (F)	59 EA		
0114	2374000000-N	840	FRAME WITH GRATE & HOOD, STD 840.03, TYPE ** (G)	54 EA		
0115	2396000000-N	840	FRAME WITH COVER, STD 840.54	4 EA		
0116	2407000000-N	840	STEEL FRAME WITH TWO GRATES, STD 840.37	5 EA		
0117	2440000000-N	852	CONCRETE TRANSITIONAL SECTION FOR CATCH BASIN	1 EA		
0118	2451000000-N	852	CONCRETE TRANSITIONAL SECTION FOR DROP INLET	23 EA		
0119	2462000000-E	836	*** SLUICE GATE (8")	1 EA		
0120	2538000000-E	846	***_*** CONCRETE CURB & GUTTER (2'-9")	1,010 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0121	2542000000-E	846	1'-6" CONCRETE CURB & GUTTER	13,770	LF	
0122	2549000000-E	846	2'-6" CONCRETE CURB & GUTTER	21,560	LF	
0123	2556000000-E	846	SHOULDER BERM GUTTER	9,580	LF	
0124	2591000000-E	848	4" CONCRETE SIDEWALK	2,620	SY	
0125	2605000000-N	848	CONCRETE CURB RAMPS	22	EA	
0126	2612000000-E	848	6" CONCRETE DRIVEWAY	400	SY	
0127	2655000000-E	852	5" MONOLITHIC CONCRETE ISLANDS (KEYED IN)	7,950	SY	
0128	2717000000-E	854	VARIABLE HEIGHT CONCRETE BAR- RIER, TYPE ***** (II)	1,110	LF	
0129	2717000000-E	854	VARIABLE HEIGHT CONCRETE BAR- RIER, TYPE ***** (III)	59	LF	
0130	2717000000-E	854	VARIABLE HEIGHT CONCRETE BAR- RIER, TYPE ***** (T2)	59	LF	
0131	2724000000-E	857	PRECAST REINFORCED CONCRETE BARRIER, SINGLE FACED	14,020	LF	
0132	2905000000-N	859	CONVERT EXISTING DROP INLET TO JUNCTION BOX	2	EA	
0133	2995000000-N	SP	GENERIC DRAINAGE ITEM CONVERT EXISTING CATCH BASIN TO TRAFFIC BEARING JUNCTION BOX	4	EA	
0134	3001000000-N	SP	IMPACT ATTENUATOR UNITS, TYPE TL-3	14	EA	
0135	3030000000-E	862	STEEL BEAM GUARDRAIL	27,837.5	LF	
0136	3045000000-E	862	STEEL BEAM GUARDRAIL, SHOP CURVED	1,112.5	LF	
0137	3140000000-E	862	25' CLEAR SPAN GUARDRAIL SEC- TIONS	1	EA	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0138	3150000000-N	862	ADDITIONAL GUARDRAIL POSTS	30 EA		
0139	3195000000-N	862	GUARDRAIL END UNITS, TYPE AT-1	3 EA		
0140	3210000000-N	862	GUARDRAIL END UNITS, TYPE CAT-1	27 EA		
0141	3215000000-N	SP	GUARDRAIL ANCHOR UNITS, TYPE III	4 EA		
0142	3287000000-N	SP	GUARDRAIL END UNITS, TYPE TL-3	34 EA		
0143	3288000000-N	SP	GUARDRAIL END UNITS, TYPE TL-2	12 EA		
0144	3317000000-N	SP	GUARDRAIL ANCHOR UNITS, TYPE B-77	31 EA		
0145	3360000000-E	863	REMOVE EXISTING GUARDRAIL	1,106 LF		
0146	3380000000-E	862	TEMPORARY STEEL BEAM GUARDRAIL	1,750 LF		
0147	3389150000-N	SP	TEMPORARY GUARDRAIL END UNITS, TYPE ***** (TL-2)	4 EA		
0148	3389150000-N	SP	TEMPORARY GUARDRAIL END UNITS, TYPE ***** (TL-3)	8 EA		
0149	3389200000-E	865	CABLE GUIDERAIL	26,900 LF		
0150	3389500000-N	865	ADDITIONAL GUIDERAIL POSTS	10 EA		
0151	3389600000-N	865	CABLE GUIDERAIL ANCHOR UNITS	34 EA		
0152	3503000000-E	866	WOVEN WIRE FENCE, 47" FABRIC	66,750 LF		
0153	3509000000-E	866	4" TIMBER FENCE POSTS, 7'-6" LONG	4,319 EA		
0154	3515000000-E	866	5" TIMBER FENCE POSTS, 8'-0" LONG	832 EA		
0155	3557000000-E	866	ADDITIONAL BARBED WIRE	1,000 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0156	3564000000-E	866	SINGLE GATES, *** HIGH, *** WIDE, *** OPENING (47", 12', 12')	7 EA		
0157	3565000000-E	866	DOUBLE GATES, *** HIGH, *** WIDE, *** OPENING (47", 10', 20')	2 EA		
0158	3628000000-E	876	RIP RAP, CLASS I	5,656 TON		
0159	3649000000-E	876	RIP RAP, CLASS B	11,250 TON		
0160	3656000000-E	876	GEOTEXTILE FOR DRAINAGE	42,700 SY		
0161	4048000000-E	902	REINFORCED CONCRETE SIGN FOUNDATIONS	13 CY		
0162	4054000000-E	902	PLAIN CONCRETE SIGN FOUNDATIONS	2 CY		
0163	4057000000-E	SP	OVERHEAD FOOTING	24 CY		
0164	4060000000-E	903	SUPPORTS, BREAKAWAY STEEL BEAM	14,099 LB		
0165	4066000000-E	903	SUPPORTS, SIMPLE STEEL BEAM	971 LB		
0166	4072000000-E	903	SUPPORTS, 3-LB STEEL U-CHANNEL	6,829 LF		
0167	4082000000-E	903	SUPPORTS, WOOD	117 LF		
0168	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (233+44 -L-)	Lump Sum	L.S.	
0169	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (279+50 -L-)	Lump Sum	L.S.	
0170	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (651+15 -L1-)	Lump Sum	L.S.	
0171	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (654+20 -L1-)	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0172	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (680+60 -L1-)	Lump Sum	L.S.	
0173	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (838+15 -L1 NORTHERN-)	Lump Sum	L.S.	
0174	4082100000-N	906	SUPPORTS, OVERHEAD SIGN STRUCTURE AT STA ***** (874+60 -L1 NORTHERN-)	Lump Sum	L.S.	
0175	4096000000-N	904	SIGN ERECTION, TYPE D	9 EA		
0176	4102000000-N	904	SIGN ERECTION, TYPE E	240 EA		
0177	4108000000-N	904	SIGN ERECTION, TYPE F	63 EA		
0178	4109000000-N	904	SIGN ERECTION, TYPE *** (OVERHEAD) (A)	11 EA		
0179	4109000000-N	904	SIGN ERECTION, TYPE *** (OVERHEAD) (B)	7 EA		
0180	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) (A)	17 EA		
0181	4110000000-N	904	SIGN ERECTION, TYPE *** (GROUND MOUNTED) (B)	10 EA		
0182	4114000000-N	904	SIGN ERECTION, MILEMARKERS	20 EA		
0183	4116100000-N	904	SIGN ERECTION, RELOCATE TYPE **** (GROUND MOUNTED) (D)	10 EA		
0184	4116100000-N	904	SIGN ERECTION, RELOCATE TYPE **** (GROUND MOUNTED) (E)	3 EA		
0185	4155000000-N	907	DISPOSAL OF SIGN SYSTEM, U-CHANNEL	33 EA		
0186	4192000000-N	907	DISPOSAL OF SUPPORT, U-CHANNEL	13 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0187	4360000000-N	SP	GENERIC SIGNING ITEM VERTICAL PANEL TYPE 3 OBJECT MARKER – OM3-C	6 EA		
0188	4360000000-N	SP	GENERIC SIGNING ITEM VERTICAL PANEL TYPE 3 OBJECT MARKER – OM3-L	19 EA		
0189	4360000000-N	SP	GENERIC SIGNING ITEM VERTICAL PANEL TYPE 3 OBJECT MARKER – OM3-R	1 EA		
0190	4400000000-E	1110	WORK ZONE SIGNS (STATIONARY)	917 SF		
0191	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	343 SF		
0192	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	498 SF		
0193	4415000000-N	1115	FLASHING ARROW BOARD	4 EA		
0194	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	7 EA		
0195	4423000000-N	SP	WORK ZONE DIGITAL SPEED LIMIT SIGNS	2 EA		
0196	4430000000-N	1130	DRUMS	1,301 EA		
0197	4445000000-E	1145	BARRICADES (TYPE III)	1,360 LF		
0198	4455000000-N	1150	FLAGGER	440 DAY		
0199	4465000000-N	1160	TEMPORARY CRASH CUSHIONS	4 EA		
0200	4470000000-N	1160	REMOVE & RESET TEMPORARY CRASH CUSHION	3 EA		
0201	4480000000-N	1165	TMA	4 EA		
0202	4485000000-E	1170	PORTABLE CONCRETE BARRIER	2,200 LF		
0203	4490000000-E	1170	PORTABLE CONCRETE BARRIER (ANCHORED)	2,120 LF		
0204	4500000000-E	1170	REMOVE AND RESET PORTABLE CON- CRETE BARRIER	2,420 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0205	4520000000-N	1266	TUBULAR MARKERS (FIXED)	50 EA		
0206	4650000000-N	1251	TEMPORARY RAISED PAVEMENT MARKERS	1,800 EA		
0207	4685000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (4", 90 MILS)	72,950 LF		
0208	4688000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (6", 90 MILS)	152,618 LF		
0209	4695000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (8", 90 MILS)	5,353 LF		
0210	4700000000-E	1205	THERMOPLASTIC PAVEMENT MARKING LINES (12", 90 MILS)	12,680 LF		
0211	4720000000-E	1205	THERMOPLASTIC PAVEMENT MARKING CHARACTER (90 MILS)	64 EA		
0212	4725000000-E	1205	THERMOPLASTIC PAVEMENT MARKING SYMBOL (90 MILS)	208 EA		
0213	4770000000-E	1205	COLD APPLIED PLASTIC PAVEMENT MARKING LINES, TYPE ** (4") (IV)	2,590 LF		
0214	4810000000-E	1205	PAINT PAVEMENT MARKING LINES (4")	426,805 LF		
0215	4815000000-E	1205	PAINT PAVEMENT MARKING LINES (6")	10,450 LF		
0216	4820000000-E	1205	PAINT PAVEMENT MARKING LINES (8")	11,875 LF		
0217	4825000000-E	1205	PAINT PAVEMENT MARKING LINES (12")	4,380 LF		
0218	4835000000-E	1205	PAINT PAVEMENT MARKING LINES (24")	1,240 LF		
0219	4840000000-N	1205	PAINT PAVEMENT MARKING CHARACTER	64 EA		
0220	4845000000-N	1205	PAINT PAVEMENT MARKING SYMBOL	138 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0221	4890000000-E	SP	GENERIC PAVEMENT MARKING ITEM POLYUREA PAVEMENT MARKING LINES, 4", 20 MILS (STANDARD GLASS BEADS)	3,223 LF		
0222	4890000000-E	SP	GENERIC PAVEMENT MARKING ITEM POLYUREA PAVEMENT MARKING LINES, 6", 20 MILS (STANDARD GLASS BEADS)	1,630 LF		
0223	4891000000-E	1205	GENERIC PAVEMENT MARKING ITEM THERMOPLASTIC PAVEMENT MARKING LINES (24", 90 MILS)	1,340 LF		
0224	4895000000-N	SP	GENERIC PAVEMENT MARKING ITEM NON-CAST IRON SNOWPLOWABLE PAVEMENT MARKER	1,520 EA		
0225	4900000000-N	1251	PERMANENT RAISED PAVEMENT MARKERS	55 EA		
0226	4935000000-N	1267	FLEXIBLE DELINEATORS (CRYSTAL)	70 EA		
0227	4940000000-N	1267	FLEXIBLE DELINEATORS (YELLOW)	70 EA		
0228	4945000000-N	1267	FLEXIBLE DELINEATORS (CRYSTAL & RED)	16 EA		
0229	4950000000-N	1267	FLEXIBLE DELINEATORS (YELLOW & RED)	12 EA		
0230	5255000000-N	1413	PORTABLE LIGHTING	Lump Sum	L.S.	
0231	5325000000-E	1510	*** WATER LINE (18")	4,874 LF		
0232	5325400000-E	1510	4" WATER LINE	15 LF		
0233	5325600000-E	1510	6" WATER LINE	297.4 LF		
0234	5326200000-E	1510	12" WATER LINE	3,912.3 LF		
0235	5326600000-E	1510	16" WATER LINE	5,657.1 LF		
0236	5329000000-E	1510	DUCTILE IRON WATER PIPE FITTINGS	35,855 LB		
0237	5540000000-E	1515	6" VALVE	4 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0238	5552000000-E	1515	10" VALVE	7	EA	
0239	5558000000-E	1515	12" VALVE	1	EA	
0240	5558600000-E	1515	16" VALVE	7	EA	
0241	5572200000-E	1515	12" TAPPING SLEEVE & VALVE	2	EA	
0242	5589100000-E	1515	1" AIR RELEASE VALVE	6	EA	
0243	5648000000-N	1515	RELOCATE WATER METER	1	EA	
0244	5649000000-N	1515	RECONNECT WATER METER	2	EA	
0245	5666000000-N	1515	FIRE HYDRANT	5	EA	
0246	5672000000-N	1515	RELOCATE FIRE HYDRANT	5	EA	
0247	5673000000-E	1515	FIRE HYDRANT LEG	80	LF	
0248	5678800000-E	1515	10" LINE STOP	4	EA	
0249	5679000000-E	1515	12" LINE STOP	3	EA	
0250	5679200000-E	1515	16" LINE STOP	4	EA	
0251	5686500000-E	1515	WATER SERVICE LINE	33.3	LF	
0252	5709200000-E	1520	4" FORCE MAIN SEWER	64	LF	
0253	5709500000-E	1520	10" FORCE MAIN SEWER	7,289.1	LF	
0254	5709600000-E	1520	12" FORCE MAIN SEWER	2,503.4	LF	
0255	5769000000-E	1520	DUCTILE IRON SEWER PIPE FITTINGS	8,835	LB	
0256	5798000000-E	1530	ABANDON *** UTILITY PIPE (4")	140.5	LF	
0257	5800000000-E	1530	ABANDON 6" UTILITY PIPE	935	LF	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0258	5804000000-E	1530	ABANDON 12" UTILITY PIPE	4,281.7 LF		
0259	5810000000-E	1530	ABANDON 16" UTILITY PIPE	9,544 LF		
0260	5815000000-N	1530	REMOVE WATER METER	12 EA		
0261	5815500000-N	1530	REMOVE FIRE HYDRANT	3 EA		
0262	5835700000-E	1540	16" ENCASEMENT PIPE	207.2 LF		
0263	5835900000-E	1540	20" ENCASEMENT PIPE	243.6 LF		
0264	5836000000-E	1540	24" ENCASEMENT PIPE	942.1 LF		
0265	5872500000-E	1550	BORE AND JACK OF *** (16")	171.6 LF		
0266	5872500000-E	1550	BORE AND JACK OF *** (20")	219.2 LF		
0267	5872500000-E	1550	BORE AND JACK OF *** (24")	238.5 LF		
0268	5872600000-E	1550	DIRECTIONAL DRILLING OF *** (12")	2,304.4 LF		
0269	5872600000-E	1550	DIRECTIONAL DRILLING OF *** (16")	516 LF		
0270	5872600000-E	1550	DIRECTIONAL DRILLING OF *** (18")	4,200.6 LF		
0271	6000000000-E	1605	TEMPORARY SILT FENCE	251,850 LF		
0272	6006000000-E	1610	STONE FOR EROSION CONTROL, CLASS A	3,850 TON		
0273	6009000000-E	1610	STONE FOR EROSION CONTROL, CLASS B	28,110 TON		
0274	6012000000-E	1610	SEDIMENT CONTROL STONE	13,640 TON		
0275	6015000000-E	1615	TEMPORARY MULCHING	245 ACR		
0276	6018000000-E	1620	SEED FOR TEMPORARY SEEDING	14,500 LB		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0277	6021000000-E	1620	FERTILIZER FOR TEMPORARY SEED- ING	74 TON		
0278	6024000000-E	1622	TEMPORARY SLOPE DRAINS	39,650 LF		
0279	6029000000-E	SP	SAFETY FENCE	39,920 LF		
0280	6030000000-E	1630	SILT EXCAVATION	134,940 CY		
0281	6036000000-E	1631	MATTING FOR EROSION CONTROL	400,000 SY		
0282	6037000000-E	SP	COIR FIBER MAT	37,285 SY		
0283	6038000000-E	SP	PERMANENT SOIL REINFORCEMENT MAT	1,400 SY		
0284	6042000000-E	1632	1/4" HARDWARE CLOTH	22,900 LF		
0285	6043000000-E	SP	LOW PERMEABILITY GEOTEXTILE	10,040 SY		
0286	6045000000-E	SP	*** TEMPORARY PIPE (36")	185 LF		
0287	6045000000-E	SP	*** TEMPORARY PIPE (42")	80 LF		
0288	6070000000-N	1639	SPECIAL STILLING BASINS	14 EA		
0289	6071012000-E	SP	COIR FIBER WATTLE	24,100 LF		
0290	6071020000-E	SP	POLYACRYLAMIDE (PAM)	9,030 LB		
0291	6071030000-E	1640	COIR FIBER BAFFLE	26,000 LF		
0292	6071050000-E	SP	*** SKIMMER (1-1/2")	21 EA		
0293	6071050000-E	SP	*** SKIMMER (2")	21 EA		
0294	6071050000-E	SP	*** SKIMMER (2-1/2")	9 EA		
0295	6071050000-E	SP	*** SKIMMER (3")	4 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0296	6071050000-E	SP	*** SKIMMER (5")	2 EA		
0297	6084000000-E	1660	SEEDING & MULCHING	245 ACR		
0298	6087000000-E	1660	MOWING	124 ACR		
0299	6090000000-E	1661	SEED FOR REPAIR SEEDING	3,000 LB		
0300	6093000000-E	1661	FERTILIZER FOR REPAIR SEEDING	13.5 TON		
0301	6096000000-E	1662	SEED FOR SUPPLEMENTAL SEEDING	8,225 LB		
0302	6108000000-E	1665	FERTILIZER TOPDRESSING	246 TON		
0303	6111000000-E	SP	IMPERVIOUS DIKE	1,142 LF		
0304	6114500000-N	1667	SPECIALIZED HAND MOWING	230 MHR		
0305	6117000000-N	SP	RESPONSE FOR EROSION CONTROL	108 EA		
0306	6117500000-N	SP	CONCRETE WASHOUT STRUCTURE	12 EA		
0307	6120000000-E	SP	CULVERT DIVERSION CHANNEL	4,100 CY		
0308	6123000000-E	1670	REFORESTATION	5 ACR		
0309	6676000000-E	SP	GENERIC PLANTING ITEM VEGETATIVE SHELF PLANTING	5,100 SF		
0310	7048500000-E	1705	PEDESTRIAN SIGNAL HEAD (16", 1 SECTION W/COUNTDOWN)	2 EA		
0311	7060000000-E	1705	SIGNAL CABLE	24,380 LF		
0312	7108000000-E	1705	VEHICLE SIGNAL HEAD (12", 1 SECTION)	14 EA		
0313	7120000000-E	1705	VEHICLE SIGNAL HEAD (12", 3 SECTION)	53 EA		
0314	7132000000-E	1705	VEHICLE SIGNAL HEAD (12", 4 SECTION)	18 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0315	7264000000-E	1710	MESSENGER CABLE (3/8")	930		LF
0316	7279000000-E	1715	TRACER WIRE	10,670		LF
0317	7300000000-E	1715	UNPAVED TRENCHING (*****) (2, 2")	10,010		LF
0318	7300000000-E	1715	UNPAVED TRENCHING (*****) (3, 2")	3,240		LF
0319	7300000000-E	1715	UNPAVED TRENCHING (*****) (4, 2")	470		LF
0320	7300100000-E	1715	UNPAVED TRENCHING FOR TEMP- ORARY LEAD-IN	1,050		LF
0321	7301000000-E	1715	DIRECTIONAL DRILL (*****) (1, 2")	160		LF
0322	7301000000-E	1715	DIRECTIONAL DRILL (*****) (2, 1-1/2")	120		LF
0323	7301000000-E	1715	DIRECTIONAL DRILL (*****) (2, 2")	1,680		LF
0324	7301000000-E	1715	DIRECTIONAL DRILL (*****) (3, 2")	660		LF
0325	7301000000-E	1715	DIRECTIONAL DRILL (*****) (4, 2")	440		LF
0326	7324000000-N	1716	JUNCTION BOX (STANDARD SIZE)	67		EA
0327	7348000000-N	1716	JUNCTION BOX (OVER-SIZED, HEA- VY DUTY)	28		EA
0328	7360000000-N	1720	WOOD POLE	7		EA
0329	7372000000-N	1721	GUY ASSEMBLY	14		EA
0330	7408000000-E	1722	1" RISER WITH WEATHERHEAD	2		EA
0331	7420000000-E	1722	2" RISER WITH WEATHERHEAD	7		EA
0332	7456000000-E	1726	LEAD-IN CABLE (*****) (14-2)	580		LF

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0333	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (48)	11,225 LF		
0334	7528000000-E	1730	DROP CABLE	600 LF		
0335	7540000000-N	1731	SPLICE ENCLOSURE	6 EA		
0336	7552000000-N	1731	INTERCONNECT CENTER	7 EA		
0337	7566000000-N	1733	DELINEATOR MARKER	27 EA		
0338	7588000000-N	SP	METAL POLE WITH SINGLE MAST ARM	8 EA		
0339	7590000000-N	SP	METAL POLE WITH DUAL MAST ARM	1 EA		
0340	7613000000-N	SP	SOIL TEST	9 EA		
0341	7614100000-E	SP	DRILLED PIER FOUNDATION	54 CY		
0342	7631000000-N	SP	MAST ARM WITH METAL POLE DE- SIGN	9 EA		
0343	7636000000-N	1745	SIGN FOR SIGNALS	48 EA		
0344	7642200000-N	1743	TYPE II PEDESTAL WITH FOUND- ATION	2 EA		
0345	7642300000-N	1743	TYPE III PEDESTAL WITH FOUND- ATION	16 EA		
0346	7648000000-N	1746	RELOCATE EXISTING SIGN	2 EA		
0347	7684000000-N	1750	SIGNAL CABINET FOUNDATION	6 EA		
0348	7696000000-N	1751	CONTROLLERS WITH CABINET (*****) (TYPE 2070E - BASE MOUNTED)	6 EA		
0349	7901000000-N	1753	CABINET BASE EXTENDER	6 EA		
0350	7948000000-N	1757	TRAFFIC SIGNAL REMOVAL	1 EA		
0351	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CAMERA EXTENSION POLE	1 EA		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0352	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV ELECTRICAL SERVICE	3 EA		
0353	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV METAL POLE (40')	3 EA		
0354	7980000000-N	SP	GENERIC SIGNAL ITEM DIGITAL CCTV CAMERA ASSEMBLY	4 EA		
0355	7980000000-N	SP	GENERIC SIGNAL ITEM DISPOSAL OF EXISTING DMS	1 EA		
0356	7980000000-N	SP	GENERIC SIGNAL ITEM DISPOSAL OF EXISTING DMS ELECTRICAL SERVICE	1 EA		
0357	7980000000-N	SP	GENERIC SIGNAL ITEM DISPOSAL OF EXISTING DMS STRUCTURE & FOUNDATION	1 EA		
0358	7980000000-N	SP	GENERIC SIGNAL ITEM DMS	6 EA		
0359	7980000000-N	SP	GENERIC SIGNAL ITEM DMS ELECTRICAL SERVICE	3 EA		
0360	7980000000-N	SP	GENERIC SIGNAL ITEM DMS STRUCTURE	3 EA		
0361	7980000000-N	SP	GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	7 EA		
0362	7980000000-N	SP	GENERIC SIGNAL ITEM FIELD EQUIPMENT CABINET	3 EA		
0363	7980000000-N	SP	GENERIC SIGNAL ITEM MICROWAVE VEHICLE DETECTION SYSTEM - MULTIPLE ZONES	18 EA		
0364	7980000000-N	SP	GENERIC SIGNAL ITEM SOIL TEST FOR CCTV POLE	3 EA		
0365	7980000000-N	SP	GENERIC SIGNAL ITEM SOIL TEST FOR DMS FOUNDATION	3 EA		
0366	7992000000-E	SP	GENERIC SIGNAL ITEM DRILLED PIER FOUNDATION FOR CCTV POLE	18 CY		
0424	5802000000-E	1530	ABANDON 10" UTILITY PIPE	9,136.5 LF		

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0425	6102000000-E	1664	SODDING	10,000	SY	
0426	6105000000-E	1664	WATER	20	M/G	
0429	7960000000-N	SP	METAL POLE FOUNDATION REMOVAL	4	EA	
0430	7972000000-N	SP	METAL POLE REMOVAL	4	EA	

CULVERT ITEMS

0367	0320000000-E	300	FOUNDATION CONDITIONING GEO-TEXTILE	9,769	SY	
0368	8035000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ***** (19+49.00 -Y30RPD-)	Lump Sum	L.S.	
0369	8056000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ***** (18+00.00 -Y32-)	Lump Sum	L.S.	
0370	8056000000-N	402	REMOVAL OF EXISTING STRUCTURE AT STATION ***** (320+01.00 -L-)	Lump Sum	L.S.	
0371	8065000000-N	SP	ASBESTOS ASSESSMENT	Lump Sum	L.S.	
0372	8126000000-N	414	CULVERT EXCAVATION, STA ***** (16+22.00 -Y30RPA-)	Lump Sum	L.S.	
0373	8126000000-N	414	CULVERT EXCAVATION, STA ***** (18+00.00 -Y32-)	Lump Sum	L.S.	
0374	8126000000-N	414	CULVERT EXCAVATION, STA ***** (19+49.00 -Y30RPD-)	Lump Sum	L.S.	
0375	8126000000-N	414	CULVERT EXCAVATION, STA ***** (19+80.00 -Y38-)	Lump Sum	L.S.	
0376	8126000000-N	414	CULVERT EXCAVATION, STA ***** (320+01.00 -L-)	Lump Sum	L.S.	
0377	8126000000-N	414	CULVERT EXCAVATION, STA ***** (612+13.00 -L1-)	Lump Sum	L.S.	

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Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0378	8126000000-N	414	CULVERT EXCAVATION, STA ***** (660+85.00 -L1-)	Lump Sum	L.S.	
0379	8126000000-N	414	CULVERT EXCAVATION, STA ***** (712+62.00 -L1-)	Lump Sum	L.S.	
0380	8133000000-E	414	FOUNDATION CONDITIONING MATERIAL, BOX CULVERT	7,053 TON		
0381	8196000000-E	420	CLASS A CONCRETE (CULVERT)	5,269.1 CY		
0382	8245000000-E	425	REINFORCING STEEL (CULVERT)	838,896 LB		

WALL ITEMS

0383	8504000000-E	460	CONCRETE BARRIER RAIL WITH MOMENT SLAB	630 LF		
0384	8801000000-E	SP	MSE RETAINING WALL NO **** (1)	5,990 SF		
0385	8801000000-E	SP	MSE RETAINING WALL NO **** (2)	1,290 SF		
0386	8801000000-E	SP	MSE RETAINING WALL NO **** (3)	6,560 SF		
0387	8801000000-E	SP	MSE RETAINING WALL NO **** (4)	3,530 SF		
0388	8839000000-E	SP	GENERIC RETAINING WALL ITEM CUSTOM BARRIER RAIL	80 LF		
0389	8847000000-E	SP	GENERIC RETAINING WALL ITEM ARCHITECTURAL SURFACE TREAT- MENT (SOUND BARRIER WALL)	516,691 SF		
0390	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND ABSORPTIVE BARRIER WALL NO -SW10-	91,231 SF		
0391	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND ABSORPTIVE BARRIER WALL NO -SW9&11-	93,961 SF		

County : Pender

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0392	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND BARRIER WALL NO -SW10-	91,231 SF		
0393	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND BARRIER WALL NO -SW22-	10,055 SF		
0394	8847000000-E	SP	GENERIC RETAINING WALL ITEM SOUND BARRIER WALL NO -SW9&11-	178,826 SF		
0395	8847000000-E	SP	GENERIC RETAINING WALL ITEM TEMPORARY SURCHARGE WALL NO 3	520 SF		
0396	8847000000-E	SP	GENERIC RETAINING WALL ITEM TEMPORARY SURCHARGE WALL NO 4	500 SF		
0427	8834000000-N	SP	GENERIC RETAINING WALL ITEM NO -SW9&11- SOUND WALL STEEL ACCESS DOOR	2 EA		
0428	8834000000-N	SP	GENERIC RETAINING WALL ITEM NO -SW10- SOUND WALL STEEL ACCESS DOOR	1 EA		

STRUCTURE ITEMS

0397	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ***** (1, 25+28.04 -Y32-)	Lump Sum	L.S.	
0398	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ***** (1, 30+17.11 -Y31-)	Lump Sum	L.S.	
0399	8091000000-N	410	FOUNDATION EXCAVATION FOR BENT ** AT STATION ***** (1, 39+82.39 -Y30-)	Lump Sum	L.S.	
0400	8112730000-N	450	PDA TESTING	8 EA		
0401	8147000000-E	420	REINFORCED CONCRETE DECK SLAB	52,701 SF		
0402	8161000000-E	420	GROOVING BRIDGE FLOORS	56,601 SF		
0403	8182000000-E	420	CLASS A CONCRETE (BRIDGE)	992.7 CY		

County : Pender

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0404	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ***** (25+28.04 -Y32-)	Lump Sum	L.S.	
0405	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ***** (30+17.11 -Y31-)	Lump Sum	L.S.	
0406	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ***** (39+82.39 -Y30-)	Lump Sum	L.S.	
0407	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ***** (658+69.17 -L1- LT)	Lump Sum	L.S.	
0408	8210000000-N	422	BRIDGE APPROACH SLABS, STATION ***** (658+69.17 -L1- RT)	Lump Sum	L.S.	
0409	8217000000-E	425	REINFORCING STEEL (BRIDGE)	154,013 LB		
0410	8238000000-E	425	SPIRAL COLUMN REINFORCING STEEL (BRIDGE)	5,405 LB		
0411	8277000000-E	430	MODIFIED 72" PRESTRESSED CONC GIRDERS	1,298.06 LF		
0412	8328200000-E	450	PILE DRIVING EQUIPMENT SETUP FOR *** STEEL PILES (HP 12 X 53)	180 EA		
0413	8328200000-E	450	PILE DRIVING EQUIPMENT SETUP FOR *** STEEL PILES (HP 14 X 73)	24 EA		
0414	8364000000-E	450	HP12X53 STEEL PILES	13,500 LF		
0415	8384000000-E	450	HP14X73 STEEL PILES	2,280 LF		
0416	8391000000-N	450	STEEL PILE POINTS	176 EA		
0417	8393000000-N	450	PILE REDRIVES	103 EA		
0418	8503000000-E	460	CONCRETE BARRIER RAIL	1,736.94 LF		
0419	8531000000-E	462	4" SLOPE PROTECTION	3,878 SY		

County : Pender

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0420	8657000000-N	430	ELASTOMERIC BEARINGS	Lump Sum	L.S.	
0421	8706000000-N	SP	EXPANSION JOINT SEALS	Lump Sum	L.S.	
0422	8860000000-N	SP	GENERIC STRUCTURE ITEM SOUND ABSORPTIVE BARRIER WALL (BRIDGE MOUNTED)	Lump Sum	L.S.	
0423	8867000000-E	SP	GENERIC STRUCTURE ITEM MODIFIED 54" PRESTRESSED CON- CRETE GIRDERS	4,176.15 LF		

1601/Jan11/Q10852229.99/D1971367842000/E430

Total Amount Of Bid For Entire Project :

6/2/2022

PAVEMENT SCHEDULE

(FINAL PAVEMENT DESIGN)

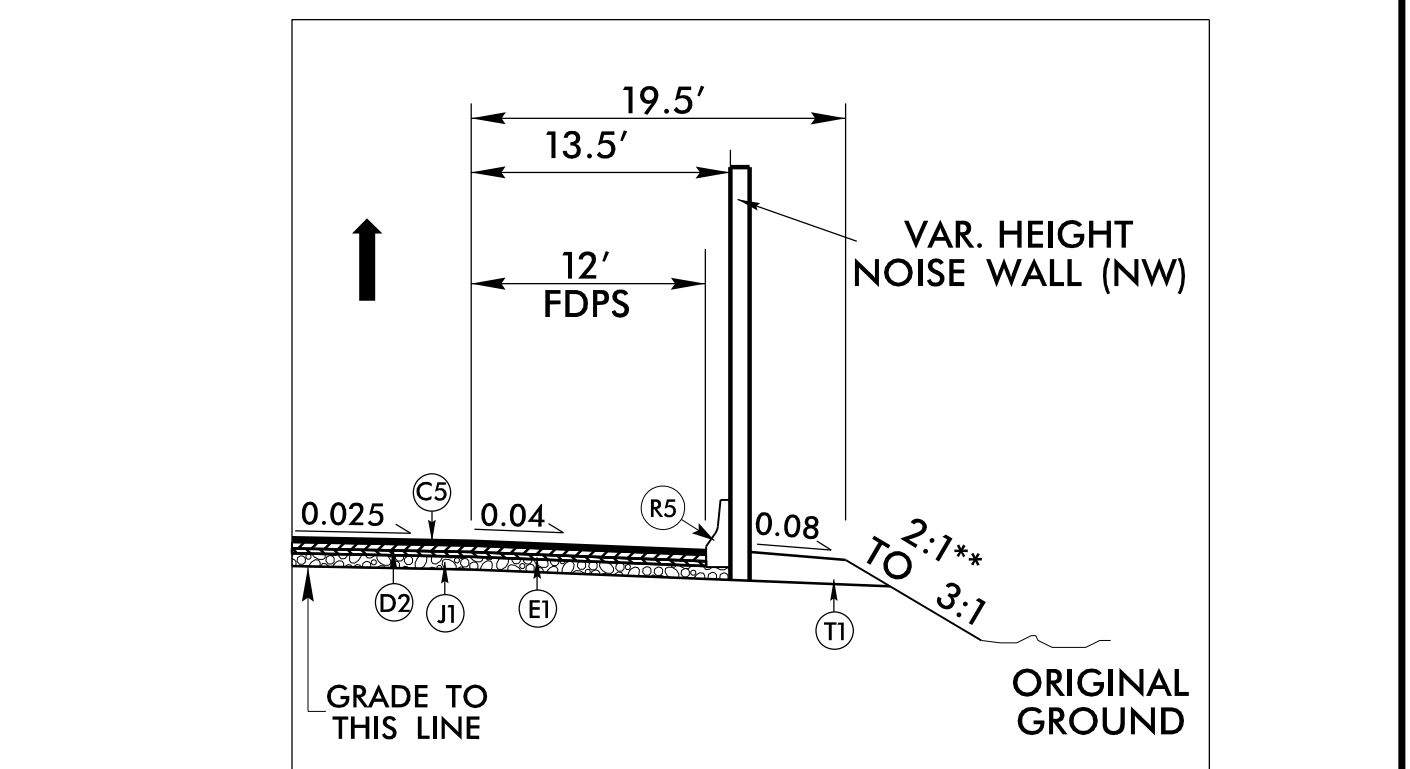
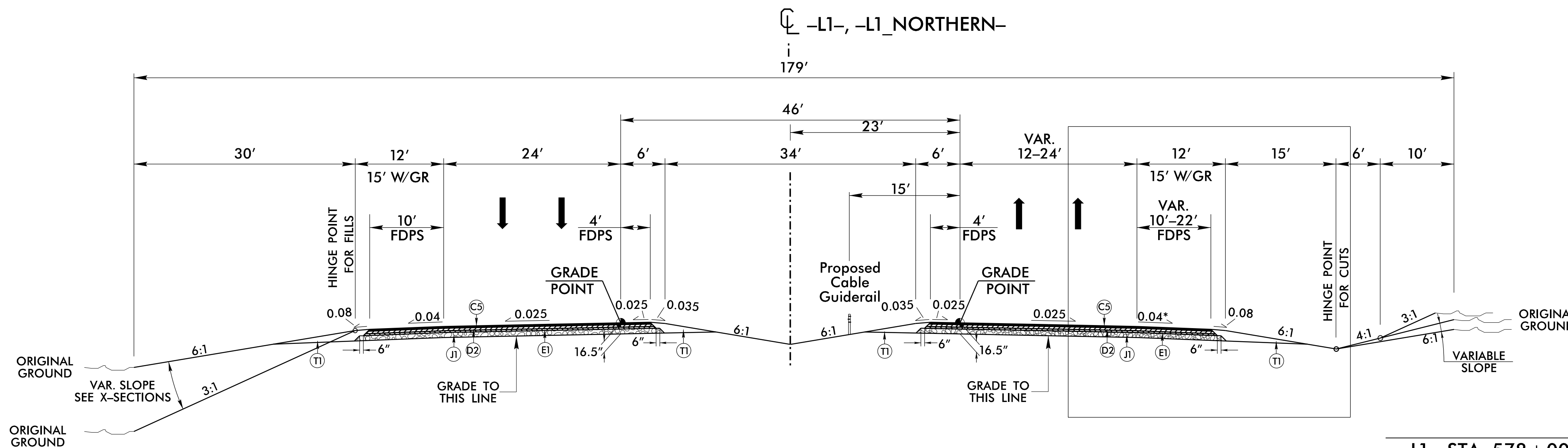
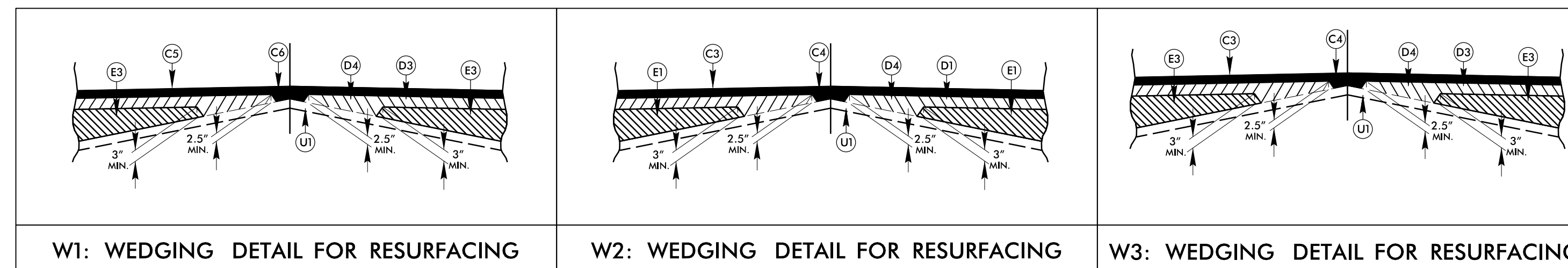
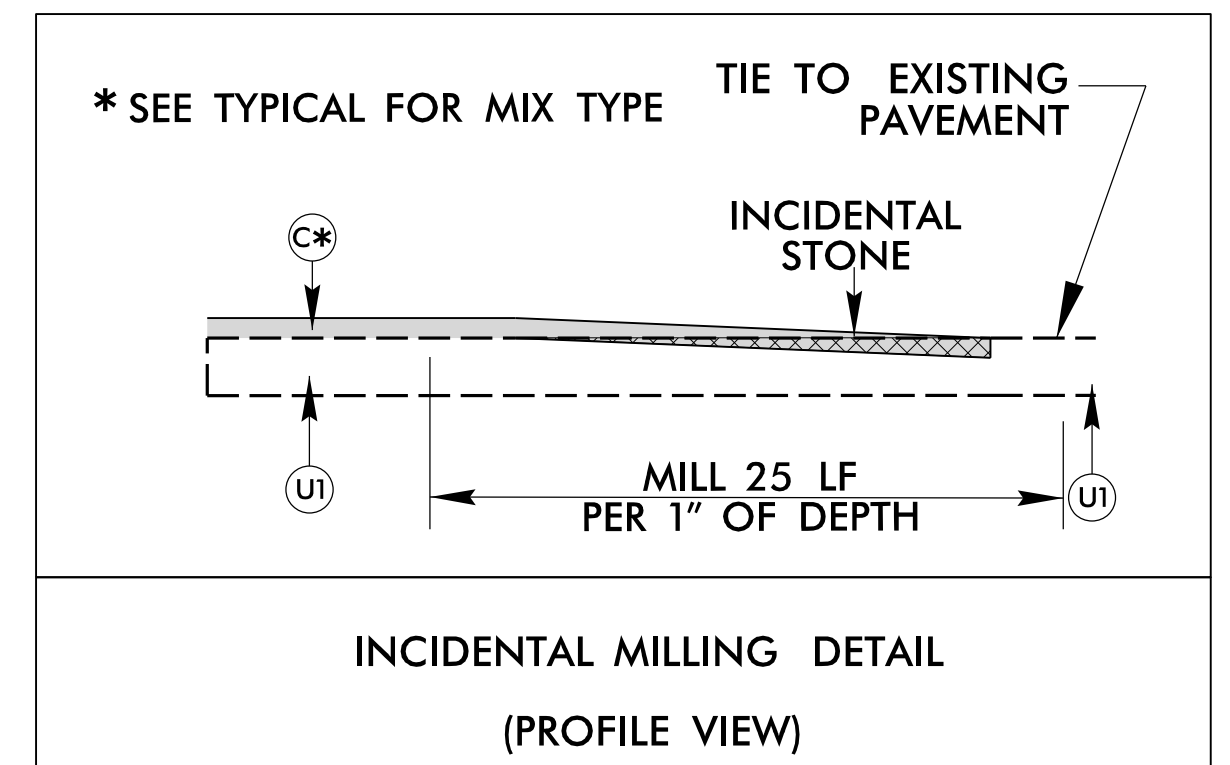
C1	PROP. APPROX. 1.5" ASPHALT CONCRETE SURFACE COURSE TYPE S9.5B, AT AN AVERAGE RATE OF 165 LBS. PER SQ. YD.	E1	PROP. APPROX. 4" ASPHALT CONCRETE BASE COURSE, TYPE B25.0C, AT AN AVERAGE RATE OF 456 LBS. PER SQ. YD.	R4	5" MONOLITHIC CONCRETE ISLAND (KEYED IN).
C2	PROP. APPROX. 2.5" ASPHALT CONCRETE SURFACE COURSE TYPE S9.5B, AT AN AVERAGE RATE OF 137.5 LBS. PER SQ. YD. IN EACH OF TWO LAYERS.	E2	PROP. APPROX. 5.5" ASPHALT CONCRETE BASE COURSE, TYPE B25.0C, AT AN AVERAGE RATE OF 627 LBS. PER SQ. YD.	R5	SINGLE FACED REINFORCED CONCRETE BARRIER.
C3	PROP. APPROX. 3" ASPHALT CONCRETE SURFACE COURSE TYPE S9.5B, AT AN AVERAGE RATE OF 165 LBS. PER SQ. YD. IN EACH OF TWO LAYERS.	E3	PROP. VAR. DEPTH ASPHALT CONCRETE BASE COURSE, TYPE B25.0C, AT AN AVERAGE RATE OF 114 LBS. PER SQ. YD. PER 1" DEPTH. TO BE PLACED IN LAYERS NOT LESS THAN 3" IN DEPTH OR GREATER THAN 5 1/2" IN DEPTH.	R6	DOUBLE FACED REINFORCED CONCRETE BARRIER.
C4	PROP. VAR. DEPTH ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, AT AN AVERAGE RATE OF 110 LBS. PER SQ. YD. PER 1" DEPTH. TO BE PLACED IN LAYERS NOT TO EXCEED 1.5" IN DEPTH.	J1	6" AGGREGATE BASE COURSE.	S1	4" CONCRETE SIDEWALK.
C5	PROP. APPROX. 3" ASPHALT CONCRETE SURFACE COURSE TYPE S9.5C, AT AN AVERAGE RATE OF 168 LBS. PER SQ. YD. IN EACH OF TWO LAYERS.	J2	8" AGGREGATE BASE COURSE.	T1	EARTH MATERIAL.
C6	PROP. VAR. DEPTH ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5C, AT AN AVERAGE RATE OF 112 LBS. PER SQ. YD. PER 1" DEPTH. TO BE PLACED IN LAYERS NOT TO EXCEED 2" IN DEPTH.	J3	10" AGGREGATE BASE COURSE.	U1	EXISTING PAVEMENT.
D1	PROP. APPROX. 2.5" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0C, AT AN AVERAGE RATE OF 285 LBS. PER SQ. YD.	J4	VAR. DEPTH AGGREGATE BASE COURSE.	V1	1.5" MILLING ASPHALT PAVEMENT
D2	PROP. APPROX. 3.5" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0C, AT AN AVERAGE RATE OF 399 LBS. PER SQ. YD.	P1	PRIME COAT.	W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAILS).
D3	PROP. APPROX. 4" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0C, AT AN AVERAGE RATE OF 456 LBS. PER SQ. YD.	R1	1'-6" CONCRETE CURB AND GUTTER.	W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAILS).
D4	PROP. VAR. DEPTH ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0C, AT AN AVERAGE RATE OF 114 LBS. PER SQ. YD. PER 1" DEPTH, TO BE PLACED IN LAYERS NOT LESS THAN 2 1/2" IN DEPTH OR GREATER THAN 4" IN DEPTH.	R2	2'-6" CONCRETE CURB AND GUTTER.	W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAILS).
		R3	2'-9" CONCRETE CURB AND GUTTER.		

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.



PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-1
ROADWAY DESIGN ENGINEER Michael D. Lindgren Professional Seal No. 025513 North Carolina License No. 025513 Date: 10/2022	PAVEMENT DESIGN ENGINEER Andrew D. Wargo Professional Seal No. 044590 North Carolina License No. 044590 Date: 10/2022
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

NOTE: AS DIRECTED BY THE ENGINEER, STABILIZE SANDY SUBGRADE MATERIAL WITH CLASS IV AGGREGATE TO PREVENT RUTTING OF THE SUBGRADE PRIOR TO PAVING DIRECTLY ON THE SUBGRADE.



USE INSET DETAIL FOR
 -L1- STA. 623+74.81 TO 699+84.72 RT (NW NO.9/11)
 -L1- STA. 638+15.43 TO 676+88.55 LT (NW NO.10)
 -L1- STA. 808+03.81 TO -Y32RPB1- STA. 13+00.26 RT (NW NO.17/18)

* VAR. SUPER ELEVATIONS SEE X-SECTIONS

**SEE ROCK PLATING DETAIL

USE TYPICAL SECTION NO. 1

-L1- STA. 578+00.00 TO TO 658+22.66 BEGIN BRIDGE
 -L1- STA. 659+17.50 END BRIDGE TO -L1- 820+00.00 BK RT
 -L1- STA. 578+00.00 TO 658+23.63 BEGIN BRIDGE
 -L1- STA. 659+19.30 END BRIDGE TO -L1- 820+00.00 BK LT
 -L1_NORTHERN- 820+00.00 AH TO -L1_NORTHERN- 874+60.24

NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.

1/4/2022 14:00:00 \\p01\proj\3300B_rdlj_tup.dgn

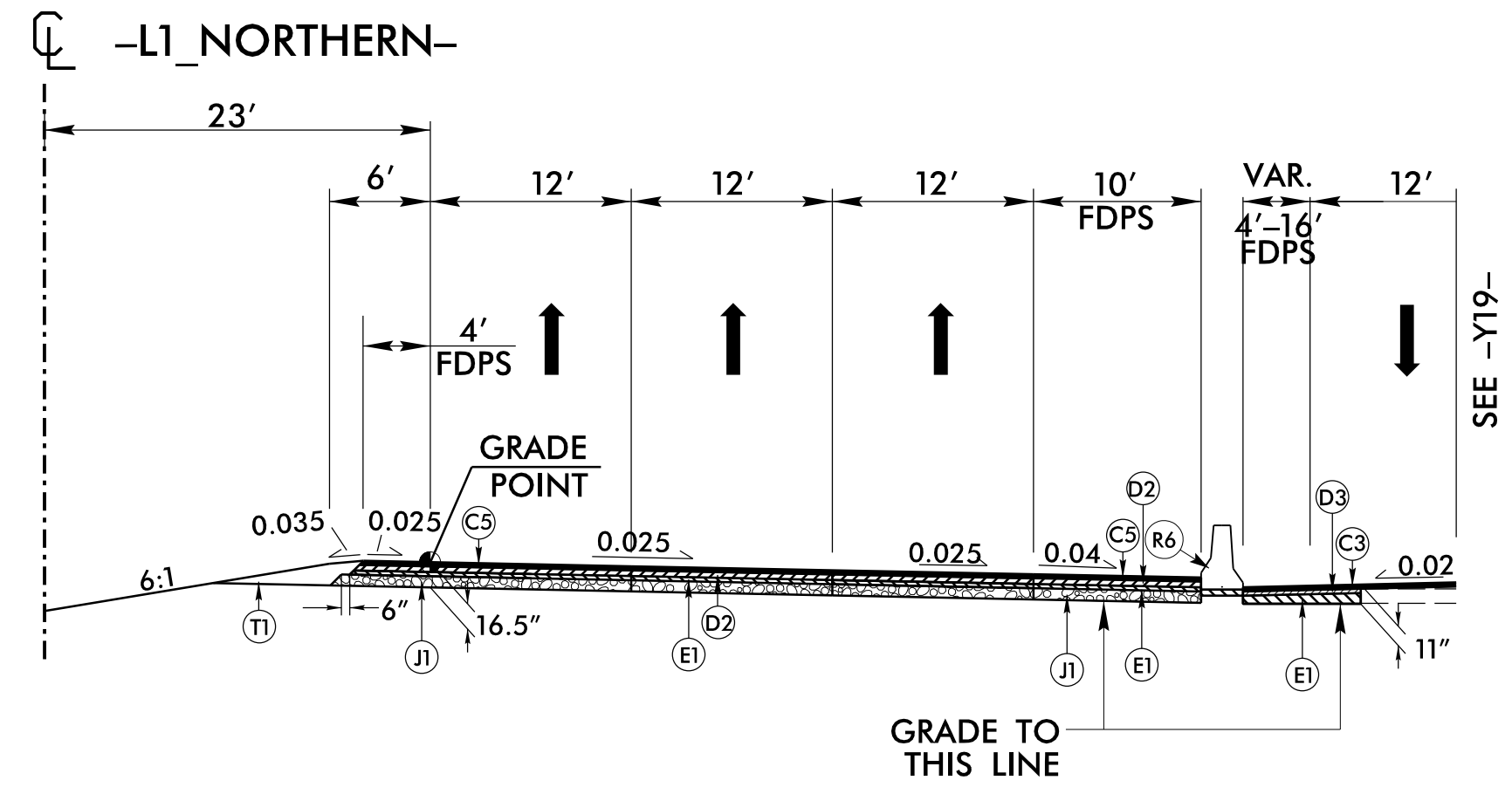
6/2/2022

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PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
E1	PROP. APPROX. 4", TYPE B25.0C
E2	PROP. APPROX. 5.5", TYPE B25.0C
E3	PROP. VAR. DEPTH, TYPE B25.0C
J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
R4	PROP. 5" MONOLITHIC CONCRETE ISLAND
R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

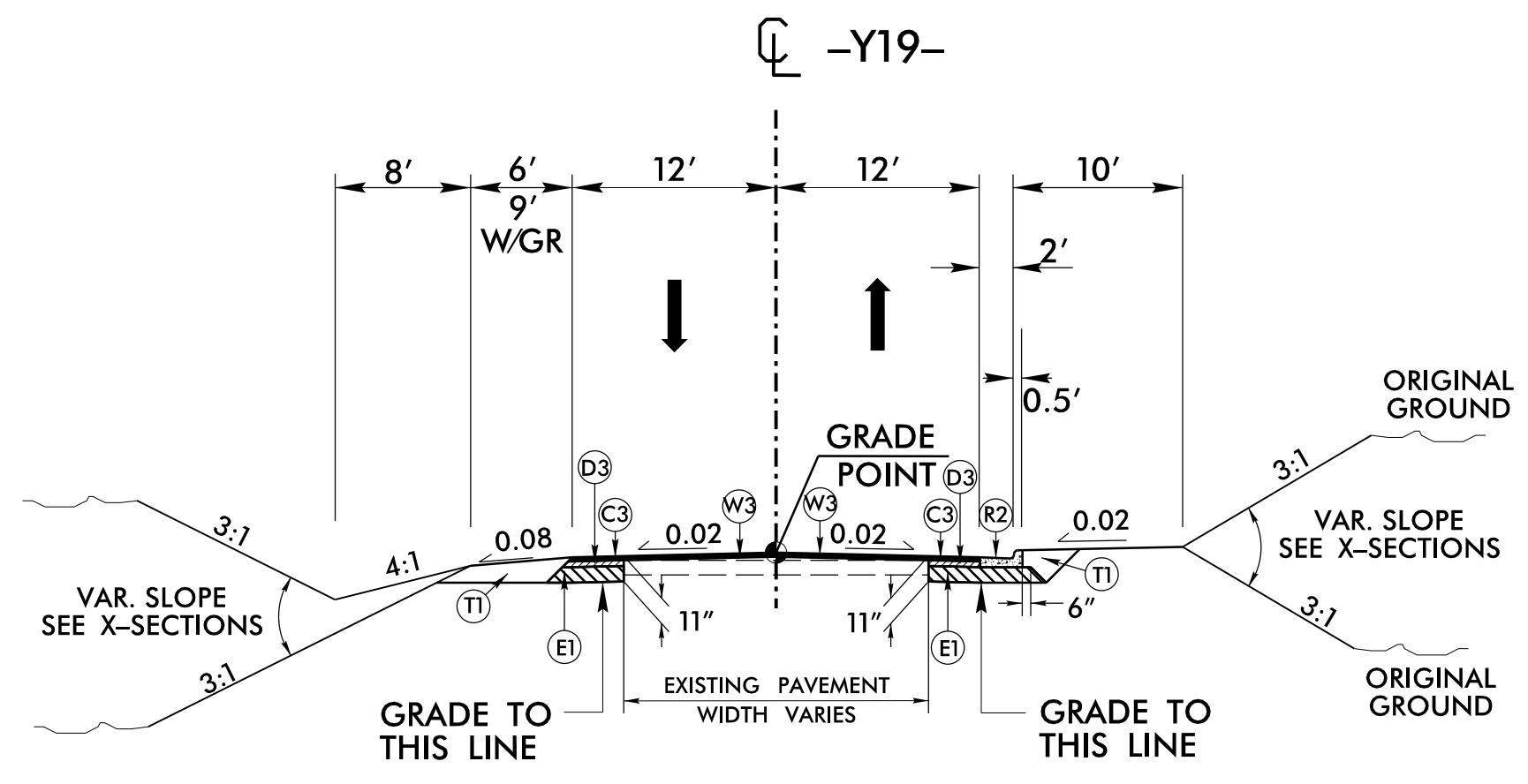
NOTES:
USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



TYPICAL SECTION NO. 2

USE TYPICAL SECTION NO. 2

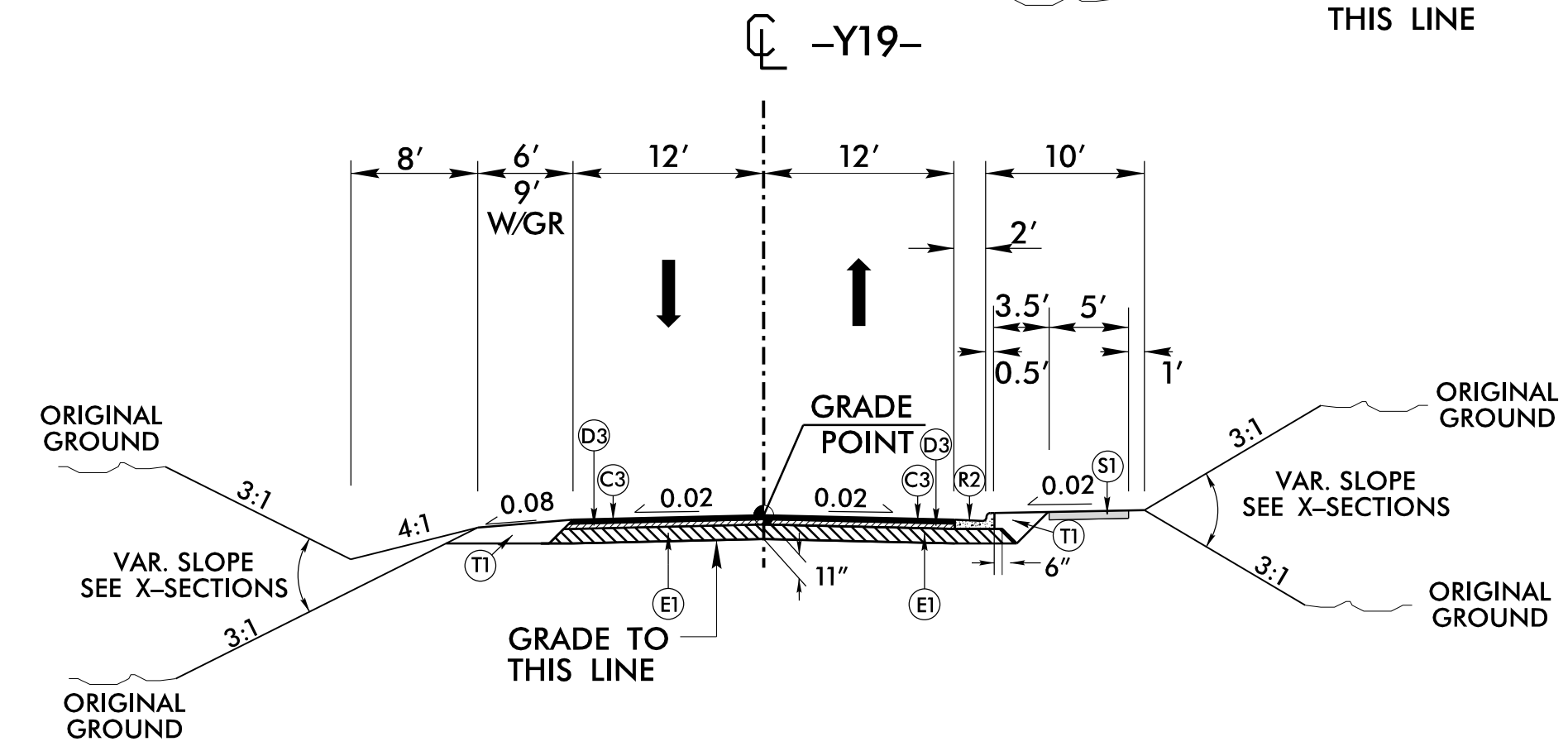
-L1_NORTHERN- STA. 866+61.46 TO -L1_NORTHERN- 874+60.24 RT



TYPICAL SECTION NO. 3

USE TYPICAL SECTION NO. 3

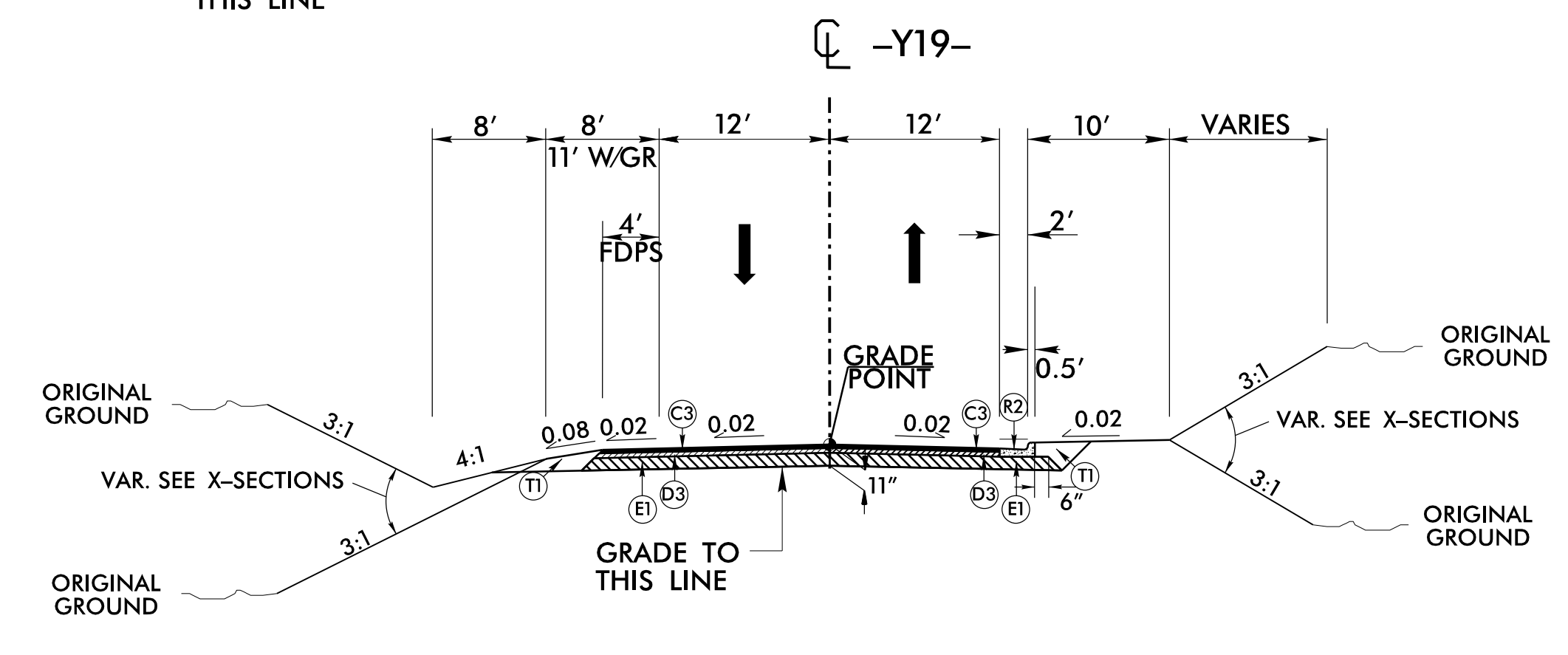
-Y19- STA. 11+27.45 TO 12+15.79
-Y19- STA. 26+34.02 TO 38+67.16



TYPICAL SECTION NO. 4

USE TYPICAL SECTION NO. 4

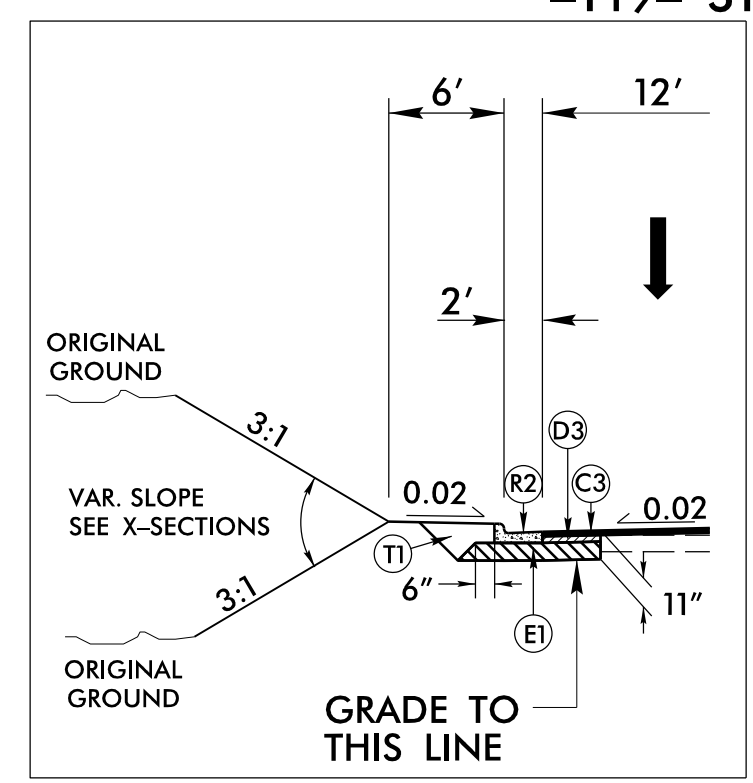
-Y19- STA. 12+15.79 TO 26+34.02
-Y19- STA. 38+67.16 TO 50+04.78



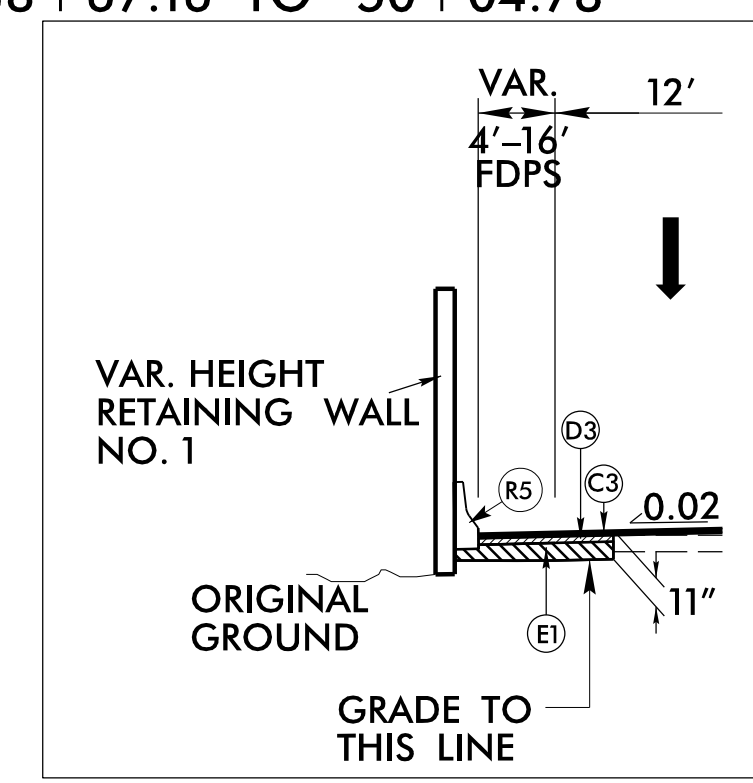
TYPICAL SECTION NO. 5

USE TYPICAL SECTION NO. 5

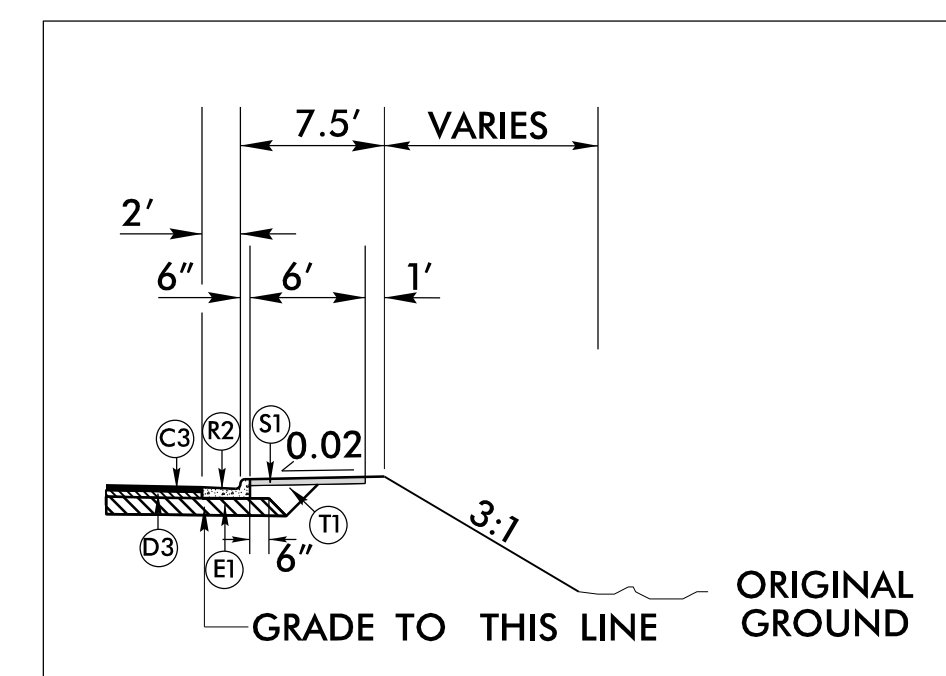
-Y19- STA. 50+04.78 TO 59+26.97



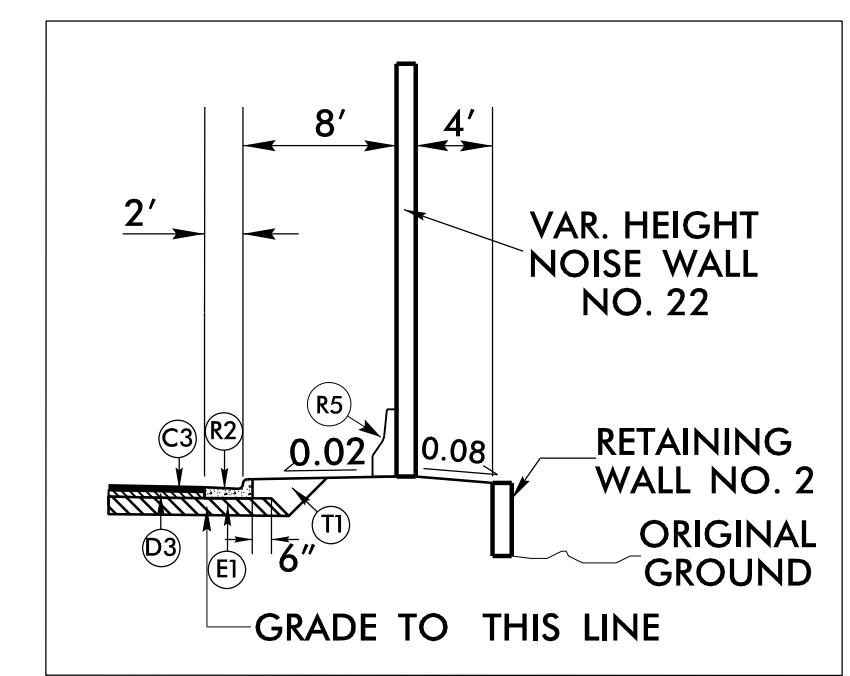
USE INSET DETAIL FOR
-Y19- STA. 11+27.45 TO 14+50.00 LT



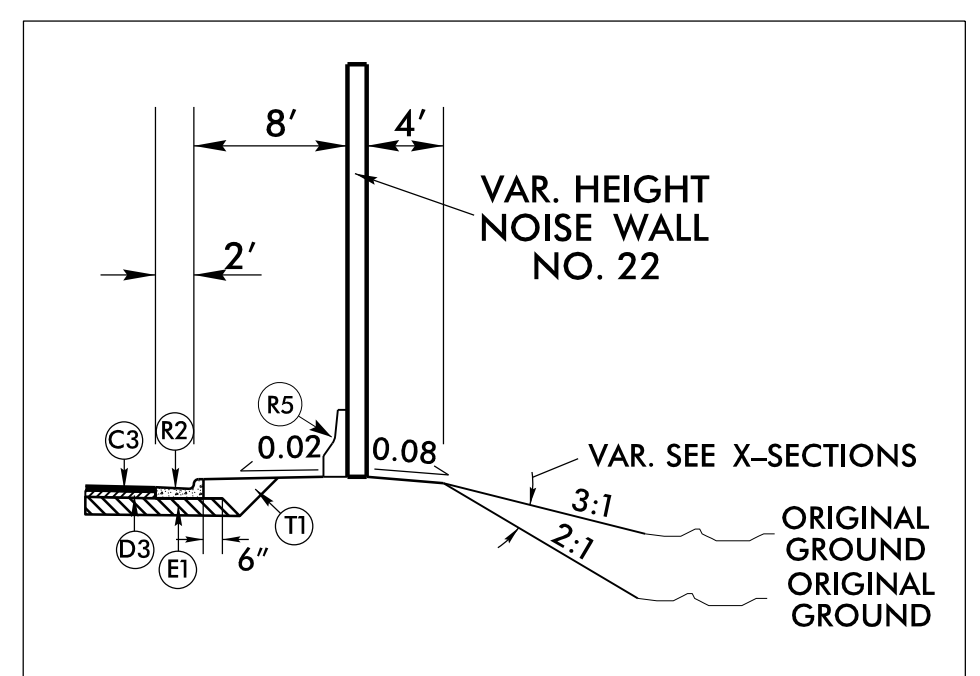
USE INSET DETAIL FOR
-Y19- STA. 37+50.00 TO 50+04.78 LT



USE INSET DETAIL FOR
-Y19- STA. 36+50.00 TO 47+85.00 RT



USE INSET DETAIL FOR
-Y19- STA. 47+85.00 TO 50+20.00 RT



USE INSET DETAIL FOR
-Y19- STA. 50+20.00 TO 55+06.18 RT

Stantec
Stantec Consulting Services Inc.
801 Jones Franklin Road
Suite 300
Raleigh, NC 27606
Tel: (919) 851-6866
Fax: (919) 851-7024
www.stantec.com
License No. F-0972

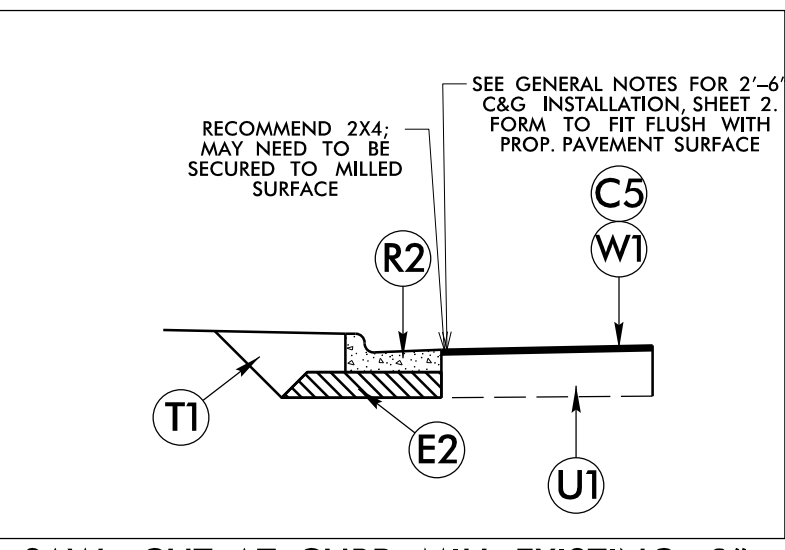
PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-2
ROADWAY DESIGN ENGINEER Michael D. Lindgren 025513	PAVEMENT DESIGN ENGINEER Andrew D. Wargo 044590
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

6/2/2022

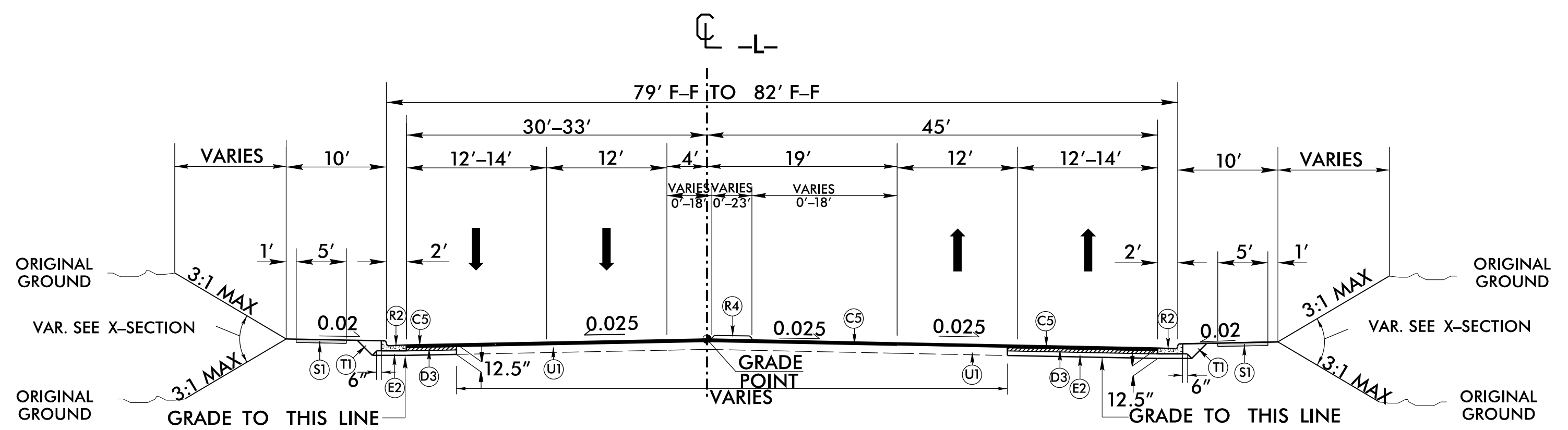
PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
E1	PROP. APPROX. 4", TYPE B25.0C
E2	PROP. APPROX. 5.5", TYPE B25.0C
E3	PROP. VAR. DEPTH, TYPE B25.0C
J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
R4	PROP. 5" MONOLITHIC CONCRETE ISLAND
R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



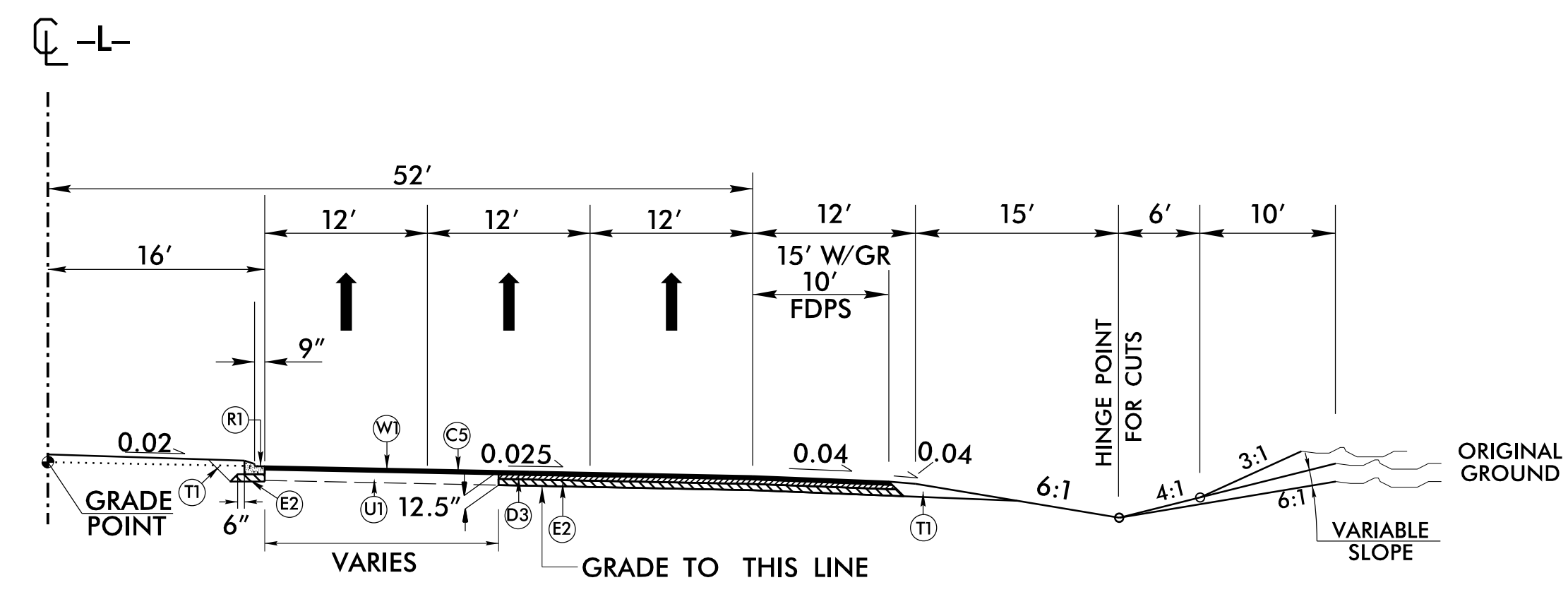
SAW CUT AT CURB; MILL EXISTING 3"; FORM CURB; PLACE 3" S9.5C



TYPICAL SECTION NO. 6

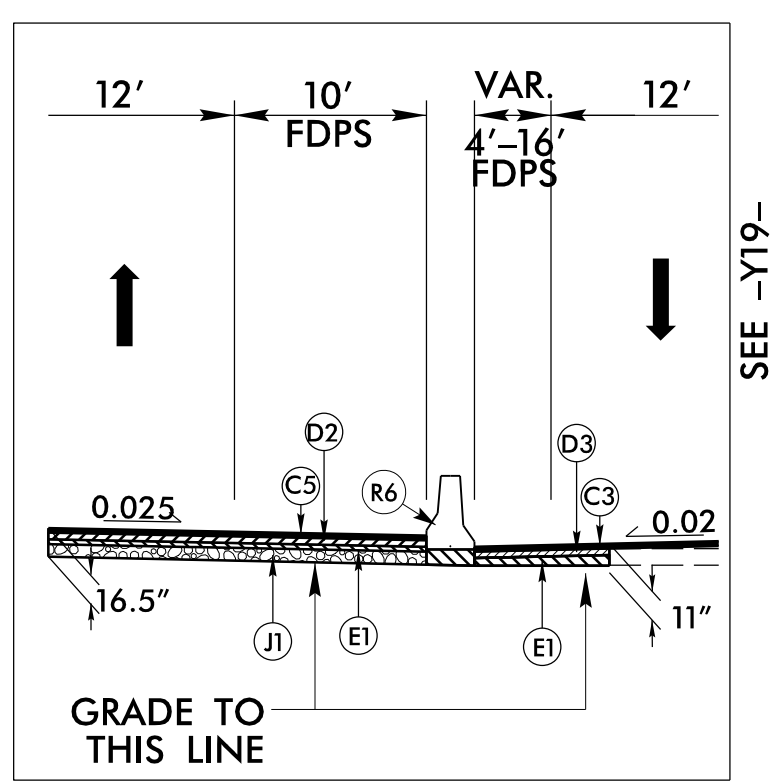
* 14' OUTSIDE LANES TO ACCOMMODATE BICYCLES
 SEE PLANS FOR SIDEWALK LOCATIONS

USE TYPICAL SECTION NO. 6
 -L- STA. 220+00.00 TO 231+00.00

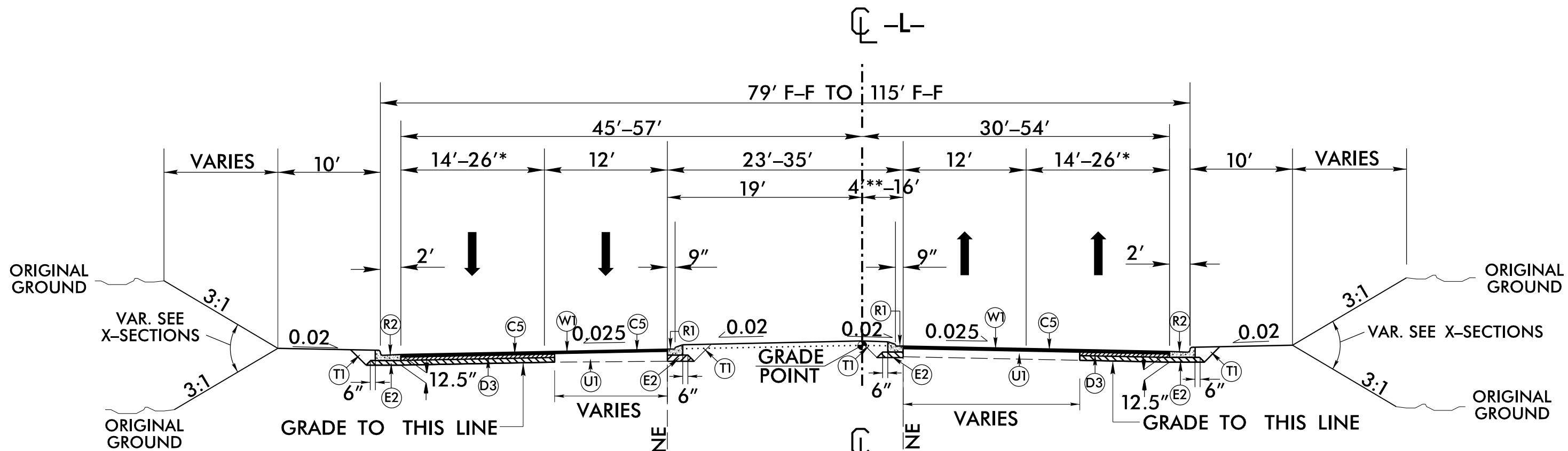


TYPICAL SECTION NO. 7

USE TYPICAL SECTION NO. 7
 -L- STA. 264+00.24 TO 268+19.69 RT



USE INSET DETAIL FOR
 -L- STA. 264+00.24 TO 268+19.69 RT



TYPICAL SECTION NO. 8

USE TYPICAL SECTION NO. 8

-L- STA. 264+00.28 TO 307+74.44
 ** TRANSITION TO 5' -L- STA. 302+95.00 TO 307+44.34

USE TYPICAL SECTION NO. 8-A IN CONJUNCTION WITH TYPICAL SECTION NO. 7
 SEE PLANS FOR MEDIAN TURN LANES

TYPICAL SECTION NO. 8-A



PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-3
ROADWAY DESIGN ENGINEER MICHAEL D. LINDGREN 025513 1/10/2022	PAVEMENT DESIGN ENGINEER JEREMY R. HAWKINS 39779 1/10/2022
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

6/2/2022
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6/2/2022

PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
E1	PROP. APPROX. 4", TYPE B25.0C
E2	PROP. APPROX. 5.5", TYPE B25.0C
E3	PROP. VAR. DEPTH, TYPE B25.0C
J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
R4	PROP. 5" MONOLITHIC CONCRETE ISLAND
R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

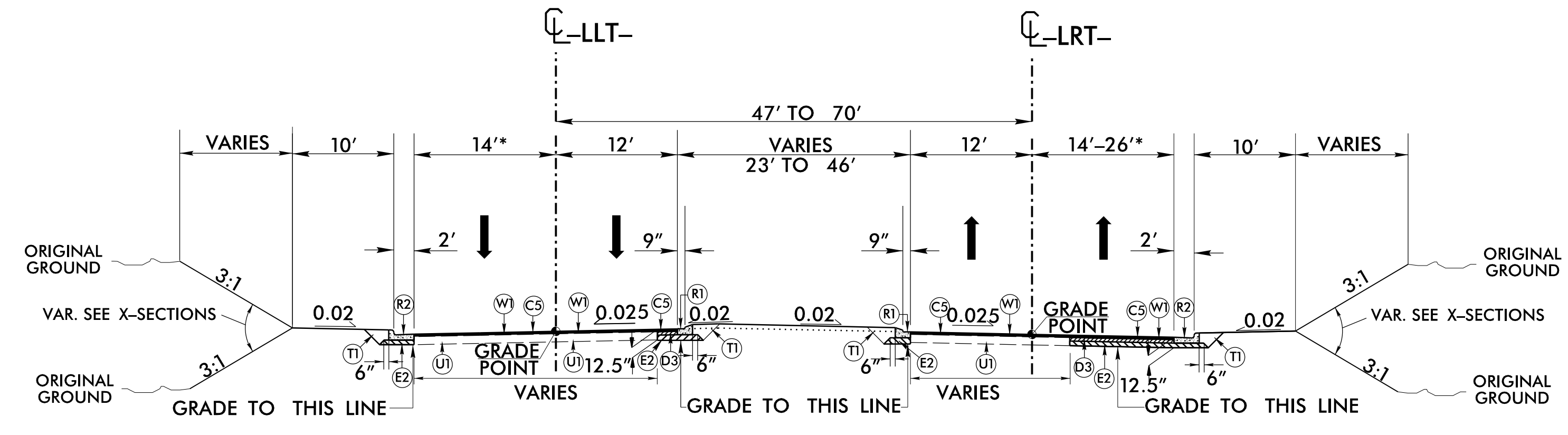
NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



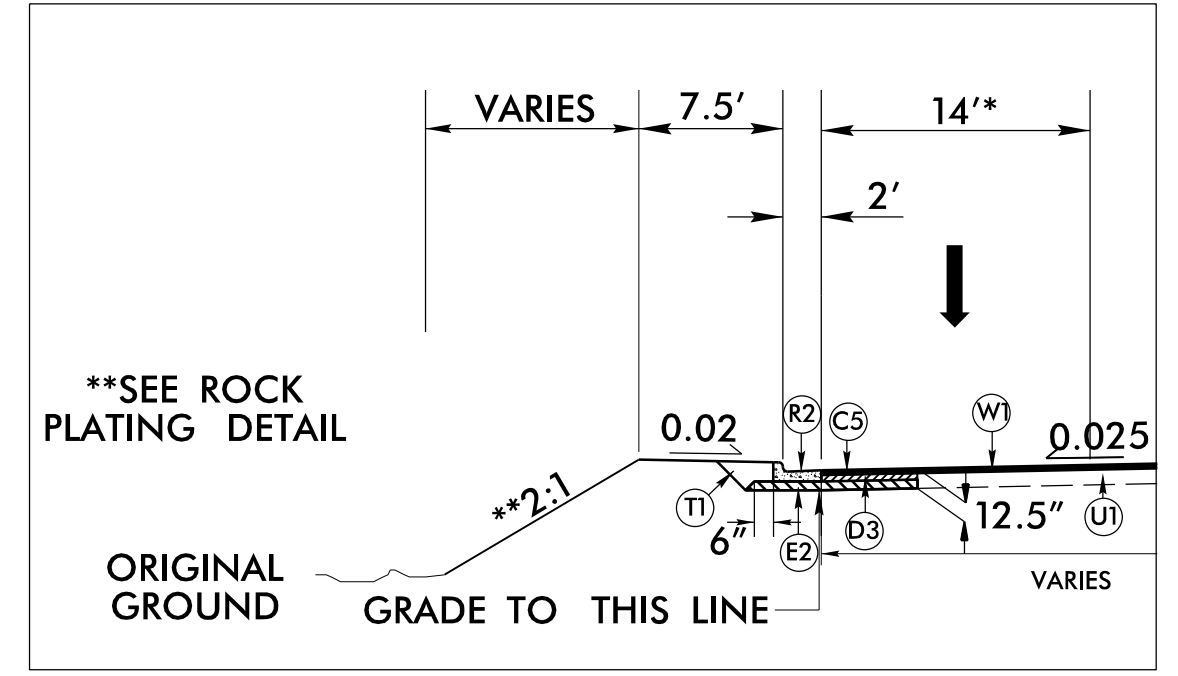
PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-4
ROADWAY DESIGN ENGINEER 	PAVEMENT DESIGN ENGINEER
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

* 14' OUTSIDE LANES TO ACCOMMODATE BICYCLES

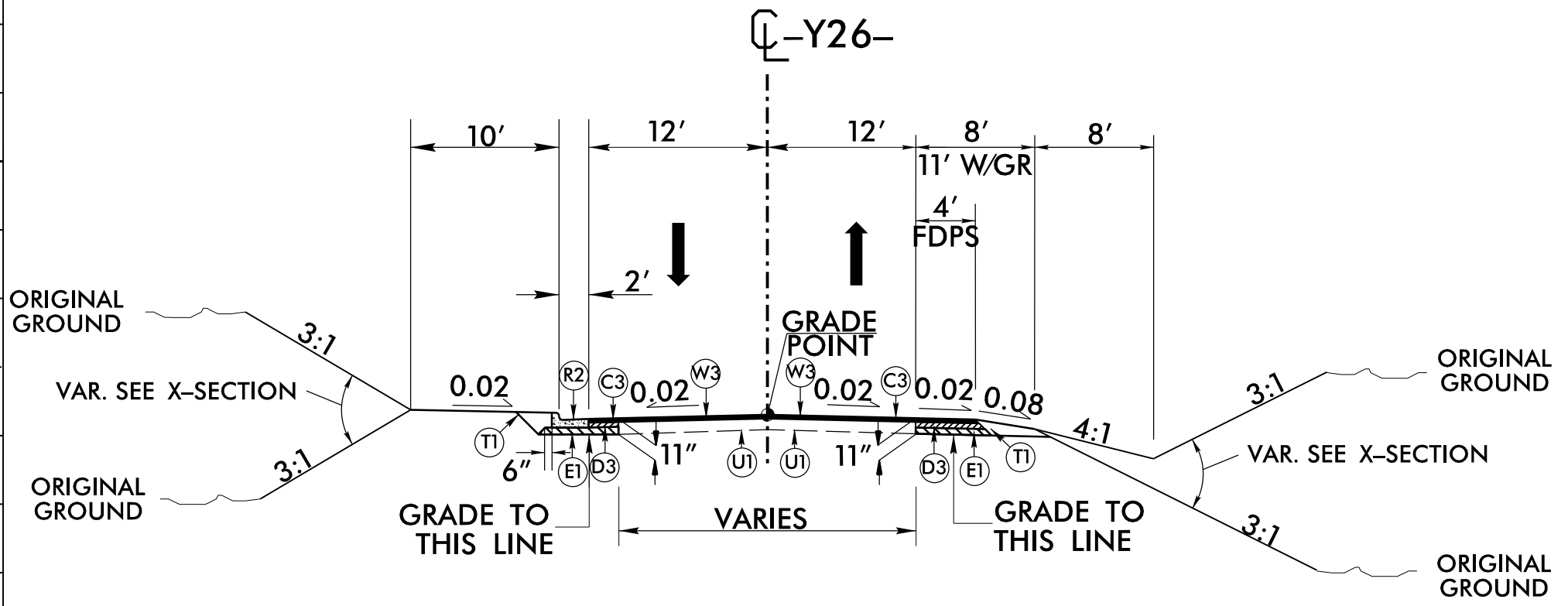


TYPICAL SECTION NO. 9

USE TYPICAL SECTION NO. 9
 -LLT- STA. 307+44.34 TO 332+55.00
 -LRT- STA. 307+44.34 TO 332+55.00

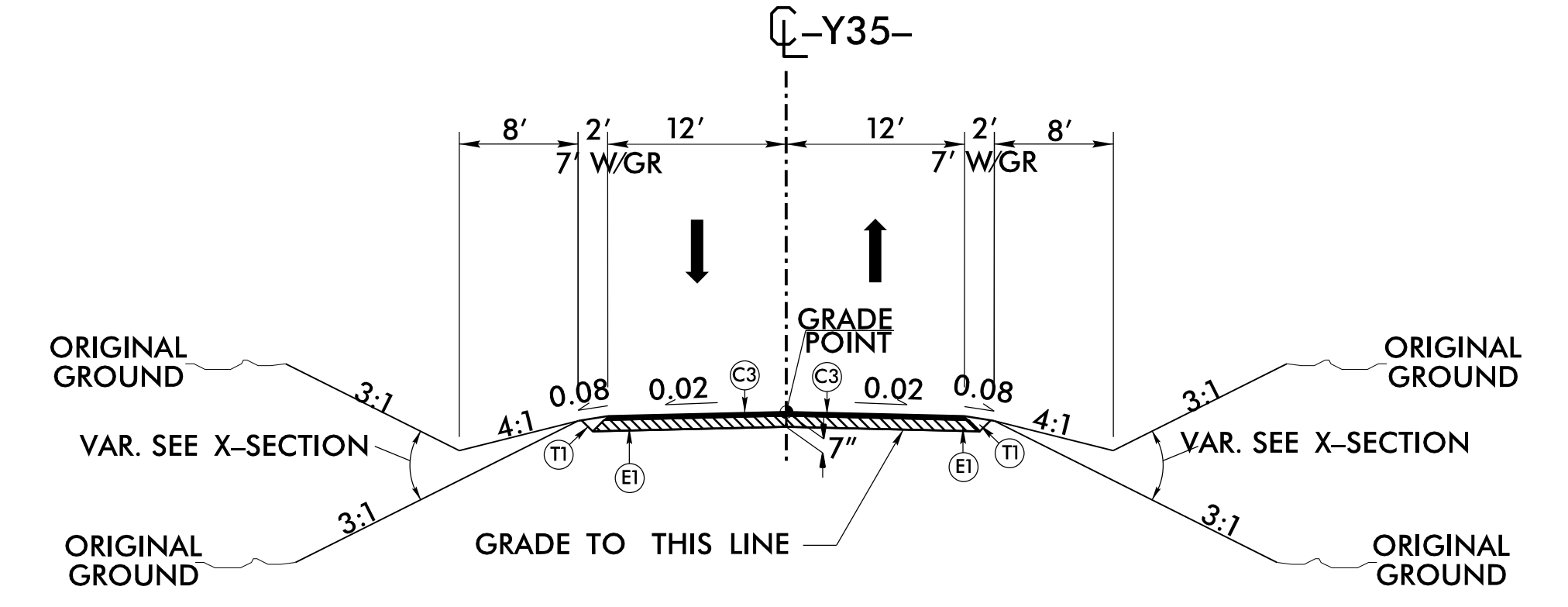


USE INSET DETAIL FOR
 -LLT- STA. 319+50.00 TO 324+00.00 LT
 -LRT- STA. 319+50.00 TO 321+00.00 RT



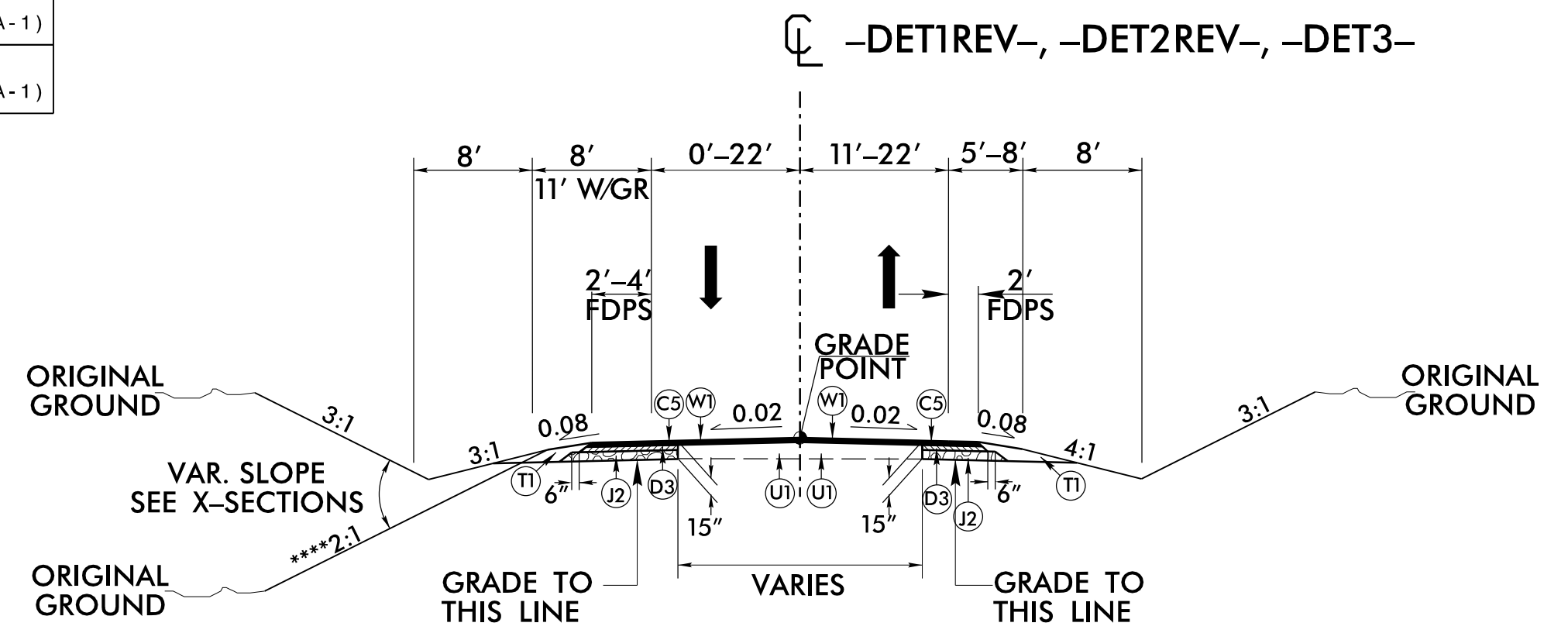
TYPICAL SECTION NO. 10

USE TYPICAL SECTION NO. 10
 -Y26- STA. 10+26.05 TO 12+25.00 LT



TYPICAL SECTION NO. 11

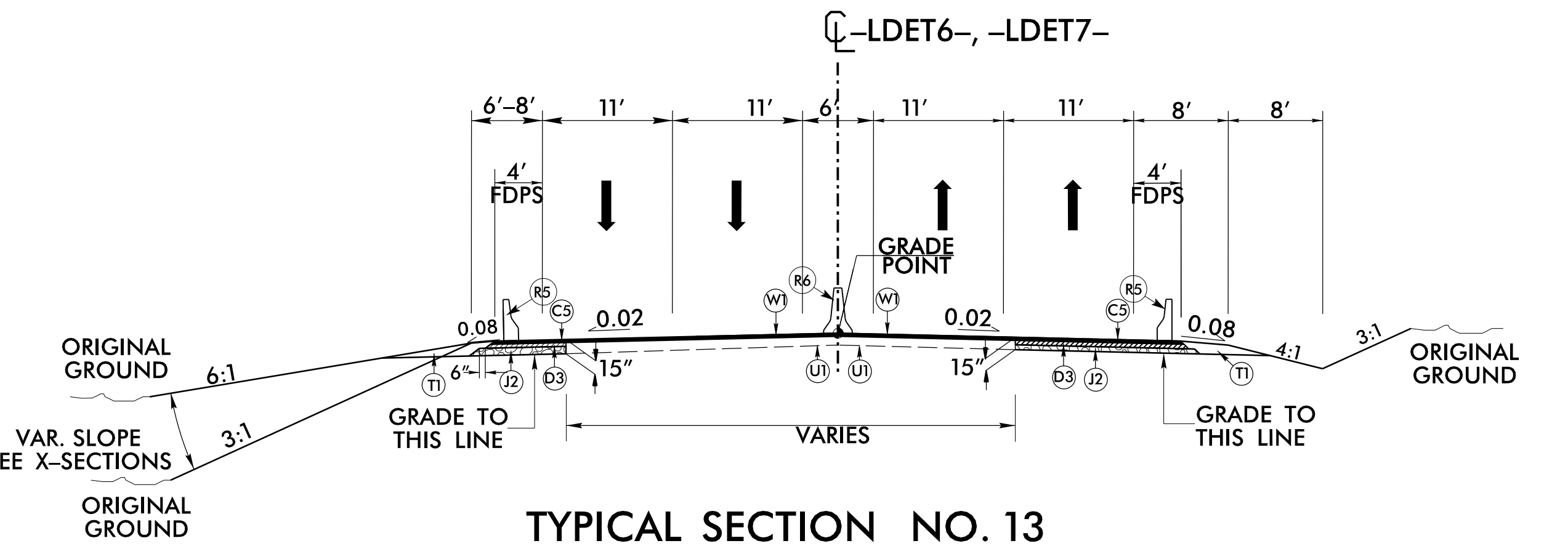
USE TYPICAL SECTION NO. 11
 -Y35- STA. 10+80.00 TO 11+62.88



TYPICAL SECTION NO. 12

USE TYPICAL SECTION NO. 12
 -DET1- STA. 13+72.19 TO 20+90.85
 -DET2- STA. 13+12.01 TO 16+82.80
 -DET3- STA. 10+00.00 TO 17+00.11

****2:1 FILL SLOPE IN WETLAND



TYPICAL SECTION NO. 13

USE TYPICAL SECTION NO. 13
 -LDET6- STA. 323+54.19 TO 325+89.90
 -LDET7- STA. 316+34.34 TO 323+43.88

NOTE: TEMPORARY CONCRETE BARRIERS ARE TRAFFIC CONTROL PAY ITEMS

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6/2/2022

1/4/2022
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PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
E1	PROP. APPROX. 4", TYPE B25.0C
E2	PROP. APPROX. 5.5", TYPE B25.0C
E3	PROP. VAR. DEPTH, TYPE B25.0C
J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
R4	PROP. 5" MONOLITHIC CONCRETE ISLAND
R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

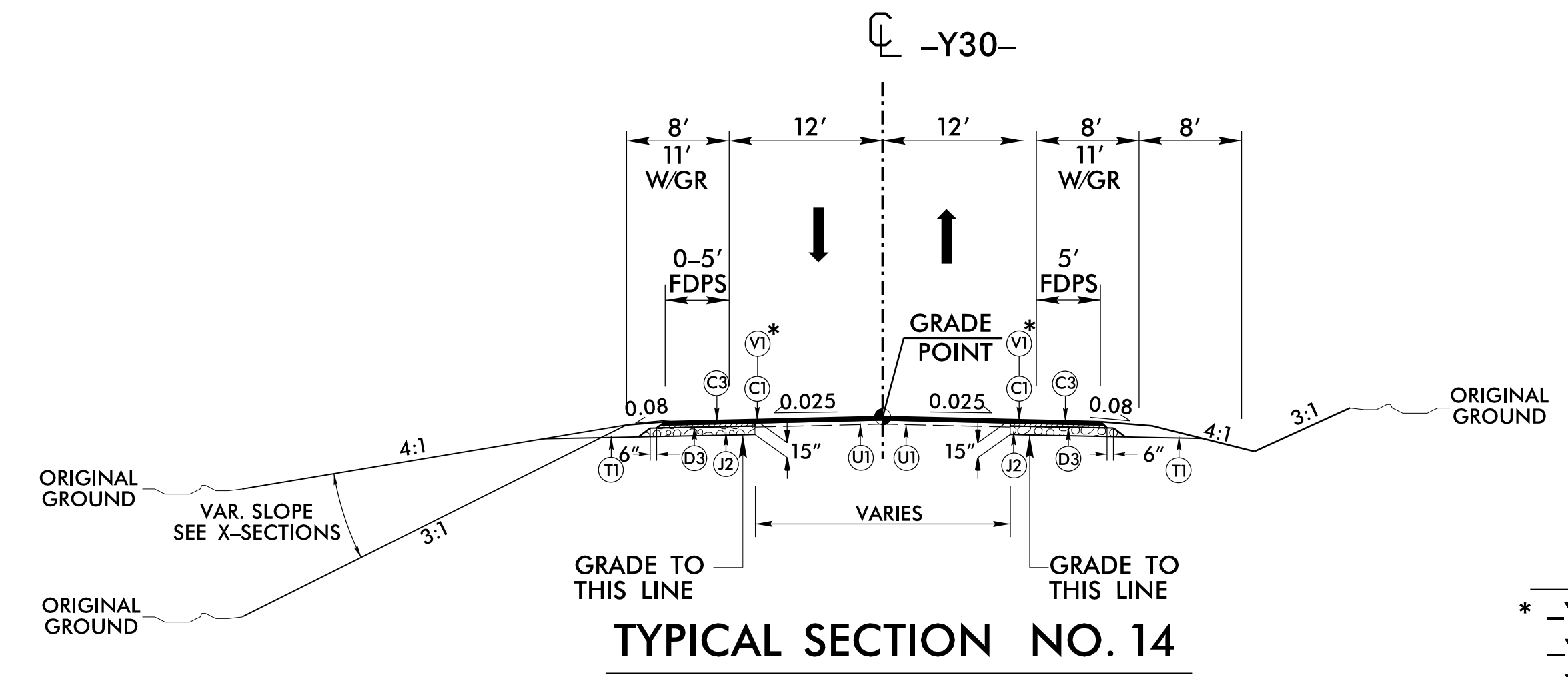
NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.

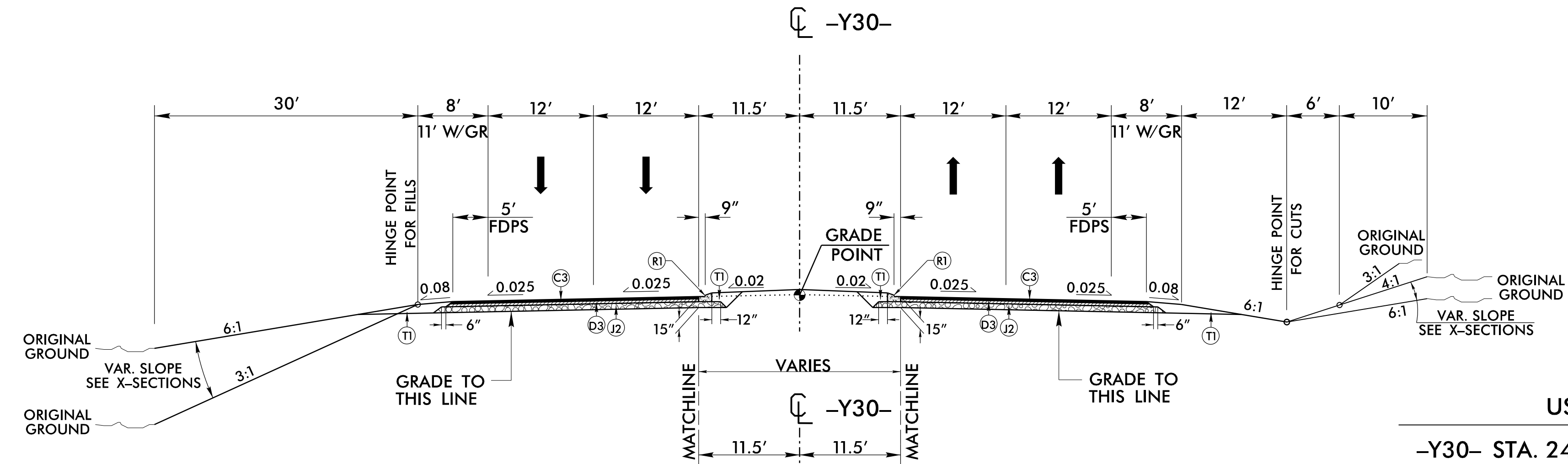


PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-5
ROADWAY DESIGN ENGINEER Michael D. Wargo 025513 10/2022	PAVEMENT DESIGN ENGINEER Michael D. Wargo 044590 10/2022

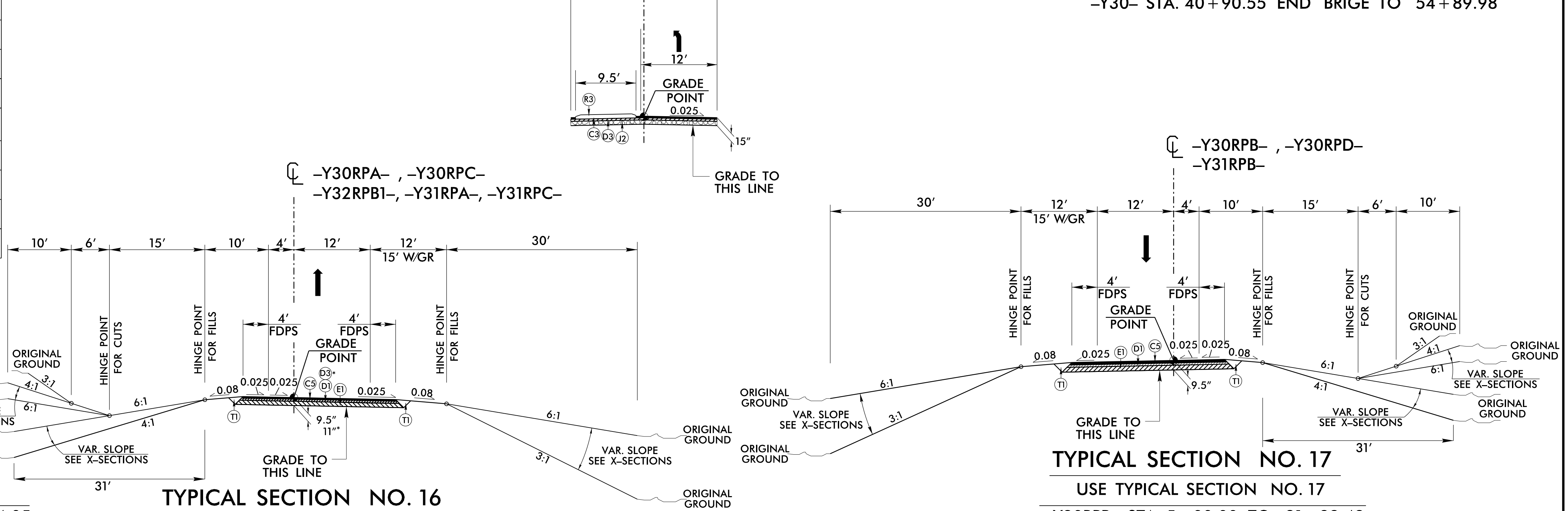
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



USE TYPICAL SECTION NO. 14
 * -Y30- STA. 19+25.00 TO 22+25.00
 -Y30- STA. 22+25.00 TO 24+75.01
 -Y30- STA. 54+89.98 TO 59+00.00



USE TYPICAL SECTION NO. 15
 -Y30- STA. 24+75.01 TO 38+74.22 BEGIN BRIDGE
 -Y30- STA. 40+90.55 END BRIDGE TO 54+89.98



USE TYPICAL SECTION NO. 16
 -Y30RPA- STA. 5+00.00 TO 25+04.05
 -Y30RPC- STA. 5+00.00 TO 25+88.12
 -Y32RPB1- STA. 5+00.00 TO 22+88.82 * USE D3
 -Y31RPA- STA. 5+00.00 TO 15+90.57
 -Y31RPC- STA. 5+00.00 TO 23+22.89

USE TYPICAL SECTION NO. 17
 -Y30RPB- STA. 5+00.00 TO 21+88.48
 -Y30RPD- STA. 5+00.00 TO 23+80.39
 -Y31RPB- STA. 5+00.00 TO 19+59.39

6/2/2022

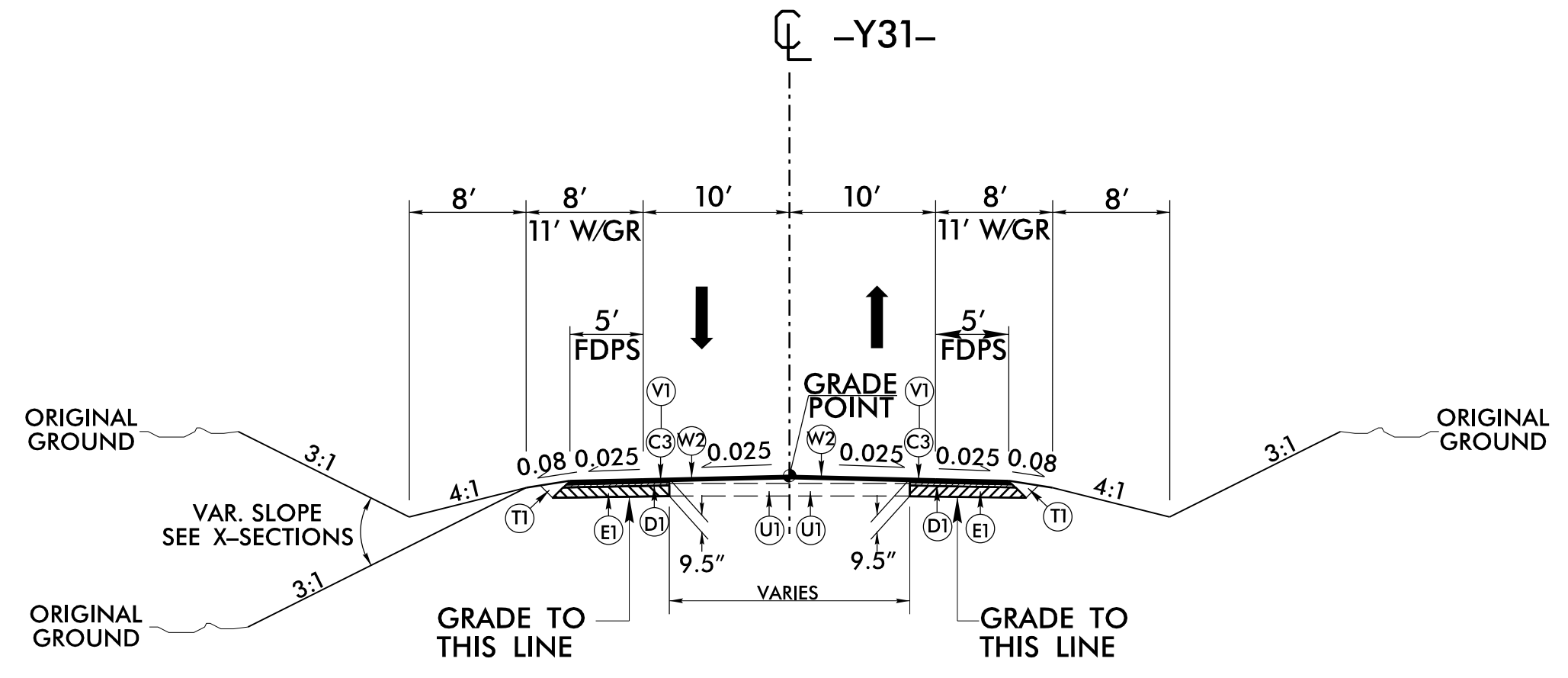
PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
E1	PROP. APPROX. 4", TYPE B25.0C
E2	PROP. APPROX. 5.5", TYPE B25.0C
E3	PROP. VAR. DEPTH, TYPE B25.0C
J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
R4	PROP. 5" MONOLITHIC CONCRETE ISLAND
R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

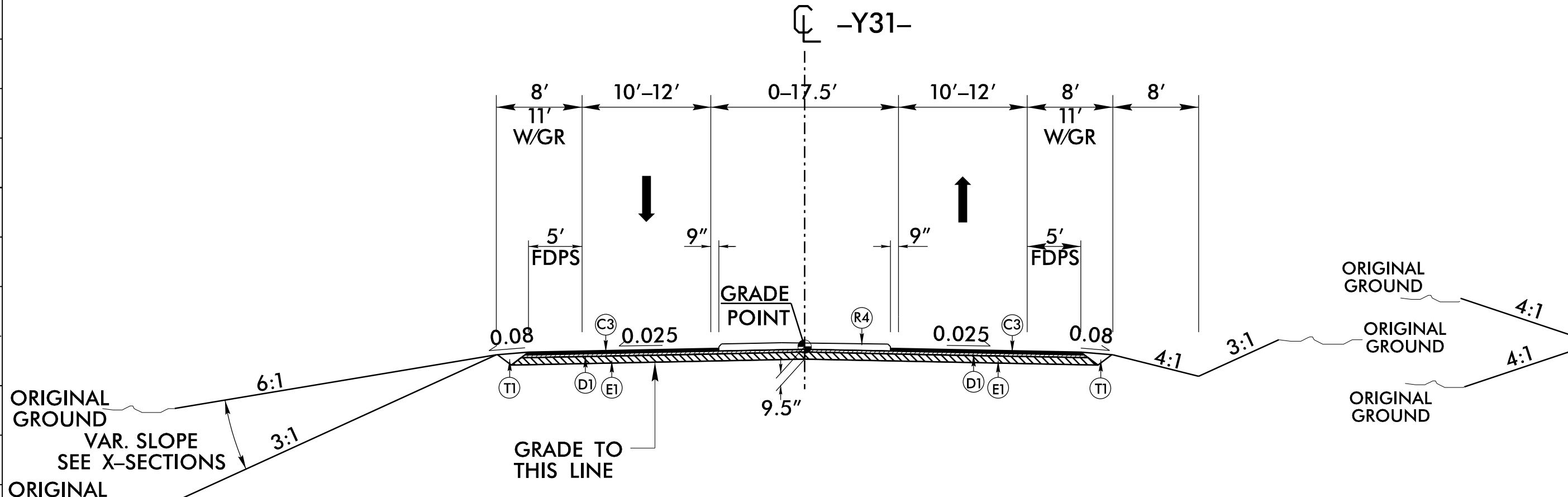
NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



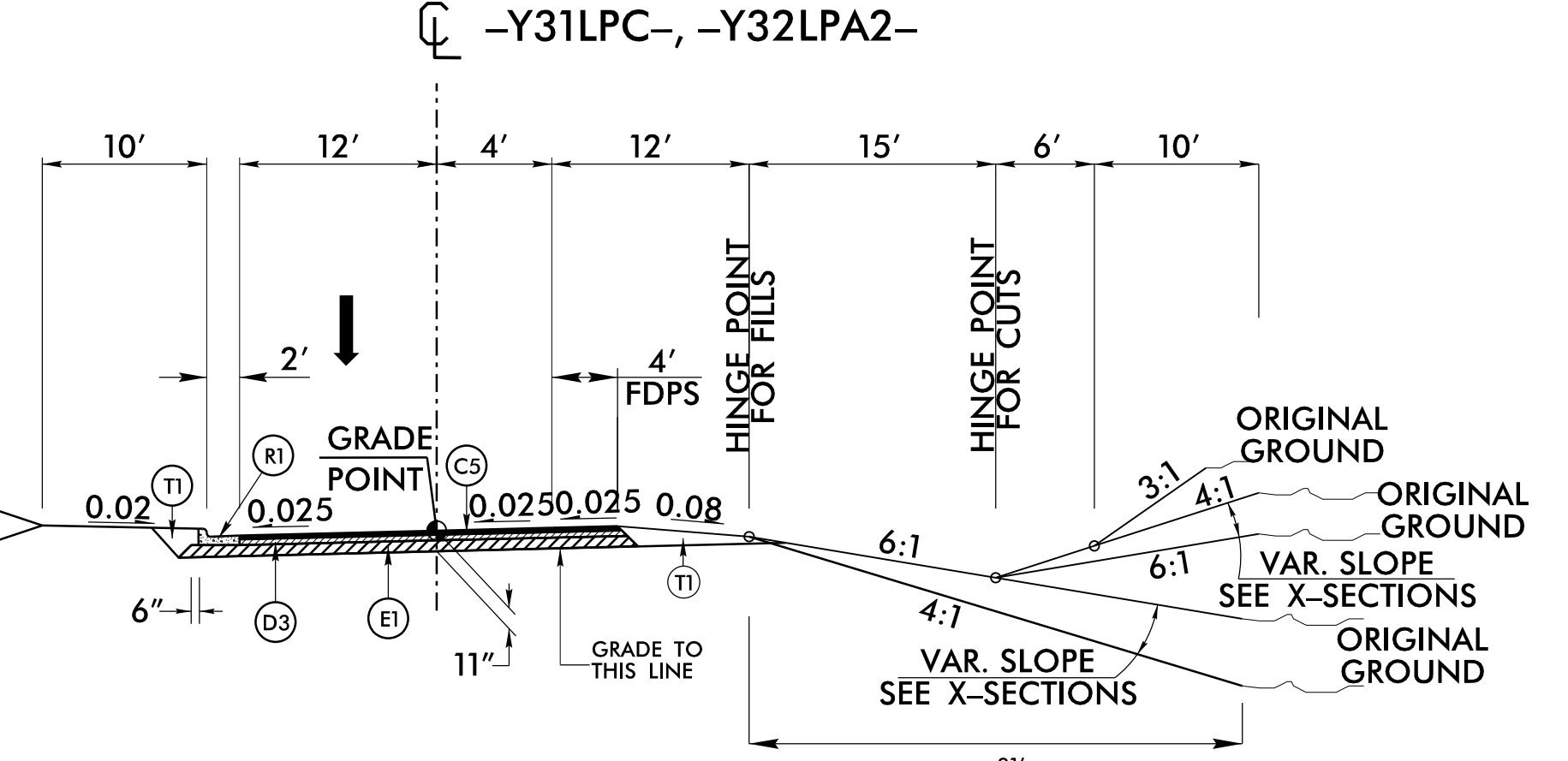
PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-6
ROADWAY DESIGN ENGINEER MICHAEL D. LINDGREN 025513 1/10/2022	PAVEMENT DESIGN ENGINEER ANDREW D. WARGO 044590 1/11/2022
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



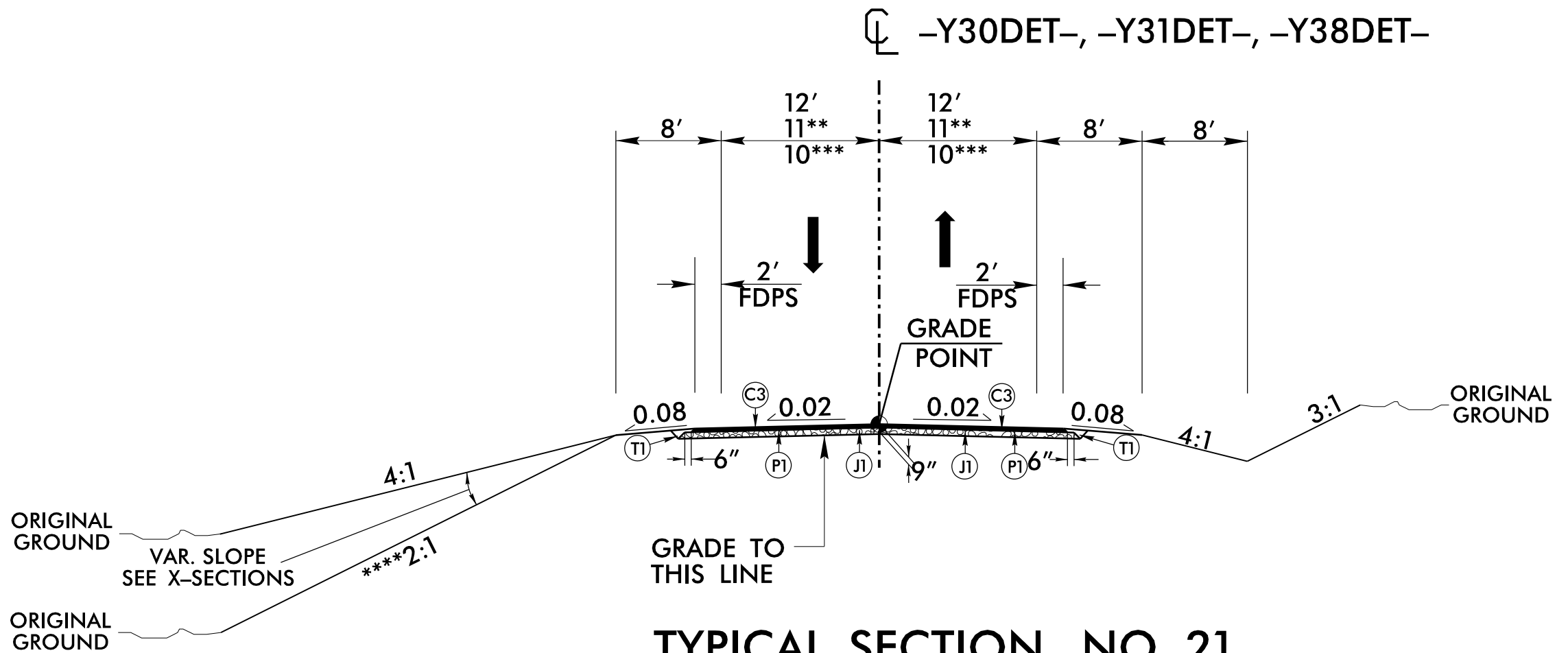
TYPICAL SECTION NO. 18
 USE TYPICAL SECTION NO. 18
 -Y31- STA. 18+20.70 TO 21+00.00
 -Y31- STA. 45+60.00 TO 46+75.00



TYPICAL SECTION NO. 19
 USE TYPICAL SECTION NO. 19
 -Y31- STA. 21+00.00 TO 29+13.36 BEGIN BRIDGE
 -Y31- STA. 31+33.86 END BRIDGE TO 45+60.00



TYPICAL SECTION NO. 20
 USE TYPICAL SECTION NO. 20
 -Y31LPC- STA. 5+00.00 TO 14+40.19
 -Y32LPA2- STA. 5+00.00 TO 14+33.19



TYPICAL SECTION NO. 21
 USE TYPICAL SECTION NO. 21
 -Y30DET- STA. 16+72.60 TO 62+57.50
 ** -Y31DET- STA. 18+20.70 TO 47+13.23
 *** -Y38DET- STA. 10+00.00 TO 17+62.67

****2:1 FILL SLOPE IN WETLAND

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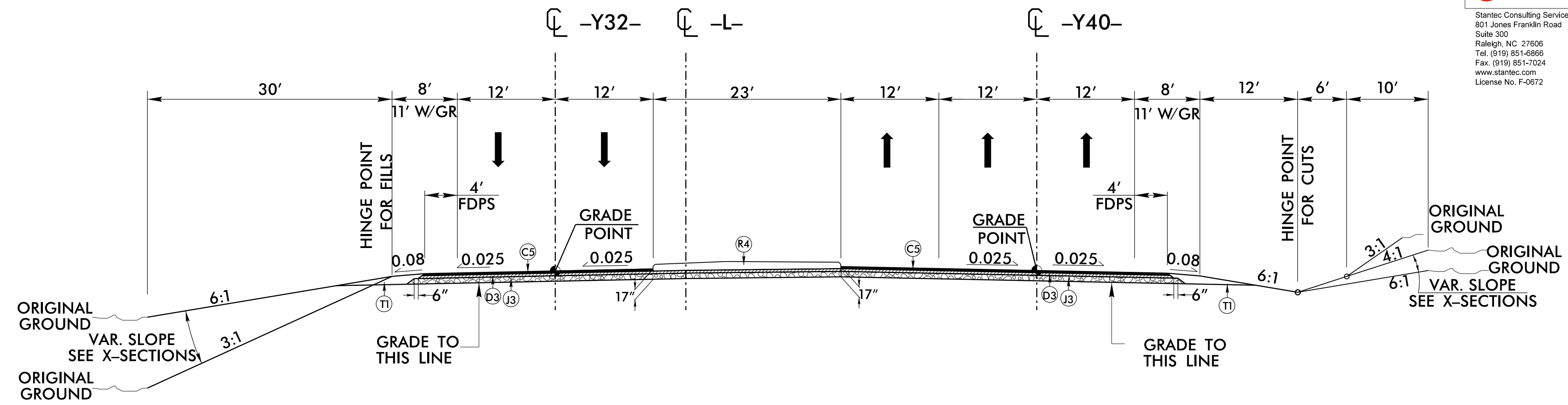
PAVEMENT DESIGN	
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C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
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J1	PROP. 6" ABC
J2	PROP. 8" ABC
J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
R2	PROP. 2'-6" CONCRETE CURB AND GUTTER
R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
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R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

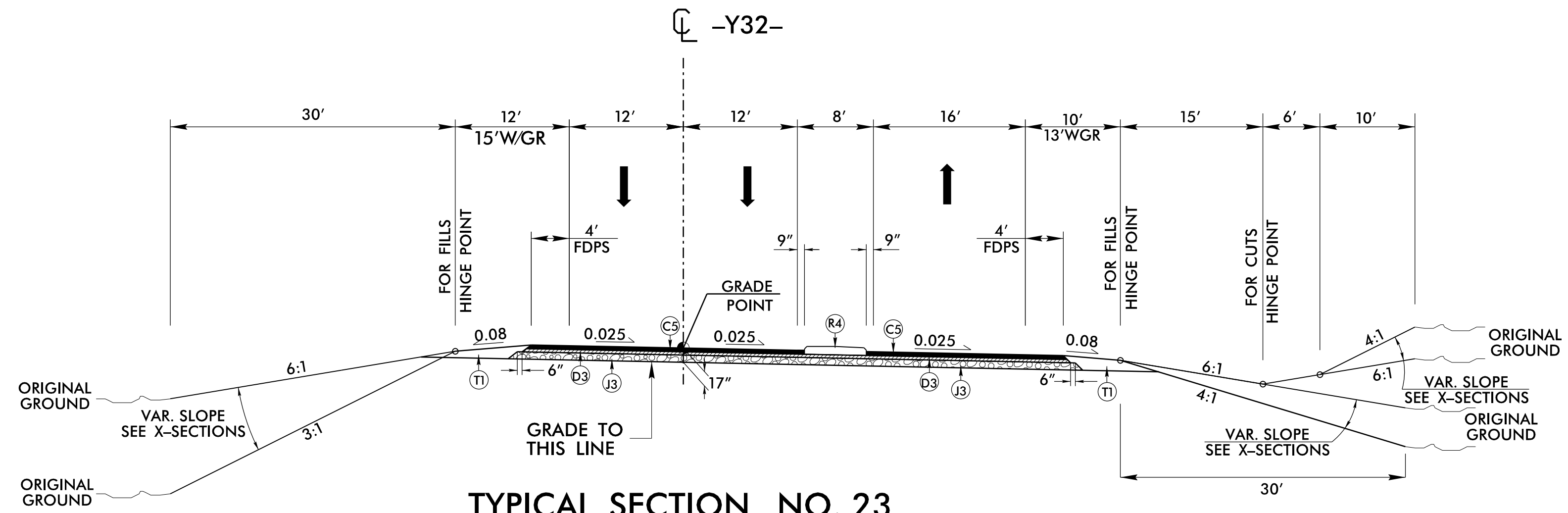
NOTES:
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 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



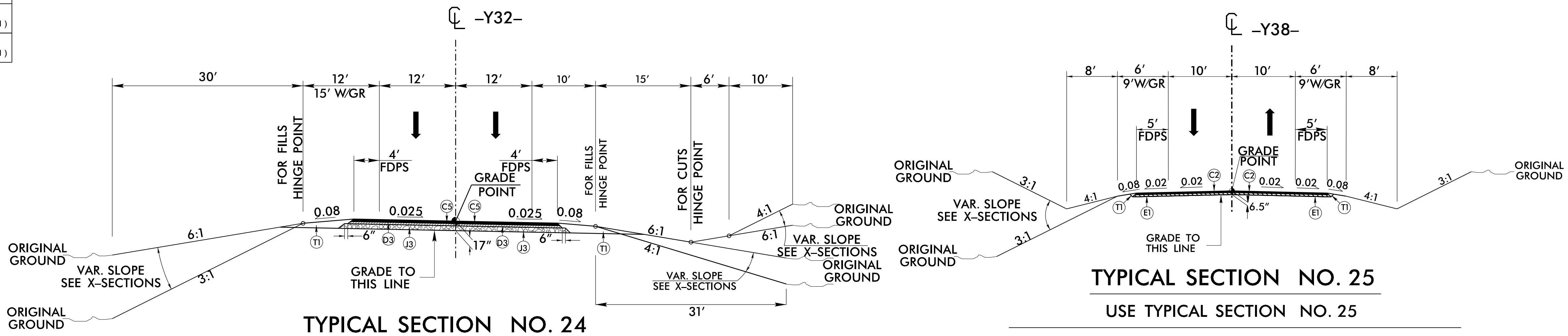
PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-7
ROADWAY DESIGN ENGINEER MICHAEL D. LINDEN 025513 10/10/2022	PAVEMENT DESIGN ENGINEER ANDREW D. WARGO 044590 11/27/2022
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



TYPICAL SECTION NO. 22
 USE TYPICAL SECTION NO. 22
 -Y32- STA. 10+00.00 TO 12+44.00



TYPICAL SECTION NO. 23
 USE TYPICAL SECTION NO. 23
 -Y32- STA. 12+44.00 TO 24+45.87 BEGIN BRIDGE
 -Y32- STA. 26+25.20 END BRIDGE TO 33+26.62



TYPICAL SECTION NO. 24
 USE TYPICAL SECTION NO. 24
 -Y32- STA. 33+26.62 TO 47+12.31

TYPICAL SECTION NO. 25
 USE TYPICAL SECTION NO. 25
 -Y38- STA. 17+15.00 TO 25+00.00

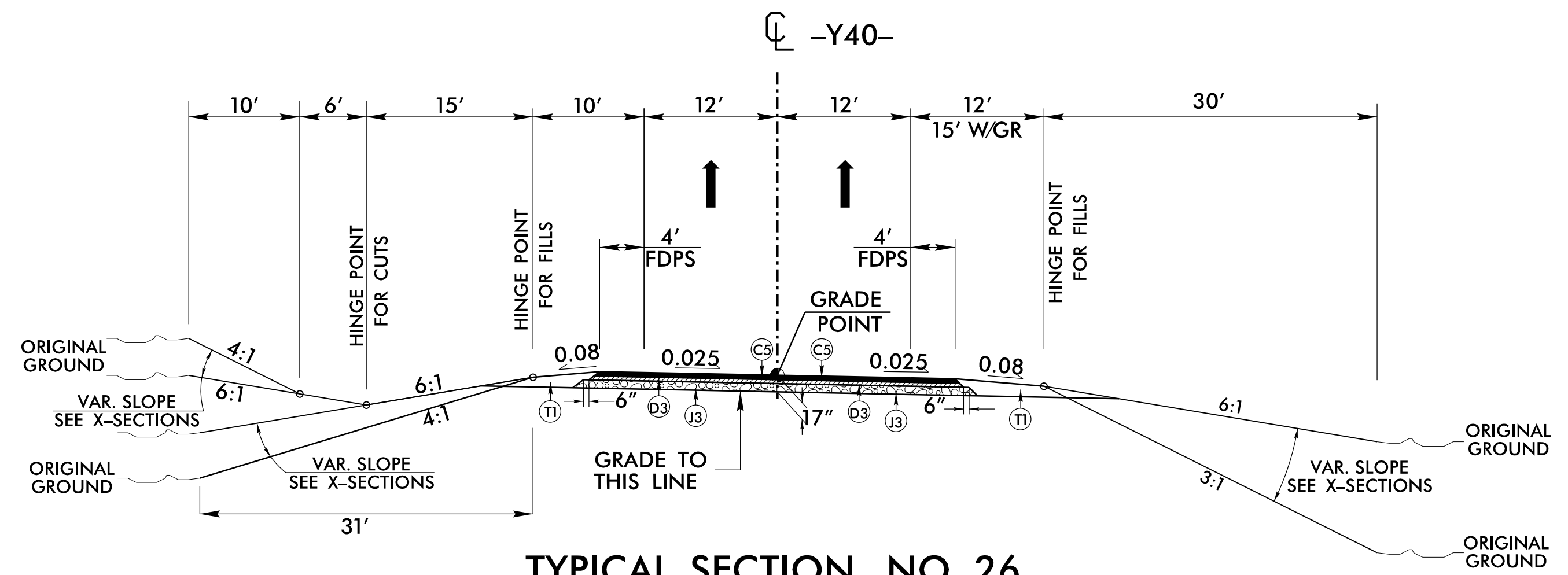
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6/2/2022

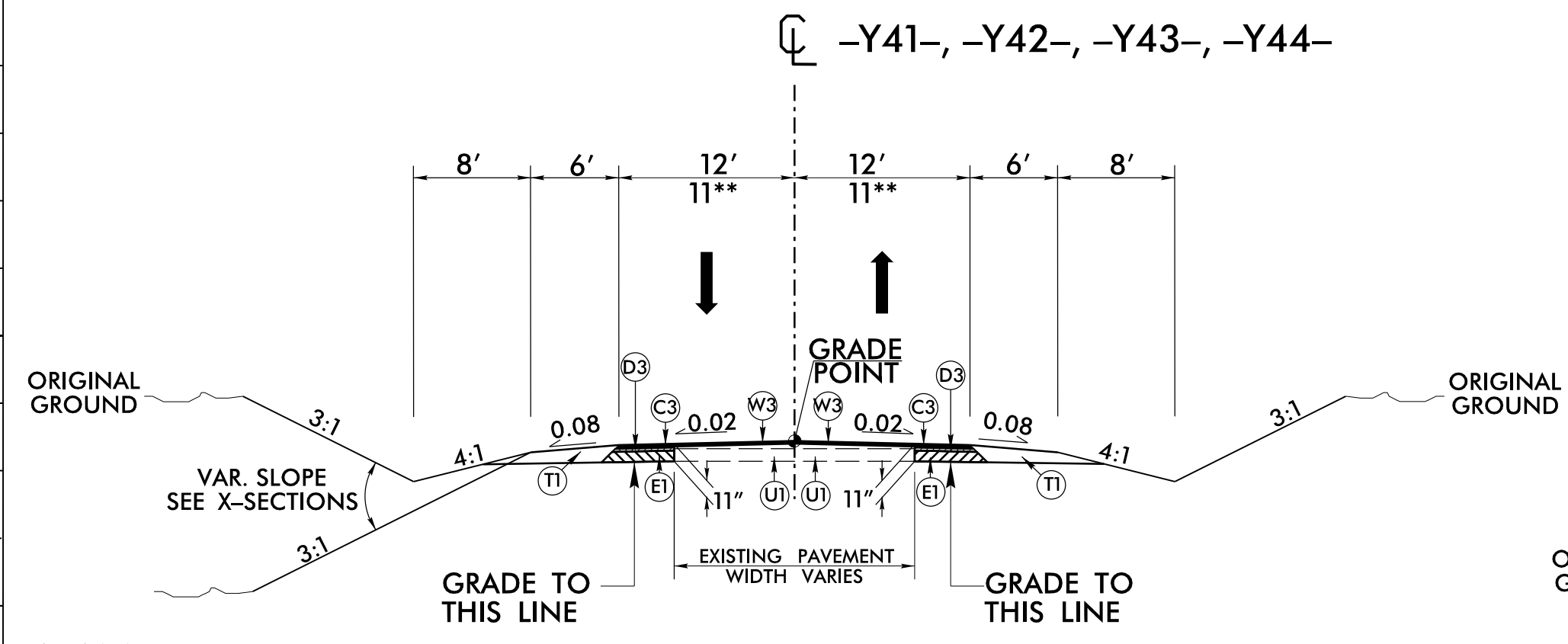
PAVEMENT DESIGN	
C1	PROP. APPROX. 1.5", TYPE S9.5B
C2	PROP. APPROX. 2.5", TYPE S9.5B
C3	PROP. APPROX. 3", TYPE S9.5B
C4	PROP. VAR. DEPTH, TYPE S9.5B
C5	PROP. APPROX. 3", TYPE S9.5C
C6	PROP. VAR. DEPTH, TYPE S9.5C
D1	PROP. APPROX. 2.5", TYPE I19.0C
D2	PROP. APPROX. 3.5", TYPE I19.0C
D3	PROP. APPROX. 4", TYPE I19.0C
D4	PROP. VAR. DEPTH, TYPE I19.0C
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J1	PROP. 6" ABC
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J3	PROP. 10" ABC
J4	PROP. VAR. DEPTH ABC
P1	PROP. PRIME COAT.
R1	PROP. 1'-6" CONCRETE CURB AND GUTTER
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R3	PROP. 2'-9" CONCRETE CURB AND GUTTER
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R5	PROP. SINGLE FACED CONCRETE BARRIER
R6	PROP. DOUBLE FACED CONCRETE BARRIER
S1	4" CONCRETE SIDEWALK.
T1	EARTH MATERIAL
U1	EXISTING PAVEMENT
V1	1.5" MILLING ASPHALT PAVEMENT
W1	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W2	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)
W3	VARIABLE DEPTH ASPHALT PAVEMENT (SEE STANDARD WEDGING DETAIL SHEET NO. 2A-1)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS SHOWN OTHERWISE.

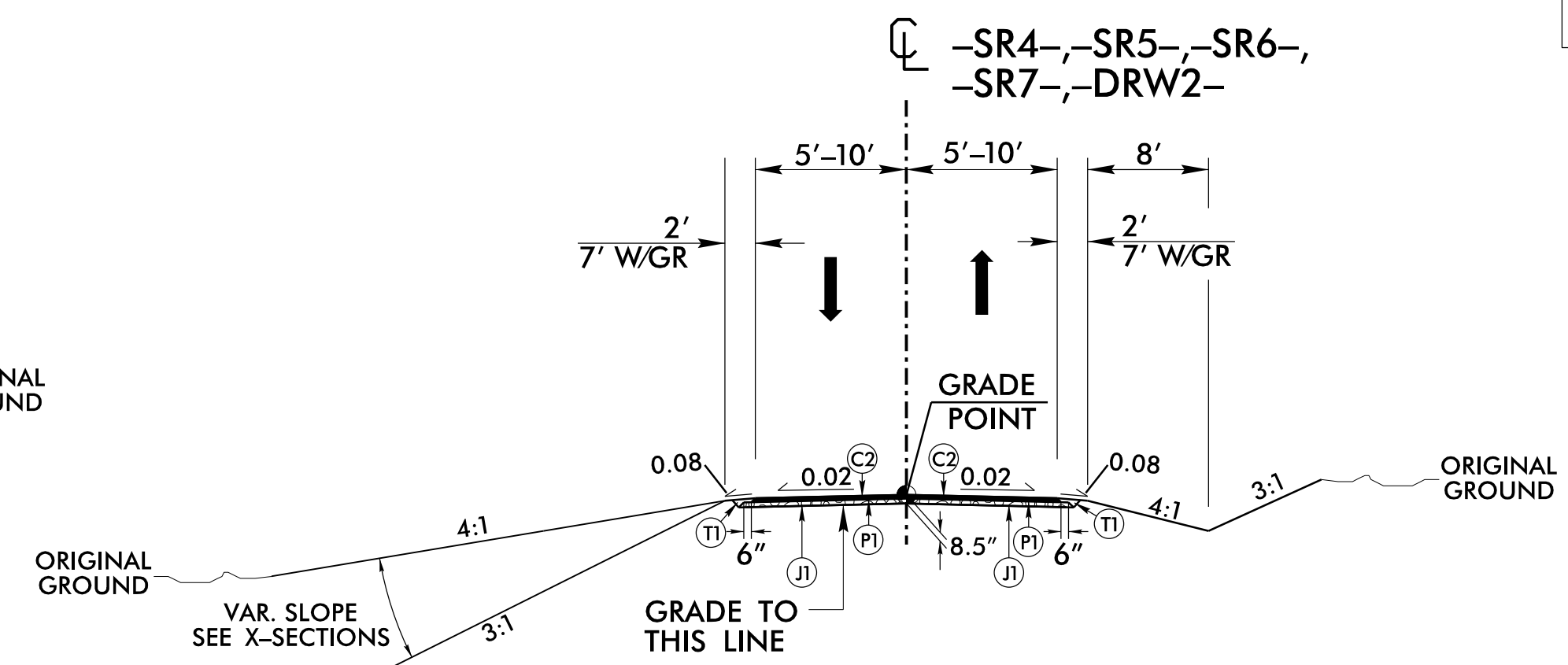
NOTES:
 USE OF 3" OF CLASS IV AGGREGATE STABILIZATION TO BE DIRECTED BY THE ENGINEER.
 SEE PLANS FOR PAVING TO THE FACE OF GUARDRAIL LOCATIONS.



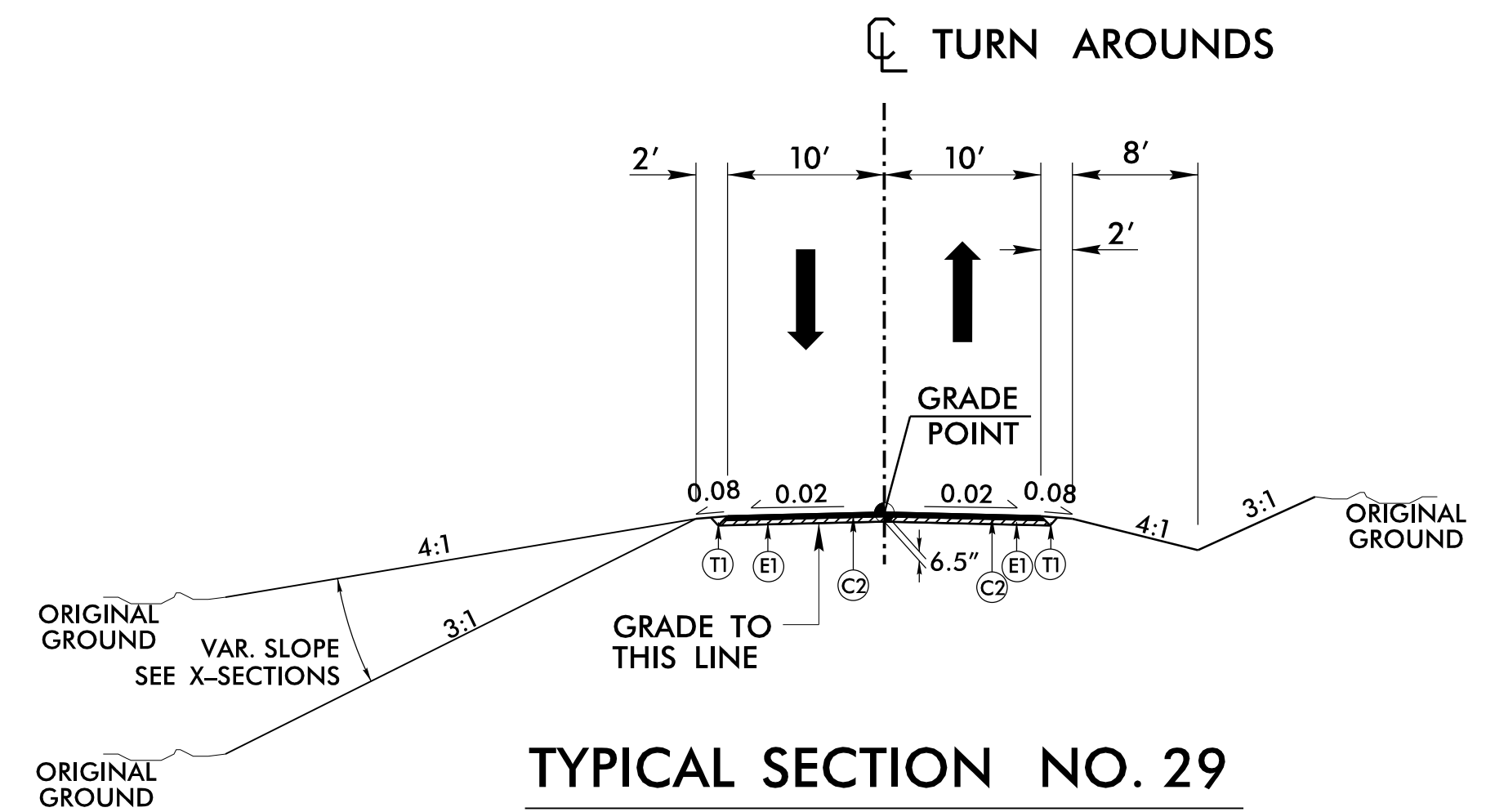
TYPICAL SECTION NO. 26
 USE TYPICAL SECTION NO. 26
 -Y40- STA. 233+44.00 TO 256+67.04



TYPICAL SECTION NO. 27
 USE TYPICAL SECTION NO. 27
 -Y41- STA. 10+14.00 TO 11+30.00
 **-Y42- STA. 10+16.70 TO 11+40.00
 -Y43- STA. 10+12.01 TO 11+10.00
 -Y44- STA. 10+12.01 TO 12+00.00



TYPICAL SECTION NO. 28
 USE TYPICAL SECTION NO. 28
 -SR4- STA. 10+12.59 TO 27+65.10
 -SR5- STA. 10+26.13 TO 21+20.00
 -SR6- STA. 10+26.80 TO 39+89.31
 -SR7- STA. 10+15.04 TO 57+20.00
 -DRW2- STA. 10+10.00 TO 12+20.00

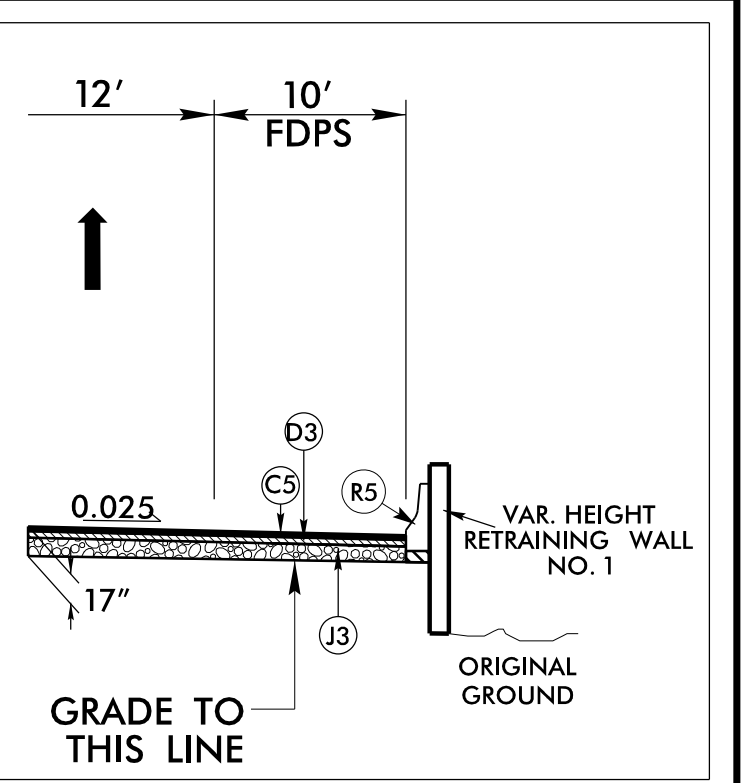


TYPICAL SECTION NO. 29
 USE TYPICAL SECTION NO. 29
 -L1- STA. 638+55 RT



PROJECT REFERENCE NO. R-3300B	SHEET NO. 2A-8
ROADWAY DESIGN ENGINEER Michael D. Lindgren 025513 1/10/2022	PAVEMENT DESIGN ENGINEER Andrew D. Wargo 044590 1/10/2022

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



-Y40- STA. 249+62.70 TO -L1_NORTHERN- 866+15.00 RT

1/10/2022
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