

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

C203195

CONTRACT AND
CONTRACT BONDS
FOR CONTRACT NO. C203195

WBS 45437.3.2 CMS-0918(94)

T.I.P NO. C-5224B

COUNTY OF FORSYTH
THIS IS THE SIGNAL CONTRACT
ROUTE NUMBER LENGTH 0.000 MILES
LOCATION WINSTON-SALEM - PHASE B.

CONTRACTOR BROOKS BERRY HAYNIE & ASSOCIATES, INC.
ADDRESS 600 DISCOVERY PLACE
MABLETON, GA 30126

BIDS OPENED JULY 16, 2013
CONTRACT EXECUTION AUG 08 2013

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

PROPOSAL

DATE AND TIME OF BID OPENING: **JULY 16, 2013 AT 2:00 PM**

CONTRACT ID C203195
WBS 454373.2

FEDERAL AID NO. CMS-0918(94)
COUNTY FORSYTH
T.L.P. NO. C-5224B
MILES 0.000
ROUTE NO.
LOCATION WINSTON-SALEM - PHASE B.

TYPE OF WORK COMPUTERIZED SIGNAL SYSTEM.

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 PROJECT SHALL COMPLY WITH CHAPTER 87 OF THE GENERAL STATUTES OF NORTH CAROLINA FOR LICENSING REQUIREMENTS WITHIN 60 CALENDAR DAYS OF BID OPENING, REGARDLESS OF FUNDING SOURCES.

BIDS WILL BE RECEIVED AS SHOWN BELOW:

THIS IS A SIGNAL PROPOSAL.

5% BID BOND OR BID DEPOSIT REQUIRED

**PROPOSAL FOR THE CONSTRUCTION OF
CONTRACT No. C203195 IN FORSYTH COUNTY, NORTH CAROLINA**

Date _____ 20 _____

**DEPARTMENT OF TRANSPORTATION,
RALEIGH, NORTH CAROLINA**

The Bidder has carefully examined the location of the proposed work to be known as Contract No. C203195; has carefully examined the plans and specifications, which are acknowledged to be part of the proposal, the special provisions, the proposal, the form of contract, and the forms of contract payment bond and contract performance bond; and thoroughly understands the stipulations, requirements and provisions. The undersigned bidder agrees to bound upon his execution of the bid and subsequent award to him by the Board of Transportation in accordance with this proposal to provide the necessary contract payment bond and contract performance bond within fourteen days after the written notice of award is received by him. The undersigned Bidder further agrees to provide all necessary machinery, tools, labor, and other means of construction; and to do all the work and to furnish all materials, except as otherwise noted, necessary to perform and complete the said contract in accordance with *the 2012 Standard Specifications for Roads and Structures* by the dates(s) specified in the Project Special Provisions and in accordance with the requirements of the Engineer, and at the unit or lump sum prices, as the case may be, for the various items given on the sheets contained herein.

The Bidder shall provide and furnish all the materials, machinery, implements, appliances and tools, and perform the work and required labor to construct and complete State Highway Contract No. C203195 in Forsyth County, for the unit or lump sum prices, as the case may be, bid by the Bidder in his bid and according to the proposal, plans, and specifications prepared by said Department, which proposal, plans, and specifications show the details covering this project, and hereby become a part of this contract.

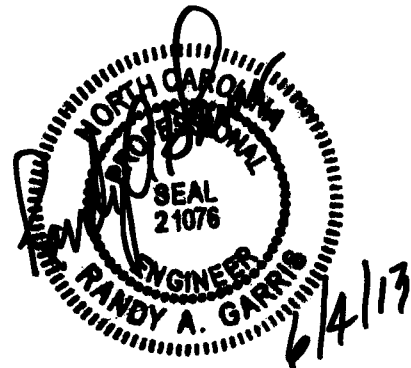
The published volume entitled *North Carolina Department of Transportation, Raleigh, Standard Specifications for Roads and Structures, January 2012* with all amendments and supplements thereto, is by reference incorporated into and made a part of this contract; that, except as herein modified, all the construction and work included in this contract is to be done in accordance with the specifications contained in said volume, and amendments and supplements thereto, under the direction of the Engineer.

If the proposal is accepted and the award is made, the contract is valid only when signed either by the Contract Officer or such other person as may be designated by the Secretary to sign for the Department of Transportation. The conditions and provisions herein cannot be changed except over the signature of the said Contract Officer.

The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Department of Transportation may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient.

An increase or decrease in the quantity of an item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided for the contract.

Accompanying this bid is a bid bond secured by a corporate surety, or certified check payable to the order of the Department of Transportation, for five percent of the total bid price, which deposit is to be forfeited as liquidated damages in case this bid is accepted and the Bidder shall fail to provide the required payment and performance bonds with the Department of Transportation, under the condition of this proposal, within 14 calendar days after the written notice of award is received by him, as provided in the *Standard Specifications*; otherwise said deposit will be returned to the Bidder.



State Contract Officer

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PROJECT SPECIAL PROVISIONS**GENERAL****CONTRACT TIME AND LIQUIDATED DAMAGES:**

(7-1-95) (Rev. 12-18-07)

108

SP1 G10 B

The date of availability for this contract is **August 26, 2013**.

The completion date for this contract is **September 1, 2016**.

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

INTERMEDIATE CONTRACT TIME NUMBER 1 AND LIQUIDATED DAMAGES:

(2-20-07) (5-2-13)

108

SP1 G14 E

The Contractor shall complete the required work of installing, maintaining and removing the traffic control devices for road closures and restoring traffic to the existing traffic pattern. The Contractor shall not close **any road** during the following time restrictions:

DAY AND TIME RESTRICTIONS

**Monday through Sunday
6:00 AM to 12:00 AM (Midnight)**

The maximum allowable time **for installation of cables across any road** is **20 minutes**. The Contractor shall reopen the travel lanes to traffic until the existing traffic queue is depleted.

The time of availability for this intermediate contract time will be the time the Contractor begins to install traffic control devices required for the road closures according to the time restrictions stated herein.

The completion time for this intermediate contract time will be the time the Contractor is required to complete the removal of traffic control devices required for the road closures according to the time restrictions stated herein and restore traffic to the existing traffic pattern.

The liquidated damages are **Two Thousand Dollars (\$2,000.00)** per **20 minute** time period.

INTERMEDIATE CONTRACT TIME NUMBER 2 AND LIQUIDATED DAMAGES:

(2-20-07) (5-2-13)

108

SP1 G14 A

The Contractor shall complete the required work of installing, maintaining, and removing the traffic control devices for lane closures and restoring traffic to the existing traffic pattern. The Contractor shall not close or narrow a lane of traffic on **US 52, US 421/I-40 Bus, I-40, ramps and loops** during the following time restrictions:

DAY AND TIME RESTRICTIONS

Monday through Friday	6:00 AM to 8:00 PM
Saturday	8:00 AM to 8:00 PM
Sunday	10:00 AM to 8:00 PM

In addition, the Contractor shall not close or narrow a lane of traffic on **US 52, US 421/I-40 Bus, I-40, ramps and loops**, detain and/or alter the traffic flow on or during holidays, holiday weekends, special events, or any other time when traffic is unusually heavy, including the following schedules:

HOLIDAY AND HOLIDAY WEEKEND LANE CLOSURE RESTRICTIONS

1. For **unexpected occurrence** that creates unusually high traffic volumes, as directed by the Engineer.
2. For **New Year's Day**, between the hours of **6:00 AM** December 31st and **8:00 PM** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **8:00 PM** the following Tuesday.
3. For **Easter**, between the hours of **6:00 AM** Thursday and **8:00 PM** Monday.
4. For **Memorial Day**, between the hours of **6:00 AM** Friday and **8:00 PM** Tuesday.
5. For **Independence Day**, between the hours of **6:00 AM** the day before Independence Day and **8:00 PM** the day after Independence Day.

If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **6:00 AM** the Thursday before Independence Day and **8:00 PM** the Tuesday after Independence Day.

6. For **Labor Day**, between the hours of **6:00 AM** Friday and **8:00 PM** Tuesday.
7. For **Thanksgiving Day**, between the hours of **6:00 AM** Tuesday and **8:00 PM** Monday.
8. For **Christmas**, between the hours of **6:00 AM** the Friday before the week of Christmas Day and **8:00 PM** the following Tuesday after the week of Christmas Day.
9. For the **ACC and NCAA Basketball tournaments**, occurring at **Greensboro Coliseum complex** between the hours of **6:00 AM** the day before the start of the tournament and **8:00 PM** the day after the end of the tournament.

10. For **the High Point Furniture Market**, between the hours of **6:00 AM** the Friday before the start of **the High Point Furniture Market** and **8:00 PM** the day after the end of **the High Point Furniture Market**.

Holidays and holiday weekends shall include New Year's, Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. The Contractor shall schedule his work so that lane closures will not be required during these periods, unless otherwise directed by the Engineer.

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.

The liquidated damages are **Two Thousand Five Hundred Dollars (\$ 2,500.00)** per 15 min. time period.

INTERMEDIATE CONTRACT TIME NUMBER 3 AND LIQUIDATED DAMAGES:

(2-20-07) (5-2-13)

108

SPI G14 A

The Contractor shall complete the required work of installing, maintaining, and removing the traffic control devices for lane closures and restoring traffic to the existing traffic pattern. The Contractor shall not close or narrow a lane of traffic on **any road other than I-40, US 52, and Business 40/US 421** during the following time restrictions:

DAY AND TIME RESTRICTIONS

Monday through Friday 7:00 AM to 9:00 AM
&
3:00 PM to 6:00 PM

In addition, the Contractor shall not close or narrow a lane of traffic on **any road other than I-40, US 52, and Business 40/US 421**, detain and/or alter the traffic flow on or during holidays, holiday weekends, special events, or any other time when traffic is unusually heavy, including the following schedules:

HOLIDAY AND HOLIDAY WEEKEND LANE CLOSURE RESTRICTIONS

1. For **unexpected occurrence** that creates unusually high traffic volumes, as directed by the Engineer.
2. For **New Year's Day**, between the hours of **7:00 AM** December 31st and **6:00 PM** January 2nd. If New Year's Day is on a Friday, Saturday, Sunday or Monday, then until **6:00 PM** the following Tuesday.
3. For **Easter**, between the hours of **7:00 AM** Thursday and **6:00 PM** Monday.

4. For **Memorial Day**, between the hours of **7:00 AM** Friday and **6:00 PM** Tuesday.
5. For **Independence Day**, between the hours of **7:00 AM** the day before Independence Day and **6:00 PM** the day after Independence Day.

If **Independence Day** is on a Friday, Saturday, Sunday or Monday, then between the hours of **7:00 AM** the Thursday before Independence Day and **6:00 PM** the Tuesday after Independence Day.
6. For **Labor Day**, between the hours of **7:00 AM** Friday and **6:00 PM** Tuesday.
7. For **Thanksgiving Day**, between the hours of **7:00 AM** Tuesday and **6:00 PM** Monday.
8. For **Christmas**, between the hours of **7:00 AM** the Friday before the week of Christmas Day and **6:00 PM** the following Tuesday after the week of Christmas Day.
9. For **Dash Baseball home games at BB&T Ballpark**, **four (4) hours before the start of the game and four (4) hours after the end of the game.** (This note applies to Broad St. and Peters Creek Pkwy)
10. For **the Dixie Classic Fair in Winston-Salem**, between the hours of **7:00 AM** the day before the start of **the Dixie Classic Fair** and **6:00 PM** the day after the end of the **Dixie Classic Fair.** (This note applies to University Pkwy, N. Cherry St., Reynolds Blvd, and Shorefair Dr.)
11. For **Wake Forest University Football games** occurring at **BB&T Field**, **four (4) hours before the start of the game and four (4) hours after the end of the game.** (This note applies to University Pkwy, N. Cherry St., Reynolds Blvd, and Shorefair Dr.)
12. For **Wake Forest University Basketball games** occurring at **Lawrence Joel Veterans Memorial Coliseum**, **two (2) hours before the start of the game and two (2) hours after the end of the game.** (This note applies to University Pkwy, N. Cherry St., Reynolds Blvd, and Shorefair Dr.)
13. For **the Holiday Shopping period at Hanes Mall from of 7:00 AM on the Tuesday before Thanksgiving to 6:00 PM on January 2nd.** (This note applies to Hanes Mall Blvd. and Stratford Rd.)

Holidays and holiday weekends shall include New Year's, Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas. The Contractor shall schedule his work so that lane closures will not be required during these periods, unless otherwise directed by the Engineer.

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.

The liquidated damages are **Five Hundred Dollars (\$ 500.00)** per 15 min. time period.

MAJOR CONTRACT ITEMS:

(2-19-02)

104

SP1 G28

The following listed items are the major contract items for this contract (see Article 104-5 of the *2012 Standard Specifications*):

Line #	Description
46	Controller With Cabinet, 2070L, 332, Base Mounted

SPECIALTY ITEMS:

(7-1-95)(Rev. 1-17-12)

108-6

SP1 G37

Items listed below will be the specialty items for this contract (see Article 108-6 of the *2012 Standard Specifications*).

Line #	Description
2	4" Concrete Sidewalk
108	Brick Pavers

SCHEDULE OF ESTIMATED COMPLETION PROGRESS:

(7-15-08) (Rev. 5-21-13)

108-2

SP1 G58

The Contractor's attention is directed to the Standard Special Provision entitled *Availability of Funds Termination of Contracts* included elsewhere in this proposal. The Department of Transportation's schedule of estimated completion progress for this project as required by that Standard Special Provision is as follows:

	<u>Fiscal Year</u>	<u>Progress (% of Dollar Value)</u>
2014	(7/01/13 - 6/30/14)	39% of Total Amount Bid
2015	(7/01/14 - 6/30/15)	36% of Total Amount Bid
2016	(7/01/15 - 6/30/16)	22% of Total Amount Bid
2017	(7/01/16 - 6/30/17)	3% of Total Amount Bid

The Contractor shall also furnish his own progress schedule in accordance with Article 108-2 of the *2012 Standard Specifications*. Any acceleration of the progress as shown by the Contractor's progress schedule over the progress as shown above shall be subject to the approval of the Engineer.

DISADVANTAGED BUSINESS ENTERPRISE:

(10-16-07)(Rev. 5-21-13)

102-15(J)

SP1 G61

Description

The purpose of this Special Provision is to carry out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts financed in whole or in part with Federal funds. This provision is guided by 49 CFR Part 26.

Definitions

Additional DBE Subcontractors - Any DBE submitted at the time of bid that will not be used to meet the DBE goal. No submittal of a Letter of Intent is required.

Committed DBE Subcontractor - Any DBE submitted at the time of bid that is being used to meet the DBE goal by submission of a Letter of Intent. Or any DBE used as a replacement for a previously committed DBE firm.

Contract Goal Requirement - The approved DBE participation at time of award, but not greater than the advertised contract goal.

DBE Goal - A portion of the total contract, expressed as a percentage, that is to be performed by committed DBE subcontractor(s).

Disadvantaged Business Enterprise (DBE) - A firm certified as a Disadvantaged Business Enterprise through the North Carolina Unified Certification Program.

Goal Confirmation Letter - Written documentation from the Department to the bidder confirming the Contractor's approved, committed DBE participation along with a listing of the committed DBE firms.

Manufacturer - A firm that operates or maintains a factory or establishment that produces on the premises, the materials or supplies obtained by the Contractor.

Regular Dealer - A firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials or supplies required for the performance of the contract are bought, kept in stock, and regularly sold to the public in the usual course of business. A regular dealer engages in, as its principal business and in its own name, the purchase and sale or lease of the products in question. A regular dealer in such bulk items as steel, cement, gravel, stone, and petroleum products need not keep such products in stock, if it owns and operates distribution equipment for the products. Brokers and packagers are not regarded as manufacturers or regular dealers within the meaning of this section.

North Carolina Unified Certification Program (NCUCP) - A program that provides comprehensive services and information to applicants for DBE certification, such that an applicant is required to apply only once for a DBE certification that will be honored by all recipients of USDOT funds in the state and not limited to the Department of Transportation only. The Certification Program is in accordance with 49 CFR Part 26.

United States Department of Transportation (USDOT) - Federal agency responsible for issuing regulations (49 CFR Part 26) and official guidance for the DBE program.

Forms and Websites Referenced in this Provision

DBE Payment Tracking System - On-line system in which the Contractor enters the payments made to DBE subcontractors who have performed work on the project.
<https://apps.dot.state.nc.us/Vendor/PaymentTracking/>

DBE-IS Subcontractor Payment Information - Form for reporting the payments made to all DBE firms working on the project. This form is for paper bid projects only.
<http://www.ncdot.org/doh/forms/files/DBE-IS.xls>

RF-1 DBE Replacement Request Form - Form for replacing a committed DBE.
<http://connect.ncdot.gov/projects/construction/Construction%20Forms/DBE%20MBE%20WBE%20Replacement%20Request%20Form.pdf>

SAF Subcontract Approval Form - Form required for approval to sublet the contract.
<http://connect.ncdot.gov/projects/construction/Construction%20Forms/Subcontract%20Approval%20Form%20Rev.%202012.zip>

JC-1 Joint Check Notification Form - Form and procedures for joint check notification. The form acts as a written joint check agreement among the parties providing full and prompt disclosure of the expected use of joint checks.
<http://connect.ncdot.gov/projects/construction/Construction%20Forms/Joint%20Check%20Notification%20Form.pdf>

Letter of Intent - Form signed by the Contractor and the DBE subcontractor, manufacturer or regular dealer that affirms that a portion of said contract is going to be performed by the signed DBE for the amount listed at the time of bid.
<http://connect.ncdot.gov/letting/LetCentral/Letter%20of%20Intent%20to%20Perform%20as%20a%20Subcontractor.pdf>

Listing of DBE Subcontractors Form - Form for entering DBE subcontractors on a project that will meet this DBE goal. This form is for paper bids only.
[http://connect.ncdot.gov/municipalities/Bid%20Proposals%20for%20LGA%20Content/08%20DBE%20Subcontractors%20\(Federal\).doc](http://connect.ncdot.gov/municipalities/Bid%20Proposals%20for%20LGA%20Content/08%20DBE%20Subcontractors%20(Federal).doc)

Subcontractor Quote Comparison Sheet - Spreadsheet for showing all subcontractor quotes in the work areas where DBEs quoted on the project. This sheet is submitted with good faith effort packages.
<http://connect.ncdot.gov/business/SmallBusiness/Documents/DBE%20Subcontractor%20Quote%20Comparison%20Example.xls>

DBE Goal

The following DBE goal for participation by Disadvantaged Business Enterprises is established for this contract:

Disadvantaged Business Enterprises **3.0 %**

- (A) *If the DBE goal is more than zero*, the Contractor shall exercise all necessary and reasonable steps to ensure that DBEs participate in at least the percent of the contract as set forth above as the DBE goal.
- (B) *If the DBE goal is zero*, the Contractor shall make an effort to recruit and use DBEs during the performance of the contract. Any DBE participation obtained shall be reported to the Department.

Directory of Transportation Firms (Directory)

Real-time information is available about firms doing business with the Department and firms that are certified through NCUCP in the Directory of Transportation Firms. Only firms identified in the Directory as DBE certified shall be used to meet the DBE goal. The Directory can be found at the following link. <https://partner.ncdot.gov/VendorDirectory/default.html>

The listing of an individual firm in the directory shall not be construed as an endorsement of the firm's capability to perform certain work.

Listing of DBE Subcontractors

At the time of bid, bidders shall submit all DBE participation that they anticipate to use during the life of the contract. Only those identified to meet the DBE goal will be considered committed, even though the listing shall include both committed DBE subcontractors and additional DBE subcontractors. Additional DBE subcontractor participation submitted at the time of bid will be used toward the Department's overall race-neutral goal. Only those firms with current DBE certification at the time of bid opening will be acceptable for listing in the bidder's submittal of DBE participation. The Contractor shall indicate the following required information:

(A) Electronic Bids

Bidders shall submit a listing of DBE participation in the appropriate section of Expedite, the bidding software of Bid Express®.

- (1) Submit the names and addresses of DBE firms identified to participate in the contract. If the bidder uses the updated listing of DBE firms shown in Expedite, the bidder may use the dropdown menu to access the name and address of the DBE firm.
- (2) Submit the contract line numbers of work to be performed by each DBE firm. When no figures or firms are entered, the bidder will be considered to have no DBE participation.
- (3) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that DBE's participation will not count towards achieving the DBE goal.

(B) Paper Bids

Blank forms will not be deemed to represent zero participation. Bids submitted that do not have DBE participation indicated on the appropriate form will not be read publicly during the opening of bids. The Department will not consider these bids for award and the proposal will be rejected.

- (1) *If the DBE goal is more than zero,*
 - (a) Bidders, at the time the bid proposal is submitted, shall submit a listing of DBE participation, including the names and addresses on *Listing of DBE Subcontractors* contained elsewhere in the contract documents in

- order for the bid to be considered responsive. Bidders shall indicate the total dollar value of the DBE participation for the contract.
- (b) If bidders have no DBE participation, they shall indicate this on the *Listing of DBE Subcontractors* by entering the word "None" or the number "0." This form shall be completed in its entirety.
 - (c) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of the bid-letting, that DBE's participation will not count towards achieving the DBE goal.
- (2) *If the DBE goal is zero*, bidders, at the time the bid proposal is submitted, shall enter the word "None"; or the number "0"; or if there is participation, add the value on the *Listing of DBE Subcontractors* contained elsewhere in the contract documents.

DBE Prime Contractor

When a certified DBE firm bids on a contract that contains a DBE goal, the DBE firm is responsible for meeting the goal or making good faith efforts to meet the goal, just like any other bidder. In most cases, a DBE bidder on a contract will meet the DBE goal by virtue of the work it performs on the contract with its own forces. However, all the work that is performed by the DBE bidder and any other DBE subcontractors will count toward the DBE goal. The DBE bidder shall list itself along with any DBE subcontractors, if any, in order to receive credit toward the DBE goal.

For example, if the DBE goal is 45% and the DBE bidder will only perform 40% of the contract work, the prime will list itself at 40%, and the additional 5% shall be obtained through additional DBE participation with DBE subcontractors or documented through a good faith effort.

DBE prime contractors shall also follow Sections A and B listed under *Listing of DBE Subcontractor* just as a non-DBE bidder would.

Written Documentation – Letter of Intent

The bidder shall submit written documentation for each DBE that will be used to meet the DBE goal of the contract, indicating the bidder's commitment to use the DBE in the contract. This documentation shall be submitted on the Department's form titled *Letter of Intent*.

The documentation shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 12:00 noon on the next official state business day.

If the bidder fails to submit the Letter of Intent from each committed DBE to be used toward the DBE goal, or if the form is incomplete (i.e. both signatures are not present), the DBE participation will not count toward meeting the DBE goal. If the lack of this participation

drops the commitment below the DBE goal, the Contractor shall submit evidence of good faith efforts, completed in its entirety, to the State Contractor Utilization Engineer or DBE@ncdot.gov no later than 12:00 noon on the eighth calendar day following opening of bids, unless the eighth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer no later than 12:00 noon on the next official state business day.

Submission of Good Faith Effort

If the bidder fails to meet or exceed the DBE goal, the apparent lowest responsive bidder shall submit to the Department documentation of adequate good faith efforts made to reach the DBE goal.

A hard copy and an electronic copy of this information shall be received in the office of the State Contractor Utilization Engineer or at DBE@ncdot.gov no later than 12:00 noon of the sixth calendar day following opening of bids unless the sixth day falls on an official state holiday. In that situation, it is due in the office of the State Contractor Utilization Engineer the next official state business day. If the contractor cannot send the information electronically, then one complete set and 9 copies of this information shall be received under the same time constraints above.

Note: Where the information submitted includes repetitious solicitation letters, it will be acceptable to submit a representative letter along with a distribution list of the firms that were solicited. Documentation of DBE quotations shall be a part of the good faith effort submittal. This documentation may include written subcontractor quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

Consideration of Good Faith Effort for Projects with DBE Goals More Than Zero

Adequate good faith efforts mean that the bidder took all necessary and reasonable steps to achieve the goal which, by their scope, intensity, and appropriateness, could reasonably be expected to obtain sufficient DBE participation. Adequate good faith efforts also mean that the bidder actively and aggressively sought DBE participation. Mere *pro forma* efforts are not considered good faith efforts.

The Department will consider the quality, quantity, and intensity of the different kinds of efforts a bidder has made. Listed below are examples of the types of actions a bidder will take in making a good faith effort to meet the goal and are not intended to be exclusive or exhaustive, nor is it intended to be a mandatory checklist.

- (A) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising, written notices, use of verifiable electronic means through the use of the NCDOT Directory of Transportation Firms) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder must solicit this interest within at least 10 days prior to bid opening to allow the DBEs to respond to the solicitation. Solicitation shall provide the opportunity to DBEs within the Division and surrounding Divisions where the project is located. The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.

- (B) Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved.
 - (1) Where appropriate, break out contract work items into economically feasible units to facilitate DBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces.
 - (2) Negotiate with subcontractors to assume part of the responsibility to meet the contract DBE goal when the work to be sublet includes potential for DBE participation (2nd and 3rd tier subcontractors).
- (C) Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.
- (D)
 - (1) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work.
 - (2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidding contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.
- (E) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associates and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.
- (F) Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or bidder.
- (G) Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

- (H) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; Federal, State, and local minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs. Contact within 7 days from the bid opening the Business Development Manager in the Business Opportunity and Work Force Development Unit to give notification of the bidder's inability to get DBE quotes.
- (I) Any other evidence that the bidder submits which shows that the bidder has made reasonable good faith efforts to meet the DBE goal.

In addition, the Department may take into account the following:

- (1) Whether the bidder's documentation reflects a clear and realistic plan for achieving the DBE goal.
- (2) The bidders' past performance in meeting the DBE goals.
- (3) The performance of other bidders in meeting the DBE goal. For example, when the apparent successful bidder fails to meet the DBE goal, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the DBE goal, but meets or exceeds the average DBE participation obtained by other bidders, the Department may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made a good faith effort.

If the Department does not award the contract to the apparent lowest responsive bidder, the Department reserves the right to award the contract to the next lowest responsive bidder that can satisfy to the Department that the DBE goal can be met or that an adequate good faith effort has been made to meet the DBE goal.

Non-Good Faith Appeal

The State Contractor Utilization Engineer will notify the contractor verbally and in writing of non-good faith. A contractor may appeal a determination of non-good faith made by the Goal Compliance Committee. If a contractor wishes to appeal the determination made by the Committee, they shall provide written notification to the State Contractual Services Engineer or at DBE@ncdot.gov. The appeal shall be made within 2 business days of notification of the determination of non-good faith.

Counting DBE Participation Toward Meeting DBE Goal

(A) Participation

The total dollar value of the participation by a committed DBE will be counted toward the contract goal requirement. The total dollar value of participation by a committed DBE will be based upon the value of work actually performed by the DBE and the actual payments to DBE firms by the Contractor.

(B) Joint Checks

Prior notification of joint check use shall be required when counting DBE participation for services or purchases that involves the use of a joint check. Notification shall be through submission of Form JC-1 (*Joint Check Notification Form*) and the use of joint checks shall be in accordance with the Department's Joint Check Procedures.

(C) Subcontracts (Non-Trucking)

A DBE may enter into subcontracts. Work that a DBE subcontracts to another DBE firm may be counted toward the contract goal requirement. Work that a DBE subcontracts to a non-DBE firm does not count toward the contract goal requirement. If a DBE contractor or subcontractor subcontracts a significantly greater portion of the work of the contract than would be expected on the basis of standard industry practices, it shall be presumed that the DBE is not performing a commercially useful function. The DBE may present evidence to rebut this presumption to the Department. The Department's decision on the rebuttal of this presumption is subject to review by the Federal Highway Administration but is not administratively appealable to USDOT.

(D) Joint Venture

When a DBE performs as a participant in a joint venture, the Contractor may count toward its contract goal requirement a portion of the total value of participation with the DBE in the joint venture, that portion of the total dollar value being a distinct clearly defined portion of work that the DBE performs with its forces.

(E) Suppliers

A contractor may count toward its DBE requirement 60 percent of its expenditures for materials and supplies required to complete the contract and obtained from a DBE regular dealer and 100 percent of such expenditures from a DBE manufacturer.

(F) Manufacturers and Regular Dealers

A contractor may count toward its DBE requirement the following expenditures to DBE firms that are not manufacturers or regular dealers:

- (1) The fees or commissions charged by a DBE firm for providing a *bona fide* service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, provided the fees or commissions are determined to be reasonable and not excessive as compared with fees and commissions customarily allowed for similar services.

- (2) With respect to materials or supplies purchased from a DBE, which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site (but not the cost of the materials and supplies themselves), provided the fees are determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

Commercially Useful Function

(A) DBE Utilization

The Contractor may count toward its contract goal requirement only expenditures to DBEs that perform a commercially useful function in the work of a contract. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the DBE shall also be responsible with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material and installing (where applicable) and paying for the material itself. To determine whether a DBE is performing a commercially useful function, the Department will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and any other relevant factors.

(B) DBE Utilization in Trucking

The following factors will be used to determine if a DBE trucking firm is performing a commercially useful function:

- (1) The DBE shall be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there shall not be a contrived arrangement for the purpose of meeting DBE goals.
- (2) The DBE shall itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
- (3) The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.
- (4) The DBE may subcontract the work to another DBE firm, including an owner-operator who is certified as a DBE. The DBE who subcontracts work to another DBE receives credit for the total value of the transportation services the subcontracted DBE provides on the contract.

- (5) The DBE may also subcontract the work to a non-DBE firm, including from an owner-operator. The DBE who subcontracts the work to a non-DBE is entitled to credit for the total value of transportation services provided by the non-DBE subcontractor not to exceed the value of transportation services provided by DBE-owned trucks on the contract. Additional participation by non-DBE subcontractors receives credit only for the fee or commission it receives as a result of the subcontract arrangement. The value of services performed under subcontract agreements between the DBE and the Contractor will not count towards the DBE contract requirement.
- (6) A DBE may lease truck(s) from an established equipment leasing business open to the general public. The lease must indicate that the DBE has exclusive use of and control over the truck. This requirement does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. This type of lease may count toward the DBE's credit as long as the driver is under the DBE's payroll.
- (7) Subcontracted/leased trucks shall display clearly on the dashboard the name of the DBE that they are subcontracted/leased to and their own company name if it is not identified on the truck itself. Magnetic door signs are not permitted.

DBE Replacement

When a Contractor has relied on a commitment to a DBE firm (or an approved substitute DBE firm) to meet all or part of a contract goal requirement, the contractor shall not terminate the DBE for convenience. This includes, but is not limited to, instances in which the Contractor seeks to perform the work of the terminated subcontractor with another DBE subcontractor, a non-DBE subcontractor, or with the Contractor's own forces or those of an affiliate. A DBE may only be terminated after receiving the Engineer's written approval based upon a finding of good cause for the termination.

All requests for replacement of a committed DBE firm shall be submitted to the Engineer for approval on Form RF-1 (*DBE Replacement Request*). If the Contractor fails to follow this procedure, the Contractor may be disqualified from further bidding for a period of up to 6 months.

The Contractor shall comply with the following for replacement of a committed DBE:

(A) Performance Related Replacement

When a committed DBE is terminated for good cause as stated above, an additional DBE that was submitted at the time of bid may be used to fulfill the DBE commitment. A good faith effort will only be required for removing a committed DBE if there were no additional DBEs submitted at the time of bid to cover the same amount of work as the DBE that was terminated.

If a replacement DBE is not found that can perform at least the same amount of work as the terminated DBE, the Contractor shall submit a good faith effort documenting the steps taken. Such documentation shall include, but not be limited to, the following:

- (1) Copies of written notification to DBEs that their interest is solicited in contracting the work defaulted by the previous DBE or in subcontracting other items of work in the contract.
- (2) Efforts to negotiate with DBEs for specific subbids including, at a minimum:
 - (a) The names, addresses, and telephone numbers of DBEs who were contacted.
 - (b) A description of the information provided to DBEs regarding the plans and specifications for portions of the work to be performed.
- (3) A list of reasons why DBE quotes were not accepted.
- (4) Efforts made to assist the DBEs contacted, if needed, in obtaining bonding or insurance required by the Contractor.

(B) Decertification Replacement

- (1) When a committed DBE is decertified by the Department after the SAF (*Subcontract Approval Form*) has been received by the Department, the Department will not require the Contractor to solicit replacement DBE participation equal to the remaining work to be performed by the decertified firm. The participation equal to the remaining work performed by the decertified firm will count toward the contract goal requirement.
- (2) When a committed DBE is decertified prior to the Department receiving the SAF (*Subcontract Approval Form*) for the named DBE firm, the Contractor shall take all necessary and reasonable steps to replace the DBE subcontractor with another DBE subcontractor to perform at least the same amount of work to meet the DBE goal requirement. If a DBE firm is not found to do the same amount of work, a good faith effort must be submitted to NCDOT (see A herein for required documentation).

Changes in the Work

When the Engineer makes changes that result in the reduction or elimination of work to be performed by a committed DBE, the Contractor will not be required to seek additional participation. When the Engineer makes changes that result in additional work to be performed by a DBE based upon the Contractor's commitment, the DBE shall participate in additional work to the same extent as the DBE participated in the original contract work.

When the Engineer makes changes that result in extra work, which has more than a minimal impact on the contract amount, the Contractor shall seek additional participation by DBEs unless otherwise approved by the Engineer.

When the Engineer makes changes that result in an alteration of plans or details of construction, and a portion or all of the work had been expected to be performed by a committed DBE, the Contractor shall seek participation by DBEs unless otherwise approved by the Engineer.

When the Contractor requests changes in the work that result in the reduction or elimination of work that the Contractor committed to be performed by a DBE, the Contractor shall seek additional participation by DBEs equal to the reduced DBE participation caused by the changes.

Reports and Documentation

A SAF (*Subcontract Approval Form*) shall be submitted for all work which is to be performed by a DBE subcontractor. The Department reserves the right to require copies of actual subcontract agreements involving DBE subcontractors.

When using transportation services to meet the contract commitment, the Contractor shall submit a proposed trucking plan in addition to the SAF. The plan shall be submitted prior to beginning construction on the project. The plan shall include the names of all trucking firms proposed for use, their certification type(s), the number of trucks owned by the firm, as well as the individual truck identification numbers, and the line item(s) being performed.

Within 30 calendar days of entering into an agreement with a DBE for materials, supplies or services, not otherwise documented by the SAF as specified above, the Contractor shall furnish the Engineer a copy of the agreement. The documentation shall also indicate the percentage (60% or 100%) of expenditures claimed for DBE credit.

Reporting Disadvantaged Business Enterprise Participation

The Contractor shall provide the Engineer with an accounting of payments made to all DBE firms, including material suppliers and contractors at all levels (prime, subcontractor, or second tier subcontractor). This accounting shall be furnished to the Engineer for any given month by the end of the following month. Failure to submit this information accordingly may result in the following action:

- (A) Withholding of money due in the next partial pay estimate; or
- (B) Removal of an approved contractor from the prequalified bidders' list or the removal of other entities from the approved subcontractors list.

While each contractor (prime, subcontractor, 2nd tier subcontractor) is responsible for accurate accounting of payments to DBEs, it shall be the prime contractor's responsibility to report all monthly and final payment information in the correct reporting manner.

Failure on the part of the Contractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from further bidding until the required information is submitted.

Failure on the part of any subcontractor to submit the required information in the time frame specified may result in the disqualification of that contractor and any affiliate companies from being approved for work on future DOT projects until the required information is submitted.

Contractors reporting transportation services provided by non-DBE lessees shall evaluate the value of services provided during the month of the reporting period only.

At any time, the Engineer can request written verification of subcontractor payments.

(A) Electronic Bids Reporting

The Contractor shall report the accounting of payments through the Department's DBE Payment Tracking System.

(B) Paper Bids Reporting

The Contractor shall report the accounting of payments on the Department's DBE-IS (*Subcontractor Payment Information*) with each invoice. Invoices will not be processed for payment until the DBE-IS is received.

Failure to Meet Contract Requirements

Failure to meet contract requirements in accordance with Subarticle 102-15(J) of the *2012 Standard Specifications* may be cause to disqualify the Contractor.

CERTIFICATION FOR FEDERAL-AID CONTRACTS:

(3-21-90)

SP1 G85

The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

- (A) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (B) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, *Disclosure Form to Report Lobbying*, in accordance with its instructions.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by *Section 1352, Title 31, U.S. Code*. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such subrecipients shall certify and disclose accordingly.

CONTRACTOR'S LICENSE REQUIREMENTS:

(7-1-95)

102-14

SP1 G88

If the successful bidder does not hold the proper license to perform any plumbing, heating, air conditioning, or electrical work in this contract, he will be required to sublet such work to a contractor properly licensed in accordance with *Article 2 of Chapter 87 of the General Statutes* (licensing of heating, plumbing, and air conditioning contractors) and *Article 4 of Chapter 87 of the General Statutes* (licensing of electrical contractors).

U.S. DEPARTMENT OF TRANSPORTATION HOTLINE:

(11-22-94)

108-5

SP1 G100

To report bid rigging activities call: **1-800-424-9071**

The U.S. Department of Transportation (DOT) operates the above toll-free hotline Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the hotline to report such activities.

The hotline is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

LOCATING EXISTING UNDERGROUND UTILITIES:

(3-20-12)

105

SP1 G115

Revise the *2012 Standard Specifications* as follows:

Page 1-43, Article 105-8, line 28, after the first sentence, add the following:

Identify excavation locations by means of pre-marking with white paint, flags, or stakes or provide a specific written description of the location in the locate request.

RESOURCE CONSERVATION:

(5-21-13)

104-13

SP1 G118

In accordance with North Carolina Executive Order 156, NCGS 130A-309.14(2), and NCGS 136-28.8, it is the policy of the Department to aid in the reduction of materials that become a part of our solid waste stream, to divert materials from landfills, and to find ways to recycle and reuse materials for the benefit of the Citizens of North Carolina.

Initiate, develop and use products and construction methods that incorporate the use of recycled or solid waste products in accordance with Article 104-13 of the *2012 Standard Specifications*. Report the quantities of reused or recycled materials either incorporated in the project or diverted from landfills on the Project Construction Reuse and Recycling Reporting Form.

A location-based tool for finding local recycling facilities and the Project Construction Reuse and Recycling Reporting Form are available at:

<http://connect.ncdot.gov/resources/Environmental/Pages/North-Carolina-Recycling-Locations.aspx>

DOMESTIC STEEL:

(4-16-13)

106

SP1 G120

Revise the *2012 Standard Specifications* as follows:

Page 1-49, Subarticle 106-1(B) Domestic Steel, lines 2-7, replace the first paragraph with the following:

All steel and iron products that are permanently incorporated into this project shall be produced in the United States except minimal amounts of foreign steel and iron products may be used provided the combined material cost of the items involved does not exceed 0.1% of the total amount bid for the entire project or \$2,500, whichever is greater. If invoices showing the cost of the material are not provided, the amount of the bid item involving the foreign material will be used for calculations. This minimal amount of foreign produced steel and iron products permitted for use is not applicable to high strength fasteners. Domestically produced high strength fasteners are required.

MAINTENANCE OF THE PROJECT:

(11-20-07) (Rev. 1-17-12)

104-10

SP1 G125

Revise the *2012 Standard Specifications* as follows:

Page 1-35, Article 104-10 Maintenance of the Project, line 25, add the following after the first sentence of the first paragraph:

All guardrail/guiderail within the project limits shall be included in this maintenance.

Page 1-35, Article 104-10 Maintenance of the Project, line 30, add the following as the last sentence of the first paragraph:

The Contractor shall perform weekly inspections of guardrail and guiderail and shall report damages to the Engineer on the same day of the weekly inspection. *Where damaged guardrail or guiderail is repaired or replaced as a result of maintaining the project in accordance with this article, such repair or replacement shall be performed within 7 consecutive calendar days of such inspection report.*

Page 1-35, Article 104-10 Maintenance of the Project, lines 42-44, replace the last sentence of the last paragraph with the following:

The Contractor will not be directly compensated for any maintenance operations necessary, except for maintenance of guardrail/guiderail, as this work will be considered incidental to the work covered by the various contract items. The provisions of Article 104-7, Extra Work, and Article 104-8, Compensation and Record Keeping will apply to authorized maintenance of guardrail/guiderail. Performance of weekly inspections of guardrail/guiderail, and the damage reports required as described above, will be considered to be an incidental part of the work being paid for by the various contract items.

GIFTS FROM VENDORS AND CONTRACTORS:

(12-15-09)

107-1

SP1 G152

By Executive Order 24, issued by Governor Perdue, and *N.C.G.S. § 133-32*, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, landlord, offeror, seller, subcontractor, supplier, or vendor), to make gifts or to give favors to any State employee of the Governor's Cabinet Agencies (i.e. Administration, Commerce, Correction, Crime Control and Public Safety, Cultural Resources, Environment and Natural Resources, Health and Human Services, Juvenile Justice and Delinquency Prevention, Revenue, Transportation, and the Office of the Governor). This prohibition covers those vendors and contractors who:

- (A) Have a contract with a governmental agency; or
- (B) Have performed under such a contract within the past year; or
- (C) Anticipate bidding on such a contract in the future.

For additional information regarding the specific requirements and exemptions, vendors and contractors are encouraged to review Executive Order 24 and *N.C.G.S. § 133-32*.

Executive Order 24 also encouraged and invited other State Agencies to implement the requirements and prohibitions of the Executive Order to their agencies. Vendors and contractors should contact other State Agencies to determine if those agencies have adopted Executive Order 24.

EMPLOYMENT:

(11-15-11) (Rev. 1-17-12)

108, 102

SP1 G184

Revise the *2012 Standard Specifications* as follows:

Page 1-20, Subarticle 102-15(O), delete and replace with the following:

- (O) Failure to restrict a former Department employee as prohibited by Article 108-5.

Page 1-65, Article 108-5 Character of Workmen, Methods, and Equipment, line 32, delete all of line 32, the first sentence of the second paragraph and the first word of the second sentence of the second paragraph.

STATE HIGHWAY ADMINISTRATOR TITLE CHANGE:

(9-18-12)

SP1 G185

Revise the *2012 Standard Specifications* as follows:

Replace all references to "State Highway Administrator" with "Chief Engineer".

PROJECT SPECIAL PROVISIONS**ROADWAY****MATERIALS:**

(2-21-12) (Rev. 5-21-13)

1000, 1005, 1050, 1074, 1078, 1080, 1081, 1087, 1092

SP10 R01

Revise the 2012 *Standard Specifications* as follows:**Page 10-1, Article 1000-1, DESCRIPTION, line 14,** add the following:

Use materials which do not produce a mottled appearance through rusting or other staining of the finished concrete surface.

Page 10-5, Table 1000-1, REQUIREMENTS FOR CONCRETE, replace with the following:

TABLE 1000-1 REQUIREMENTS FOR CONCRETE											
Class of Concrete	Min. Comp. Strength at 28 days	Maximum Water-Cement Ratio				Consistency Max. Slump		Cement Content			
		Air-Entrained Concrete		Non Air- Entrained Concrete		Vibrated	Non- Vibrated	Vibrated		Non- Vibrated	
		Rounded Aggregate	Angular Aggregate	Rounded Aggregate	Angular Aggregate			Min.	Max.	Min.	Max.
<i>Units</i>	<i>psi</i>					<i>inch</i>	<i>inch</i>	<i>lb/cy</i>	<i>lb/cy</i>	<i>lb/cy</i>	<i>lb/cy</i>
AA	4,500	0.381	0.426	-	-	3.5	-	639	715	-	-
AA Slip Form	4,500	0.381	0.426	-	-	1.5	-	639	715	-	-
Drilled Pier	4,500	-	-	0.450	0.450	-	5-7 dry 7-9 wet	-	-	640	800
A	3,000	0.488	0.532	0.550	0.594	3.5	4	564	-	602	-
B	2,500	0.488	0.567	0.559	0.630	2.5	4	508	-	545	-
B Slip Formed	2,500	0.488	0.567	-	-	1.5	-	508	-	-	-
Sand Light- weight	4,500	-	0.420	-	-	4	-	715	-	-	-
Latex Modified	3,000 7 day	0.400	0.400	-	-	6	-	658	-	-	-
Flowable Fill excavatable	150 max. at 56 days	as needed	as needed	as needed	as needed	-	Flow- able	-	-	40	100
Flowable Fill non-excavatable	125	as needed	as needed	as needed	as needed	-	Flow- able	-	-	100	as needed
Pavement	4,500 design, field 650 flexural, design only	0.559	0.559	-	-	1.5 slip form 3.0 hand place	-	526	-	-	-
Precast	See Table 1077-1	as needed	as needed	-	-	6	as needed	as needed	as needed	as needed	as needed
Prestress	per contract	See Table 1078-1	See Table 1078-1	-	-	8	-	564	as needed	-	-

Page 10-65, Article 1050-1, GENERAL, line 41, replace the first sentence with:

All fencing material and accessories shall meet Section 106.

Page 10-23, Table 1005-1, AGGREGATE GRADATION-COARSE AGGREGATE, replace with the following:

TABLE 1005-1 AGGREGATE GRADATION - COARSE AGGREGATE												
Percentage of Total by Weight Passing												
Std. Size #	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#10	#16	#40	#200
Remarks												
4	100	90-100	20-55	0-15	-	0-5	-	-	-	-	-	A
Asphalt Plant Mix												
467M	100	95-100	-	35-70	-	0-30	0-5	-	-	-	-	A
Asphalt Plant Mix												
5	-	100	90-100	20-55	0-10	0-5	-	-	-	-	-	A
AST, Sediment Control Stone												
57	-	100	95-100	-	25-60	-	0-10	0-5	-	-	-	A
AST, Str. Concrete, Shoulder Drain, Sediment Control Stone												
57M	-	100	95-100	-	25-45	-	0-10	0-5	-	-	-	A
AST, Concrete Pavement												
6M	-	-	100	90-100	20-55	0-20	0-8	-	-	-	-	A
AST												
67	-	-	100	90-100	-	20-55	0-10	0-5	-	-	-	A
AST, Str. Concrete, Asphalt Plant Mix												
78M	-	-	-	100	98-100	75-100	20-45	0-15	-	-	-	A
Asphalt Plant Mix, AST, Weep Hole Drains, Str. Concrete												
14M	-	-	-	-	-	100	35-70	5-20	-	0-8	-	A
AST												
9	-	-	-	-	-	100	85-100	10-40	-	0-10	-	A
AST												
ABC	-	100	75-97	-	55-80	-	35-55	-	25-45	-	14-30	4-12 ^B
Aggregate Base Course, Aggregate Stabilization												
ABC (M)	-	100	75-100	-	45-79	-	20-40	-	0-25	-	-	0-12 ^B
Maintenance Stabilization												
Light-weight ^C	-	-	-	-	100	80-100	5-40	0-20	-	0-10	-	0-2.5
AST												

A. See Subarticle 1005-4(A).

B. See Subarticle 1005-4(B).

C. For Lightweight Aggregate used in Structural Concrete, see Subarticle 1014-2(E)(6).

Page 10-115, Subarticle 1074-7(B), Gray Iron Castings, lines 10-11, replace with the first two sentences with the following:

Supply gray iron castings meeting all facets of AASHTO M 306 excluding proof load. Proof load testing will only be required for new casting designs during the design process, and conformance to M306 loading (40,000 lbs.) will be required only when noted on the design documents.

Page 10-126, Table 1078-1, REQUIREMENTS FOR CONCRETE, replace with the following:

**TABLE 1078-1
REQUIREMENTS FOR CONCRETE**

Property	28 Day Design Compressive Strength 6,000 psi or less	28 Day Design Compressive Strength greater than 6,000 psi
Maximum Water/Cementitious Material Ratio	0.45	0.40
Maximum Slump without HRWR	3.5"	3.5"
Maximum Slump with HRWR	8"	8"
Air Content (upon discharge into forms)	5 + 2%	5 + 2%

Page 10-151, Article 1080-4 Inspection and Sampling, lines 18-22, replace (B), (C) and (D) with the following:

- (B) At least 3 panels prepared as specified in 5.5.10 of AASHTO M 300, Bullet Hole Immersion Test.
- (C) At least 3 panels of 4"x6"x1/4" for the Elcometer Adhesion Pull Off Test, ASTM D4541.
- (D) A certified test report from an approved independent testing laboratory for the Salt Fog Resistance Test, Cyclic Weathering Resistance Test, and Bullet Hole Immersion Test as specified in AASHTO M 300.
- (E) A certified test report from an approved independent testing laboratory that the product has been tested for slip coefficient and meets AASHTO M253, Class B.

Page 10-162, Subarticle 1081-1(A) Classifications, lines 4-7, delete the second and third sentences of the description for Type 3A.

Page 10-162, Subarticle 1081-1(B) Requirements, lines 26-30, replace the second paragraph with the following:

For epoxy resin systems used for embedding dowel bars, threaded rods, rebar, anchor bolts and other fixtures in hardened concrete, the manufacturer shall submit test results showing that the

bonding system will obtain 125% of the specified required yield strength of the fixture. Furnish certification that, for the particular bolt grade, diameter and embedment depth required, the anchor system will not fail by adhesive failure and that there is no movement of the anchor bolt. For certification and anchorage, use 3,000 psi as the minimum Portland cement concrete compressive strength used in this test. Use adhesives that meet Section 1081.

List the properties of the adhesive on the container and include density, minimum and maximum temperature application, setting time, shelf life, pot life, shear strength and compressive strength.

Page 10-169, Subarticle 1081-3(G) Anchor Bolt Adhesives, delete this subarticle.

Page 10-179, Subarticle 1087-4(A) Composition, lines 39-41, replace the third paragraph with the following:

All intermixed and drop-on glass beads shall not contain more than 75 ppm arsenic or 200 ppm lead.

Page 10-180, Subarticle 1087-4(B) Physical Characteristics, line 8, replace the second paragraph with the following:

All intermixed and drop-on glass beads shall comply with NCGS § 136-30.2 and 23 USC § 109(r).

Page 10-181, Subarticle 1087-7(A) Intermixed and Drop-on Glass Beads, line 24, add the following after the first paragraph:

Use X-ray Fluorescence for the normal sampling procedure for intermixed and drop-on beads, without crushing, to check for any levels of arsenic and lead. If any arsenic or lead is detected, the sample shall be crushed and repeat the test using X-ray Fluorescence. If the X-ray Fluorescence test shows more than a LOD of 5 ppm, test the beads using United States Environmental Protection Agency Method 6010B, 6010C or 3052 for no more than 75 ppm arsenic or 200 ppm lead.

Page 10-204, Subarticle 1092-2(A) Performance and Test Requirements, replace **Table 1092-3 Minimum Coefficient of Retroreflection for NC Grade A** with the following:

TABLE 1092-3 MINIMUM COEFFICIENT OF RETROREFLECTION FOR NC GRADE A (Candelas Per Lux Per Square Meter)								
Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Green	Red	Blue	Fluorescent Yellow Green	Fluorescent Yellow
0.2	-4.0	525	395	52	95	30	420	315
0.2	30.0	215	162	22	43	10	170	130
0.5	-4.0	310	230	31	56	18	245	185
0.5	30.0	135	100	14	27	6	110	81
1.0	-4.0	120	60	8	16	3.6	64	48
1.0	30.0	45	34	4.5	9	2	36	27

TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS:

(8-21-12)

1101.02

SP11 R10

Revise the *2012 Roadway Standard Drawings* as follows:

Drawing No. 1101.02, Sheet 12, TEMPORARY LANE CLOSURES, replace General Note #11 with the following:

11- TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS (TMCMS) USED ON SHADOW VEHICLES FOR "IN LANE" ACTIVITIES SHALL BE A MINIMUM OF 43" X 73". THE DISPLAY PANEL SHALL HAVE FULL MATRIX CAPABILITY WITH THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

12- TMCMS USED FOR ADVANCED WARNING ON VEHICLES LOCATED ON THE SHOULDER MAY BE SMALLER THAN 43" X 73". THE DISPLAY PANEL SHALL HAVE THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

Drawing No. 1101.02, Sheet 13, TEMPORARY LANE CLOSURES, replace General Note #12 with the following:

12- TRUCK MOUNTED CHANGEABLE MESSAGE SIGNS (TMCMS) USED ON SHADOW VEHICLES FOR "IN LANE" ACTIVITIES SHALL BE A MINIMUM OF 43" X 73". THE DISPLAY PANEL SHALL HAVE FULL MATRIX CAPABILITY WITH THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

13- TMCMS USED FOR ADVANCED WARNING ON VEHICLES LOCATED ON THE SHOULDER MAY BE SMALLER THAN 43" X 73". THE DISPLAY PANEL SHALL HAVE THE CAPABILITY TO PROVIDE 2 MESSAGE LINES WITH 7 CHARACTERS PER LINE WITH A MINIMUM CHARACTER HEIGHT OF 18". FOR ADDITIONAL MESSAGING, CONTACT THE WORK ZONE TRAFFIC CONTROL SECTION.

PROJECT SPECIAL PROVISIONS

**CITY OF WINSTON-SALEM TRAFFIC SIGNAL SYSTEM
UPGRADE/EXPANSION PROJECT**

PHASE B

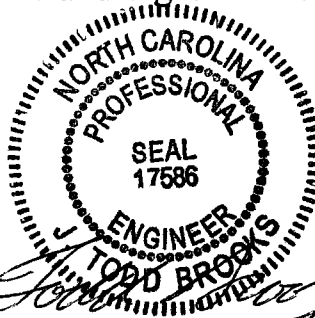
Western Section

N.C. Project No. C-5224B (WBS # 45437.3.2)
F.A. Project No. CMS-0918 (94)
Forsyth County



Prepared for:

North Carolina Department of Transportation
ITS and Signals Unit



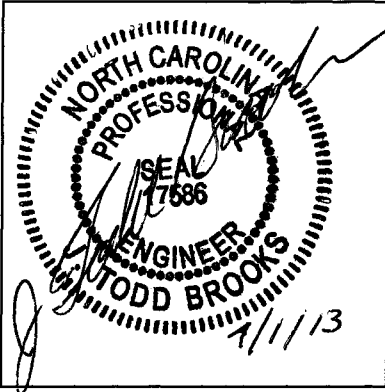
Prepared by:

7/1/13

ATKINS

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Phone: (919) 876-6888
NCBEES # F-0326

April 1, 2013



Project Special Provisions

Based On

NCDOT ITS and Signals Project Special Provisions

Version 12.1

Prepared by:

ATKINS

1616 East Millbrook Road, Suite 310
Raleigh, NC 27609 • NCBEES # F-0326

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1. GENERAL REQUIREMENTS

1.1. DESCRIPTION

(A) Summary of Work

This project is the second phase of a two-phase project to rehabilitate and expand the existing City of Winston-Salem, North Carolina's computerized traffic signal system controlled by a Centrac[®] distributed processing system. Overall project work will be primarily comprised of communications system replacement and expansion, field equipment upgrades, enhancement of the central system/Traffic Management Center (TMC) and the expansion of the video monitoring system. However, not all of this work is included in Phase B. In its entirety, the overall project includes:

- Signal display upgrades at selected locations and replacement of existing controllers and cabinets with new Model 2070L controllers housed in Model 332 or 336S cabinets for the approximately 401 signalized intersections that will comprise the expanded system;
- Replacement of an existing copper-wire communications system with a new Ethernet-based, fault-tolerant, predominantly fiber-optic communications system comprised of approximately 138 roadway miles of fiber-optic cable (120 new miles + 18 miles of existing NCDOT ITS cables), along with a new downtown wireless communications network and some wireless communications links in outlying areas;
- Expanding the existing video surveillance system from 11 existing CCTV cameras to 30 CCTV cameras while retaining the existing central video equipment and software;
- Retaining the existing Centrac[®] distributed processing central software but replacing central computers with new computer workstations and servers; and,
- Installation of a separate, dark fiber-optic communications cable coincident with the signal system communications cable along several routes for future termination and use by the City of Winston-Salem's Information Systems (IS) Department independent of the signal system.

This Phase B project encompasses the western geographic area of the city. The preceding Phase A contractor is constructing a fiber-optic communications ring that will encircle the downtown. This communications ring, hereinafter referred to as the "Red Ring," is roughly comprised of segments of the following streets:

- Northwest Boulevard, Patterson Avenue, and Martin Luther King, Jr. Drive along its northern perimeter;
- Martin Luther King, Jr. Drive along its eastern perimeter;
- Rams Drive, Salem Avenue, Cemetery Street and Wachovia Street along its southern perimeter;
- Peters Creek Parkway, First Street and Hawthorne Road along its western perimeter.

The purpose of the Red Ring is to intercept all radial rings outside of the downtown, those constructed in Phase A as well as Phase B, and aggregate their data using managed Ethernet switches (i.e., routing switches) in communications hub cabinets installed at points along the ring by the Phase A contractor.

There will be two homerun fiber-optic communications cable links from the Red Ring to the City of Winston-Salem Traffic Management Center (TMC) housed in the Clark Campbell Transportation Center located at 100 West Fifth Street inside the ring. The primary link will be a new fiber-optic communications cable routed from the north along portions of Patterson Avenue, 7th Street, 8th Street, Oak Street and Trade Street directly to the TMC. Designated fibers in an existing fiber-optic communication cable owned by the North Carolina Department of Transportation (NCDOT) that runs along Church Street from Cemetery Street to the City's Transportation Department offices on the third floor of the Bryce A. Stuart Municipal Building at 100 East First Street will provide the secondary homerun link from the south. The Phase B contractor will install a new underground fiber optic communications cable between the Bryce Stuart Building and the TMC to complete this secondary link.

Phase B will be comprised of 184 signalized intersections, 28 video surveillance cameras (install 18 new and retain 10 existing) and approximately 75 miles of fiber-optic communications cable. In addition to installing new fiber-optic cable, Phase B will use designated fibers in existing communications cables owned by NCDOT along US 52, University Parkway, and Church Street and an existing City-owned cable along Hanes Mill Road. Phase B establishes Ethernet-based fiber-optic communications between all Phase B field devices and the TMC, the Bryce Stuart Building and the City's Signal Shop (i.e., Traffic Maintenance Shop) located at 650 Stadium Drive, Building 42. The Phase B contractor will be responsible for integrating the Phase B traffic signals into the Centrac[®] system and integrating the new Phase B CCTV cameras into the existing central video surveillance system using the portion of the new fiber-optic communications system constructed in Phase B and the homerun communications links constructed by the Phase A contractor.

All of the existing signals that have NEMA controllers and cabinets are to be replaced with Model 2070L controllers in Type 332 and 336S cabinets under this project. However, there is an existing independent closed-loop system on Robinhood Road between Meadowlark Drive and Olivet Church Road comprised of two signals that have existing Model 2070L controllers in Type 332 cabinets linked by existing fiber-optic communications cable. This existing 2070 closed-system and their existing 12-fiber communications cable will be incorporated into the expanded and upgraded Winston-Salem Signal System primarily by replacing the existing local controllers with new Model 2070L controllers loaded with an IP-version of the Department's OASIS[™] local controller software and by replacing the existing fiber-optic transceivers in the controller cabinets with new Ethernet edge switches.

New fiber-optic communications cable will be installed primarily by overlashing to the existing communications cable but also by lashing to new messenger cable, installing in existing underground conduit/duct systems, and installing in new underground conduit/duct systems. To migrate from the existing to the new communications system while minimizing disruptions to signal system operations, the existing twisted-pair copper wire communications system will be progressively decommissioned as the new Ethernet-based fiber-optic communications system is built-out and brought online.

Provide a complete, fully functional and fully integrated traffic signal system, video surveillance system, and Ethernet communications system. Perform the following major tasks under this contract, as shown in the Plans (the list that follows is not meant to be all-inclusive):

- Furnish and install a new Ethernet-based fiber-optic communications system for the traffic signal system comprised of fiber-optic cable, fiber-optic drop cables, and fiber-optic splice centers (i.e., splice enclosures, interconnect centers, etc.), fiber-optic splice cabinets, Ethernet switches and related electronics;
- Furnish and install new, dark fiber-optic communications cable along with aerial and underground splice enclosures for future termination and use by the City's IS Department;
- Furnish and install underground conduit/duct, junction boxes, risers with heat shrink tubing, risers with weatherheads, messenger cable, fiber-optic cable storage guides, wood poles, and pole guy assemblies with guy guards;
- Furnish and install Ethernet edge switches;
- Furnish and install new cabinets and ancillary equipment, extending existing field wiring as necessary;
- Furnish and install new traffic signal controllers and conflict monitors inside existing cabinets;
- Modify existing cabinet foundations and install new cabinet foundations;
- Upgrade existing traffic signal displays;
- Remove existing control equipment and cabinets;
- Remove existing twisted-pair, copper wire communications cable, including associated risers, splice cabinets and junction boxes, where designated in the Plans;
- Furnish and install detector loops, junction boxes, and lead-in cables;
- Furnish and install signal cable;
- Furnish and install CCTV camera assemblies and CCTV cabinets;
- Furnish and install digital video encoders;
- Modify existing electrical services and install new electrical services and associated grounding;
- Fully integrate all components, except the IS Department communications cable, into a fully-functioning Ethernet-based, fiber-optic communications network.
- Fully integrate wireless communications links into the Ethernet-based communications network.
- Fully integrate all traffic signal controllers, system detectors, software, computers and servers into a fully functioning distributed processing traffic control system.
- Fully integrate all CCTV cameras, video components and software into a fully functioning video monitoring system.

Traffic signals and fiber-optic communications cable being installed by others under separate but concurrent NCDOT TIP and City road improvement contracts will ultimately be integrated (by others) into the upgraded and expanded Winston-Salem Signal System. These concurrent projects include but may not be limited to the following:

NCDOT TIP Projects:

- Winston-Salem Signal System Upgrade & Expansion – Phase A (C-5224A)
- Salem Creek Connector - from Rams Drive to Martin Luther King, Jr. Drive (U-2925)
- Union Cross Road – from Wallburg Road to Sedge Garden Road (U-4909)

City of Winston-Salem Projects:

- CCTV Video Surveillance System Upgrade Project (C-5142)
- CCTV Video Surveillance System Expansion Projects (C-4981A, C-4981B, C-4981C)
- Clemmons Road Widening – from Old Salisbury Road to S. Main Street (U-2923)
- Motor Road Extension - from Old Rural Hall Road to Old Walkertown Road (200303)

Private Developer Project:

- New signal – Stratford Road at Business 40 EB Ramps/Piedmont Federal Driveway (Sig. Inv. No. 09-0869)

Some traffic signal work on the above projects may be underway by the time construction begins on this signal system project, but most of the work is expected to run concurrent with the signal system construction. Contractors for different traffic signal projects who are working within the same area shall coordinate and cooperate with each other. Each contractor shall conduct his work so as not to interfere with or hinder the progress of the work being performed by the other contractors.

The Department will stagger the start of construction on this Phase B from the start of construction on the Phase A project, but there will be concurrent construction on Phase A while Phase B is being constructed. In addition, Phase B construction work may overlap construction work in Phase A where the geographic boundaries of phases meet. In some cases, the work on the adjoining Phase A may be interrelated to the Phase B work. For example, Phase B's fiber-optic communications cable may be required to splice into fiber-optic cable being installed in Phase A or terminate at a communications hub being installed in Phase A. Contractors for the two different phases who are working within the same area shall coordinate and cooperate with each other. Each contractor shall conduct his work so as not to interfere with or hinder the progress of the work being performed by the other contractor.

(B) Specifications and Special Provisions

Conform to these Project Special Provisions and the North Carolina Department of Transportation (NCDOT) *Standard Specifications for Roads and Structures*, dated January 2012, hereinafter referred to as the "*Standard Specifications*". Conform to the Codes and Regulations described in Section 1700 of the *Standard Specifications*.

Within these Project Special Provisions, the "Department" refers to the North Carolina Department of Transportation, and the "City" refers to the City of Winston-Salem's Transportation Department.

(C) Coordination of Plans, Specifications, and Special Provisions

The *Standard Specifications*, the Plans and these Project Special Provisions are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all.

They are complementary and provide and describe the complete contract. In case of a discrepancy or conflict, the following will apply in ascending order:

- Calculated dimensions shall govern over scaled dimensions;
- Supplemental Specifications shall govern over *Standard Specifications*;
- Plans shall govern over Supplemental Specifications, *Standard Specifications* and *Roadway Standard Drawings*;
- Project Special Provisions shall govern over Standard Special Provisions, Plans, *Standard Specifications*, Supplemental Specifications and *Roadway Standard Drawings*.

In the event of a contradiction within the Project Special Provisions as to the measurement and payment of any pay item, the text of the respective Measurement and Payment subsection for the pay item in question shall govern.

The Contractor shall not take advantage of any apparent error or omission in the contract. In the event such errors or omissions are discovered, the Engineer will make such corrections and interpretations as may be determined necessary for the fulfillment of the intent of the contract.

1.2. MATERIALS

(A) Qualified Products

Furnish new equipment, materials, and hardware unless otherwise required. Inscribe manufacturer's name, model number, serial number, and any additional information needed for proper identification on each piece of equipment housed in a case or housing.

2012 ITS and Signals Qualified Products List (QPL) is available on the North Carolina Department of Transportation's website at the following address:

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

Signal and communications equipment, material, and hardware shall be pre-approved on the QPL by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project. Consult the QPL website to obtain pre-approval procedures.

(B) Submittal Requirements

Furnish a Type 3 material certification in accordance with Article 106-3 of the *Standard Specifications*. When requested by the Department, provide additional certifications from independent testing laboratories and sufficient data to verify item meets applicable specifications. Ensure additional certification states the testing laboratory is independent of the material manufacturer and neither the laboratory nor the manufacturer has a vested interest in the other.

Identify all proprietary parts in Contractor-furnished material. The Department reserves the right to reject material that uses proprietary components not commercially available through electronic or electrical supply houses.

For Contractor-furnished material listed on the QPL, furnish submittals in the format defined by the QPL.

For Contractor-furnished material not on the QPL, furnish three copies of the equipment list including three copies of catalog cuts. Identify proposed material on catalog cuts by a reproducible means (highlighter pen does not transfer to copies). Ensure material lists contain material description, brand name, manufacturer's address and telephone number, stock number, size, identifying trademark or symbol, and other appropriate ratings.

Do not fabricate or order material until receipt of the Engineer's approval.

Refer to the "Submittal Data and Documentation" section of these Project Special Provisions for additional submittal requirements.

(C) Observation Period

Prior to final acceptance, all Contractor-furnished equipment and software shall successfully complete a 60-day Observation Period.

The 60-day Observation Period is considered to be part of the work included in the total contract time and must be completed prior to final acceptance of the project.

Final acceptance will occur following the successful completion of the 60-day Observation Period and after all documentation requirements have been fully satisfied.

Refer to the "Testing and Acceptance" section of these Project Special Provisions for additional requirements.

(D) Warranties

Unless otherwise required herein, provide manufacturer's warranties on Contractor-furnished equipment for material and workmanship that are customarily issued by the equipment manufacturer or that are at least one year in length, whichever is greater, from the date of final acceptance of the project by the Department. Include unconditional coverage for all parts and labor necessary or incidental to repair of defective equipment or workmanship and malfunctions that arise during warranty period.

For light emitting diode (LED) traffic signal modules, provide a written warranty against defects in materials and workmanship for a period of 60 months after installation of the modules. During the warranty period, the manufacturer must provide replacement modules within 45 days of receipt of modules that have failed at no cost to the Department.

Ensure all Contractor-furnished equipment, including pieces and components of equipment, hardware, firmware, software, middleware, internal components, and subroutines which perform any date or time data recognition function, calculation, or sequencing will support a four digit year format for a period of at least 50 years and will support user-definable parameters for setting the start and end dates for daylight savings time.

Upon receipt of the Department's written final acceptance of project, transfer manufacturer's warranties with proper validation by the manufacturer to the Department and the City. Provide warranties in the names of both the North Carolina Department of Transportation and the City of Winston-Salem.

(E) Firmware Licensing and Upgrades

Provide the Department with a license to duplicate all programmable devices in equipment for maintenance and software upgrades. Provide binary or hexadecimal format

files for each device that may be programmed by the Department. Ensure files are provided on PC compatible compact disks or other approved media.

Ensure software/firmware performance upgrades that occur during the contract period up through final acceptance of the project are furnished to the Department at no additional cost.

Make software/firmware upgrades that are developed to correct operating characteristics available to the Department at no additional cost until the warranty period expires.

Provide licensed copies of all software/firmware to the Department for any programmable devices furnished by the Contractor and installed under this project for which licensed software has not already been provided by the City and the Department. The Department shall have the right to install any and all software/firmware for maintenance and support on all hardware provided under this contract. This shall include but not be limited to all servers for the Signal System, CCTV System, LAN System, traffic signal controllers and network. Provide software/firmware for maintenance and support of workstations, laptop computers, system support software, utility software, traffic signal controllers, and CCTV systems and controllers, and all other programmable devices.

(F) Wire and Cable

Furnish wire and cable on reels. When requested by the Department, furnish samples of wire and cable to the Department at no additional cost.

(G) Painting

Where painting of signal heads, signal poles, and pedestals is required, apply paint at the factory. No field painting will be allowed except when paint has been scratched or marred or for such items as weatherheads and CCTV camera mounting plates field-installed on existing metal poles. In such cases, apply two field coats of the same color and grade enamel as the original paint to the scratched or marred portions and to the weatherhead and camera mounting plate. For the aforementioned unfinished components that require field painting, prepare the surface to receive the paint in accordance with the coating manufacturer's instructions, including application of primer.

(H) Performance of Warranty Repair and Maintenance

Provide authorization to the Traffic Electronics Center of the North Carolina Department of Transportation (NCDOT) to perform all warranty repairs after project acceptance. The decision to perform warranty work at the Traffic Electronics Center by NCDOT electronics technicians or to have warranty work performed by the vendor shall be at the discretion of the Department. Provide any training required by the manufacturer to authorize the Traffic Electronics Center to perform warranty work and ensure manufacturer will furnish parts to the Traffic Electronics Center for all warranty repairs at no cost to the Department. In addition, ensure the manufacturer agrees to provide prompt technical support to the NCDOT electronics technicians for a period of one year after the end of the warranty period at no cost to the Department. Defective parts replaced under warranty by the Traffic Electronics Center will be returned to the vendor at the vendor's request. Provide schematics, part lists, and other documentation to perform bench repair to the Traffic Electronics Center within 2 weeks upon request. The Department agrees not to divulge any proprietary information in the schematics, part lists and other documentation upon request from the vendor. After project acceptance and at the request of the Department, the manufacturer shall perform warranty repairs to equipment which fails during the warranty period

at no cost to the Department including freight costs to ship repaired equipment back to the Traffic Electronics Center. Ensure all equipment is repaired and returned to the Traffic Electronics Center within 21 calendar days of receipt by the manufacturer.

1.3. CONSTRUCTION METHODS

(A) General

Before beginning signal work, verify all existing signal equipment is in satisfactory working order. Report all defective signal equipment to the Engineer so as not to be held responsible for defects.

Identify and label all field wiring (e.g., signal conductors, pushbutton wires, loop detector lead-ins, etc.) in existing controller cabinets prior to disconnecting any field wiring.

Do not remove and replace more than one controller and cabinet per day unless otherwise approved by the Engineer. Once controller and cabinet replacement has begun at a given location, complete the removal and replacement work at that location before beginning removal and replacement of a controller and cabinet at another location.

Locate existing conduit, cable runs, inductive detection loops, lead-in, junction boxes, and detection equipment before installing or using equipment that can damage or interfere with such facilities. The locations of existing inductive detection loops shown on the Plans are approximate.

Locate all underground utilities before beginning drilling, digging, and trenching operations.

Ensure that an IMSA certified, or equivalent, Level II traffic qualified signal technician is standing by to provide emergency maintenance services whenever work is being performed on traffic signal controller cabinets and traffic signal controller cabinet foundations. Standby status is defined as being able to arrive, fully equipped, at the work site within 30 minutes ready to provide maintenance services.

Immediately cease work and notify the Engineer and affected owners if damage to existing utilities, cables, or equipment occurs. Make all required repairs and replacements at no additional cost to the Department.

Avoid trimming (i.e., pruning) trees wherever possible. Removal and topping of trees is strictly prohibited. Obtain approval from the City of Winston-Salem's Urban Forester for any proposed tree trimming and pruning prior to performing tree trimming. All tree trimming must be performed by an ISA Certified Arborist Trimming and must conform to ANSI A300 standards. In accordance with Section 74-302 of the City Code, obtain a no-cost permit from the City before trimming or pruning of any tree on public right-of-way. Contact the City's Urban Forester at 336-748-3019, to request this permit. In addition, the Contractor must obtain a Minor Work Certificate of Appropriateness from the Historic Resources Commission for any tree trimming or pruning in and around Old Salem. The Contractor will be assessed civil penalties (i.e., fines) for any tree trimming performed in violation of the requirements of the Project Special Provisions and the City Code, including but not limited to work performed by someone other than an ISA Certified Arborist, unauthorized tree trimming, failure to obtain required permit and approvals, excessive tree trimming and tree removal.

(B) Contractor's Office

Throughout the project until final acceptance, the Contractor shall maintain a full-time staffed office with storage and testing facilities within the Winston-Salem City Limits.

(C) Work within Historic Districts

Several signalized intersections, some proposed CCTV camera sites and several fiber-optic communications cable routes lie within or adjacent to historic districts. The Department has coordinated with the agencies that have jurisdiction over these historic districts and has received the permits and certificates for the work called for in the Plans in these historic districts. Do not deviate from the work called for in the Plans within a historic district without the prior approval of the Engineer and the agency/agencies that have jurisdiction over the historic district. Where construction work must deviate from the Plans, notify the Engineer in advance so that the Department can request/apply for the appropriate approvals for such changes prior to the Contractor performing work at that location.

Avoid damaging or removing sidewalks and curbs within designated historic districts whenever possible. Do not damage, disturb or remove any existing granite curbs. Where granite curbs conflict with the installation of underground conduit and cable, bore (drill) conduit underneath granite curb. Do not bore through granite curbs. Replace any granite curb damaged due to construction of this project at no cost to the Department or the City. Immediately notify the Engineer and coordinate with the City of Winston-Salem's Director of the Streets Division at 336-734-1550 when any existing granite curb is disturbed or damaged by construction of this project. As directed by the Engineer, reset disturbed granite curb and replace damaged granite curb in accordance with the City's standard detail for "Proper Installation of Granite Curb" (see Special Detail sheet in the construction plans).

Where removal and replacement of concrete sidewalk and concrete curb is unavoidable, replace them with concrete materials that match the finish, appearance and color of the adjacent existing sidewalk as close as technically feasible as determined by the Engineer. Finishes may include but are not limited to water-washed, broom and trowel. The dimensions and the profile (i.e., shape) of the new curbing shall match that of the adjacent existing curbing.

Where removal and replacement of sidewalk constructed of materials other than concrete is unavoidable, notify the Engineer and coordinate with the City of Winston-Salem's Director of the Streets Division at 336-734-1550 at least two weeks prior to disturbing the existing sidewalk. Replace the sidewalk with in-kind materials that match the finish, appearance and color of the adjacent existing sidewalk as close as technically feasible as determined by the Engineer and the City's Streets Division Director. If the sidewalk is constructed of materials such as brick, stone or pavers, carefully remove and subsequently reinstall the bricks, stones or pavers using methods approved by the Engineer. Take photographs and make sketches to record the pattern of the existing materials prior to removal. Replace any bricks, stones or pavers damaged due to construction on this project with approved in-kind, matching materials.

Repair and replacement of existing sidewalk will be measured and paid for in accordance with the "Equipment Cabinet Foundations" section of these Project Special Provisions.

Complete all repairs with in-kind materials to all sidewalks removed for construction and reopen the repaired and restored sidewalk to pedestrian traffic within five consecutive calendar days following initial removal. If the Contractor fails to repair and reopen a sidewalk

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 sidewalk will be deducted from payment due the Contractor, plus **\$500 liquidated damage per occasion, per day, or any portion thereof,** until corrected.

For new signal cabinet foundations constructed within historic districts, use concrete tinted to light earth-toned palette to soften the visual impact of the new concrete.

Do not trim, remove or damage tree limbs within historic districts. Hand-lashing of aerial cables to messenger cable may be required in some areas due to overhanging and protruding tree limbs along the cable route.

(D) Work within the Central Business District (CBD)

The central business district (CBD) in downtown Winston-Salem experiences large volumes of vehicular and pedestrian traffic and on-street parking during business hours on weekdays as well as on some weekends due to special events. The CBD is defined as the area in downtown Winston-Salem bounded by Broad Street on the west, Seventh Street on the north, Patterson Avenue on the east and First Street on the south inclusive. The M.C. Benton, Jr. Convention and Civic Center, which hosts several large meetings throughout the year, is located in the CBD. In addition, the CBD is occasionally the site of festivals and parades and other cultural events and celebrations.

Do not perform any work within the CBD without prior approval of the Department. Submit to the Department for review and approval two weeks in advance a schedule for proposed work that will require narrowing or closing a lane, road, sidewalk or pedestrian crossing within this area.

(E) Regulations and Codes

Furnish material and workmanship conforming to the *National Electric Code* (NEC), *National Electric Safety Code* (NESC), Underwriters Laboratories (UL), or other listing agencies approved by the North Carolina Department of Insurance, and all local safety codes in effect on the date of advertisement. Comply with Article 4, Chapter 87 of the *North Carolina General Statutes* (Licensing of Electrical Contractors). Comply with the Plans, all previously referenced specifications, and all applicable local ordinances and regulations before and during all stages of the electrical work.

When required by the local ordinances and governmental agencies, upon completion of the work, have all systems inspected and approved in writing by the authorized governmental electrical inspector for the area. Furnish written certification of the authorized inspector's approval to the Engineer. Inspection by the authorized governmental electrical inspector must neither eliminate nor take the place of the inspections by the Engineer. Upon the Engineer's receipt of written certification and the Contractor's written request for a final inspection of the installations, the Engineer will perform a final inspection.

Where required, conform to ITE, AASHTO, and ASTM standards in effect on the date of advertisement.

Notify the Engineer, local traffic enforcement agency, local utility company, and affected railroad companies seven business days before operational shutdowns to coordinate connection or disconnection to an existing utility or system, unless otherwise instructed herein.

Install meter bases and service disconnects as required by the NESC, NEC, local utility companies, and local ordinances. Install standoffs only when required and approved by the local utility companies. Where a standoff must be used, obtain the local utility company's approval prior to installing the standoff.

(F) Utility Services

Coordinate all work to ensure electrical power of proper voltage, phase, frequency, and ampacity is available to complete the work. Use electrical service cables with THWN insulation.

When electrical, telephone, and telecommunication service is not furnished by the Department or the City and is required, contact the utility company and make application to ensure all work can be completed. Obtain authorization for service in the Department's name for Department-owned locations and in the City's name for City-owned locations. Make application for service in the Department's name for Department-owned locations and in the City's name for City-owned locations.

The Department and the City will be responsible for direct payment of monthly utility company usage charges. The Contractor will be responsible for all expenses associated with utility installation costs, hookups, etc.

Coordinate all work involving electrical service 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.

(G) Maintenance and Repair of Material

Ensure that an IMSA certified, or equivalent, Level II traffic qualified signal technician is standing by to provide emergency maintenance services whenever work is being performed on traffic signal controller cabinets and traffic signal controller cabinet foundations. Standby status is defined as being able to arrive, fully equipped, at the work site within 30 minutes ready to provide maintenance services.

Furnish the Engineer with the name, office telephone number, cellular (mobile) telephone number, and pager number of the supervisory employee who will be responsible for maintenance and repair of equipment during all hours.

Maintain and repair all Contractor-furnished and installed signal and communications related equipment within the project construction limits until completion of the Observation Period and receipt of written notification of final acceptance of the project. This requirement for maintaining and repairing said equipment shall remain in effect in the event of severe weather (see NOAA National Severe Storms Laboratory website <http://www.nssl.noaa.gov/primer/>) or a natural disaster, including but not limited to floods, winter weather, lightning, damaging winds, hail, tornado, tropical storm or hurricane. Items reused (that are unmodified), such as signal heads, signal cable, local detector loops and lead-in cable, will be maintained by others.

Make entries into the maintenance diaries housed inside each traffic signal controller cabinet upon each visit to the controller cabinet. Maintain these diaries through final acceptance of the project.

For all failures, malfunctions, damages to equipment, or errors in workmanship affecting signal operation, begin necessary repairs within four hours of notification.

Complete repairs within eight hours of notification. Comply with Section 150 of the *Standard Specifications* for maintenance of traffic flow. The inability to contact the supervisory employee or prearranged alternate will not extend repair time requirements.

Remove and replace all signal and communications related equipment that fails. The Department will furnish the Contractor replacement equipment for Department-furnished equipment that fails, except for equipment furnished by other contractors within the construction limits of separate NCDOT TIP projects and City of Winston-Salem projects that have not yet been formally accepted by the Department. Maintenance and repair of equipment within the construction limits of NCDOT TIP projects will be the responsibility of the respective TIP project contractors until the Department's final acceptance of those TIP projects.

Except for damages and malfunctions caused by the Contractor's work activities, the Contractor will not be held responsible for pre-existing conditions reported to the Engineer before starting traffic signal work at the specific intersection. The Contractor will assume responsibility for all maintenance and emergency services necessary once traffic signal work has begun at the specific intersection and for all damages and malfunctions caused either directly or indirectly by the Contractor's work activities.

In the event the Contractor fails to perform in accordance with the Plans and Project Special Provisions within the time frame specified, the Department reserves the right to perform maintenance and emergency service necessary to ensure continuous traffic signal operation. Further, all expenses incurred by the Department in implementing this option will be deducted from payment due the Contractor, plus **\$2,500 liquidated damages per occasion, per day, or any portion thereof**, until corrected.

Perform yearly maintenance on all traffic signal conflict monitors. The year shall be defined as beginning on the date of installation of the controller and cabinet at the intersection. Use a signal conflict monitor tester that is capable of interfacing with an Intel®-based notebook computer for input/output. The tester shall test signal conflict monitor displays, timing and voltage functions and input/output combinations of either true or false conflicts. All outputs shall be in plain English. It shall be possible to generate a hard copy printout or to store the results to a file on computer disc. A "No Faults Detected" indication shall be displayed as appropriate.

Ensure that the signal conflict monitor tester is maintained and calibrated per the manufacturer's recommendation. Provide to the Engineer a copy of the manufacturer's certification that the signal conflict monitor tester has been certified before testing any traffic signal conflict monitors. Perform test on each traffic signal conflict monitor per the manufacturer's recommendation. Provide one (1) copy of the traffic signal conflict monitor test results to the Engineer. Place one (1) copy in the traffic signal controller cabinet. Perform these yearly tests for the life of the project.

(H) Inspections

The City and the Department may access the Contractor's equipment to perform railroad, signal, and preventative maintenance inspections, and conflict monitor certification as necessary. The Contractor shall be present for these inspections.

(I) Removal of Existing Equipment and Material

Remove all Department-owned and City-owned signal and communications related equipment and material that will not be used. Signal and communications equipment and materials to be removed under this project include, but are not limited to: signal controllers and cabinets and the equipment housed therein; signal and lead-in cables; poles; splice cabinets; cabinet foundations; junction boxes; messenger cable; communications cable; and guy assemblies. Assume ownership of removed poles (including stub poles), messenger cable, junction boxes, interconnect cable, communications cable, and supporting hardware. Return all other Department-owned equipment and material between 8:00 a.m. and 12:00 p.m., Monday through Thursday, to the Division 9 Traffic Services Office located at 350 Craft Drive in Winston-Salem, North Carolina, 27105. Return all other City-owned equipment and material between 8:00 a.m. and 12:00 p.m., Monday through Thursday, to the City Signal Shop located in City Yard Building 42 on Paul Howell Boulevard (27101). The Department will deduct the cost of Department-owned and City-owned equipment damaged by the Contractor from money due to the Contractor.

(J) Railroad Preemption

Where railroad preemption is required, coordinate all work with the railroad. Do not place signals into operation until signal and railroad company equipment has been interconnected with required railroad-highway crossing devices and railroad preemption is working properly. Ensure preemption sequences begin immediately after activation of train detection. Contact and coordinate with the railroad company to schedule interconnection of the signal to the railroad controller cabinet. Install lead-in cable from the signal controller cabinet to a railroad company furnished and installed lockable junction box. Interconnection will be made by the railroad company. Provide fail-safe operation such that removal of voltage from the railroad side of the isolation relay will initiate the railroad preemption sequence.

Conduct a railroad-highway interconnection preemption inspection for each intersection prior to placing new signal equipment into steady operation. The inspection shall be performed with all appropriate Division, City and Railroad personnel in attendance. The signal shall pass all requirements of the preemption inspection before it can be accepted under the project by the Engineer. The railroad preemption inspection form is available on the NCDOT ITS & Signals Unit website:

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

The Contractor along with other appropriate personnel shall conduct additional preemption inspections annually as long as the signal is in operation under the Contractor's jurisdiction until the signal is accepted by the Engineer.

(K) Timing of Signals

Implement timing values for signal controllers. Modify proposed phasing and timing of existing controllers. Reinstall all existing time-based coordination. As directed, make modifications to existing coordination to account for changes in signal phasing.

The Department reserves the right to make, or have the Contractor make, field timing changes necessary for pattern optimization and to eliminate identifiable, potential hazards to the motoring public. The Engineer will notify the Contractor of timing changes made or supply the

Contractor with revised timing plans if the Department requires the Contractor to implement the timing changes.

Verify time-base coordination in 2070L controllers that upon installation will not be immediately connected to communicate with the new signal system over the new Ethernet fiber-optic cable network. Verify time-base coordination in existing 2070L controllers that upon disconnection from existing coordinated communication will not be immediately connected to the signal system over the fiber-optic cable network. Reset the controller's clock to the common time source if it has drifted. **Ensure that controllers' internal clocks are all synchronized at least once per week to the same date and time of day.** Maintain the time synchronization in all controllers during any time that communication with the TMC is interrupted.

Record the time and date of each visit, the activity performed and name of person who visited the cabinet and performed the clock maintenance activity. Maintain a record of clock maintenance activity in a single document and furnish to the Engineer for review upon request. Failure to visit each intersection that is not online to check and update clocks will result in **liquidated damages of \$1,500 per visit not performed.**

(L) Wire and Cable

For installation in a conduit system, lubricate cable and wires before installing in conduit. Use lubricant that will not physically or chemically harm cable jacket, wire insulation, and conduit.

Only splice lead-in cables in junction boxes using UL[®]-approved, underground splice connectors or in condulets using gel-filled splice connectors. Splice all other electrical wire and cable (i.e., signal cable, etc.) inside equipment cabinets, cabinet base extenders/adapters, and terminal splice boxes at nickel-plated brass, recessed-screw, barrier-type terminal blocks or using gel-filled splice connectors. Unless specifically allowed, connect no more than two conductors to the same terminal screw. Do not splice any electrical wire or cable other than lead-in cables in junction boxes or condulets.

Maintain color coding of wires through splices.

Protect ends of wire and cable from water and moisture.

Place permanent labels on all wires and cables to clearly identify each one. Use an indelible black ink marker or approved labeling devices to write on the permanent labels when required.

Install all wire and cable with necessary hardware including, but not limited to shoulder eyebolts, washers, nuts, thimbleyelets, three-bolt clamps, J-hooks, split bolt connectors, grounding clamps, and lashing material.

(M) Electrical Services and Grounding

Where electrical services do not include an external electrical service disconnect, modify or replace the electrical service to add an electrical service disconnect and a new grounding electrode system. Comply with the "Electrical Service" section of these Project Special Provisions.

Provide a grounding electrode system at all new 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.

Modify existing electrical services, as necessary, to meet the grounding requirements of the NEC, these Project Special Provisions and the Plans. Remove any ground rods in the cabinet foundation and install a new grounding electrode system. Cut off abandoned ground rods in the cabinet foundation flush with the foundation surface. Where a grounding electrode system is connected to the electrical service in accordance with the NEC, test grounding electrode resistance for a maximum of 20 ohms. Grounding electrode resistance test must be verified or witnessed by the Engineer or the Engineer's designated representative. Furnish and install additional ground rods to grounding electrode system as necessary to meet the Project Special Provisions and test requirements. Refer to the "Electrical Service" section of these Project Special Provisions for additional requirements pertaining to grounding of electrical services.

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. The form is located on the Department's website at:

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

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

(N) Electrical Bonding

Using an approved termination means, connect a number 14 AWG minimum 19-strand copper conductor (Type THWN) with green insulation to serve as an equipment grounding conductor to metal poles, vehicular and pedestrian signal pedestals, and other metallic components which are not otherwise bonded, through means approved by the Engineer.

(O) Traffic Signal Activation

Do not place signal in steady (stop-and-go) mode until inspected and authorized by the Engineer.

(P) Requirements for Cables Crossing Railroads

Copies of all executed railroad agreements and related correspondence may be obtained from the Engineer upon request.

(1) Railroad Crossings

Application has been made with Norfolk Southern Corporation (NS), herein called the Railroad Company, for the encroachment agreements necessary under this Contract. Do not commence cable routings over or under railroad-owned facilities until notification and coordination with Engineer and the appropriate Railroad Company has occurred. Install fiber-optic communications cable as shown on the Plans. All work associated with the crossing is to conform to the Railroad Company's specifications. For work within NS rights of way, comply with latest approved edition of NCSE-4 (Specifications for Wire, Conduit and Cable Occupations of Norfolk Southern Corporation Property) and NSCE-8 (Specifications for Pipeline Occupancy of Norfolk Southern Corporation Property).

Cable crossings include the following locations:

Plan Sheet	Location	Railroad Company
CL B-043	At-Grade Crossing across Clemmons Road near Stratford Road / Crossing # 721503J	NS
CL B-050	At-Grade Crossing across Burke Mill Road near Stratford Road / Crossing # 721495U	NS
CL B-051	At-Grade Crossing across Hanes Mall Blvd near Stratford Road / Crossing # 910602D	NS
CL B-053	At-Grade Crossing across Hanes Mall Circle near Stratford Road / Crossing # 910603K	NS
CL B-055	At-Grade Crossing across Healy Drive near Stratford Road / Crossing # 736257V	NS
CL B-132	RR Underpass at First Street west of Northwest Boulevard / Crossing # 722150C	NS
CL B-225	RR Overpass at Reynolda Road west of Northwest Boulevard / Crossing # 722148B	NS
CL B-244	At-Grade Crossing across Shattalon Drive east of Bethania Station Road / Crossing # 722024H	NS
CL B-294	RR Underpass at US 52 north of the Ziglar Road overpass / Crossing # 722019L	NS

(2) Insurance Requirements

The Department has provided Railroad Protective Liability Insurance to Norfolk Southern as part of the Department's encroachment agreements with Norfolk Southern for each of the NS locations listed in the table above

If required by the railroad, pay for railroad personnel to be present when work is performed.

In addition to any other forms of insurance or bonds required under the terms of the Contract and the *Standard Specifications*, take out and keep in force from the commencement of all construction on railroad right-of-way until the final inspection and acceptance of the project by the Engineer, insurance of the following kinds and amount. It is understood that the amounts specified are minimum amounts and that larger amounts may be carried if so desired. Any insurance taken out due to these requirements shall be subject to the approval of the Engineer, and the Railroad Companies as to form and amount. Furnish satisfactory policies prior to beginning of the work on railroad right-of-way.

Refer to the following web links for more specific insurance requirements and requirements for working on the rights-of-way of each railroad company. In the event of a conflict between the requirements of one or more railroad companies and the requirements contained in the Plans or these Project Special Provisions, the requirements of the railroad company shall govern.

Norfolk Southern Corporation:

http://www.nscorp.com/nscportal/nscorp/Customers/Publications/pdf/SEC3_MISC3.pdf

Commercial General Liability Insurance

Furnish evidence to the Engineer of Contractor's commercial General Liability Insurance coverage with a combined single limit of not less than \$1,000,000 for each occurrence for operations performed on the railroad right-of-way. The Contractor's policy shall name Norfolk Southern Railway Company as an additional insured. If any part of the work is sublet, similar insurance in the same amounts and evidence thereof as required of the Prime Contractor shall be provided by or on behalf of the Subcontractor to cover Subcontractor's operations on the railroad right-of-way.

Keep such insurance in force until final inspection of the project, or that portion or portions within the railroad right-of-way, by the Engineer or, in the case of Subcontractors, until the Contractor furnishes a letter to the Engineer stating that the Subcontractor has completed his/her subcontracted work within the railroad right-of-way to Contractor's satisfaction, and that the Contractor will accomplish any additional work necessary on the railroad right-of-way with the Contractor's own forces.

Termination of Insurance and Policies to be Submitted

Any insurance policies given hereunder shall cover all Contractor-performed work the Contractor in connection with the work in the introductory paragraph within railroad right-of-way, but shall not be liable for accidents occurring after acceptance of the completed project by the Department. Such policies shall contain a clause requiring 30 days written notice be given to the Engineer and to the appropriate Railroad Company, prior to cancellation or change.

Submit to the Engineer the original and one copy of the Commercial General Liability Policy, one certified duplicate copy of all other policies, and certificates of insurance in an original and two copies as required by these Project Special Provisions.

No extra allowance will be made for the insurance required hereunder. The entire cost shall be included in the contract unit price bids for other pay items.

The named insured under the commercial General Liability Insurance Policy is the respective Railroad Company, and the designation of the job site description of work is as follows: All construction on the <<RAILROAD COMPANY>> right-of-way on NCDOT Project No. C-5224B in Winston-Salem and Forsyth County, North Carolina.

(3) Flagging Protection or Watchman Service

Provide 72 hours advance notice to Norfolk Southern in order that flagging service can be arranged and provided. Do not undertake any work within the NS right-of-way until the flagman is at the job site.

(4) Delays Caused by Operations of Others

Neither the Department nor the Railroad Company assumes any responsibility for any work performed by others in connection with the construction of the project, and the Contractor shall have no claim whatsoever against the Department or the Railroad Company for any Inconvenience, delay, or additional cost incurred by the Contractor on account of such operations by others.

(5) Time Extensions

No time extensions related to railroad encroachments will be allowed until the related work becomes the controlling factor relative to overall project completion.

(6) Cooperation with Others

Cooperate with others participating in the construction of the project to the end that all work may be carried on to the best advantage.

(7) Authority of Railroad Engineer

The authorized representative of the Railroad Company, hereinafter referred to as the Railroad Engineer, will have the final authority in all matters affecting the safe maintenance of railroad traffic of his company.

(8) Interference with Railroad Operations

Arrange and conduct work so that there will be no interference with railroad operations, including train, signal, telephone and telegraphic services, or damage to the property of the Railroad Company or to the poles, wire, and other facilities of tenants on the rights-of-way of the Railroad Company. Wherever work is liable to affect the operations or safety of trains, first submit the method of doing such work to the Railroad Engineer for approval. However, such approval will not relieve the Contractor from liability.

Should conditions arising from or in connection with the work, require that immediate and unusual provisions be made to protect train operations and property of the Railroad Company, it shall be a part of the required services by the Contractor to make such provisions and if, in the judgment of the Railroad Engineer such provisions are insufficient, the Railroad Engineer or the Department may, at the expense of the Contractor, require or provide such provisions as may be deemed necessary.

(9) Directional Drilling beneath Norfolk Southern Tracks

Prior to the commencement of horizontal directional drilling (HDD) beneath railroad tracks either owned or operated by Norfolk Southern Corporation, submit to NS for approval a complete construction procedure of the proposed directional drilling operation. Include with the submission the manufacturer's catalog information describing the type of equipment to be used. Comply with requirements of the encroachment agreement with NS and with "Specifications for Pipeline Occupancy of Norfolk Southern Corporation Property" (NSCE-8).

(10) Storage of Materials

Do not store materials and equipment where they will interfere with railroad operations, nor on the rights-of-way of the Railroad Company without first having obtained permission from the Railroad Engineer. Such permission will be with the understanding that the Railroad Company will not be liable or damage to such material and equipment from any cause, and that the Railroad Engineer may move or require the Contractor to move, at the Contractor's expense, such material and equipment.

(11) Completion and Acceptance of Work

Upon completion of the work, remove from within the limits of the railroad right-of-way all machinery, equipment, surplus materials, or rubbish and leave said rights-of-way in a neat and orderly condition. Acceptance of the work will be contingent upon final inspection by the Department and by the Railroad Company (if required by the Railroad Company) to determine if

the work was completed satisfactorily in a manner acceptable to the Department and the Railroad Company.

1.4. CONSTRUCTION STAGING/MIGRATION

(A) Introduction

This section addresses the general flow of construction in regards to communications throughout the life of the project. It is essential that the Contractor make every effort to minimize communications downtime to the traffic signals.

Follow the outline of construction described below. Update the construction schedule monthly. Submit a detailed field migration plan (including details of controller cabinet change-outs) and schedule to the Department for review and approval at least two weeks prior to the onset of work, and no later than 60 days after Notice to Proceed. Provide monthly updates to the migration plan at each monthly coordination/construction progress meeting during the project. Include a detail of controller cabinet change-outs, listing every intersection, existing and future control zone, and existing and future communication zone, and a schedule of the migration. Include information explaining how the following situations will be handled:

- Existing pole-mount cabinet converted to base-mount,
- Existing cabinet foundation retained,
- Base-mount cabinet on new foundation,
- Installation and splicing of 6-fiber drop cable assemblies,
- Installation of drop cable assemblies into risers with existing fiber-optic cable,
- Reel-to-reel splice locations,
- Transitioning the City's existing twisted-pair communications network to and Ethernet based system over fiber-optic cable, and changing out the controllers;
- Removal of existing twisted pair copper cable once a controller cabinet has been changed out;
- Removal of existing twisted pair copper cable from followed by installation of new fiber-optic communications cable in the existing underground duct system between the Bryce A. Stuart Building and the Traffic Management Center in downtown Winston-Salem, including replacement of the 4-inch riser on the existing wood pole on east side of Church Street north of the Business 40 bridge; and
- How to coordinate with others at the time new cabinets are set to make the necessary signal changes at the TMC to get the controller online.

Submit a System Design Report to the Engineer for Department review and approval prior to beginning any migration from the existing signal system and communications system to the new signal system and new Ethernet communications system. Submit the System Design Report in both hard copy and electronic form. Refer to "Submittal Data and Documentation" section of these Project Special Provisions for additional requirements.

(B) General

The block diagrams for the new signal system, as shown on the Plans, depicts the completed system equipment to be retained and the new equipment to be installed. The proposed sequence is described below.

Setup a test facility to configure local equipment. Configure the managed Ethernet switch for the additional permanent IP addresses, VLANs, and other configuration data for this project.

Modify the existing device database. Convert the signal timing data and build the system and intersection graphics where necessary for signals not yet on the Centrac[®] signal system.

After the controllers are replaced, additional database work must be performed. Reconfigure the controllers' communications addresses on the existing serial communications network to the Ethernet network. Revise the offset references when the NEMA controllers are replaced with 2070s. The NEMA controllers use offsets referenced to the end of the coordinated phase green. The 2070s, with Oasis IP-based firmware, use as an offset reference to the beginning of the green interval of the coordinated phase. If there are two coordinated phases such as two and six, then the new reference is to be the beginning of the coordinated phase green of the second phase.

(C) Field Infrastructure

The approach to maintaining and maximizing communications to all signals throughout the construction process requires that the new fiber-optic communications infrastructure be constructed while the existing communications infrastructure remains in place and operational. This will allow the intersections, even those in close proximity to one another, to function on the existing communications system until such time as they are migrated to the new Ethernet fiber-optic communications system. The new Ethernet fiber-optic communications network is comprised of:

- 1) New aerial cable overlashed to existing communications cable while the existing communications cable remains in use.

Install the messenger cable and down guys before beginning any overhead fiber-optic cable installation. The overlashed existing twisted pair communications cable will be abandoned in place after construction. Certain aerial routes are on new pole lines or deviate from the course of the existing communications cable. Existing twisted pair copper wire communications cable that is not overlashed (e.g., in risers, where route changes, etc.) will be removed along with existing splice cabinets, unused risers and abandoned junction boxes, after communications have completely migrated to the new fiber-optic cable and the existing twisted-pair communications cable is no longer in use, except where the Plans call for it to remain in place for future use by the City's IS Department.

- 2) New underground cable in a new trenched, drilled or bored conduit.

In certain situations, as shown in the Plans, the fiber-optic cable will be installed in an existing spare conduit that runs alongside the conduit containing the existing communications cable. In some cases, as shown in the Plans, the fiber-optic cable will be installed inside the same conduit that contains the existing communications cable.

- 3) Certain segments of existing NCDOT fiber-optic cable, namely that being installed under TIP projects C-4981B, U-2826B and other existing City and NCDOT fiber-optic cable spliced into the new fiber-optic network.
- 4) Construct 900 MHz wireless communications.

- 5) Work along Clemmons Road from Old Salisbury Road to S. Main Street (TIP Project U-2923) shall not begin until after substantial completion of that project. Coordinate and schedule work to avoid conflicts with TIP Project U-2923.

(D) Field Migration

Follow the outline of construction described below. Submit a detailed field migration plan (including details of controller cabinet change-outs) and schedule to the Engineer for review and approval at least two weeks prior to the onset of work. Update the migration plan monthly and submit it five business days prior to the monthly construction meeting. Do not disconnect any existing twisted-pair communications and do not replace any existing traffic signal controllers until such time that all new fiber-optic cable is installed and accepted for use. Obtain approval from the Engineer for any deviations from this sequence. Note that fiber-optic cable for future termination and use by the City's IS Department will be installed along many but not all cable routes coincident with the fiber-optic cables for the signal system. The general routes of these IS Department fiber cables are shown on the IS Cable Schematics in Volume II of the Plans.

(1) General Requirements

Configure the edge switches for the permanent IP addresses, VLANs, and other configuration data before their field installation.

Notify the City of Winston-Salem Signal System Manager at (336) 747-6879 at least two weeks prior to the commencement of work on a particular communications channel to ensure that time-base coordination will be operating and effective during the time of communications interruption. Place in time-base coordination, those signals within existing communications circuits that actively being migrated to the Ethernet communications system.

Where possible, start at the outer edges of the existing local communications circuit and work inward toward the TMC. The existing twisted-pair, copper wire communications cable will be progressively decommissioned as the new Ethernet-based fiber-optic communications system is built-out and brought online, starting at the outer reaches of the system boundaries and working inward toward the TMC. Construct the IS Department fiber-optic cable at the same time as the signal system fiber-optic cable.

Group the work by the existing communications circuits, allowing intersection migration to take place in discrete packages. The boundaries of the existing communications circuits are documented in these Plans. Interrupt communications, replace cabinets and controllers, and migrate signals from the existing communications network to the new fiber-optic communications network.

If the communications conversion in the subject communications circuit interrupts the communication in another existing communications circuit, the Contractor must re-establish communication continuity in the adjacent communications circuit before any work can continue.

Upon successful testing, integrate into the central system software under Ethernet communications.

Complete the migration of all traffic signals in one Ethernet circuit before beginning work on traffic signals in another Ethernet circuit. Complete the intersection migrations in a communications circuit within the number of workdays equal to no more than the number of signalized intersections in the communications circuit. Exceptions to the requirements in this section must be approved by the Engineer.

In addition to grouping work by existing communications circuits, further organize work by proposed communications ring.

Synchronize the clocks of the traffic signal controllers a minimum of once per week while the controllers are off-line from the communications system (refer the “Time-Base Coordination” subsection later in Section 1 of these Project Special Provisions for additional requirements).

As each Ethernet circuit is completed and lit, test communications to each Ethernet edge switch in that circuit as per the requirements of “Testing and Acceptance” section of these Project Special Provisions.

Prior to the end of any work day, ensure that communication between the TMC and existing signal controllers still connected to the existing communications cable is reestablished and working correctly.

Construct and splice drop cables to existing and proposed CCTV cameras while maintaining the existing communications. Migrate the existing and proposed cameras as the adjacent traffic signals are migrated to new system whenever possible.

Splice existing NCDOT ITS fiber-optic cables to the proposed trunk cables where called for in the Plans. The new fiber network will be spliced into several segments of existing NCDOT ITS single mode fiber-optic cable as described in the table below:

Existing NCDOT ITS Cable Spliced to Proposed Trunk Cables

Route	Segment	Existing Cable Size
US 52	Ziglar Road to Hanes Mill Rd.	72
US 52	Germanton Road to Motor Road	72
University Parkway	Sun View Road to Hanes Mill Rd.	144
University Parkway	Hanes Mill Rd. to Oak Summit Rd.	144
University Parkway	Shattalon Drive to North Point Blvd.	144
University Parkway	Bethabara Rd to Reynolds Blvd.	144
**Church Street	Cemetery Street to Bryce Stuart Building	72

** Notify in advance the City of Winston-Salem Signal System Manager (336)747-6879 as well as Triad Regional ITS Engineer.

Notify the Engineer and coordinate with the Triad Regional ITS Engineer at (336) 315-7079 at least two weeks prior to the commencement of splicing or other work on these cables. Provide the Triad Regional ITS Engineer updated splice details, updated field splicing location, and Contractor emergency contact information prior to beginning work. **Do not cut the entire cable and re-splice all the fibers**, unless prior approval is obtained from NCDOT. The interruption of connectivity of these cables shall be limited to 48 hours or less, and shall occur only on a non-holiday weekend. **Liquidated damages** for failure to restore communications in

an existing NCDOT ITS fiber-optic communications cable within 48 hours are **\$1500 per 24-hour period or any portion thereof**.

Repair at own expense, any damage to NCDOT fiber within 48 hours of notification of the incidence of damage. **Liquidated damages** for failure to repair a damaged NCDOT ITS fiber-optic communications cable and restore communications within 48 hours are **\$1500 per 24-hour period or any portion thereof**.

(2) Step 1

The City has joint-use permits for the proposed new attachments of aerial fiber-optic communications cable. Joint-use permits issued by the utility pole owners expire 120 days from the date of issuance. The Contractor shall commence installation of messenger cables and guy assemblies at the outset of construction and work continuously and expeditiously to complete this work prior to the joint-use permit expiration date. In the event that this work cannot be completed within 120 days, notify the Engineer 20 calendar days in advance to allow the City to request an extension of the permit.

(3) Step 2

The fiber-optic cable in this Phase B project will tie into existing NCDOT ITS fiber-optic cables at the following locations:

- US 52 at Ziglar Road
- US 52 at Hanes Mill Road
- US 52 at Germanton Road
- US 52 at Motor Road
- University Parkway between Cherry Street and Hanes Mill Road

Notify the Engineer and coordinate with the Triad Regional ITS Engineer at (336) 315-7079 at least two weeks prior to the commencement of splicing or other work on these cables. Provide the Triad Regional ITS Engineer updated splice details, updated field splicing location, and Contractor emergency contact information prior to beginning work. Do not cut the entire cable and re-splice all the fibers, unless prior approval is obtained from NCDOT. The interruption of connectivity of these cables shall be limited to 48 hours or less, and shall occur only on a non-holiday weekend. Repair at own expense, any damage to NCDOT fiber within 48 hours of notification of the incidence of damage.

Adhere to the instructions in the preceding paragraph anywhere the project Plans call for a relocation of, or splicing into, other NCDOT cables that connect cameras with the Triad Regional Transportation Management Center (TRTMC).

(4) Step 3

Begin construction of the trunk cables along the major routes. For those routes with overhead cable, overlash the new fiber-optic cable to the existing communications cable. For the underground routes, install the new cable in spare ducts, where available, or inside the same conduit as the existing communications cable as shown on the Plans. Provide cable storage for subsequent and future splices where called for in the Plans.

These trunk cables will connect to the existing Gigabit managed Ethernet switches at communications hub cabinets along the Red Ring, providing a homerun route for Ethernet communications to the City's TMC. Construct the trunk cables into the existing hub cabinets as

shown on the Plans. Establish Ethernet communications and test as per requirements of the “Testing and Acceptance” section of these Project Special Provisions.

(5) Step 4

Construct the trunk cables to the minor arterials and non-redundant links and splice them to the trunk cables constructed in Step 3.

(6) Step 5

Construct and splice drop cables to local intersections in conjunction with new risers or conduits into the controller cabinets while maintaining the existing communications.

(7) Step 6

Configure the edge switches for the permanent IP addresses, VLANs, and other configuration data before their field installation.

Once the Ethernet communications in Step 3 are established and successfully tested, and continuous communications paths are established with outlying signals, begin the process of transferring communications from the old twisted-pair copper network to the new fiber network. See “Time-Based Coordination” section below for further details. Exceptions to the requirements in this section must be approved by the Engineer. Notify the City of Winston-Salem Signal System Manager at least two weeks prior to the commencement of work on a particular communications channel to ensure that time-base coordination will be operating and effective during the time of communications interruption. As each Ethernet circuit is completed and lit, test the intersection communications as per the requirements of “Testing and Acceptance” section of these Project Special Provisions.

Generally, start at the outer edge of the existing twisted-pair copper circuit and work towards the TMC. Group the work by the existing communications circuits as identified in the Plans, allowing intersection migration to take place in discrete packages.

Interrupt communications, replace cabinets and controllers, and migrate signals from the existing twisted-pair, copper wire communications network to the new fiber-optic communications network. If communications conversion in the subject communications circuit interrupts the communication in another communications circuit, the Contractor must re-establish communication continuity in the adjacent communications circuit before any work can continue.

Upon successful testing, integrate into the central system software under Ethernet communications.

Complete the work of migrating all the traffic signals in one communications circuit before moving to the next communications circuit. Complete the intersection migrations in a communications circuit within the number of workdays equal to no more than the number of signalized intersections in the communications circuit. Exceptions to the requirements in this section must be approved by the Engineer.

As each Ethernet circuit is completed and lit, test intersection communications as per the requirements of “Testing and Acceptance” section of the Project Special Provisions.

Ensure controller cabinet change-outs adhere to all requirements listed in Subsections 1.3(A) and 1.3(F) as well as in Section 3, “Temporary Traffic Control”, of the Project Special Provisions.

Prior to the end of any work day, ensure that communications between the Ethernet edge switches, the managed Ethernet switches, and the managed Ethernet core switch in TMC, are reestablished, if they were interrupted, and are working correctly.

(8) Step 7

Construct and splice drop cables to existing and proposed CCTV cameras while maintaining the existing communications. Migrate the existing and proposed cameras as the adjacent traffic signals are replaced.

(9) Step 8

Remove the existing underground twisted-pair copper cable between the TMC and the Bryce Stuart Building and along the west side of Church Street between the Bryce Stuart Building and the existing junction box just north of bridge over Business 40.

(10) Step 9

Perform the following work within 48 consecutive hours on a non-holiday weekend to remove the existing 2-inch riser with weatherhead from the existing wood pole on the west side of Church Street just north of the Business 40 bridge and replace it with a new 4-inch rigid galvanized steel riser as show in the Plans on Sheet CL B-309.

Notify the Engineer, the City of Winston-Salem Signal System Manager at (336) 747-6879 and coordinate with the Triad Regional ITS Engineer at (336) 315-7079 at least two weeks prior to the commencement of splicing or other work on the existing NCDOT 72-fiber cable along Church Street between Cemetery Street and the Bryce Stuart Building. Provide the City of Winston-Salem Signal System Manager and the Triad Regional ITS Engineer updated splice details, updated field splicing location, and Contractor emergency contact information prior to beginning work. The interruption of connectivity of this 72-fiber cable shall be limited to 48 hours or less, and shall occur only on a non-holiday weekend. **Liquidated damages** for failure to restore communications in this existing 72-fiber NCDOT ITS communications cable within 48 hours are **\$1500 per 24-hour period or any portion thereof.**

Repair at own expense, any damage to NCDOT fiber within 48 hours of notification of the incidence of damage. **Liquidated damages** for failure to repair a damaged NCDOT ITS fiber-optic communications cable and restore communications within 48 hours are **\$1500 per 24-hour period or any portion thereof.**

In order to replace the existing 2-inch riser with weatherhead with a new 4-inch riser, the existing 72-fiber NCDOT ITS Communications cable must be temporarily “unspliced” from existing splice enclosure S 32-3 adjacent to the Cemetery Street at Church Street intersection and pulled back (i.e., uninstalled) to an existing junction box in the sidewalk on the west side of Church Street just north of the Business 40 bridge. Doing so will temporarily interrupt communications between the Bryce Stuart Building and the traffic signal system as well as some NCDOT Regional ITS communications. Once the existing riser has been removed and new riser installed, the 72-fiber cable will be immediately reinstalled along its original route and re-spliced in existing splice enclosure S 32-3 to restore communications. Refer to Notes 1 through 6 on

Sheet CL B-309 of the Plans for additional requirements and sequence of work for installing the new 4-inch riser with seal on pole on west side of Church Street just north of the Business 40 bridge. In general, the work that must be accomplished during this 48-hour period includes but is not limited to the following:

- Removal of the existing twisted-pair copper wire communications cable from the existing underground duct running beneath the side on the west side of Church Street between the Bryce Stuart Building and the pole at the north end of the Business 40 bridge;
- Removal of the existing twisted-pair copper wire communications cable from the existing riser that is being replaced;
- Temporarily uninstalling and pulling back the existing 72-fiber communications cable along Church Street to a point north of Business 40;
- Removal of the existing 2-inch riser with weatherhead with existing in-line communications cable splice box on the existing pole;
- Installation of new 4-inch rigid galvanized steel riser to replace the removed riser;
- Re-installation of the existing 72-fiber communications cable; and
- Re-splicing the 72-fiber cable into existing fiber-optic communications network at the Splice S 32-3.

Pulling back (i.e., uninstalling) the existing 72-fiber communications cable along, temporarily storing it on a cable reel, and subsequently reinstalling it along its original route will be measured and paid for in accordance with the “Fiber-Optic Cable” section of these Project Special Provisions. Similarly, disconnecting (“unsplicing”) this 72-fiber communications cable from the existing splice enclosure and subsequently resplicing it within this same enclosure after reinstalling the cable will be measured and paid for in accordance with the “Fiber-Optic Splice Centers” section of these Project Special Provisions. Refer to those sections of these Project Special Provisions for additional requirements.

(11) Step 10

Install the proposed 48-fiber signal system communications cable between the TMC and Splice S 32-3 as shown in the Plans. Concurrent with installation of the 48-fiber signal system cable, install the proposed 24-fiber IS communications cable between the TMC and City Hall and the proposed 96-fiber IS communications cable between City Hall and a new IS splice enclosure where it meets the 144-fiber IS cable installed in Phase A on Church Street just north of Cemetery Street as shown in the Plans. Seal the 4-inch riser with an Engineer-approved conduit sealing bushing (see the “Riser Assemblies” section of these Project Special Provisions). Modify Splice S 32-3 for the new 48-fiber communications cable. Terminate the new 48-fiber signal system communications cable in the TMC. Transfer the existing communications from the existing City fiber-optic cable and connect the new fiber-optic cable for communications between the TMC and the Bryce Stuart Building (via Splice S 32-3). Remove the remaining old head end equipment (modems, other communications hardware, etc) as shown in the Plans.

(12) Step 11

Conduct system testing, acceptance and burn in period.

Test the IS Department fiber-optic cable per the requirements of the “Testing and Acceptance” section of these Project Special Provisions.

(E) Intersection Parameters and Database

The Contractor shall submit requests for intersection timing parameters and data to the Engineer at least three weeks (15 business days) prior to needing them. The City will provide all intersection parameters, database and timing plans in ASC/2 and/or ASC/3 format electronically as portable document format (PDF) files and as Microsoft Excel[®] files. The Contractor shall be responsible for converting City-furnished timing data to OASIS[™]-formatted data and for loading the OASIS[™]-formatted data into the Model 2070L controllers and conflict monitors.

(F) Time-Based Coordination (TBC)

Before the existing communication is interrupted within a control zone, verify the time-based coordination plans installed in all the intersection controllers within the control zone. (If necessary, time-based plans will be provided electronically by the Engineer for the Contractor to implement.)

Verify the time reference on each controller at least once per week (by synchronizing with a National Standard Time source while time-based coordination is in use and make any corrections necessary to maintain proper coordination. Reset the controller’s clock to the common time source if it has drifted. **Ensure that the controllers’ internal clocks are all synchronized at least once per week to the same date and time of day.** Maintain the time synchronization in all controllers during any time that communication with the TMC is interrupted.

Record the time and date of each visit, the activity performed and name of the person who visited the cabinet and performed the clock maintenance activity. Maintain a record of clock maintenance activity in a single document and furnish to the Engineer for review upon request. Failure to visit weekly each intersection that is not online to check and update clocks will result in **liquidated damages of \$1,500 per visit not performed.**

The Engineer reserves the right to make, or have the Contractor make, field timing changes necessary for the pattern optimization and to eliminate identifiable, potential hazards to the motoring public. The Engineer will notify the Contractor of timing changes made or supply the Contractor with revised timing plans if the Department requires the Contractor to implement the timing changes.

Ensure that the time-based coordination plans from existing controllers are transferred to the replacement controllers at those same locations.

1.5. MEASUREMENT AND PAYMENT

There will be no direct payment for work covered in this section. Payment at the contract unit prices for the various items in the contract will be full compensation for all work covered by this section. Include the incidental costs for furnishing and/or installing materials and equipment expressly required under the contract for successful completion of the contract, but whose measurement and payment is not specifically stated under any of the contract pay items, into the unit cost(s) for the various items in the contract.

2. MOBILIZATION

2.1. DESCRIPTION

This work consists of preparatory work and operations to mobilize personnel, materials and equipment to the project site.

2.2. MEASUREMENT AND PAYMENT

Mobilization will be paid as contract lump sum price.

Partial payments for *Mobilization* will be made with the first and second partial pay estimates paid on the contract and will be made at the rate of 50% lump sum price on each of these partial pay estimates, provided the amount bid for *Mobilization* does not exceed 5% of the total amount bid for the contract. Where the amount bid for *Mobilization* exceeds 5% of the total amount bid for the contract, 2.5% percent of the total amount bid will be paid on each of the first two partial pay estimates. That portion exceeding 5% will be paid on the last partial pay estimate.

Such price and payment includes, but is not limited to, the movement of personnel, equipment, supplies, and incidentals to the project site, for the establishment of offices, buildings, and other facilities necessary for work on the project; the removal and disbandment of those personnel, equipment, supplies, incidentals, or other facilities that were established for the prosecution of work on the project; and for all other work and operations that shall be performed for costs incurred before beginning work on the various items on the project site.

Payment will be made under:

Pay Item	Pay Unit
Mobilization	Lump Sum

3. TEMPORARY TRAFFIC CONTROL

3.1. DESCRIPTION

Furnish, install, maintain, relocate, and remove temporary traffic control devices in accordance with these Project Special Provisions, the Transportation Management Plan, the MUTCD, and Roadway Standard Drawings to maintain and control vehicular and pedestrian traffic in a safe and efficient manner during signal system construction. All temporary traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise specified in the contract.

3.2. GENERAL REQUIREMENTS

(A) Maintenance of Traffic

The Contractor will be required to maintain traffic, both vehicular and pedestrian, within the limits of the project, including roadways that cross or intersect the project, unless otherwise provided for in the contract or approved by the Engineer. The Contractor shall conduct his work in a safe manner that will create a minimum amount of inconvenience to traffic, both vehicular and pedestrian.

Maintain vehicular and pedestrian traffic through work zones in accordance with these Project Special Provisions, the MUTCD, and *Roadway Standard Drawings*, 23 CFR 630 Subparts J and K and the Transportation Management Plan (TMP).

Mark all hazards with signs, barricades, drums or other warning devices until the hazard is eliminated.

(B) Temporary Lane Closures

(1) General

Operate all equipment and personnel within the designated work area during lane closures. Do not impede or stop traffic for the purpose of performing construction related work on the traffic side of the lane closure, except when called for in the Transportation Management Plan.

Install lane closures with the traffic flow, beginning with devices on the upstream side of traffic. Remove lane closures against the traffic flow, beginning with devices on the downstream side of traffic.

Vehicles used to install or remove lane closures shall have flashing or rotating beacons.

(2) Intersections

When construction proceeds through an intersection, provide flagger(s) and all other necessary Traffic Control as required by the Plans to direct the traffic through the intersection. When an intersection is signalized, have authorized personnel place the signal in flash mode prior to beginning work in the intersection.

When it is necessary to close a lane of traffic for construction on the departure (downstream) side of an intersection, implement the lane closure on the approach (upstream) side of the intersection. Close the appropriate lane of dual turn lanes that would otherwise turn into the lane that is closed on the departure side of the intersection.

(C) Traffic Stoppage

Limit the stoppage of traffic to times specified in the Plans. Provide enough time between consecutive stoppages to allow the traffic queue to dissipate.

(D) Traffic Control Supervision

Provide the service of at least one qualified work zone supervisor. The work zone supervisor shall have the overall responsibility for the proper implementation of the traffic management plans and ensure all employees working inside the NCDOT and City rights-of-way have received the proper training appropriate to the job decisions each individual is required to make.

The work zone supervisor is not required to be on site at all times but shall be available to address concerns of the Engineer. The name and contract information of the work zone supervisor shall be provided to the Engineer prior to or at the preconstruction conference.

Qualification of work zone supervisors shall be done by an NCDOT approved training agency or other approved training provider. For a complete listing of these, see the Work Zone Traffic Control's webpage: <http://www.ncdot.gov/doh/preconstruct/wztc/>

Coordinate with and cooperate with traffic control supervisors of adjacent or overlapping construction projects to insure safe and adequate traffic control is maintained throughout the projects at all times including periods of construction inactivity in accordance with Article 105-7 of the *Standard Specifications*.

(E) Vehicular Access

Maintain continuous and safe vehicular access, including but not limited to, all residences, businesses, schools, police and fire stations, hydrants, other emergency services, hospitals and mailboxes. Conduct operations in such a manner as to limit the inconvenience to property owners.

(F) Pedestrian Access

Maintain continuous and safe pedestrian access, including but not limited to, all residences, businesses, schools and mailboxes. Conduct operations in such a manner as to limit the inconvenience to pedestrians. Pay special attention to pedestrian areas used by visually-impaired pedestrians. Coordinate with local Orientation and Mobility Specialists to make appropriate provisions for visually impaired pedestrians when construction activities will disrupt pedestrian paths that they normally use.

Protect open excavations within or adjacent to areas subject to pedestrian traffic from pedestrian intrusion by surrounding the excavation/hazard with orange plastic mesh construction fencing (also referred to as safety fence, tree protection barricade, warning fence, etc.) or other method approved by the Engineer. Do not use tape, flagging, rope or plastic chain strung between barricades, cones or stakes.

Determine the extent of pedestrian needs through engineering judgment or by the traffic control supervisor responsible for the work zone. Inspect the work zone regularly so effective pedestrian traffic is maintained. When pedestrian movement through or around a work site is necessary, provide a separate usable footpath. If the previous pedestrian facility was accessible to pedestrians with disabilities, provide a footpath during temporary traffic control that is accessible. Do not have any abrupt changes in grade or terrain that could cause a tripping hazard

or could be a barrier to wheelchair use. Provide barriers and channelizing devices that are detectable to pedestrians who have visual disabilities. Provide temporary pedestrian facilities that are made of concrete, asphalt or other suitable material as approved by the Engineer at all locations where the existing sidewalks have been removed for construction operations.

Do not sever or move pedestrian facilities for non-construction activities such as parking for vehicles and equipment. Separate pedestrian movements from both work site activity and vehicular traffic.

(G) Greenways

Comply with all requirements of the “Pedestrians” for all work that is adjacent to, encroaches upon or is within City of Winston-Salem Greenways. Maintain and make provisions for bicycle ingress and egress and provide for safe passage of bicycles along greenways in manner similar to the requirement for pedestrians. At least two weeks prior to beginning any work that may affect or disrupt pedestrian and bicycle traffic along a City Greenway, coordinate with the City of Winston-Salem Department of Transportation concerning any special requirements, any special events like bike races, and work day/hour limitations for the affected Greenway. A map showing the location and routes of the City’s Greenways may be found at the following Web address:

<http://www.ci.winston-salem.nc.us/Assets/CityOfWS/Documents/Recreation/Greenways/greenways12brochure-web.pdf>

(H) Alternate to Transportation Management Plan

If desired, submit an alternate TMP a minimum of 30 calendar days in advance of the anticipated implementation to allow for adequate review time. Do not implement alternate plans for traffic control until approved in writing and properly sealed. No adjustment in compensation or extension of the completion date(s) will be allowed due to the review time of the alternate. If an alternate TMP is implemented, the Contractor shall be responsible for any unanticipated changes to subsequent Steps.

(I) Temporary Traffic Control Plan Not fully Covered in the Contract

When the Transportation Management Plan does not cover a particular work function, notify the Engineer to allow for the development or modification of a sealed set of the Transportation Management Plans.

3.3. MATERIALS

(A) Work Zone Traffic Control Devices

Refer to Division 10 of the *Standard Specifications*.

Use temporary traffic control devices that comply with 23 CFR 630 Subpart K. Provide a Type 7 material certifications in accordance with Article 106-3 of the *Standard Specifications* at least 72 hours before use for all used temporary traffic control devices.

Provide temporary traffic control devices that are listed on the NCDOT Approved Product List.

(B) Work Zone Signs

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Barricade Mounted Signs	1089-3
Work Zone Signs	1089-1
Work Zone Sign Supports	1089-2

Portable work zone signs shall be roll up or approved composite substrates. Use portable work zone signs only with portable work zone sign stands specifically designed for one another.

Provide portable work zone sign stands, portable signs and sheeting that meet NCHRP 350 for Category II traffic control devices and are listed on the NCDOT Approved Products List.

Provide portable work zone signs and stands that are crash tested together as a system by the manufacturer. Poor performance of portable work zone signs or portable work zone sign stands at any site, whether or not related to a specific contract, will be grounds for non-acceptance of a product on any project under contract.

(C) Flashing Arrow Boards

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Flashing Arrow Boards	1089-6

Use arrow boards that are on the NCDOT Approved Product List.

Poor performance of arrow boards at any site, whether or not related to a specific contract, will be grounds for non-acceptance of a product on any project under contract.

(D) Portable Changeable Message Signs

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Portable Changeable Message Signs	1089-7

Use portable changeable message signs that are on the NCDOT Approved Products List.

Poor performance of portable changeable message signs at any site, whether or not related to a specific contract, will be grounds for non-acceptance of a product on any project under contract.

(E) Drums

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Drums	1089-5

Provide drums that are on the NCDOT Approved Products List.

(F) Cones

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Cones	1089-5

Provide cones that are on the NCDOT Approved Products List.

(G) Barricades

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Barricades	1089-3

Provide barricades that meet NCHRP 350 for Category II traffic control devices and are on the NCDOT Approved Products List.

(H) Flaggers

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Flaggers	1089-10

(I) Truck Mounted Attenuators

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Truck Mounted Impact Attenuators	1089-9

Use TMAs that meet NCHRP 350 Test Level II or III for work zone traffic control devices and are on the NCDOT Approved Products List.

Historical performance of the TMA will help determine the future use of the material by the Department, even if the TMA has been approved. Poor performance of TMA at any site, whether or not related to a specific contract, will be grounds for non-acceptance of a product on any project under contract.

(J) Skinny Drums

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Skinny Drums	1089-5

Provide skinny drums that are on the NCDOT Approved Products List.

3.4. CONSTRUCTION METHODS**(A) Work Zone Traffic Control Devices**

Ensure all traffic control devices inspected and approved before using them on the project. Install temporary traffic control devices before construction operations begin and during the proper phase of construction. Maintain and relocate temporary traffic control devices during the

time they are in use. Keep these devices in place as long as they are needed and immediately remove thereafter. When operations are performed in stages, install only those devices that apply to the present conditions.

(B) Work Zone Signs

(1) Work Zone Signs (Barricade Mounted)

Mount approved composite or roll-up signs to barricade rails so that the signs do not cover more than 50% of the top two rails or 33% of the total area of the three rails. Mount signs at least 1 foot from the ground to the bottom of the sign.

(2) Work Zone Signs (Portable)

Install the portable work zone sign and sign stand to stand plumb within 10° left and right, within 20° front and back and be capable of standing erect in windy conditions.

Install roll-up or approved composite signs at least 1 foot from the bottom of the sign to the edge of pavement elevation on two-lane two-way roadways and at least 5 feet from the bottom of the sign to the edge of pavement elevation on multi-lane roadways.

Clean the sign face prior to use.

When not in use for periods longer than 30 minutes, lay the portable work zone sign flat on the ground and collapse the sign stand and lay it flat on the ground.

(C) Flashing Arrow Boards

Use arrow boards that have the capability to display mode selections.

Do not use straight-line caution or chevron displays.

Mount flashing arrow boards on trucks, trailers, or other mobile units.

Expedite repairs due to failure, malfunction or damage to an arrow board. Furnish another arrow board approved by the Engineer during the repair time. Repair or replace arrow boards immediately; otherwise, suspend all construction activities requiring the use of the sign until the sign is restored to operation.

Perform all maintenance operations recommended by the manufacturer of the sign.

(D) Portable Changeable Message Signs

Mount all portable changeable message signs on a trailer or truck so as to support the message board in a level position and in accordance with the Plans. Align and sight the portable changeable message sign to provide optimal driver visibility. Messages on a portable changeable message sign shall consist of no more than 2 phases, and a phase shall consist of no more than 3 lines of text. Each phase shall be capable of being understood by itself, regardless of the order in which it is read. Messages shall be centered and uppercase within each line of the legend. If more than one portable changeable message sign is simultaneously legible to road users, then only one of the signs shall display a sequential message at any given time. As guidance, the display time for each phase shall be at least 2 seconds, and the sum of the display times for both of the phases shall be no more than 8 seconds. Sign operator will adjust the display rate so the 2 phase message can be understood by the motorist approaching the sign at the posted speed limit. Relocate the units for the various stages of construction as shown in the Plans or as needed to adequately inform the motorists.

Provide an experienced operator for the portable changeable message sign during periods of operation to ensure that the messages displayed on the sign panel are in accordance with the Plans and in accordance with message content guidelines. Ensure that the message sign is illuminated properly to meet the existing light conditions, and that all adjustments for operation of the sign are made as needed to properly guide motorists.

Expedite repairs due to failure, malfunction, or damage to a portable changeable message sign. Furnish another portable changeable message during the repair time. Repair and/or replace portable changeable message sign immediately; otherwise, suspend all construction activities requiring the use of the sign until the sign is restored to operation.

Perform all maintenance operations recommended by the manufacturer of the sign. Include the periodic cleaning of the sign face and associated solar panels in maintenance operations.

(E) Drums

Use the same type of reflective sheeting on all drums installed at any one time during the life of the project. Spacing of these devices is equal in feet to the speed limit in the taper and twice the speed limit in the tangent sections

Use a ballasting method in accordance with the manufacturer's specification. When using tire ballasting method, use approved manufacturer's tires and place the tires flush with the ground.

Immediately replace any drum, ballast or reflective sheeting that are torn, crushed, discolored or otherwise damaged.

(F) Cones

Use reflective adhesive sheeting on all cones used between dusk and dawn. Use the same type of reflective sheeting on all cone collars installed at any one time during the life of the project. Do not use cones in the upstream taper of lane or shoulder closures for multilane roadways and use for no longer than 3 consecutive days.

Use ballasting methods in accordance with manufacturer's specification. Cones may be used on all facilities for daytime and nighttime work with speed limits at or below 55 mph. If used at night, the cones shall have adhesive reflective sheeting and shall meet the height requirements in the *Roadway Standard Drawings*.

Cones may be used instead of drums, where allowed in the TMP plans or by the Engineer, on facilities with speed limits above 55 mph, if both the work is performed during daylight conditions and the devices are removed after each work period. Drums shall be used in the tapers.

The maximum spacing for cones on multi-lane roadways is equal in feet to the posted speed limit.

Immediately replace any cone that is torn, crushed, discolored or otherwise damaged.

(G) Barricades

At the end of the workday, properly close the road where construction equipment accesses a road closure through Type III barricades.

Use sandbags or other approved ballasting methods to prevent overturning of barricades by the wind. If needed, place sandbags or other acceptable ballasting on the feet of the frame. Do not ballast barricades with objects such as rocks or chunks of concrete.

Do not anchor barricades to any pavement surfaces unless such anchoring method has passed the crash test requirement of NCHRP 350 for work zone category II devices.

Point the striped diagonals on the barricade rails in the direction of traffic flow.

(H) Flaggers

Provide the service of properly equipped and qualified flaggers (see *Roadway Standard Drawings* No. 1150.01) at locations and times for such period as necessary for the control and protection of vehicular and pedestrian traffic. Anyone who controls traffic is required to be qualified. Qualification consists of each flagger receiving proper training in the set-up and techniques of safely and competently performing a flagging operation. Qualification of flaggers is to be done by an NCDOT approved training agency or other approved training provider. For a complete listing of these, see the Work Zone Traffic Control's webpage.

Prior to beginning work on the project, a Qualification Statement that all flaggers used on the project have been properly trained through an NCDOT approved training resource shall be provided to the Engineer.

Use flagging methods that comply with the guidelines in the MUTCD.

(I) Truck Mounted Attenuator

Before use, furnish the Engineer detailed brochures, specifications, and other manufacturer's data that completely describes the performance criteria, installation, and instructions for the TMA.

Use only TMAs that meet the crash test requirements of *Standard Specifications* Article 1089-9(A).

Do not park TMAs against rigid objects (i.e. bridge piers or portable concrete barrier) except as a temporary safety measure and in no case for longer than 72 hours. Install the TMA on a truck that is fully operational, in good running order, and in accordance with the manufacturer's specifications.

Use the appropriate lighting and delineation on the truck and TMAs as shown in the contract.

Repair or replace within 24 hours any attenuator that becomes crushed or otherwise damaged so that it will perform its intended purpose. Suspend all construction activities until the attenuator is repaired or replaced. Provide safe control of traffic until the attenuator has been repaired by using approved methods.

(J) Skinny Drums

Use the same type of reflective sheeting (Type III High Intensity Prismatic or greater) on all skinny drums installed at any one time during the life of the project. Use ballasting methods in accordance with the manufacturer's specification.

Immediately replace any skinny drum, ballast or reflective sheeting that are torn, crushed, discolored or otherwise damaged.

Skinny drums may be used instead of cones on all facilities with speed limits of 55 mph and below. Spacing of these devices is equal in feet to the speed limit in the taper and twice the speed limit or every other skip in the tangent sections.

Skinny drums may be used instead of cones and drums where allowed in the TMP or by the Engineer on facilities with speed limits above 55 mph, if all the following apply:

- 1) The work is performed during daylight conditions,
- 2) The devices are removed after each work period and
- 3) Drums are used in the tapers.

Do not use skinny drums on control-of-access facilities with speed limits above 55 mph that either involve night work or allow devices to remain in place overnight.

Do not use skinny drums for tapers on multilane or control-of-access roadways with speed limits above 55 mph.

Do not intermix with drums or cones unless directed by the Engineer or the TMP.

(K) Law Enforcement

Use uniformed law enforcement officers and marked law enforcement vehicles equipped with blue lights mounted on top of the vehicle and law enforcement vehicle emblems to direct or control traffic as required by the Plans or by the Engineer.

Use a law enforcement officer(s) when an existing traffic signal must be taken out of operation in order to remove and replace the existing cabinet and controller. Use a law enforcement officer(s) when a traffic signal must be deactivated while constructing a conduit entrance into an existing cabinet foundation (subject to the Engineer's prior approval), while overlaying an existing cabinet foundation with a new preformed foundation and while removing and replacing an existing foundation with a new preformed foundation in the same location.

(L) Pedestrian Safety

Install measures for separating pedestrian traffic from the work area and from adjacent vehicular traffic where pedestrian paths are evident or sidewalks are present. Use protective barricades, warning and guidance devices and signs to provide a safe, well-defined passageway for pedestrians. When a sidewalk must be closed temporarily to perform construction work, refer to Chapter 6D, "Pedestrian and Worker Safety," and Typical Applications 28 and 29 (TA-28 and TA-29) of the 2009 Edition of the *Manual on Uniform Traffic Control Devices* (MUTCD 2003) for appropriate pedestrian traffic control measures. The MUTCD 2009 is available online at the following web address: <http://mutcd.fhwa.dot.gov>

3.5. MAINTENANCE AND INSPECTION

(A) Work Zone Traffic Control Devices

Submit a proposed traffic control device maintenance schedule and checklist for approval prior to construction. Perform continuous maintenance and scheduled inspections of traffic control devices. Review and maintain all traffic handling measures to ensure that adequate provisions are in place for the safety of the public and workers.

Maintenance activities include cleaning, repair or replacement of temporary traffic control devices that are damaged, torn, crushed, discolored, displaced or deteriorated beyond effectiveness.

If there are traffic control devices in use, perform inspection on a daily basis.

If the name and telephone number of the agency, Contractor or supplier is shown on the non-retroreflective surface of all channelizing devices, use letters and numbers that are a non-reflective color and not over 2 inches in height.

3.6. FAILURE TO MAINTAIN TRAFFIC CONTROL

Failure to maintain temporary traffic control measures and traffic control devices in accordance with this Project Special Provision may result in formal notification of noncompliance. Implement remedial action immediately for imminent danger situations as directed. Implement remedial action within 48 hours after notification of a safety issue that is not an imminent danger situation. See Articles 107-21 and 108-7 of the *Standard Specifications*.

Failure to comply may result in having the work performed with available forces and equipment. In cases of willful disregard for the safety of the public, the Engineer may proceed immediately to implement the measures necessary to provide the appropriate level of traffic control to ensure that the safety of all concerned parties is maintained.

3.7. MEASUREMENT AND PAYMENT

Nominal dimensions will be used to compute sign panel areas.

Work zone signs (barricade mounted) will be measured and paid for as the actual number of square feet satisfactorily installed on barricades and accepted by the Engineer. Payment will be made for the initial installation only. Relocation of signs will be considered incidental to the measurement of the quantity of signs.

Work zone signs (portable) will be measured and paid for as the actual number of square feet satisfactorily installed and accepted by the Engineer. Payment will be made for the initial installation only. Relocation of signs will be considered incidental to the measurement of the quantity of signs.

No direct payment will be made for portable work zone sign stands. All portable work zone sign stands will be incidental to the work of providing work zone signs.

Flashing arrow board will be measured and paid for as the maximum number of boards that have been satisfactorily placed and accepted by the Engineer in use at any one time during the life of the project as required by the contract. Relocation, repair, replacement and maintenance of arrow boards is considered incidental to the work of this section of the Project Special Provisions.

Portable changeable message sign will be measured and paid for as the maximum number of portable changeable message signs acceptably placed and in operation, at any one time during the life of the project. Payment for *portable changeable message sign* will be made on the following schedule:

- 70% of the unit bid upon placing the unit in service.
- 20% of the unit bid when the project is 50% complete.
- 10% of the unit bid when the project is 100% complete.

Relocation, replacement, repair and maintenance of portable changeable message signs is considered incidental to the work of this section of the Project Special Provisions.

Drums will be measured and paid for as the maximum number of drums acceptably placed and in use at any one time during the life of the project. Relocation, repair, replacement and maintenance of cones will be incidental to the work of this section of the Project Special Provisions.

Cones will be measured and paid for as the maximum number of cones acceptably placed and in use at any one time during the life of the project. Relocation, repair, replacement and maintenance of cones will be incidental to the work of this section of the Project Special Provisions.

Barricades (Type III) will be measured and paid for as the maximum number of linear feet of barricades acceptably placed and in use at any one time during the life of the project. Measurement will be made of the total length of each barricade along one rail. Relocation, repair, replacement and maintenance of barricades will be incidental to the work of this section of the Project Special Provisions.

Flagger (hour) will be measured and paid for as the actual number of hours that each flagger is satisfactorily provided and accepted by the Engineer during the life of the project. Flagging conducted for the convenience of the Contractor's operations is not compensated. The Department will pay for flaggers, including those used at Y-lines that are used in conjunction with a lane closure. Flaggers used for operations not involving a lane closure will be incidental to that operation and no payment will be made. Flaggers used for hauling operations, where the only need for a lane closure is due to the hauling operation, will be incidental to that operation and no payment will be made. Any flagger used for less than one hour will be incidental to that operation.

TMA will be measured and paid for as the maximum number of TMAs acceptably placed and in use at any one time during the life of the project for all operations other than moving and mobile operations. TMAs will be incidental to all moving and mobile operations. In the case of emergency situations, TMAs will not be paid for when payment has already been made for a stationary unit. Relocation of TMAs will be incidental to the measurement of the quantities of TMAs and no separate payment will be made.

Skinny drum will be measured and paid for as the actual number of skinny drums satisfactorily placed, accepted by the Engineer and in use at any one time during the life of the project. Relocation, repair, replacement and maintenance of skinny drums is considered incidental to the work of this section of the Project Special Provisions.

Law enforcement will be measured and paid for as the actual number of hours that each law enforcement officer is provided during the life of the project as approved by the Engineer and subject to the following conditions:

- Measurement and payment will not exceed 3 hours per police officer provided to direct traffic at a given signalized intersection during the removal and replacement of a controller cabinet.
- Measurement and payment will not exceed 1 hour per police officer provided to direct traffic at a given signalized intersection while constructing a new conduit entrance into an existing cabinet foundation, overlaying an existing cabinet foundation with a new preformed foundation or replacing an existing foundation with a new preformed foundation in the same location.

There will be no direct payment for marked law enforcement vehicles as they are considered incidental to the pay item.

No measurement will be made of orange plastic mesh construction fencing or other approved methods of protecting open excavations/hazards from pedestrian intrusion as such measures will be considered incidental to the excavation work.

If the Contractor fails to maintain acceptable traffic control measures or temporary traffic control devices and the Engineer implements measures necessary to provide the appropriate level of traffic control, the actual cost of performing said work will be deducted from the monies due the Contractor on the contract.

Payment will be made under:

Pay Item	Pay Unit
Work Zones Signs (Barricade Mounted)	Square Foot
Work Zones Signs (Portable)	Square Foot
Flashing Arrow Board	Each
Portable Changeable Message Sign	Each
Drums	Each
Cones	Each
Barricades (Type III)	Linear Foot
Flagger	Hour
TMA	Each
Skinny Drum	Each
Law Enforcement	Hour

4. SIGNAL HEADS

4.1. DESCRIPTION

Furnish, install vehicle LED signal heads, visors, interconnecting brackets, wire entrance fittings, mounting assemblies, signal cable, lashing wire, grounding systems, and all necessary hardware.

4.2. MATERIALS

(A) General

Furnish material, equipment and hardware under this section that is pre-approved on the ITS and Signals QPL.

Fabricate vehicle signal head housings and end caps from ultraviolet and heat-stabilized virgin polycarbonate material.

Fabricate tunnel and traditional visors for vehicle signal heads from ultraviolet and heat-stabilized virgin polycarbonate material. Fabricate tunnel and traditional visors for pedestrian signal heads from sheet aluminum.

Paint all surfaces inside and outside of signal housings and doors. Paint outside surfaces of tunnel and traditional visors, messenger cable mounting assemblies, and pole and pedestal mounting assemblies. Have electrostatically-applied, fused-polyester paint a minimum of 2.5 to 3.5 mils thick. Do not apply paint to the latching hardware or rigid vehicle signal head mounting brackets for mast arm attachments.

Paint the signal housings and visors black (Federal Standard 595C, Color Chip Number 17038) when:

- The vehicle signal will be mounted on metal poles or mast arms that currently have a black finish.
- The existing pedestrian and vehicle signals at the intersection where the new signals will be installed are painted black.

For signals at all other locations, paint the signal housings highway yellow (Federal Standard 595C, Color Chip Number 13538).

Have the interior surfaces of tunnel and traditional visors painted an alkyd urea black synthetic baking enamel with a minimum gloss reflectance and meeting the requirements of MIL-E-10169, "Enamel Heat Resisting, Instrument Black." Paint the exterior surfaces of tunnel and traditional visors black (Federal Standard 595C, Color Chip Number 17038).

For pole mounting, provide side of pole mounting assemblies with framework and all other hardware necessary to make complete, watertight connections of the signal heads to the poles and pedestals. Fabricate the mounting assemblies and frames from aluminum with all necessary hardware, screws, washers, etc. to be stainless steel. Provide mounting fittings that match the positive locking device on the signal head with the serrations integrally cast into the brackets. Provide upper and lower pole plates that have a 1¼-inch vertical conduit entrance hubs with the hubs capped on the lower plate and 1½-inch horizontal hubs. Ensure that the assemblies provide rigid attachments to poles and pedestals so as to allow no twisting or swaying of the signal heads.

Ensure that all raceways are free of sharp edges and protrusions, and can accommodate a minimum of ten Number 14 AWG conductors. Furnish pole-mounting assemblies that are the same color as the housing of the pedestrian or vehicle signal head that will be attached to them (e.g., furnish black assemblies for black signal heads and yellow assemblies for yellow signal heads). Comply with the painting requirements for signal heads listed above.

For pedestal mounting, provide a post-top slipfitter mounting assembly that matches the positive locking device on the signal head with serrations integrally cast into the slipfitter. Provide stainless steel hardware, screws, washers, etc. Provide a minimum of six 3/8 X 3/4-inch long square head bolts for attachment to pedestal. Provide a center post for multi-way slipfitters. Furnish post-top slipfitter mounting assemblies that are either the same color as the housing of the pedestrian or vehicle signal head that will be attached to them (e.g., furnish black assemblies for black signal heads and yellow assemblies for yellow signal heads) or which have a natural aluminum finish. Comply with the painting requirements for signal heads listed above.

For light emitting diode (LED) traffic signal modules, provide the following requirements for inclusion on the Department's Qualified Products List (QPL) for traffic signal equipment.

1. Sample submittal,
2. Third-party independent laboratory testing results for each submitted module with evidence of testing and conformance with all of the Design Qualification Testing specified in Section 6.4 of each of the following Institute of Transportation Engineers (ITE) specifications:
 - Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement
 - Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement
 - Pedestrian Traffic Control Signal Indications – Light Emitting Diode (LED) Pedestrian Traffic Signal Modules.

(Note: The Department currently recognizes two approved independent testing laboratories. They are Intertek ETL Semko and Light Metrics, Incorporated with Garwood Laboratories. Independent laboratory tests from other laboratories may be considered as part of the QPL submittal at the discretion of the Department.)

3. Evidence of conformance with the requirements of these specifications,
4. A manufacturer's warranty statement in accordance with the required warranty, and
5. Submittal of manufacturer's design and production documentation for the model, including but not limited to, electrical schematics, electronic component values, proprietary part numbers, bill of materials, and production electrical and photometric test parameters,
6. Evidence of approval of the product to bear the Intertek ETL Verified product label for LED traffic signal modules.

In addition to meeting the performance requirements for the minimum period of 60 months, provide a written warranty against defects in materials and workmanship for the modules for a period of 60 months after installation of the modules. During the warranty period, the manufacturer must provide replacement modules within 45 days of receipt of modules that have failed at no cost to the State or City. Repaired or refurbished modules may not be used to fulfill

the manufacturer's warranty obligations. Provide manufacturer's warranty documentation to the Department during evaluation of product for inclusion on the ITS and Signals QPL.

(B) Vehicle Signal Heads

Comply with the ITE standard "Vehicle Traffic Control Signal Heads". Provide housings with provisions for attaching backplates.

Provide visors that are 8 inches in length for 8-inch vehicle signal head sections. Provide visors that are 10 inches in length for 12-inch vehicle signal heads.

Provide a termination block with one empty terminal for field wiring for each indication plus one empty terminal for the neutral conductor. Have all signal sections wired to the termination block. Provide barriers between the terminals that have terminal screws with a minimum Number 8 thread size and that will accommodate and secure spade lugs sized for a Number 10 terminal screw.

Mount termination blocks in the yellow signal head sections on all in-line vehicle signal heads. Mount the termination block in the red section on five-section vehicle signal heads.

Furnish vehicle signal head interconnecting brackets. Provide one-piece aluminum brackets less than 4.5 inches in height and with no threaded pipe connections. Provide hand holes on the bottom of the brackets to aid in installing wires to the signal heads. Lower brackets that carry no wires and are used only for connecting the bottom signal sections together may be flat in construction.

For messenger cable mounting, provide messenger cable hangers, wire outlet bodies, balance adjusters, bottom caps, wire entrance fitting brackets, and all other hardware necessary to make complete, watertight connections of the vehicle signal heads to the messenger cable. Fabricate mounting assemblies from malleable iron and provide serrated rings made of aluminum. Provide messenger cable hangers and balance adjusters that are galvanized before being painted. Fabricate balance adjuster eyebolt and eyebolt nut from stainless steel or galvanized malleable iron. Provide messenger cable hangers with U-bolt clamps. Fabricate washers, screws, bolts, clevis pins, cotter pins, nuts, and U-bolt clamps from stainless steel.

For mast arm mounting, provide rigid vehicle signal head mounting brackets and all other hardware necessary to make complete, watertight connections of the vehicle signal heads to the mast arms and to provide a means for vertically adjusting the vehicle signal heads to proper alignment. Fabricate the mounting assemblies from malleable iron or aluminum, and provide serrated rings made of aluminum. Provide stainless steel cable attachment assemblies to secure the brackets to the mast arms. Ensure all fastening hardware and fasteners are fabricated from stainless steel.

Provide LED vehicular traffic signal modules (hereafter referred to as modules) that consist of an assembly that uses LEDs as the light source in lieu of an incandescent lamp for use in traffic signal sections. Use LEDs that are aluminum indium gallium phosphorus (AlInGaP) technology for red and yellow indications and indium gallium nitride (InGaN) for green indications. Install the ultra bright type LEDs that are rated for 100,000 hours of continuous operation from -40°F to +165°F. Design modules to have a minimum useful life of 60 months and to meet all parameters of this specification during this period of useful life.

For the modules, provide spade terminals crimped to the lead wires and sized for a #10 screw connection to the existing terminal block in a standard signal head. Do not provide other types of crimped terminals with a spade adapter.

Ensure the power supply is integral to the module assembly. On the back of the module, permanently mark the date of manufacture (month & year) or some other method of identifying date of manufacture.

Tint the red, yellow and green lenses to correspond with the wavelength (chromaticity) of the LED. Transparent tinting films are unacceptable. Provide a lens that is integral to the unit with a smooth outer surface.

(1) LED Circular Signal Modules:

Provide modules in the following configurations: 12-inch circular sections, and 8-inch circular sections. All makes and models of LED modules purchased for use on this project shall appear on the current NCDOT ITS & Signals Qualified Products List (QPL).

Provide the manufacturer's model number and the product number (assigned by the Department) for each module that appears on the 2012 or most recent ITS & Signals QPL. In addition, provide manufacturer's certification in accordance with Article 106-3 of the *Standard Specifications*, that each module meets or exceeds the ITE "Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Circular Signal Supplement" dated June 27, 2005 (hereafter referred to as VTCSH Circular Supplement) and other requirements stated in this specification.

Provide modules that meet the following requirements when tested under the procedures outlined in the VTCSH Circular Supplement:

Module Type	Max. Wattage at 165° F	Nominal Wattage at 77° F
12-inch red circular	17	11
8-inch red circular	13	8
12-inch green circular	15	15
8-inch green circular	12	12

For yellow circular signal modules, provide modules tested under the procedures outlined in the VTCSH Circular Supplement to insure power required at 77° F is 22 Watts or less for the 12-inch circular module and 13 Watts or less for the 8-inch circular module.

Note: Use a wattmeter having an accuracy of $\pm 1\%$ to measure the nominal wattage and maximum wattage of a circular traffic signal module. Power may also be derived from voltage, current and power factor measurements.

(2) LED Arrow Signal Modules

Provide 12-inch omnidirectional arrow signal modules. All makes and models of LED modules purchased for use on this project shall appear on the current NCDOT ITS & Signals Qualified Products List (QPL).

Provide the manufacturer's model number and the product number (assigned by the Department) for each module that appears on the 2012 or most recent ITS & Signals QPL. In addition, provide manufacturer's certification in accordance with Article 106-3 of the *Standard Specifications*, that each module meets or exceeds the requirements for 12-inch omnidirectional

modules specified in the ITE “Vehicle Traffic Control Signal Heads – Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement” dated July 1, 2007 (hereafter referred to as VTCSH Arrow Supplement) and other requirements stated in this specification.

Provide modules that meet the following requirements when tested under the procedures outlined in the VTCSH Arrow Supplement:

Module Type	Max. Wattage at 165° F	Nominal Wattage at 77° F
12-inch red circular	12	9
12-inch green circular	11	11

For yellow arrow signal modules, provide modules tested under the procedures outlined in the VTCSH Arrow Supplement to insure power required at 77° F is 12 Watts or less.

Note: Use a wattmeter having an accuracy of $\pm 1\%$ to measure the nominal wattage and maximum wattage of an arrow traffic signal module. Power may also be derived from voltage, current and power factor measurements.

(C) Signal Cable

Furnish 16-4 and 16-7 signal cable that complies with IMSA specification 20-1 except provide the following conductor insulation colors:

- For 16-4 cable: white, yellow, red, and green;
- For 16-7 cable: white, yellow, red, green, yellow with black stripe tracer, red with black stripe tracer, and green with black stripe tracer. Apply continuous stripe tracer on conductor insulation with a longitudinal or spiral pattern.

Provide a ripcord to allow the cable jacket to be opened without using a cutter. IMSA specification 19-1 will not be acceptable. Provide a cable jacket labeled with the IMSA specification number and provide conductors constructed of stranded copper.

4.3. CONSTRUCTION METHODS

(A) General

Bag new vehicle signal heads with burlap bags or bags made of non-ripping material specifically designed for covering signal heads until signal heads are placed in operation. Do not use trash bags of any type.

When new signal heads are placed into operation, immediately bag and remove signals heads that are not to be reused.

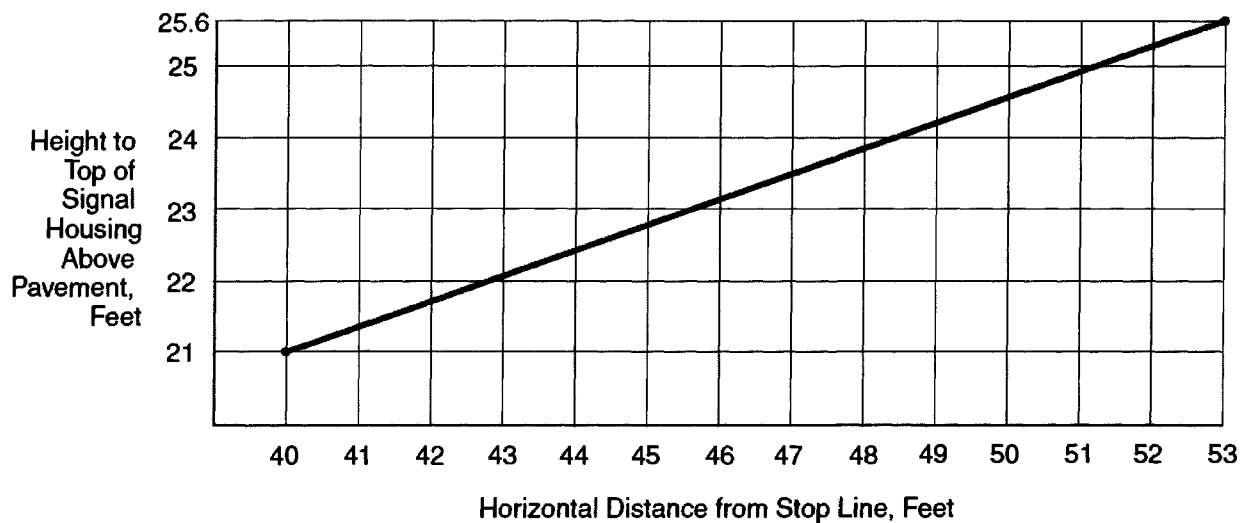
Adjust each signal head vertically and horizontally so that light output will be of maximum effectiveness for traffic and pedestrians. Do not tilt signal heads forward.

(B) Vehicle Signal Heads

Install vehicle signal heads such that the top of the signal housing located over any portion of a highway that can be used by motor vehicles is no more than 25.6 ft above the pavement.

Install vehicle signal heads such that the maximum mounting height to the top of the signal housing is as shown in the graph below if the location is between 40 ft and 53 ft from the stop line.

**Maximum Mounting Height of Signal Heads
Located Between 40 Feet and 53 Feet from Stop Line**



Graph of maximum mounting height of signal heads.

Install vehicle signal heads such that the bottom of the signal housing and any related attachments to the signal head located over any portion of a highway that can be used by motor vehicles is at least 16.5 ft above the pavement directly below the signal head.

- 1) Install vehicle signal heads such that the bottom of the signal housing (including brackets) of a signal head that is vertically arranged and not located over a roadway is as follows:
 - (a) A minimum of 8 ft and a maximum of 19 ft above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
 - (b) A minimum of 8 ft and a maximum of 19 ft above the median island grade of a center median island if located on the near side of the intersection.
- 2) Install vehicle signal heads such that the bottom of the signal housing (including brackets) of a signal head that is horizontally arranged and not located over a roadway is as follows:
 - (a) A minimum of 8 ft and a maximum of 22 ft above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
 - (b) A minimum of 8 ft and a maximum of 22 ft above the median island grade of a center median island if located on the near side of the intersection.

Where vehicle signal heads are installed on messenger cable, install mounting hardware consisting of messenger cable hanger, balance adjuster, bottom cap, wire entrance fitting bracket, and insulating bushings.

Where vehicle signal heads are installed on mast arms, install mounting hardware consisting of rigid vehicle signal head mounting brackets.

Install signal cable in continuous lengths between signal controller cabinets and signal heads. Route signal cable to minimize the length of cable installed and the number of cables and conductors in each run. Pull 36 inches of additional signal cable into controller cabinets.

Wrap signal cable to messenger cable with at least 4 turns of wrapping tape spaced at intervals less than 15 inches or lash signal cable to messenger cable with one 360-degree spiral of lashing wire per 12 inches.

Make electrical connections inside each signal head, signal controller cabinet, and termination compartment in metal poles. Do not splice cable at any other point between signal heads and controller cabinet.

Coil sufficient signal cable beside each vehicle signal head to accommodate head shifts during various construction phases. For final signal head locations, coil 36 inches on each side of signal head if signal cable comes from both directions. If signal cable terminates at the signal head, coil 36 inches of signal cable on the same side as the cable run.

4.4. MEASUREMENT AND PAYMENT

Vehicle signal head () and will be measured and paid for as the actual number of signal heads of each type, size, and number of sections furnished, installed, and accepted.

No measurement will be made of visors, wire entrance fittings, interconnecting brackets, mounting assemblies, as these will be considered incidental to furnishing and installing signal heads.

Signal cable will be measured and paid for as actual linear feet of signal cable furnished, installed, and accepted. Measurement will be point to point with no allowance for sag. Twenty-five feet will be allowed for vertical segments up or down poles.

No measurement will be made for drip loops, coiled sections, or lashing wire as these will be considered incidental to furnishing and installing signal cable.

Payment will be made under:

Pay Item	Pay Unit
Vehicle Signal Head (12", 3 Section)	Each
Vehicle Signal Head (12", 5 Section)	Each
Signal Cable	Linear Foot

5. MESSENGER CABLE

5.1. DESCRIPTION

Furnish and install messenger cable (span wire) with cable clamps, machine bolts, eyebolts, 3-bolt clamps, J-hooks, eye nuts, split-bolt connectors, metal pole clamps, stainless steel bands, and all necessary hardware.

Furnish and install pole grounding systems consisting of #6 AWG solid bare copper wire, messenger bonding clamps, hot-dipped galvanized wire staples, ground rods, and exothermic welding.

5.2. MATERIALS

(A) General

Material, equipment, and hardware furnished under this section shall be pre-approved on the ITS & Signals QPL.

(B) Messenger Cable

Comply with ASTM A475 for extra high strength grade wire strand, Class A zinc coating. Fabricate messenger cable from seven steel wires twisted into a single concentric strand.

(C) Pole Line Hardware

Provide universal grade strandvises used for extra high strength steel messenger cable.

Provide other pole line hardware constructed of hot-dipped galvanized steel conforming to ASTM A153.

Provide machine bolts, eyebolts, and thimble eye bolts with minimum tensile strength of 12,400 lbs. Provide hot-dipped galvanized nuts, 3" x 3" curved square washers, and thimbleyelets.

Provide suspension clamp fabricated from hot-dipped galvanized steel with minimum length of 5 3/4". Ensure clamp has a groove rated for the messenger cable size it is intended to secure. Provide J-hook fabricated from 3/8" thick hot-dipped galvanized steel flat or oval stock with sufficient hook radius to cradle 11/16" diameter cable. Provide two 1/2" diameter hot-dipped galvanized bolts and nuts to tighten the clamp around the messenger cable. Provide one 5/8" diameter hot-dipped galvanized bolt of sufficient length to attach J-hook and clamp to the wood pole with a 3" x 3" curved square washer and double nuts.

Provide 3-bolt clamp fabricated from hot-dipped galvanized steel with minimum length of 5 3/4". Ensure clamp has 2 parallel grooves rated for the messenger cable size it is intended to secure. Provide three 5/8" diameter hot-dipped galvanized bolts and nuts to tighten the clamp around the messenger cable.

Provide parallel groove clamp consisting of high strength, high conductivity non-copper bearing aluminum alloy clamp halves with interlocking fingers to prevent mismatch. Ensure clamp halves have molded grooves to secure #8-1/0 AWG stranded copper wires. Provide clamps with grooves prefilled with antioxidant joint compound. Provide 3/8" hex head, square shank, galvanized steel bolt with galvanized steel lock washer and nut.

Provide 1/2" and 3/4" wide, .030" thick Type 316 stainless steel straps with Type 316 stainless steel buckles.

Provide either 0.05" x 0.30" aluminum wrapping tape or 0.06" diameter Type 316 stainless steel lashing wire for lashing cables to messenger cable. Ensure aluminum wrapping tape is 1350 alloy, O-temper, with 12,800 psi tensile strength. Use 0.045" diameter Type 316 stainless steel lashing wire to lash fiber-optic communications cable to messenger cable.

Provide hot-dipped galvanized steel clamp with groove sized for 1/4" to 3/8" messenger cable for securing lashing wire(s) to messenger cables at ends of each spiraled run. Ensure clamp hardware is hot-dipped galvanized steel.

Provide galvanized metal pole clamps and stainless steel banding hardware for attaching pole line hardware (e.g., strandvises, three-bolt clamps, etc.) to metal signal poles.

Refer to the following article 1091-2, "Wire", of the *Standard Specifications*.

(D) Grounding Electrodes

Provide grounding electrodes (i.e., ground rods) as indicated in these Project Special Provisions and on the Plans. Provide 5/8" diameter, 10-foot long, copper-clad steel ground rods with 10 mil thick copper cladding.

5.3. CONSTRUCTION METHODS

(A) General

Install guy assemblies before installing messenger cable.

Use 3/8-inch messenger cable for spans supporting vehicle signal heads, and/or signs.

Use 1/4-inch messenger cable for spans supporting only cables unless otherwise specified.

For messenger cable crossing over railroad tracks, provide a minimum of 27 feet of vertical clearance, unless otherwise specified.

For permanent installations, install messenger cable in continuous lengths with no splices except where an insulator is required. With prior approval, existing messenger for temporary installations may be extended instead of installing new messenger cable.

Tension messenger cable to eliminate appreciable sag and to match sag of surrounding utilities. Otherwise, allow 3% to 4% sag of the span length between poles.

For mid-run spans using wood poles, attach messenger cable to the pole with a 3-bolt cable clamp with J-hook consisting of 5/8" diameter machine bolts, J-hooks, washers and square nuts to attach messenger cable to wood poles. Provide machine bolts that are 3" longer than the pole diameter. For mid-run spans using metal or other Department-approved poles, attach messenger cable to the pole with a 3-bolt clamp with J-hook secured to the metal pole via a pole band clamp. Refer to *Metal Pole Standard Drawing Sheet M6* found on the Department's website.

When terminating spans at wood poles, connect messenger cable to a dead-end strandvise attached to the pole via a 5/8" diameter shoulder eye bolt or 5/8" diameter shoulder angle bolt with 5/8" eye nut as shown in *Roadway Standard Drawing No. 1720.01*. When terminating spans at metal or other Department-approved poles, connect messenger cable to a dead-end strandvise attached to the pole via a pole attachment clamp. Refer to *Metal Pole Standard Drawing Sheet M6* as shown in the previous paragraph. Do not install more than one messenger cable and

strandwise assembly to a single metal or other Department-approved pole attachment clamp. During installation, ensure that messenger cable is centered and directly aligned at the pole clamp's attachment point such that the cable does not exert forces on the sides of the clamp's attachment point.

Do not drill holes in metal poles to attach messenger cable. Do not attach messenger cable to metal poles that are owned by anyone other than the City or the Department without prior approval of the Engineer and the pole owner. Where such attachments are approved, use attachment methods and hardware approved by the pole owner.

Maintain electrical continuity at all splices.

On joint use poles at signal and ITS equipment installations (i.e., Controller Cabinets, CCTV Cabinets, Communications Hub Cabinets, etc.), do not use existing utility company grounds. Install a new, separate grounding system for the signal and ITS equipment.

(B) Messenger Cable for Signal Heads or Loop Lead-In Cable

For messenger cable attached to joint use poles, install a new pole grounding system that complies these Project Special Provisions. If a pole ground exists on a joint use pole, bond new pole grounding system to existing pole ground using number 6 AWG minimum solid bare copper grounding wire terminated with split bolt connectors or parallel groove clamps at each end. If existing poles do not have a pole grounding system, install a new pole grounding system that complies with these Project Special Provisions.

(C) Messenger Cable for Communications Cable

For messenger cable attached to joint use poles, bond messenger cable to existing pole ground at each end and at 1300-foot intervals. Install bond using #6 AWG minimum solid bare copper grounding wire terminated with split bolt connectors or parallel groove clamp at each end. If existing poles do not have a pole grounding system, install a new pole grounding system that complies these Project Special Provisions.

(D) Messenger Cable for Multiple Cables

On multiple messenger cable arrangements, connect all messenger cable ends with #6 AWG minimum solid bare copper wire and bond with split bolt connectors or parallel groove clamp and terminate to pole ground.

(E) Pole Grounding System

On Department-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the pole base or to the electrical service grounding electrode system located within 10 feet of the pole. Install #6 AWG solid bare copper ground wire up the pole to a point adjacent to the uppermost span. Staple the ground wire to the pole using hot dipped galvanized 1.5" staples. Staple the ground wire to the pole 4 inches apart from the ground level to 8 feet above the ground, and then 24 inches apart from 8 feet above ground level to a point adjacent to the span.

5.4. MEASUREMENT AND PAYMENT

Messenger cable (_____) will be measured and paid for as actual horizontal linear feet of messenger cable furnished, installed, and accepted. Measurement will be point to point with no allowance for sag.

No measurement will be made of cable clamps, machine bolts, eye bolts, 3-bolt assemblies, eye nuts, split bolt connectors, metal pole clamps, stainless steel banding hardware, and pole grounding systems as these will be considered incidental to furnishing and installing messenger cable.

Pole grounding system will be measured and paid for as the actual number of new pole grounding systems furnished, installed and accepted.

No separate measurement will be made of #6 AWG solid bare copper wire, messenger bonding clamps, hot-dipped galvanized wire staples, ground rods, or exothermic welding as these items will be considered incidental to furnishing and installing a pole grounding system. Bonding to an existing pole grounding system will be considered incidental to furnishing and installing messenger cable.

Payment will be made under:

Pay Item	Pay Unit
Messenger Cable (1/4")	Linear Foot
Messenger Cable (3/8")	Linear Foot
Pole Grounding System	Each

6. UNDERGROUND CONDUIT

6.1. DESCRIPTION

Furnish and install conduit for underground installation with tracer wire, miscellaneous fittings, all necessary hardware, marker tape, backfill, graded stone, paving materials, and seeding and mulching.

6.2. MATERIALS

(A) General

Except for HDPE conduit, furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Refer to the following articles of the *Standard Specifications*:

Backfill 1018-2

Graded Stone 545-2 and 545-3

(B) Conduit Bodies, Boxes and Fittings

Use conduit bodies, boxes, and fittings that meet UL Standard 514A or 514B for electrical and communications installations.

(C) Conduit Types

(1) Rigid Metallic Conduit

Provide rigid hot dipped galvanized steel conduit that meets UL Standard 6 with rigid full weight sherardized or galvanized threaded fittings.

(2) PVC Conduit

Provide non-metallic conduit and duct including associated couplings, approved for below ground use with or without concrete encasement in accordance with UL Standard 651A. Provide Schedule 40 conduit unless otherwise specified.

(3) Solid Wall HDPE Conduit

Use HDPE conduit that conforms to UL Standard 651B. Provide conduit meeting the requirements of the table below with minimum wall thickness ratios corresponding to EPEC-40 (Schedule 40), EPEC-80 (Schedule 80) or EPEC-B (SDR 13.5) as listed in UL Standard 651B, Table 5.1, 5.2 and 5.3.

Provide HDPE conduit with an outer diameter to minimum wall thickness ratio that complies with ASTM D 3035, Standard Dimension Ratio (SDR) 11 or better (thicker wall) **for use in railroad rights-of-way**. Provide HDPE conduit with an outer diameter to minimum wall thickness ratio that complies with ASTM D 3035, Standard Dimension Ratio (SDR) 13.5 for all other applications.

HDPE CONDUIT SIZE	
Conduit Trade Size	Furnish
1"	EPEC-40
1-1/4"	EPEC-40
1-1/2"	EPEC-B (SDR 13.5)
2"	EPEC-B (SDR 13.5)
2-1/2"	EPEC-B (SDR 13.5)
3"	EPEC-B (SDR 13.5)
4"	EPEC-B (SDR 13.5)
5"	EPEC-80
6"	EPEC-80

Ensure the PE resin compounds used in manufacturing the conduit meet or exceed the cell classification PE 334420C (black with 2% minimum carbon black) or PE 334420E (colored conduit with UV inhibitors) in ASTM D3350 and the table below.

RESIN PROPERTIES		
Property	Requirement	Test Method
Density	0.940 - 0.947g/cm ³	ASTM D1505 ASTM D792 ASTM D4883
Melt Index (condition 190/2.16 is acceptable)	< 0.4 grams/10 minutes	ASTM D1238
Flexural Modulus	80,000 psi, min.	ASTM D790
Tensile Strength	Tensile Strength 3,000 psi, min.	ASTM D638
Elongation	Elongation 400%, min.	ASTM D638
Slow Crack Growth Resistance	An ESCR as per condition B, 10% IGEPAL requirement of F50>24 hrs is allowable	ASTM D1693
Hydrostatic Design Basis	"0" for Non-Pressure Rated Pipe	ASTM D2837
UV Resistance (Outdoor Conduit Only)	Stabilize with at least 2% by weight carbon black or colored with UV Inhibitor	ASTM D4218

Furnish conduits in the colors for the applications shown in the table below. For conduits manufactured with stripes, ensure the stripes are uniformly located around the conduit with 120 degrees of separation. Do not use “Solid Yellow” or “Black with Yellow Stripes” conduit.

CONDUIT COLORS		
Conduit Contents	Preferred Solid Color	Alternate
Signal Cable	Black	None
Loop Lead-in Cable	White	Black with White Stripes
Communications Cable (Copper, Fiber Optic, Coaxial)	Orange	Black with Orange Stripes
Electrical Power Cable	Red	Black with Red Stripes

Ensure the HDPE conduit is resistant to benzene, calcium 1 chloride, ethyl alcohol, fuel oil, gasoline, lubricating oil, potassium chloride, sodium chloride, sodium nitrate and transformer oil and is protected against degradation due to oxidation and general corrosion.

Furnish factory lubricated, low friction, conduit with a coefficient of friction of 0.10 or less in accordance with Telcordia GR-356. Ensure the supplied conduit is identified and certified as meeting, UL Standard 651B. Ensure the conduit is marked at least with the following information on 10 ft or less intervals:

- 1) Material: HDPE
- 2) Trade Size: i.e., 2"
- 3) Conduit Type: SDR 13.5 or EPEC-B
- 4) Manufacturer's name or trademark
- 5) Manufacturer's identity code to identify manufacturing date, facility, etc.
- 6) UL symbol or UL listing number

Furnish coilable conduit that is supplied on reels in continuous lengths for transportation and storage outside. Ensure that the process of installing the coilable conduit on the reel does not alter the properties or performance of the conduit for its intended purpose.

(D) Conduit Plugs, Pull Line, and Tracer Wire

Furnish conduit plugs that provide a watertight barrier when installed in conduit. Furnish conduit plugs sized in accordance with conduit. Ensure conduit plug provides a means to secure a pull line to the end of the plug. Provide removable and reusable duct plugs. Conduit plugs are not required to be listed electrical devices.

For all spared conduits, furnish 3/4", pre-lubricated, woven polyester tape, pull line with minimum rated tensile strength of 2,500 lb. Pull lines are not required to be listed electrical devices.

Provide green insulated number 14 AWG, THWN, stranded copper wire to serve as tracer wire.

Furnish non-detectable underground marker tape with the wording “WARNING – Fiber-Optic Cable” in all trenches containing one or more conduits that will house fiber-optic communications cable.

(E) Mechanical Couplings for HDPE Conduit

Provide mechanical couplings that are both watertight and airtight for joining two segments of HDPE conduit of like diameter. Provide couplings designed to accommodate pneumatic methods of cable installation. Provide couplings suitable for burial underground and which meet the following requirements:

- The coupling shall not fail by leakage when subjected to sustained internal pressure testing as noted in ASTM F 2176.
- The coupling shall not fail by leakage when subjected to sustained external pressure testing as noted in ASTM F 2176.
- The coupling assemblies tested shall be able to comply with the tensile loading requirements as specified in ASTM F 2176.
- As specified in ASTM F 2176, the coupling shall not fail when conditioned at low temperature conditions of 10° F and tested by an impact with a force of 20 ft-lb using Type “B” as described in Test Method ASTM D 2444.

(F) Duct and Conduit Sealer

Use duct and conduit sealer or mastic which is a putty-like compound and:

- Is permanently non-hardening, non-oxidizing, and non-corrosive to metals, rubber, plastic, lacquer and paints;
- Is readily workable for thumbing into openings and forming into seals around wires inside conduits and openings around conduits;
- Has a service temperature range of minus 30°F to 200°F;
- Is clean, non-poisonous and non-injurious to human skin;
- Seals against water, dust and air and shall adhere to wood, glass, plastics, metal, rubber and painted surfaces; and
- Is non-conductive.

6.3. CONSTRUCTION METHODS

(A) General

Except where the Plans call for a specific installation method or where the Engineer directs otherwise, underground conduit may be installed by either trenching, directional drilling or plowing at the option of the Contractor but will be measured and paid for as “underground conduit,” regardless of installation method (see “Measurement and Payment” subsection).

Refer to Section 1 of these Project Special Provisions for additional requirements concerning work within and adjacent to historic districts.

Ensure conduit is free of moisture and debris before pulling cables.

Where cable is not immediately installed or conduit is for future use (spare), seal the ends of the conduit with a conduit plug immediately following installation of the conduit. Secure a pull line to the conduit plug in such a manner that it will not interfere with installation of the conduit plug and provides a watertight seal.

Extend ends of conduit 2" to 4" above concrete surfaces and 4" above crushed stone bases. For metallic conduit, install metallic bushings and bond conduits.

All conduits installed in a common trench or bore must be the same size and all conduits in a continuous longitudinal run must be the same size. Do not intermix different size conduits in the same run.

Install a minimum of two conduits (i.e., at least one for fiber-optic cable plus one dedicated spare) for all underground routes unless the Plans show otherwise. Exceptions on plans may include short runs to CCTV cameras, short PVC runs to controller cabinets from main trunk line, or installations under railroad tracks.

Install junction boxes in underground conduit runs as shown on the Plans. Do not exceed 150 feet between junction boxes in any underground conduit route that conveys traffic signal or lead-in cable and 1,500 feet between junction boxes in any underground conduit route that conveys communications cable without the prior approval the Engineer.

(1) Conduit Entering Junction Boxes

Terminate conduits installed for communications cables (fiber optics, Ethernet and coaxial) in oversized or special-sized junction boxes as shown on the Plans. Do not install other conduits in these junction boxes unless otherwise specified.

Terminate conduits installed for signal wiring, including loop lead-in cable, in standard size junction boxes unless otherwise specified.

For all conduits entering junction boxes, seal spare conduits with approved conduit plugs. Seal conduits containing fiber-optic communications cable, Ethernet cable, signal cable and lead-in cable with duct and conduit sealer.

(2) Tracer Wire

Install tracer wire in all conduits containing fiber-optic cable, unless otherwise indicated on the Plans or the Engineer directs otherwise. Pull tracer wire simultaneously in continuous length with the fiber-optic cable. Where multiple pulls of fiber-optic cable are required and conduit is placed in the same trench, only one tracer wire is required. Where multiple pulls of fiber-optic cable are required and conduits may separate into individual trenches, install a tracer wire in each conduit run. Splice tracer wire only in cabinets and junction boxes using waterproof butt splice connectors. Coil and store 10 feet of spare tracer wire in junction boxes. Label all tracer wires entering an equipment cabinet. For a given tracer wire run between two controller cabinets, bond the tracer wire to the equipment ground inside the controller cabinet at one end of run only; do not bond both ends of the tracer wire in a continuous run to cabinet grounds at each end of the run. Establish a consistent convention for which end the tracer wire will be bonded along a give roadway or corridor. For example, bond the end of the tracer wire closest/to (in the direction of) the Winston-Salem TMC.

(3) Ground Surface Restoration

Upon completion of conduit installation and backfilling of all trenches and other 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. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. 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 by 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, plus **\$500 liquidated damages per occasion, per day, or any portion** thereof, until corrected.

(4) Plan of Record Drawings

Upon completion of the conduit system for communications, furnish the Engineer with a plan of record drawing detailing both the horizontal and vertical (i.e. depth) locations of the conduit system.

(B) Trenching**(1) General**

Install PVC, HDPE, or rigid metallic conduit for all underground runs as specified in the Plans. Install rigid metallic conduit for all trenched underground runs located inside railroad right-of-way, unless otherwise specified. Clean existing underground conduit to be incorporated into a new system by drawing a mandrel through the conduit followed by a swab. Clear obstructions or blockages in an existing underground conduit designated for reuse by using compressed air, water jetting, rod and mandrel or other method as approved by the Engineer. Once obstruction/blockage has been cleared, perform aforementioned cleaning procedure to clean out any remaining materials which may cause cable abrasions. Bond all metallic conduit.

If more than one conduit is required between the same points, install conduit in one common trench.

Install non-detectable marker tape longitudinally in the trench 6 to 12 inches below the unpaved ground surface or below the underside of the paved surface.

Install longitudinal runs of conduit a minimum of 1 foot from back of curb or 6 feet from edge of pavement in the absence of curb. If ditches are present, install conduit a minimum of 4 feet from the bottom of the ditch line.

Maintain a minimum trench depth of 30" (or 12" in areas blocked by rock or impenetrable obstructions) below finished grade or 6" below roadway sub-base, whichever is deeper. Upon completion, restore surface to like-original condition within five consecutive calendar days of

occurrence of damage. Remove all rock and debris from backfill material. Remove excess material from site and compact area according to Article 300-7 of the *Standard Specifications*. Backfill with excavated material and compact to 95% of original density.

Backfill trench at locations along the trench path where non-movable objects, such as rocks and boulders, cannot be avoided. The purpose of the backfill is to provide a gradual change in elevation of the trench, so that excessive bending and stress will not be transferred to conduits once underground conduit system is installed.

After installation of conduits and upon completion of tamping and backfilling, perform a mandrel test on each conduit to ensure no conduit has been damaged. Furnish a non-metallic mandrel having a diameter of approximately 50% of the inside diameter of the conduit in which it is to be pulled through. If damage has occurred, replace the entire length of conduit. Ensure pull line is re-installed.

Use HDPE conduit in trenched areas unless otherwise specified in the Plans. Use 2-inch PVC or rigid galvanized conduit between junction boxes adjacent to the controller cabinet and the 2-inch conduit stub-outs from the cabinet foundation.

Use 2-inch PVC conduits for short conduit segments used to convey IS Department fiber-optic cable between a junction box housing both signal system and IS fiber-optic cables and an adjacent junction box used exclusively for IS Department fiber-optic cable.

Comply with the *NCDOT Policies and Procedures for Accommodating Utilities on Highway Rights-of-Way* in effect on the date of advertisement.

(2) Unpaved Trenching

Install conduit in unpaved areas. Rake smooth the top 1-1/2 inches and seed with same type of grass as surrounding area. Finish unpaved areas flush with the surrounding natural ground. Restore damaged grassed areas. Seed and mulch, using methods and material approved by the Engineer, within five consecutive calendar days following initial damage to grassed areas, unless the Engineer approves otherwise due to weather and soil conditions. If the Contractor fails to repair the grassed areas 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 grassed area will be deducted from payment due the Contractor, plus **\$500 liquidated damages per occasion, per day, or any portion thereof,** until corrected.

Adapt operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses. When the Engineer determines that weather and soil conditions are unfavorable, including but not limited to extremely wet or frozen soil, do not distribute any limestone or fertilizer and do not sow any seed. During seasons of the year when temperatures are not conducive to germination and growth of the type of grass seed to be planted, seed and mulch the disturbed areas with temporary seeding that will germinate and grow under the prevailing temperatures until such time that permanent seeding can be established, as approved and directed by the Engineer.

As directed by the Engineer, apply additional seed or completely reseed areas which have been previously seeded and mulched but which have been damaged, have failed to successfully establish a stand of vegetation or have an unsatisfactory cover of vegetation. Perform supplemental and repair seeding promptly at all locations and times as directed by the Engineer.

(3) Paved Trenching

On concrete surfaces, replace the entire joint of concrete and match the original concrete as to color and finish unless otherwise specified. On all other surfaces, neatly cut and replace the width of trench with like material. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. Place graded stone material to temporarily maintain pedestrian traffic where repairs cannot be performed immediately.

Finish paved areas with materials matching damaged areas. For conduit installed under roadways, cut neatly and replace the width of paved area damaged by trenching. For conduit installed under sidewalks and walkways, remove entire section of slab from joint to joint and replace. Place graded stone material to temporarily maintain traffic where repairs cannot be performed immediately. Comply with Article 545-4 of the *Standard Specifications*.

Complete repairs to all paved areas removed for construction within five consecutive calendar days following initial removal. If the Contractor fails to repair the paved area 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 paved area will be deducted from payment due the Contractor, plus **\$500 liquidated damages per occasion, per day, or any portion thereof**, until corrected.

(C) Plowing (HDPE Conduit Only)

Direct plow HDPE ducts simultaneously using chute plow method. Direct plow ducts at a minimum depth so the top of the highest duct is 30 inches deep unless otherwise approved.

Provide sufficient personnel to feed chute, operate prime mover and equipment carrying reels (if separate equipment is used), observe chute feeding, observe plowing, and observe reel payout. Use chute with adequate dimensions to allow for passage of duct without damage. During plow operation, continuously check chute opening and path to be sure there are no obstructions and monitor payout reels to be sure reels are turning at a steady rate.

(D) Directional Drilling**(1) Pre-Approvals and Minimum Depth Requirements**

Obtain approval before beginning drilling operations.

At all points where HDPE conduit will traverse under roadways, driveways, sidewalks, or Controlled Access Areas including entrance/exit ramps, maintain a minimum depth of 4 feet or 8 times the back reamer's diameter, whichever is deeper. For an installation that runs parallel to a controlled access area or entrance/exit ramps maintain a minimum depth of 30 inches below finished grade. Maintain a minimum clearance of 30 inches below finished grade when crossing ditch lines.

For installations in railroad right-of-way, minimum cover (measured from the base of the rail to the top of the pipe) shall be 15 feet, with a minimum of 15 feet below the finished grade of ditch lines. For the following structures, the minimum clearance requirements are:

MINIMUM CLEARANCE REQUIREMENTS FOR STRUCTURES	
Man-made Structure	Minimum Clearance Requirement
Bridge foundation	5' horizontal & 4' vertical (clearances greater than minimum horizontal should continue to use the 4V:5H ratio, i.e., 10' horizontal should be no deeper than 8')
Drainage pipes 60" or less	1' above or below [while maintaining a minimum depth of 30" below grade]
Drainage pipes greater than 60"	1' above or 4' below [while maintaining a minimum depth of 30" below grade]
Box Culverts	1' above or 4' below [while maintaining a minimum depth of 30" below grade]
Slope protection	2' below
Slope protection foundation footing	5' below
Railroad tracks	15' minimum between base of rail to top of pipe; 15' minimum below finished grade of ditch line.

Guarantee the drill rig operator and digital walkover locating system operator are factory-trained to operate the make and model of equipment provided and have a minimum of one-year experience operating the make and model of drill rig. Submit documentation of the operators' training and experience for review at least two weeks before start of directional drilling operations.

Provide a means of collecting and containing drilling fluid/slurry that returns to the surface such as a slurry pit. Provide measures to prevent drilling fluids from entering drainage ditches and storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto pedestrian walkways, driveways, and streets. Disposal on public or railroad right-of-way or railroad drainage ditches/facilities is prohibited. Immediately remove all drilling fluids/slurry that are accidentally spilled.

(2) Directional Drill Operations

Provide grounding for the drill rig in accordance with the manufacturer's recommendations. Place excavated material near the top of the working pit and dispose of properly. Backfill pits and trenches to facilitate drilling operations immediately after drilling is completed.

When directionally drilling conduit beneath railroad right-of-way, place drill rig so that launching and receiving pits are outside railroad right-of-way if possible. If not possible, ensure the pits are outside the railroad influence zone. The railroad influence zone (also referred to as the embankment line) begins at a point on the existing grade 10 feet horizontally from center line of track and extends downward on a 1 ½ (H) to 1 (V) slope away from tracks.

No geotechnical investigations have been performed at the sites of proposed directional drill operations for this project. Prior to performing the directional drilling operation, field investigate the site of the proposed directional drill conduit, including but not limited to walking the bore

path and talking to adjacent property owners, to ascertain the soil conditions that may be encountered and to review the site's topography. Ensure that the equipment, tooling, personnel expertise and techniques used at each site are sufficient to complete the directional drill operation successfully, regardless of soil conditions encountered. At all times, have alternate drill heads available in case the soil conditions do not match expected conditions.

Use drill head suitable for type of material being drilled and sized no more than 2 inches larger than the outer diameter of the conduit, unless in railroad right-of-way. In railroad right-of-way the drill head must be sized no more than 1.5 times the outside diameter of the conduit being installed. Direct drill to obtain proper depth and desired destination. Pressure grout with an approved bentonite/polymer slurry mixture to fill all voids. Do not jet alone or wet bore with water.

During drilling operation, locate drill head every 10 feet along drill path and before traversing underground utilities or structures. Within railroad right-of-ways, mark the location and depth 10 foot intervals and when traversing underground utilities and structures. Use digital walkover locating system to track drill head during directional drilling operation. Ensure locating system is capable of determining pitch, roll, heading, depth, and horizontal position of the drill head at any point.

Once drill head has reached final location, remove head, and install back reamer of appropriate size (no more than 2 inches larger than outer diameter of conduits [or 1.5 times the outside diameter in railroad right-of-way]) to simultaneously facilitate back reaming of drill hole and installation of conduit. Use back reamer that is sized larger than actual conduits to ensure conduits are not adversely subjected to deviations caused by the original drill operation and are as straight as practical in their final position.

The intent of these Project Special Provisions is to limit the diameter of the actual drill shaft/hole so that it is no more than 2 inches larger than the conduit outer diameter, unless in railroad right-of-way. Within railroad right-of-way, the diameter of the bore hole may not exceed 1.5 times the outside diameter of the specified conduit. This enlarged diameter may be accomplished either during the original bore or during the back reaming/conduit installation process.

Once installation of conduit has started, continue installation without interruption so as to prevent conduit from becoming firmly set. Apply bentonite/polymer slurry mixture during conduit installation.

Upon completion of conduit installation, perform a mandrel test on conduit system to ensure conduit has not been damaged. Furnish non-metallic mandrel with a diameter of approximately 50% of the inside diameter of the conduit in which it is to be pulled through. If damage has occurred, replace the entire length of conduit and ensure that pull line is re-installed.

(3) Drilling Fluids

Use lubrication for subsequent removal of material and immediate installation of the conduit. The use of water and other fluids in connection with directional drilling operations will be permitted only to the extent necessary to lubricate cuttings. Do not jet alone or wet bore with water. Use drilling fluid/slurry consisting of at least 10% high-grade bentonite/polymer slurry to consolidate excavated material and seal drill hole walls.

Transport waste drilling fluid/slurry from site and dispose of in a method that complies with local, state and federal laws and regulations. Disposal on public or railroad right-of-ways or within public or railroad drainage ditches/facilities is prohibited.

(E) Maximum Length of Directional Drill

The length of a directional drill shall not exceed 1,500 feet measured horizontally along the route of the directionally drilled conduit(s), unless otherwise approved by the Engineer. For routes longer than 1,500 feet, begin a successive directional drill where the first directional drill reaches 1,500 feet and install an oversized heavy-duty junction box where the two directional drilled conduit runs meet. The spacing of junction boxes in a directionally drilled route shall not exceed 1,500 feet.

(F) Splicing and Coupling of HDPE Conduit

Install a continuous HDPE conduit free from splices or couplings between junction boxes whenever possible. However, splicing or coupling of HDPE conduit may be permitted, subject to the prior approval of the Engineer, to complete an underground HDPE conduit run when the end of an HDPE reel is reached. However, splicing in the middle of a directional drill operation is prohibited.

Join the HDPE conduit ends by installing mechanical couplings in accordance with the manufacturer's instructions or by splicing the conduits using either a butt-fusion welder or an electro-fusion welder. Submit the proposed method of coupling or splicing the conduits to the Engineer for review and approval prior to joining any HDPE conduits.

Otherwise, install an oversized junction box where the ends of the HDPE conduits meet in lieu of joining the ends through splicing and coupling. Install an oversized junction box where the number of conduits in the underground run changes and where a directionally drilled conduit meets a trenched conduit. For example, install an oversized junction box where two directionally drilled conduits meet a single run of trenched conduit.

6.4. MEASUREMENT AND PAYMENT

Tracer wire will be measured along the horizontal linear feet of tracer wire furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be made in linear feet. No payment will be made for excess tracer wire in junction boxes and/or cabinets.

IS tracer wire will be measured along the horizontal linear feet of tracer wire furnished, installed, and accepted inside conduit used to convey IS Department fiber-optic cable(s) exclusively. Measurement will be along the approximate centerline of the IS Department conduit system. Payment will be made in linear feet. No payment will be made for excess tracer wire in junction boxes and/or cabinets.

Underground conduit (qty)(size) will be measured in horizontal linear feet of underground conduit installation of each type furnished, installed, and accepted, without regard to the installation method. Measurement will be along the approximate centerline of the conduit system. Payment will be in linear feet.

No measurement will be made of 1" underground conduit that conveys electrical service wire between a service riser and a disconnect/meter and between a disconnect and an equipment cabinet as such work will be considered incidental to furnishing and installing a new electrical

service, furnishing and installing and equipment cabinet disconnect or modifying an existing electrical service. (See “Electrical Service” section of these Project Special Provisions).

IS underground conduit (qty)(size) will be measured in horizontal linear feet of underground conduit installation of each type used exclusively to convey IS Department fiber-optic cable(s) that are furnished, installed, and accepted, without regard to the installation method. Measurement will be along the approximate centerline of the IS Department conduit system. Payment will be in linear feet.

Directional drill (qty)(size) will be measured horizontal linear feet of directional drill for underground conduit installation furnished, installed, and accepted. Measurement will be along the approximate centerline of the conduit system. Payment will be made in linear feet. When directional drilling is used where the Plans call for “Underground Conduit”, directional drilling will be measured and paid for as Underground Conduit. There will be no additional compensation for field-investigating site conditions nor for providing any specialized equipment, tooling, personnel or techniques necessary to complete the installation of the underground conduit through directional drilling for the soil conditions encountered, including but not limited to rock.

IS directional drill (qty)(size) will be measured horizontal linear feet of directional drill for underground conduit used exclusively to convey IS Department fiber-optic cable(s) that are furnished, installed, and accepted. Measurement will be along the approximate centerline of the IS Department conduit system. Payment will be made in linear feet. When directional drilling is used where the Plans call for “IS Underground Conduit”, directional drilling will be measured and paid for as Underground Conduit. There will be no additional compensation for field-investigating site conditions nor for providing any specialized equipment, tooling, personnel or techniques necessary to complete the installation of the underground conduit through directional drilling for the soil conditions encountered, including but not limited to rock.

No measurement will be made of vertical segments, non-metallic conduit, metallic conduit, conduit sealing material, pull lines, duct plugs, marker tape, and miscellaneous fittings, as these will be considered incidental to conduit installation.

No measurement will be made of clearing existing blockages and obstructions from existing conduits nor for cleaning existing conduits prior to installation of new communications cable inside the existing conduits as such work will be considered incidental to furnishing and installing the communications cable.

No measurement will be made of restoration of paved roadways/driveways and unpaved ground surfaces with like materials, including but not limited to backfill, graded stone, paved materials, seeding and mulching, as this work will be considered incidental to conduit installation. No measurement will be made of removing, stockpiling and resetting existing granite curb as such work will be considered incidental to conduit installation. The Department will make no payment for a given underground conduit run until all repairs to paved and unpaved surfaces damaged/disturbed during the installation of the underground conduit have been completed and accepted.

Repair and replacement of existing sidewalk will be measured and paid for in accordance with the “Signal Cabinet Foundations” section of these Project Special Provisions.

No measurement will be made of horizontal segments between the base of a riser and an adjacent junction box or base-mounted cabinet foundation that are 10 feet or less in length measured from the center of the riser to the center of the junction box or from the center of the riser to the center of the vertical sweep through the cabinet foundation as these will be considered incidental to riser installation.

No measurement will be made of conduit segments between adjacent traffic signal system junction boxes that are 10 feet or less in length measured from center of junction box to center of junction box as these will be considered incidental to furnishing and installing the junction boxes.

Conduit will be paid for per linear foot based on quantity and size of conduits. As examples, an installation of a single 2" HDPE conduit would be paid as:

Directional Drill (1)(2") Linear Foot

No measurement or payment will be made for furnishing and installing and subsequently removing graded stone material for temporary maintenance of traffic where a portion of existing pavement has been removed as such work will be considered incidental to furnishing and installing underground conduit.

Payment will be made under:

Pay Item	Pay Unit
Tracer Wire	Linear Foot
IS Tracer Wire ✓	Linear Foot
Underground Conduit (1)(2")	Linear Foot
Underground Conduit (2)(2") ✓	Linear Foot
IS Underground Conduit (1)(2") ✓	Linear Foot
Directional Drill (2)(2")	Linear Foot
IS Directional Drill (1)(2")	Linear Foot

7. JUNCTION BOXES

7.1. DESCRIPTION

Furnish and install junction boxes (pull boxes) with covers, washed stone, grounding systems, and all necessary hardware.

7.2. MATERIALS

(A) General

Provide electrical junction boxes with covers of the type and size indicated by the contract or the Plans for the termination of conduits, for splicing loop wires to loop lead-in cables and for splicing and storing fiber-optic communications cable.

Except for special-sized junction boxes, material, equipment, and hardware furnished under this section shall be pre-approved on the ITS and Signals QPL.

Provide #67 washed stone aggregates in conformance with Sections 545 and 1005 of the *Standard Specifications*.

(B) Polymer Concrete (PC) Junction Boxes

Provide polymer concrete (PC) boxes which are stackable, have bolted covers and have open bottoms. Ensure vertical extensions of 6" to 12" are available from the junction box manufacturer.

Use polymer concrete material made of an aggregate consisting of sand and gravel bound together with a polymer and reinforced with glass strands to fabricate box and cover components which are exposed to sunlight. Other thermosetting glass-reinforced materials may be used for components which are not normally exposed to sunlight.

Provide certification that the polymer concrete boxes and covers meet Tier 15 requirements of ANSI/SCTE 77. Provide certification that testing methods are compliant with ANSI/SCTE 77.

Provide junction box covers with the required logos on the cover as follows:

- For standard size junction boxes, provide covers with the standard *Traffic Signal* logo.
- For oversized and special-sized junction boxes that house fiber-optic communications cable for the traffic signal system (including junction boxes that house fiber-optic communications cables for both the signal system and the City's IS Department), provide covers with the following log/imprint:
WSDOT – F.O. (line 1), (336) 727-8000 (line 2).
- For oversized and special-sized junction boxes that house fiber-optic communications cable for City's IS Department only (i.e., that do not house fiber-optic cable for the signal system), provide covers with the following logo/imprint:
WS I.S. – F.O. (line 1), (336) 727-8000 (line 2).

Provide at least 2 size 3/8" diameter hex head stainless steel cover bolts to match inserts in the box. Provide pull slot(s) with stainless steel pin(s). Polymer concrete junction boxes are not required to be listed electrical devices.

(C) Junction Box Sizes

Provide junction boxes and covers of the following sizes as called for in the Plans:

Junction Box Size	Minimum Inside Dimensions
Standard Size	16"(l) x 10"(w) x 10"(d)
Oversized	30"(l) x 15"(w) x 24"(d)
Special-Sized	36"(l) x 24"(w) x 24"(d)

7.3. CONSTRUCTION METHODS**(A) General**

Install junction boxes flush with finished grade. Backfill beneath and around the junction box using #67 washed stone as shown in NCDOT Roadway Standard Drawing No. 1716.01. Do not install sealant compound between junction boxes and covers.

Upon completion of junction box 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. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. 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 restoration of all ground disturbed during junction box installation within five consecutive calendar days following initial removal and excavation. If the Contractor fails to repair and restore the disturbed 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, plus **\$500 liquidated damage per occasion, per day, or any portion thereof**, until corrected.

Install standard size junction boxes as shown in the Plans and where underground splicing of electrical cables is necessary. Install standard size junction boxes within 3 feet of pole or pole foundation where transitioning from below ground to a riser assembly. Install standard size junction boxes within 5 ft of each end of each lateral run of conduit for electrical cables. When lateral runs for electrical cables are greater than 150 feet, install additional junction boxes to ensure distances between junction boxes does not exceed 150 feet.

Install oversized junction boxes as shown in the Plans in underground fiber-optic communications cable runs where the conduit run transitions from directionally drilled conduit to trenched conduit and where transitioning from below ground to a riser assembly. Install

oversized junction boxes in underground fiber-optic communications cable runs at maximum intervals of 1,500 feet, or where shown in the Plans, whichever is less.

Install special-sized junction boxes at all underground splice enclosure locations in underground fiber-optic communications cable runs as shown in the Plans.

(B) GPS Coordinates

Provide real world coordinates for all junction boxes and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including but not limited to manufacturer, model number, City system ID number and NCDOT inventory number) in the Microsoft Excel spreadsheet using the format shown in example below.

City Sys ID#	NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
	05-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
		Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

7.4. MEASUREMENT AND PAYMENT

Junction box () will be measured and paid in actual number of junction boxes of each size and type furnished, installed, and accepted.

IS junction box () will be measured and paid in actual number of IS junction boxes of each size and type used to house IS Department fiber-optic cables exclusively that are furnished, installed, and accepted.

No measurement will be made of covers, washed stone, removal of existing junction boxes and grounding systems as these will be considered incidental to furnishing and installing junction boxes and IS junction boxes.

No measurement will be made of restoration of paved roadways/driveways and unpaved ground surfaces with like materials, including but not limited to backfill, washed stone, paved materials, seeding and mulching, as this work will be considered incidental to junction box installation. The Department will make no payment for a given junction box until all repairs to

paved and unpaved surfaces damaged/disturbed during the installation of the junction box have been completed and accepted.

Repair and replacement of existing sidewalk will be measured and paid for in accordance with the “Signal Cabinet Foundations” section of these Project Special Provisions.

No measurement will be made of collecting and recording GPS coordinates for junction boxes and compiling this data in the prescribed Microsoft Excel spreadsheet as such work will be considered incidental to furnishing and installing junction boxes.

Payment will be made under:

Pay Item	Pay Unit
Junction Box (Standard Size)	Each
Junction Box (Over-sized)	Each
Junction Box (Special-Sized)	Each
IS Junction Box (Over-sized)	Each
IS Junction Box (Special-Sized)	Each

8. EXTENSION OF EXISTING FIELD WIRING AT CONTROLLER CABINETS

8.1. DESCRIPTION

Furnish and install terminal splice cabinets to splice and extend existing signal and loop lead-in cables (i.e., field wiring) to new controller cabinets. Furnish and install gel-filled splice connectors to splice and extend existing conductors inside new controller cabinets.

8.2. MATERIALS

(A) Terminal Blocks

Provide terminal block (i.e., terminal strips) constructed of electrical grade thermoplastic or thermosetting plastic with the terminals recessed between molded barriers for splicing and extending existing field wiring. Provide terminal blocks with the number of terminals required in these provisions or with a sufficient number to accommodate splicing and extending of incoming existing field wiring conductors. Each terminal shall have two terminal screws that have a minimum outside diameter of 3/16 inches. A removable shorting bar shall be provided between the screws of each terminal. Both the screws and shorting bar shall be made of corrosion resistant nickel-plated brass. Provide separate terminal blocks for signal conductors and loop lead-in conductors.

(B) Terminal Splice Cabinets

Provide NEMA Type 3 or Type 4 enclosures fabricated of sheet steel or sheet aluminum with continuous weld construction and with a drip shield top. The steel enclosures shall be stainless steel. Aluminum enclosures shall have a standard mill finish.

Provide an enclosure with a terminal block having at least 20 terminals with each terminal having two terminal screws. Mount the terminal block on the back wall of the enclosure in such a manner that no mounting screws, nuts, etc., protrude through the enclosure. Center the terminal block both horizontally and vertically on the back wall of the enclosure in line with the long dimension of the enclosure. Install additional terminal blocks as necessary.

Provide an enclosure of sufficient size to accommodate entrances for a minimum of four 2-inch galvanized rigid metal conduits in the bottom of the enclosure. The dimensions of the enclosure shall not be less than 16" wide x 20" high x 8" deep. The enclosure shall have a hinged front door which opens to the side and which is secured by a Corbin No. 2 lock and latch. A door handle is not required.

Provide conduit entrances in the bottom of the cabinet only which are of the size and number required for the specific location where cabinet will be installed. Conduit entrances in the top or sides of the cabinet are prohibited. Conduit entrances may be either pre-drilled or field-drilled, but shall not exceed the number required for the location. Extra or spare entrances, capped or otherwise, are not acceptable. Field-verify the required number, size and position of entrances prior to drilling.

Provide all necessary hardware and mounting brackets for attaching the terminal splice cabinet on the pole. Such hardware shall provide for mounting the cabinet to metal or wood signal poles using at least two stainless steel bands (straps) of the size recommended by the manufacturer, one near the top of cabinet and one near the bottom.

Furnish rigid galvanized conduit, fittings and conduit outlet bodies along with new pull boxes where required to replace existing short risers. Use conduits, fittings and conduit outlet bodies of same nominal size as the existing short risers being replaced. Furnish conduit fittings and outlet bodies as required to install existing risers into base of new terminal splice cabinet.

(C) Gel-Filled Splice Connectors

Furnish gel-filled connectors of the appropriate wire gauge to butt splice and extend the existing conductors of signal cables and loop lead-in cables inside controller cabinets.

(D) Signal Cable and Loop Lead-In Cable

Furnish new traffic signal cables and loop lead-in cables for extending existing cables from new terminal splice cabinet. Furnish equivalent size conductor signal cable. Furnish loop lead-in cable which complies with the "Lead-In Cable" section of these Project Special Provisions. Furnish new conductors and new cables that match the insulation color coding of the conductors in the existing cables to which they are being spliced.

8.3. CONSTRUCTION METHODS

(A) General

Prior to splicing and extending existing conductors or rerouting existing conductors through new conduits and risers, place permanent labels on all incoming and outgoing conductors in the controller cabinet using a naming convention such as Phase 1 Green, Phase 2 Yellow, Loop 2A, etc., unless the conductors are already labeled. Where there are existing labels on the conductors, confirm that they are labeled correctly and replace any labels that are incorrect.

Place similar permanent labels on the ends of all new conductors used to extend the existing conductors.

Perform standard megger tests on loops after splicing and extending loop lead-ins. Upon approval of the Engineer, replace lead-in cables or loop and lead-in cable assemblies that do not pass standard megger tests.

Maintain the color coding of individual conductors through the splice. Splice and extend existing conductors using new conductors with the same insulation color. Do not splice together conductors with different color insulation.

(B) Inside Controller Cabinets

Where a new controller cabinet is being mounted over existing conduit stubouts on an existing foundation or over existing riser bases at a pole-mounted location and the existing field wiring will not reach the terminal blocks provided inside the new cabinet, splice and extend the incoming and outgoing signal and loop lead-in conductors inside the controller cabinet using gel-filled butt splice connectors.

(C) External to Controller Cabinets

Where new controller cabinets are being installed in a different location from the existing cabinet location and the Plans do not call for re-cabling of the intersection, install, as shown on the Plans, a terminal splice cabinet to splice and extend existing signal and loop lead-in conductors as required to reach the new controller cabinet through new risers and conduits.

Do not splice and extend conductors external to the controller cabinet where the existing field wiring is of sufficient length to reach the new cabinet in its new location. An example would be

where the Plans call for the new cabinet to be placed on a new foundation located at the same or lesser distance from the adjacent signal pole as the existing base-mounted cabinet and foundation. At such locations, pull the existing cables out of the existing cabinet, risers and conduit and reroute them to the new cabinet via the new risers and conduits.

Use a terminal splice cabinet when an existing pole-mounted cabinet is being replaced with a new base-mounted cabinet and the Plans do not call for re-cabling the intersection. Use a terminal splice cabinet where an existing base-mounted cabinet is being replaced with a new base-mounted cabinet on a new foundation in a new location and the existing cabling is not long enough to reach the base of the new cabinet and the Plans do not call for re-cabling the intersection.

Do not route electrical service wire through the terminal splice cabinet.

(D) Terminal Splice Cabinets

Disconnect the conductors from the existing cabinet, remove the existing pole-mounted controller cabinet, but retain the existing risers, conduit outlet bodies and cables housed therein. Install the new terminal splice cabinet on the pole at same location as removed cabinet with bottom of splice cabinet at the same vertical height as the bottom of the removed cabinet. Install conduit entry holes into base of new cabinet and attach existing risers. Adjust existing conduits and modify/add conduit outlet bodies as necessary to attach to new cabinet. Splice the existing signal cables and loop lead-in cables to the new cables on the terminal splice block and extend new signal cables and new lead-in cables to new base mounted cabinet via two separate, new 2-inch rigid galvanized short risers and underground conduits as shown in the Plans. Use 16-14 AWG insulated solderless crimp terminals on the ends of conductors being spliced. Install the terminals with a ratcheting-type crimp tool. Bond the terminal splice cabinet to the equipment ground in the controller cabinet using a 14 AWG stranded THHN copper wire with green insulation. Do not put loop grounds and other grounds with neutral conductors.

At certain intersections with existing pole-mounted controller cabinets, existing lead-in cables or pedestrian signal cables are routed underground to existing pole-mounted cabinets and enter the bottom of existing cabinet via a short riser. A short riser is defined as a short section of vertical conduit between the bottom of a pole-mounted cabinet and the ground below that conveys cables between an underground conduit and the cabinet. Where these short risers are attached to the face of the pole, attach the short riser into a conduit entrance on the bottom of the new terminal splice cabinet and splice the existing cables to the new cables on the terminal block in the cabinet.

Where the existing short riser is “freestanding” (i.e., it is offset horizontally more than one inch from the face of the signal pole and is not secured to the face of the signal pole) or is damaged (i.e., crimped or severely bent), replace the existing short riser with a new short riser attached to the face of the pole as shown in the Plans. Feed the existing cables through the new conduit and short riser and into the new terminal splice cabinet. Splice the existing conductors to the new conductors on the terminal block.

(E) Terminal Splice Cabinet Where Existing Cabinet is Base-Mounted

Mount the terminal splice cabinet on the pole with the center of the cabinet 48 inches above the ground at the base of the pole. Install new risers to the terminal splice cabinet and short risers from the terminal splice cabinet to the underground conduits leading to the new controller

cabinet foundation. Disconnect field wiring from existing base-mounted controller cabinet, carefully pull the cables out of the tops of the existing risers and reroute the existing cables through new risers to a terminal splice cabinet. Splice the existing signal cables and loop lead-in cables to the new cables on the terminal splice block and extend new signal cables and new lead-in cables to new base mounted cabinet via two separate, new 2-inch rigid galvanized short risers and underground conduits as shown in the Plans. Use 16-14 AWG insulated solderless crimp terminals on the ends of conductors being spliced. Install the terminals with a ratcheting-type crimp tool. Bond the terminal splice cabinet to the equipment ground in the controller cabinet using a 14 AWG stranded THHN copper wire. Do not put loop grounds and other grounds with neutral conductors.

Where a loop lead-in cable or pedestrian signal cable enters the existing cabinet foundation directly via an existing underground conduit instead of through a riser, take care to protect the existing cables and the conduit stubout so as not to damage them when removing the existing controller cabinet and its existing foundation. Pull the cables back out of the foundation stubouts from a junction box, handhole, or transformer base, if available, before removing the cabinet foundation. Upon removal of the cabinet foundation, install a junction box over the conduit stubouts and install new underground conduit(s) from the junction box to a stubout in the new cabinet foundation. Splice the loop lead-in cable to new lead-in cable in the junction box in accordance with *Roadway Standard Drawing No. 1725.01* and run the new lead-in cable from the junction box directly to the new controller cabinet via the new underground conduit. Do not splice and extend existing pedestrian signal cable. Remove the existing pedestrian signal cable and install new, continuous pedestrian signal cable from the pedestrian signal to the new controller cabinet via the existing and new underground conduits.

Where these short risers are attached to the face of the pole, attach the short riser into a conduit entrance on the bottom of the new terminal splice cabinet and splice the existing cables to the new cables on the terminal block in the cabinet.

8.4. MEASUREMENT AND PAYMENT

Terminal Splice Cabinet will be measured and paid for as the actual number of terminal splice cabinets, furnished, installed, and accepted.

No measurement will be made of new full-height risers attached to the bottom of terminal splice cabinet as these will be considered incidental to furnishing and installing terminal splice cabinets.

No measurement will be made of replacement of existing conduit bodies and fittings, and installation of new conduit bodies and fittings as these will be considered incidental to furnishing and installing terminal splice cabinets.

No measurement will be made of new short risers that replace of existing short risers as they will be considered incidental to furnishing and installing terminal splice cabinets.

When required to intercept existing underground conduit, new junction boxes will be paid for in accordance with the "Junction Boxes" section of these Project Special Provisions as approved by the Engineer.

No measurement will be made of additional signal cable/conductors and loop lead-ins, as the splicing of all existing signal conductors and loop lead-ins in the splice cabinet, extending them

through new risers and conduits and connecting them to the new controller cabinet will be considered incidental to furnishing and installing terminal splice cabinets.

No measurement will be made of gel-filled splice connectors and additional signal and loop lead-in cable/conductors as the splicing and extending of conductors inside the controller cabinet will be considered incidental to furnishing and installing the new controller and cabinet.

No measurement will be made of testing of loops after splicing and extending lead-in cables as performing standard megger tests will be considered incidental to splicing and extending the lead-in cables.

Engineer-approved replacement of loops will be paid as provided for under *Inductive Loop Sawcut* in accordance with the “Inductive Detection Loops” section of these Project Special Provisions. Engineer-approved replacement of loop lead-ins will be paid as provided for under *Lead-In Cable* in accordance with the “Lead-In Cable” section of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
Terminal Splice Cabinet	Each

9. WOOD POLES

9.1. DESCRIPTION

Furnish and install wood poles with grounding systems and all necessary hardware.

9.2. MATERIALS

(A) General

Material, equipment, and hardware furnished under this section shall be pre-approved on the ITS and Signals QPL.

Furnish treated timber poles that meet the requirements of ANSI O5.1, except the timber shall be treated Southern Pine or treated Douglas Fir.

Treat poles in accordance with AWWA Standard U1, except require retention of preservative as below.

Give all poles a preservative treatment of either pentachlorophenol, or chromated copper arsenate. The same type of preservative shall be used throughout the entire length of the project.

Minimum retention for poles treated with pentachlorophenol will be 0.45 lb. by assay of dry chemical per cubic foot of wood. Minimum retention for poles treated with chromated copper arsenate will be 0.6 lb. by assay of dry chemical per cubic foot of wood.

Refer to the following sections of the *Standard Specifications*:

- 1091-6, "Grounding Electrodes"
- 1082, "Inspection Requirements"
- 1091-2, "Wire and Cable"
- 1082, "Structural Timber and Lumber"

(B) Wood Poles for Signals and Aerial Cable Routes

Unless otherwise specified in the Plans, furnish Class 3 wood poles that have a minimum length of 40 feet and are of a sufficient length to maintain the minimum required clearances above the roadway, obstructions, and affected railroad tracks.

(C) CCTV Wood Poles

Furnish Class 3 or better wood poles to mount CCTV cameras and cabinets that are of sufficient length to permit the CCTV camera to be mounted at the mounting height specified in the Plans. To provide for mounting heights of up to 35 feet above the ground at the base of the pole, furnish CCTV wood poles that are at least 50 feet in length. The Contractor is encouraged to visit the site of the proposed CCTV poles to confirm the length of pole required to attain the specified mounting prior to ordering the CCTV poles.

9.3. CONSTRUCTION METHODS

Install poles at locations shown on the Plans. Except where the Plans specify an exact location (i.e., show offsets and dimensions from a known points), place the pole at an offset from the edge of travel way that is consistent with other fixed objects and utility poles along that side of the road, but in no case closer than 1.5 feet from the face of curb. Within intersection radii, install poles a minimum of 7 feet behind face of curb or 10 feet from the edge of travel way

where there is no curb. If the Plans do not specify an exact locations, the pole is not within the intersection radius and there are no other poles along the side of the road where the pole is to be installed, locate the pole as far as practical from the edge of the roadway, using the setback distances in the following table as a guide:

Speed Limit	Desirable Minimum Setback Distance	
	from face of curb in curb & gutter section	from edge of travel way in shoulder section (no curb)
≤ 25 mph	8 feet	10 feet
30-35 mph	10 feet	12 feet
40 mph	12 feet	16 feet
45 mph	16 feet	18 feet
50 mph	20 feet	22 feet
55 mph	22 feet	24 feet
≥ 60 mph	n/a	30 feet

Measure the setback distance from the face of curb or edge of travel lane to the face of the pole.

Field conditions and site specific constraints may require the pole to be located at setback distances less than those listed above, subject to the approval of the Engineer.

Mark final pole locations and receive approval from the Engineer before installing poles.

Ensure poles are of sufficient length to maintain the minimum required clearances above the roadway, obstructions, and affected railroad tracks

Drill or auger a hole for placement of pole and to allow for compacting. Set poles for signals and aerial cable routes at the manufacturer's recommended depth or at a depth equal to 10% of the pole length plus 2 feet, whichever is greater, but in no case less than of 5 feet deep. Set CCTV wood poles at a minimum depth of 10 feet. Ensure the pole is within 2 degrees of vertical when fully loaded.

Backfill hole with pole installed and tamp backfill in 6 inch lifts with a mechanical tamp until compacted density is at least 95% of original density.

On new Department-owned or City-owned poles, install a grounding system consisting of #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the base of the pole or to the electrical service grounding electrode system located within 10 feet of the pole. Install ground wire so as to minimize damage from vandalism and environmental

exposures. Install ground wire up pole to a point adjacent to the uppermost span. Use hot-dipped galvanized 1.5” wire staples to secure ground wire to pole, spacing the staples along the ground as follows:

- 4 inches apart from ground level to 8 feet above ground level;
- 24 inches apart from 8 feet above ground level to point adjacent to uppermost span.

9.4. MEASUREMENT AND PAYMENT

Wood pole will be measured and paid for as the actual number of wood poles furnished, installed, and accepted.

CCTV wood pole will be measured and paid for as the actual number of CCTV wood poles furnished, installed, and accepted regardless of length.

Pole grounding systems, where required, will be measured and paid for in accordance with the “Messenger Cable” section of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
Wood Pole	Each
CCTV Wood Pole	Each

10. GUY ASSEMBLIES

10.1. DESCRIPTION

Furnish and install guy assemblies with all necessary hardware.

10.2. MATERIALS

Material, equipment, and hardware furnished under this section shall be pre-approved on the ITS and Signals QPL.

Furnish guy assemblies with anchor assemblies, guy cable, and guy cable guard.

Provide anchor assemblies with all miscellaneous hardware consisting of either expanding anchor with rod and triple-eye attachment, screw anchor with extension rod and triple-eye attachment, or expanding rock anchor with triple-eye attachment. Ensure anchor assembly size is adequate for site conditions. Provide rods constructed of hot-dipped galvanized steel sized according to the soil bearing conditions in the area. Provide triple-eye guy attachments constructed of hot-dipped galvanized steel. Anchor assemblies with double-strand eyes may be used in lieu of those with the triple-eye feature when only one guy cable is to be attached. Ensure anchor assemblies are 7 feet minimum in length.

For type of anchor assembly furnished, ensure the following:

1) Expanding Anchor

Provide steel construction with protective paint or heat shrink of 6 mil plastic to protect metal during shipping and storage.

2) Screw Anchor

Provide hot-dipped galvanized steel construction.

3) Expanding Rock Anchors

Provide malleable iron and rust-resisting paint construction.

Provide 3-bolt clamp to match messenger cable size.

Provide full round guy cable guards that are 8 feet in length and constructed of ultraviolet (UV) stabilized, high impact, bright yellow, high density polyethylene (HDPE).

Provide guy cables consisting of messenger cable of the same size as the largest sized messenger cable to be guyed. Comply with the “Messenger Cable” section of these Project Special Provisions.

Refer to the “Pole Line Hardware” subsection of the “Messenger Cable” section of these Project Special Provisions.

10.3. CONSTRUCTION METHODS

(A) General

Comply with *Roadway Standard Drawing* (RSD) No. 1721.01 when constructing guy assemblies.

(B) Guy Assemblies for Signal Heads or Loop Lead-in Cable

Install guy assemblies with guy cable, guy guards, anchors, three-bolt clamps and associated fittings. Use two-bolt attachment method where there is adequate room on the pole to comply

with the NESC. Attach guy assembly and guy cable to two separate bolts with one bolt for span and one bolt for guy cable.

Where adequate spacing is not available and a violation of the NESC would occur with the two-bolt attachment method, use approved one-bolt attachment method for attaching messenger cable and guy assembly.

Bond guy assembly to existing pole ground and to the messenger cable using parallel groove clamp or equivalent. If existing City or NCDOT poles do not have a grounding system, install a grounding system consisting of number #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the base of the pole or to the electrical service grounding electrode system located within 10 feet of the pole. Install ground wire so as to minimize damage from vandalism and environmental exposures. Install ground wire up pole to a point adjacent to the uppermost span. Install ground wire up pole to a point adjacent to the uppermost span. Use hot-dipped galvanized 1.5" wire staples to secure ground wire to pole, spacing the staples along the ground as follows:

- 4 inches apart from ground level to 8 feet above ground level;
- 24 inches apart from 8 feet above ground level to point adjacent to uppermost span.

Do not use guy anchors as grounding electrodes.

Do not attach to existing guy assemblies unless specifically approved by owner.

When proposed guy assembly replaces an existing guy assembly, remove the existing guy assembly, including guy anchor if not reused for the new guy assembly.

(C) Guy Assemblies for Communications Cable

When installing messenger cable for supporting only communications cable, use approved one-bolt attachment method for attaching messenger cable and guy assembly.

Bond guy assembly to existing pole ground and to the messenger cable using parallel groove clamp or equivalent. If existing City or NCDOT poles do not have a grounding system, install a grounding system consisting of number #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the base of the pole or to the electrical service grounding electrode system located within 10 feet of the pole. Install ground wire so as to minimize damage from vandalism and environmental exposures. Install ground wire up pole to a point adjacent to the uppermost span. Use hot-dipped galvanized 1.5" wire staples to secure ground wire to pole, spacing the staples along the ground as follows:

- 4 inches apart from ground level to 8 feet above ground level;
- 24 inches apart from 8 feet above ground level to point adjacent to uppermost span.

Do not use guy anchors as grounding electrodes.

Do not attach to existing guy assemblies unless specifically approved by owner.

When proposed guy assembly replaces an existing guy assembly, remove the existing guy assembly, including guy anchor if not reused for the new guy assembly.

10.4. MEASUREMENT AND PAYMENT

Guy assembly will be measured and paid as the actual number of direct down guy (i.e., standard guy) assemblies furnished, installed, and accepted.

Guy assembly (____) will be measured and paid as the actual number of guy assemblies of each type (aerial or sidewalk) furnished, installed, and accepted.

No measurement will be made of guy cable, guy guards, anchors, clamps, strandvises, 2" galvanized pipe, pole plates, other fittings, or the removal of existing guy assemblies as these will be considered incidental to furnishing and installing guy assemblies.

Pole grounding systems, where required, will be measured and paid for in accordance with the "Messenger Cable" section of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
Guy Assembly	Each
Guy Assembly (Aerial)	Each
Guy Assembly (Sidewalk)	Each

11. RISER ASSEMBLIES

11.1. DESCRIPTION

Furnish and install riser assemblies with clamp-on, aluminum weatherheads, heat shrink tubing, conduit sealing bushing, galvanized pole attachment fittings, stainless steel banding hardware, grounding and all necessary hardware.

11.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

Provide conduit for risers that is rigid hot dipped galvanized steel conduit that meets UL Standard 6 with rigid full weight sherardized or galvanized threaded fittings.

Refer to the following sections of the *Standard Specifications*:

- 1091-6, "Grounding Electrodes"
- 1091-2, "Wire and Cable"

In addition, refer to the "Pole Line Hardware" subsection of the "Messenger Cable" section of these Project Special Provisions.

Provide Schedule 40 PVC female adapter to connect an underground run of PVC conduit to the threaded end of a rigid metallic elbow/sweep at the base of a rigid metallic riser. Provide PVC adapters that have the same nominal diameter as the riser to join underground conduit of the same diameter to the riser. 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.

Furnish appropriately sized clamp-on aluminum weatherheads for electrical control and power cables.

Furnish heat shrink tubing for the installation of fiber-optic or coaxial cable in a new riser, except for new 4" riser. Ensure the heat shrink tubing is made of modified polyolefin and includes a hot-melt adhesive. Provide tubing that has a length of at least 5" before heating. Ensure the heat shrink tubing will provide a watertight fit around individual cables and outer wall of the riser after heat is applied in accordance with the manufacturer's instructions.

Furnish heat shrink tubing retrofit kits for the installation of fiber optic cable or coaxial cables to an existing riser with existing cables. Ensure the heat shrink material is made of modified polyolefin and is supplied in a flat sheet design. Ensure the kit contains an apparatus to secure both ends of the flat sheet together to form a tube shaped cylinder. Ensure the securing apparatus is flexible to the point that it will allow the heat shrink material to conform to the shape and dimensions of the riser and cables once heat is applied and will not separate during the heating process. Provide heat shrink tubing retrofit kits with a hot-melt adhesive. Provide the flat sheet heat shrink material that has a minimum length of 5" prior to heating. Ensure the heat shrink tubing retrofit kit provides a watertight fit around individual cables and outer wall of the riser after heat is applied in accordance with the manufacturer's instructions.

For sealing the new 4" rigid galvanized steel riser to be installed on the pole on the west side of Church Street just north of the Business 40 bridge, furnish a conduit sealing bushing designed for installation around cables after they been installed in the 4" rigid galvanized steel riser (i.e., that does not require the bushing to be threaded onto the cables before they are installed in the riser). Provide a sealing bushing designed to fit inside the end of the riser to form a watertight, weatherproof seal around the each cable in the riser and between the cables and the wall of the riser. Provide a sealing bushing fabricated with the number and diameter of holes (ports) required for the number and size of communications cables being installed in the riser as shown in the Plans. Do not field drill holes in the sealing bushing. Provide a sealing bushing comprised of a neoprene sealing ring sandwiched between two PVC coated steel pressure discs. The neoprene disc shall have factory precut slits between the outer edge of the bushing and each cable port so that the disc can be slipped onto cables already installed in the riser. Similarly, the pressure discs shall be of segmental, "pie shaped" design so that they can be placed around cables already installed in the riser. The top pressure disc of the assembly shall be larger than the bottom disc so that it will rest on top of the riser end rather than inside the riser, thereby supporting the cables in their vertical position and helping secure the bushing at the top of the riser. Furnish stainless steel hex socket head cap screws with washers to insert through each segment the pressure plates and the neoprene sealing ring between them, thereby compressing the ring and forcing the it against the inside wall of the riser and around the cables to form a watertight seal.

Submit catalog cuts/manufacturer's literature for the conduit sealing bushing to the Engineer for approval prior to use.

11.3. CONSTRUCTION METHODS

Install risers with required weatherheads, heat shrink tubing, or riser seal on poles using pole attachment fittings and, on metal poles, stainless steel banding hardware. Maintain a 10" minimum and 18" maximum offset from signal messenger to the top riser for all risers. On utility-owned poles, maintain a 40" offset from the electrical utility's power conductors to top of riser and riser attachment fittings.

Use approved heat shrink tubing retrofit kits when installing new fiber-optic or coaxial cable into existing risers that contain existing fiber-optic or coaxial cables.

Install heat shrink tubing retrofit kits in existing risers as specified.

Before installing the new 4-inch rigid galvanized steel riser on the pole on the west side of Church Street north of the Business 40 bridge, refer to the "Construction Staging/Migration" subsection in Section 1 of these Project Special Provisions and comply with all requirements listed therein. Seal the top of the new 4-inch riser an approved conduit sealing bushing following installation of all communications cables as shown on the Plans. DO NOT seal the 4-inch riser until all fiber optic cables are installed as shown on the Plans. When installing the conduit sealing bushing, slip the pressure plates and neoprene sealing ring around the previously installed cables and loosely insert the stainless steel socket head screws with washers through the pressure plates and sealing ring. Insert the assembly into the end of the riser with the larger top plate resting on the top end of the riser, then tighten the screws in accordance with the manufacturer's instructions.

Do not use a conduit sealing bushing to seal any riser other than a 4-inch riser.

Use separate 1-inch riser with weatherhead for pedestrian signals.

Use separate 1-inch riser with weatherhead for electrical service.

Use separate 2-inch riser with weatherhead for signal cables (bundled). Use separate 2-inch riser with weatherhead for the combination of all lead-in cable and twisted-pair communications cable. Install conduit on all risers for lead-in cable. Use a 2-inch riser with weatherhead for composite cable routed to a CCTV camera.

Use a separate riser with heat shrink tubing for fiber-optic communications cables and coaxial cable. For pole-mounted cabinets only, use 1-inch risers with heat shrink tubing for all new risers, that will contain fiber-optic communications drop cables and for new risers that will contain coaxial cable routed to a radio antenna, unless the Plans call for use of a 2-inch riser with heat shrink tubing at a specific location. Connect 1-inch risers to the bottom of the pole-mounted cabinet using a pair of standard 90-degree elbows to form a 180-degree sweep up into the bottom of the cabinet. Standard 90-degree elbows for 1-inch conduit have a 5.75-inch radius and equal horizontal and vertical legs that measure approximately 8 inches each. Smaller elbows are prohibited. Larger elbows may only be used if approved by the Engineer. For all other locations use 2-inch risers with heat shrink tubing. Install risers with heat shrink tubing so that cable can be installed without violating its minimum bending radius. Install cable so it does not share a riser with any other cable type. Use the same 2-inch riser that houses the signal system fiber-optic communications cable to convey the IS Department fiber-optic cable on coincident routes unless the Plans call for installation of a separate riser to convey the IS Department cable.

Install heat shrink tubing in accordance with manufacturer's recommendations. Provide tubing a minimum of 5 inches in length with a minimum of 2.5 inches extended over cables and 2.5 inches extended over risers after heat has been applied. Use nylon filler rods with UV protection or equivalent and sealing spacer clips to separate cables where multiple cables enter a riser. Ensure sealing spacer clips have a heat activated sealing compound with the sealing compound fully encapsulating the space between cables. Ensure heat shrink tubing provides a watertight fit around individual cables and outer walls of risers. Do not use cut sections of cable or any other devices in lieu of filler rods. Use aluminum tape around cables to prevent damage from sealing chemicals. Use a heat source that will provide even heat distribution around tubing. Ensure no damage occurs to any cables. Do not use a heat source with an open flame.

Remove existing weatherheads, sealing bushings, heat shrink tubing and riser caps and install heat shrink tubing retrofit kits on existing risers according to the installation procedures above.

Transition from rigid galvanized steel risers to underground PVC conduits using an approved rigid galvanized steel sweeping elbow with PVC female adapter. Use PVC female adapters that have the same nominal diameter as the riser to join underground conduit of the same diameter to the riser. Apply Teflon thread tape to the threads of rigid galvanized steel sweeping elbow before screwing the PVC adapter onto the threaded end of the elbow. Connect the threaded female end of the PVC adapter to the threaded male end of the rigid galvanized steel sweeping elbow without the use of additional fittings, hardware or adhesives. Connect the opposite, non-threaded end of the adapter to the underground PVC conduit using a slip fit, glued connection.

Bond all new risers, a minimum of 10 feet above grade, to the pole ground using a #6 AWG minimum solid bare copper wire and an approve pipe clamp, a split-bolt connector or parallel groove clamp. On pole-mounted cabinets where the risers are connected to the cabinet, bond

risers in the cabinet using ground bushings with a #6 AWG minimum solid bare copper wire to cabinet ground bus.

If a pole ground exists on a joint-use pole, bond new riser to the existing pole ground using #6 AWG minimum solid bare copper wire terminated with split-bolt connectors or parallel groove clamp.

If the existing pole does not have a grounding system, install new grounding system consisting of #6 AWG solid bare copper wire that is exothermically welded to a single ground rod installed at the base of the pole or to the electrical service grounding electrode system located within 10 feet of the pole. Install ground wire so as to minimize damage from vandalism and environmental exposures. Install ground wire up pole to a point adjacent to the uppermost span. Use hot-dipped galvanized 1.5" wire staples to secure ground wire to pole, spacing the staples along the ground as follows:

- 4 inches apart from ground level to 8 feet above ground level;
- 24 inches apart from 8 feet above ground level to point adjacent to uppermost span.

11.4. MEASUREMENT AND PAYMENT

" Riser with _____ will be measured and paid as the actual number of risers of each type and size furnished, installed, and accepted.

IS " Riser with _____ will be measured and paid as the actual number of risers of each type and size used to convey IS Department fiber-optic cables exclusively that are furnished, installed, and accepted.

No measurement will be made of weatherheads, heat shrink tubing, conduit sealing bushings, bushings, conduit outlet bodies such as condulets, elbows, conduit fittings, PVC female adapters, and pole attachment fittings as these will be considered incidental to furnishing and installing risers.

Pole grounding systems, where required, will be measured and paid for in accordance with the "Messenger Cable" section of these Project Special Provisions.

No measurement will be made for horizontal sections of underground conduit that connect the riser to stub-outs in an adjacent cabinet foundation or to an adjacent junction box and that measure 10 feet or less in horizontal length from the center of the riser to the center of junction box or from the center of the riser to the center of the vertical sweep through the controller cabinet foundation. Such conduit will be considered incidental to furnishing and installing the riser assembly.

No measurement will be made for vertical conduit segments (i.e., short risers) extending from an entrance in the bottom of a pole-mounted cabinet to ground level below the cabinet to tie directly onto an underground conduit as such conduits will be considered incidental to furnishing and installing the pole-mounted cabinet.

No measurement will be made of 1" risers with weatherheads furnished and installed as part of new electrical services as they will be considered incidental to furnishing and installing new electrical services (see "Electrical Service" section of these Project Special Provisions).

Heat shrink tubing retrofit kit will be measured and paid for as the actual number of heat shrink tubing retrofit kits furnished, installed, and accepted.

IS Heat shrink tubing retrofit kit will be measured and paid for as the actual number of heat shrink tubing retrofit kits for risers housing IS fiber-optic cable furnished, installed, and accepted.

No measurement will be made of removing existing weatherheads, sealing bushings, heat shrink tubing and riser caps from existing risers as such removals will be considered incidental to furnishing and installing heat shrink tubing retrofit kits.

Payment will be made under:

Pay Item	Pay Unit
1" Riser with Weatherhead	Each
2" Riser with Weatherhead	Each
1" Riser with Heat Shrink Tubing	Each
2" Riser with Heat Shrink Tubing	Each
4" Riser with Seal	Each
IS 2" Riser with Heat Shrink Tubing	Each
Heat Shrink Tubing Retrofit Kit	Each
IS Heat Shrink Tubing Retrofit Kit	Each

12. INDUCTIVE DETECTION LOOPS

12.1. DESCRIPTION

Furnish and install inductive detection loops with loop slot sealant, loop wire, conduit with fittings, and all necessary hardware.

12.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

(A) Loop Sealant

Provide the Engineer with a Type 3 material certifications and material safety data sheets (MSDS) for the sealant in accordance with Article 106-3 of the *Standard Specifications*.

Provide loop slot sealant that completely encapsulates loop wire when installed according to manufacturer's instructions. Provide loop sealant that does not generate temperatures greater than 220° F. Ensure sealant bonds with asphalt and concrete pavement saw slots so sealant and encapsulated loop wire do not come out of slot. Ensure sealant is self-leveling, but with sufficient viscosity to prevent exit from saw slot when installed along a 10% grade.

Provide sealant that protects loop wire by preventing the entrance of dirt, water, rocks, sticks, and other debris into saw slot, and is resistant to traffic, water, gasoline, chemical and chemical fumes, mild alkalis, oils, and mild acids. Ensure sealant will not be affected by water and sealant does not chemically interact with pavement and loop wire insulation.

Ensure loop sealant has sufficient flexibility to permit expected pavement expansion and contraction due to weather and to permit pavement movement due to traffic without cracking for a temperature range of -40 to 160° F.

Provide sealant with a usable life of at least ten minutes once mixed, when the ambient temperature is 75° F. Ensure sealant dries to tack-free state in less than 2 hours, and does not flow within or out of saw slot after exposed surface has become tack free. Tack free time will be determined by testing with a cotton ball until no sealant adheres to cotton ball and no cotton adheres to sealant.

Ensure two-part sealant cures within 48 hours to attain 95% of published properties for the cured material.

Ensure one part sealant cures within 30 days to attain 95% of published properties for the cured material.

(B) Loop Wire

Provide loop wire composed of 19-strand conductor insulated by a cross-linked polyethylene compound. Ensure insulated conductors are completely encased in tubes of low density polyethylene compound. Print manufacturer's name, manufacture year, and any applicable part number on encasing tube at intervals of 2 feet or less.

Provide #14 AWG copper conductors fabricated from 19 strands that comply with ASTM B3 before insulating. Ensure stranded conductors use either concentric or bunch stranding, and

comply with circular mil area and physical requirements of ASTM B8 or ASTM B174 for bunch stranding.

Provide insulating compound that is cross-linked thermosetting black polyethylene in accordance with ASTM D 2655. Ensure insulation is applied concentrically about conductor. Provide insulation thickness not less than 0.026" at any point and minimum average thickness of 0.030" as measured by UL Standard 62.

Ensure insulation of finished conductor will withstand application of a 60 Hertz or 3,000 Hertz, 7,500 volt (RMS) essentially sinusoidal spark test potential as specified in UL Standard 83.

Provide insulated conductors that are factory-installed in protective encasing tube that complies with the following:

- Encasing tube fabricated of polyethylene compound conforming to ASTM D1248 for Type I, Class C, Grade E5.
- Minimum inside diameter of 0.150"
- Wall thickness of 0.040" \pm 0.010"
- Outside diameter of 0.240" \pm 0.010" Conduit

(C) Conduit

Comply with the "Underground Conduit" section of these Project Special Provisions for PVC conduit.

12.3. CONSTRUCTION METHODS

All work performed in this section shall be done in the presence of the Engineer.

Notify Engineer one week before installing inductive detection loops.

Coordinate sawcutting and loop placement with pavement markings. For new construction or for resurfacing, install inductive detection loops before placing final layer of surface course. On unmarked pavement, pre-mark locations of stop lines and lane lines before locating inductive detection loops.

Before sawcutting, pre-mark inductive detection loop locations and receive approval. Sawcut pavement at approved pre-marked locations. Do not allow vehicles to travel over unsealed loop slots.

Install conduit with bushings from edge of pavement to junction box. Do not sawcut through curb. Do not sawcut or drill holes for conduit or wires through granite curb. See additional requirements for work in historic districts in Section 1 of these Project Special Provisions.

Remove all loose material and wash saw slots with a high-pressure method using an air and water mixture. Dry saw slots with compressed air. Clear saw slots of jagged edges and protrusions. Seat loop conductor at bottom of saw slot without damaging loop wire.

Before sealing loop conductors, test that impedance from the loop wire to ground is at least 100 megohms. For each location with inductive loops, submit a completed Inductive Detection Loop & Grounding Test Results form and place copy in controller cabinet. Ensure all loops are included on form. The form is located on the Department's website at <https://connect.ncdot.gov/resources/safety/Pages/ITS-and-Signals.aspx>.

Embed loop conductors in saw slot with loop sealant. Seal saw slot and dispose of excess sealant in an environmentally safe manner.

Between where loop conductor pairs leave the saw cut in pavement and enter a junction box, twist loop conductor pairs a minimum of 5 turns per foot. Permanently label each twisted pair in the junction box with nylon cable tie using indelible ink. Indicate loop number and loop polarity on the tie.

12.4. MEASUREMENT AND PAYMENT

Inductive loop sawcut will be measured and paid as the actual linear feet of inductive loop sawcut furnished, installed, and accepted.

No measurement will be made of loop slot sealant, loop wire, conduit, and conduit fittings as these will be considered incidental to furnishing and installing inductive detection loops.

Payment will be made under:

Pay Item	Pay Unit
Inductive Loop Sawcut	Linear Foot

13. LEAD-IN CABLE

13.1. DESCRIPTION

Furnish and install lead-in cable with all necessary hardware to be used in conjunction with, but not limited to, inductive detection loops, pedestrian pushbutton assemblies or railroad circuitry.

13.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

Furnish lead-in cable with two conductors of #14 AWG fabricated from stranded tinned copper that complies with IMSA Specification 50-2 except as follows:

- Ensure conductor is twisted with a maximum lay of 2.0 inches, resulting in a minimum of 6 turns per foot.
- Provide a ripcord to allow cable jacket to be opened without using a cutter.

Provide length markings in a contrasting color showing sequential feet and within 1% of actual cable length. Ensure character height of the markings is approximately 0.10 inch.

Refer to the “Pole Line Hardware” subsection of the “Messenger Cable” section of these Project Special Provisions.

13.3. CONSTRUCTION METHODS

For underground runs, install lead-in cable in 2-inch non-metallic conduit. For aerial installation, wrap lead-in cable to messenger cable with at least four turns of wrapping tape spaced at intervals less than 15 inches or lash lead-in cable to messenger cable with one 360° spiral of lashing wire per 12 inches.

Where railroad preemption is required, install lead-in cable from signal controller cabinet to railroad company furnished and installed lockable junction box.

Except where the plans call for splicing and extending existing lead-in cable conductors inside a new controller cabinet or for using a terminal splice box to splice and extend existing lead-in cable to a new cabinet location, splicing of lead-in cable will be allowed only for runs in excess of 750 feet. Splice lead-in cable in terminal splice boxes, junction boxes, condulets on poles or controller cabinets.

Test each complete loop system from the controller cabinet by using a megger to verify that impedance from the loop system to the ground is at least 50 megohms. After successful completion of megger test, test loop system resistance using an electronic ohmmeter to verify loop system resistance is less than 0.00885 ohms per foot.

13.4. MEASUREMENT AND PAYMENT

Lead-in cable will be measured and paid as the actual linear feet of lead-in cable furnished, installed, and accepted. Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. Terminate all cables before determining length of cable run.

If markings are not visible, measurement will be point to point with no allowance for sag. Twenty-five feet will be allowed for vertical segments up or down poles.

Payment will be made under:

Pay Item	Pay Unit
Lead-in Cable	Linear Foot

14. FIBER-OPTIC CABLE

14.1. DESCRIPTION

Furnish and install single mode fiber-optic (SMFO) communications cable and drop cable assemblies, fiber-optic cable storage guides (snow shoes), communications cable identification markers, lashing wire, and all necessary hardware. Pull back (i.e., uninstall) existing fiber-optic communications cable, temporarily store it on a cable reel, then subsequently reinstall it along its existing route, with all associated materials, labor and hardware necessary, as shown in the Plans.

14.2. MATERIALS

(A) General

Refer to the “Pole Line Hardware” subsection of the “Messenger Cable” section of these Project Special Provisions for lashing wire, wrapping tape and hardware used for installation of aerial fiber-optic cable.

(B) SMFO Communications Cable

Furnish single-mode fiber-optic communications cable that is pre-approved on the ITS and Signals QPL.

Furnish single-mode fiber-optic cable manufactured into a loose buffer tube design installed around a central strength member where the cable complies with RUS CFR 1755.900 and ICEA 640 requirements. Ensure the manufacturer is ISO 9001 and TL9000 registered and that the manufacturer’s cable is RUS listed. The operating temperature range of the cable shall be -40°F to +158°F.

Furnish individual fibers manufactured from silica and dopant materials with each fiber having a color coated finish that is compatible with local injection detection (LID) devices. Distinguish each fiber from others by color coding that meets EIA/TIA-598. Furnish single mode fiber that does not exceed attenuation ratings of 0.25 dB/km at 1550 nm and 0.35 dB/km at 1310 nm and complies with ITU G.652D and IEC 60793-2-50 Type B.1.3 industry standards for low water peak, single mode fiber. Provide fibers that are useable and with a surface, sufficiently free of imperfections and inclusions to meet optical, mechanical and environmental requirements.

Ensure the core central strength member is a dielectric glass reinforced rod and that the completed cable assembly has a maximum pulling rating of 600 lbf during installation (short term) and 180 lbf long term installed.

Construct buffer tubes (nominal size of 2.5 mm) manufactured from a polypropylene copolymer material to provide good kink resistance and allows the buffer tube to maintain flexibility in cold temperature over the expected lifetime of the cable. Except for 6-fiber drop cables, provide exactly 12 fibers per buffer tube in all cables regardless of the total number of fibers the cables contain. Do not provide cables with any other fiber count per buffer tube. Ensure that all buffer tubes are filled with a water-blocking gel or water swellable material. Construct the cable such that the buffer tubes are stranded around the central strength member in a reverse oscillating arrangement to allow for mid-span entry. Distinguish each buffer tube from others by color coding that meets EIA/TIA-598. Use filler tubes to maintain a circular cross-section of the cable. Ensure the filler tubes are the same nominal size as the buffer tubes. Apply

binders (water swellable yarn, aramid fiber, etc.) with sufficient tension to secure buffer tubes and filler tubes to the central member without crushing the buffer tubes. Ensure that binding material is non-hygroscopic, non-wicking and dielectric with low shrinkage. Ensure the binders are of a high tensile strength that is helically stranded evenly around cable core.

Ensure the cable core is protected from the ingress of moisture by a water swellable material or that is filled with a water blocking compound that is non-conductive. Ensure the water swellable material (when activated) or the water blocking compound is free from dirt and foreign matter and is removable with conventional nontoxic solvents. Furnish at least one ripcord to aid in the process of removing the outer jacket. Furnish the outer jacket constructed of a medium-density polyethylene material to provide reduced friction and enhanced durability. Ensure the polyethylene material contains carbon black to provide UV protection and does not promote the growth of fungus. Ensure the cable jacket is free of slits, holes or blisters and the nominal outer jacket thickness is > 0.050 ".

Ensure the completed cable assembly contains identifications markings printed along the outside cover of the jacket every 2 feet. Ensure the character height of the markings is approximately 0.10". Provide length markings in sequential feet and within one percent of actual cable length.

Mark each cable with the following:

- (1) Sequential length marks in feet as specified
- (2) The name of the manufacturer
- (3) "OPTICAL CABLE"
- (4) Month/year of manufacture
- (5) Number(s) of and type(s) of fibers
- (6) Cable ID Number for product traceability

(C) Drop Cable

Provide drop cable meeting the material requirements list in "SMFO Communications Cable" subsection above with the exceptions herein to provide communications links between splice enclosures and the Ethernet edge switches through interconnect centers mounted in controller cabinets and in CCTV cabinets. Furnish drop cables containing a minimum of six individual fibers.

To facilitate installation in 1" risers at pole-mounted cabinet locations, furnish low bend radius drop cable that complies with RUS-CRF 1755.900 and is RUS listed. A low bend radius cable is defined as a fiber-optic cable whose manufacturer-specified minimum bend radius does not exceed 5.75 inches when loaded and 4 inches when installed for a 6-fiber cable. Ensure drop cable has the same operating characteristics as the SMFO cable it is to be coupled with.

On one end of the cable, furnish LC connectors for termination of all drop cable fibers on connector panel mounted inside an equipment cabinet. Provide either factory preassembled drop cables with SMFO pigtails and LC connectors already attached or field install the pigtails and connectors. For field installed connectors, provide cabinet-mounted interconnect centers that are

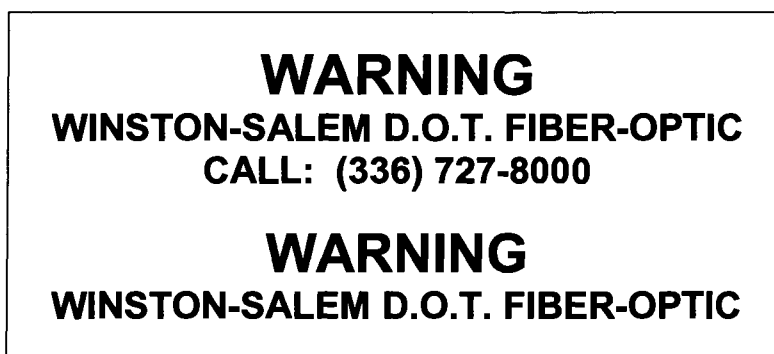
pre-equipped with factory-preassembled connector panels, SMFO pigtails with LC connectors and splice trays; then fusion splice all drop cable fibers to the SMFO pigtails.

Ensure attenuation of drop cable at 1310 nm does not exceed 0.4 dB/km and the attenuation at 1550 nm does not exceed 0.3 dB/km. Ensure attenuation loss for complete drop cable does not exceed a mean value of 1.5 dB.

(D) Communications Cable Identification Markers

Furnish communications cable identification markers that are resistant to fading when exposed to UV sources and changes in weather. Use markers designed to coil around fiber-optic cable that do not slide or move along the surface of the cable once installed. Ensure exposure to UV light and weather does not affect the markers natural coiling effect or deteriorate performance. Provide communications cable wraps that permit writing with an indelible marking pen.

Furnish cable identification markers with the following text for signal system communications cables:

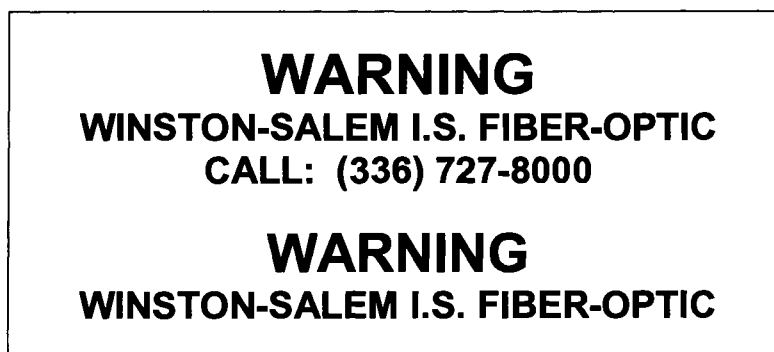


Overall Marker Dimensions: 7(l) x 4 (w) inches

Lettering Height: 3/8 inch for "WARNING"; 1/4" for all other lettering

Colors: Black text on yellow background

Furnish cable identification markers with the following text for City of Winston-Salem IS Department communications cables:



Overall Marker Dimensions: 7(l) x 4 (w) inches

Lettering Height: 3/8 inch for "WARNING"; 1/4" for all other lettering

Colors: Black text on white background

Submit a sample of proposed communications cable identification marker to the Engineer for approval before installation.

(E) Fiber-Optic Cable Storage Guides

Furnish fiber-optic cable storage guides (snowshoes) that are pre-approved on the ITS and Signals QPL.

Furnish fiber-optic storage guides (snowshoes) that are non-conductive and resistant to fading when exposed to UV sources and changes in weather. Ensure snowshoes have a captive design such that fiber-optic cable will be supported when installed in the rack and the minimum bending radius will not be violated. Provide stainless steel attachment hardware for securing snowshoes to messenger cable and black UV resistant tie-wraps for securing fiber-optic cable to snowshoe. Ensure snowshoes are stackable so that multiple cable configurations are possible.

(F) Aerial Cable Protectors

Furnish aerial cable protectors designed to protect aerial fiber-optic communications cable from damage by squirrels and from tree limb abrasion. Provide cable protectors that are designed to fit over the cable as a wrap-around protective sleeve, that have a round shape and are fabricated with cable tie slots spaced approximately 12 inches apart along the entire length. Size the cable protectors to properly fit over the cable(s) lashed to messenger cable in accordance with the manufacturer's guidelines. Provide cable protectors that are constructed of rugged, durable dielectric material such as high density PVC that is black in color, formulated for outdoor use and has special additives to prevent degradation from ultraviolet light. Provide aerial cable protectors that are designed for a service life of at least 10 years.

14.3. CONSTRUCTION METHODS

(A) General

Provide cable manufacturer's attenuation and Optical Time Domain Reflectometer (OTDR) testing data for each reel of cable.

Install SMFO communications cable, snow shoes, communications cable identification markers, lashing wire, and all necessary hardware.

Comply with manufacturer's recommendations. Install communications cable on signal poles, utility poles, messenger cable, and in conduits as required to bring the fiber-optic cable into and, if necessary, out of each splice enclosure.

Take all precautions necessary to ensure cable is not damaged during storage, handling, and installation. Do not violate minimum bending radius of 20 times the radius of cable diameter or manufacturer's recommendation, whichever is greater. Do not step on cable nor run over cable with vehicles or equipment. Do not pull cable over or around obstructions, or along the ground.

Determine lengths of cable necessary to reach from termination-point to termination-point. Install cable in continuous lengths between approved splicing facilities. Additionally, provide a sufficient amount of slack cable to allow for an additional 20 feet of cable to be present after

removal of outer sheath for termination. Store the 20 feet of spare cable inside the cabinet. Measure slack cable by extending cable straight out of communications hub cabinet door. No splicing is permitted at any field cabinets other than communications hub cabinets and splicing drop cable fibers to SMFO pigtails in cabinet-mounted interconnect centers.

Keep cable ends sealed at all times during installation to effectively prevent the ingress of moisture. Use approved heat shrink cable end cap. Do not use tape to seal cable ends.

Before installing cable, provide three copies of cable manufacturer's recommended and maximum pulling tension. Do not exceed manufacturer's recommended pulling tension. Use pulling grips containing a breakaway rotating swivel. Coil cable in a figure-8 configuration whenever cable is unreeled for subsequent pulling.

Install fiber-optic cable in separate risers with heat shrink tubing (1-inch or 2-inch as shown on the Plans) or separate conduits. Do not share risers or conduits containing fiber-optic cable with other non-fiber-optic cable unless the Plans specify otherwise or the Engineer directs or approves otherwise.

Seal all conduits containing fiber-optic communications cable in junction boxes and cabinet bases with duct and conduit sealer. Comply with the requirements for duct and conduit sealer in the "Underground Conduit" section of these Project Special Provisions.

(B) Aerial Installation

Install one communications cable identification marker on both the signal system cable and the IS Department cable within 36 inches of pole attachment points and at locations where more than one cable originates or terminates. At splice enclosures, install a communications cable marker on one of the cables where it enters or exits the splice enclosure and ensure that the marker is installed so that it visible (but not necessarily readable) from the ground below. At fiber-optic cable storage guides (i.e., snow shoes), install a communications cable marker at each end, 6 inches or less from the inner edge of each snow shoe, to identify the cable being stored.

Double lash fiber-optic cable to messenger cable with one 360° spiral per foot.

Machine lashing of any cable is not permitted along any messenger cable span to which a traffic signal or overhead sign is or will be attached. Either reuse existing 0.05" x 0.30" aluminum wrapping tape or furnish and install new aluminum wrapping tape.

Use pole attachment hardware and roller guides with safety clips to install aerial run cable.

Use a breakaway swivel so as not to exceed 80% of the maximum allowable pulling tension specified by the cable's manufacturer if cable is pulled by mechanical means. Do not allow cable to contact the ground or other obstructions between poles during installation.

Use a cable suspension clamp when attaching cable tangent to a pole. Select and place cable blocks and corner blocks so as not to exceed the cable's minimum bending radius. Do not pull cable across J-hooks.

Store 100 feet of each fiber-optic cable on all cable runs that are continuous without splices as shown in the Plans. Store 100 feet of IS Department fiber-optic cable at future splice points as shown on the Plans. Obtain approval for spare cable storage locations. Store spare fiber-optic cable on fiber-optic cable storage guides (snow shoes). Where the Plans call for both signal system and IS fiber-optic cable to be stored at the same location, use stacked snow shoes and

store the spare signal system cable on the top rack (closest to messenger) and the IS Department cable on the bottom rack. Where spare cable storage locations for the signal system cable and the IS Department cable are shown separately on the Plans but fall adjacent to one another due to field conditions during construction, the spare cables may also be stored on stacked snowshoes at a common location instead of separately, subject to the approval of both the Engineer and the City IS Department's authorized representative.

Locate spare cable storage in the middle of spans between termination points. Do not store spare fiber-optic cable over the roadway or driveways.

(C) Underground Installation

Install fiber-optic cable underground in conduit using cable pulling lubricants recommended by the fiber-optic cable manufacturer. Where more than one fiber-optic cable is being installed in a multiple conduit underground run, ensure that at least one conduit remains empty for future use by installing more than one cable in a conduit as needed, unless directed otherwise by the Engineer.

Obtain approval of cable pulling lubricant and method of pulling before installing underground fiber-optic cable.

Use a breakaway swivel so as not to exceed 80% of the maximum allowable pulling tension specified by the cable's manufacturer if cable is pulled by mechanical means.

Keep tension on cable reel and pulling line at start of each pull. Do not release tension if pulling operation is halted. Restart pulling operation by gradually increasing tension until cable is in motion.

For pulling cable through manholes, junction boxes, and vaults, feed cable by manually rotating the reel. Do not pull cable through intermediate junction boxes, handholds, or openings in conduit unless otherwise approved.

Inside all junction boxes, install communications cable identification markers on each communications cable entering the junction box.

In a junction box where no splice enclosure is required, store 50 feet of each fiber-optic cable on all cable runs as shown in the Plans.

In a junction box where a splice enclosure is required but not immediately installed, store 50 feet of fiber-optic cable intended for the splice as shown in the Plans.

Store 50 feet of IS Department fiber-optic cable at future splice points as shown on the Plans. Obtain approval for spare cable storage locations. Unless otherwise indicated on the plans, IS Department fiber-optic cable may be stored in the same junction box where signal system fiber-optic cable is stored, except for locations where the splice enclosures for the signal system cable and the IS Department cable are coincident, including locations designated as future splice points where 50 feet of spare cable is stored initially. At such coincident splice locations, store for future splicing or splice the IS Department cable in a separate, "IS cable only" junction box installed next to the signal system junction box in accordance with the Special Detail in the Plans.

If a blockage is encountered when attempting to install a communications cable inside an existing conduit in accordance with the Plans, use compressed air, water jetting, rod and mandrel

or other Engineer-approved method to clear the obstruction or blockage in the existing underground conduit. Once obstruction/blockage has been substantially cleared, draw a mandrel through the conduit followed by a swab to clean out any remaining materials which may cause cable abrasions. Use a mandrel constructed of aluminum or stainless steel that is at least 6 inches in length and has an outer diameter that is approximately 1/2 inch less than the inside diameter of the conduit being cleared.

(D) Indoor Installation

Install the fiber-optic cable in risers and conduit between the building entrance and the enclosed communications racks being installed inside the TMC using cable pulling lubricants recommended by the fiber-optic cable manufacturer as well as the flexible fabric multi-celled innerduct installed by the Phase A Contractor in the TMC risers and conduit. Obtain approval of cable pulling lubricant and method of pulling before installing the fiber-optic cable.

Use a breakaway swivel so as not to exceed 80% of the maximum allowable pulling tension specified by the cable's manufacturer if cable is pulled by mechanical means. Keep tension on cable reel and pulling line at start of each pull. Do not release tension if pulling operation is halted. Restart pulling operation by gradually increasing tension until cable is in motion.

For pulling cable through junction boxes and cabinets, feed cable by manually rotating the reel. Do not pull cable through cabinets, junction boxes, handholds, or openings in conduit unless otherwise approved. Inside all junction boxes and cabinets, install communications cable identification markers on each communications cable entering the junction box.

Store 30 feet of each fiber-optic cable inside the enclosed communications racks inside the TMC after terminating the cables in the rack-mounted splice centers housed therein.

(E) Installation of Drop Cable

Verify the length of drop cable needed, including slack, to reach from termination point to termination point.

At aerial splice enclosures, install the aerial splice enclosure and corresponding cable storage guide 50 feet apart and store between the splice enclosure and corresponding cable storage guide 50 feet of slack cable for each cable entering and exiting the splice enclosure.

At below ground splice enclosures, coil 50 feet of slack cable for each cable entering and exiting the splice enclosure in the manhole or junction box where enclosure is located. Coil and store any drop cable in excess of what is needed for storage in the manhole or junction box in the base of the equipment cabinet. Where fiber-optic cables are installed but not immediately spliced, store 50 feet of drop cable and 50 feet of fiber-optic trunk cable inside the manhole or junction box to facilitate subsequent splicing in the splice enclosure. Cap and seal ends of cables that have yet to be spliced or terminated with a waterproof heat-shrink cap/seal as approved by the Engineer.

At the equipment cabinet end of drop cable, terminate all fibers by splicing them to factory-assembled SMFO pigtails with LC connectors and connecting the pigtails to the connector panel in the rack-mounted interconnect center. Label all connectors, pigtails and the connector panel. At the aerial or underground splice location, cap off all unused fibers and label to correspond with the connector panel. After termination, coil and store in the base of the equipment cabinet 20 feet of drop cable plus any additional drop cable in excess of what is needed for overhead storage.

Where the Plans call for a fiber-optic drop cable to be installed in an existing riser, remove all existing cables from the riser and remove the existing weatherhead, sealing bushing or heat shrink tubing. Install the new fiber-optic drop cable in the existing riser and install new heat shrink tubing at the top of the existing riser using a heat shrink tubing retrofit kit. If the riser contains existing fiber-optic communications cable, carefully remove the fiber-optic cable from the riser so as not to violate its minimum bending radius or otherwise damage the cable. Temporarily coil and store the existing fiber-optic cable overhead in a manner approved by the Engineer until the new drop cable can be spliced into the existing cable in an aerial splice enclosure. Once splicing has been completed, furnish and install fiber-optic cable storage guides and permanently store all remaining spare cable.

Using an OTDR, test the end-to-end connectivity of the drop cable from patch panel installed inside the signal or CCTV cabinet to the adjacent managed Ethernet switches. Comply with the OTDR testing and reporting requirements of the “Fiber-Optic Splice Centers” section of these Project Special Provisions when testing drop cable.

(F) Aerial Cable Protector

Where shown in Plans and as directed by the Engineer, at locations where aerial fiber-optic communications cables are subject to damage by squirrels or from tree limb abrasion, install cable protectors over the fiber-optic cable that are of sufficient length to protect the cable from the potential threat as directed by the Engineer. Do not install aerial cable protectors at any locations without the prior approval of the Engineer. Do not install cable protectors for lengths of application that are shorter or longer than approved/directed by the Engineer.

(G) Pull Back and Reinstall Existing Communications Cable

Where shown in Plans (see Sheet CL B-309) and as directed by the Engineer, carefully pull back (i.e., unlash and uninstall) the existing 72-fiber communications cable along the west side of Church Street from Cemetery Street to the junction box in the sidewalk just north of the Business 40 bridge. Prior to unlash the existing cable and pulling it back, test the existing 72-fiber cable in the presence of the Engineer using an OTDR to verify that all fibers are operational and in good condition. Promptly report any failures or defects in the existing cable to the Engineer prior to uninstalling the cable to avoid being held responsible for existing damage to or defects in the existing cable.

Upon completion of cable testing observed by the Engineer, carefully unlash and remove (pull back) the existing 72-fiber cable from existing Splice S 32-3 to the junction box north. Temporarily store the cable for later reinstallation by collecting it on a cable reel placed adjacent to the existing junction box. Surround the cable reel and open junction box with orange plastic construction fencing or other Engineer-approved method to protect pedestrians from this hazard. After removal of the existing copper communications, 2-inch riser, 2-inch to 4-inch conduit reducer and splice box from pole, install new 4-inch riser on pole (see “Riser Assemblies” section of these Project Special Provisions). Following installation of the new 4-inch riser, carefully re-install the existing 72-fiber cable along its original route from the junction box back to Splice S 32-3. Comply with the construction methods in the preceding subsections above when re-installing the cable in the replacement riser and along the original aerial route. Re-store slack 72-fiber cable on existing cable storage guides in aerial span above Business 40 bridge. Re-test the fiber-optic cable using an OTDR in the presence of the Engineer to demonstrate that

cable incurred no damage while being pulled back, temporarily stored and subsequently reinstalled.

The Contractor, at his own expense, will be responsible for the replacement of the entire length of the 72-fiber cable between Splice S 32-3 and the Bryce Stuart Building if any damage is done to the existing 72-fiber during the work done to pull back, store and reinstall the existing cable.

14.4. MEASUREMENT AND PAYMENT

Communications cable (____-fiber) will be measured and paid as the actual linear feet of fiber-optic cable of each fiber count furnished, installed, and accepted according to the following conditions: 80% of the payment will be made upon acceptance of the installed cable and the remaining 20% of the payment will be made following splicing, testing and final acceptance (including completion of the 60-day Observation Period). Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. Terminate all fibers before determining length of cable run.

IS Communications cable (____-fiber) will be measured and paid as the actual linear feet of fiber-optic cable of each fiber count exclusively for use by the City IS Department that are furnished, installed, and accepted according to the following conditions: 80% of the payment will be made upon acceptance of the installed cable and the remaining 20% of the payment will be made following splicing, testing and final acceptance (including completion of the 60-day Observation Period). Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. Terminate all fibers before determining length of cable run.

Drop cable will be measured and paid as the actual linear feet of fiber-optic drop cable comprise of a minimum of 6 fibers that are furnished, installed, and accepted according to the following conditions: 80% of the payment will be made upon acceptance of the installed and spliced drop cable, and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day Observation Period).

Aerial cable protector will be measured and paid as the actual linear feet of aerial cable protector furnished, installed, and accepted. No measurement and payment will be made of any aerial cable protector installed without the prior approval of the Engineer or for cable protector installed at locations or for lengths of application other than approved or directed by the Engineer.

Pull back and reinstall communications cable will be measured and paid as the actual linear feet of existing fiber-optic communications cable tested, pulled back, temporarily stored, then re-installed, re-tested and accepted. Measurement will be made by calculating the difference in length markings located on outer jacket from end of the cable at the existing splice enclosure to the point of entry into the underground duct system in the junction box. No measurement and payment will be made of temporarily storing the existing cable on cable reel, measures to protect pedestrians from the cable reel and open junction box and reinstalling the existing fiber on existing cable storage guides as these will be considered incidental to pulling back and reinstalling the existing communications cable.. The disconnecting (i.e., unsplicing) of the cable from the existing splice and the resplicing of the cable at the existing splice enclosure following reinstallation of the cable will be measured and paid for in accordance with the "Fiber-Optic

Splice Centers” section of these Project Special Provisions. The 4-inch riser with seal will be measured and paid for in accordance with the “Riser Assemblies” section of these Project Special Provisions.

No measurement will be made for terminating, splicing, and testing fiber-optic cable, communications cable identification markers, fiber-optic cable storage guides, SMFO jumpers and pigtails, mechanical sealing devices and conduit seals/sealing putty, as these will be considered incidental to the installation of fiber-optic cable and drop cables.

No measurement will be made of removing existing cables from existing risers as such removals will be considered incidental to furnishing and installing the fiber-optic cables and drop cables.

No measurement will be made of clearing a blockage or obstruction from an existing conduit necessary to install a communications cable in an existing underground conduit as such work will be considered incidental to installation of the communications cable.

No measurement will be made of removing existing weatherheads, sealing bushings, heat shrink tubing and riser caps to install new fiber-optic drop cables in existing risers as such removals will be considered incidental to furnishing and installing heat shrink tubing retrofit kits. Heat shrink tubing retrofit kits will be measured and paid for in accordance with the “Riser Assemblies” section of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
Communications Cable (24-Fiber)	Linear Foot
Communications Cable (36-Fiber)	Linear Foot
Communications Cable (48-Fiber)	Linear Foot
Communications Cable (72-Fiber)	Linear Foot
IS Communications Cable (24-Fiber)	Linear Foot
IS Communications Cable (48-Fiber)	Linear Foot
IS Communications Cable (96-Fiber)	Linear Foot
Drop Cable	Linear Foot
Aerial Cable Protector	Linear Feet
Pull Back and Reinstall Communications Cable	Linear Feet

15. FIBER-OPTIC SPLICE CENTERS

15.1. DESCRIPTION

Furnish and install fiber-optic interconnect centers, fiber-optic splice enclosures, and all necessary hardware.

Modify existing fiber-optic interconnect centers and/or splice enclosures as shown in the plans. Refer to manufacturer's recommendations for opening, modifying and re-sealing the existing fiber-optic interconnect center and/or fiber-optic splice enclosure.

15.2. MATERIALS

Furnish material, equipment, and hardware furnished under this section that is pre-approved on the ITS and Signals QPL.

(A) Interconnect Center

Furnish compact, modular interconnect centers designed to mount inside equipment cabinets. Design and size interconnect centers to accommodate all fibers entering cabinets. Provide interconnect centers for controller cabinets and CCTV cabinets that are one rack unit (RU) high.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Design and size the splice trays to be dielectric, to accommodate all fibers entering splice tray, and to provide sufficient space to prevent microbending of optical fibers. Provide connector panels with LC-type connectors.

Furnish SMFO pigtails with each interconnect center. Provide pigtails are a maximum of 6 feet in length with a factory-assembled LC connectors on one end. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled.

For connecting Ethernet edge switches to the interconnect center patch panels, furnish SMFO jumpers that are a minimum of 3 feet in length with factory-assembled LC connectors on one end (i.e., the interconnect center end) and, on the other end, factory-assembled connectors of the same type provided on the Ethernet edge switch. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

(B) Hub Splice Center

Furnish a separate rack-mounted fiber-optic splice housing for each fiber-optic communications cable entering and terminated inside each hub cabinet. (Note: Where a given cable is severed and both ends of the cable are pulled into the hub cabinet for splicing, each cable end is considered a separate cable requiring a separate splice housing.) Provide splice centers sized to accommodate fusion splicing of all fibers in the designated cable to pigtails in splice trays housed inside the splice center and terminating those pigtails on the splice center's connector panels (i.e., patch panels) as shown in the Plans. Equip each splice center with LC-compatible connector panels with 12 connectors on each panel (arranged in either a simplex or duplex arrangement) to terminate fibers from each buffer tube in the incoming cable on a unique connector panel (i.e., one connector panel per buffer tube).

Provide a splice housing that is either a one-piece unit designed to house the connector panels as well as the splice trays or a two-part unit comprised of a rack-mountable connector housing (i.e., distribution panel) and a matching splice housing. For a two-part unit, furnish a

connector housing and splice housing made by the same manufacturer and designed by the manufacturer to work together as a unit. Provide a splice center designed to house a separate splice tray for each buffer tube in the cable and to store buffer tubes following splicing. The splice center, whether a single unit or a two-piece unit, shall occupy no more than four rack units. Provide splice centers that have connector panels on the front of the unit that are protected by a transparent door or shield constructed of rigid, durable plastic or acrylic material.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Design and size the splice trays to be dielectric, to accommodate all fibers entering splice tray, and to provide sufficient space to prevent microbending of optical fibers.

Furnish SMFO pigtails with each hub splice center. Provide pigtails are a maximum of 6 feet in length with factory-assembled LC connectors. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled. Factory pre-terminated and pre-assembled pigtailed connector panels may be furnished in lieu pigtails pre-assembled with LC connectors, subject to the Engineer's approval.

For connecting managed Ethernet switches to the hub splice center patch panels, furnish SMFO jumpers that are a minimum of 3 feet in length with factory-assembled LC connectors one end (i.e., the interconnect center end) and, on the other end, factory-assembled connectors of the same type provided on the Ethernet edge switch. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which they are to be coupled.

Provide all hardware needed to install these units in the rack inside the hub cabinet.

(C) Splice Enclosure

Furnish splice enclosures that are re-enterable using a mechanical dome-to-base seal with a flash test valve, and are impervious to the entry of foreign material (water, dust, etc.). Ensure enclosures are manufactured in such a manner to be suitable for aerial, pedestal, buried, junction box, and manhole installation.

Provide enclosures with a minimum of one oversized oval port that will accept two cables and with a minimum of four round ports (for single cables) that will accommodate all cables entering enclosure. Provide heat shrink cable shields with enclosure to ensure weather-tight seal where each cable enters enclosure.

Within enclosures, provide enough hinged mountable splice trays to store the number of splices required, plus the capacity to house six additional splices. Provide a fiber containment basket for storage of loose buffer tubes expressed (i.e., uncut and unspliced) through the enclosure. Ensure enclosures allow sufficient space to prevent microbending of buffer tubes when coiled.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray. Provide splice trays that are dielectric.

(D) Existing Splice Enclosures

When adding a new fiber-optic cable to an existing splice enclosure or otherwise modifying an existing splice inside an existing splice enclosure, furnish heat shrink cable shields that are compatible with the enclosure to ensure weather-tight seal where each new cable enters the existing enclosure and to replace any existing seals that are broken or removed while modifying the splice.

For modifications to the existing splices housed in Multilink® Starfighter™ 4000-D dome splice enclosures installed on State Project U-2826B, furnish cable addition kits and multi-port grommet inserts compatible with the existing 4000-D enclosure as needed to enable insertion of an additional fiber-optic cable(s) into the existing splice enclosure as shown on the Plans. Provide splice trays and splice protectors as needed that are compatible with the existing 4000-D splice enclosure to accommodate splicing of the new fiber-optic cables to the existing fiber-optic cables inside the existing splice enclosure.

Provide splice trays that hold, protect, organize optical fibers, and secure fibers inside splice tray for new or modified splices inside existing splice enclosures and interconnect centers. Provide splice trays that are dielectric and that are compatible with the existing splice enclosure or interconnect center. Provide splice trays that are sized to accommodate all fibers entering the splice tray and to provide sufficient space to prevent microbending of optical fibers.

Furnish SMFO pigtails for terminating new fibers on the connector panel of an existing interconnect center. Provide pigtails containing connector panels that are a maximum of 6 feet in length with a factory-assembled LC connector on one end. Ensure SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled. Provide connector panels with LC-type connectors that are compatible with the existing interconnect center.

For connecting Ethernet edge switches to the interconnect center patch panel, furnish SMFO jumpers that are a minimum of 3 feet in length with factory-assembled LC connectors one end (i.e., the interconnect center end) and, on the other end, factory-assembled connectors of the same type provided on the Ethernet edge switch. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

15.3. CONSTRUCTION METHODS

(A) General (Workmanship Identification Information)

Include on the cover of each splice tray in a legible format the following workmanship identification information:

- Splice location reference # or identification information (e.g., 09-xxxx tray 1 of 3, 09-xxxx tray 2 of 3, etc.);
- Date the splice was made;
- Name of company that performed the splicing;
- Name of person who performed the splicing.

(B) Workmanship

Upon cutting the cable and removing the outer jacketing material down to the individual buffer tubes, secure the central strength member to the enclosure so that no tensile force is applied to the fibers. Secure the individual buffer tubes to the splice trays by a method recommended by the manufacturer. Determine the length of each buffer tube needed to ensure that the buffer tube can be looped a minimum of two times around the inside of the splice tray. Upon determining the length of buffer tube needed, remove the buffer tube to expose the individual fibers for fusion splicing. Adjust individual fiber lengths as necessary to ensure that once the fusion splicing process is completed the finished splices will align with the “splice

block organizer” supplied within the splice tray. Ensure the splice block organizer has individual fusion splice space holders for each fiber splice.

While prepping the individual fibers for splicing, install the heat shrink protective tube over the fiber and then perform the splicing operations, following the manufacturer’s instructions. Verify that the newly formed splice does not exceed 0.05 dB of attenuation. If the attenuation is more than 0.05 dB, then remake the splice until it meets the 0.05 dB or less requirement. Finish the splicing operation by sliding the heat shrink tube over the splice and applying heat to active the heat shrink tubing. Secure the finished splice in the splice block organizer. Ensure each splice is properly secured in a space holder in the splice block organizer. Multiple splices secured to the same space holder are unacceptable.

Ensure all buffer tubes are contained within splice trays so that no bare fibers are outside of the tray. Do not damage the fibers are damaged or violate the minimum bend radius of the fiber.

Prior to installing the cover over the splice tray and placing it in its final resting location, take a MANDATORY digital photograph of the splice tray that shows the final workmanship. Ensure that the photograph shows the “Workmanship Identification Information” as well as the workmanship associated with installing and terminating the fiber. Include digital copies of each photograph on a compact disc as part of the OTDR Test Results submittal.

(C) Termination and Splicing within Interconnect Centers & Hub Splice Centers

Terminate and fusion splice all fibers as shown in the Plans.

Label all fiber-optic connectors, whether on jumpers, connector panels, or other equipment, to prevent improper connection. Obtain approval of fiber-optic connector labeling method.

For all fibers designated for termination to a connector panel within an interconnect center or hub splice center, fusion splice the fibers to pigtails.

For all fibers designated to pass through interconnect center, neatly coil and express the fibers without cutting. For all buffer tubes designated to pass through interconnect center, neatly coil excess tubing inside interconnect center.

At locations on Hanes Mill Road, existing fiber-optic communications cable is terminated and spliced inside the existing NEMA signal controller cabinets that are designated to be replaced with new 2070L controllers and 332 cabinets. As shown on the Plans, replace these existing fiber-optic interconnect centers with new rack-mounted interconnect centers in conjunction with the controller and cabinet change-outs at these locations. Re-splice the existing fiber-optic cables and terminate the designated fibers on new SMFO pigtails with LC connectors inside the new rack-mounted interconnect center and connect the pigtails to the appropriate connectors on the patch panel of the new interconnect center. Furnish and install new fiber-optic jumpers between appropriate connectors on the interconnect center patch panel and the Ethernet edge switch. Do not reuse the existing interconnect centers and splice trays.

(D) Interconnect Centers in Controller and CCTV Cabinets

Install interconnect centers with connector panels, splice trays, storage for slack cable or fibers, mounting and strain relief hardware, and all necessary hardware. Mount the interconnect center in the rack inside the controller cabinet or CCTV cabinet at the location indicated in the Plans. Install SMFO jumpers between the appropriate connectors on the interconnect center and the edge switch.

(E) Hub Splice Center

Install hub splice centers with connector panels, splice trays, storage for slack cable or fibers, mounting and strain relief hardware, and all necessary hardware inside existing hub cabinets installed by the Phase A contractor where shown in the Plans. Mount hub splice centers below the Phase A hub splice centers installed by the Phase A contractor in the rack inside the existing communications hub cabinet as shown in the Plans.

Install new fiber-optic cable in existing spare conduits installed by the Phase A contractor. and terminate new fiber-optic cable in rack-mounted hub splice centers as shown in the Plans.

Install SMFO jumpers between the appropriate connectors on the connector panels of the splice center and the managed Ethernet switch inside the hub cabinet.

(F) Termination and Splicing within Splice Enclosure

Install splice enclosures with splice trays, basket containment assemblies, racking for slack cable or fibers, mounting and strain relief hardware, and all other necessary hardware. Install separate splice enclosures for the signal system fiber-optic cables and the IS Department fiber-optic cables. Do not splice IS Department cables and signal system cables within the same splice enclosure.

Do not install splice enclosures for IS Department fiber-optic cable in junction boxes that are designated to house, either now or at some later date, splice enclosures for the signal system fiber-optic cable. At such locations, splice the IS Department fiber-optic cable in an “IS cable only” junction box installed next to the signal system cable junction box.

Do not install aerial splice enclosures and storage guides over roadways or driveways.

Fusion splice all fibers including fibers designated to be coupled with fibers from a drop cable. For all fibers designated to pass through splice enclosure, coil and express the fibers without cutting.

For all buffer tubes designated to pass through splice enclosure, neatly coil excess tubing inside basket provided with enclosure.

Label all fiber-optic splices. Obtain approval of fiber-optic connector labeling method.

Install heat shrink cable shields using methods recommended by the manufacturer of the enclosure. Perform a pressurization flash test on enclosure in accordance with manufacturer’s recommended procedures at the conclusion of splicing procedure and before final placement of enclosure.

For aerial installations, secure enclosures to messenger cable using manufacturer supplied hardware. Secure SMFO cable and drop cables to snowshoes.

Install enclosures with enough slack cable to allow enclosure to be lowered to ground level and extended into a splicing vehicle.

For underground, manhole and junction box facility installations, place the enclosure along with required spare cables in the facility in a neat and workmanship like manner. Install underground splice enclosures only in special-sized junction boxes unless the Plans indicate otherwise or the Engineer approves otherwise.

(G) Modify Existing Splice

Modify existing fiber-optic interconnect centers and/or splice enclosures as shown in the Plans. Terminate and splice new fibers and re-splice existing fibers within existing interconnect centers and splice enclosures as shown on the Plans. Use existing splice trays, where available, inside the splice center and install additional patch panels, splice trays and pigtails where necessary and fusion splice fiber connections as required by the Plans, then perform OTDR testing. Provide new splice trays that are compatible with the existing splice enclosures when previously unspliced buffer tubes are spliced. Install new fiber-optic jumpers and make connections to Ethernet edge switches and managed Ethernet switches, other equipment and/or patch panels as necessary. Comply with all requirements of “Interconnect Center” and “Splice Enclosure” subsections above.

Install new cable addition kit and new multi-port grommet inserts in the existing Multilink® Starfighter™ 4000-D dome splice enclosures installed under State Project U-2826B as required to insert a new fiber-optic cable(s) into the existing splice enclosure as shown on the Plans. Install additional splice trays as necessary to splice the new cable(s) to the existing NCDOT fiber-optic cable as shown in the Plans. Insert the new fiber-optic cable(s) through the new grommet insert and fusion splice fibers in the new cable to designated fibers in the existing cables as shown in the Plans.

Install new fiber-optic jumpers and make connections to Ethernet edge switches and managed Ethernet switches, other equipment and/or patch panels as necessary. Comply with all requirements of the “Interconnect Center” and “Splice Enclosure” subsections above.

Relocate existing aerial splice enclosure and corresponding existing fiber-optic cable storage rack(s) as shown on the Plans. Unlash existing, reroute and relash existing fiber-optic cable as required to relocate the existing aerial splice enclosure.

(H) Testing

Provide written notification to the Engineer a minimum of 10 working days before beginning the OTDR tests.

After splicing is completed, perform bi-directional OTDR tests on each fiber, including unused fibers. Install a 1,000-foot pre-tested launch cable between the OTDR and fiber-optic cable to be tested and a 1,000-foot pre-tested destination cable on the end of the fiber-optic cable to be tested. Ensure each launch cable has been tested and is compatible with the fiber-optic cable being installed. Provide the Engineer with test results of the launch cable before use. Re-test or replace launch cable at the Engineer’s request.

Ensure fusion splice losses do not exceed 0.05 dB and connectors have a loss of 0.5 dB or less. If any fiber exceeds maximum allowable attenuation or if fiber-optic properties of the cable have been impaired, take appropriate actions up to and including replacement of the fiber-optic cable. Corrective action will be at no additional cost to the Department.

Clearly label each OTDR trace identifying a starting and ending point for all fibers being tested. Record the attenuation level of each fiber and clearly indicate OTDR trace results in report format. Furnish two hard copies of each of the OTDR trace results and electronic copies of all trace results along with digital photographs showing workmanship for each splice on a compact disc. Furnish the manufacturer’s make, model number and software version of the OTDR used for testing.

Provide the Engineer with two copies of the software needed to view the OTDR traces electronically.

15.4. MEASUREMENT AND PAYMENT

Interconnect center will be measured and paid as the actual number of fiber-optic interconnect centers furnished, installed, and accepted according to following conditions: 80% of the payment will be made upon acceptance of the installed interconnect centers and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day observation period).

Hub splice center (___fiber) will be measured and paid as the actual number of fiber-optic splice centers of each fiber count furnished, installed in communications hub cabinets, and accepted according to following conditions: 80% of the payment will be made upon acceptance of the installed hub splice centers and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day observation period).

Splice enclosure will be measured and paid as the actual number of fiber-optic splice enclosures that are furnished, installed, and accepted, regardless of installation location (i.e., aerial, underground, manhole, or junction box), according to following conditions: 80% of the payment will be made upon acceptance of the installed splice enclosures and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day Observation Period).

IS Splice enclosure will be measured and paid as the actual number of fiber-optic splice enclosures used to splice IS Department cables that are furnished, installed, and accepted, regardless of installation location (i.e., aerial, underground, manhole, or junction box), according to following conditions: 80% of the payment will be made upon acceptance of the installed splice enclosures and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day Observation Period).

Modify existing splice will be measured and paid as the actual number of existing fiber-optic splice enclosures, interconnect centers and splice centers where existing splices are reconfigured, new fibers are spliced to existing fibers and new fibers are terminated in the existing splice center. Measurement will be made per existing splice enclosure without regard to type and location of splice enclosure and without regard to the number of splices and terminations required at each location. Payment for modify existing splice will be full compensation for all materials and work required to modify the existing splices in accordance with the plans. No measurement will be made of cable addition kits, grommet inserts, heat shrink tubing, splice trays and splice protectors as such work will be considered incidental to modifying the existing splice. No measurement will be made of relocating an existing aerial splice enclosure and associated fiber-optic cable storage guide(s) as such work will be considered incidental to modifying the existing splice.

Where the Plans call for pulling back and reinstalling an existing fiber-optic communications cable, the temporary disconnecting (unsplicing) of the existing cable from an existing splice enclosure and the subsequent resplicing of the existing cable in the same existing splice enclosure will be measured and paid for as a single modify existing splice. No separate measurement will be made for the initial work to disconnect the existing cable from the existing splice.

IS modify existing splice will be measured and paid as the actual number of existing fiber-optic splice enclosures, interconnect centers and splice centers where existing splices are reconfigured, new fibers are spliced to existing fibers and new fibers are terminated in the existing splice center for IS Department use. Measurement will be made per existing splice enclosure without regard to type and location of splice enclosure and without regard to the number of splices and terminations required at each location. Payment for IS modify splice will be full compensation for all materials and work required to modify the existing splices in accordance with the plans. No measurement will be made of cable addition kits, grommet inserts, heat shrink tubing, splice trays and splice protectors as such work will be considered incidental to modifying the existing splice. No measurement will be made of relocating an existing aerial splice enclosure and associated fiber-optic cable storage guide(s) as such work will be considered incidental to modifying the existing splice.

No measurement will be made of fusion splices, splice trays, splice protectors, pigtails, jumpers, connector panels, labeling, photographs, testing and corrective actions, repairs and replacements needed for exceeding the maximum allowable attenuation or other defects, as these will be considered incidental to furnishing and installing fiber-optic interconnect centers and splice enclosures, and modifying existing splices.

No measurement will be made for removal of existing interconnect centers as such work will be considered incidental to furnishing and installing fiber-optic interconnect centers.

Payment will be made under:

Pay Item	Pay Unit
Interconnect Center	Each
Hub Splice Center (36-Fiber)	Each
Splice Enclosure	Each
IS Splice Enclosure	Each
Modify Existing Splice	Each
IS Modify Existing Splice	Each

16. CABLE MARKERS

16.1. DESCRIPTION

Furnish and install delineator markers (tubular marker posts), joint-use utility pole tags/decals, equipment cabinet decals, and curb/sidewalk markers/medallions with all necessary hardware and adhesives to warn of buried fiber-optic communications cable.

16.2. MATERIALS

(A) Delineator Markers

Furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Furnish delineator markers, also referred to as tubular marker posts that are approximately 6 feet long and constructed of Type III, high-density polyethylene (HDPE) material. Provide delineator assemblies that are ultraviolet stabilized to help prevent components from color fading, warping, absorbing water, and deterioration with prolonged exposure to the elements. Provide delineators designed to self-erect after being knocked down or pushed over. Provide orange delineator posts.

Provide text, including City contact number, hot stamped in black on a yellow reflective background material that will not fade or deteriorate over time. Provide delineator markers with nominal message height of 15" that contain the following text visible from all directions approaching the assembly:

W A R N I N G	F I B E R	O P T I C	C A B L E S
BEFORE EXCAVATING OR IN AN EMERGENCY CALL (336) 727-8000			
CITY OF WINSTON-SALEM TRAFFIC SIGNAL SYSTEM			

(B) Cabinet Decals

Furnish pressure-sensitive, waterproof decals to apply to the exterior surface of field equipment cabinets. Construct decals of durable vinyl or plastic that is chemical resistant and resists tearing and shrinking. Screen print text and symbols on decal using UV-stable, fade-resistant, waterproof ink. Ensure that decal will adhere permanently to a milled aluminum surface under a variety of weather conditions and a wide range of air temperatures (0° F to 150° F minimum). Provide a decal that can be applied without special surface preparation.

Provide cabinet decals that contain the text and symbols, text emphasis and text proportions depicted in the following examples format:



Overall Decal Dimensions:

6"(w) x 4"(h) minimum,

7"(w) x 5"(h) maximum

Text Height (min.):

1/2" for *WARNING*

3/8" for *BURIED FIBER-OPTIC CABLE*, and *CALL (336) 727-8000*,

1/4" for all other

Background Color: Yellow

Text Color: Black

Symbol Color: Black

Symbol Size: 1.5"- 2" DIA

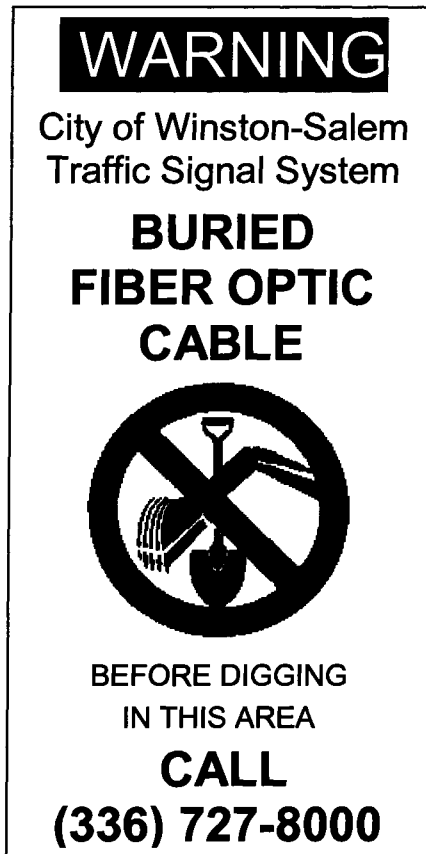
Submit sample of proposed cabinet decals to the Engineer for approval before installation. In lieu of designing a custom decal, the contractor may submit for the Engineer's approval a stock/standard decal format (i.e., off-the-shelf format) from the decal manufacturer that differs from the example format proposed above but that still embodies the content and intent conveyed by the example format.

(C) Utility Pole Signs

Furnish signs for installation on wood utility poles that are constructed of 40 mil aluminum or high-impact, UV-resistant plastic such as high impact polyolefin. Provide signs with rounded corners (0.25" max. radius) and that have pre-drilled/pre-punched fastener holes at the top and bottom edge of the sign and centered horizontally on the sign. Provide hot-dipped, galvanized wood screws or ring-shanked nails for attaching the sign to wood utility poles.

Ensure that background of sign is fade resistant. Screen print text and symbols on decal using UV-stable, fade-resistant, waterproof ink.

Provide utility pole signs that contain the text and symbols, text emphasis and text proportions depicted in the following examples format:



Overall Tag Dimensions: 3.5"(w) x 7"-12"(h)

Text Height (min.):

1/2" for *WARNING*;

3/8" for *BURIED FIBER-OPTIC CABLE*;

3/8" for *CALL* and *(336) 727-8000*;

1/4" for all other

Text Color: Black

Background Color: Yellow

Symbol Color: Black

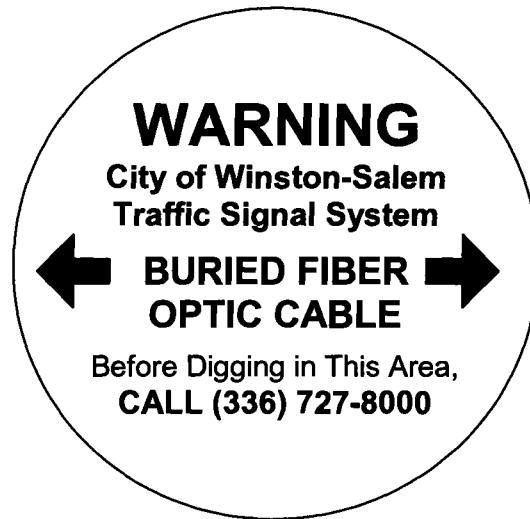
Symbol Size: 2" Diameter

Submit sample of proposed pole sign to the Engineer for approval before installation. In lieu of designing a custom sign, the contractor may submit for the Engineer's approval a stock/standard sign format (i.e., off-the-shelf format) from the sign manufacturer that differs from the example format proposed above but that still embodies the content and intent conveyed by the example format.

(D) Curb Markers

Furnish durable, non-reflective curb markers fabricated from UV-resistant, non-metallic materials other than ceramic material, such as polyurethane or high impact polypropylene or other high impact plastic. Provide curb markers that are designed for outdoor use, that are waterproof, that resist fading, that are temperature stable and that resist chemical and mechanical abrasion. Furnish curb markers with a quick-setting adhesive to permanently adhere curb markers to Portland cement concrete and granite as well as other non-porous hard surfaces. Do not provide markers that require intrusive fasteners to secure the marker to the surface. Provide curb markers that do not require special tools such as torches, tamping machines or drills or hardware or special surface preparation for installation. Furnish curb markers from a manufacturer that has been producing such curb markers for a minimum of 10 consecutive years. Provide curb markers with a manufacturer's warranty of 10 years or more.

For general marking of underground cable routes in accordance with this Project Special Provision, provide curb markers that contain the text and symbols, text emphasis and text proportions depicted in the following example format:



Overall Curb Marker Dimensions: 2.5" diameter

Text: Black

Background: Orange

Submit samples of proposed curb marker to the Engineer for approval before installation. In lieu of designing a custom curb marker, the Contractor may submit for the Engineer's approval a stock/standard curb marker format (i.e., off-the-shelf format) from the curb marker manufacturer that differs from the example format proposed above but that still embodies the content and intent conveyed by the example format.

Have the curb marker manufacturer provide a list of references along with contract information for at least five different municipal government agencies and/or state departments of transportation that have installed the proposed manufacturer's curb marker and can attest to the performance of the manufacturer's curb marker over a continuous period of no less than seven years. Submit these references to the Engineer for review in conjunction with submission of the sample.

16.3. CONSTRUCTION METHODS

(A) Cable Markers in Historic Districts

Obtain the Engineer's approval prior to installing any cable markers (i.e., cabinet decals, utility pole signs/decals, and curb markers) within historic districts. The Engineer may modify the application criteria described herein or delete the requirement for some or all cable markers based upon the requirements of the particular historic district.

(B) Delineator Markers

Submit sample of proposed delineator markers for approval before installation.

Install delineator markers using a method that firmly and securely anchors delineator marker in the ground to prohibit twisting and easy removal.

Install delineator markers at locations specified on the plans. Do not install delineator markers at locations other than those specified in the Plans without the prior approval of the Engineer.

(C) Cabinet Decals

Clean the surface to which the decal will be applied using a mild cleaner that will not damage, deface or discolor the milled aluminum finish of the equipment cabinet. Ensure surface is thoroughly dry before applying decal. Observe any application temperature restrictions specified by the manufacturer when applying the decals.

Apply decal to two sides of the cabinet. Do not apply to cabinet doors or over any cabinet vents/louvers. Place the decals in the top right corner.

Do not apply decals to cabinets where cable is fed to the cabinet from aerial drop on a nearby pole unless the Engineer directs otherwise. Apply decals to cabinet where fiber-optic cable is routed to and/or from the cabinet in an underground conduit run other than the stub-out from a nearby riser that conveys and aerial drop cable.

(D) Pole Signs

Using the hot-dipped galvanized, ring-shanked nails or wood screws, mount the pole sign on the side of pole facing the adjacent street at a height of approximately 5 feet above the ground. Secure the sign to the pole with at least one fastener at the top of the sign and one at the bottom through the pre-drilled/pre-punched fastener holes provided. Do not field-drill or field-punch signs. Do not install over cables, ground wires, other pole signs, pole tags or pole birthmark (embossed class and length). Mount sign to wood poles only; do not attach sign to metal poles.

Install signs on pole line that is parallel to and adjacent to the underground cable route. Install on each pole in the line along the route, unless otherwise approved by the Engineer. When two or more poles are located in close proximity to one another, install the sign on only one of the poles as approved by the Engineer.

(E) Curb Markers

Install curb markers along curbed streets where the presence of underground fiber-optic communications cable cannot be marked otherwise by placing signs or decals on utility poles. Examples could include but are not limited to: streetscaped areas, residential neighborhoods, areas without utility poles and downtown areas.

Install the curb markers at the beginning and end of the underground run, at the beginning, and end of each street block along the underground run, at the midpoint of each street block that is approximately 200-500 feet long, and at intervals of approximately 200 feet elsewhere along the underground run. Premark the proposed locations of the curb markers with 2" x 3" wire flags and obtain the Engineer's approval of the proposed locations prior to installing the curb markers. Remove wire flags immediately following installation and acceptance of curb markers. Do not mark fiber-optic drop cable that originates at an aerial splice enclosure and travels a short distance underground between the riser pole and the equipment cabinet, unless otherwise directed by the Engineer. Do not install any curb markers without the Engineer's prior approval.

Clean surface to which the curb marker will be applied. Make sure application surface is flat, dry, and free of any loose debris or cracks. Apply adhesive to back side of curb marker in accordance with manufacturer's instructions. When installing on curb, position marker on top of curb, not on the face of the curb, and center the marker on the top of the curb. Align the curb marker so that arrows (if any) are parallel to underground cable run and so that text can be read from the adjacent street. Apply the curb marker to the application surface and press firmly. Ensure that entire edge around perimeter of marker is sealed to the application surface.

Where underground conduit runs and associated junction boxes are within 10 feet of the adjacent curb and junction boxes are visible from the curb (e.g., in sidewalk, between curb and sidewalk, at back of sidewalk, etc.), install the curb markers on the lids of each oversized and special-sized junction box in lieu of installing them on the curb unless directed otherwise by the Engineer. Where the junction boxes are greater than 10 feet from the curb, install curb markers on the lids of each oversized and special-sized junction box in addition to installing them on the curb unless directed otherwise by the Engineer.

Where there is no curb and there are no poles on which to install pole tags or decals to mark the underground run, install curb markers on the lids of each oversized and special-sized junction box.

16.4. MEASUREMENT AND PAYMENT

Delineator marker will be measured and paid for as the actual number of delineator markers (tubular marker posts) furnished, installed, and accepted.

No measurement will be made of utility pole signs, cabinet decals, curb markers and curb marker adhesive as they will be considered incidental to furnishing and installing underground conduit.

Payment will be made under:

Pay Item	Pay Unit
Delineator Marker	Each

17. REMOVE EXISTING COMMUNICATIONS CABLE

17.1. DESCRIPTION

Remove existing communications cable. Remove existing communications cable splice boxes/cabinets and associated risers and in-ground junction boxes as designated in the Plans.

17.2. MATERIALS

Furnish rigid galvanized threaded pipe caps or rigid galvanized threaded pipe plugs to seal the ends of vertical conduits after “short risers” underneath pole-mounted cabinets are cutoff near ground level.

Furnish heavy duty, dielectric, heat shrink end caps designed to seal off and provide mechanical and mechanical protection to the ends of electrical and telecommunications cables. Provide end caps appropriated sized for the cables that they will be sealing.

17.3. CONSTRUCTION METHODS

(A) General

Do not reuse any removed communications cable, messenger cable, junction boxes, pole attachment hardware or abandoned risers on the project, unless otherwise specified.

(B) Removal of Aerial Communications Cable

Removal of existing aerial communications cable also includes removal and proper disposal of aerial splice enclosures, messenger cable and mounting hardware, associated guy assemblies, as well as abandoned risers, splice boxes and splice cabinets. Removal of guy assemblies includes the removal of guy anchors if not used by any other guy assembly.

Unless otherwise directed by the Engineer, remove and properly dispose of existing wood poles that are vacated upon removal of the existing communications cable (i.e., where the communications cable was the only attachment to the pole).

(C) Limited Removal of Downtown Underground Communications Cable

The existing twisted-pair copper wire communications cable between the TMC and the Bryce Stuart Building is installed in an existing underground duct system jointly used by the City and Time Warner Cable. Do not cut or remove this existing communications cable until all traffic signals have been successfully migrated over to the new Ethernet-based fiber-optic communications network. Contact the City of Winston-Salem Department of Transportation a minimum of two weeks prior to removing the existing twisted-pair cable for assistance in identifying and confirming the cable to be removed. Clearly label or tag the cable to be removed prior to removal. In addition, notify Time Warner and City’s IS Department a minimum of two weeks in advance of the cable removal to allow them to have representatives present during the removal process.

Subject to the Engineer’s approval, the existing communications cable being removed may be used as a pull line to install the new fiber-optic communications cable in its place in the existing duct system. Comply with the installation requirements in the “Fiber-Optic Cable” section of these Project Special Provisions when installing then new fiber-optic cable in the existing duct system. Exercise due care when removing the cable and provide all measures

necessary to prevent damage to the existing Time Warner and IS Department cables that reside in the existing duct system and junction boxes. The Contractor will be responsible for the cost of any repairs to the existing cables due to damage incurred during the process of removing the existing twisted-pair copper wire communications cable and installing the new fiber-optic communications cable.

Do not enter any Duke Energy manholes or other Duke Energy junction boxes, especially those that contain electrical power service cables.

(D) Removal of Underground Communications Cable Outside of Downtown

Removal of existing underground communications cable includes proper disposal of junction boxes, if required. Where junction boxes have been removed, backfill hole to 95% of surrounding density and finish level with surrounding ground.

When removing existing communications cable from an underground conduit that will be retained for future use, install a pull tape in the vacated underground conduit in conjunction with or immediately following removal of the existing cable. Seal the ends of the vacated conduit with an approved duct plug or duct and conduit sealer following installation of the pull tape.

When the Contractor has made reasonable attempts to remove an existing communications cable but is unable to do so as confirmed by the Engineer, carefully cut the existing cable close to the end of the conduit/duct, leaving just enough cable exposed to apply a heat shrink end cap over the end of the cable. Clean and prepare end of cable in accordance with heat shrink cable end cap manufacturer's instructions. Install a heat shrink cap appropriately sized for the cable being sealed over the end of the cable, then abandon the cable in the existing conduit/duct. Remove and dispose of the severed cable remnant.

At pole-mounted controller cabinets that have an existing short riser that conveys existing twisted-pair communications cable directly into the bottom of the cabinet from an underground conduit run and that short riser will not be retained for installation of a fiber-optic drop cable, remove the short riser and existing communications cable as follows:

1. Disconnect the twisted-pair communications cable inside the pole-mounted controller cabinet.
2. Disconnect the short riser from the bottom of the cabinet and then cut off the short riser and communications cable flush with the sidewalk below the cabinet or at least 6 inches below ground where there is no sidewalk.
3. Where there short riser is within sidewalk below the cabinet, leave just enough conduit exposed to install a rigid galvanized threaded pipe cap or rigid galvanized threaded pipe plug. Install a rigid galvanized threaded pipe cap or threaded pipe plug to seal the conduit

17.4. MEASUREMENT AND PAYMENT

Remove existing communications cable will be measured in horizontal linear feet of existing communications cable removed and accepted. Payment will be in linear feet. Sag, vertical segments, and spare segments of communications cable will not be paid for, as these distances will be considered incidental to the removal of existing communications cable.

No additional measurement will be made for multiple communications cables being removed from the same underground conduit or same pole. No payment will be made for communications cable that cannot be removed and is abandoned in place.

No measurement will be made of the removal of messenger cable, pole attachment hardware, guy assemblies, aerial splice enclosures, wood poles, stub poles, risers and in-ground junction boxes vacated upon removal of the existing communications cable, as these will be considered incidental to the removal of the existing communication cable.

No measurement will be for installing a pull tape inside of and sealing the ends of an existing conduit that will be retained for future use after removing an existing communications cable from that conduit as such work will be considered incidental to installation of new fiber-optic communications cable.

Remove splice cabinet will be measured as the actual existing communications cable splice boxes and cabinets successfully removed, disposed of and accepted without regard to the size or type of cabinet/box, mounting location or mounting method. Such payment includes removal and disposal of cabinet/box mounting brackets and hardware.

No measurement will be made of the removal of risers vacated upon removal of existing splice boxes/cabinets and associated communications cable and of threaded pipe caps and threaded pipe plugs installed on remainders of short risers cut-off flush with sidewalks below pole-mounted cabinets, as these will be considered incidental to the removal of the existing splice box/cabinet and the existing communications cable. No measurement will be made of conduit plugs.

Payment will be made under:

Pay Item	Pay Unit
Remove Existing Communications Cable	Linear Foot
Remove Splice Cabinet	Each

18. CABLE TRANSFERS

18.1. DESCRIPTION

Remove and reinstall existing communications cable for pole relocations.

18.2. CONSTRUCTION METHODS

During the project, transfers of existing communications cable from one pole to an adjacent pole may be required. Perform transfers as directed by the Engineer. Remove existing cable from the pole and reinstall the cable and any existing attachment hardware on the adjacent second pole. Remove all communications hardware from first pole from which the cable was removed. Furnish and install any new attachment hardware as required.

18.3. MEASUREMENT AND PAYMENT

Cable transfer will be measured and paid as the actual number of cable transfers with attachment hardware from one pole to an adjacent pole furnished, installed, and accepted.

Payment will be made under:

Pay Item	Pay Unit
Cable Transfer	Each

19. SIGNS INSTALLED FOR SIGNALS

19.1. DESCRIPTION

Furnish and install signs for signals with approved cable hangers, rigid sign mounting brackets, U-channel posts, and all necessary hardware.

19.2. MATERIALS

Comply with Articles 1092-1, Signs and Hardware, and 1092-2 Retroreflective Sheeting, of the *Standard Specifications*.

Use Grade C retroreflective sheeting, except for black sheeting. Use non-reflective for black sheeting.

Conform to the message layout, size, and color as required in the *MUTCD*.

For messenger cable mounting, furnish either messenger cable hangers with free-swinging, 360° adjustable sign brackets or 3-bolt clamps as directed. Furnish aluminum, galvanized steel, or stainless steel sign supporting hardware.

For ground mounting, furnish steel, 3 lb., U-channel posts with hardware for ground mounting. Comply with Section 903, Ground Mounted Sign Supports of the *Standard Specifications*.

For mast-arm mounting, furnish rigid aluminum, galvanized steel or stainless steel sign mounting brackets.

19.3. CONSTRUCTION METHODS

Install signs with approved mounting hardware. Comply with sign offsets and mounting heights as shown in the *MUTCD* and NCDOT *Roadway Standard Drawing* No. 904.50.

For messenger cable mounting, install signs 6 inches minimum from signal heads.

For ground mounting, comply with Section 903, Ground Mounted Supports of the *Standard Specifications*.

For mast arm mounting, install attachment brackets to allow adjustment so signs:

- Are aimed in required direction,
- Are plumb as viewed from respective approaches,
- May be tilted forward or backward as required, and
- May be raised or lowered on mast arm throughout full length of sign.

19.4. MEASUREMENT AND PAYMENT

Sign for signals will be measured and paid as the actual number of signs for signals, regardless of mounting method, furnished, installed, and accepted.

Payment will be made under:

Pay Item	Pay Unit
Sign for Signals	Each

20. EQUIPMENT CABINET FOUNDATIONS

20.1. DESCRIPTION

Furnish and install foundations for base-mounted equipment cabinets, including signal controller cabinets and CCTV cabinets, and all necessary hardware.

Furnish either poured concrete foundations or preformed cabinet pad foundations and all necessary hardware. Obtain approval of foundation type.

20.2. MATERIALS

Furnish preformed cabinet pad foundation material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

Provide preformed cabinet pad foundations with 7"(l) x 18"(w) minimum opening for the entrance of conduits. For precast signal cabinet foundations, include steel reinforcement to ensure structural integrity during shipment and placing of item. Include four 3/4" coil thread inserts for lifting. Comply with Article 1077-16 of the *Standard Specifications*.

Furnish cabinet foundations with chamfered top edges. Provide minimum Class B concrete in accordance with Article 1000-4, "Portland Cement Concrete for Structures and Incidental Construction," of the *Standard Specifications*.

Provide standard cabinet foundations in unpaved areas with a minimum pad area that extends 24" from front and back of cabinet base extenders and adapters, and 3" from sides of cabinet base extenders and adapters. For cabinet foundations installed within brick or concrete sidewalks, omit the 24" from the front and rear of the cabinet and provide a foundation that extends 3" from all four sides of the cabinet base extender as shown on the special detail in the Plans.

Furnish Class B Portland cement concrete in accordance with Article 848-2 of the *Standard Specifications*, to replace removed or damaged sections of existing sidewalk and restore locations to preconstruction condition.

Furnish replacement sidewalk pavers where required to restore locations to preconstruction condition that are of the same color, texture, shape, dimensions and materials as the damaged or modified items.

Provide replacement materials for other special pavement treatments or landscaping that are the same materials as the damaged or modified items to restore locations to preconstruction condition.

For repair of concrete sidewalks within historic districts that are removed or damaged by construction, provide concrete tinted to match the appearance of the existing sidewalk.

20.3. CONSTRUCTION METHODS

Comply with Section 825, "Incidental Concrete Construction – General," of the *Standard Specifications*.

Refer to Section 1 of these Project Special Provisions for requirements concerning construction within historic districts.

Obtain approval for final cabinet foundation locations before pouring concrete base or installing a preformed cabinet base. Locate new cabinets so as not to obstruct sight distance of vehicles turning on red or create any ADA violations or pedestrian conflicts. Maintain 12 inches minimum from service pole to closest point on foundation unless otherwise approved.

Do not install foundations over uncompacted fill or muck. Hand tamp soil before placing concrete or preformed cabinet base and ensure ground is level.

When using poured concrete foundations, use procedures, equipment, and hardware as follows:

- Use a minimum of four 1/2-inch diameter expanding type anchor bolts to secure cabinet to foundation.
- In unpaved areas, install cabinet foundations a minimum 4 inches above and 4 inches below finished grade. In paved areas, install foundations 1 inch above the paved surface at its highest point and 4 inches below the paved surface at its lowest point.
- Locate external stubbed out conduit at cabinet foundation so conduit is in middle of cabinet. Provide service conduit as the rightmost conduit coming into cabinet. Provide two spare conduits stubbed out; one pointed toward service pole and the other toward direction of lead-in cable. Inscribe identification arrow in foundation indicating direction of spare conduits.
- Ensure that conduits extend 2" to 3" above finished cabinet foundation.
- Give cabinet foundation a broom finish. Seal space between cabinet base and foundation with permanent, flexible, waterproof sealing material.

If using preformed cabinet pad, use loop sealant to seal the conduit stub-outs within the knock-out. Do not use preformed cabinet pad for cabinet foundations located within or adjacent to historic districts.

Restore the disturbed ground surrounding the new cabinet foundation to its original, preconstruction 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. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. Replace concrete sidewalk in whole slabs from joint to joint and comply with Article 848-3 of the *Standard Specifications*. Replace sidewalk pavers using pavers of the same color, texture, shape, dimensions and materials as the damaged or modified items. Place graded stone material to temporarily maintain pedestrian traffic where repairs cannot be performed immediately. Comply with Article 545-4 of the *Standard Specifications*.
- 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, plus **\$500 liquidated damages per occasion, per day, or any portion thereof**, until corrected.

20.4. MEASUREMENT AND PAYMENT

Signal cabinet foundation will be measured and paid as the actual number of signal cabinet foundations furnished, installed, and accepted.

CCTV cabinet foundation will be measured and paid as the actual number of CCTV cabinet foundations furnished, installed, and accepted.

4" concrete sidewalk will be measured and paid as the actual square yards of concrete furnished, installed and accepted. Measurement will be made along the surface of the completed and accepted work. Such price includes, but is not limited to, excavating and backfilling, sawing the existing sidewalk, furnishing and placing concrete, and constructing and sealing joints.

No measurement will be made of special finishing, staining and tinting of concrete sidewalk to match the appearance of existing sidewalk as such work will be considered incidental to furnishing and installing 4" concrete sidewalk.

Brick pavers will be measured and paid as the actual square feet of brick pavers furnished, installed and accepted.

No measurement or payment will be made for restoration of the surrounding unpaved ground surfaces in accordance with these Project Special Provisions as such work will be considered incidental to furnishing and installing signal cabinet foundations.

No measurement or payment will be made for furnishing and installing and subsequently removing graded stone material for temporary maintenance pedestrian traffic where a portion of an existing sidewalk has been removed as such work will be considered incidental to furnishing and installing signal cabinet foundations.

Payment will be made under:

Pay Item	Pay Unit
Signal Cabinet Foundation	Each
CCTV Cabinet Foundation	Each
4" Concrete Sidewalk	Square Yard
Brick Pavers	Square Foot

21. MODIFY CABINET FOUNDATIONS

21.1. DESCRIPTION

Where approved by the Engineer, install conduit entrances into existing foundations in accordance with the Plans and Project Special Provisions.

Modify existing foundations in accordance with the Plans and Project Special Provisions.

21.2. MATERIALS

Comply with the provisions of “Signal Cabinet Foundations” section of these Project Special Provisions.

21.3. CONSTRUCTION METHODS

(A) General

Ensure that an IMSA certified, or equivalent, Level II traffic qualified signal technician is standing by to provide emergency maintenance services whenever work is being performed on traffic signal controller cabinet foundations. Standby status is defined as being able to arrive, fully equipped, at the work site within 30 minutes ready to provide maintenance services.

(B) Install Conduit Entrance into Existing Foundation

Maintain a minimum of 3 inches of cover between new conduit and edge of foundation. Maintain minimum clearances of 1 inch from the flange of the base adapter and 2 inches from existing conduits. Avoid damaging existing conduit, conductors, and anchor bolts. Repair all such damages. Where approved by the Engineer, the foundation may be chipped instead of drilled for conduit entrance. When possible, maintain traffic signal operations while drilling is performed.

Bond new metallic conduit to the cabinet grounding system.

After installation of conduit, place grout to seal around conduit, and return the foundation to normal appearance.

(C) Modify Foundation

Enlarge existing cabinet foundations to accommodate the new cabinet and/or to provide a maintenance technician pad.

Excavate the ground around the existing foundation to a depth sufficient to expose a minimum of 4 inches of the foundation below existing grade.

Rough the sides of the existing foundation from the top to a point 4 inches below grade by means of a chisel or other method approved by the Engineer.

Wash the sides of the foundation with water pressurized at 50 psi and thoroughly dry with compressed air.

Drill holes approximately 6 inches deep on 12-inch centers into the existing foundation. Clean holes with compressed air only prior to applying epoxy and installing dowels. Do not clean holes with water or any other liquid. Install #4 dowels and epoxy into place. Provide dowels of the following lengths:

Foundation Extension	Length of Dowel
>16"	18"
>6" and ≤16"	11"
≤6"	8"

Use concrete to install the maintenance technician pad.

Form the sides of the modified foundation to a minimum depth of 4 inches below grade.

Position forms so that all existing exposed foundation surfaces at or above grade level will be matched.

Apply a coating of approved epoxy bonding agent to all exposed roughened concrete surfaces as recommended by the manufacturer.

As a minimum, enlarge the foundation to the distance specified for new cabinet foundations. Maintenance technician pads should be added to the foundation to provide a minimum work area of 24 inches [length] x 30 inches [width] from both the front and rear doors of the cabinet, unless otherwise directed by the Engineer. Increase the pad enlargement beyond these minimum dimensions to match the width of the existing foundation along the side to which concrete is being added to maintain the rectangular shape of the pad.

Provide a 1-inch chamfer on all new outside edges.

Modify cabinet foundations located within or adjacent to historic districts as shown in the Plans using a concrete mix tinted to match the appearance of the existing concrete foundation being modified.

(D) Alternate Methods of Modifying Foundations

Where the Plans call for a new conduit entrance to be installed into an existing cabinet foundation or for the existing foundation to be modified by expanding it, the Contractor may, subject to the approval of the Engineer and at no additional cost to the Department, use one of the following methods in lieu of core-drilling and/or expanding the existing base:

- Remove the existing cabinet foundation and replace it with a new preformed cabinet pad in the same location.
- Overlay the existing cabinet foundation with a new preformed cabinet pad.
- Install a new cabinet foundation adjacent to the existing foundation.

Comply with the construction methods for each method described below.

Do not use alternate methods for modifying foundations within or adjacent to historic districts. Comply with the Plans when modifying foundations within or adjacent to historic districts.

(1) In Situ Replacement

Carefully remove the existing concrete from around the existing conduit spread, taking care not to damage the conduit stubs or the existing field wiring. Construct additional conduit stub-out(s) where the Plans call for a new conduit entrance in the existing foundation. Once existing concrete has been completely removed and new stub-out(s) has

been constructed, immediately set a preformed cabinet pad over the existing conduit spread and new stubout(s). Install preformed cabinet pad in accordance with the manufacturer's instructions. Reinstall existing controller and cabinet or install new controller and cabinet on the new preformed pad. Provide preformed cabinet pads that are listed on the ITS and Signals QPL.

(2) Overlay Existing Foundation

Where the top of the existing cabinet foundation is no more than 2 inches above the surrounding ground, overlay the existing foundation by setting a preformed cabinet pad over the existing conduit spread and existing foundation. Level and hand tamp the ground around the existing foundation and install the preformed pad in accordance with the manufacturer's instructions. Furnish and install couplings, nipples, and bushings (PVC or rigid galvanized steel) to extend the existing conduit stub-outs so that the tops of the conduits are 2-3 inches above the top of the preformed pad. Use existing field wiring, splicing and extending the field wiring inside the controller cabinet as needed (refer to Extension of Existing Field Wiring section of these Project Special Provisions). Install new conduit entrance(s) into the existing foundation if necessary.

Immediately reinstall the existing controller and cabinet or install the new controller and cabinet once the preformed pad is set in place.

Backfill around the perimeter of the new pad with topsoil to a point 4 inches below the top surface of the new pad. Gently slope the backfill to tie into the existing ground line with a gradual slope no steeper than 4:1; do not create an abrupt or unsightly mound. Ensure the preformed pad and backfill does not block the flow of runoff or impound water. Hand tamp the new soil and apply grass seed and mulch.

Do not use this method where the top of the existing cabinet foundation is more than 2 inches higher than the surrounding ground, unless the Engineer approves otherwise.

(3) Construct New Foundation Adjacent to Existing Foundation

Construct a new cabinet foundation with all necessary hardware adjacent to the existing foundation and rewire the cabinet using one of the following methods:

- Install new risers on adjacent cabinet pole, “pull back” existing field wiring to the top of the existing risers, reinstall existing wiring through the new risers to the new foundation and splice and extend field wiring with gel-filled butt splice connectors in base of new cabinet if necessary.
- Install new risers with terminal splice cabinet on adjacent cabinet pole, “pull back” existing field wiring to the top of the existing risers, and reinstall existing wiring through the new risers to the terminal splice cabinet. Inside the terminal splice cabinet, splice the existing wiring to new conductors from the new base-mounted controller cabinet.

Comply with the “Signal Cabinet Foundations” section and the “Extension of Existing Field Wiring” section of these Project Special Provisions.

(E) Ground Surface Restoration

Restore the disturbed ground surrounding the modified cabinet foundation 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. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. 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, plus **\$500 liquidated damages per occasion, per day, or any portion thereof**, until corrected.

21.4. MEASUREMENT AND PAYMENT

Conduit entrance into existing foundation will be measured as the actual number of conduit entrances drilled into existing cabinet foundations furnished, installed and accepted. As approved by the Engineer, police provided for directing traffic while a signal is inoperable during construction of conduit entrance into existing foundation will be measured and paid for separately in accordance with the “Temporary Traffic Control” section of these Project Special Provisions.

Modify foundation for controller cabinet will be measured as the actual number of existing cabinet foundations modified and accepted.

Alternate methods for adding conduit entrances to and modifying existing cabinet foundations will be measured and paid as *conduit entrance into existing foundation* and/or *modify foundation for controller cabinet*, as specified in the Plans for the given location. Such payment will be full compensation for all work required to add the conduit entrance and/or modify the cabinet foundation using one of the alternate methods described above. No separate measurement will be made of preformed cabinet pads, removal of existing foundations or splicing and extending existing field wiring required due to the use of an alternate method for adding a conduit entrance or for modifying an existing cabinet foundation.

No measurement or payment will be made for restoration of the surrounding unpaved ground surfaces in accordance with these Project Special Provisions as such work will be considered incidental to the pay items above.

Payment will be made under:

Pay Item	Pay Unit
Conduit Entrance into Existing Foundation	Each
Modify Foundation for Controller Cabinet	Each

22. CONTROLLERS WITH CABINETS

22.1. DESCRIPTION

Furnish and install controllers with cabinets and all necessary hardware. Furnish all pole or foundation mounting hardware, detector sensor cards, one Corbin Number 2 cabinet key, one police panel key, conflict monitors, surge protection, grounding systems, AC/DC isolator cards, auxiliary files (where required) and all necessary hardware. Furnish and install new controllers and conflict monitors in existing cabinets. Install updates of local controller and operating system software.

22.2. MATERIALS - GENERAL

Except for conflict monitors, furnish material, equipment, and hardware under this section that is pre-approved on the ITS and Signals QPL.

22.3. MATERIALS – TYPE 2070L CONTROLLERS

Conform to CALTRANS *Transportation Electrical Equipment Specifications* (TEES) (dated August 16, 2002, plus Errata 1 dated October 27, 2003 and Errata 2 dated June 8, 2004) except as required herein.

Furnish Model 2070L controllers. Ensure that removal of the CPU module from the controller will place the intersection into flash.

The Department will provide local controller software at the beginning of the burning-in period. Contractor shall give 5 working days notice before needing software. Program software provided by the Department. The Department will provide updates to the local controller software for installation by the Contractor up through final acceptance of the project.

Provide Model 2070L controllers with the latest version of OS9 operating system software and device drivers, composed of the unit chassis and at a minimum the following modules and assemblies:

- MODEL 2070-1B, CPU Module, Single Board
- MODEL 2070-2A, Field I/O Module (FI/O)
- MODEL 2070-3B, Front Panel Module (FP), Display B (8x40)
- MODEL 2070-4A, Power Supply Module, 10 AMP
- MODEL 2070-7A, Async Serial Com Module (9-pin RS-232)

Provide all updates to the OS9 operating system software released up through final acceptance of the project at no additional cost to the Department.

Provide Model 2070L controllers that are capable of properly running the Department's OASIS local controller software and that are capable of operating properly within an Ethernet communications system.

22.4. MATERIALS – GENERAL CABINETS

Provide a moisture resistant coating on all circuit boards.

Provide one 20 mm diameter radial lead UL-recognized metal oxide varistor (MOV) between each load switch field terminal and equipment ground. Electrical performance is outlined below.

PROPERTIES OF MOV SURGE PROTECTOR	
Maximum Continuous Applied Voltage at 185° F	150 VAC (RMS) 200 VDC
Maximum Peak 8x20μs Current at 185° F	6500 A
Maximum Energy Rating at 185° F	80 J
Voltage Range 1 mA DC Test at 77° F	212-268 V
Max. Clamping Voltage 8x20μs, 100A at 77° F	395 V
Typical Capacitance (1 MHz) at 77° F	1600 pF

Provide a power line surge protector that is a two-stage device that will allow connection of the radio frequency interference filter between the stages of the device. Ensure that a maximum continuous current is at least 10A at 120V. Ensure that the device can withstand a minimum of 20 peak surge current occurrences at 20,000A for an 8x20 microsecond waveform. Provide a maximum clamp voltage of 395V at 20,000A with a nominal series inductance of 200μh. Ensure that the voltage does not exceed 395V. Provide devices that comply with the following:

Frequency (Hz)	Minimum Insertion Loss (dB)
60	0
10,000	30
50,000	55
100,000	50
500,000	50
2,000,000	60
5,000,000	40
10,000,000	20
20,000,000	25

22.5. MATERIALS – TYPE 170E CABINETS

(A) Type 170 E Cabinets General

Conform to the city of Los Angeles' Specification No. 54-053-08, *Traffic Signal Cabinet Assembly Specification* (dated July 2008), except as required herein.

Furnish model 336S pole-mounted and base-mounted cabinets configured for 8 vehicle phases, 4 pedestrian phases, and 6 overlaps. When overlaps are required, provide auxiliary output files for the overlaps. Do not reassign load switches to accommodate overlaps unless shown on electrical details. Provide 336S pole-mounted and base-mounted cabinets that are 46" high with 40" high internal rack assemblies.

Furnish model 332 base mounted cabinets configured for 8 vehicle phases, 4 pedestrian phases, and 6 overlaps. When overlaps are required, provide auxiliary output files for the overlaps. Do not reassign load switches to accommodate overlaps unless shown on electrical details.

Provide model 200 load switches, model 222 loop detector sensors, model 252 AC isolators, and model 242 DC isolators according to the electrical details. As a minimum, provide one (1) model 2018 conflict monitor, one (1) model 206L power supply unit, two (2) model 204 flashers,

one (1) DC isolator (located in slot I14), and four (4) model 430 flash transfer relays (provide seven (7) model 430 flash transfer relays if auxiliary output file is installed) with each cabinet.

(B) Type 170 E Cabinet Electrical Requirements

Provide a cabinet assembly designed to ensure that upon leaving any cabinet switch or conflict monitor initiated flashing operation, the controller starts up in the programmed start up phases and start up interval.

Furnish two sets of non-fading cabinet wiring diagrams and schematics in a paper envelope or container and placed in the cabinet drawer.

All AC+ power is subject to radio frequency signal suppression.

Provide surge suppression in the cabinet for each type of cabinet device. Provide surge protection for the full capacity of the cabinet input file. Provide surge suppression devices that operate properly over a temperature range of -40° F to +185° F. Ensure the surge suppression devices provide both common and differential modes of protection.

Provide a pluggable power line surge protector that is installed on the back of the PDA (power distribution assembly) chassis to filter and absorb power line noise and switching transients. Ensure the device incorporates LEDs for failure indication and provides a dry relay contact closure for the purpose of remote sensing. Ensure the device meets the following specifications:

Peak Surge Current (Single pulse, 8x20μs).....20,000A
 Occurrences (8x20μs waveform).....10 minimum @ 20,000A
 Maximum Clamp Voltage.....395VAC
 Operating Current.....15 amps
 Response Time.....< 5 nanoseconds

Provide a loop surge suppressor for each set of loop terminals in the cabinet. Ensure the device meets the following specifications:

Peak Surge Current (6 times, 8x20μs)
 (Differential Mode).....400A
 (Common Mode).....1,000A
 Occurrences (8x20μs waveform).....500 min @ 200A
 Maximum Clamp Voltage
 (Differential Mode @400A).....35V
 (Common Mode @1,000A).....35V
 Response Time.....< 5 nanoseconds
 Maximum Capacitance.....35 pF

Provide a data communications surge suppressor for each communications line entering or leaving the cabinet. Ensure the device meets the following specifications:

Peak Surge Current (Single pulse, 8x20μs).....	10,000A
Occurrences (8x20μs waveform).....	100 min @ 2,000A
Maximum Clamp Voltage.....	Rated for equipment protected
Response Time.....	< 1 nanosecond
Maximum Capacitance.....	1,500 pF
Maximum Series Resistance.....	15Ω

Provide a DC signal surge suppressor for each DC input channel in the cabinet. Ensure the device meets the following specifications:

Peak Surge Current (Single pulse, 8x20μs).....	10,000A
Occurrences (8x20μs waveform).....	100 @ 2,000A
Maximum Clamp Voltage.....	30V
Response Time.....	< 1 nanosecond

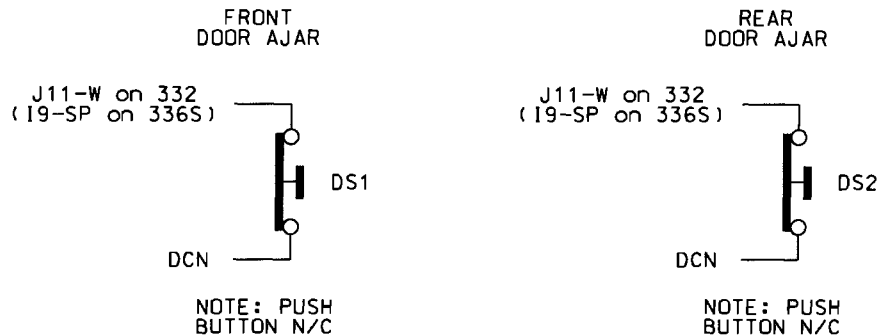
Provide a 120 VAC signal surge suppressor for each AC+ interconnect signal input. Ensure the device meets the following specifications:

Peak Surge Current (Single pulse, 8x20μs).....	20,000A
Maximum Clamp Voltage.....	350VAC
Response Time.....	< 200 nanoseconds
Discharge Voltage.....	<200 Volts @ 1,000A
Insulation Resistance.....	≥100 MΩ

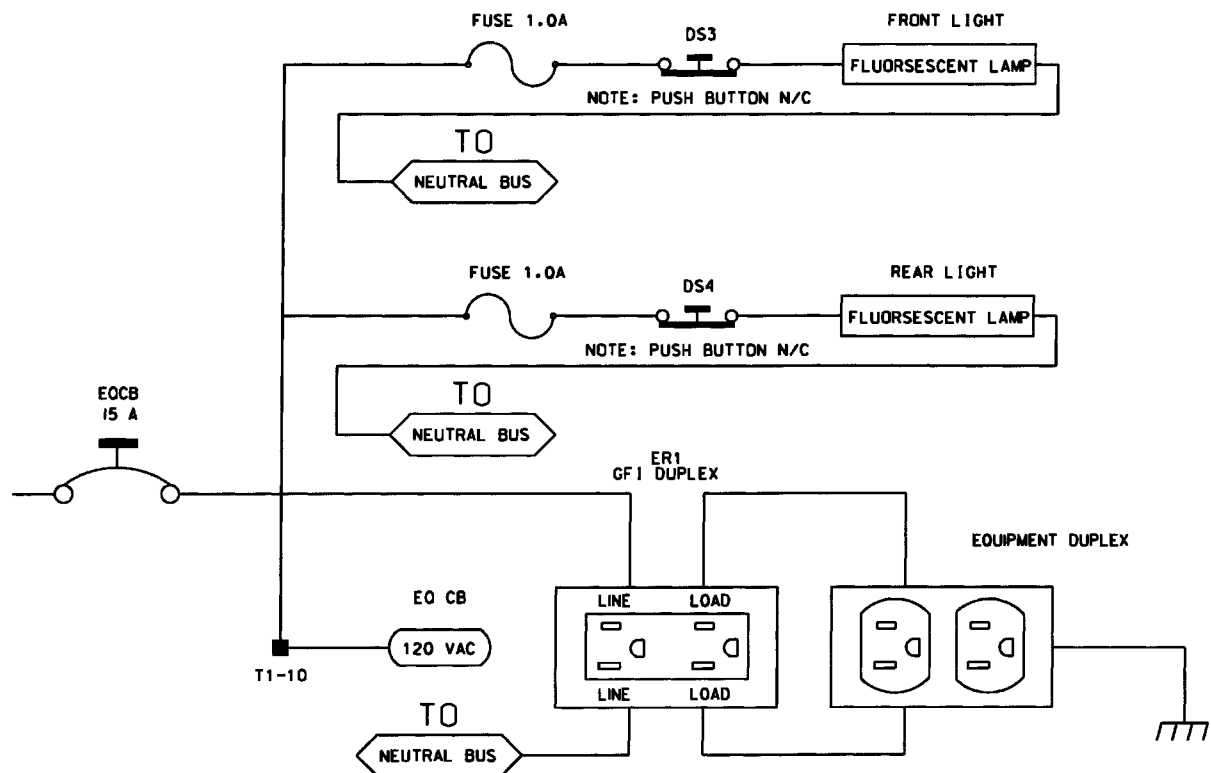
Provide conductors for surge protection wiring that are of sufficient size (ampacity) to withstand maximum overcurrents which could occur before protective device thresholds are attained and current flow is interrupted.

If additional surge protected power outlets are needed to accommodate fiber transceivers, modems, etc., install a UL listed, industrial, heavy-duty type power outlet strip with a minimum rating of 15 A / 125 VAC, 60 Hz. Provide a strip that has a minimum of 3 grounded outlets. Ensure the power outlet strip plugs into one of the controller unit receptacles located on the rear of the PDA. Ensure power outlet strip is mounted securely; provide strain relief if necessary.

Provide a door switch in the front and a door switch in the rear of the cabinet that will provide the controller unit with a Door Ajar alarm when either the front or the rear door is open. Ensure the door switches apply DC ground to the Input File when either the front door or the rear door is open.



Furnish a fluorescent fixture in the rear across the top of the cabinet and another fluorescent fixture in the front across the top of the cabinet at a minimum. Ensure that the fixtures provide sufficient light to illuminate all terminals, labels, switches, and devices in the cabinet. Conveniently locate the fixtures so as not to interfere with a technician's ability to perform work on any devices or terminals in the cabinet. Provide a protective diffuser to cover exposed bulbs. Install 16 watt T-4 lamps in the fluorescent fixtures. Provide a door switch to provide power to each fixture when the respective door is open. Wire the fluorescent fixtures to the 15 amp ECB (equipment circuit breaker).



Furnish a police panel with a police panel door. For model 336S cabinets, mount the police panel on the rear door. Ensure that the police panel door permits access to the police panel when the main door is closed. Ensure that no rainwater can enter the cabinet even with the police panel door open. Provide a police panel door hinged on the right side as viewed from the front. Provide a police panel door lock that is keyed to a standard police/fire call box key. In addition to the

requirements of LA Specification No. 54-053-08, provide the police panel with a toggle switch connected to switch the intersection operation between normal stop-and-go operation (AUTO) and manual operation (MANUAL). Ensure that manual control can be implemented using inputs and software such that the controller provides full programmed clearance times for the yellow clearance and red clearance for each phase while under manual control.

Provide a 1/4-inch locking phone jack in the police panel for a hand control to manually control the intersection. Provide sufficient room in the police panel for storage of a hand control and cord.

Ensure the 336S cabinet Input Files are wired as follows:

336 Cabinet Port-Bit/C-1 Pin Assignment														
Slot #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
C-1 (Spares)	59	60	61	62	63	64	65	66	75	76	77	78	79	80
Port C-1	3-2 56	1-1 39	3-4 58	1-3 41	3-1 55	1-2 40	3-3 57	1-4 42	2-5 51	5-5 71	5-6 72	5-1 67	5-2 68	6-7 81
Port C-1	2-1 47	1-5 43	2-3 49	1-7 45	2-2 48	1-6 44	2-4 50	1-8 46	2-6 52	5-7 73	5-8 74	5-3 69	5-4 70	6-8 82

For model 332 base mounted cabinets, ensure terminals J14-E and J14-K are wired together on the rear of the Input File. Connect TB9-12 (J14 Common) on the Input Panel to T1-2 (AC-) on the rear of the PDA.

Provide detector test switches mounted at the top of the cabinet rack or other convenient location which may be used to place a call on each of eight phases based on the chart below. Provide three positions for each switch: On (place call), Off (normal detector operation), and Momentary On (place momentary call and return to normal detector operation after switch is released). Ensure that the switches are located such that the technician can read the controller display and observe the intersection.

Connect detector test switches for cabinets as follows:

336 Cabinet		332 Cabinet	
Detector Call Switches	Terminals	Detector Call Switches	Terminals
Phase 1	I1-F	Phase 1	I1-W
Phase 2	I2-F	Phase 2	I4-W
Phase 3	I3-F	Phase 3	I5-W
Phase 4	I4-F	Phase 4	I8-W
Phase 5	I5-F	Phase 5	J1-W
Phase 6	I6-F	Phase 6	J4-W
Phase 7	I7-F	Phase 7	J5-W
Phase 8	I8-F	Phase 8	J8-W

Provide the PCB 28/56 connector for the conflict monitor unit (CMU) with 28 independent contacts per side, dual-sided with 0.156 inch contact centers. Provide the PCB 28/56 connector

contacts with solder eyelet terminations. Ensure all connections to the PCB 28/56 connector are soldered to the solder eyelet terminations.

Ensure that all cabinets have the CMU connector wired according to the 332 cabinet connector pin assignments (include all wires for auxiliary output file connection). Wire pins 13, 16, R, and U of the CMU connector to a separate 4 pin plug, P1, as shown below. Provide a second plug, P2, which will mate with P1 and is wired to the auxiliary output file as shown below. Provide an additional plug, P3, which will mate with P1 and is wired to the pedestrian yellow circuits as shown below. When no auxiliary output file is installed in the cabinet, provide wires for the green and yellow inputs for channels 11, 12, 17, and 18, the red inputs for channels 17 and 18, and the wires for the P2 plug. Terminate the two-foot wires with ring type lugs, insulated, and bundled for optional use.

PIN	P1		P2		P3	
	FUNCTION	CONN TO	FUNCTION	CONN TO	FUNCTION	CONN TO
1	CH-9G	CMU-13	OLA-GRN	A123	2P-YEL	114
2	CH-9Y	CMU-16	OLA-YEL	A122	4P-YEL	105
3	CH-10G	CMU-R	OLB-GRN	A126	6P-YEL	120
4	CH-10Y	CMU-U	OLB-YEL	A125	8P-YEL	111

Do not provide the P20 terminal assembly (red monitor board) or red interface ribbon cable as specified in the LA Specification NO. 54-053-08.

Provide a P20 connector that mates with and is compatible with the red interface connector mounted on the front of the conflict monitor. Ensure that the P20 connector and the red interface connector on the conflict monitor are center polarized to ensure proper connection. Ensure that removal of the P20 connector will cause the conflict monitor to recognize a latching fault condition and place the cabinet into flashing operation.

Wire the P20 connector to the output file and auxiliary output file using 22 AWG stranded wires. Ensure the length of these wires is a minimum of 42 inches. Provide a durable braided sleeve around the wires to organize and protect the wires.

Wire the P20 connector to the traffic signal red displays to provide inputs to the conflict monitor as shown below. Ensure the pedestrian Don't Walk circuits are wired to channels 13 through 16 of the P20 connector. When no auxiliary output file is installed in the cabinet, provide wires for channels 9 through 12 reds. Provide a wire for special function 1. Terminate the unused wires with ring type lugs, insulated, and bundled for optional use.

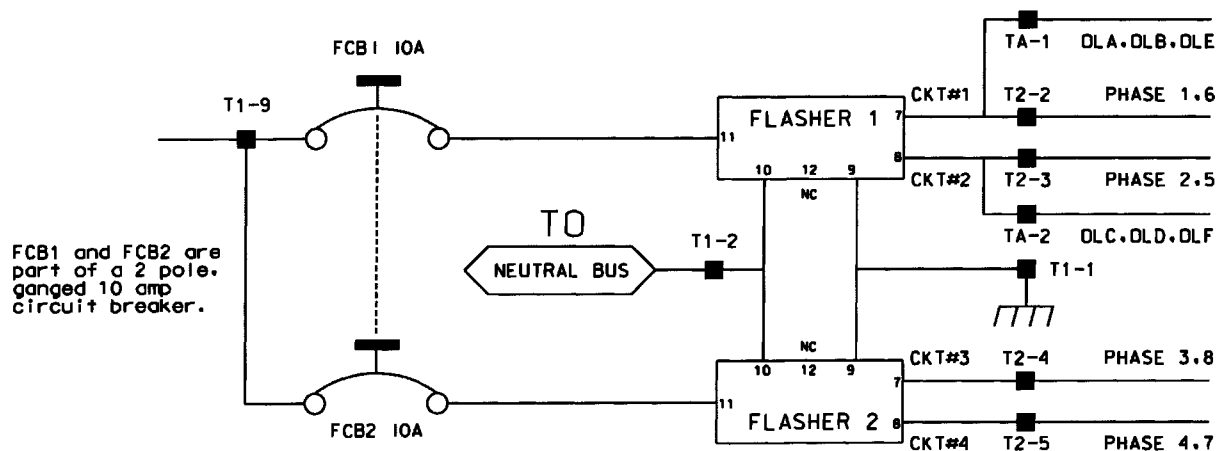
P20 Connector					
PIN	FUNCTION	CONN TO	PIN	FUNCTION	CONN TO
1	Channel 15 Red	119	11	Channel 16 Red	110
2	Channel 14 Red	104	12	Chassis GND	01-9
3	Channel 13 Red	113	13	N/C	
4	Channel 12 Red	AUX 101	14	Spec Function 1	
5	Channel 10 Red	AUX 124	15	Channel 11 Red	AUX 114
6	Channel 9 Red	AUX 121	16	Channel 8 Red	107
7	Channel 7 Red	122	17	Channel 6 Red	134
8	Channel 5 Red	131	18	Channel 4 Red	101
9	Channel 3 Red	116	19	Channel 2 Red	128
10	Channel 1 Red	125	20	Red Enable	01-14

Do not wire pin 12 of the load switch sockets.

Ensure the controller unit outputs to the auxiliary output file are pre-wired to the C5 connector. When no auxiliary output file is installed in the cabinet, connect the C5 connector to a storage socket located on the Input Panel or on the rear of the PDA.

In addition to the requirements of LA Specification No. 54-053-08, ensure relay K1 on the Power Distribution Assembly (PDA) is a four pole relay and K2 on the PDA is a two pole relay.

Provide a two pole, ganged circuit breaker for the flash bus circuit. Ensure the flash bus circuit breaker is an inverse time circuit breaker rated for 10 amps at 120 VAC with a minimum of 10,000 RMS symmetrical amperes short circuit current rating. Do not provide the auxiliary switch feature on the flash bus circuit breaker. Ensure the ganged flash bus circuit breaker is certified by the circuit breaker manufacturer to provide gang tripping operation.



Ensure auxiliary output files are wired as follows:

AUXILIARY OUTPUT FILE TERMINAL BLOCK TA ASSIGNMENTS	
POSITION	FUNCTION
1	Flasher Unit #1, Circuit 1/FTR1 (OLA, OLB)/FTR3 (OLE)
2	Flasher Unit #1, Circuit 2/FTR2 (OLC, OLD)/FTR3 (OLF)
3	Flash Transfer Relay Coils
4	AC -
5	Power Circuit 5
6	Power Circuit 5
7	Equipment Ground Bus
8	NC

Provide four spare load resistors mounted in each cabinet. Ensure each load resistor is rated as shown in the table below. Wire one side of each load resistor to AC-. Connect the other side of each resistor to a separate terminal on a four (4) position terminal block. Mount the load resistors and terminal block either inside the back of Output File No. 1 or on the upper area of the Service Panel.

ACCEPTABLE LOAD RESISTOR VALUES	
VALUE (ohms)	WATTAGE
1.5K – 1.9 K	25W (min)
2.0K – 3.0K	10W (min)

Provide Model 200 load switches, Model 204 flashers, Model 242 DC isolators, Model 252 AC isolators, and Model 206L power supply units that conform to CALTRANS' "Transportation Electrical Equipment Specifications" dated March 12, 2009 with Erratum 1.

(C) Type 170 E Cabinet Physical Requirements

Do not mold, cast, or scribe the name "City of Los Angeles" on the outside of the cabinet door as specified in LA Specification No. 54-053-08. Do not provide a Communications Terminal Panel as specified in LA Specification No. 54-053-08. Do not provide terminal block TBB on the Service Panel. Do not provide Cabinet Verification Test Program software or associated test jigs as specified in LA Specification No. 54-053-08.

Furnish unpainted, natural, aluminum cabinet shells for all locations except those identified in the "Special Coatings for Cabinets" subsection above to have custom finish applied to the cabinets. Ensure that all non-aluminum hardware on the cabinet is stainless steel or a Department approved non-corrosive alternate.

Ensure the lifting eyes, gasket channels, police panel, and all supports welded to the enclosure and doors are fabricated from 0.125 inch minimum thickness aluminum sheet and meet the same standards as the cabinet and doors.

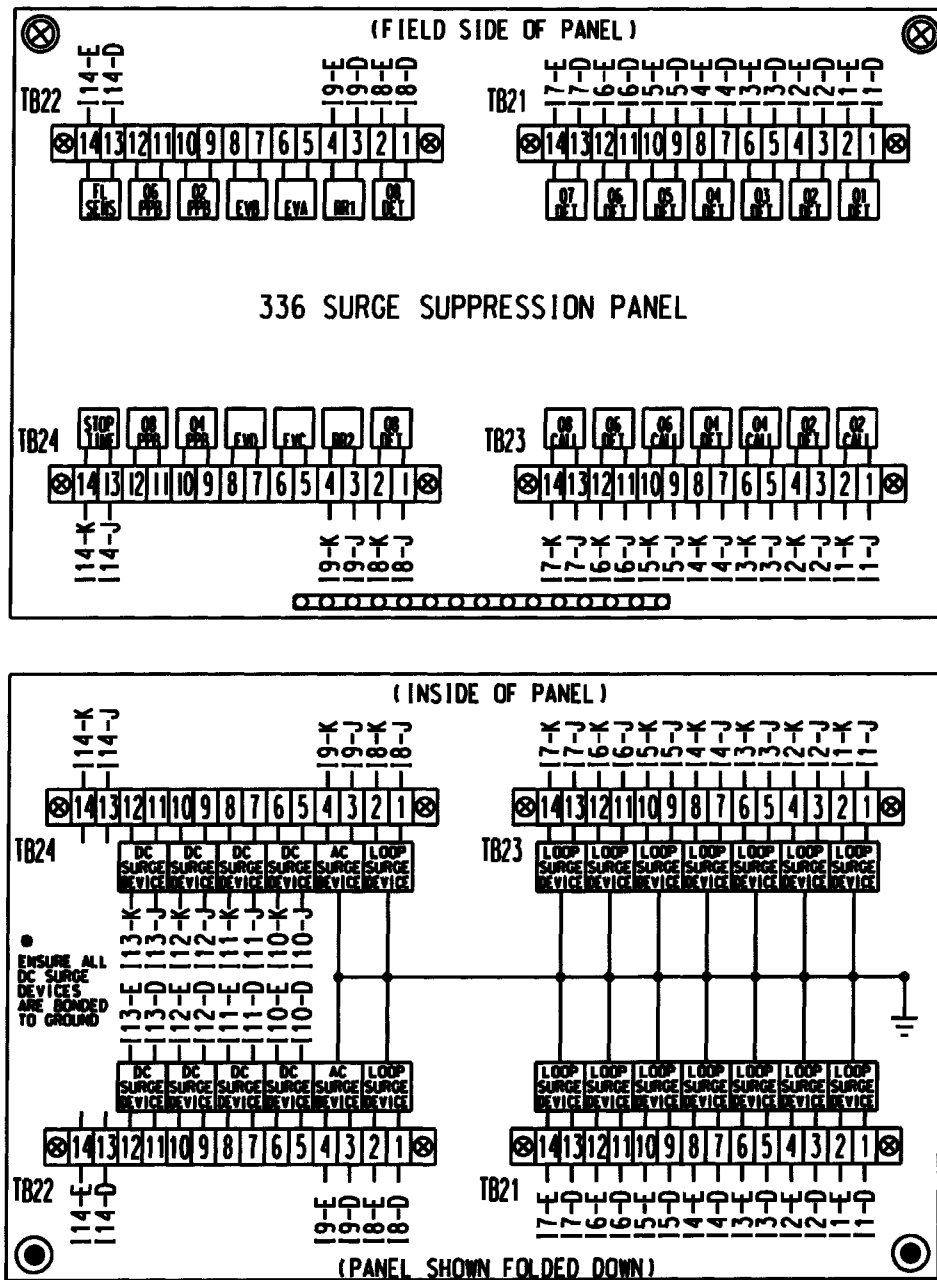
Provide front and rear doors with latching handles that allow padlocking in the closed position. Furnish 0.75 inch minimum diameter stainless steel handles with a minimum 0.5 inch

shank. Place the padlocking attachment at 4.0 inches from the handle shank center to clear the lock and key. Provide an additional 4.0 inches minimum gripping length.

Provide Corbin #2 locks on the front and rear doors. Provide one (1) Corbin #2 and one (1) police master key with each cabinet. Ensure main door locks allow removal of keys in the locked position only.

Provide a surge protection panel with 16 loop surge protection devices and designed to allow sufficient free space for wire connection/disconnection and surge protection device replacement. For model 332 cabinets, provide an additional 20 loop surge protection devices. Provide an additional two AC+ interconnect surge devices to protect one slot and eight DC surge protection devices to protect four slots. Provide no protection devices on slot I14.

For 336S pole-mounted and 336S base-mounted cabinets, mount surge protection devices for the AC+ interconnect inputs, inductive loop detector inputs, and low voltage DC inputs on a swing down panel assembly fabricated from sturdy aluminum. Attach the swing down panel to the bottom rear cabinet rack assembly using thumb screws. Ensure the swing down panel allows for easy removal of the input file without removing the surge protection panel assembly or its parts. Have the surge protection devices mounted horizontally on the panel and soldered to the feed through terminals of four 14 position terminal blocks with #8 screws mounted on the other side. Ensure the top row of terminals is connected to the upper slots and the bottom row of terminals is connected to the bottom slots. Provide a 15 position copper equipment ground bus attached to the field terminal side (outside) of the swing down panel for termination of loop lead-in shield grounds. Ensure that a Number 4 AWG green wire connects the surge protection panel assembly ground bus to the main cabinet equipment ground.



For 332 base mounted cabinets, mount surge protection panels on the left side of the cabinet as viewed from the rear. Attach each panel to the cabinet rack assembly using bolts and make it easily removable. Mount the surge protection devices in vertical rows on each panel and connect the devices to one side of 12 position, double row terminal blocks with #8 screws. For each surge protection panel, terminate all grounds from the surge protection devices on a copper equipment ground bus attached to the surge protection panel. Wire the terminals to the rear of a standard input file using spade lugs for input file protection.

Provide permanent labels that indicate the slot and the pins connected to each terminal that may be viewed from the rear cabinet door. Label and orient terminals so that each pair of inputs

is next to each other. Indicate on the labeling the input file (I or J), the slot number (1-14) and the terminal pins of the input slots (either D & E for upper or J & K for lower).

Provide a minimum 14 x 16 inch pull out, hinged top shelf located immediately below controller mounting section of the cabinet. Ensure the shelf is designed to fully expose the table surface outside the controller at a height approximately even with the bottom of the controller. Ensure the shelf has a storage bin interior which is a minimum of 1 inch deep and approximately the same dimensions as the shelf. Provide an access to the storage area by lifting the hinged top of the shelf. Fabricate the shelf and slide from aluminum or stainless steel and ensure the assembly can support the 2070L controller plus 15 pounds of additional weight. Ensure shelf has a locking mechanism to secure it in the fully extended position and does not inhibit the removal of the 2070L controller or removal of cards inside the controller when fully extended. Provide a locking mechanism that is easily released when the shelf is to be returned to its non-use position directly under the controller.

(D) Model 2018 Enhanced Conflict Monitor

Furnish Model 2018 Enhanced Conflict Monitors that provide monitoring of 18 channels. Ensure each channel consists of a green, yellow, and red field signal input. Ensure that the conflict monitor meets or exceeds CALTRANS *Transportation Electrical Equipment Specifications* dated March 12, 2009 with Erratum 1 (hereafter referred to as CALTRANS's 2009 TEES) for a model 210 monitor unit and other requirements stated in this specification.

Ensure the conflict monitor is provided with a 18 channel conflict programming card. Pin EE and Pin T of the programming card shall be connected together. Pin 16 of the conflict programming card shall be floating. Ensure that the absence of the conflict programming card will cause the conflict monitor to trigger (enter into fault mode), and remain in the triggered state until the programming card is properly inserted and the conflict monitor is reset.

Provide a conflict monitor that incorporates LED indicators into the front panel to dynamically display the status of the monitor under normal conditions and to provide a comprehensive review of field inputs with monitor status under fault conditions. Ensure that the monitor indicates the channels that were active during a conflict condition and the channels that experienced a failure for all other per channel fault conditions detected. Ensure that these indications and the status of each channel are retained until the Conflict Monitor is reset. Furnish LED indicators for the following:

- AC Power (Green LED indicator)
- VDC Failed (Red LED indicator)
- WDT Error (Red LED indicator)
- Conflict (Red LED indicator)
- Red Fail (Red LED indicator)
- Dual Indication (Red LED indicator)
- Short Yellow/Sequence Failure (Red LED indicator)
- Program Card/PC Ajar (Red LED indicator)
- Monitor Fail/Diagnostic Failure (Red LED indicator)
- 54 Channel Status Indicators (1 Red, 1 Yellow, and 1 Green LED indicator for each of the 18 channels)

Provide a switch to set the Red Fail fault timing. Ensure that when the switch is in the ON position the Red Fail fault timing value is set to 1350 +/- 150ms (2018 mode). Ensure that when the switch is in the OFF position the Red Fail fault timing value is set to 850 +/- 150ms (210 mode).

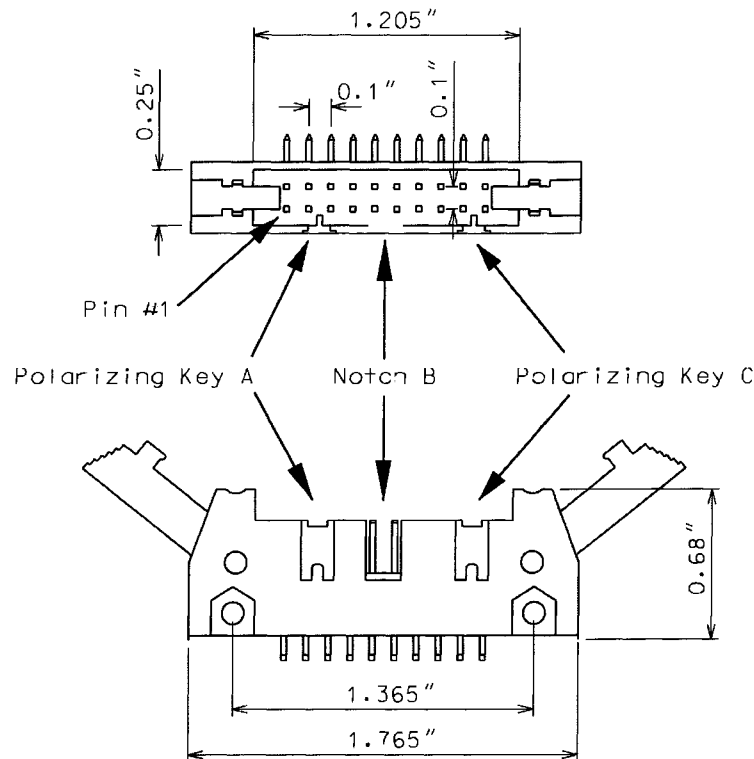
Provide a switch to set the Watchdog fault timing. Ensure that when the switch is in the ON position the Watchdog fault timing value is set to 1.0 +/- 0.1s (2018 mode). Ensure that when the switch is in the OFF position the Watchdog fault timing value is set to 1.5 +/- 0.1s (210 mode).

Provide a jumper or switch to set the AC line brown-out levels. Ensure that when the jumper is present or the switch is in the ON position the AC line dropout voltage threshold is 98 +/- 2 Vrms, the AC line restore voltage threshold is 103 +/- 2 Vrms, and the AC line brown-out timing value is set to 400 +/- 50ms (2018 mode). Ensure that when the jumper is not present or the switch is in the OFF position the AC line dropout voltage threshold is 92 +/- 2 Vrms, the AC line restore voltage threshold is 98 +/- 2 Vrms, and the AC line brown-out timing value is set to 80 +/- 17ms (210 mode).

Provide a jumper or switch that will enable and disable the Watchdog Latch function. Ensure that when the jumper is not present or the switch is in the OFF position the Watchdog Latch function is disabled. In this mode of operation, a Watchdog fault will be reset following a power loss, brownout, or power interruption. Ensure that when the jumper is present or the switch is in the ON position the Watchdog Latch function is enabled. In this mode of operation, a Watchdog fault will be retained until a Reset command is issued.

Provide a jumper that will reverse the active polarity for pin #EE (output relay common). Ensure that when the jumper is not present pin #EE (output relay common) will be considered 'Active' at a voltage greater than 70 Vrms and 'Not Active' at a voltage less than 50 Vrms (Caltrans mode). Ensure that when the jumper is present pin #EE (output relay common) will be considered 'Active' at a voltage less than 50 Vrms and 'Not Active' at a voltage greater than 70 Vrms (Failsafe mode).

In addition to the connectors required by CALTRANS' 2009 TEES, provide the conflict monitor with a red interface connector mounted on the front of the monitor. Ensure the connector is 20-pin, right angle, male connector with latching clip locks and polarizing keys. Ensure the right angle solder tails are designed for 0.062" thick printed circuit board. Keying of the connector shall be between pins 3 and 5, and between 17 and 19. Ensure the connector has two rows of pins with the odd numbered pins are on one row and the even pins on the other row. Ensure the connector pin row spacing is 0.10" and pitch is 0.10". Ensure the mating length of the connector pins is 0.24". Ensure the pins are finished with gold plating 30µ" thick.



Ensure the red interface connector pins on the monitor have the following functions:

Pin #	Function	Pin #	Function
1	Channel 15 Red	2	Channel 16 Red
3	Channel 14 Red	4	Chassis Ground
5	Channel 13 Red	6	Special Function 2
7	Channel 12 Red	8	Special Function 1
9	Channel 10 Red	10	Channel 11 Red
11	Channel 9 Red	12	Channel 8 Red
13	Channel 7 Red	14	Channel 6 Red
15	Channel 5 Red	16	Channel 4 Red
17	Channel 3 Red	18	Channel 2 Red
19	Channel 1 Red	20	Red Enable

Ensure that the removal of the P-20 red interface ribbon cable will cause the monitor to recognize a latching fault condition and place the cabinet into flashing operation.

Provide Special Function 1 and Special Function 2 inputs to the unit which shall disable only Red Fail Monitoring when either input is sensed active. A Special Function input shall be sensed active when the input voltage exceeds 70 Vrms with a minimum duration of 550 ms. A Special Function input shall be sensed not active when the input voltage is less than 50 Vrms or the duration is less than 250 ms. A Special Function input is undefined by these specifications and may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms or the duration is between 250 ms and 550 ms.

Ensure the conflict monitor recognizes field signal inputs for each channel that meet the following requirements:

- consider a Red input greater than 70 Vrms and with a duration of at least 500 ms as an “on” condition;
- consider a Red input less than 50 Vrms or with a duration of less than 200 ms as an “off” condition (no valid signal);
- consider a Red input between 50 Vrms and 70 Vrms or with a duration between 200 ms and 500 ms to be undefined by these specifications;
- consider a Green or Yellow input greater than 25 Vrms and with a duration of at least 500 ms as an “on” condition;
- consider a Green or Yellow input less than 15 Vrms or with a duration of less than 200 ms as an “off” condition; and
- consider a Green or Yellow input between 15 Vrms and 25 Vrms or with a duration between 200 ms and 500 ms to be undefined by these specifications.

Provide a conflict monitor that recognizes the faults specified by CALTRANS’ 2009 TEES and the following additional faults. Ensure the conflict monitor will trigger upon detection of a fault and will remain in the triggered (in fault mode) state until the unit is reset at the front panel or through the external remote reset input for the following failures:

1. **Red Monitoring or Absence of Any Indication (Red Failure):** A condition in which no “on” voltage signal is detected on any of the green, yellow, or red inputs to a given monitor channel. If a signal is not detected on at least one input (R, Y, or G) of a conflict monitor channel for a period greater than 1000 ms when used with a 170 controller and 1500 ms when used with a 2070L controller, ensure monitor will trigger and put the intersection into flash. If the absence of any indication condition lasts less than 750 ms when used with a 170 controller and 1200 ms when used with a 2070L controller, ensure conflict monitor will not trigger. Red fail monitoring shall be enabled on a per channel basis by the use of switches located on the conflict monitor. Have red monitoring occur when both the following input conditions are in effect:
 - a) Red Enable input to monitor is active (Red Enable voltages are “on” at greater than 70 Vrms, off at less than 50 Vrms, undefined between 50 and 70 Vrms), and
 - b) Neither Special Function 1 nor Special Function 2 inputs are active.
 - c) Pin #EE (output relay common) is not active.
2. **Short/Missing Yellow Indication Error (Sequence Error):** Yellow indication following a green is missing or shorter than 2.7 seconds (with ± 0.1 -second accuracy). If a channel fails to detect an “on” signal at the Yellow input for a minimum of 2.7 seconds (± 0.1 second) following the detection of an “on” signal at a Green input for that channel, ensure that the monitor triggers and generates a clearance/short yellow error fault indication. Short/missing yellow (clearance) monitoring shall be enabled on a per channel bases by the use of switches located on the monitor. This fault shall not occur when the channel is programmed for Yellow Inhibit, when the Red Enable signal is inactive or pin #EE (output relay common) is active.
3. **Dual Indications on the Same Channel:** In this condition, more than one indication (R,Y,G) is detected as “on” at the same time on the same channel. If dual indications are detected for a period greater than 500 ms, ensure that the conflict monitor triggers and

displays the proper failure indication (Dual Ind fault). If this condition is detected for less than 200 ms, ensure that the monitor does not trigger. G-Y-R dual indication monitoring shall be enabled on a per channel basis by use of switches located on the conflict monitor. G-Y dual indication monitoring shall be enabled for all channels by use of a switch located on the conflict monitor. This fault shall not occur when the Red Enable signal is inactive or pin #EE (output relay common) is active.

4. **Configuration Settings Change:** The configuration settings are comprised of (as a minimum) the permissive diode matrix, dual indication switches, yellow disable jumpers, any option switches, any option jumpers, and the Watchdog Enable switch. Ensure the conflict monitor compares the current configuration settings with the previous stored configuration settings on power-up, on reset, and periodically during operation. If any of the configuration settings are changed, ensure that the conflict monitor triggers and causes the program card indicator to flash. Ensure that configuration change faults are only reset by depressing and holding the front panel reset button for three seconds. Ensure the external remote reset input does not reset configuration change faults.

Ensure the conflict monitor will trigger and the AC Power indicator will flash at a rate of 2 Hz \pm 20% with a 50% duty cycle when the AC Line voltage falls below the “drop-out” level. Ensure the conflict monitor will resume normal operation when the AC Line voltage returns above the “restore” level. Ensure the AC Power indicator will remain illuminated when the AC voltage returns above the “restore” level. Should an AC Line power interruption occur while the monitor is in the fault mode, then upon restoration of AC Line power, the monitor will remain in the fault mode and the correct fault and channel indicators will be displayed.

Provide a flash interval of at least 6 seconds and at most 10 seconds in duration following a power-up, an AC Line interruption, or a brownout restore. Ensure the conflict monitor will suspend all fault monitoring functions, close the Output relay contacts, and flash the AC indicator at a rate of 4 Hz \pm 20% with a 50% duty cycle during this interval. Ensure the termination of the flash interval after at least 6 seconds if the Watchdog input has made 5 transitions between the True and False state and the AC Line voltage is greater than the “restore” level. If the watchdog input has not made 5 transitions between the True and False state within 10 \pm 0.5 seconds, the monitor shall enter a WDT error fault condition.

Ensure the conflict monitor will monitor an intersection with up to four approaches using the four-section Flashing Yellow Arrow (FYA) vehicle traffic signal as outlined by the NCHRP 3-54 research project for protected-permissive left turn signal displays. Ensure the conflict monitor will operate in the FYA mode and FYAc (Compact) mode as specified below to monitor each channel for the following fault conditions: Conflict, Red Fail, Dual Indication, and Clearance. Provide a switch to select between the FYA mode and FYAc mode. Provide a switch to select each FYA phase movement for monitoring.

FYA Mode				
FYA Signal Head	Phase 1	Phase 3	Phase 5	Phase 7
Red Arrow	Channel 9 Red	Channel 10 Red	Channel 11 Red	Channel 12 Red
Yellow Arrow	Channel 9 Yellow	Channel 10 Yellow	Channel 11 Yellow	Channel 12 Yellow
Flashing Yellow Arrow	Channel 9 Green	Channel 10 Green	Channel 11 Green	Channel 12 Green
Green Arrow	Channel 1 Green	Channel 3 Green	Channel 5 Green	Channel 7 Green

FYAc Mode				
FYA Signal Head	Phase 1	Phase 3	Phase 5	Phase 7
Red Arrow	Channel 1 Red	Channel 3 Red	Channel 5 Red	Channel 7 Red
Yellow Arrow	Channel 1 Yellow	Channel 3 Yellow	Channel 5 Yellow	Channel 7 Yellow
Flashing Yellow Arrow	Channel 1 Green	Channel 3 Green	Channel 5 Green	Channel 7 Green
Green Arrow	Channel 9 Green	Channel 9 Yellow	Channel 10 Green	Channel 10 Yellow

Ensure that the conflict monitor will log at least nine of the most recent events detected by the monitor in non-volatile EEPROM memory (or equivalent). For each event, record at a minimum the time, date, type of event, status of each field signal indication with RMS voltage, and specific channels involved with the event. Ensure the conflict monitor will log the following events: monitor reset, configuration, previous fault, and AC line. Furnish the signal sequence log that shows all channel states (Greens, Yellows, and Reds) and the Red Enable State for a minimum of 2 seconds prior to the current fault trigger point. Ensure the display resolution of the inputs for the signal sequence log is not greater than 50 ms.

Provide a conflict monitor with Ethernet 10/100 Mbps, RJ-45 port for data communication access to the monitor by a local notebook computer and remotely via a workstation or notebook computer device connected to the signal system local area network. The Ethernet port shall be electrically isolated from the conflict monitor's electronics and shall provide a minimum of 1500 Vrms isolation. Integrate unit with Ethernet switch in cabinet.

Provide software to retrieve the time and date from a network server. This mechanism will be used to synchronize the on-board times between the conflict monitor and the controller.

Furnish Windows-based, graphic user interface software to view and retrieve all event log information. In addition, provide software that will search and display a list of conflict monitor IP addresses and IDs on the network. Furnish software to change the conflict monitor's network parameters such as IP address and subnet mask. Install on workstations and notebook computers where the signal system client software is installed.

MONITOR BOARD EDGE CONNECTOR

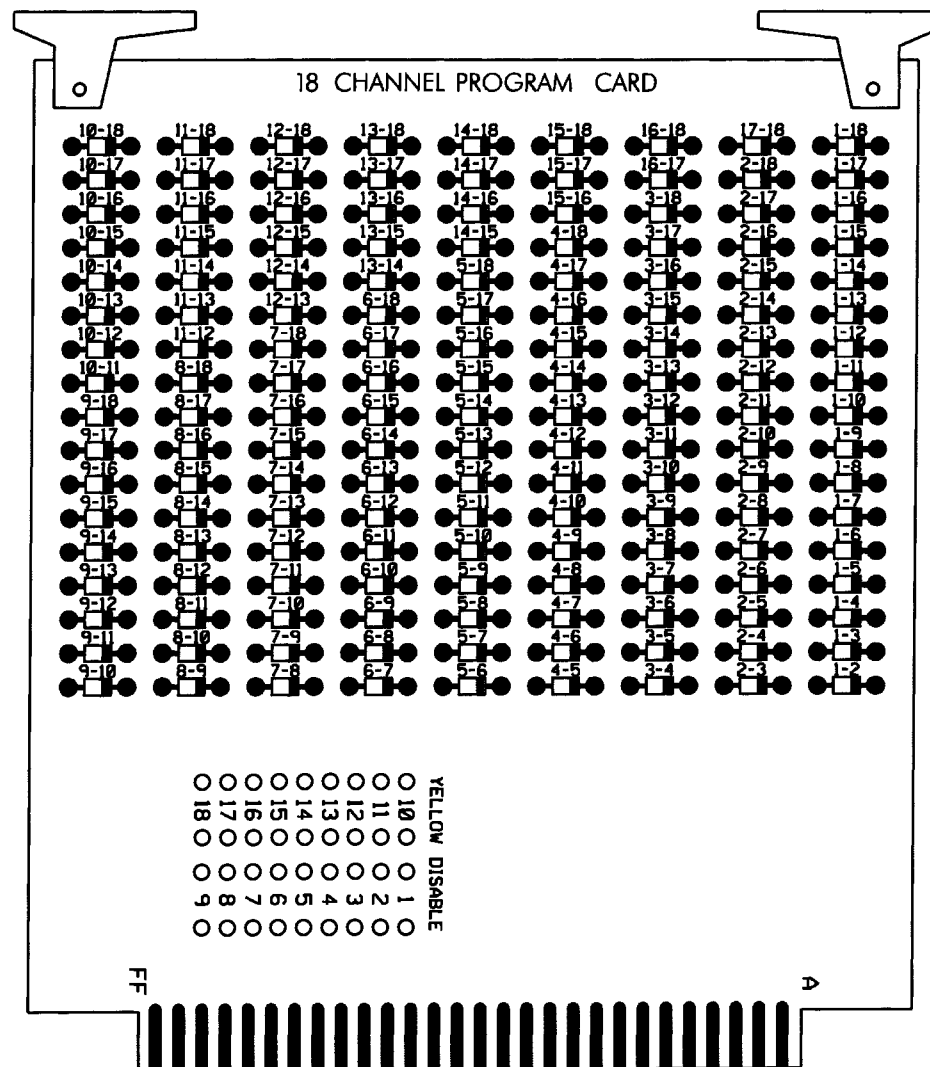
Pin #	Function (Back Side)	Pin #	Function (Component Side)
1	Channel 2 Green	A	Channel 2 Yellow
2	Channel 13 Green	B	Channel 6 Green
3	Channel 6 Yellow	C	Channel 15 Green
4	Channel 4 Green	D	Channel 4 Yellow
5	Channel 14 Green	E	Channel 8 Green
6	Channel 8 Yellow	F	Channel 16 Green
7	Channel 5 Green	H	Channel 5 Yellow
8	Channel 13 Yellow	J	Channel 1 Green
9	Channel 1 Yellow	K	Channel 15 Yellow
10	Channel 7 Green	L	Channel 7 Yellow
11	Channel 14 Yellow	M	Channel 3 Green
12	Channel 3 Yellow	N	Channel 16 Yellow
13	Channel 9 Green	P	Channel 17 Yellow
14	Channel 17 Green	R	Channel 10 Green
15	Channel 11 Yellow	S	Channel 11 Green
16	Channel 9 Yellow	T	Channel 18 Yellow
17	Channel 18 Green	U	Channel 10 Yellow
--		--	
18	Channel 12 Yellow	V	Channel 12 Green
19	Channel 17 Red	W	Channel 18 Red
20	Chassis Ground	X	Not Assigned
21	AC-	Y	DC Common
22	Watchdog Timer	Z	External Test Reset
23	+24VDC	AA	+24VDC
24	Tied to Pin 25	BB	Stop Time (Output)
25	Tied to Pin 24	CC	Not Assigned
26	Not Assigned	DD	Not Assigned
27	Relay Output, Side #3, N.O.	EE	Relay Output, Side #2, Common
28	Relay Output, Side #1, N.C.	FF	AC+

-- Slotted for keying between Pins 17/U and 18/V

CONFLICT PROGRAM CARD PIN ASSIGNMENTS

Pin #	Function (Back Side)	Pin #	Function (Component Side)
1	Channel 2 Green	A	Channel 1 Green
2	Channel 3 Green	B	Channel 2 Green
3	Channel 4 Green	C	Channel 3 Green
4	Channel 5 Green	D	Channel 4 Green
5	Channel 6 Green	E	Channel 5 Green
6	Channel 7 Green	F	Channel 6 Green
7	Channel 8 Green	H	Channel 7 Green
8	Channel 9 Green	J	Channel 8 Green
9	Channel 10 Green	K	Channel 9 Green
10	Channel 11 Green	L	Channel 10 Green
11	Channel 12 Green	M	Channel 11 Green
12	Channel 13 Green	N	Channel 12 Green
13	Channel 14 Green	P	Channel 13 Green
14	Channel 15 Green	R	Channel 14 Green
15	Channel 16 Green	S	Channel 15 Green
16	N/C	T	PC AJAR
17	Channel 1 Yellow	U	Channel 9 Yellow
18	Channel 2 Yellow	V	Channel 10 Yellow
19	Channel 3 Yellow	W	Channel 11 Yellow
20	Channel 4 Yellow	X	Channel 12 Yellow
21	Channel 5 Yellow	Y	Channel 13 Yellow
22	Channel 6 Yellow	Z	Channel 14 Yellow
23	Channel 7 Yellow	AA	Channel 15 Yellow
24	Channel 8 Yellow	BB	Channel 16 Yellow
--		--	
25	Channel 17 Green	CC	Channel 17 Yellow
26	Channel 18 Green	DD	Channel 18 Yellow
27	Channel 16 Green	EE	PC AJAR (Program Card)
28	Yellow Inhibit Common	FF	Channel 17 Green

-- Slotted for keying between Pins 24/BB and 25/CC



22.6. MATERIALS – TYPE 170 DETECTOR SENSOR UNITS

Furnish detector sensor units (i.e., detector cards) that comply with Chapter 5, Section 1, “General Requirements” and Chapter 5, Section 2, “Model 222 & 224 Loop Detector Sensor Units,” of the CALTRANS *Transportation Electrical Equipment Specifications*, dated March 12, 2009 with Erratum 1.

22.7. CONSTRUCTION METHODS

(A) General

Identify and label all field wiring (e.g., signal conductors, pushbutton wires, loop detector lead-ins, etc.) in existing controller cabinets prior to disconnecting any field wiring.

Remove existing controllers and cabinets where required. Remove the maintenance diary from the existing cabinet and place it in the new cabinet. Take existing equipment out of service only at the time directed. Provide a law enforcement officer(s) to direct traffic through the

signalized intersection while the signal is inoperable. Complete installation the new controller and cabinet and **restore signal operations within three hours** of taking the existing controller and cabinet out of service.

Turn to the next clean page (i.e., next page with no entries) in the diary and make an entry on the new page upon installation of the new controller and cabinet to document the date and time of installation. Maintain the maintenance diary and update it upon each subsequent visit to the cabinet until final acceptance of the project.

If the existing maintenance diary is found to be in poor condition or nearly full, notify the Engineer to have the City provide a new diary. Upon receipt of the new maintenance diary, place the new diary inside the cabinet and give the old diary to the Engineer for return to the City for archiving. Prior to removing the existing maintenance diary, make an entry in the old diary to document the date and time it was removed from the cabinet and turned over to the Engineer. Make the initial entry in the new maintenance diary to document the date and time of installation of the new cabinet and controller and the date the new maintenance diary was placed inside the cabinet. Maintain the maintenance diary and update it upon each subsequent visit to the cabinet until final acceptance of the project.

Locate new cabinets so as not to obstruct sight distance of vehicles turning on red.

Install controllers, cabinets, detector sensor units, and hardware that provide required phasing, color sequence, flash sequence, interconnection, railroad clearance and preemption, and emergency vehicle clearance and preemption.

For all Department-owned signals, stencil the signal inventory number on both the front and rear doors of the cabinet. Use 3-inch black characters. Do not stencil letters or numbers on the cabinets for City-owned signals.

Provide external electrical service disconnect, mounted independent of the cabinet, at all new cabinet locations and at existing cabinet locations where specified in the Plans.

Do not program controller for late night flashing operation at railroad preemption installations. For all other installations, do not program controller for late night flashing operation unless otherwise directed. Ensure all signal heads for same approach flash concurrently during flashing operation.

Provide serial number and cabinet model number for each new controller and controller cabinet installed.

When installing a pole mounted cabinet in a new location or in an existing location where new risers and cabling are replacing existing risers and cabling, mount the cabinet so that the height to cabinet middle is 4 feet from the ground below. Avoid mounting cabinets so that they overhang and encroach upon an adjacent sidewalk or pedestrian path. Where a minor overhang of the sidewalk or pedestrian path cannot reasonably be avoided, ensure that a minimum of 4 feet of clear sidewalk width will remain once the cabinet is installed. Do not mount cabinets where one of its doors opens into a street, driveway or other area subject to vehicular traffic or where an existing physical feature such as a pole, sign post, down guy, shrub or tree prevents its doors from being opened at least 90 degrees.

When replacing an existing pole-mounted cabinet with a new pole-mounted cabinet and the existing risers and cabling are being retained, mount the new cabinet so that the cabinet bottom

rests upon the existing riser connections even though this causes the cabinet middle to be higher or lower than 4 feet above ground, unless the Plans indicate or the Engineer directs otherwise. Except where the “Summary of Work by Intersection” sheet calls for use of the “Reconfigured Pole Mounted 336S Cabinet Detail” to mount the 2070L controller lower in the rack inside such cabinets, comply with the cabinet layout shown in *Roadway Standard Drawing No. 1751.01*, Sheet 2 of 2.

Do not construct new conduit entry holes into existing metal poles to attain the 4-foot mounting height.

Program and activate controllers with proposed phasing and timing.

Install all updates to the local controller software and OS9 operating system software during the life of the project up through final acceptance of the project, including existing 2070L controllers that will be retained and incorporated into the upgraded and expanded Winston-Salem Signal System.

Once all new cables have been installed in and existing cables, where applicable, have been removed from base-mounted cabinets, seal all conduits entering the cabinet base as follows:

- Seal spare conduits with approved conduit plugs.
- Seal conduits containing fiber-optic communications cable with duct and conduit sealer.
- Seal conduits containing signal cable, and loop lead-in wire with duct and conduit sealer.

Seal existing conduits as well as new conduits, regardless of whether cables are being removed from or installed in them. Comply with the requirements for conduit plugs and duct and conduit sealer in the “Underground Conduit” section of these Project Special Provisions.

(B) Existing Controllers and Conflict Monitors in Existing Cabinets

At locations indicated in the Plans where an existing 2070L controller housed in a 332 cabinet is being incorporated into the expanded Winston-Salem Signal System, remove the existing 2070L controller and existing conflict monitor and replace them with a new 2070L controller and conflict monitor. Install a new 2070L controller programmed with Department-furnished “IP version” of the OASIS™ local controller software (i.e., OASIS™ IP) and intersection-specific timing data. Install a new conflict monitor with a 10/100 Ethernet port. Return the existing controller and conflict monitor to the Department.

(C) Electrical Service and Grounding

Where electrical services do not include an external electrical service disconnect, modify or replace the electrical service as shown in the Plans to add an electrical service disconnect and a new grounding electrode system.

Provide a grounding electrode system at all new electrical services.

Comply with all requirements of the “Electrical Service” section of these Project Special Provisions.

(D) Edge Switch

Install and program the Ethernet edge switches in accordance with the “Communications Hardware” section of these Project Special Provisions.

(E) Workshop

Provide enclosed workshop to store, set up and test new controllers and cabinets before installation. Locate workshop within the City Limits of Winston-Salem. Ensure workshop provides protection from weather and sufficient space to house two test observers, all necessary test equipment and material, controllers and cabinets. Provide the workshop until final acceptance of the project.

Configure and test each controller and cabinet to match the proposed signal design. Ensure all equipment furnished and installed or modified by the Contractor at each location operates in full compliance with the Plans and Project Special Provisions. Test each controller and cabinet for proper color sequence, flashing operation, phase timings, preemption, coordination, and conflict monitor programming. Ensure that simultaneous conflicting phase outputs will cause the cabinet to revert to flashing operation. For intersections with any type of preemption, submit a completed Preemption Test Procedure Checklist. The checklist is located on the Department's Website.

Test the cabinet and controller for eight hours minimum. Following this test, and before installation, the Engineer will inspect the equipment in operation. The Engineer may require other tests to ensure proper operation. These tests shall be at no additional cost to the Department.

(F) GPS Coordinates

Provide real world coordinates for all junction boxes and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including to but not limited to manufacturer, model number, City system ID number and NCDOT inventory number) in the Microsoft Excel® spreadsheet using the format shown in example below.

City System ID#	NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
	05-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
		Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG1118HA00(Cover)
		Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG1118HA00(Cover)
		Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG1118HA00(Cover)
		Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG1118HA00(Cover)
		Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG1118HA00(Cover)
		Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG1118HA00(Cover)

22.8. MEASUREMENT AND PAYMENT

Controller with cabinet () will be measured and paid as the actual number of each type of controllers with cabinets of each type and mounting method that are furnished, installed, and accepted, subject to the following conditions: 90% of the payment will be made upon acceptance of the unit; 10% of the payment will be made following final acceptance of the integrated system (including completion of the 60-day observation period).

No measurement will be made of conflict monitors, grounding systems, modems and workshop as these will be considered incidental to furnishing and installing controllers with cabinets.

New and modified electrical services and electrical service grounding systems will be measured and paid for in accordance with the "Electrical Service" section of these Project Special Provisions.

Detector card (Model 222) will be measured and paid as the actual number of Model 222 detector cards furnished, installed, and accepted.

Auxiliary output file will be measured and paid as the actual number of auxiliary output files furnished, installed, and accepted.

Install controller (2070L) in existing cabinet will be measured and paid as the actual number of 2070L controllers with Model 2018 enhanced conflict monitors furnished, installed in existing 332 cabinets, and accepted. No measurement will be made of the new conflict monitor nor of the removal of the existing 2070L controller and conflict monitor from the existing cabinet as such work will be considered incidental to furnishing and installing the new controller in the existing cabinet.

Ethernet edge switches will be measured and paid for in accordance with the "Communications Hardware" section of these Project Special Provisions.

No measurement or payment will be made of any hardware and fasteners required for mounting controller cabinets to poles and foundations as these items will be considered incidental to installing controllers with cabinets.

No measurement or payment will be made of conduit nipples, fittings, signal cable, service wire, locknuts and bushings or other materials necessary to mount a new pole-mounted cabinet in the same location as an existing pole-mounted cabinet that is being replaced.

No measurement or payment will be made of sealing conduits with duct plugs, mechanical sealing devices and duct and conduit sealer as such work will be considered incidental to furnishing and installing controllers with cabinets.

No measurement will be made of collecting and recording GPS coordinates for controller cabinets and junction boxes and compiling this data in the prescribed Microsoft Excel[®] spreadsheet as such work will be considered incidental installing controllers with cabinets and installing controllers.

Payment will be made under:

Pay Item	Pay Unit
Controller with Cabinet (2070L, 336S, Pole Mounted)	Each
Controller with Cabinet (2070L, 332, Base Mounted)	Each
Detector Card (Model 222)	Each
Auxiliary Output File	Each
Install Controller (2070L) in Existing Cabinet	Each

23. CABINET BASE ADAPTER AND BASE EXTENDER

23.1. DESCRIPTION

Furnish and install cabinet base adapters and base extenders with all necessary hardware for 170E-family cabinets.

23.2. MATERIALS

Fabricate base adapters and extenders from the same materials and with the same finish as cabinet housing. Fabricate base adapter and extender in the same manner as controller cabinets, meeting all applicable specifications called for in Section 7.5 of CALTRANS TEES (11/19/99). Provide base adapters and extenders that have a minimum height of 12". Provide cabinet base adapters that comply with the details shown in the Plans.

23.3. CONSTRUCTION METHODS

(A) General

Unless otherwise shown in the Plans, install a cabinet base extender at locations requiring a new Model 332 cabinet on an existing/modified or new foundation and where an existing base-mounted Model 332 cabinet that is being retained does not have a cabinet base extender.

Install a cabinet base adapter at locations requiring a new Model 332 cabinet to be installed on an existing/modified foundation where the opening in the bottom of a cabinet base extender will not fit over the existing conduit spread. Unless otherwise directed by the Engineer, install cabinet base adapters only at locations indicated in the Plans. Do not install cabinet base adapters where the plans call for use of a cabinet base extender without the prior approval of the Engineer.

Where the plans require a Model 336 cabinet to be base mounted, install a cabinet base adapter or extender, as required.

Use permanent, flexible waterproof sealing material to:

- Seal between cabinet base and cabinet base adapter/extender, and
- Seal space between cabinet base adapter/extender and foundation.

23.4. MEASUREMENT AND PAYMENT

Cabinet base extender will be measured and paid as the actual number of cabinet base extenders furnished, installed, and accepted.

Cabinet base adapter will be measured and paid as actual number of cabinet base adapters furnished, installed, and accepted.

Payment will be made under:

Pay Item	Pay Unit
Cabinet Base Extender	Each
Cabinet Base Adapter	Each

24. ELECTRICAL SERVICE

24.1. DESCRIPTION

At locations called out in the Plans, install a new electrical service and modify an existing electrical service, including an external disconnect and meter base.

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.

24.2. MATERIALS

(A) Electrical Service

Provide material, equipment and hardware under this section that is pre-approved on the 2012 ITS and Signals QPL by the date of equipment installation.

Provide, modify and/or upgrade 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. Replace electrical service feeder conductors and conduits between the disconnects and the controller cabinets as required.

Provide external electrical service disconnects at all new and existing cabinet locations unless otherwise specified in the Plans. Where electrical services do not include an external electrical service disconnect, modify service to include electrical service disconnect and a new grounding electrode system.

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.

Furnish 3-wire stranded #8 AWG copper service conductors with THWN rating for supplying power to the meter base/disconnects where only one device is being connected (1 signal, 1 CCTV, or 1 communications hub cabinet). Furnish 3-wire stranded #3 AWG copper service conductors with THWN rating for supplying power to the meter base/disconnect where multiple devices are sharing the service. 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 field 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:

Traffic Signal Cabinet:

- 1 single-pole 50A breaker
- 1 spare slot/space (minimum)
- 3-wire stranded #8 AWG copper feeder conductors with THWN rating

CCTV Camera Cabinet:

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

Traffic Signal Cabinet and CCTV Camera Cabinet:

- 1 single-pole 50A breaker (Signal)
- 1 single-pole 15A breaker (CCTV)
- 1 spare slot/space (minimum)
- 3-wire stranded #8 AWG copper feeder conductors with THWN rating (Signal)
- 3-wire stranded #12 AWG copper feeder conductors with THWN rating (CCTV)

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°. 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 disconnects, meter bases, 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 a combination panel with pedestal extension as shown in the Plans for all new ground-mounted electrical service assemblies for underground electrical service. Do not provide wood posts, steel U-channel posts, square tube sign posts, metal framing channels or any method other than an underground service pedestal to mount meter bases and disconnects for new underground electrical service. 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.

Where the Plans call for modifying an existing electrical service for a traffic signal, provide a single-pole 50A inverse time circuit breaker with at least 10,000 RMS symmetrical amperes short circuit current rating to replace an existing circuit breaker in an existing disconnect.

(B) Grounding Electrodes (Ground Rods)

Furnish 5/8"x10' copper clad steel grounding electrodes (ground rods), #4 AWG solid bare copper conductors, and exothermic welding kits for grounding system installations. Comply with the NEC, the *Standard Specifications*, these Project Special Provisions and the Plans.

24.3. 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.

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. Refer to Section 1 of these Project Special Provisions for additional requirements concerning sidewalks and curbs in historic districts. 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, plus **\$500 liquidated damages per occasion, per day, or any portion thereof**, until corrected.

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. Where equipment is being attached to metal poles with a black coating, provide stainless steel bands, clamps and hardware that have a factory-applied, baked-on powder coated black satin finish that is UV fade-resistant and chip resistant. Field-application of coating and field-painting of bands, clamps and mounting hardware is prohibited. Submit catalog cuts/manufacturer's literature for banding hardware and clamps, both coated and uncoated, to the Engineer for approval.

(B) New Electrical Service for Traffic Signal

At locations identified in the Plans, install new electrical service for a traffic signal controller cabinet. Comply with *Roadway Standard Drawing* Nos. 1700.01 and 1700.02 as well as the

special details entitled “Signal Cabinet Detail, Pole-Mounted” and “Ground Mounted Electrical Service Detail” provided in the Plans.

Install a new electrical service comprised of an external service disconnect as well as a meter base with meter socket cover, even if the new service is replacing an existing non-metered electrical service. After installation of the meter base with meter socket cover, the local power company will remove the meter socket cover and transfer the existing meter or install a new meter and make any necessary connections to the power lines.

For locations that have existing PVC service risers, replace the existing electrical service with a new electrical service that has a rigid galvanized riser, as described above.

(C) 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. Mount the combination panel on the CCTV pole. 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.

(D) New Shared Electrical Service for Traffic Signal and CCTV

For locations where a single new electrical service is being provided to both a traffic signal controller cabinet and a CCTV cabinet (i.e., two separate circuits from single electrical service), install the new electrical service with two circuit breakers in the disconnect adjacent to the signal controller cabinet in accordance with the “New Electrical Service for Traffic Signal” subsection above. Install new 1” rigid galvanized underground conduits and short risers between the new disconnect and the CCTV cabinet. Route new conductors from the circuit breaker to the cabinets through the new underground rigid conduit and short risers. Permanently label the circuit breakers to identify which circuit serves the signal controller cabinet and which circuit serves the CCTV cabinet.

(E) Modify Existing Electrical Service for Traffic Signal

Where an existing electrical service for a traffic signal controller cabinet has an existing circuit breaker that is rated less than 50A, replace the existing circuit breaker with a new single-pole 50 A inverse time circuit breaker. Test and upgrade grounding system as required to ensure that grounding system complies with the grounding requirements for electrical service in these Project Special Provisions.

(F) 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 exothermic welding kits for grounding system installations. Comply with NEC, the *Standard Specifications*, these Project Special Provisions and the Plans.

Modify existing electrical services, as necessary, to meet the grounding requirements of the NEC, these Project Special Provisions and the Plans. Remove any ground rods in the cabinet foundation and install a new grounding electrode system. Cut off abandoned ground rods in the cabinet foundation flush with the foundation surface. Where a grounding electrode system is connected to the electrical service in accordance with the NEC, test grounding electrode resistance for a maximum of 20 ohms. Grounding electrode resistance test must be verified or witnessed by the Engineer or the Engineer's designated representative. Furnish and install additional ground rods to grounding electrode system as necessary to meet the requirements of these Project Special Provisions and test requirements.

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. The form is located 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.

24.4. MEASUREMENT AND PAYMENT

New electrical service will be measured and paid for as the actual number of complete, functional electrical service locations furnished, installed and tested, regardless of type (i.e., traffic signal only; CCTV cabinet only; shared service for signal and CCTV).

No measurement will be made of risers with weatherheads for electrical service as they will be considered incidental to furnishing and installing a new 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, black powder coating of disconnect and meter base where required and any remaining hardware and conduit to connect the electrical service to the cabinet as they will be considered incidental to furnishing and installing new electrical service.

Modify existing electrical service (traffic signal) will be measured and paid for as the actual number of existing electrical service locations that have been modified by replacing an existing breaker with a new 50A breaker.

5/8" X 10' grounding electrode (ground rod) will be measured and paid as the actual number of 5/8" copper clad steel ground rods furnished, installed and accepted as part of grounding systems for new and modified electrical services and equipment cabinet disconnects. No separate payment will be made for #4 AWG solid bare copper grounding conductors or exothermic welding kits as they will be considered incidental to furnishing and installing the

ground rod. No measurement and payment for grounding electrodes furnished and installed for purposes other than electrical service grounding systems.

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

The Department will make no payment for a given new electrical service until all repairs to paved and unpaved surfaces damaged/disturbed during the installation the electrical service have been completed and accepted.

Repair and replacement of existing sidewalk will be measured and paid for in accordance with the “Equipment Cabinet Foundations” section of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
New Electrical Service	Each
Modify Existing Electrical Service (Traffic Signal)	Each
5/8” x 10’ Grounding Electrode	Each

25. ETHERNET RADIO

25.1. DESCRIPTION

Furnish and install an Ethernet radio system with all necessary hardware and signage in accordance with the Plans and this Project Special Provision to provide a data link between traffic signal controllers. Provide a radio system with a bi-directional, full duplex communications channel between two “line-of-sight” antennas using license free, spread spectrum technology operating in the 902-928 MHz frequency band.

Furnish material and workmanship conforming to the *National Electrical Code* (NEC), the *National Electrical Safety Code* (NESC), Underwriters Laboratories (UL) or a third-party listing agency accredited by the North Carolina Department of Insurance, and all local safety codes in effect on the date of advertisement. Comply with all regulations and codes imposed by the owner of affected utility poles.

25.2. MATERIALS

(A) General

Refer to “Pole Line Hardware” subsection in the “Messenger Cable” section of these Project Special Provisions.

Refer to the following articles of the *Standard Specifications*:

Wire	1091-2
Signs and Hardware	1092-1
Retroreflective Sheeting	1092-2

Refer to *Roadway Standard Drawing* No. 1756.01.

(B) 900 MHz Ethernet Radio Transceivers

Furnish license free 902 – 928 MHz Ethernet radio transceivers with antennas, coaxial cable and mounting hardware, and configuration software. Design radio transceivers to work in “point-to-point”, “store and forward repeater”, “point-to-multipoint” and “peer to peer” configurations. Provide radios that can operate as repeaters. Ensure the 900 MHz Ethernet radio transceivers meet the following minimum requirements:

- License free (ISM) spread spectrum radio band (902 – 928 MHz),
- Frequency hopping technology (direct sequence spread spectrum technology is not acceptable),
- Bi-directional, full duplex,
- Provide at least 3 Programmable Radio Frequency (RF) output levels ranging from 1mW up to 1 Watt,
- Provide user-selectable radio frequency channels (Min. 50) and hopping patterns (Min. 50) that will allow the user to adjust operating characteristics to avoid interference within the intended 902 – 928 MHz frequency range,
- Ethernet interface capable of operating at 1.1 Mbs with a data rate of 345 Kbps,
- DB9-F connector for RS-232/422/485 serial port,
- Maximum of 8mSec. end-to-end latency
- 16 bit Cyclic Redundancy Check (CRC) error checking with auto re-transmit,

- Built-in store-and-forward (single radio repeater, back-to-back radio set-ups are not allowed to accomplish this function),
- Data encryption 128 bit WEP, 128 bit WPA, 256 Bit AES,
- Receiver sensitivity of -108dBm @ 10^{-6} BER,
- Antenna port: Threaded Connector (Nickel or Silver Plated Brass),
- Front panel LED indicators:
 - Power,
 - Transmit data,
 - Receive data,
 - Data Port Indicators, consisting of at least 3 LED's grouped together representing a Low, Medium or High Signal Strength with regards to the communications link with another targeted radio. Software running on a laptop is not acceptable in meeting this requirement for front panel LED Data Port Indicators.
- Operating temperature of -40 to $+165^{\circ}\text{F}$ at 0 to 95% Humidity.
- Power supply requirements:
 - Wall adapter:
 - Input Voltage (120 VAC UL/CSA) wall cube plug-in module
 - Output Voltage (6 VDC to 24 VDC)
 - Typical current draw of no greater than 400 mA when powered with 12 VDC input, and transmitting 1 Watt of RF output power.
 - Radio Sleep mode with a maximum current draw of $<1\mu\text{A}$; and
- Shelf mounted design.

Furnish a Radio Frequency Signal Jumper constructed of an RG-58 Coaxial Cable. On one end of the cable, supply a RF Threaded Connector that is compatible with the radio supplied and on the other end supply a Standard N-Type Male Connector to mate with the lightning arrestor. Provide the jumper in 6-foot lengths. Ensure that the cable is pre-assembled by a manufacturing facility. Contractor and Vendor assembled cables are not acceptable.

Furnish an Ethernet data interface cable to be installed between the Ethernet radio and either a traffic signal controller or Ethernet edge switch. Ensure cable is a minimum of 6 feet long. Ensure that the cable is assembled in a manufacturing facility. Contractor and/or Vendor assembled cables are not acceptable.

Ensure that installing the Ethernet radio system with a fully functional traffic signal controller does not require any field device modifications with regards to hardware or software.

(C) Software

Furnish units with a Windows[®]-based software program that uses a GUI (Graphical User Interface) to provide “remote programming, radio configuration, remote maintenance, diagnostics and spectrum analyzer” features. Ensure the software will operate on all past and current Microsoft[®] Windows[®] operating platforms: Windows 98[®], Windows 2000[®], Windows NT[®], Windows XP[®], Windows Vista[®] or Windows[®] 7. Provide software approved by the Engineer that is designed to function with the approved radio. Provide configuration software that can be upgraded in the future at no additional charge.

Ensure the radio modem is configurable from a single location (i.e. master radio location) via supplied software (no extra cost). Furnish software supplied with drivers to allow easy set-up

with all industry standard traffic signal controllers, including 2070 controllers containing custom software written specifically for the North Carolina Department of Transportation.

(D) Directional Antenna (Yagi)

Furnish a directional antenna of welded construction that allows for vertical and horizontal polarization. Furnish 8.5 dBd Gain or 13 dBd Gain antenna that meets the following minimum specifications:

Properties of 8.5 dBd Gain Antenna

Property	Requirement
Frequency range	896 – 940 MHz
Nominal gain	8.5 dBd
Front to back ratio	18 dB
Horizontal beamwidth (at half power points)	65 degree
Vertical beamwidth (at half power points)	55 degree
Power rating, UHF frequency	200 Watts
Lightning protection	DC ground
Termination	Coaxial pigtail with a standard N-Type female connector
Impedance	50 ohms
Length	24"
Rated wind velocity	125 mph
Rated wind velocity (with 0.5 inch radial ice)	100 mph
Projected wind surface area (flat plane equivalent)	0.26 sq ft
Number elements	6

Furnish mounting hardware with the antenna that will secure the antenna to a mounting pipe that has a 1.5" Nominal Pipe Size (approximately 2" OD pipe diameter), as recommended by the manufacturer of the antenna and as approved by the Engineer.

C-5224B – Winston-Salem Signal System – Phase B**Properties of 13 dBd Gain Antenna**

Property	Requirement
Frequency range	902 – 928 MHz
Nominal gain	13 dBd
Front to back ratio	20 dB
Horizontal beamwidth (at half power points)	40 degree
Vertical beamwidth (at half power points)	35 degree
Power rating, UHF frequency	200 Watts
Lightning protection	DC Ground
Termination	Coaxial pigtail with a Standard N-Type Female Connector
Impedance	50 ohms
Length	53"
Rated wind velocity	125 mph
Rated wind velocity (with 0.5 inch radial ice)	100 mph
Projected wind surface area (flat plane equivalent)	0.46 sq ft
Number elements	13

Furnish mounting hardware with the antenna that will secure the antenna to a mounting pipe that has a 1.5" Nominal Pipe Size (approximately 2" OD pipe diameter), as recommended by the manufacturer of the antenna and as approved by the Engineer.

(E) Omnidirectional Antenna

Furnish a omnidirectional antenna of solid, single piece construction that meets the following minimum specifications:

Properties of Omnidirectional Antenna

Property	Requirement
Frequency range	900-928 MHz
Nominal gain	Typical gains of 3 or 6 dBd (dependent upon gain needed for application)
Termination	Standard N-Type female connector
Impedance	50 ohms
VSWR	1.5:1
Vertical beam width	33 degrees (3 dBd gain) 17 degrees (6 dBd gain)
Lightning protection	DC ground
Power rating, UHF frequency	100 Watts
Length	25" (3 dBd gain), 65" (6 dBd gain)
Rated wind velocity	125 mph

Furnish mounting hardware with the antenna that will secure the antenna to a mounting pipe that has a 1.5" Nominal Pipe Size (approximately 2" OD pipe diameter), as recommended by the manufacturer of the antenna and as approved by the Engineer.

(F) Antenna Mounting Hardware Kit

Furnish an antenna mounting kit to support the antenna when attached to a metal pole, mast arm or wood pole.

Ensure the Antenna Mounting Hardware Kit includes at least one 96" galvanized steel cable with a stainless steel bolt, nut and lock washer assembly on each end. Ensure the pole base plate accepts a 1 1/2" NPT aluminum pipe, and provides a surface that is at least 6 3/4" long x 4 1/4" to provide contact with the pole. Ensure the pole base plate is designed to allow both ends of the 96" galvanized cables to be secured and tightened to the base plate. Provide a 90 degree elbow with internal threads on both ends to accommodate 1-1/2" NPT aluminum pipes. Provide a 1-1/2" x 18" long aluminum pipe threaded on both ends and a 1 1/2" x 24" aluminum pipe threaded on one end with an end cap.

(G) Coaxial Cable

Furnish 400 Series cable to provide a link between the antenna and the lightning arrestor that meets the following minimum specifications:

Properties of Coaxial Cable

Property	Requirement
Attenuation (dB/100 ft) @ 900 MHz	3.9 dB
Power rating @ 900 MHz	0.58 kW
Center conductor	0.108" diameter Copper Clad Aluminum
Dielectric: Cellular PE	0.285" diameter
Shield	Aluminum Tape – 0.291" diameter Tinned Copper Braid – 0.320" diameter
Jacket	Black UV protected polyethylene
Bend radius	1" with less than 1 ohm impedance change at bend
Impedance	50 ohms
Capacitance per foot	23.9 pF/ft
End connectors	Standard N-Type Male Connectors on both ends

(H) Standard N-Type Male Connector

Furnish standard N-Type male connector(s) of proper sizing to mate with the 400 series coaxial cable and use a crimping method to secure the connector to the coaxial cable. Furnish a connector that meets the following minimum requirements:

- 1) Center contact: Gold plated beryllium copper (spring loaded, non-solder),
- 2) Outer contact: Silver plated brass,
- 3) Body: Silver plated brass,
- 4) Crimp sleeve: Silver plated copper,
- 5) Dielectric: Teflon PTFE,

- 6) Waterproofing sleeve: Adhesive lined polyolefin – heat shrink,
- 7) Attachment Size: Crimp Size 0.429" (minimum) hex, and
- 8) Electrical Properties:
 - a) Impedance: 50 ohms,
 - b) Working voltage: 1000 vrms (max),
 - c) Insertion loss: $0.1 \times \sqrt{F_{GHz}}$ and
 - d) VSWR: 1.25:1 (max) up to 3GHz.

(I) Coaxial Cable Shield Grounding and Weatherproofing Kits

Furnish a coaxial cable shield grounding kit containing components that will adequately bond and ground the cable shield to the pole ground. Ensure the grounding kit complies with MIL-STD-188-124A for coaxial cable and protects the cable from lightning currents in excess of 200kA. Ensure each kit is supplied, as a minimum, with the following:

- Preformed strap: 24 Gauge copper strap that is a minimum of 1-5/8 inch long and is sized to mate with the 400 series coaxial cable,
- Tensioning hardware: Copper nuts and lock washers,
- Grounding lead cable: #6 AWG, stranded, insulated copper wire

Furnish a weatherproofing kit containing components that will protect the coaxial cable shield grounding system against the ingress of moisture and prevent vibrations from loosening the connections. Ensure the weatherproofing kit is supplied, as a minimum, with the following:

- Butyl mastic tape: 3-3/4 inches wide by 24 inches long (approximately),
- Electrical tape: 2 inches wide by 20 inches long (approximately)

(J) Coaxial Cable Power Divider (Splitter)

Furnish a coaxial cable power divider for repeater radio sites in accordance with the table below. Ensure the power divider accommodates a single primary input RF source and divides/splits the signal (power) equally between 2 output ports.

Properties of Coaxial Cable Power Divider

Property	Requirement
Power Division	2 - Way
Frequency	900 - 1100 MHz
Insertion Loss	0.22 dB
Impedance	50 Ohm
VSWR ref. to 50 Ohm (max)	1.3:1
Max. Input Power	500 Watts
Connectors	Standard N-Type Female
Dimension	2.5"W x 5"L
Weight	1.5 lb (approximately)

(K) Lightning Arrestor

Furnish a lightning arrestor installed in line between each antenna and its designated radio modem inside the equipment cabinet that complies with the requirements listed in the table below. Furnish a lightning arrestor with multi-strike capability, low strike throughput energy, flange mount and bulkhead mount options and a standard N-Type female connector on both the surge-side and protected-side connectors.

Properties of Lightning Arrestor

Property	Requirement
Filter Type	DC Block (non gas tube design)
Surge	20kA, 800MHz to 2.0GHz $\leq 1.1 : 1$ VSWR 18kA, 800MHz to 2.3GHz $\leq 1.1 : 1$ VSWR 18kA, 700MHz to 2.7GHz $\leq 1.2 : 1$ VSWR
Insertion loss	≤ 0.1 dB over frequency range
Max power	500 w @ 920MHz (750 W @ at 122° F)
RF power	300 Watts
Let through voltage	$\leq \pm 3$ Volts for 3kA @ 8/20 μ s Waveform
Throughput energy	≤ 0.5 μ J for 3kA @ 8/20 μ s Waveform
Temperature	-40 to 185° F Storage/Operating 122° F
Vibration	1G at 5 Hz up to 100Hz
Unit impedance	50 Ω
VSWR	1.1:1
Frequency range	800 MHz to 2200 MHz

(L) Disconnect Switch

Where an antenna is mounted on a joint-use pole, furnish a double pole, single throw snap switch in a weatherproof outlet box with cover, suitable for use in wet locations. Ensure outlet box and cover supports a lockout tag device. Ensure outlet box includes one ½-inch hole in back of box. Furnish mounting hardware, sealing gaskets and lockout tag. On NCDOT and City-owned poles, the disconnect switch can be omitted.

(M) Warning Signs(s) and Decal(s)

Where an antenna is mounted on a joint-use pole, furnish an “RF Warning Sign” and “Decal” in accordance with *Roadway Standard Drawing* No. 1736.01, Sheets 3 and 4 of 5. Furnish stainless steel banding hardware or other attachment method approved by the Engineer to secure the sign to either metal or wood poles. On NCDOT or City-owned poles, the warning signs and decals are not required and may be omitted.

25.3. CONSTRUCTION METHODS**(A) General**

Perform a radio path site survey test before installing any equipment. Ensure the test evaluates the Signal Strength (dBm), Fade Margin (dB), Signal-to-Noise Ratio, Data Integrity (poll test), and a complete frequency spectrum scan. Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed. During the initial radio path signal strength test it may be determined that a repeater station may be necessary to

complete the intended link. Provide the test results to the Engineer for review and approval. Submit copies of the test results and colored copies of the frequency spectrum scan along with an electronic copy of this information. The Engineer will approve final locations of antennas and any necessary repeater stations. Install a coaxial cable, a power divider, an antenna splitter cable and additional antenna locations where it is determined that a dual antenna configuration is necessary to accommodate communications in multiple directions.

Install the antennas in accordance with the following table:

Location	Antenna	
	Direction Pointing	Type/Gain
Peters Creek Parkway at Bridgton Road	South	1- Yagi (13 dB)
Peters Creek Parkway at Olivers Crossing Road	North	1- Yagi (13 dB)
Ebert Road at London Lane	South	1- Yagi (13 dB)
Ebert Road at Ardmore Road	North	1- Yagi (13 dB)

At certain locations it may be necessary to integrate the radio system with a fiber-optic system. Follow the details shown in the fiber-optic splice plans.

Refer to and comply with *Roadway Standard Drawing* No. 1756.01.

(B) Antenna

Install the antenna in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the NESC) and as specified in the antenna manufacturer's recommendations. Secure the antenna mounting hardware to the pole and route the coaxial cable such that no strain is placed on the N-Type Male coaxial connectors. On wood pole installations, bond the antenna mounting hardware to the pole ground using # 6 AWG bare copper wire using split bolt or compression type fitting. Install two antennae at a repeater site with a coaxial antenna cable splitter. Secure splitter to pole.

(C) Cabling

Install the coaxial cable shield grounding system by carefully removing the outer jacket of the coaxial cable without damaging the cable shield. Install the shield grounding system following the cable manufacturer's recommendations. Install and weatherproof the connection using the appropriate weatherproofing materials and following the manufacturer's recommendations. On wood poles, secure the #6 AWG grounding lead cable to the pole ground using split bolt or compression type fitting or an Engineer approved method. On metal poles, secure the #6 AWG grounding lead cable to the pole using an Engineer approved method.

Do not exceed the 1-inch bend radius of the coaxial cable as it traverses from the cabinet to the antenna assembly. Connect the lightning arrestor to the coaxial cable in the equipment cabinet. Properly ground and secure the arrestor in the cabinet.

(D) Cabinet and Electrical Power Wiring

Fasten all wiring and harness supports to the cabinet with screws or other removable mechanical means. Do not use adhesives.

Do not locate terminals on the underside of the shelf or at other places where they are not readily visible and accessible, or where they may be a hazard to personnel. Provide a clear plastic guard for exposed 120 VAC terminals on the power panel.

Permanently label all cables entering the cabinet. Ensure the power supply for the radio system is **NOT** connected to the GFCI receptacle circuit located in the cabinet. Place a copy of all manufacturer equipment specifications and instruction and maintenance manuals in the equipment cabinet.

(E) Disconnect Switch

At locations where the antenna is mounted on a joint-use pole, install a double pole, snap switch to remove power from the Ethernet radio transceiver system. Comply with *Roadway Standard Drawing* No. 1756.01, Sheet 1 of 5. Do not mount weatherproof box on the traffic signal cabinet door. Drill a hole in the side of the traffic signal cabinet. Mount the outlet box over the hole using a ½-inch chase nipple and bushings. Ensure sealing gaskets are in place and no water can enter the cabinet. Securely mount the weatherproof outlet box with additional mounting screws. Bond the outlet box to the equipment ground bus. Run the power supply cord of the Ethernet radio unit into the outlet box and connect to switch. Securely attach power supply cord to equipment rack. Install disconnect switch with lockout tag cover. The disconnect switch is required where the antenna is mounted on a joint-use pole. If the antenna is mounted on an NCDOT or City-owned pole, the disconnect switch is not required and may be omitted.

Do not install the power supply for the radio in a GFCI protected outlet.

(F) Warning Sign(s) and Decal(s)

At locations where the antenna is mounted on a joint use pole, mount the warning sign to the pole as shown on *Roadway Standard Drawing* No. 1736.01, Sheet 2 of 5. Ensure there are no conflicts between the warning sign and surrounding utilities. Mount warning sign to be easily viewed. Do not mount warning sign under pole grounds or conduit.

Clean and remove any dirt or oil on traffic cabinet before placing decal. Place decal adjacent to the disconnect switch located on the outside of traffic cabinet as shown on *Standard Drawing* No. 1736.01, Sheet 1 of 5.

The RF warning signs and decals are required when antennas are mounted on joint-use poles. If the antenna is mounted on an NCDOT or City-owned pole, the warning signs and decals are not required and may be omitted.

25.4. MEASUREMENT AND PAYMENT

900MHz Ethernet Radio will be measured and paid as the actual number of Ethernet radios furnished, installed and accepted according to following conditions: 80% of the payment will be made upon acceptance of the installed radio system and the remaining 20% of the payment will be made following final acceptance (including completion of the 60-day Observation Period). This item includes the appropriate sized antenna(e), antenna mounting hardware, radio, power supplies and power cords, disconnect/snap switch, signs, decals, data interface cable, coaxial cable, lightning arrestor, radio frequency jumper, coaxial cable power divider (splitter), coaxial

cable connectors, coaxial cable shield grounding system with weatherproofing, labeling, any integration between the radio system and a fiber-optic network if necessary, installation materials and configuration software necessary to complete this work, including the radio path site survey and warranties.

Riser assemblies will be measured and paid for separately in accordance with the “Riser Assemblies” section of these Project Special Provisions.

Payment will be made under:

Pay Item

900MHz Ethernet Radio

Pay Unit

Each

26. ETHERNET CABLE

26.1. DESCRIPTION

Furnish and install copper Ethernet cable, as shown in the Plans, for interconnecting various hardware in an Ethernet network located between the traffic signal cabinets, CCTV cabinets, the TMC, the Signal Shop and the Bryce Stuart Building.

26.2. MATERIALS

(A) Ethernet Cable

Provide Category 5 Enhanced (5e) Ethernet cable that complies with ANSI/TIA-568-A-5 standards for four-pair shielded twisted copper for Ethernet communications. The cable shall meet all of the mechanical requirements of ANSI/ICEA S-80-576 applicable to four-pair inside wiring cable for plenum or general cabling.

Furnish Ethernet cable meeting the following minimum performance requirements:

- Specified frequency range: 1-100 MHz
- Attenuation: 24 dB
- NEXT: 37.1 dB
- ACR: 3.1 dB
- ELFEXT: 17 dB
- Power-sum ELFEXT: 14.4 dB
- Return loss: 8 dB
- Propagation delay: 548 nsec
- Delay skew: 50 nsec

Furnish Ethernet cable meeting the following physical requirements:

- Jacket: PVC, UV resistant
- Insulation: Polyolefin
- Core: Gel-filled or flooded core
- Binder: Clear mylar with 100% coverage
- Shield: Aluminum/mylar with 100% coverage
- Drain Wire: 24 AWG, seven stranded tinned copper
- Conductors: Annealed bare copper
- Conductor size: 24 AWG

For Ethernet cable installed in outdoors on aerial messenger cable and in underground conduits, provide the cable rated for such conditions (i.e., UV-resistant, wet conditions, etc.).

(B) Connectors

Provide RJ-45 connectors with gold wire conductors terminated according EIA/TIA-568-A/568-B standards. Provide connectors with eight contacts. Furnish connectors appropriately rated for the cable being installed. Provide cables with factory-installed connectors for interior cables.

(C) Ethernet Patch Cords

Furnish Fast Ethernet patch cords meeting the following physical requirements:

- Minimum of five (5)-foot length,
- Category 5e,
- RJ-45 connectors on both ends,
- Molded anti-snag hoods over connectors, and
- Gold plated connectors.

Furnish Ethernet patch cords meeting the following minimum performance requirements:

- TIA/EIA-568-A-5, Additional Transmission Performance Specifications for 4-pair 100 Ω Enhanced Category 5e 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: 10 dB. and
- Propagation Delay: 548 nsec.

(D) Environmental Requirements

Provide 4-pair twisted copper Ethernet cable and connectors rated for an ambient operating temperature range of -30° 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.

26.3. CONSTRUCTION METHODS**(A) General**

Install Category 5e Ethernet cable for traffic signal controller cabinets, traffic signal and utility poles, and in conduits or on messenger cable to bring the cable between traffic signal controller and CCTV cabinets.

Furnish all tools, equipment, materials, supplies, and hardware necessary to install a fully operational Ethernet cable system as depicted in the Plans. Install the Ethernet cable 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.

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.

Immediately cease work and notify the Engineer and the affected owner should damage to existing cables or equipment occur. Make the required repairs at no additional cost to the Department.

Provide the Engineer with three copies of the Ethernet cable manufacturer's recommended and maximum pulling tensions for each Ethernet cable size before the installation of Ethernet cable.

Install Ethernet cable in continuous lengths with no splices outside cabinets.

Cut cables to length to minimize coils of spare cable. Cut outer jacket and trim conductors per manufacturer's recommendations. Ensure all conductors extend to the end of the channel and make solid electrical contact with the gold connectors. Crimp the RJ-45 connector body to lock conductors in channels.

(B) Aerial Installation

Use pole attachment hardware and roller guides with safety clips to install the aerial Ethernet cable.

Maintain tension during the pulling process for aerial run Ethernet cable by using a mechanical clutch (dynamometer) device with breakaway swivel approved by the Engineer. Do not exceed 80 percent of the manufacturer's maximum allowable pulling tension. Do not allow the Ethernet cable to contact the ground or other obstructions between the poles during installation. Do not use a motorized vehicle to generate cable-pulling forces.

(C) Messenger Cable Installation

Double lash the Ethernet cable to the messenger cable where the messenger cable is used solely to support the communications cable.

Wrap the communications cable to the messenger cable using aluminum ribbon wraps where the messenger cable supports other cables (i.e., traffic signal cable, lead-in cable, etc.).

(D) Underground Installation

Install underground Ethernet cable as shown in the Plans using cable-pulling lubricants approved by the Ethernet cable manufacturer and the Engineer. Obtain the Engineer's approval of the cable lubricant and method of pulling before the installation of underground Ethernet cable.

Do not exceed 80 percent of the manufacturer's maximum pulling tension when installing underground Ethernet cable.

Use a clutch device (dynamometer) with breakaway swivel so as not to exceed the allowable pulling tension if the cable is pulled by mechanical means. Do not use a motorized vehicle to generate cable-pulling forces.

Keep tension on the cable reel and the pulling line at the start of each pull. Do not release the tension in the cable if the pulling operation is halted. Restart the pulling operation by gradually increasing the tension until the cable is in motion.

Set cable reels up on the same side of the junction box as the conduit section in which the cable is to be installed. Place the reel level and align the reel with the conduit section such that the cable will pass from the top of the reel in a smooth bend into the conduit without twisting. Do not pull the cable from the bottom of the reel. Manually feed the cable by rotating the reel. Do not pull the cable through intermediate junction boxes, pull boxes, handholes, or openings in conduit unless otherwise approved by the Engineer.

Crimp the RJ-45 connector body to lock conductors in channels. Test each connector from end to end.

(E) Ethernet Patch Cords

Install Ethernet patch cords between Ethernet patch panels and devices and network interface box and devices.

26.4. MEASUREMENT AND PAYMENT

Ethernet cable will be measured and paid as the actual linear feet of Ethernet cable furnished, installed, and accepted. Measurement will be made by calculating the difference in length markings located on outer jacket from start of run to end of run for each run. No measurement will be made of connectors as such work is considered incidental to installing the Ethernet cable.

No measurement will be made for Ethernet patch cables that connect adjacent devices/equipment (e.g., between an edge switch and a controller housed in the same cabinet) as they will be considered incidental to furnishing and installing the equipment that they connect.

Payment will be made under:

Pay Item

Ethernet Cable

Pay Unit

Linear Foot

27. CCTV FIELD EQUIPMENT

27.1. DESCRIPTION

Furnish and install CCTV field equipment, cabinets and local camera control software described in this Section. Remove and deliver existing CCTV field equipment and cabinets that will not be used per Section 1 of these Project Special Provisions and as shown in the Plans.

Furnish and install new electrical service for CCTV as shown in the Plans.

Provide a system to protect field devices and electronic equipment from lightning and surge protection using UL[®] listed surge protection devices.

27.2. MATERIALS

(A) General

Provide new CCTV camera assemblies with composite cable and CCTV cabinets.

Each CCTV camera assembly shall consist of the following:

- NEMA environmental dome enclosure,
- CCTV color digital signal processing camera unit with zoom lens, filter, control circuit, and accessories,
- Control receiver/driver that complies with the NTCIP specifications listed below,
- Motorized pan, tilt, and zoom,
- Power supplies,
- Pole-mount camera attachment hardware,
- All necessary cable, connectors and incidental hardware to make a complete and operable system,
- NEMA Type 4, IP 66 enclosure constructed of aluminum with a clear acrylic dome or approved equal camera unit housing,
- 60-foot composite cable for power supply and video and data transmission, and
- Surge protection devices.

Each CCTV cabinet assembly shall consist of the following:

- Type 336A cabinet, pole-mounted or base-mounted as shown on the Plans,
- Local interface panel,
- Power supplies/transformers,
- Transient voltage surge suppressors, and
- All necessary cable, connectors and incidental hardware to make a complete and operable system.

Provide camera software as described herein only if the cameras are of a different model and brand from what currently exists in the City's CCTV system.

Provide CCTV field equipment that is fully compatible and interoperable with existing CCTV field equipment and existing CCTV central software installed by others under City Projects C-5142 and C-4198.

(B) Standards

- ANSI,
- ASTM,
- CE, Class B,
- EIA Standards 170, 232, 422, 250C and 485,
- FCC Rules Part 15, Sub-part J,
- FCC Class A,
- FCC, Class B,
- IEEE,
- ICEA,
- IMSA,
- ISO 9001,
- NEC,
- NEMA 4X, IP 66,
- NEMA Type 1,
- NTSC, and
- UL Listed.

Provide UL listed surge protection devices according to the UL 1449, 2nd edition standard that comply with the NEMA requirements as detailed in the NEMA LS 1 (1992) standard.

Provide a means to ground all equipment as called for in the Standard Specifications, these Project Special Provisions, and the Plans.

(C) Camera Assembly**(1) Cameras**

Provide new ¼-inch charged-coupled device (CCD) color day/night cameras. Provide cameras with automatic gain control (AGC) for clear images in varying light levels. The camera must meet the following minimum requirements:

- Video signal format: NTSC composite color video output, 1 volt peak to peak,
- Horizontal resolution: 540 TV Lines,
- Image sensor resolution: 768 horizontal pixels by 752 vertical pixels,
- Automatic gain control (AGC): 0-20 dB, peak-average adjustable,
- White balance: Automatic through the lens with manual override,
- Electronic-shutter: Dip-switch selectable NTSC electronic shutter with speed range from 1/2 of a second (off) to 1/30,000 of a second (NTSC),
- Overexposure protection: Built-in circuitry or a protection device to prevent any damage to the camera when pointed at strong light sources, including the sun,
- Gain control: Automatic and manual,
- Sensitivity: 1.5 lux at 90% scene reflectance,
- Sync system: Internal AC line lock, phase adjustable using remote control, V-sync,

- Signal to noise ratio: Greater than 50 dB,
- Video output connection: 1-volt peak to peak, 75 ohms terminated, BNC connector, and
- Primary voltage: 120 VAC,
- Camera voltage: 24 VAC or 24 VDC, and
- Camera power: 73 VA with heater at 24 VAC or 3 amps at 24 VDC.

(2) Lens

Provide each camera with a motorized zoom lens with automatic iris control with manual override and neutral density spot filter. Provide lenses that meet the following optical specifications:

- Automatic focus: Automatic with manual override,
- Horizontal angle of view: 54 degrees at 3.6 mm wide zoom and 2.5 degrees at 82 mm telephoto zoom,
- Focal length: 3.6 mm to 124 mm, 35X optical zoom, 12X electronic zoom,
- Zoom Speed: 2.9, 4.2 and 5.8 seconds,
- Lens aperture: Minimum of f/1.6,
- Maximum Sensitivity at 35 IRE: .025 lux at ½ second color, .1 lux at 1/60 second black and white, .004 lux at ½ second black and white,
- Preset positioning: Minimum of 128 presets.

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. Provide mechanical or electrical means 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.

(3) Pan and Tilt Unit

Equip each new dome style assembly with a pan and tilt unit. The pan and tilt unit must be integral to dome system. The pan and tilt unit must be rated for outdoor operation, provide dynamic braking for instantaneous stopping, prevent drift, and have minimum backlash. The dome must have an auto flip dome rotation to rotate and reposition camera for viewing objects passing below camera. Provide electronic image stabilization. The pan and tilt units must meet or exceed the following specifications:

- Pan: Continuous 360 degrees,
- Tilt: +2 to -92 degrees minimum,
- Presets: Minimum of 128 presets,
- Preset accuracy: .1 degree,
- Preset pan speed: .1 degrees/second to 200 degrees/second,
- Preset tilt speed: .1 degrees/second to 400 degrees/second,

- Privacy zones: Minimum of eight user configurable shapes,
- Input voltage: 24 VDC or 24 VAC, and
- Motors: Two-phase induction type, continuous duty, instantaneous reversing.

(4) Power Supplies

Provide all power supplies necessary for the camera and its pan tilt unit. Mount power supplies in the camera cabinet and utilize composite cable to supply power the camera and pan tilt unit.

(5) Control Receiver/Driver

Each new camera unit must contain a control receiver/driver that is integral to the CCTV dome assembly. The control receiver/driver must 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, and
- Minimum of 128 preset positions for pan, tilt, and zoom.

In addition, each control receiver/driver must accept status information from pan/tilt unit and motorized lens for preset positioning of those components. The control receiver/driver must relay pan, tilt, zoom, and focus positions from the field to remote camera control units. 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.

(6) Camera Housing

Provide new dome style enclosure for assemblies with a high performance integrated dome system or approved equal. Provide the dome housing with a 1½” NPT threaded cable entry. Equip each camera housing with a mounting assembly for attachment to the CCTV camera pole. The enclosures must be equipped with a strip heater. Provide a sunshield fabricated from corrosion resistant aluminum and finished in a neutral color of weather resistant enamel. The viewing area of the enclosure must be tempered glass.

For CCTV-08 at the intersection of Peters Creek Parkway and Stafford Village Boulevard, provide a dome enclosure that is black in color for consistency with the black finish on the existing metal pole with mast arm to which it is being attached.

Provide surge protectors for all ungrounded conductors that will enter the CCTV enclosure as described below. House the surge protectors within the CCTV housing in a manner approved by the Engineer.

A dome-type environmental housing shall have a sustained ambient operating temperature of -50 degrees F to 122 degrees F, with 100 percent non-condensing relative humidity as defined within the NEMA TS-2 (1998) standard.

The enclosure shall have a NEMA 4X/IP-66 rating.

(D) Composite Cable

Provide a composite cable for carrying the CCTV power, analog video and serial data between the camera and CCTV cabinet. The composite cable shall consist of:

- Outer jacket composed of UV resistant PVC,
- RG-59U coaxial cable
 - Maximum outer diameter .75 in.,
 - PVC jacket,
 - 75 ohm rating,
 - Nominal capacitance of 17.5 pF/ft.,
 - 22 AWG stranded copper center conductor,
 - Bare copper stranded shield,
- Data cable
 - 22 AWG stranded cable,
 - Two twisted pairs,
 - Nominal capacitance of 26 pF/ft.,
 - Nominal impedance of 55 ohms,
 - Common shield/drain wire,
- Power Cable,
 - 16 AWG,
 - Four wire, and
 - THWN stranded.

(E) Camera Mounting Bracket

Provide a pole attachment assembly for the CCTV camera unit to mount on wood poles, metal poles, and metal mast arms. The attachment assembly shall use stainless steel banding around the pole approved by the Engineer.

For CCTV-08 at the intersection of Peters Creek Parkway and Stafford Village Boulevard, provide a parapet/roof top style pipe mount as shown on the Special Detail (i.e., “SD” sheet) in the Plans to attach the camera to the existing metal signal pole with mast arm. Provide a mounting assembly that is black in color for consistency with the black finish on the existing metal pole with mast arm to which it is being attached. Provide black stainless steel banding for attaching the assembly to the existing metal pole with mast arm. Submit shop drawings of the attachment assembly for review and approval by the Engineer prior to delivery.

Provide the CCTV attachment assembly that allows 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.

Provide CCTV camera attachment assembly that is able to withstand wind loading at the maximum wind speed and gust factor called for in the interim revision of the 2002 ASHTO Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals and can support a minimum camera unit dead load of 45 pounds.

(F) Camera Cabinet**(1) General**

Provide cabinets to house CCTV related and communications equipment described herein. Provide the cabinets with a 19-inch communications rack for all equipment.

Provide Type 336A CCTV cabinets that provide for and meet the following minimum requirements:

- Ethernet edge switch (paid for separately),
- Digital video encoder (paid for separately),
- Termination of the composite cable to the camera,
- Local interface panel with maintenance access points for data and video connections to observe camera images and program/monitor camera status,
- Fiber-optic interconnect center (paid for separately),
- Grounding bus bar,
- 19-inch rack system for mounting of all devices in the cabinet,
- Pull-out shelf for laptop and maintenance use,
- Stationary shelf for shelf-mounting the digital video encoder and Ethernet edge switch,
- Fluorescent lighting,
- Ventilation fan,
- Thermostats,
- 120 VAC power supply,
- 120 VAC GFCI-protected duplex outlets for tools,
- 120 VAC surge protected duplex outlets for equipment,
- Surge protection on incoming and outgoing electrical lines (power and data),
- Transformers/power supplies, and
- Power strip along vertical rail.

Provide cabinets complete with a prefabricated cabinet shell, and all internal components and equipment, back and side panels, front and back doors, terminal strips, cabling and harnesses, surge protection for power and communication circuits, power distribution blocks or assemblies, shelves, connectors and all mounting hardware necessary for installation of equipment.

Provide the cabinets using unpainted sheet aluminum with a minimum thickness of 0.125 inch.

Provide the rack assembly with a removable, standard 19-inch EIA compliant rack. Equip each cabinet with an aluminum storage compartment mounted in the rack assembly with the following dimensions (± 0.5 inch): 16 inches wide, 14 inches long and 1.75 inches deep. Provide the compartment with a ball bearing telescoping drawer guides to allow full extension from the rack assembly. The storage compartment shall open to provide a full-depth storage space for cabinet documentation and other miscellaneous items. The storage compartment shall be of adequate construction to support a weight of 20 pounds without sagging when extended. The top of the storage compartment shall be hinged aluminum. Provide at least one removable metal a full-depth shelf with each cabinet.

Provide all cabinets and exterior door seams with continuously welded seams and with smooth exterior welds. Provide all cabinets with two (2) full-size doors (one front, one back). Provide the doors with three hinges, or a full-length stainless steel piano hinge, with stainless steel pins spot-welded at the top. The hinges shall utilize stainless steel hinge pins. Mount the hinges so that they cannot be removed from the door or cabinet without first opening the door. Brace the door and hinges to withstand a 100-pound per vertical foot of door height load applied vertically to the outer edge of the door when standing open. There shall be no permanent deformation or impairment of any part of the door or cabinet body when the load is removed. Provide the cabinet door with a #2 Corbin lock. Provide two keys for each cabinet. Provide the cabinet doors so they can be padlocked. Provide door openings with double flanges on all four sides.

Doorstops shall be included at 90° and 180° positions. Provide both the door and the doorstop mechanism of sufficient strength to withstand a simulated wind load of five pounds per square foot of door area applied to the both inside and outside surfaces without failure, permanent deformation, or compromising of door position and normal operation. Provide the cabinets without auxiliary police doors.

Ensure that cabinet doors include a gasket to provide a dust and weather-resistant seal when closed. Provide the gasket material with closed-cell neoprene and shall maintain its resiliency after exposure to the outdoor environment. The gasket shall show no sign of rolling or sagging, and shall ensure a uniform dust and weather-resistant seal around the entire door facing.

Provide both pole-mounted and base-mounted (i.e., open bottom) versions of the 336A CCTV cabinet as required by the Plans. Provide base adapters for the base-mounted 336A CCTV cabinets that comply with the “Cabinet Base Adapter and Base Extender” section of these Project Special Provisions.

(2) Ventilation

Provide a cooling fan in all cabinets with a minimum capacity of 100 CFM. Provide a thermostat to control the ventilation system.

Provide the cabinets with vent openings in the door to allow convection cooling of electronic components. Locate the vent opening on the lower portion of the cabinet door and cover fully on the inside with a commercially available disposable three layer graded type filter.

Provide cabinets with a serial number unique to the manufacturer. Engrave the entire identification code on a metallic plate that is epoxied to the cabinet on the upper right hand sidewall.

(3) Electrical

Provide a power distribution assembly that consists of power filters, transient voltage suppression, equipment grounding, main and branch circuit breakers for equipment, electrical outlets, lighting and ventilation.

Provide AC isolation within the cabinet. Configure all cabinets to accept 120 VAC from the utility company.

Provide UL listed circuit breakers with an interrupt capacity of 5,000 amperes and insulation resistance of 100 MΩ at 500 VDC. Provide power distributions blocks for use as power feed and junction points for two and three wire circuits. The line side of each shall be capable of handling

up to 2/0 AWG conductors. Isolate the AC neutral and equipment ground wiring and terminal blocks from the line wiring by an insulation resistance of at least 10 MΩ when measured at the AC neutral.

For components that are furnished by the Contractor that are mounted on cabinet side panels, fasten with hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include, but are not limited to, terminal blocks; bus bars, and DC power supply chassis.

Tag and identify all cabinet wiring installed by the Contractor by the use of insulated pre-printed sleeves. The wire markers shall identify in plain words with sufficient details without abbreviations or codes.

Neatly arrange all wiring in the cabinet, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling so as to avoid sharp edges and to avoid conflicts with other equipment or cabling. Terminate all wiring on a terminal block, strip, bus bar, device clamp, lug; or connector, do not splice any wiring. Label all wiring, cables, terminal strips, and distribution blocks provided by the Contractor. Provide strain relief for all cabling with connectors, all cabling entering knockouts or ports at the equipment, and where appropriate.

(4) Cable Terminations

Terminate all field cabling on the respective surge protection devices for composite coaxial video, 4-wire EIA 422 data communications, and 24 VAC power cable.

Provide an interface panel to permit a technician to connect a laptop and video monitor to the front side to control the camera locally and view live CCTV video without disconnecting the field wiring. All field wiring shall be routed through the surge protection units before the interface panel. Clearly label all connections on the interface panel.

Provide three adaptor cables to convert USB data to RS-422/RS-232.

Provide a video splitter on the video cable to simultaneously provide video to the video monitor port and to the encoder. Provide a switch for selecting and local camera PTZ control.

(5) Surge Suppression

Provide surge protection both ahead of and behind the ITS device electronics for the cameras. All surge protection devices shall have an ambient operating temperature of -40 degrees F to 165 degrees F with 95 percent non-condensing relative humidity. All surge protection devices shall comply with the following standards:

- UL 1449 version 3 for electrical power,
- UL 497B for paired data communications, and
- UL 497C for coaxial communications.

For those CCTV cabinets with Ethernet communications over twisted-pair copper cable, provide surge protection devices meeting UL 1449A.

Grounding

Provide a cabinet grounding system as shown in the Plans. Incorporate a means to bond (i.e., connected) all metal components of the camera and cabinets to the grounding system with a

grounding cable that uses a mechanical connection on the equipment side and an exothermic welded connection at the down cable.

Line Side CCTV Power

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 lighting 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: 20,000 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 stage output terminal, 19 amps),
 - Equipment neutral out (neutral terminal to protected equipment),
 - Ground (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 the 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, and
- 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.

Load Side CCTV Power

Load side protection is designed to restrict surge current transients from entering the power source from the CCTV device and/or site. The surge protection for the CCTV power source shall have an operating voltage of 120 volts single phase and a maximum continuous operating voltage of 150 volts single phase.

The device's surge protection shall be rated at a minimum of 90,000 amps per phase and have maximum clamping voltage ratings of 330 volts at 500 amps, 395 volts at 3,000 amps, and

533 volts at 10,000 amps. The surge protection shall also be UL listed for a minimum suppressed voltage of 330 volts per line to the neutral/ground. The suppression device shall be of the metal oxide varistor (MOV) type.

Load Side CCTV Data/Video

Provide specialized surge protection devices at the supply and load sides of all low voltage connections to the CCTV device and its operating subsystems. Provide specialized surge protection devices at the supply and load sides of all low voltage Ethernet data connections between a CCTV and traffic signal cabinet. These connections include, but are not limited to, coaxial video cables and low voltage control serial and Ethernet data cables that comply with EIA requirements as detailed in the EIA-232/422/485 standards.

The surge protection shall have an operating voltage to match the characteristics of the CCTV, such as 24 volts of direct current (VDC) or 24 volts of alternating current and less than 5 VDC for data and video functions. These specialized surge protection units shall be UL listed according to the UL 497B (paired-data cable) and UL 497C (coaxial cable) standards. The minimum surge current rating for the surge protection shall be 2,000 amps for data and telecommunications, 2,000 amps for twisted pair video, and 4,000 amps for binary network connectors (BNC).

(G) Grounding

Provide a minimum of four grounding electrodes with a minimum length of 10 feet each and listed according to UL requirements as detailed in the *UL 467J* standard. Provide copper clad or solid copper electrodes.

(H) Software

Provide a Vendor-supplied GUI-based software to setup, configure and operate the cameras in the field. This software shall include features to set communications addresses and protocols, define camera ID lens control, digital signal processing (DSP) settings, azimuth configuration, presets, tours, and privacy zones. The software shall allow the user to control all functions of the camera locally from the CCTV cabinet at the base of the pole with a serial or USB cable.

27.3. CONSTRUCTION METHODS

(A) Electrical and Mechanical Requirements

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

Install surge protectors on all ungrounded conductors entering the CCTV enclosure as described below. House the protectors in a small, ventilated weatherproof cabinet attached near the CCTV attachment point in a manner approved by the Engineer. The air terminal ground wire must not pass through this cabinet.

(B) CCTV Camera Assembly

Mount CCTV camera units at a height sufficient to adequately see traffic in all direction and as approved by the Engineer. Mount cameras on poles at the attachment heights shown on Special Details in the Plans.

Mount CCTV camera on the side of pole that is nearest to the intended field of view, to avoid occlusion of the view by the pole or utility lines. Obtain approval of camera orientation from the Engineer. Comply with the “Wood Poles” section of these Project Special Provisions.

(C) CCTV Camera Attachment to Pole

Have the Engineer approve the pole location prior to installing the camera on an existing pole and prior to setting a new pole. At locations shown in the Plans, assemble the camera attachment hardware for the CCTV camera unit and attach to the pole using stainless steel banding approved by the Engineer. Submit shop drawings for review and approval by the Engineer prior to installation.

Install the camera attachment assembly to the pole in a manner that allows 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.

Install CCTV camera attachment assembly that is able to withstand wind loading at the maximum wind speed and gust factor called for in the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, 4th Edition, 2006 Interim, and can support a minimum camera unit dead load of 45 pounds.

Install a 1” rigid galvanized weatherhead and threaded 1” rigid galvanized conduit stem into the existing metal signal pole at the intersection of Peters Creek Parkway and Stafford Village Boulevard to route the composite cable from the CCTV camera into the interior of the existing signal pole. Coat the new entry hole into the pole with an approved galvanized pipe prior to installing the conduit stem and weatherhead. Field apply a black coating to the conduit stem and weatherhead and the CCTV camera mounting plate using appropriate primer/etcher to prepare galvanized surfaces to receive the black paint/coating.

(D) CCTV Cabinet

Except where the Plans call for base-mounting, mount the CCTV cabinet on the pole supporting the CCTV camera it controls using approved hardware and attachment brackets. Mount the cabinet 4 feet from the ground to the center of the cabinet. Avoid mounting cabinets where they will overhang and encroach upon an adjacent sidewalk or pedestrian path. Where a minor overhang of the sidewalk or pedestrian path cannot be reasonably avoided, ensure that a minimum of 4 feet of clear sidewalk width will remain once the cabinet is installed. Do not mount cabinets above pedestrian pushbuttons or where they will hinder access to pedestrian pushbuttons. Have the Engineer approve the proposed mounting position prior to attaching the CCTV cabinet to the pole.

Where the Plans call for a base-mounted CCTV cabinet (e.g., Peters Creek Parkway at Stafford Village Boulevard), install a new cabinet base extender on a new CCTV cabinet foundation and mount the new CCTV cabinet on the base extender. Install the cabinet base extender and CCTV cabinet foundation in accordance with the “Cabinet Base Extender and Adapter” and “Equipment Cabinet Foundations” sections of these Project Special Provisions.

Ground all cabinets in accordance with the requirements of these Project Special Provisions. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

Tag and identify all cabinet wiring installed by the Contractor by the use of insulated pre-printed sleeves. The wire markers shall identify in plain words with sufficient details without abbreviations or codes.

Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Terminate all wiring on a terminal block, strip, bus bar, device clamp, lug, or connector, do not splice any wiring. Label all wiring, cables, terminal strips, and distribution blocks installed by the Contractor. Provide strain relief for all cabling with connectors, all cabling entering knockouts or ports at the equipment, and where appropriate.

Fasten all components installed by the Contractor to be mounted on cabinet side panels with hex-head or Phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include, but are not limited to, terminal blocks; bus bars, and DC power supply chassis.

Connect the CCTV camera cabinet to the CCTV camera assembly using a composite cable carrying the video, serial data and power. Terminal strips shall be provided with the cabinets to support 4-wire EIA 422 communications and the 24 VAC power as will be required for power and data.

Mount the digital video encoder on a shelf in the 19" equipment rack inside the cabinet in accordance with the "Digital Video Encoder" section of these Project Special Provisions. Mount the fiber-optic interconnect center in accordance with the "Fiber-Optic Communications Cable" section of these Project Special Provisions.

Install the Ethernet edge switch inside the cabinet in accordance with the "Communications Hardware" section of these Project Special Provisions. Mount the edge switch on the same shelf in the CCTV cabinet as the video encoder. Connect the appropriate connectors on the interconnect center with those on the Ethernet edge switch using SMFO jumpers.

(E) Power Service

Provide 120 VAC power from the existing electrical service for an existing traffic signal controller cabinets as shown on the Plans. For locations where traffic signal cabinet power service is not available, install new power service under separate pay item as shown in the Plans. Comply with the "Electrical Service" section of these Project Special Provisions and the details shown in the Plans.

(F) Grounding

Ground the CCTV pole and subsystems in accordance with the special details (i.e., "SD" sheets) in the Plans.

(1) Device Line Side

Connect the surge protection devices on the CCTV power source on the line side. This device shall provide protection between line-to-neutral, line-to-ground, line-to-line and neutral-to-ground.

(2) Device Load Side

Connect the surge protection devices in the power line side ahead of all CCTV electronic equipment. This installation technique is designed to restrict earth current transients induced within the ground or directly from the power source from entering the ITS device through the incoming 120/240-volt power circuit. This device shall provide protection between line-to-neutral, line-to-ground, line-to-line and neutral to ground.

(3) Device Data/Video Supply

Connect the specialized surge protection devices at the supply and line sides of all low voltage connections to the CCTV device and its operating subsystems. These connections include, but are not limited to, Category 5E data cables, coaxial video cables, twisted pair video cables, and low voltage control cables that comply with EIA requirements as detailed in the EIA-232/422/485 standards.

(G) Existing CCTV Equipment

Existing CCTV equipment is located in two traffic signal cabinets and those cabinets will be replaced in this project. The existing equipment and their disposition includes the following:

- CCTV E6, Hanes Mill Rd/Oak Summit: Relocate existing encoder, CCTV test panel, CCTV composite cable to new signal cabinet, all other equipment to be removed. Install replacement interconnect center and Ethernet edge switch.
- CCTV E7, Hanes Mall Blvd/Hanes Pt Shopping Center: Relocate existing encoder, CCTV test panel, CCTV composite cable to new signal cabinet remove existing modem broadband. Install fiber-optic drop cable, interconnect center and Ethernet edge switch. Coordinate with City to remove broadband Internet service.

At other existing CCTV locations, the following work shall be performed:

- CCTV E8, Hanes Mall Blvd/Stratford: Remove existing broadband modem. Reuse existing encoder. Install fiber-optic drop cable, interconnect center and Ethernet edge switch. Coordinate with City to remove broadband Internet service.
- CCTV E9, Hanes Mall Blvd/Brookview Hills: Remove existing broadband modem. Reuse existing encoder. Install fiber-optic drop cable, interconnect center and Ethernet edge switch. Coordinate with City to remove broadband Internet service.
- CCTV E10, Hanes Mall Blvd/Trulant Way: Remove existing broadband modem. Reuse existing encoder. Install fiber-optic drop cable, interconnect center and Ethernet edge switch. Coordinate with City to remove broadband Internet service.
- CCTV E11, Silas Creek/Yorkshire: Remove existing broadband modem. Reuse existing encoder. Install fiber-optic drop cable, interconnect center and Ethernet edge switch. Coordinate with City to remove broadband Internet service.

(H) Software

If Vendor software is provided to program and operate the cameras, install the Vendor-supplied GUI-based software to setup, configure and operate the cameras on each laptop supplied with the project.

(I) Relocate Existing CCTV Equipment

At two locations on the Project, existing CCTV equipment for an existing CCTV camera that is being retained resides inside an adjacent existing NEMA traffic signal controller cabinet. In conjunction with the controller cabinet change-outs at these locations, disconnect the equipment and remove it from the existing NEMA controller cabinet and reinstall it inside the new Type 332 controller cabinet. Connect the relocated existing CCTV camera control equipment to the new Ethernet edge switch using an Ethernet cable.

(J) GPS Coordinates

Provide real world coordinates for all junction boxes and equipment cabinets installed or utilized under this project. Provide the coordinates in feet units using the North Carolina State Plane coordinate system (1983 North American Datum also known as NAD '83). Furnish coordinates that do not deviate more than 1.7 feet in the horizontal plane and 3.3 feet in the vertical plane. Global positioning system (GPS) equipment able to obtain the coordinate data within these tolerances may be used. Submit cut sheets on the GPS unit proposed to collect the data for approval by the Engineer.

Provide both a digital copy and hard copy of all information regarding the location (including but not limited to manufacturer, model number, City system ID number and NCDOT inventory number) in the Microsoft Excel spreadsheet using the format shown in example below.

City System ID#	NCDOT Inv #	Name	Location	Latitude	Longitude	Manufacturer	Model #
	05-0134	Equipment Cabinet	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5500	35.6873	McCain	Type-332
		Junction Box # 1 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5516	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 2 (Phase 2 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5506	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 3 (Near Cabinet)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5501	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 4 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5486	35.6873	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 5 (Phase 6 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5493	35.6876	Quazite	PG1118BA12(Box) PG118HA00(Cover)
		Junction Box # 6 (Phase 4 Side)	US 70 at Raynor Rd./ Auburn-Knightdale	-78.5503	35.6879	Quazite	PG1118BA12(Box) PG118HA00(Cover)

27.4. MEASUREMENT AND PAYMENT

CCTV camera assembly will be measured and paid as the actual number of CCTV camera assemblies furnished, installed, and accepted according to following conditions: 90% of the payment will be made upon acceptance of the installed CCTV camera assembly and the remaining 10% of the payment will be made following final acceptance (including completion of the 60-day observation period).

No separate measurement will be made for composite cabling, connectors, CCTV camera attachment assemblies, software, grounding equipment, surge protector devices, composite cable, other cabling, and conduit, or any other equipment or labor required to install the CCTV assembly and integrate it with the fiber-optic communications equipment as they are considered incidental to furnishing and installing the CCTV camera assembly and the CCTV cabinet.

No separate measurement will be made for providing a CCTV camera assembly with black housing, a CCTV camera mounting assembly that is black in color and black stainless steel banding hardware for CCTV-08 at the intersection of Peters Creek Parkway and Stafford Village Boulevard as they will be considered incidental to furnishing and installing the CCTV camera assembly.

No separate measurement will be made for furnishing and installing a 1" rigid galvanized conduit and 1" rigid galvanize conduit stem in the existing metal signal pole at the the intersection of Peters Creek Parkway and Stafford Village Boulevard and field-painting the weatherhead, conduit, and camera mounting plate with a black coating as such work will be considered incidental to furnishing and installing the CCTV camera assembly.

CCTV cabinet (____) will be measured and paid as the actual number of CCTV cabinets of each mounting type furnished, installed, and accepted, according to following conditions: 90% of the payment will be made upon acceptance of the installed CCTV cabinet and the remaining 10% of the payment will be made following final acceptance (including completion of the 60-day observation period).

No separate measurement and payment will be made for hardware, fasteners and brackets required to mount CCTV cabinets to a pole or foundations as shown in the Plans as such work with be considered incidental to furnishing and installing the CCTV cabinets.

No measurement will be made of relocating existing CCTV equipment from existing NEMA controller cabinets to the new Type 332 controller cabinets that are replacing them, as such work will be considered incidental to furnishing and installing controllers with cabinets (see the Controllers with Cabinets section of these Project Special Provisions).

Cabinet base extenders for base-mounted CCTV cabinets will be measured and paid for in accordance with the "Cabinet Base Adapter and Base Extender" section of these Project Special Provisions.

Foundations for base-mounted CCTV cabinets will be measured and paid for in accordance with the "Equipment Cabinet Foundations" section of these Project Special Provisions.

Installation of Ethernet edge switches and digital video encoders will be measured and paid for in accordance with the "Communications Hardware" and "Central Video Equipment" sections of these Project Special Provisions.

Payment will be made under:

Pay Item	Pay Unit
CCTV Camera Assembly	Each
CCTV Cabinet (Pole Mount)	Each
CCTV Cabinet (Base Mount)	Each

28. CCTV INTEGRATION AND SOFTWARE MODIFICATION

28.1. DESCRIPTION

Modify the City's existing CCTV system software package to add the additional cameras and video devices provided in this Project.

28.2. MATERIALS

(A) CCTV Control Software

The existing CCTV system software allows users to:

- Select and control selected analog and IP-based cameras via software based graphical controls, including PTZ and other advance features of cameras,
- Assign CCTV images to specific output devices (network video recorder, monitors, workstation video capture cards), and component device inputs,
- Facilitate video sharing,
- Video display control such as individual monitors and monitor walls,
- Video image capture, and
- Video archiving.

The system software supports TCP/IP and SNMP. Provide a graphical user interface for CCTV control functions.

The software is a scalable product that controls both analog and IP video streams.

A window can span one or more display monitors. Provide the following features for the new cameras added under this project:

- Drag and drop maps to display video on maps,
- Zoom in and out feature,
- Pan/tilt control of cameras, and
- Presets for setting camera positions.

(1) Graphical User Interface

The graphical user interface (GUI) consists of an interface for configuring all devices and variables of the system. The configuration of the GUI permits those users with access privileges to add, delete or modify devices.

The GUI consists of the users' normal operational interface. The user GUI provides a graphic map of the overall project area with icons representing camera locations. At a minimum, update the GUI to include the project cameras in the users' GUI with a map display, available device list, and viewer for current events.

Map Display

Expand this graphic display with the same map used for the signal system software. Map format shall be the same format as existing map. The maps shall be customizable, with access privileges, to add icons, labels, hyperlinks, and alarms. Provide maps that are zoomable.

Utilize the existing icons that provide the user with camera control, unless that camera is in use by another user. If the selected camera is in use by another user, a message identifying the

current user shall be displayed. In addition, a display showing the camera's current user defined preset position will be shown. The icon shall also display current status. At the operator's discretion, the GUI or the camera control panel may be used to control all camera functions.

Device List

Clicking on an icon in the CCTV system software shall produce a scrollable, drop-down list that contains the name of all video outputs (such as monitors, NVR, encoders, etc.) that are connected to the system. A subsequent click on the appropriate video output name shall select the device on which the video is to be displayed or transmitted and provide access to that device's controls available to the user. Output devices presently in use shall not be available for use until they have been de-selected.

(2) Device Drivers

Provide device drivers for each device in the system including cameras, monitors, video recorders provided with this project. Provide the ability to share device drivers. Device drivers may run as an executable program or window service.

(3) FTP Image Capture

Utilize the existing FTP image capture software applications and add the cameras provided under this project to the database.

(B) Regional ITS Graphical Interface Software (GUI)

The Regional ITS Graphical User Interface (GUI) Software is housed on a server in the TRTMC. The software includes a zoomable static display map that includes a location of each ITS device. This map can be dynamically sized. Each ITS device is associated with an icon that loads an executable application. All ITS elements, icon and their respective locations are stored in the 1983 North American Datum North Carolina state plane coordinates in English units (feet). Text notes are stored for each device, which includes the dates of the last modification.

The purpose of the Regional ITS GUI is to provide a common interface among the various traffic operations and management centers in the region to launch traffic management applications on other servers from local computer workstations in their respective centers. The Regional ITS GUI assumes the following:

- When a field device on the GUI is actuated, the client software for the application is present on the workstation from where the application is launched,
- The user on the local workstation has network level rights to log onto the application server where the ITS devices native software resides, and
- The user on the local workstation has application level security rights to use the application software for the devices actuated.

28.3. CONSTRUCTION METHODS

(A) CCTV Control Software

Update the database of the existing CCTV software on the video server along with the CCTV software decoders to add the cameras, workstations and monitors provided under this Project.

For each camera assign names consistent with the existing system. Configure presets and tours for each camera.

Assign operator rights to City staff as provided by the Engineer. Provide NCDOT staff access for those staff members provided by the Engineer.

(B) Regional ITS Graphical User Interface (GUI) Software

Update the existing EIC server in the TRTMC and edit any existing unified device database to add the new CCTV devices with icons and correct coordinates. The unified device database contains the coordinates of each device in individual records and contains a maximum of fifty fields. Collect the location data from all CCTV field devices required to include the new CCTV devices in the database. Ensure the map extents have adequate coverage to show the new CCTV devices. Ensure the existing capability to import data from other file formats is maintained. All additions to the database must be viewable by all current users of the system.

28.4. MEASUREMENT AND PAYMENT

Modify CCTV Software shall be measured and paid as a lump sum. This shall include furnishing, installing, and all materials, equipment, labor, tools, storage, shipping, and incidentals necessary to modify the existing software, complete system integration, and provide a complete operating system.

Modify Regional ITS GUI Software shall be measured and paid as a lump sum. This shall include furnishing, installation, and all materials, equipment, labor, tools, storage, shipping, and incidentals necessary to modify the existing software, complete system integration, and provide a complete operating system.

Payment will be made under:

Pay Item	Pay Unit
Modify CCTV Software	Lump Sum
Modify Regional ITS GUI Software	Lump Sum

29. SIGNAL SYSTEM SOFTWARE MODIFICATIONS

29.1. DESCRIPTION

The Contractor will be responsible for:

- Migrating the Phase B controllers from NEMA to 2070L models and to the Ethernet network over single mode fiber-optic cable,
- Installing firmware on the new 2070L controllers included in this project,
- Adding Phase B controllers and associated devices to the Ethernet network over single mode fiber-optic cable that are not currently part of the system, and
- Database modifications and conversions associated with the above items.

The intent is to maintain the current set of features already installed on the present installation.

Install the following software as furnished by the Engineer:

- Local Controller Software (latest IP version of NCDOT's OASIS® software package)

The Contractor shall be responsible for the migration of, development of and integration of all system graphics (and associated system devices) described in the following specifications.

29.2. FUNCTIONAL REQUIREMENTS

(A) General

The overall architecture of the Centrac® system is a client server design based on hybrid centralized/distributed intersection control concepts.

Processing is distributed and the OASIS® IP communications protocol will be used for all intersection controller interfaces. Client workstations access a networked file server that perform traffic management, system communications, database management, and system graphics.

All firmware furnished under this project (both for individual field equipment locations and for central software) that maintain internal clocks and utilize those clocks for display of time, reporting of time back to system users, reporting of time on reports and event logs, and/or use of internal time clock to coordinate actions and activities with other software or devices is able to adjust to leap-year and current day light savings time dates automatically without user intervention or adjustment.

(1) Local Area Network Requirements

A 10/100/1000 Base-T Ethernet, local area network (LAN) supports the distributed client/server architecture constructed during Phase A (C-5224A).

The software allows for a minimum of sixteen (16) simultaneous users (including remote users) of the traffic signal system applications software. No degradation in system performance shall occur when sixteen operators use the system simultaneously. Each user, subject to his or her security level, shall have full access for system control, database entry/examination, malfunction diagnosis, system operation evaluation and measures of effectiveness analysis.

Access by any particular user to any particular command shall be allowed or disallowed based upon that user's assigned security level.

(B) Distributed Processing Signal System Software

(1) General

The Centrac[®]s system software shall communicate directly with the local intersection 2070 controllers installed under this project. The Centrac[®]s signal system software shall interface with the latest IP version of NCDOT's OASIS[®] local controller software package.

The Centrac[®]s software provides central monitoring of up to 1000 intelligent controllers. The system design shall accommodate future expansion. The addition of new intersections and detectors, in the field, shall not require additional software or central hardware, except for modems or transceivers and shall require only modification of the control database.

All changes to the Centrac[®]s system, including adding new controllers, configuring communications, modifying maps and intersection displays, etc., shall be performed through the system graphical user interface and by updating files in the system software folders. The use of initialization files and external editors will not be allowed.

(2) Power Failure

The traffic control program may suddenly stop execution for various hardware or software reasons. In such event, alarms shall alert the operator as to the problem and circuitry shall ensure against the transmission of erroneous data by the field communications subsystem.

In the event that the operator determines that the operation of the system is improper, he/she shall be able to immediately force all system intersections to an off-line, or a time-based coordination timing plan stored in the local controller (depending on the local day plan) from any system workstation.

(3) Field Communications

Within the Winston-Salem computerized signal system, traffic signal controllers will be integrated with field Ethernet edge switches that are arranged in redundant ring communications channels supporting a minimum twenty (20) traffic signal controllers on a dedicated communications channel. The software shall operate with a fully redundant communications network. Each controller will be connected to the system via a pair of optical fibers and field Ethernet switch. A channel consists of two fibers: one transmitting and the other receiving.

Each channel with its boundaries and the controllers and CCTV cameras contained within it are depicted on the cable schematic diagram shown in the Plans.

(4) Database Preparation

Complete all data entry modifications to the existing database necessary to implement the operation of the traffic signals in this Project.

The City will furnish intersection timing information and coordination parameters (cycle, split, offset) for conversion by the Contractor into the new database. Any existing custom intersection displays will also be provided by the Department or the City. Otherwise, default intersection timing data and standard intersection maps will be utilized when configuring intersections onto the system. Program all system detectors shown in the plans. Coordinate with

the City to provide setup, naming/labeling, logging and any features required for the operation of all system detectors.

TOD/DOW plans, alarms and other information for the operation of the signal system shall be entered by the Contractor.

(5) System Function Monitoring

Verification of on-street system operation shall be incorporated in the new signal system. Operation of all controller equipment shall be monitored, with current displays and malfunctions reported in near real-time. Continuous, polled communication shall occur from the local controller to the communication server.

(6) Database Backup and Restoration

The Centrac[®]s system has a simple means of copying the database files from the hard disk to a removable storage device or archive server. All files required to restore the system to operation without the need to manually re-enter data shall be included on removable storage device.

(7) Graphical User Interface

In the existing software, graphical icons are used on the displays to represent system devices. The icons provide easy access to traffic control data (signal timing, geometric, etc.), real-time data (intersection, link status, etc.), the database, and graphical image files.

Update the GUI to include an intersection/link base map with windowed table reports and management input windows. The updated GUI provides interactive mechanisms to assist in creating, editing, and modifying editable dynamic graphic screens that are linked to system dynamic elements. As a result, all operator actions are immediately visible as a change in the system graphic.

System Graphics

These existing dynamic condition maps provide a simple mechanism for system navigation, presentation of status, and selections within the user interface.

Backgrounds for the system-wide graphic contain commercial vector images of geographically accurate maps or scanned images. These images are compatible with common GIS packages such as ARCGIS. These images are used as the display layers of real-time graphics displays. The graphics for the entire system shall use ESRI map objects embedded environment, or approved equivalent.

Backgrounds for the control section and intersection displays shall be .bmp or .jpg formats in the same format as the existing graphics.

All updates to the graphics for system maps, control section maps, and intersection displays shall be submitted to the Engineer for approval before being integrated with the software.

System Map

The Contractor shall update ESRI-based system-wide map or approved equivalent to provide a dynamic display of the entire surveillance area to ensure the project limits are included and any layers the agency requires, including but not limited to interstate highways, major arterial roads, railroads, jurisdiction boundaries, and bodies of water. It shall be possible to “zoom in” and “drill

down” to any specific area of the map using the pointing device to select one corner of an area to view, and then select the opposite corner of the area to view. (Zoom out capability shall also be provided).

The updated graphic shall dynamically display the status of the controllers (e.g., coordination, emergency vehicle preemption, railroad preemption, transition, free operation, flashing, failure, intersection phase status). Intersection status and roadway links shall change color dynamically based on user definable color selection.

Intersection phase status (green, yellow and red) shall display in real-time on the intersection phasing icon. The intersection control status shall display as the background color on the intersection plan icon. Intersection plan information shall display as a number on the intersection plan icon.

Control Section Map

Create new subsection maps/zones or areas to provide a display for signals within the project limits. The default displays will be called control section maps, and shall provide a more detailed display of selected zones or areas of the system. A control section shall be able to be called from the system map display via a double mouse click or from a drop down menu. A minimum of fifteen (15) control section displays shall be capable of being simultaneously displayed while the system map is open and the maximum number intersection display windows are open. The control section map interface shall be an integrated portion of the distributed processing system software and shall not be a stand-alone package.

The updated control section maps shall provide a dynamic display of the signal system, including landmarks, streets, signalized intersections, interstate highways (if applicable), railroads (if applicable), system detectors, system detector actuation. Labels for these items shall also be displayed. All labeling shall be approved by the Engineer. The graphic shall also dynamically display the status of the controllers in the sub-area (e.g., coordination, emergency vehicle preemption, railroad preemption transition, free operation, flashing, failed, intersection phase status). Volume and occupancy levels shall be displayed as color bars on the map. Intersection phase status (green, yellow, and red) shall be displayed in real-time using arrow icons. Link status shall be shown as green for free flow or near free flow conditions. Yellow shall be shown for moderate congestion or transition conditions. Red shall be shown for congested conditions, and flashing red shall be used to indicate severe congestion or major delays. The control section display shall be capable of being dynamically sized by a workstation user. Resizing the window shall not reduce the amount of data displayed on a workstation monitor, and the same aspect ratio shall be monitored as before the resizing. The control section map graphic shall include a user-definable control section map title. North shall either be at the top or right side of the monitor when displaying a control sub-area. Vertical and horizontal scroll bars may be provided if the size of the sub-area is such that it cannot be displayed on a monitor at a scale (as determined by the Engineer) that is adequate for viewing by the operator. The City will provide to the Contractor the final control sections boundaries for each control section display to be developed by the Contractor. Submit a sample of a control section display or map for review by the Engineer.

Intersection Display

The intersection graphic shall display both static and dynamic information. The static information shall include the intersection name, geometrics of the intersection (including a graphic display of the number of lanes and their associated use), adjacent land use, the location of the controller, and a layout of the intersection with the intersections signal locations and number of heads. The dynamic information to be displayed shall include:

- All vehicle signal indications for each active phase, and up to sixteen (16) overlaps with red, yellow, and green indicators
- All pedestrian signal indications, for up to sixteen (16) active phases. WALK, flashing DONT WALK, and steady DONT WALK shall be shown
- Vehicle and pedestrian detector actuations for each active phase
- Cycle timer (central and local clocks)
- Timing plan in effect (with cycle length and offset)

Operational status of the intersection shall include the following, but not be limited to:

- Timing in effect (in coordination, TOD, TR, etc.)
- Status mode (transition, free operation, flash, pre-emption (railroad or emergency vehicle))
- Control mode (manual control, local control, failed, etc.)

The intersection display shall accommodate all OASIS[®] phasing.

The intersection display shall be capable of being dynamically sized by a workstation user. Resizing the window shall not reduce the amount of data displayed on a workstation monitor.

The Contractor shall provide intersection display graphics for the signals within the project limits. The City will provide any existing templates they have for use by the Contractor.

(8) Intersection Monitoring

The status of each controller shall be monitored and any detected error condition is logged. Error conditions are stored in a form that specifies the type, date, and time of the error. Error processing is performed during both coordinated and free operations.

The software monitors for the following conditions:

Communications Status

The system software reports the present status of the communication system at the controller. Changes in status of the communication system are recorded in the system log.

Communication Error

If communication between the communications servers and local intersection is lost for a number of consecutive seconds, a failure is identified and an error message is logged and the intersection shall be dropped from system monitoring. Upon identification of a communications error, the software continuously attempts to re-establish communications to the intersection and regain monitoring of the intersection.

Flash Conditions

The system has the following flash mode capabilities:

- **Central Flash:** Individual intersections and control sections are capable of being placed on flash by operator command or schedule entry.
- **Cabinet Flash:** Cabinet flash mode is indicated when a controller enters flash via manual selection at the cabinet.
- **Conflict Flash:** Conflict flash results from a tripped conflict monitor at the local intersection. Conflict flash is logged as a failure by the software system.

The type of flash mode (central, cabinet, or conflict), the intersection name, date and time is logged for each entry or exit from flash.

Local Preemption

The system monitors and recognizes the occurrence of preemption at each local intersection. System log messages are recorded to note the beginning and ending times of local preemption and the type of preemption (e.g. emergency vehicle, railroad, etc.).

Implemented Local Manual Control

Local manual control is initiated and controlled by hardware at the intersection. The software identifies any intersection that is in local manual control by means of a status message. When the local manual control status is removed, the local software initiates the transition back to normal operation and the system log messages are recorded at the start and end of local manual control condition.

Local and System Detectors

The system allows users to set up and gather detector data from local and system detectors for traffic responsive operation or other analytical purposes.

Timing Plans

An intersection timing plan is defined as a unique combination of cycle length, split and offset at an intersection.

(9) Intersection Control

The software allows any user to control and implement changes to any intersection controller via the GUI, either through scheduled events, manually controlled events, or time-of-day plans programmed in the local controller. All parameters and events that can be programmed from the controller front panel are available at central for remote implementation. Any aspect of the

controller timing shall be assessable from central, and allow editing of all timings. Full upload and download of timings to controllers is also allowed.

(10) Security

Maintain the same security access as is configured in the existing system.

(C) Local Controller Firmware

Local controller firmware shall be the latest version of the NCDOT-approved IP-based controller firmware. The Engineer will furnish the latest version of the firmware at the time of burn-in. Request the firmware from the Engineer a minimum of seven business days prior to burn-in.

29.3. INSTALLATION AND INTEGRATION

(A) Distributed Processing Signal System Software

Load all parameters necessary to implement coordinated signal operations. The Engineer will furnish the timing parameters in standard traffic engineering format (cycle, split, and offset) prior to the initiation of the 60-day observation period. Make any modifications to the cycle, split, and offset information furnished by the Engineer that are necessary to implement the timing plans into the system database. The test period may not begin until the timing parameters have been loaded. The Engineer may, at his/her option, observe the loading of the timing plans.

As directed by the Engineer, make modifications to the coordinated signal timing parameters (cycle, split and offset) prior to system acceptance to improve system coordination and efficiency. The Engineer will furnish the parameters to be modified by the Contractor. Make these modifications at no additional cost. No timing plan changes will be required after the successful completion of the system operational test (as approved by the Engineer).

Prepare comprehensive, detailed graphic displays for the system display, for all control section displays, and for all intersection displays. Contractor shall install all displays and fully integrate with system software. Submit all graphics to the Engineer for approval prior to the System Operational Test and prior to integration in the software.

Program all new system detectors installed under this project, and all existing system detectors being reused, in the signal system software. Install all associated graphics related to system detectors. Integrate system detector locations (based on the actual installation in the field) on all associated system graphics.

Submit specific landmarks and features to be displayed in the section and intersection displays to the Engineer for approval. Develop each screen upon approval of the areas to be displayed by each screen and make revisions as required from review.

(B) Local Controller Firmware

Install NCDOT-furnished local controller firmware on all new controllers. Use the latest IP-based version available at the time of installation as directed by the Engineer. Request local controller firmware from Engineer a minimum of five business days prior to use of software during burn-in period.

All controllers in the final Signal System shall have identical local software.

29.4. TESTING

Provide the following tests and demonstration of the system software:

- System Operational Test (as called for in “Testing and Acceptance” section)
- 60-Day Observation Period (as called for in the “Testing and Acceptance” section)

29.5. MEASUREMENT AND PAYMENT

Modify signal system software shall be measured and paid as a lump sum. This shall include the furnishing, installing, testing, and all materials, equipment, labor, tools, storage, shipping, and incidentals necessary to update databases, system graphics and complete system integration and provide a complete, operational system. Partial payment for this item will be made as follows: 50% of the lump sum price upon modification and installation of the software and 50% of the lump sum price upon successful completion of the Observation Period. No payment will be made for providing software license and source code as required in these Project Special Provisions.

All other software and hardware otherwise required to accomplish the functionality required by the Project Special Provisions will not be paid for separately but will be considered incidental. No payment will be made for providing software license and source code as required in these Project Special Provisions.

Testing will not be paid for separately but will be considered incidental to equipment installation.

Payment will be made under:

Pay Item	Pay Unit
Modify Signal System Software	Lump Sum

30. COMMUNICATIONS HARDWARE

30.1. DESCRIPTION

Furnish and install all equipment described below for a fully functional Gigabit Ethernet network for communication to the signal system and CCTV.

(A) Ethernet Edge Switch

Furnish and install a hardened, field Ethernet edge switch (hereafter “edge switch”) for field devices. Ensure that the edge switch provides wire-speed, Ethernet connectivity at each ITS device location to the managed Ethernet switch.

(B) Network Management Software

For the communications network, utilize the existing network management software (NMS) for configuration, troubleshooting, security, and system monitoring. The Contractor shall modify the current system configuration to include all of the Ethernet edge switches and other Ethernet devices installed on the project.

Ensure that the system is interoperable with all end-to-end communications elements (i.e., video encoder, edge switch) that connect each CCTV camera to analog and digital video monitors.

30.2. MATERIALS

(A) General

Ensure that the Ethernet edge switches are fully compatible and interoperable with the trunk Ethernet network interface and that the Ethernet switches support half and full duplex Ethernet communications.

Furnish Ethernet edge switches 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 Ethernet switches have 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.

Provide all SMFO jumpers required to connect the existing managed Ethernet switches and proposed Ethernet edge switches with the connector panels of fiber-optic splice centers. Provide SMFO jumpers with factory-assembled LC connectors one end (i.e., the fiber-optic interconnect center/connector housing end) and, on the other end, factory-assembled connectors of the same type provided on the existing managed Ethernet switch and Ethernet edge switches. Provide SMFO jumpers that are a minimum of 3 feet in length for Ethernet switches inside controller cabinets and CCTV cabinets. Ensure SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled.

(B) Ethernet Edge Switch**(1) Standards**

Ensure that the edge switches comply 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 802.1P standard for Quality of Service (QoS),
- IEEE 802.1Q standard for port-based virtual local area networks (VLANs),
- IEEE 802.1Q-2005 standard for MAC bridges used with the Multiple Spanning Tree Protocol,
- IEEE 802.1w standard for MAC bridges used with the Rapid Spanning Tree Protocol (RSTP),
- 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
- RFC 783 – TFTP
- RFC 854 – Telnet Protocol Specification,
- RFC 1112 – IGMP v1,
- RFC 1541 – Dynamic Host Configuration Protocol for IPv4,
- RFC 2030 – SNMP
- RFC 2068 – HTTP
- RFC 2236 – IGMP v2,
- RFC 2865 – RADIUS
- RFC 3414 – SNMPv3-USM
- RFC 3415 – SNMPv3-VACM.

Ensure that the edge switches have 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.

(2) Functional

Ensure that the edge switches support all Layer 2 management features and certain Layer 3 features related to multicast data transmission. 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 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 the TFTP and SNTP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(3) Physical Features

Mounting: Provide shelf mount edge switches. Optionally, if cabinet space dictates provide mounting kit to attach the edge switch to a vertical rack rail or a DIN rail in the cabinet. If the Contractor elects to use DIN rail mounting supply the DIN rail with the edge switch.

Ports: Provide 10/100 Mbps auto-negotiating ports (RJ-45) copper 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 fully-functional ports with Type LC connectors and the optics for the optical ports. Do not use mechanical transfer registered jack (MTRJ) or ST type connectors.

Provide edge switches having a minimum of two optical 100 Base FX ports capable of transmitting data at 100 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.

Provide 10/100 Mbps optical ports that consist of fiber pairs, one fiber will transmit (TX) data and one fiber will receive (RX) data. Provide optical ports that meet the following minimum requirements:

- Optical receiver sensitivity: -32 dBm,
- Optical transmitter power: -15.5 dBm,
- Typical transmission distance: 20 km, and
- Operating wavelength: 1310 nm.

Copper Ports: Provide edge switches that include a minimum of six copper ports. Provide Type RJ-45 copper ports and that auto-negotiate speed (i.e., 10/100 Base) and duplex (i.e., full or half). Ensure that all 10/100 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 switches support/comply with the following (remotely) minimum requirements:

- Ability to configure static MAC addresses,
- Ability to disable automatic address learning per ports, known 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.

Network Capabilities: Provide edge switches that support/comply with the following minimum requirements:

- Provide full implementation of IGMPv2 snooping (RFC 2236),
- Provide full implementation of SNMPv1, SNMPv2c, and/or SNMPv3,
- 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,
- 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 edge switches that support/comply 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) of the Ethernet agent, and
- Support of the TFTP and SNTP. Ensure that the Ethernet edge switch supports port mirroring for troubleshooting purposes when combined with a network analyzer.

(4) Electrical Specifications

Ensure that the edge switches operate and power is supplied with 115 current VAC. Ensure that the edge switches have 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 switches have diagnostic light emitting diodes (LEDs), including link, TX, RX, speed (for Category 5e ports only), and power LEDs.

(5) Environmental Specifications

Provide Ethernet edge switches that adhere to the following environmental constraints as defined in the environmental requirements section of the NEMA TS 2 standard if located within a climate-controlled environment:

- Operating temperature range: -30°F to 165°F,
- Storage temperature range: 14°F to 158°F, and
- Operating relative humidity range: 10% to 90%, non-condensing.

Verify that the edge switch manufacturer certifies their device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard. Verify that vibration and shock resistance meet the 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 switches shall meet or exceed the following environmental standards:

- IEEE 1613 (electric utility substations),
- IEC 6185003 (electric utility substations),
- IEEE 61800-3 (variable speed drive systems), and
- IEC 61000-6-2 (generic industrial).

(C) Network Management Software

Utilize the existing network management software that provides configuration, troubleshooting, security and system monitoring for the ITS communications network. Furnish additional licenses to add the devices installed under this project. Ensure that the system includes the following features:

- Able to create and maintain system and user identification and passwords,
- GUI interface,
- Syslog and SNMP alarm manager,
- Distributed server support for scalable management,
- Physical and logical topology for viewing every element on the network and how it is connected,
- Fault management and alarm view to see the health and status of every element on the network,
- Configuration management for configuring multiple elements and images, perform multi-step upgrades and archive device configurations,
- Switch configuration and monitoring,
- Inventory tool for the managed devices,
- VLAN manager,
- IP/MAC Address finder,
- Administration tool,
- Spanning Tree monitor,
- Support industry standard protocols such as SNMP, ANS.1, and XML,
- Handle commands from system clients via ASN.1 and/or XML-defined protocol over a standard TCP/IP connection,

- Command underlying nodes (devices such as decoders, encoders, and switches),
- Report status of system nodes and alarms,
- Monitor system node connections,
- Store recent alarms in an internal database,
- Cooperate with another server in redundant set (when working in redundant configuration),
- Receive SNMP traps generated by network infrastructure, translate SNMP traps as system alarms, and send alarms as SNMP traps,
- Support remote configuration and diagnostics, and
- Restore video and connections in case of system component restarts.

30.3. CONSTRUCTION METHODS

(A) General

Ensure that all communications hardware is UL listed.

Verify that network/field/data patch cords meet all ANSI/EIA/TIA requirements for Category 5e four-pair unshielded twisted pair cabling with stranded conductors and RJ-45 connectors.

Receive approval for the System Design Report described in these Project Special Provisions before submitting product submittal data, purchasing, installing and configuring the computer and communications hardware at each facility.

Ensure that all project IP addresses are assigned as defined in the System Design Report. Ensure the as-built documentation includes the identification of all IP addresses and VLANs, and associated hardware devices and device locations. Configure the Ethernet network so the traffic signals and CCTV cameras are in separate VLANs.

The City will designate who their network administrator is for the ITS LAN. Upon project completion ensure that the City's network administrator will be able to remotely manage the Ethernet switches for switch configuration, performance monitoring, and troubleshooting.

(B) Managed Ethernet Switches

(1) General

Ensure that all project IP addresses and VLAN IDs are assigned as defined in the System Design Report. Ensure that at a minimum, the switch configuration includes the following features: SNMP, STP, Port Security, all required VLANs, Unicast Routing protocols, and Multicast Routing protocols. Ensure unused switch ports are disabled.

Ensure that the existing managed Ethernet switches are fully accessible by technicians without blocking access to other equipment. Verify that fiber-optic jumpers consist of a length of cable that is connectorized on both ends, primarily used for interconnecting termination or patching facilities and/or equipment. Use fiber-optic jumpers that are factory assembled and connectorized and are certified by the fiber-optic jumpers' manufacturer to meet the relevant performance standards required below. Verify that network/field/data jumper cables meet all ANSI/EIA/TIA requirements for Category 5e 4-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.

(2) Existing Managed Ethernet Switches

Install jumpers for the existing managed Ethernet switches and Ethernet core switch to connect the fiber-optic cable provided in this project. Ensure the previously unused ports that were blocked and are to be used in this project are no longer blocked.

(C) Ethernet Edge Switch

Ensure that the City's network administrator will be able to manage each edge switch individually or as a group/cluster for switch configuration, performance monitoring, and troubleshooting. Note that these specifications require additional minimum management intelligence (i.e., Layer 2+) typical of most current industrial Ethernet deployments. Ensure that the edge switch includes Layer 2+ capability providing architecture standardization, open connectivity (i.e., interoperability), bandwidth management, rate limiting, security filtering, and general integration management of an advanced Ethernet switching architecture.

Ensure that all project IP addresses and VLAN IDs are assigned as defined in the System Design Report. Ensure that at a minimum, the switch configuration includes the following features: SNMP, STP, Port Security, all required VLANs. Ensure unused switch ports are disabled.

Mount the edge switch inside each field cabinet by securely fastening the edge switch to the vertical rail of the equipment rack or to a shelf 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 is connectorized on both ends, primarily used for interconnecting termination or patching facilities and/or equipment. Use fiber-optic jumpers that are factory assembled and connectorized and are certified by the fiber-optic jumpers' manufacturer to meet the relevant performance standards required below. Verify that network/field/data jumper cables meet all ANSI/EIA/TIA requirements for Category 5e 4-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.

(D) Existing Hub Cabinet

Terminate the fiber-optic cables on this Project in the hub splice centers installed under this Project in the existing hub cabinets as described in these Project Special Provisions and as shown in the Plans.

Label spare circuits of the data cables and connect them to the cabinet ground bus bar.

Neatly bundle and identify all field wiring cables in the cabinet with permanent waterproof tags.

(E) Network Management Software

Utilize the existing NMS server application on the ITS communications server. Configure the NMS to monitor and manage the proposed edge switches and other Ethernet devices included in this Project. Expand the database through an automatic utility within the NMS or manually enter the data. Establish groupings of devices with like functions or features, this would include geographically related, device types, owners. Setup automatic database and configuration backups. Setup system and device alarms and alarm notifications.

Update the graphical network views. Use mapping images already used in Project C-5224A to geographically locate devices.

30.4. MEASUREMENT AND PAYMENT

The switches include all appropriate ports, cabling, grounding, redundancies, labeling and any integration between the switches and the communications network as necessary to make a fully working installation. All power supplies, power cords, adapters, mounting hardware, DIN rail mounting brackets, DIN rails, connectors, serial cables, signs, decals, disconnect switches, installation materials, and configuration software necessary to complete this work, will be included and will be incidental.

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

Modify network management software will be measured and paid as lump sum modified, installed, and accepted.

Additional software licenses for the network management software shall be incidental to modify network management software.

No separate measurement will be made for SMFO jumpers, coaxial cables, communication cables, Ethernet patch cables, electrical cables, mounting hardware, nuts, bolts, brackets, connectors, risers, grounding equipment, surge suppression, or training as these will be considered incidental to the pay items listed above.

Payment will be made under:

Pay Item	Pay Unit
Ethernet Edge Switch	Each
Modify Network Management Software	Lump Sum

31. DIGITAL VIDEO EQUIPMENT

31.1. DESCRIPTION

Furnish and install digital video encoders for converting analog and digital video.

31.2. MATERIALS

(A) Digital Hardware Video Encoder (DVE)

Furnish and install digital hardware video encoder hardware to create a video-over-IP network system, as shown in the Plans. The video encoder units may be shelf or rack-mounted.

Furnish digital hardware video encoder components that utilize the Moving Picture Experts Group's MPEG-4 Part 10/H.264 video compression technology in accordance with the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) requirements detailed in the ISO/IEC 13818 and 14496-14 standards, respectively. Provide the ability for the user to select the video compression technology. Ensure that the hardware video encoder is capable of unicast and multicast operation, and that they support the Session Announcement Protocol (SAP) as recommended by the Internet Engineering Task Force (IETF) RFC 2974, and Differentiated Services/Quality of Service (DiffServ/QoS) software components. Ensure that the digital video encoder provides 99.999% error-free operation.

Provide a DVE that is a hardware-based network device able to accept a minimum of one analog National Television System Committee (NTSC) video input and digitize it for transport across IP networks. Use a digital video encoder that provides a minimum of two serial data interfaces for transmission of command and control data to other devices (typically camera PTZ commands), as well as console and configuration functions. Provide compatible decoder software along with the digital video encoder at no additional cost.

Furnish digital video encoders compatible with those provided in State Projects C-4192 and C-4152.

(1) Video Specifications

Ensure that any video input utilizes a BNC connector and delivers one-volt peak-to-peak (Vp-p) NTSC composite video signals for encoding. Ensure that the DVE operates with both color and monochrome video, and that they allow the user to select and adjust video resolution. Ensure that the DVE support resolutions that include, but are not limited to those in table below. Ensure that the MPEG-4 DVE is capable of delivering color and monochrome video at 30 fps regardless of resolution, and that they can do so using variable, programmable bit rates from 32 Kbps to 4 Mbps. Ensure that the DVE provides fixed and variable bit rate modes.

Resolution Specifications

Compression Technology	Resolution	NTSC Requirements
MPEG-4	QCIF	176 horizontal x 120 vertical
MPEG-4	CIF	352 horizontal x 240 vertical
MPEG-4	2CIF	704 horizontal x 288 vertical

Note: The resolutions attained depend on the data transmission rate.

(2) Environmental Specifications

Unless stated otherwise in the Plans, provide digital video encoders that meet all specifications during and after being subjected to an ambient operating temperature range of -30°F to 165°F as defined in the environmental requirements section of the NEMA TS 2 standard, with a maximum non-condensing relative humidity of 95%.

Ensure that cabinets housing system components comply with the environmental requirements detailed in the NEMA TS 2 standard. House the digital video encoder in a field cabinet with protection from moisture and airborne contaminants, blowing rain, wind, blowing sand, blowing dust, humidity, roadside pollutants, vandalism, and theft. Ensure that the digital video encoder is resistant to vibration and shock, and conforms to Sections 2.1.9 and 2.1.10, respectively, of the NEMA TS 2 standard.

31.3. CONSTRUCTION METHODS**(A) General**

Receive approval for the System Design Report described in these Project Special Provisions before submitting products submittal data, purchasing, installing and configuring the central video equipment described in this section of the Project Special Provisions.

(B) Digital Hardware Video Encoder**(1) Serial Interface**

Use hardware-based digital video encoders having a minimum of two serial data interfaces and connectors that conform to EIA-232/422/485 standards. Ensure that the serial interfaces support EIA-232 as well as 2-wire and 4-wire EIA-422/485 connections. Ensure that the serial port(s) support data rates up to 115.2 Kbps. Serial interface parameters, such as data format, number of bits, handshaking, and parity, shall be software programmable through local connection to the digital video encoders and through connections over the network. Serial interface ports may utilize RJ-45 connectors, D-sub connectors, or screw terminals.

(2) Network Interface

Ensure that the digital video encoder local area network (LAN) connection supports the requirements detailed in the IEEE 802.3 standard for 10/100 Ethernet connections. Provide a DVE having a minimum of one Ethernet port, which shall be a 10/100 Base-TX connection. Ensure that the connector complies with the EIA and Telecommunications Industry Association (TIA) requirements as detailed in the EIA/TIA-568-A standard. Provide copper-based network interface ports that utilize RJ-45 connectors.

Ensure that all Category 5e unshielded twisted pair/shielded twisted pair network cables are compliant with the EIA/TIA-568-B standard. Ensure that the network communication conforms to User Datagram Protocol (UDP), Version 4 of the Internet Protocol (IP) and Version 2 of the Internet Group Multicast Protocol (IGMP).

(3) Front Panel Status Indicators

Ensure the digital video encoders have light-emitting diode (LED) displays, liquid crystal displays (LCDs), or similar illuminated displays to configuration and management. Provide digital video encoders that support local and remote configuration and management. Configuration and management functions shall include access to all user-programmable features, including but not limited to addressing, serial port configuration, video settings, device monitoring, diagnostic utilities, and security functions. Ensure that the digital video encoders and digital video decoders support configuration and management via serial login, telnet login, and Simple Network Management Protocol (SNMP).

(4) Electrical Specifications

Ensure that all wiring meets NEC requirements and standards. Provide equipment that operates on a nominal voltage of 120 VAC. The equipment shall operate within a voltage range of 89 VAC to 135 VAC. The operating frequency range for power shall be 60-hertz ± 3 Hz. If the device requires operating voltages of less than 120 VAC, supply the appropriate voltage converter.

Furnish, install and integrate the digital video encoders in each CCTV cabinet shown in the Plans. Connect the analog input of the digital video encoder to the CCTV camera as defined above. Connect the Ethernet output of the digital video encoder to Ethernet edge switch. Use standard coax cable with BNC (gold-plated center pin) connectors. Connect the RS-422 PTZ serial communications from the camera to the serial port of the digital video encoder. Configure ports and IP addresses for multicast broadcast and VLANs.

31.4. MEASUREMENT AND PAYMENT

The materials provided in this section include all appropriate ports, cabling, grounding, redundancies, labeling and any integration between the devices and the communications network as necessary to make a fully working installation.

All power supplies, power cords, adapters, mounting hardware, connectors, serial cables, signs, decals, installation materials, and configuration software necessary to complete this work, are to be included and will be incidental.

Digital hardware video encoder will be measured and paid as the actual number of digital hardware video encoders furnished, installed, and accepted.

No separate measurement will be made for coaxial or DVI-D cables, cable connectors, communication cables, Ethernet cables between equipment housed within the same room/rack/cabinet, electrical cables, video display monitor mounts, mounting hardware, nuts, bolts, brackets, connectors, grounding equipment, surge suppression or documentation as these will be considered incidental to the pay items listed above.

Payment will be made under:

Pay Item

Digital Hardware Video Encoder

Pay Unit

Each

32. BUILDING MODIFICATIONS AND FIBER-OPTIC CABLE TERMINATION

32.1. DESCRIPTION

At locations called for in the Plans, route fiber-optic cable in existing conduits into the TMC as shown. Terminate fiber-optic cable in fiber-optic splice centers in the TMC as shown in the Plans.

32.2. MATERIALS

(A) Fiber-Optic Splicing and Termination

Furnish SMFO pigtails with each splice housing and corresponding connector housing. Provide pigtails that are a maximum of 6 feet in length with a factory assembled LC connectors on one end. Ensure that the SMFO pigtails meet the operating characteristics of the SMFO cable with which it is to be coupled.

Furnish SMFO jumpers that are a minimum of 3 feet in length with factory assembled LC connectors on one end (i.e., the splice/interconnect center end) and, on the other end, factory-assembled connectors of the same type provided on the Ethernet edge switch and provided on the Ethernet core switch. Ensure that SMFO jumpers meet the operating characteristics of the SMFO cable with which it is to be coupled. Provide all of SMFO jumpers with all of the connector combinations necessary to provide the connectivity indicated in the Plans and required by these Project Special Provisions to produce a fully-functional Ethernet communications system.

Provide connector panels with LC-type connectors for connector housings and interconnect centers installed in all facilities.

For each splice housing and interconnect center, provide splice trays that hold, protect, and organize optical fibers, and secure fibers inside splice tray. Design and size splice trays to be dielectric, to accommodate all fibers entering the splice tray, and to provide sufficient space to prevent microbending of optical fibers.

(B) TMC Building Modifications

(1) Rack-Mounted Connector and Splice Housings

Furnish one rack-mountable connector housing (i.e., distribution panel) and a matching splice housing for splicing the fibers in the incoming signal system trunk cable to SMFO fiber optic pigtails and terminating on patch panels in the communications cabinet that was installed in the TMC under Project C-5224A (i.e., one connector housing for each incoming cable). Each connector housing shall have LC-compatible connector panels and shall have a capacity for terminating a minimum of 48 fibers on the patch panel. The connector housing shall occupy no more than four rack units. Provide a matching splice housing and necessary splice trays for fusion splicing the incoming single-mode fibers in the 48-fiber trunk cable to the pigtails. The splice housing shall occupy no more than four rack units, shall be of the same manufacturer as the associated connector housing and designed to work with the connector housing. The splice housing shall have the capacity to splice at least 48 fibers. Store a minimum of 20 LF of each fiber-optic cable inside the communications rack cabinet that contains the splice and connector housings. Provide all hardware needed to install these units in the TMC.

32.3. CONSTRUCTION METHODS

(A) General

Contact Engineer prior to entering any building. Coordinate and obtain approval from Engineer regarding allowable working time in buildings.

Use existing cable conduits, risers and raceways to route fiber optic cable.

When working inside the buildings, cover all furnishings, including chairs and electronic and computer equipment with drop cloths to protect them from debris and to aid in cleanup. Replace the raised floor panels and ceiling panels and clean up all dust and debris by the end of each work period unless otherwise approved by the Engineer. Replace any floor panels damaged during installation of the above ceiling conduit at no expense to the Department.

Perform all work called for in the Plans to pull the fiber-optic cable into the building through existing conduits, risers and cable raceways.

Terminate all optical fibers in splice centers unless otherwise shown on the Plans.

Install splice centers with connector panels, splice trays, storage for slack cable or fibers, mounting and strain relief hardware, and all necessary hardware. Comply with all requirements of the "Fiber-Optic Splice Centers" section of these Project Special Provisions.

(B) Traffic Management Center (TMC)

Install equipment and route cable into the TMC through the flexible fabric innerduct installed inside the existing rigid metal conduit and risers by the Phase A contractor as shown in the Plans. Contact Larry Walker at (336) 747-6879 at least 30 days in advance of work to confirm work schedule, work restrictions and to make arrangements for gaining access to the building. Perform all work in accordance with NESC regulations and guidelines.

Install the required rack-mounted fiber connector housing and splice housing in the communications rack in the TMC as shown in the Plans. Fusion splice all fibers in the entering fiber-optic cables to SMFO pigtails inside rack-mounted splice housing, then connect the pigtails to the appropriate connectors in the connector housing. Terminate all pigtails from the incoming cable. Clearly label the connector housing using an approved labeling method. Install SMFO jumpers between the connector panels and the Ethernet core switch.

32.4. MEASUREMENT AND PAYMENT

TMC modifications will be measured and paid at the contract lump sum price. The price and payment will be full compensation for all work required to route and terminate the fiber-optic cable into the TMC as shown in the Plans.

No separate payment will be made for splice housings, connector housings, splice trays, splicing as these will be considered incidental to the TMC modifications.

No separate measurement will be made for mounting hardware, nuts, bolts, brackets, connectors, grounding equipment as these will be considered incidental to the pay items listed above.

Payment will be made under:

Pay Item

Pay Unit

TMC Modifications

Lump Sum

33. SUBMITTAL DATA AND DOCUMENTATION

33.1. DESCRIPTION

Provide project documentation for Department review and approval as described below.

33.2. SUBMITTALS

(A) General

The intent of this subsection of the Project Special Provisions is to provide the requirements for submittal data (i.e., shop drawings, catalogue cuts, manufacturers' literature, proposed changes to splice drawings, construction schedule, system design report, etc.) and the process by which submittal data will be reviewed.

Provide all submittal documentation in either 8½" x 11" or 11" x 17" format. No documentation smaller than 8½" x 11" will be accepted. No documentation larger than 11" x 17" will be accepted without the prior approval of the Engineer. All submittals will be reviewed and approved by the Department. Absence of comment will not grant approval.

(B) Project Construction Schedule

Prepare and submit for approval by the Engineer a schedule of the proposed working progress on the project in accordance with the instructions and on forms furnished by the Department. Update and submit the schedule no less than monthly.

The project schedule shall include a monthly schedule of values. At the end of each calendar month shown on the schedule, show a value (in dollars) of the cumulative project work projected to be completed. The initially proposed project schedule shall be submitted no later than 5 business days prior to the date of the project preconstruction conference and shall be approved before any work is begun on the project. Update and submit the project schedule five business days prior to the monthly construction meetings.

When conditions beyond the Contractor's control have adversely affected the Contractor's progress, or the Department has extended the completion date, the Contractor may submit a revised progress schedule to the Department for approval. Such revised progress schedule will not be approved unless accompanied by a detailed written statement giving the Contractor's reasons for the proposed revision.

The project construction schedule shall show at least:

- Major Activities,
- Critical Path,
- Task Dependencies,
- Float Time for Each Task,
- Project Start and Completion,
- Task Durations,
- Task Begin and End Dates,
- Milestones,
- Material Submittals,
- Submittal Review Periods,
- Equipment Deliveries,

- Sample and Material Testing,
- Acceptance and Demonstration Testing,
- Training,
- Observation Period,
- Final Acceptance.

(C) Qualified Products

Furnish new equipment, materials, and hardware unless otherwise required. Inscribe manufacturer's name, model number, serial number, and any additional information needed for proper identification on each piece of equipment housed in a case or housing.

The ITS & Signals Qualified Products List (QPL) is available on the North Carolina Department of Transportation's Website. Certain signal and communications equipment, material, and hardware shall be pre-approved on the QPL by the date of installation. Equipment, material, and hardware not pre-approved when required will not be allowed for use on the project. Consult the QPL Website to obtain pre-approval procedures.

(D) System Design Report

Prepare a System Design Report to describe the proposed network architecture and its configuration. Provide schematics to illustrate the network architecture and configuration, in addition to the written description. Provide a detailed description of the hardware and software to be installed. The report shall depict and describe the entire layout of the equipment and their connectivity. Provide a detailed listing of the hardware including brand and model numbers, functions and descriptions. Provide a detailed listing of the VLAN configuration and IP addresses.

Submit the report and obtain approval before providing material submittals for the following packages of items as described below: central video equipment, software, computer hardware, and communications equipment.

(E) Fiber-optic Splicing Drawings

Submit drawings that illustrate any proposed changes to the fiber-optic splicing details for Department review and approval at least 10 working days prior to beginning fiber-optic splicing. Do not perform any fiber-optic splicing until the Department approves the proposed changes.

(F) Submittal Requirements

Provide written certification to the Department that all Contractor-furnished material is in accordance with the contract. When requested by the Department, provide additional certifications from independent testing laboratories and sufficient data to verify item meets applicable specifications. Ensure additional certification states the testing laboratory is independent of the material manufacturer and neither the laboratory nor the manufacturer has a vested interest in the other.

The intent of submittals is to show completely the materials meet the requirements of the Plans and Project Special Provisions and how the Contractor intends to construct or configure the materials. The Contractor shall clearly demonstrate in the submittals that the desired materials shall meet or exceed the requirements of the Plans and Project Special Provisions. Each submittal shall be sufficiently complete and detailed for the Department to review and approve the submittal. If the Department deems the submittal insufficient in detail or completeness for

review or approval, the submittal will be returned as rejected. Additional time will not be granted for resubmittal.

Before material submittal data begins, provide to the Department a list of all submittals with approximate dates of submission that the Contractor intends to make. It is incumbent upon the Contractor to schedule reviews in a timely manner that will not delay his schedule.

Certain groups of materials are related in function and operate as a subsystem together. To ensure individual and subsystem compliance with the project requirements materials shall be submitted as packages as follows:

Submittal Package	Description
System Design Report	See "System Design Report" subsection above.
Controllers and Cabinets	2070L Controllers, 332 and 336S Cabinets, Conflict Monitors, Base Adapters, Base Extenders, Preformed Cabinet Foundations
Fiber-optic Cable	Fiber-optic Cable, Drop Cables, Splice Enclosures, Interconnect Centers, Rack-mounted Splice Housing and Connector Housings, Hub Splice Centers, Splice Trays, Cable Addition Kits, Multiport Grommet Inserts, Delineator Markers, Underground Cable Markers, Communications Cable Identification Markers
CCTV Equipment	Composite Video Cable, CCTV camera, CCTV cabinet
Video Equipment*	Encoders
Communications Equipment*	Ethernet Edge Switches, (see "Communications Hardware" section of these Project Special Provisions for further requirements)
Wireless Communications Equipment*	Ethernet radios, Ethernet radio antennas and antenna mounting hardware, RF disconnect switch, RF warning sign and decals, lightning arrestors
Field Infrastructure	Conduit, Junction Boxes, Terminal Splice Boxes/Cabinets, Electrical Service Equipment (Disconnects, Meter Bases, Combination Panels), Riser Seals, Conduit Sealing Bushings, Stainless Steel Banding Hardware, and Misc. Hardware

* Indicates submittal packages that cannot be submitted for review until the System Design Report has been submitted and approved.

Identify all proprietary parts in Contractor-furnished material. The Department reserves the right to reject material that uses proprietary components not commercially available off-the-shelf products.

For Contractor-furnished material listed on the QPL, furnish submittals in the format defined by the QPL.

For Contractor-furnished material not on the QPL, furnish three copies of the equipment list including three copies of catalog cuts. Identify proposed material on catalog cuts by a reproducible means (highlighter pen does not transfer to copies). Ensure material lists contain material description, brand name, manufacturer's address and telephone number, stock number, size, identifying trademark or symbol, and other appropriate ratings. For submittals showing a variety of models and parts available from the manufacturer, clearly identify by circles, marking our other means the specific materials for which approval is requested.

Allocate 40 consecutive calendar days for the Department to review and respond to a submittal. Do not deviate from what is approved without approval by the Department. Do not fabricate or order material until receipt of the Department's approval. All submittals will be returned as either "Approved (as submitted)", "Approved as Noted" or "Rejected". The Contractor may proceed with fabrication or ordering for items marked "Approved". If an item is marked "Approved as Noted" without any stipulation for resubmittal, then the Contractor may proceed with fabrication or ordering. For any other notations, the Contractor shall revise the submittal, address comments and resubmit for approval.

33.3. DOCUMENTATION

(A) General

Provide all manuals and plan of record (i.e., "as-built") documentation. All as-built plans and documentation shall be reviewed and accepted by the Engineer prior to final acceptance of the project. All documentation, except as otherwise specifically approved by the Engineer, must meet the following requirements:

1. Provide final as-built plans on 11" x 17" paper along with a PDF of each as-built plan sheet. Provide draft as-built plans for Department review on 22" x 34" paper. No documentation for as-built plans smaller than 11" x 17" will be accepted.
2. Provide any documentation that exceeds the size of 11" x 17" paper in a reproducible format 22" x 34" in size.
3. For electrical schematics and cabinet wiring diagrams not bound into printed manuals, provide paper copies at least 22" x 34" in size.
4. No non-plan documentation smaller than 8.5" x 11" will be accepted.
5. Do not fold or crease reproducibles.

As a minimum, provide the documentation described in the paragraphs below.

(B) Plan of Record Documentation

Provide as-built drawings that depict any changes of components, measurement or layout of the Plans. Show all construction changes, with the final location and depth of conduits, wiring external to the cabinet, locations of splice closures, system detector locations, and SMFO cable terminations, etc., in detail in a reproducible format. Submit as-built construction changes within 10 consecutive calendar days after the Observation Period begins. Note and date each change on the drawings. Failure to revise as-built documentation to reflect current work may result in withholding of payments until the as-built documentation is brought current. The submitted as-built documentation may be field-checked by the Engineer at his discretion. If the as-built documentation is found to have an unacceptable number of inaccuracies, the Engineer may

withhold payment until the as-built plans are corrected. Include all field installation including the SMFO cable network installed on the drawings.

For underground conduit systems that house communications cable, furnish the Engineer with a plan of record drawing detailing the locations of the conduit system, including junction boxes and their corresponding GPS coordinates. For directionally-drilled underground conduit systems, identify the vertical location (i.e., depth) of the conduits along the run.

Store documentation for signal installations in a manila envelope placed in a weatherproof holder inside the cabinet drawer. Store all documentation furnished with the controllers and cabinets, including manuals, electrical schematic diagram, and cabinet wiring diagram inside the envelope in the weatherproof holder. Provide two marked-up “redline” copies of the signal plan and the electrical and programming detail, placing one copy in the weatherproof holder inside the cabinet drawer immediately upon installation of the cabinet and giving the second copy to the Engineer.

For CCTV camera assemblies, provide two copies of a parts list(s) that includes serial and model numbers of all Contractor-furnished equipment prior to final acceptance. All equipment and appurtenances shall be identified by name, model number, serial number, technical support and warranty telephone numbers, and any other pertinent information required to facilitate equipment maintenance.

The Department will provide the Contractor one electronic copy of the Plans for his use in developing the as-built drawings. Modify the original electronic file such that all changes are marked with callout boxes or other method approved by the Engineer. Any other base maps that may be necessary for the Contractor to prepare the as-built drawings in accordance with these Project Special Provisions will be the Contractor’s responsibility. Use CADD conventions that are consistent with those used on the original plans.

Within 10 consecutive calendar days after the Observation Period begins, furnish one reproducible copy of the draft as-built plans in hard copy format for review. Provide draft hard copy as-built drawings on 22”x 34” bond plan sheets.

Upon receipt of review comments from the Engineer, correct any errors and make all necessary revisions to the draft as-built plans prior to final acceptance of the project. Submit final as-built plans in electronic and hard copy format. Provide final hard copy as-built drawings on 11”x 17” bond plan sheets. Provide electronic plans in MicroStation (latest release in use by the Department) format along with copies of the same files saved/exported in AutoCAD format (for City use). Provide the electronic files on CD or DVD.

(C) Manuals

Provide at least five hard copies along with one electronic copy (on CD or DVD) of the following manuals:

- Operator’s manuals containing detailed operating instructions for each different type or model of equipment. Ensure that manuals contain instructions for possible modification to equipment.
- Maintenance procedures manuals containing detailed preventative and corrective maintenance procedures and troubleshooting procedures for each different type of model of equipment.

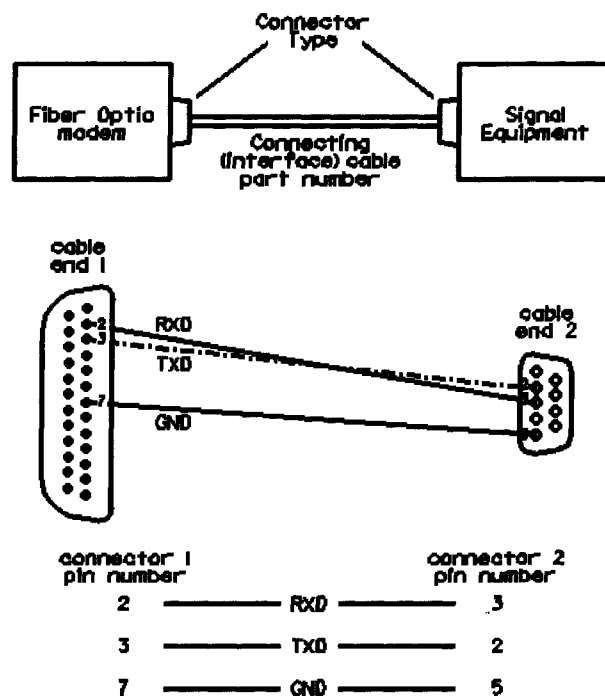
- Installation, operations and training manuals for all Contractor-provided software.

The manuals provided above shall be in addition to manuals provided with and stored inside each control equipment cabinet.

(D) Wiring Diagrams

Provide detailed wiring diagrams that include interconnection (wired and wireless) of equipment with pin-out configurations, pin functions, and cable parts numbers. This includes configuration at each field equipment cabinet or equipment cabinet at central locations. Provide two copies of system connection diagrams showing system interconnection cables and associated terminations. Use naming convention approved by the Engineer and conforming to Belcore standards. Provide one electronic copy of the wiring diagrams in MicroStation format.

Example:



(E) Splice Diagrams

Prepare as-built splice diagrams that depict the communications cable plant as constructed. Depict the splices made at each splice enclosure by identifying spliced fiber and buffer tube. Ensure the splice diagram is in a similar format to those provided with the project plans. Identify all expressed fibers, spare fibers, used fibers and capped fibers.

Original splice diagrams will be provided in electronic format in MicroStation format. Designate any changes to these diagrams by using a method approved by the Engineer. Furnish as-built splice diagrams in MicroStation format along with copies of the same files saved/exported in AutoCAD format (for City use). Provide the electronic files on CD or DVD.

33.4. MEASUREMENT AND PAYMENT

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

34. SYSTEM SUPPORT AND TEST EQUIPMENT

34.1. DESCRIPTION

Furnish equipment in accordance with these Plans and Project Special Provisions.

34.2. MATERIALS

Furnish equipment listed in this section as described elsewhere in these Project Special Provisions.

34.3. CONSTRUCTION

Deliver all materials and equipment furnished under this section to the City of Winston-Salem Signal Shop.

34.4. MEASUREMENT AND PAYMENT

Furnish detector card (Model 222) will be measured and paid as the actual number of Type 222 detector cards furnished and accepted.

Furnish 2070L controller will be measured and paid as the actual number of 2070L controllers furnished and accepted.

Furnish _____ cabinet will be measured and paid as the actual number of each type of controller cabinet furnished and accepted.

Furnish 2018 enhanced conflict monitor will be measured and paid as the actual number of Model 2018 enhanced conflict monitors furnished and accepted.

Furnish CCTV camera assembly will be measured and paid as the actual number of CCTV camera assemblies furnished accepted. This item includes composite cabling, connectors, CCTV camera attachment assemblies, software, grounding equipment, surge protector devices and cabling.

Furnish CCTV cabinet (pole mount) will be measured and paid as the actual number of pole mounted CCTV cabinets furnished and accepted. This item includes mounting hardware, fasteners and brackets to mount the CCTV cabinet to a pole.

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

Furnish 900MHz Ethernet Radio will be measured and paid as the actual number of Ethernet radios furnished and accepted. This item includes one spare antenna, coaxial cable shield grounding system with weatherproofing, lightning arrestor, power supply and power cord per radio.

Furnish Ethernet radio lightning arrestor will be measured and paid as the actual number of Ethernet radio lightning arrestors furnished and accepted.

Furnish digital hardware video encoder will be measured and paid as the actual number of digital hardware video encoders furnished and accepted.

Test controller (2070L) will be measured and paid as the actual number of 2070L controllers furnished, installed in the half-rack inside the TMC, and accepted. No measurement will be

made of Ethernet cable required to connect the test controller to the managed Ethernet switch and the power cord required to plug the test controller into the rack-mounted UPS as they will be considered incidental to furnishing and installing the test controller.

Payment will be made under:

Pay Item	Pay Unit
Furnish Detector Card (Model 222)	Each
Furnish 2070L Controller	Each
Furnish 332 Cabinet	Each
Furnish 336S Cabinet	Each
Furnish 2018 Enhanced Conflict Monitor	Each
Furnish CCTV Camera Assembly	Each
Furnish CCTV Cabinet (Pole Mount)	Each
Furnish Ethernet Edge Switch	Each
Furnish 900MHz Ethernet Radio	Each
Furnish Ethernet Radio Lightning Arrestor	Each
Furnish Digital Hardware Video Encoder	Each
Test Controller (2070L)	Each

35. TRAINING

35.1. DESCRIPTION

Provide training for the installation, operation and maintenance of:

- Ethernet core switch,
- Managed Ethernet switches,
- Ethernet edge switches,
- Servers,
- Network configuration,
- Fiber-optic communications cable,
 - Fiber-optic interconnect centers,
 - Splice enclosures (aerial and underground)
 - Splice trays and other related fiber-optic equipment in accordance with the Plans and Project Special Provisions,
- Wireless communications equipment,
- CCTV field equipment, if the equipment supplied is not exactly the same equipment provided under the Phase A project (C-5224A),
- Digital video equipment, if the equipment supplied is not exactly the same equipment provided under the Phase A project (C-5224A),
- Controller hardware and local controller software including:
 - 2070L Controllers,
 - Cabinets,
 - Conflict monitors,
 - Detectors,
 - OASIS® IP (Version) controller software, and
- System support and test equipment.

35.2. MATERIALS

(A) General

Provide training in the installation, operation, maintenance, troubleshooting and repair of all equipment and software. Prepare training outline, agenda, training manuals, training exercises, instructor resumes and any other teaching aids and submit them for approval by the Department prior to conducting training. For each course, provide a training exercise to demonstrate through hands-on activities the subject matter covered in the course lecture or course section. For exercises requiring computers, furnish enough computers to have one computer per two students.

Provide all laptop computers, projectors and projector screens needed for the training. Provide all audiovisual equipment needed for presentations and demonstrations, including video players. Provide new test cabinets, controllers and conflict monitors for use during the training. Furnish all power cords, extension cords, power strips and other cables required for the equipment used in the training.

Provide draft-training material to the Department for review and approval at least 60 days prior to the scheduled training. Provide adequate time for review and revision of the draft training materials. Furnish all audio-visual equipment, demonstration equipment, including a test

cabinet, and "hands-on" equipment in support of the envisioned training. Each training participant shall receive a copy of course materials including both comprehensive and presentation manuals. Assume there will be a maximum of 16 students in each class session. Provide two additional copies of these documents to the Department.

Utilize training personnel well versed in the subject matter and with extensive field experience dealing with real world problems. Utilize training personnel that have been certified by the respective manufacturers.

The City shall provide the training facility. Provide the Department with a 30-day notification to carry out the training so that arrangements can be made for attendance. Coordinate a mutually agreeable date, time and location with the City through the Engineer. The Engineer shall approve the training schedule time and location. A "day" of training shall consist of 8 hours of training.

When two sessions are required, conduct the first session early in the project, scheduling it to occur immediately prior to the first implementation of the given software or hardware so that City and Department staff can become familiar with the software or hardware prior to its implementation on the project. Conduct the second session near the conclusion of the project. If more than two sessions are required, conduct the remaining sessions approximately midway between the first and last sessions. Do not conduct multiple sessions back-to-back or near end of project. **Conduct the first session of training on 2070 traffic signal controllers, cabinets, conflict monitors and controller firmware at least one week prior to installing the first new controller with cabinet on the project.**

Develop the course content specifically for the products supplied for this project. The course shall include the following topics:

- Introductory-level briefing to familiarize attendees;
- Terminology;
- Theory of operation;
- Installation;
- Hardware and software configuration;
- Operating procedures and capabilities;
- Testing, diagnostics and troubleshooting;
- Software applications;
- Use of the system documentation to operate, diagnose, maintain, and expand the system; and
- "Hands-on" use of the system, laptop computer and software, system test equipment, and any other system equipment supplied.

Provide course lengths as follows:

Course	Type of Training	Total Students	No. of Sessions	Length (Days)
CCTV Field Equipment	Lecture and Hands-on Exercises	16	1	1
Digital Video Equipment	Lecture and Hands-on Exercises	16	1	0.5
Wireless communications equipment	Lecture and Hands-on Exercises	16	1	2

Do not conduct any training on this topic until the System Design Report has been submitted for review and subsequently approved by the Department.

Provide additional specific training as described below.

(B) CCTV Field Equipment

Provide CCTV field equipment training that includes operational theory and procedures of the field components of the CCTV system if the equipment supplied is not exactly the same equipment provided under the Phase A project (C-5224A). This training shall be oriented towards the users and maintenance personnel of the system. The training session shall be presented by field service specialist(s) employed by the suppliers of the CCTV field components. This training session shall include exercises that should take one-half of the day. Provide training for the CCTV field equipment and the local CCTV camera software as described below:

Course	Type of Training	Length (Days)
Operations	Lecture	0.5
Theory of operation	Lecture, Demonstration	
Local camera programming	Lecture, Demonstration and Hands-on	
Camera addresses		
Presets		
Privacy zones		
Privacy zones		
Tours		
Other features		
Maintenance	Lecture	0.5
Routine maintenance	Lecture, Demonstration and Hands-on	
Testing	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(C) Digital Video Equipment

Provide digital video equipment training that includes operational theory and procedures of the central components of the CCTV system, if the equipment supplied is not exactly the same

equipment provided under the Phase A project (C-5224A). This training shall be oriented towards users and maintenance personnel of the system. This training session shall include hands-on exercises that should take approximately one-half of the session. The training shall address the use of, but not limited to encoders. Provide training for the digital video equipment as described below:

Course	Type of Training	Length (Days)
Operations and Theory of operations	Lecture	0.25
Programming	Lecture, Demonstration and Hands-on	0.25
Maintenance	Lecture	
Routine maintenance	Lecture, Demonstration and Hands-on	
Testing	Lecture, Demonstration and Hands-on	
Troubleshooting	Lecture, Demonstration and Hands-on	

(D) Wireless Communications System

Provide training for the Ethernet radio modem as described below if the equipment supplied is not exactly the same equipment provided under the Phase A project (C-5224A):

Course	Type of Training	Length (Days)
Operations	Lecture, Demonstration	1.5
Theory of operation	Lecture	
Safety	Lecture	
Antenna alignment	Lecture	
Site Surveys	Lecture, Demonstration and Hands-on	
Procedures		
Interpreting and understanding the results		
Programming and software	Lecture, Demonstration and Hands-on	
Configuration		
Repeater applications		
Maintenance	Lecture	
Routine maintenance	Lecture, Demonstration and Hands	
Testing	Lecture, Demonstration and Hands	
Troubleshooting	Lecture, Demonstration and Hands	

35.3. MEASUREMENT AND PAYMENT

Training will be measured and paid at the contract lump sum price. The price and payment will be full compensation for all work required by this section of these Project Special Provisions.

Payment will be made under:

Pay Item**Pay Unit**

Training

Lump Sum

36. TESTING AND ACCEPTANCE

36.1. GENERAL

Conduct and complete successfully the following progressive series of tests before acceptance: field demonstration test prior to installation, installed standalone tests, system test of the network hardware, network management software and an operational test. Develop a comprehensive series of test plans for each device to determine the equipment was correctly installed and meets the requirements of materials, workmanship, performance, and functionality required in the plans and project special provisions. The test plans shall describe the functions to be tested, purpose of test, setup requirements, procedures to be followed, any inputs and expected outputs for each test, criteria for pass/fail and any required tools or test equipment. Any software testers shall be pre-approved by the Department.

Develop as part of the Test Plan a Traceability Matrix of all the individual subsystem functional requirements to be used to cross-reference each planned test to a specific contract requirement to be verified. This Test Evaluation/Traceability Matrix shall be used by the Engineer to crosscheck the functional requirements and the results.

A key element of test plans, where appropriate, is the introduction of forced errors into the functional test. The test plan shall check the actual result of the forced error against the anticipated result. Tests will be performed by the Contractor and witnessed by the Department and the City. No deviation from the written test procedure shall be permitted without approval from the Engineer. Any changes to the approved test procedure to accommodate unforeseen events during the time of testing shall be documented in a copy of the master test procedure. Immediately following the conclusion of each test, the Department, the City and the Contractor shall meet to agree on the results observed and recorded during the testing. This will form the basis for the conclusions reported in the test plan. All test results, notes, and observations shall be maintained in both electronic and hard copy. Maintain complete records of all test results during all stages of testing.

36.2. INSTALLED SITE TESTS

Conduct an approved, standalone equipment installation test at the field site. Test all standalone functions of the field equipment using equipment installed as detailed in the plans, or as directed by the Engineer.

Complete approved test plan forms and turn them over to the Engineer for review as a basis for rejection or acceptance. Provide a minimum notice of 30 calendar days prior to all tests to permit the Engineer or his representative to observe each test.

If any unit fails to pass its stand-alone test, correct the unit or substitute another unit in its place, then repeat the test.

If a unit has been modified as a result of a standalone test failure, prepare a report describing the nature of the failure and the corrective action taken and deliver it to the Engineer prior to re-testing the unit. If a failure pattern develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Department or an extension of the contract period.

Utilize vendor supplied device software to perform diagnostic tests of each device. The vendor supplied diagnostic software shall be provided to the Department before final acceptance. Test the following features of each competent as described below.

(A) Fiber-Optic Cable

Conduct optical time domain reflectometer (OTDR) tests on the cable on the reel and after the cable is installed and terminated. Provide written notification a minimum of ten days before beginning fiber-optic cable testing.

Consult the "IS Cable Schematic" in the Plans for testing points for the IS Department fiber-optic cable. Certain segments of the IS Department fiber-optic cable may not be terminated initially to facilitate testing. Install mechanical connectors on all fibers at the test points in the tube shown in the Plans to facilitate testing sections of the cable. When testing is complete, finish splicing the cable as shown in the Plans and seal the ends of the cable using an approved heat-shrink cap/seal and house the end of the cable in the splice enclosure.

After splicing is completed, perform bi-directional OTDR tests on each fiber, including unused fibers, to ensure the following:

- Fusion splice loss does not exceed 0.05 dB,
- Terminations and connections have a loss of 0.5 dB or less, and
- Reflection loss is 40 dB or greater for each connector.

Install a 1000-foot pre-tested launch cable between the OTDR and fiber-optic cable to be tested.

If exceeded, remake splices until the loss falls below 0.05 dB. The Engineer will record each attempt for purposes of acceptance.

Test the fiber-optic cable at both 1310 and 1550 nm.

Furnish durable labeled plots and electronic copies on a CD or DVD of test results for each fiber including engineering calculations demonstrating that OTDR test results meet or exceed the attenuation requirements and that optical properties of the cable have not been impaired. Clearly label each OTDR trace identifying a starting and ending point for all fibers being tested.

Provide engineering calculations and tests for fiber-optic cable that demonstrate the loss budget where the fiber originates and where the fiber meets an electronic device. The calculations shall summarize the optical losses versus the allowable losses for the communications equipment between each pair of communications hardware. Provide a summary section or spreadsheet with a labeled tabular summary showing each test segment with begin and end points and actual versus allowable losses. Label the manufacturer's make, model number and software version of the OTDR used for testing.

Furnish one hard copy of each of the OTDR trace results and electronic copies of all trace results on a CD or DVD.

If any fiber exceeds the maximum allowable attenuation or if the fiber-optic properties of the cable have been impaired, take approved corrective action including replacement of complete segments of fiber-optic cable if required. Corrective action will be at no additional cost to the Department.

(B) Ethernet Communications System

Test any cable installed as part of this project per TIA 568 specifications for continuity, opens, shorts, split pairs, mis-wiring and reversed pairs. Test for DC resistance, impedance, and line capacitive loading. Correct any faults and retest. If retest fails, replace defective cable or connectors.

Once the Ethernet edge switches have been installed, conduct local field acceptance tests of the Ethernet edge switch field site according to the submitted test plan. Perform the following:

- Verify that physical construction has been completed as detailed in the Plans,
- Inspect the quality and tightness of ground and surge protector connections,
- Verify proper voltages for all power supplies and related power circuits,
- Connect devices to the power sources,
- Verify all connections, including correct installation of communication and power cables, and
- Perform testing on multicast routing functionality.

Repair or replace defective or failed equipment and retest.

Upon satisfactory completion of operational test, begin an Observation Period of 60 days prior to system acceptance.

(C) Traffic Signal Controllers and Conflict Monitors

The following items, not otherwise required to be tested elsewhere, shall be tested: cable continuity, grounding, power-up self-test, proper controller sequencing, detector and pedestrian pushbutton calls.

(D) Communications System Support Equipment

Perform self-diagnostic tests on all electronic test equipment provided to the Department to ensure the equipment is proper operating order. Utilize the supplied test equipment in the training for the fiber-optic cable.

(E) CCTV Field Equipment

Develop an operational test plan that demonstrates all requirements of the equipment and software. Submit for approval before conducting tests.

Notify the Department at least 14 calendar days prior to the proposed date for the tests. The Department and the City shall have the right to witness such tests, or to designate an individual or entity to witness such tests.

Perform the following local field operational tests at the camera assembly field site in accordance with the test Plans. A laptop computer shall provide camera control and positioning. After completing the installation of the camera assembly, including the camera hardware, power supply, and connecting cables, the Contractor shall:

- Furnish all equipment, appliances, and labor necessary to test the installed cable and to perform the following tests before any connections are made,
- Verify that physical construction has been completed,
- Inspect the quality and tightness of ground and surge protector connections,
- Check the power supply voltages and outputs,
- Connect devices to the power sources,

- Perform continuity tests on the surveillance camera's stranded conductor element using a meter having a minimum input resistance of 20,000 ohms per volt and show that each conductor has a resistance of not more than 16 ohms per 984.3 feet of conductor;
- Measure the insulation resistance between the conductors, and between each conductor, ground, and shield using a megger. The resistance must be infinity. Perform all resistance testing after final termination and cable installation, but prior to the connection of any electronics or field devices; and
- Replace any cable that fails to meet these parameters, or if any testing reveals defects in the cable, and retest new cable as specified; and
- Verify installation of specified cables and connections between the camera, PTZ, camera control receiver, and control cabinet,
- Perform the CCTV assembly manufacturer's initial power-on test in accordance with the manufacturer's recommendation,
- Set the camera control address,
- Verify the presence and quality of the video image in the field cabinet with a portable NTSC-approved monitor or laptop computer
- Exercise the pan, tilt, zoom, focus, iris opening, and manual iris control selections, and the operation, preset positioning, and power on/off functions,
- Demonstrate the pan and tilt speeds and extent of movement to meet all applicable standards, specifications, and requirements,
- Verify proper voltage of all power supplies, and
- Interconnect the communication interface device with the communication network's assigned fiber-optic trunk cable and verify that there is a transmission LED illuminated.

Test the grounding system per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 as applicable. Measure the ground impedance utilizing an instrument designed specifically to measure and document the ground impedance. Provide written test results of the ground impedance for each location to the engineer prior to backfilling the grounding electrode. The test results shall include the instrument model, date of instrument calibration, and local environmental conditions at the time of testing. Certify and sign the test results by the Contractor.

Repair or replace defective or failed equipment and retest.

(F) Digital Video Equipment

Test the components of the digital video equipment as follows:

- Check all ground, power, data, Ethernet and digital video connections,
- Run power up self test on each piece of equipment,
- Run all available vendor-supplied self-diagnostics.

(G) Ethernet Radio Equipment

Test the Ethernet radios as follows:

- Check all ground, power, data, Ethernet and analog video connections,
- Run power up self test on each piece of equipment,
- Run all available vendor-supplied self-diagnostics,

- Check received signal strength, noise levels, bandwidth, and accuracy of test data transmission between each pair of nodes,
- Adjust hopping patterns as necessary to maximize the quality of the signal strength,
- If adjusting the hopping pattern does not significantly improve the quality of the signal strength, then adjust antenna as necessary to maximize the quality of the signal strength, and
- Test the transmission of data to ensure the transmission of data from the spread spectrum radios to the edge switches. Run the system diagnostics from end to end.

36.3. SYSTEM TESTING

(A) General

Conduct tests as described below of the traffic signal and CCTV subsystems. Conduct approved device subsystem tests on the field equipment with the Winston-Salem TMC equipment including, at a minimum, all remote communications hardware monitoring and control functions. These tests shall be a demonstration of overall system stability. During this test period, limit downtime due to mechanical, electrical, or other malfunctions to a maximum of eight hours. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours.

Conduct device and subsystem tests of any repaired or replaced equipment.

Display the event log from the traffic signal and CCTV software for a minimum of seven days. Complete approved data forms and turn them over to the Engineer for review, and as a basis for rejection or acceptance.

The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If a component has been modified as a result of a test failure, prepare a report and deliver it to the Engineer prior to retesting.

(B) CCTV Subsystem

After completing the integration of the CCTV cameras into the CCTV subsystem software, conduct a minimum of a seven-day test of the CCTV subsystem hardware and software. This will include that portion of the communications network serving the CCTV subsystem. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If during that time it is determined by the Department or the City there are hardware or software failures that are the responsibility of the Contractor, the Contractor shall make repairs or replacements to the satisfaction of the Department and the City.

Test the following features of each competent as described below.

(1) CCTV Field Equipment

The following items, not otherwise required to be tested elsewhere, shall be tested for each CCTV site from the City's TMC:

- Power-up self-tests,
- Iris control,
- Preset functions,
- Presence and quality of the video image,
- Preset positioning, and power on/off functions,
- Camera and controller access and security from all laptops and workstations,
- Disconnect camera and take local control and reconnect camera at local cabinet to the communications and verify Winston-Salem TMC control is regained,
- Confirm ability to change camera ID,
- Verify unique camera identifier and icons on GUI,
- Viewing of camera image on each monitor.

(2) Digital Video Equipment

Verify that all CCTV images can be displayed correctly on each monitor using the CCTV central software.

(3) CCTV Central Software

Thoroughly test all functions of the software from the Winston-Salem TMC and the TRTMC to ensure correct operation. Test the components of the CCTV central equipment from both the signal shop and the Winston-Salem TMC as follows:

- Use the GUI interface to select and view each camera,
- Use and the GUI interface to test the ability to control the pan-tilt-zoom and iris settings of each camera,
- Use the GUI interface and test the ability to select and place any camera on any monitor,
- Utilizing a TRTMC workstation demonstrate the ability to select, control and tview the camera images, and
- Use the image capture software to test the ability to capture video images and transport them to NCDOT via the existing EIC Server.

(C) Traffic Signal Subsystem

After completion of the integration of the traffic signals into the new signal system central software, conduct a minimum of a seven-day test of the traffic signal subsystem hardware and that portion of the communications network serving the traffic signal subsystem. The Engineer has the right to suspend the test to correct deficiencies and restart the test or to extend the test period by time equal to the downtime in excess of eight hours. If during that time it is determined by the Department that there are failures that are the responsibility of the Contractor, the Contractor shall make repairs or replacements to the satisfaction of the Department.

Verify communications port addressing from the traffic signal controllers.

36.4. OBSERVATION PERIOD

(A) General

A 60-day Observation Period shall begin upon the successful completion of the installed site tests and the system tests described in the preceding subsections as well as the correction of all known deficiencies, including minor construction items and punch-list items developed by the Engineer. During this period the Department and the City shall observe equipment and software operation to determine that all components of the fiber-optic communications system operate properly and interface with the traffic signal subsystem components and CCTV subsystem components according to the requirements of the Plans and these Project Special Provisions over an extended period of time.

During the Observation Period, respond to failures of the Contractor's equipment within two hours and make repairs within eight hours. For items that pose a traffic safety hazard such as a controller failure, make repairs within four hours. If any failures affect major system components for more than 48 hours, the Department shall suspend the Observation Period beginning when the failure occurred. Resume the Observation Period after successful repair or replacement. Failures of the following types will cause the Department to terminate the Observation Period and restart the Observation Period from zero once the failures have been corrected:

1. System or component failures that necessitate a redesign of any component; and
2. Three or more major system component failures of like nature within any 30-day period.

Major system components include:

- Ethernet edge switches;
- The fiber-optic communications network (not including the City IS Department fiber-optic cable); and
- CCTV equipment.

Begin a new 60-day Observation Period with the approval of the Engineer after the faulty equipment has been repaired or replaced and the redesigned components have been installed.

A successful 60-day Observation Period shall consist of continuous operation with no more than a total of five calendar days of non-operation due to mechanical, electrical, or other malfunctions.

The Observation Period shall be completed by the project completion date and prior to final acceptance of the project. The Observation Period shall not begin until the both the CCTV and traffic signal subsystem tests have been successfully completed. The Observation Period shall not begin without the approval of the Engineer.

(B) CCTV Subsystem

During the Observation Period, the Department and the City will observe equipment and software operation according to the requirements of the Plans and these Project Special Provisions. Verify that the TRTMC can view and control the proposed cameras.

Major subsystem components include the CCTV cameras, Ethernet switches, fiber-optic cable, and CCTV cabinets.

(C) Traffic Signal Subsystem

During the Observation Period, the Department and the City will observe equipment and software operation according to the requirements of the Plans and these Project Special Provisions.

Major subsystem components include the all Ethernet switches, Ethernet radio equipment, fiber-optic cable, controllers and conflict monitors, and cabinets.

36.5. MEASUREMENT AND PAYMENT

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

36.6. FINAL ACCEPTANCE

Final system acceptance is defined as the time when all work and materials described in the Plans and these Project Special Provisions have been furnished and completely installed by the Contractor; all parts of the work have been approved and accepted by the Engineer; and the CCTV and signal subsystems have been operated continuously and successfully for the 60-day Observation Period.

Final acceptance shall not occur until:

- All field demonstration, installed site, system, and operational tests have been satisfactorily completed;
- All punch-list discrepancies have been rectified;
- All documentation has been delivered and accepted; and
- All required training has been completed.

STANDARD SPECIAL PROVISION
AVAILABILITY OF FUNDS – TERMINATION OF CONTRACTS

(5-20-08)

Z-2

General Statute 143C-6-11. (h) Highway Appropriation is hereby incorporated verbatim in this contract as follows:

(h) Amounts Encumbered. – Transportation project appropriations may be encumbered in the amount of allotments made to the Department of Transportation by the Director for the estimated payments for transportation project contract work to be performed in the appropriation fiscal year. The allotments shall be multiyear allotments and shall be based on estimated revenues and shall be subject to the maximum contract authority contained in *General Statute 143C-6-11(c)*. Payment for transportation project work performed pursuant to contract in any fiscal year other than the current fiscal year is subject to appropriations by the General Assembly. Transportation project contracts shall contain a schedule of estimated completion progress, and any acceleration of this progress shall be subject to the approval of the Department of Transportation provided funds are available. The State reserves the right to terminate or suspend any transportation project contract, and any transportation project contract shall be so terminated or suspended if funds will not be available for payment of the work to be performed during that fiscal year pursuant to the contract. In the event of termination of any contract, the contractor shall be given a written notice of termination at least 60 days before completion of scheduled work for which funds are available. In the event of termination, the contractor shall be paid for the work already performed in accordance with the contract specifications.

Payment will be made on any contract terminated pursuant to the special provision in accordance with Subarticle 108-13(E) of the *2012 Standard Specifications*.

STANDARD SPECIAL PROVISION
NCDOT GENERAL SEED SPECIFICATION FOR SEED QUALITY

(5-17-11)

Z-3

Seed shall be sampled and tested by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory. When said samples are collected, the vendor shall supply an independent laboratory report for each lot to be tested. Results from seed so sampled shall be final. Seed not meeting the specifications shall be rejected by the Department of Transportation and shall not be delivered to North Carolina Department of Transportation warehouses. If seed has been delivered it shall be available for pickup and replacement at the supplier's expense.

Any re-labeling required by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory, that would cause the label to reflect as otherwise specified herein shall be rejected by the North Carolina Department of Transportation.

Seed shall be free from seeds of the noxious weeds Johnsongrass, Balloonvine, Jimsonweed, Witchweed, Itchgrass, Serrated Tussock, Showy Crotalaria, Smooth Crotalaria, Sicklepod, Sandbur, Wild Onion, and Wild Garlic. Seed shall not be labeled with the above weed species on the seed analysis label. Tolerances as applied by the Association of Official Seed Analysts will NOT be allowed for the above noxious weeds except for Wild Onion and Wild Garlic.

Tolerances established by the Association of Official Seed Analysts will generally be recognized. However, for the purpose of figuring pure live seed, the found pure seed and found germination percentages as reported by the North Carolina Department of Agriculture and Consumer Services, Seed Testing Laboratory will be used. Allowances, as established by the NCDOT, will be recognized for minimum pure live seed as listed on the following pages.

The specifications for restricted noxious weed seed refers to the number per pound as follows:

<u>Restricted Noxious Weed</u>	<u>Limitations per Lb. Of Seed</u>	<u>Restricted Noxious Weed</u>	<u>Limitations per Lb. of Seed</u>
Blessed Thistle	4 seeds	Cornflower (Ragged Robin)	27 seeds
Cocklebur	4 seeds	Texas Panicum	27 seeds
Spurred Anoda	4 seeds	Bracted Plantain	54 seeds
Velvetleaf	4 seeds	Buckhorn Plantain	54 seeds
Morning-glory	8 seeds	Broadleaf Dock	54 seeds
Corn Cockle	10 seeds	Curly Dock	54 seeds
Wild Radish	12 seeds	Dodder	54 seeds
Purple Nutsedge	27 seeds	Giant Foxtail	54 seeds
Yellow Nutsedge	27 seeds	Horsenettle	54 seeds
Canada Thistle	27 seeds	Quackgrass	54 seeds
Field Bindweed	27 seeds	Wild Mustard	54 seeds
Hedge Bindweed	27 seeds		

Seed of Pensacola Bahiagrass shall not contain more than 7% inert matter, Kentucky Bluegrass, Centipede and Fine or Hard Fescue shall not contain more than 5% inert matter whereas a maximum of 2% inert matter will be allowed on all other kinds of seed. In addition, all seed shall not contain more than 2% other crop seed nor more than 1% total weed seed. The germination rate as tested by the North Carolina Department of Agriculture shall not fall below 70%, which includes both dormant and hard seed. Seed shall be labeled with not more than 7%, 5% or 2% inert matter (according to above specifications), 2% other crop seed and 1% total weed seed.

Exceptions may be made for minimum pure live seed allowances when cases of seed variety shortages are verified. Pure live seed percentages will be applied in a verified shortage situation. Those purchase orders of deficient seed lots will be credited with the percentage that the seed is deficient.

FURTHER SPECIFICATIONS FOR EACH SEED GROUP ARE GIVEN BELOW:

Minimum 85% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 83% pure live seed will not be approved.

Sericea Lespedeza
Oats (seeds)

Minimum 80% pure live seed; maximum 1% total weed seed; maximum 2% total other crop; maximum 144 restricted noxious weed seed per pound. Seed less than 78% pure live seed will not be approved.

Tall Fescue (all approved varieties)
Kobe Lespedeza
Korean Lespedeza
Weeping Lovegrass
Carpetgrass

Bermudagrass
Browntop Millet
German Millet – Strain R
Clover – Red/White/Crimson

Minimum 78% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 76% pure live seed will not be approved.

Common or Sweet Sundangrass

Minimum 76% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 restricted noxious weed seed per pound. Seed less than 74% pure live seed will not be approved.

Rye (grain; all varieties)
Kentucky Bluegrass (all approved varieties)
Hard Fescue (all approved varieties)
Shrub (bicolor) Lespedeza

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 144 noxious weed seed per pound. Seed less than 70% pure live seed will not be approved.

Centipedegrass
Crownvetch
Pensacola Bahiagrass
Creeping Red Fescue

Japanese Millet
Reed Canary Grass
Zoysia

Minimum 70% pure live seed; maximum 1% total weed seed; maximum 2% total other crop seed; maximum 5% inert matter; maximum 144 restricted noxious weed seed per pound.

Barnyard Grass
Big Bluestem
Little Bluestem
Bristly Locust
Birdsfoot Trefoil
Indiangrass
Orchardgrass
Switchgrass
Yellow Blossom Sweet Clover

STANDARD SPECIAL PROVISION**ERRATA**

(1-17-12) (Rev. 9-18-12)

Z-4

Revise the *2012 Standard Specifications* as follows:

Division 2

Page 2-7, line 31, Article 215-2 Construction Methods, replace “Article 107-26” with “Article 107-25”.

Page 2-17, Article 226-3, Measurement and Payment, line 2, delete “pipe culverts,”.

Page 2-20, Subarticle 230-4(B), Contractor Furnished Sources, change references as follows: **Line 1**, replace “(4) Buffer Zone” with “(c) Buffer Zone”; **Line 12**, replace “(5) Evaluation for Potential Wetlands and Endangered Species” with “(d) Evaluation for Potential Wetlands and Endangered Species”; and **Line 33**, replace “(6) Approval” with “(4) Approval”.

Division 4

Page 4-77, line 27, Subarticle 452-3(C) Concrete Coping, replace “sheet pile” with “reinforcement”.

Division 6

Page 6-7, line 31, Article 609-3 Field Verification of Mixture and Job Mix Formula Adjustments, replace “30” with “45”.

Page 6-10, line 42, Subarticle 609-6(C)(2), replace “Subarticle 609-6(E)” with “Subarticle 609-6(D)”.

Page 6-11, Table 609-1 Control Limits, replace “Max. Spec. Limit” for the Target Source of $P_{0.075}/P_{be}$ Ratio with “1.0”.

Page 6-40, Article 650-2 Materials, replace “Subarticle 1012-1(F)” with “Subarticle 1012-1(E)”

Division 10

Page 10-74, Table 1056-1 Geotextile Requirements, replace “50%” for the UV Stability (Retained Strength) of Type 5 geotextiles with “70%”.

Division 12

Page 12-7, Table 1205-3, add “FOR THERMOPLASTIC” to the end of the title.

Page 12-8, Subarticle 1205-5(B), line 13, replace “Table 1205-2” with “Table 1205-4”.

Page 12-8, Table 1205-4 and 1205-5, replace “THERMOPLASTIC” in the title of these tables with “POLYUREA”.

Page 12-9, Subarticle 1205-6(B), line 21, replace “Table 1205-4” with “Table 1205-6”.

Page 12-11, Subarticle 1205-8(C), line 25, replace “Table 1205-5” with “Table 1205-7”.

Division 15

Page 15-6, Subarticle 1510-3(B), after line 21, replace the allowable leakage formula with the following: $W = LD\sqrt{P} \div 148,000$

Page 15-6, Subarticle 1510-3(B), line 32, delete “may be performed concurrently or” and replace with “shall be performed”.

Page 15-17, Subarticle 1540-3(E), line 27, delete “Type 1”.

Division 17

Page 17-26, line 42, Subarticle 1731-3(D) Termination and Splicing within Interconnect Center, delete this subarticle.

Revise the *2012 Roadway Standard Drawings* as follows:

1633.01 Sheet 1 of 1, English Standard Drawing for Matting Installation, replace “1633.01” with “1631.01”.

STANDARD SPECIAL PROVISION**PLANT AND PEST QUARANTINES****(Imported Fire Ant, Gypsy Moth, Witchweed, And Other Noxious Weeds)**

(3-18-03)

Z-04a

Within Quarantined Area

This project may be within a county regulated for plant and/or pests. If the project or any part of the Contractor's operations is located within a quarantined area, thoroughly clean all equipment prior to moving out of the quarantined area. Comply with federal/state regulations by obtaining a certificate or limited permit for any regulated article moving from the quarantined area.

Originating in a Quarantined County

Obtain a certificate or limited permit issued by the N.C. Department of Agriculture/United States Department of Agriculture. Have the certificate or limited permit accompany the article when it arrives at the project site.

Contact

Contact the N.C. Department of Agriculture/United States Department of Agriculture at 1-800-206-9333, 919-733-6932, or <http://www.ncagr.com/plantind/> to determine those specific project sites located in the quarantined area or for any regulated article used on this project originating in a quarantined county.

Regulated Articles Include

1. Soil, sand, gravel, compost, peat, humus, muck, and decomposed manure, separately or with other articles. This includes movement of articles listed above that may be associated with cut/waste, ditch pulling, and shoulder cutting.
2. Plants with roots including grass sod.
3. Plant crowns and roots.
4. Bulbs, corms, rhizomes, and tubers of ornamental plants.
5. Hay, straw, fodder, and plant litter of any kind.
6. Clearing and grubbing debris.
7. Used agricultural cultivating and harvesting equipment.
8. Used earth-moving equipment.
9. Any other products, articles, or means of conveyance, of any character, if determined by an inspector to present a hazard of spreading imported fire ant, gypsy moth, witchweed or other noxious weeds.

STANDARD SPECIAL PROVISION**AWARD OF CONTRACT**

(6-28-77)

Z-6

“The North Carolina Department of Transportation, in accordance with the provisions of *Title VI of the Civil Rights Act of 1964* (78 Stat. 252) and the Regulations of the Department of Transportation (*49 C.F.R., Part 21*), issued pursuant to such act, hereby notifies all bidders that it will affirmatively insure that the contract entered into pursuant to this advertisement will be awarded to the lowest responsible bidder without discrimination on the ground of race, color, or national origin”.

STANDARD SPECIAL PROVISION**MINORITY AND FEMALE EMPLOYMENT REQUIREMENTS**

Z-7

NOTICE OF REQUIREMENTS FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (*EXECUTIVE NUMBER 11246*)

1. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, see as shown on the attached sheet entitled "Employment Goals for Minority and Female participation".

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The Contractor's compliance with the Executive Order and the regulations in *41 CFR Part 60-4* shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in *41 CFR 60-4.3(a)*, and its effort to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project or the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the executive Order and the regulations in *41 CFR Part 60-4*. Compliance with the goals will be measured against the total work hours performed.

2. As used in this Notice and in the contract resulting from this solicitation, the "covered area" is the county or counties shown on the cover sheet of the proposal form and contract.

**EMPLOYMENT GOALS FOR MINORITY
AND FEMALE PARTICIPATION**

Economic Areas

Area 023 29.7%

Bertie County
Camden County
Chowan County
Gates County
Hertford County
Pasquotank County
Perquimans County

Area 024 31.7%

Beaufort County
Carteret County
Craven County
Dare County
Edgecombe County
Green County
Halifax County
Hyde County
Jones County
Lenoir County
Martin County
Nash County
Northampton County
Pamlico County
Pitt County
Tyrrell County
Washington County
Wayne County
Wilson County

Area 025 23.5%

Columbus County
Duplin County
Onslow County
Pender County

Area 026 33.5%

Bladen County
Hoke County
Richmond County
Robeson County
Sampson County
Scotland County

Area 027 24.7%

Chatham County
Franklin County
Granville County
Harnett County
Johnston County
Lee County
Person County
Vance County
Warren County

Area 028 15.5%

Alleghany County
Ashe County
Caswell County
Davie County
Montgomery County
Moore County
Rockingham County
Surry County
Watauga County
Wilkes County

Area 029 15.7%

Alexander County
Anson County
Burke County
Cabarrus County
Caldwell County
Catawba County
Cleveland County
Iredell County
Lincoln County
Polk County
Rowan County
Rutherford County
Stanly County

Area 0480 8.5%

Buncombe County
Madison County

Area 030 6.3%

Avery County
Cherokee County
Clay County
Graham County
Haywood County
Henderson County
Jackson County
McDowell County
Macon County
Mitchell County
Swain County
Transylvania County
Yancey County

SMSA Areas

Area 5720 26.6%
Currituck County

Area 9200 20.7%
Brunswick County
New Hanover County

Area 2560 24.2%
Cumberland County

Area 6640 22.8%
Durham County
Orange County
Wake County

Area 1300 16.2%
Alamance County

Area 3120 16.4%
Davidson County
Forsyth County
Guilford County
Randolph County
Stokes County
Yadkin County

Area 1520 18.3%
Gaston County
Mecklenburg County
Union County

Goals for FemaleParticipation in Each Trade

(Statewide) 6.9%

STANDARD SPECIAL PROVISION**REQUIRED CONTRACT PROVISIONS FEDERAL - AID CONSTRUCTION CONTRACTS**

FHWA - 1273 Electronic Version - May 1, 2012

Z-8

- I. General
- II. Nondiscrimination
- III. Nonsegregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Compliance with Governmentwide Suspension and Debarment Requirements
- XI. Certification Regarding Use of Contract Funds for Lobbying

ATTACHMENTS

- A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).
The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.
Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.
Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).
2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.
3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.
4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are

incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

- a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.
- b. The contractor will accept as its operating policy the following statement:
"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."
2. **EEO Officer:** The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.
3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:
 - a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.
 - b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.
 - c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.
 - d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.
 - e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.
4. **Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.
 - a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.
 - b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.
 - c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.
5. **Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:
 - a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
 - b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.
 - c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.
 - d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.
6. **Training and Promotion:**
 - a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.
 - b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).
 - c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.
 - d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. **Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:
 - a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.
 - b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.
 - c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.
 - d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.
8. **Reasonable Accommodation for Applicants / Employees with Disabilities:** The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.
9. **Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.
 - a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.
 - b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.
10. **Assurance Required by 49 CFR 26.13(b):**
 - a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.
 - b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.
11. **Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.
 - a. The records kept by the contractor shall document the following:
 - (1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;
 - (2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and
 - (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;
 - b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

- a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the

Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:
 - (i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
 - (ii) The classification is utilized in the area by the construction industry; and
 - (iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
 - (2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
 - (3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
 - (4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
 - c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
 - d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.
2. **Withholding.** The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.
 3. **Payrolls and basic records**
 - a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.
 - b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the

payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at [http://www.dol.gov/esa/whd/forms/ wh347instr.htm](http://www.dol.gov/esa/whd/forms/wh347instr.htm) or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency.

- (2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
 - (i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;
 - (ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
 - (iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
 - (3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.
 - (4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.
 - c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.
4. **Apprentices and trainees**

- a. Apprentices (programs of the USDOL). Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- b. Trainees (programs of the USDOL). Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- c. **Equal employment opportunity.** The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.
- d. **Apprentices and Trainees (programs of the U.S. DOT).** Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.
5. **Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.
6. **Subcontracts.** The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.
7. **Contract termination: debarment.** A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.
8. **Compliance with Davis-Bacon and Related Act requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.
9. **Disputes concerning labor standards.** Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.
10. **Certification of eligibility.**
 - a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
 - b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
 - c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

VI. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. **Overtime requirements.** No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
2. **Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.
3. **Withholding for unpaid wages and liquidated damages.** The FHWA or the contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.
4. **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).
 - a. The term "perform work with its own organization" refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees

from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
 - (2) the prime contractor remains responsible for the quality of the work of the leased employees;
 - (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
 - (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.
- b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.
2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.
 3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.
 4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.
 5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.
2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).
3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1. Instructions for Certification – First Tier Participants:

- a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.
- b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.
- c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.
- d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
- e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contractor). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).
- f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.
- g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.
- h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.
- i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
- j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

- a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:
 - (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;
 - (2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and
 - (4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Participants:

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200)

- a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.
- b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

- c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.
- d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).
- e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
- f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold.
- g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (<https://www.epls.gov/>), which is compiled by the General Services Administration.
- h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
- i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion—Lower Tier Participants:

- 1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.
- 2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000 (49 CFR 20).

- 1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:
 - a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
 - b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- 2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.
- 3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

STANDARD SPECIAL PROVISION**ON-THE-JOB TRAINING**

(10-16-07) (Rev. 5-21-13)

Z-10

Description

The North Carolina Department of Transportation will administer a custom version of the Federal On-the-Job Training (OJT) Program, commonly referred to as the Alternate OJT Program. All contractors (existing and newcomers) will be automatically placed in the Alternate Program. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level. Instead, these requirements will be applicable on an annual basis for each contractor administered by the OJT Program Manager.

On the Job Training shall meet the requirements of 23 CFR 230.107 (b), 23 USC – Section 140, this provision and the On-the-Job Training Program Manual.

The Alternate OJT Program will allow a contractor to train employees on Federal, State and privately funded projects located in North Carolina. However, priority shall be given to training employees on NCDOT Federal-Aid funded projects.

Minorities and Women

Developing, training and upgrading of minorities and women toward journeyman level status is a primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority and women as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Manager, will assign training goals for a calendar year based on the contractors' past three years' activity and the contractors' anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from 1 to 15 per contractor per calendar year. The Contractor shall sign an agreement to fulfill their annual goal for the year. A sample agreement is available at www.ncbowd.com/section/on-the-job-training.

Training Classifications

The Contractor shall provide on-the-job training aimed at developing full journeyman level workers in the construction craft/operator positions. Preference shall be given to providing training in the following skilled work classifications:

Equipment Operators	Office Engineers
Truck Drivers	Estimators
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has established common training classifications and their respective training requirements that may be used by the contractors. However, the classifications established are not all-inclusive. Where the training is oriented toward construction applications, training will be allowed in lower-level management positions such as office engineers and estimators. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance to FHWA the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and

The number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

The Contractor may allow trainees to be trained by a subcontractor provided that the Contractor retains primary responsibility for meeting the training and this provision is made applicable to the subcontract. However, only the Contractor will receive credit towards the annual goal for the trainee.

Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment, monthly and completion reports documenting company compliance under these contract documents. These documents and any other information as requested shall be submitted to the OJT Program Manager.

Upon completion and graduation of the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

All trainees enrolled in the program will receive an initial and Trainee/Post graduate interview conducted by the OJT program staff.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no instance shall a trainee be paid less than the local minimum wage. The Contractor shall adhere to the minimum hourly wage rate that will satisfy both the NC Department of Labor (NCDOL) and the Department.

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and who receives training for at least 50 percent of the specific program requirement. Trainees will be allowed to be transferred between projects if required by the Contractor's scheduled workload to meet training goals.

If a contractor fails to attain their training assignments for the calendar year, they may be taken off the NCDOT's Bidders List.

Measurement and Payment

No compensation will be made for providing required training in accordance with these contract documents.

STANDARD SPECIAL PROVISION
MINIMUM WAGES
GENERAL DECISION NC130091 01/04/2013 NC91

Z-91

Date: January 4, 2013

General Decision Number: NC130091 01/04/2013 NC91

Superseded General Decision Numbers: NC20120091

State: North Carolina

Construction Type: HIGHWAY

COUNTIES:

Alamance	Forsyth	Yadkin
Davie	Stokes	

HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects, railroad construction, bascule, suspension and spandrel arch bridges designed for commercial navigation, bridges involving marine construction, and other major bridges).

Modification Number
0

Publication Date
01/04/2013

SUNC2011-072 09/16/2011

	Rates	Fringes
CARPENTER (Form Work Only)		
Alamance County	13.04	
Davie	13.41	
Forsyth, Stokes, and Yadkin Counties	13.10	
CEMENT MASON/CONCRETE FINISHER		
Alamance County	14.08	
Davie, Forsyth, Stokes, and Yadkin Counties	14.51	
IRONWORKER (Reinforcing)	14.88	
LABORER		
Asphalt, Asphalt Distributor, Raker, and Spreader		
Alamance County	12.20	
Davie, Forsyth, Stokes, and Yadkin Counties	12.32	
Common or General		
Alamance County	10.10	
Davie County	10.72	
Forsyth County	10.03	
Stokes County	9.54	
Yadkin County	10.86	
Concrete Saw	13.52	
Landscape	9.89	
Luteman	12.73	
Mason Tender (Cement/Concrete)	11.43	
Pipelayer	12.69	
Traffic Control (Cone Setter)		
Alamance County	11.15	
Davie, Forsyth, Stokes, and Yadkin Counties	12.25	

	Rates	Fringes
Traffic Control (Flagger)		
Alamance and Davie Counties	8.93	
Forsyth, Stokes, and Yadkin Counties	7.25	
POWER EQUIPMENT OPERATORS		
Backhoe/Excavator/Trackhoe		
Alamance County	14.78	
Davie County	15.43	
Forsyth, Stokes, and Yadkin Counties	14.96	
Broom/Sweeper	14.82	
Bulldozer		
Alamance County	14.66	
Davie, Forsyth, Stokes, and Yadkin Counties	16.15	
Crane		
Alamance County	16.83	
Davie County	16.31	
Forsyth, Stokes, and Yadkin Counties	16.13	
Curb Machine	14.43	
Distributor	15.27	
Drill	18.28	
Grader/Blade		
Alamance County	14.83	
Davie, Forsyth, Stokes, and Yadkin Counties	16.03	
Loader		
Alamance County	14.43	
Davie, Forsyth, Stokes, and Yadkin Counties	14.48	
Mechanic	14.00	
Milling Machine	14.38	
Oiler	13.58	
Paver		
Alamance County	16.00	
Davie, Forsyth, Stokes, and Yadkin Counties	16.06	
Roller	13.15	
Scraper	14.00	
Screed	14.85	
Tractor	12.94	
TRUCK DRIVER		
Distributor	16.75	
Dump Truck		
Alamance County	11.69	
Davie, Forsyth, and Stokes Counties	11.50	
Yadkin County	11.80	
Flatbed Truck	15.02	
Lowboy Truck	15.34	
Off the Road Truck	13.78	
Single Axle Truck	13.40	
Tack Truck	16.51	
Water Truck	13.03	

Welders – Receive rate prescribed for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters, PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, D.C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
ROADWAY ITEMS						
0001	0000100000-N	800	MOBILIZATION	Lump Sum	L.S.	
0002	2591000000-E	848	4" CONCRETE SIDEWALK	8 SY		
0003	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	840 SF		
0004	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	72 SF		
0005	4415000000-N	1115	FLASHING ARROW BOARD	3 EA		
0006	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	3 EA		
0007	4430000000-N	1130	DRUMS	150 EA		
0008	4435000000-N	1135	CONES	150 EA		
0009	4445000000-E	1145	BARRICADES (TYPE III)	50 LF		
0010	4450000000-N	1150	FLAGGER	400 HR		
0011	4480000000-N	1165	TMA	6 EA		
0012	4510000000-N	SP	LAW ENFORCEMENT	450 HR		
0013	4516000000-N	1180	SKINNY DRUM	100 EA		
0014	7060000000-E	1705	SIGNAL CABLE	4,910 LF		
0015	7120000000-E	1705	VEHICLE SIGNAL HEAD (12", 3 SECTION)	1 EA		
0016	7144000000-E	1705	VEHICLE SIGNAL HEAD (12", 5 SECTION)	13 EA		
0017	7252000000-E	1710	MESSENGER CABLE (1/4")	99,190 LF		
0018	7264000000-E	1710	MESSENGER CABLE (3/8")	125 LF		
0019	7279000000-E	1715	TRACER WIRE	93,225 LF		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0020	7301000000-E	1715	DIRECTIONAL DRILL (*****) (2, 2")	41,115 LF		
0021	7312000000-N	1716	JUNCTION BOX (*****) (OVER-SIZED)	242 EA		
0022	7312000000-N	1716	JUNCTION BOX (*****) (SPECIAL-SIZED)	62 EA		
0023	7324000000-N	1716	JUNCTION BOX (STANDARD SIZE)	22 EA		
0024	7360000000-N	1720	WOOD POLE	7 EA		
0025	7372000000-N	1721	GUY ASSEMBLY	358 EA		
0026	7384000000-E	1722	***" RISER WITH ***** (1", HEAT SHRINK TUBING)	14 EA		
0027	7408000000-E	1722	1" RISER WITH WEATHERHEAD	16 EA		
0028	7420000000-E	1722	2" RISER WITH WEATHERHEAD	82 EA		
0029	7432000000-E	1722	2" RISER WITH HEAT SHRINK TUBING	217 EA		
0030	7444000000-E	1725	INDUCTIVE LOOP SAWCUT	2,530 LF		
0031	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (24)	312,235 LF		
0032	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (36)	84,380 LF		
0033	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (48)	3,520 LF		
0034	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (72)	23,195 LF		
0035	7528000000-E	1730	DROP CABLE	44,830 LF		
0036	7540000000-N	1731	SPLICE ENCLOSURE	161 EA		
0037	7552000000-N	1731	INTERCONNECT CENTER	170 EA		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0038	7566000000-N	1733	DELINEATOR MARKER	69 EA		
0039	7575142200-N	SP	NEW ELECTRICAL SERVICE	125 EA		
0040	7575160000-E	1734	REMOVE EXISTING COMMUNICATIONS CABLE	32,950 LF		
0041	7575180000-N	1735	CABLE TRANSFER	5 EA		
0042	7636000000-N	1745	SIGN FOR SIGNALS	24 EA		
0043	7684000000-N	1750	SIGNAL CABINET FOUNDATION	24 EA		
0044	7686000000-N	1752	CONDUIT ENTRANCE INTO EXISTING FOUNDATION	103 EA		
0045	7687000000-N	1752	MODIFY FOUNDATION FOR CONTROL- LER CABINET	114 EA		
0046	7696000000-N	1751	CONTROLLER WITH CABINET (*****) (2070L, 332, BASE MOUNTED)	146 EA		
0047	7696000000-N	1751	CONTROLLER WITH CABINET (*****) (2070L, 336S, POLE MOUNTED)	22 EA		
0048	7708000000-N	1751	DETECTOR CARD (*****) (MODEL 222)	923 EA		
0049	7901000000-N	1753	CABINET BASE EXTENDER	142 EA		
0050	7901010000-N	1753	CABINET BASE ADAPTER	3 EA		
0051	7980000000-N	SP	GENERIC SIGNAL ITEM 4" RISER WITH SEAL	1 EA		
0052	7980000000-N	SP	GENERIC SIGNAL ITEM 5/8" X 10' GROUNDING ELECTRODE	385 EA		
0053	7980000000-N	SP	GENERIC SIGNAL ITEM 900MHZ ETHERNET RADIO	4 EA		
0054	7980000000-N	SP	GENERIC SIGNAL ITEM AUXILIARY OUTPUT FILE	99 EA		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0055	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET (BASE MOUNT)	1 EA		
0056	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET (POLE MOUNT)	17 EA		
0057	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET FOUNDATION	1 EA		
0058	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CAMERA ASSEMBLY	18 EA		
0059	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV WOOD POLE	15 EA		
0060	7980000000-N	SP	GENERIC SIGNAL ITEM DIGITAL HARDWARE VIDEO ENCODER	18 EA		
0061	7980000000-N	SP	GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	174 EA		
0062	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 2018 ENHANCED CONFLICT MONITOR	8 EA		
0063	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 2070L CONTROLLER	9 EA		
0064	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 332 CABINET	7 EA		
0065	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 336S CABINET	1 EA		
0066	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 900MHZ ETHERNET RADIO	1 EA		
0067	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH CCTV CABINET (POLE MOUNT)	1 EA		
0068	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH CCTV CAMERA ASSEMBLY	1 EA		
0069	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH DETECTOR CARD (MODEL 222)	46 EA		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0070	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH DIGITAL HARDWARE VIDEO ENCODER	1 EA		
0071	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH ETHERNET EDGE SWITCH	9 EA		
0072	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH ETHERNET RADIO LIGHT- NING ARRESTOR	1 EA		
0073	7980000000-N	SP	GENERIC SIGNAL ITEM GUY ASSEMBLY (AERIAL)	36 EA		
0074	7980000000-N	SP	GENERIC SIGNAL ITEM GUY ASSEMBLY (SIDEWALK)	37 EA		
0075	7980000000-N	SP	GENERIC SIGNAL ITEM HEAT SHRINK TUBING RETROFIT KIT	22 EA		
0076	7980000000-N	SP	GENERIC SIGNAL ITEM HUB SPLICE CENTER (36 FIBER)	3 EA		
0077	7980000000-N	SP	GENERIC SIGNAL ITEM INSTALL CONTROLLER (2070L) IN EXISTING CABINET	2 EA		
0078	7980000000-N	SP	GENERIC SIGNAL ITEM IS 2" RISER WITH HEAT SHRINK TUBING	10 EA		
0079	7980000000-N	SP	GENERIC SIGNAL ITEM IS HEAT SHRINK TUBING RETROFIT KIT	1 EA		
0080	7980000000-N	SP	GENERIC SIGNAL ITEM IS JUNCTION BOX (OVER-SIZED)	1 EA		
0081	7980000000-N	SP	GENERIC SIGNAL ITEM IS JUNCTION BOX (SPECIAL- SIZED)	12 EA		
0082	7980000000-N	SP	GENERIC SIGNAL ITEM IS MODIFY EXISTING SPLICE	3 EA		
0083	7980000000-N	SP	GENERIC SIGNAL ITEM IS SPLICE ENCLOSURE	39 EA		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0084	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY EXISTING ELECTRICAL SERVICE (TRAFFIC SIGNAL)	23 EA		
0085	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY EXISTING SPLICE	15 EA		
0086	7980000000-N	SP	GENERIC SIGNAL ITEM POLE GROUNDING SYSTEM	22 EA		
0087	7980000000-N	SP	GENERIC SIGNAL ITEM REMOVE SPLICE CABINET	163 EA		
0088	7980000000-N	SP	GENERIC SIGNAL ITEM TERMINAL SPLICE CABINET	15 EA		
0089	7980000000-N	SP	GENERIC SIGNAL ITEM TEST CONTROLLER (2070L)	1 EA		
0090	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY CCTV SOFTWARE	Lump Sum	L.S.	
0091	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY NETWORK MANAGEMENT SOFTWARE	Lump Sum	L.S.	
0092	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY REGIONAL ITS GUI SOFT- WARE	Lump Sum	L.S.	
0093	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY SIGNAL SYSTEM SOFTWARE	Lump Sum	L.S.	
0094	7985000000-N	SP	GENERIC SIGNAL ITEM TMC MODIFICATIONS	Lump Sum	L.S.	
0095	7985000000-N	SP	GENERIC SIGNAL ITEM TRAINING	Lump Sum	L.S.	
0096	7990000000-E	SP	GENERIC SIGNAL ITEM AERIAL CABLE PROTECTOR	13,510 LF		
0097	7990000000-E	SP	GENERIC SIGNAL ITEM ETHERNET CABLE	2,455 LF		
0098	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (24 FIBER)	99,850 LF		

County : Forsyth

Line #	Item Number	Sec #	Description	Quantity	Unit Cost	Amount
0099	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (48 FIBER)	195,610 LF		
0100	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (96 FIBER)	39,780 LF		
0101	7990000000-E	SP	GENERIC SIGNAL ITEM IS DIRECTIONAL DRILL (1, 2")	100 LF		
0102	7990000000-E	SP	GENERIC SIGNAL ITEM IS TRACER WIRE	100 LF		
0103	7990000000-E	SP	GENERIC SIGNAL ITEM IS UNDERGROUND CONDUIT (1, 2")	100 LF		
0104	7990000000-E	SP	GENERIC SIGNAL ITEM LEAD-IN CABLE	17,620 LF		
0105	7990000000-E	SP	GENERIC SIGNAL ITEM PULL BACK AND REINSTALL COMMUNICATIONS CABLE	760 LF		
0106	7990000000-E	SP	GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (1, 2")	1,995 LF		
0107	7990000000-E	SP	GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (2, 2")	49,260 LF		
0108	7991000000-E	SP	GENERIC SIGNAL ITEM BRICK PAVERS	8 SF		

1254/Jun26/Q1169880.0/D791266592200/E108

Total Amount Of Bid For Entire Project :

Vendor 1 of 6: BROOKS BERRY HAYNIE & ASSOCIATES, INC.
(3560)
Call Order 008 (Proposal: C203195)

Bid Information

County: FORSYTH	Bid Checksum: 3D133F61
Address: 600 Discovery Pl Mableton , Georgia , 30126	Bid Total: \$6,239,371.08 ✓
Signature Check: Alex_Owen_3560	Items Total: \$6,239,371.08 ✓
Time Bid Received: July 16, 2013 11:24 AM	Time Total: \$0.00
Amendment Count: 1	
	DBE GOAL SET 3.0
Bidding Errors: None.	DBE GOAL MET 3.0

Vendor 1 of 6: BROOKS BERRY HAYNIE & ASSOCIATES, INC.
(3560)
Call Order 008 (Proposal: C203195)

Bid Bond Information

Projects:	Bond Maximum:
Counties:	State of Incorporation:
Bond ID: SNC13260026	Agency Execution Date: 7/10/2013 10
Paid by Check: No	Surety Name: surety2000
Bond Percent: 5%	Bond Agency Name: Liberty Mutual Insurance Company

Vendor 3560's Bid Information for Call 008, Letting L130716, 07/16/13

Brooks-Berry-Haynie & Associates, Inc. (3560)
Call Order 008 (Proposal ID C203195)

LIST OF DBE PARTICIPANTS

VENDOR NUMBER	DBE NAME ADDRESS	WORK CODE TYPE OF WORK	CERT TYPE AMOUNT	
8450 WB	CARLSON CONSTRUCTION SERVICES L P.O. BOX 669547 , MARIETTA, GA 30066		Sub	190,188.00
			TOTAL:	\$190,188.00
				3.05%

Committed

Vendor 3560's Bid Information for Call 008, Letting L130716, 07/16/13

Brooks-Berry-Haynie & Associates, Inc. (3560)
Call Order 008 (Proposal ID C203195)

Miscellaneous Data Info - Contractor Responses:

NON-COLLUSION AND DEBARMENT CERTIFICATION

Explanation of the prospective bidder that is unable to certify to any of the statements in this certification:

Explanation:
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED
NOT ANSWERED

AWARD LIMITS ON MULTIPLE PROJECTS

By answering YES to this statement, the bidder acknowledges that they are using the award limits on multiple projects. No

It is the desire of the Bidder to be awarded contracts, the value of which will not exceed a total of NOT ANSWERED for those projects indicated herein, for which bids will be opened on (MM/DD/YY)

The Award Limits shall apply to the following projects:

Contract Number	County
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	

Bid Bond Data Info - Contractor Responses:

BondID: SNC13260026
Surety Registry Agency: surety2000
Verified?: Yes

Surety Agency: Liberty Mutual Insurance Company

Bond Execution Date: 7/10/2013 10

Bond Amount: \$311,968.55 (Five Percent of Bid)

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
Section 0001 ROADWAY ITEMS				
Alt Group				
0001	0000100000-N MOBILIZATION	LUMP	LUMP	305,000.00
0002	2591000000-E 4" CONCRETE SIDEWALK	8.000 SY	165.00000	1,320.00
0003	4405000000-E WORK ZONE SIGNS (PORTABLE)	840.000 SF	9.65000	8,106.00
0004	4410000000-E WORK ZONE SIGNS (BARRICADE MOUNTED)	72.000 SF	15.00000	1,080.00
0005	4415000000-N FLASHING ARROW BOARD	3.000 EA	710.00000	2,130.00
0006	4420000000-N PORTABLE CHANGEABLE MESSAGE SIGN	3.000 EA	900.00000	2,700.00
0007	4430000000-N DRUMS	150.000 EA	55.00000	8,250.00
0008	4435000000-N CONES	150.000 EA	25.00000	3,750.00
0009	4445000000-E BARRICADES (TYPE III)	50.000 LF	32.00000	1,600.00
0010	4450000000-N FLAGGER	400.000 HR	50.00000	20,000.00
0011	4480000000-N TMA	6.000 EA	3,100.00000	18,600.00

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0012	4510000000-N LAW ENFORCEMENT	450.000 HR	45.00000	20,250.00
0013	4516000000-N SKINNY DRUM	100.000 EA	28.50000	2,850.00
0014	7060000000-E SIGNAL CABLE	4,910.000 LF	2.24000	10,998.40
0015	7120000000-E VEHICLE SIGNAL HEAD (12", 3 SECTION)	1.000 EA	896.00000	896.00
0016	7144000000-E VEHICLE SIGNAL HEAD (12", 5 SECTION)	13.000 EA	1,175.00000	15,275.00
0017	7252000000-E MESSENGER CABLE (1/4")	99,190.000 LF	1.25000	123,987.50
0018	7264000000-E MESSENGER CABLE (3/8")	125.000 LF	5.15000	643.75
0019	7279000000-E TRACER WIRE	93,225.000 LF	0.37000	34,493.25
0020	7301000000-E DIRECTIONAL DRILL (***** (2, 2"))	41,115.000 LF	12.76000	524,627.40
0021	7312000000-N JUNCTION BOX (***** (OVER-SIZED)	242.000 EA	530.00000	128,260.00
0022	7312000000-N JUNCTION BOX (***** (SPECIAL-SIZED)	62.000 EA	945.00000	58,590.00
0023	7324000000-N JUNCTION BOX (STANDARD SIZE)	22.000 EA	215.00000	4,730.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195

Project(s): CMS-0918(94)

Letting Date: 07-16-13 Call Order: 008

Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0024	7360000000-N WOOD POLE EA	7.000	1,052.00000	7,364.00
0025	7372000000-N GUY ASSEMBLY EA	358.000	235.00000	84,130.00
0026	7384000000-E ***" RISER WITH ***** (1", HEAT SHRINK TUBING) EA	14.000	288.00000	4,032.00
0027	7408000000-E 1" RISER WITH WEATHERHEAD EA	16.000	255.00000	4,080.00
0028	7420000000-E 2" RISER WITH WEATHERHEAD EA	82.000	280.00000	22,960.00
0029	7432000000-E 2" RISER WITH HEAT SHRINK TUBING EA	217.000	290.00000	62,930.00
0030	7444000000-E INDUCTIVE LOOP SAWCUT LF	2,530.000	7.50000	18,975.00
0031	7516000000-E COMMUNICATI ONS CABLE (**FIBER) (24) LF	312,235.000	1.13000	352,825.55
0032	7516000000-E COMMUNICATI ONS CABLE (**FIBER) (36) LF	84,380.000	1.20000	101,256.00
0033	7516000000-E COMMUNICATI ONS CABLE (**FIBER) (48) LF	3,520.000	1.28000	4,505.60
0034	7516000000-E COMMUNICATI ONS CABLE (**FIBER) (72) LF	23,195.000	1.44000	33,400.80
0035	7528000000-E DROP CABLE LF	44,830.000	1.40000	62,762.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0036	7540000000-N SPLICE ENCLOSURE EA	161.000	1,075.00000	173,075.00
0037	7552000000-N INTERCONNEC T CENTER EA	170.000	900.00000	153,000.00
0038	7566000000-N DELINEATOR MARKER EA	69.000	50.00000	3,450.00
0039	7575142200-N NEW ELECTRICAL SERVICE EA	125.000	1,046.00000	130,750.00
0040	7575160000-E REMOVE EXISTING COMMUNICATIONSCABLE LF	32,950.000	0.60000	19,770.00
0041	7575180000-N CABLE TRANSFER EA	5.000	55.22000	276.10
0042	7636000000-N SIGN FOR SIGNALS EA	24.000	264.00000	6,336.00
0043	7684000000-N SIGNAL CABINET FOUNDATION EA	24.000	736.00000	17,664.00
0044	7686000000-N CONDUIT ENTRANCE INTO EXISTINGFOUNDATION EA	103.000	361.00000	37,183.00
0045	7687000000-N MODIFY FOUNDATION FOR CONTROL-LER CABINET EA	114.000	585.00000	66,690.00
0046	7696000000-N CONTROLLER WITH CABINET (*****) (2070L, 332, BASE MOUNTED) EA	146.000	9,885.00000	1,443,210.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0047	7696000000-N CONTROLLER WITH CABINET (*****) (2070L, 336S, POLE MOUNTED)	22.000 EA	9,150.00000	201,300.00
0048	7708000000-N DETECTOR CARD (***** (MODEL 222)	923.000 EA	103.25000	95,299.75
0049	7901000000-N CABINET BASE EXTENDER	142.000 EA	380.00000	53,960.00
0050	7901010000-N CABINET BASE ADAPTER	3.000 EA	495.00000	1,485.00
0051	7980000000-N GENERIC SIGNAL ITEM 4" RISER WITH SEAL	1.000 EA	112.00000	112.00
0052	7980000000-N GENERIC SIGNAL ITEM 5/8" X 10' GROUNDING ELECTRODE	385.000 EA	210.00000	80,850.00
0053	7980000000-N GENERIC SIGNAL ITEM 900MHZ ETHERNET RADIO	4.000 EA	2,975.00000	11,900.00
0054	7980000000-N GENERIC SIGNAL ITEM AUXILIARY OUTPUT FILE	99.000 EA	720.00000	71,280.00
0055	7980000000-N GENERIC SIGNAL ITEM CCTV CABINET (BASE MOUNT)	1.000 EA	3,681.00000	3,681.00
0056	7980000000-N GENERIC SIGNAL ITEM CCTV CABINET (POLE MOUNT)	17.000 EA	3,220.00000	54,740.00
0057	7980000000-N GENERIC SIGNAL ITEM CCTV CABINET FOUNDATION	1.000 EA	750.00000	750.00

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0058	7980000000-N GENERIC SIGNAL ITEM CCTV CAMERA ASSEMBLY	18.000 EA	3,220.00000	57,960.00
0059	7980000000-N GENERIC SIGNAL ITEM CCTV WOOD POLE	15.000 EA	1,390.00000	20,850.00
0060	7980000000-N GENERIC SIGNAL ITEM DIGITAL HARDWARE VIDEO ENCODER	18.000 EA	2,455.00000	44,190.00
0061	7980000000-N GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	174.000 EA	985.00000	171,390.00
0062	7980000000-N GENERIC SIGNAL ITEM FURNISH 2018 ENHANCED CONFLICTMONITOR	8.000 EA	725.00000	5,800.00
0063	7980000000-N GENERIC SIGNAL ITEM FURNISH 2070L CONTROLLER	9.000 EA	1,770.00000	15,930.00
0064	7980000000-N GENERIC SIGNAL ITEM FURNISH 332 CABINET	7.000 EA	6,300.00000	44,100.00
0065	7980000000-N GENERIC SIGNAL ITEM FURNISH 336S CABINET	1.000 EA	5,800.00000	5,800.00
0066	7980000000-N GENERIC SIGNAL ITEM FURNISH 900MHZ ETHERNET RADIO	1.000 EA	1,800.00000	1,800.00
0067	7980000000-N GENERIC SIGNAL ITEM FURNISH CCTV CABINET (POLE MOUNT)	1.000 EA	3,315.00000	3,315.00
0068	7980000000-N GENERIC SIGNAL ITEM FURNISH CCTV CAMERA ASSEMBLY	1.000 EA	3,470.00000	3,470.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0069	7980000000-N GENERIC SIGNAL ITEM FURNISH DETECTOR CARD (MODEL 222)	46.000 EA	65.00000	2,990.00
0070	7980000000-N GENERIC SIGNAL ITEM FURNISH DIGITAL HARDWARE VIDEOENCODER	1.000 EA	2,550.00000	2,550.00
0071	7980000000-N GENERIC SIGNAL ITEM FURNISH ETHERNET EDGE SWITCH	9.000 EA	875.00000	7,875.00
0072	7980000000-N GENERIC SIGNAL ITEM FURNISH ETHERNET RADIO LIGHT- NING ARRESTOR	1.000 EA	300.00000	300.00
0073	7980000000-N GENERIC SIGNAL ITEM GUY ASSEMBLY (AERIAL)	36.000 EA	231.00000	8,316.00
0074	7980000000-N GENERIC SIGNAL ITEM GUY ASSEMBLY (SIDEWALK)	37.000 EA	350.00000	12,950.00
0075	7980000000-N GENERIC SIGNAL ITEM HEAT SHRINK TUBING RETROFIT KIT	22.000 EA	150.00000	3,300.00
0076	7980000000-N GENERIC SIGNAL ITEM HUB SPLICE CENTER (36 FIBER)	3.000 EA	2,145.00000	6,435.00
0077	7980000000-N GENERIC SIGNAL ITEM INSTALL CONTROLLER (2070L) IN EXISTING CABINET	2.000 EA	3,150.00000	6,300.00
0078	7980000000-N GENERIC SIGNAL ITEM IS 2" RISER WITH HEAT SHRINK TUBING	10.000 EA	288.00000	2,880.00
0079	7980000000-N GENERIC SIGNAL ITEM IS HEAT SHRINK TUBING RETROFITKIT	1.000 EA	155.00000	155.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0080	7980000000-N GENERIC SIGNAL ITEM IS JUNCTION BOX (OVER-SIZED)	1.000 EA	530.00000	530.00
0081	7980000000-N GENERIC SIGNAL ITEM IS JUNCTION BOX (SPECIAL-SIZED)	12.000 EA	945.00000	11,340.00
0082	7980000000-N GENERIC SIGNAL ITEM IS MODIFY EXISTING SPLICE	3.000 EA	640.00000	1,920.00
0083	7980000000-N GENERIC SIGNAL ITEM IS SPLICE ENCLOSURE	39.000 EA	1,075.00000	41,925.00
0084	7980000000-N GENERIC SIGNAL ITEM MODIFY EXISTING ELECTRICAL SERVICE (TRAFFIC SIGNAL)	23.000 EA	615.00000	14,145.00
0085	7980000000-N GENERIC SIGNAL ITEM MODIFY EXISTING SPLICE	15.000 EA	638.00000	9,570.00
0086	7980000000-N GENERIC SIGNAL ITEM POLE GROUNDING SYSTEM	22.000 EA	250.00000	5,500.00
0087	7980000000-N GENERIC SIGNAL ITEM REMOVE SPLICE CABINET	163.000 EA	182.15000	29,690.45
0088	7980000000-N GENERIC SIGNAL ITEM TERMINAL SPLICE CABINET	15.000 EA	1,860.00000	27,900.00
0089	7980000000-N GENERIC SIGNAL ITEM TEST CONTROLLER (2070L)	1.000 EA	2,380.00000	2,380.00
0090	7985000000-N GENERIC SIGNAL ITEM MODIFY CCTV SOFTWARE	LUMP	LUMP	4,940.00

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918 (94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0091	7985000000-N GENERIC SIGNAL ITEM MODIFY NETWORK MANAGEMENT SOFTWARE	LUMP	LUMP	7,760.00
0092	7985000000-N GENERIC SIGNAL ITEM MODIFY REGIONAL ITS GUI SOFTWARE	LUMP	LUMP	2,945.00
0093	7985000000-N GENERIC SIGNAL ITEM MODIFY SIGNAL SYSTEM SOFTWARE	LUMP	LUMP	65,930.00
0094	7985000000-N GENERIC SIGNAL ITEM TMC MODIFICATIONS	LUMP	LUMP	1,000.00
0095	7985000000-N GENERIC SIGNAL ITEM TRAINING	LUMP	LUMP	5,500.00
0096	7990000000-E GENERIC SIGNAL ITEM AERIAL CABLE PROTECTOR	13,510.000 LF	3.62000	48,906.20
0097	7990000000-E GENERIC SIGNAL ITEM ETHERNET CABLE	2,455.000 LF	1.15000	2,823.25
0098	7990000000-E GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (24 FIBER)	99,850.000 LF	1.16000	115,826.00
0099	7990000000-E GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (48 FIBER)	195,610.000 LF	1.26000	246,468.60
0100	7990000000-E GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (96 FIBER)	39,780.000 LF	1.56000	62,056.80

State of NC
Dept of Transportation

Date: 06-18-13
Revised: 06-26-13

Contract ID: C203195 Project(s): CMS-0918(94)
Letting Date: 07-16-13 Call Order: 008
Bidder: 3560 - Brooks-Berry-Haynie & Associates, Inc.

Line No.	Item Description	Approx. Quantity and Units	Unit Price Dollars Cts	Bid Amount Dollars Ct
0101	7990000000-E GENERIC SIGNAL ITEM IS DIRECTIONAL DRILL (1, 2") LF	100.000	10.75000	1,075.00
0102	7990000000-E GENERIC SIGNAL ITEM IS TRACER WIRE LF	100.000	0.40000	40.00
0103	7990000000-E GENERIC SIGNAL ITEM IS UNDERGROUND CONDUIT (1, 2") LF	100.000	4.56000	456.00
0104	7990000000-E GENERIC SIGNAL ITEM LEAD-IN CABLE LF	17,620.000	1.10000	19,382.00
0105	7990000000-E GENERIC SIGNAL ITEM PULL BACK AND REINSTALL COMMUNICATIONS CABLE LF	760.000	2.80000	2,128.00
0106	7990000000-E GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (1, 2") LF	1,995.000	4.56000	9,097.20
0107	7990000000-E GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (2, 2") LF	49,260.000	7.82000	385,213.20
0108	7991000000-E GENERIC SIGNAL ITEM BRICK PAVERS SF	8.000	18.41000	147.28
	Section 0001 Total			6,239,371.08
	Bid Total			6,239,371.08

NON-COLLUSION AND DEBARMENT CERTIFICATION

The bidder certifies that neither he, nor any official, agent or employee of the bidder has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in connection with this bid, and that the bidder intends to do the work with its own bonafide employees or subcontractors and is not bidding for the benefit of another contractor. In addition, submitting this electronic bid constitutes the bidder's certification of Status under penalty of perjury under the laws of the United States and in accordance with the Debarment Certification on file with the Department.

By submitting this bid, the bidder certifies to the best of his knowledge and belief that he and his principals:

- a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- b. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records; making false statements; or receiving stolen property;
- c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph b. of this certification; and
- d. Have not within a three-year period preceding this proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

Where the prospective bidder is unable to certify to any of the statements in this certification, the bidder shall submit an explanation in the blanks provided herein. The explanation will not necessarily result in denial of participation in a contract.

Explanation:

NOT ANSWERED

NOT ANSWERED

NOT ANSWERED

NOT ANSWERED

If the prequalified bidder's status changes, he shall immediately submit a new fully executed non-collusion affidavit and debarment certification with an explanation of the change to the Contract Office prior to submitting the bid.

Failure to furnish a certification or an explanation will be grounds for rejection of a bid

AWARD LIMITS ON MULTIPLE PROJECTS

By answering YES to this statement, the bidder acknowledges that they are using the award limits on multiple projects. No

A bidder who desires to bid on more than one project on which bids are to be opened on the same date, and who also desires to avoid receiving an award of more projects than he is equipped to handle, may bid on any number of projects but may limit the total amount of work awarded to him on selected projects by completing the AWARD LIMITS ON MULTIPLE PROJECTS.

The Award Limits on Multiple Projects must be filled in on each project bid for which the Bidder desires protection.

It is the desire of the Bidder to be awarded contracts, the value of which

will not exceed a total of NOT ANSWERED for those

projects indicated herein, for which bids will be opened on (MM/DD/YY)

The Award Limits shall apply to the following projects:

Contract Number	County
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	
NOT ANSWERED	

It is agreed that if I am (we are) the low Bidder(s) on indicated projects, the total value of which is more than the above stipulated award limits, the Board of Transportation will award me (us) projects from among those indicated that have a total value not to exceed the award limit and will result in the lowest total bids to the Department of Transportation.

NORTH CAROLINA STATE DEPARTMENT OF TRANSPORTATION
DBE COMMITMENT ITEMS

DATE:06-18-13
PAGE: 13

PROPOSAL: C203195
LETTING: L130716 CALL: 008
VENDOR: 3560 Brooks-Berry-Haynie & Associates, Inc.

LINE	ITEM	ITEM	UNIT	SUBCONTRACTOR	SUBCONTRACTOR	EXTENDED
NO.	NO.	DESC.	TYPE	QUANTITY	UNIT PRICE	AMOUNT

DBE SUBCONTRACTOR: 8450 CARLSON CONSTRUCTION SERVICES LLC
Will Use Quote: Yes

0035	7528000000-E	DROP CABLE	LF	44830.000	1.10000	49313.00
0036	7540000000-N	SPLICE ENCLO	EA	161.000	875.00000	140875.00

DBE COMMITMENT TOTAL FOR SUBCONTRACTOR:	190,188.00	Committed
DBE COMMITMENT TOTAL FOR VENDOR (SubContractor)	190,188	

TOTAL DBE COMMITMENT FOR VENDOR:	Entered:	3.05% or	190188.00
	Required:	3.00% or	187181.13
		<GOAL MET>	

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
ROADWAY ITEMS						
0001	0000100000-N	800	MOBILIZATION	Lump Sum LS	305,000.00	305,000.00
0002	2591000000-E	848	4" CONCRETE SIDEWALK	8 SY	165.00	1,320.00
0003	4405000000-E	1110	WORK ZONE SIGNS (PORTABLE)	840 SF	9.65	8,106.00
0004	4410000000-E	1110	WORK ZONE SIGNS (BARRICADE MOUNTED)	72 SF	15.00	1,080.00
0005	4415000000-N	1115	FLASHING ARROW BOARD	3 EA	710.00	2,130.00
0006	4420000000-N	1120	PORTABLE CHANGEABLE MESSAGE SIGN	3 EA	900.00	2,700.00
0007	4430000000-N	1130	DRUMS	150 EA	55.00	8,250.00
0008	4435000000-N	1135	CONES	150 EA	25.00	3,750.00
0009	4445000000-E	1145	BARRICADES (TYPE III)	50 LF	32.00	1,600.00
0010	4450000000-N	1150	FLAGGER	400 HR	50.00	20,000.00
0011	4480000000-N	1165	TMA	6 EA	3,100.00	18,600.00
0012	4510000000-N	SP	LAW ENFORCEMENT	450 HR	45.00	20,250.00
0013	4516000000-N	1180	SKINNY DRUM	100 EA	28.50	2,850.00
0014	7060000000-E	1705	SIGNAL CABLE	4,910 LF	2.24	10,998.40
0015	7120000000-E	1705	VEHICLE SIGNAL HEAD (12", 3 SECTION)	1 EA	896.00	896.00
0016	7144000000-E	1705	VEHICLE SIGNAL HEAD (12", 5 SECTION)	13 EA	1,175.00	15,275.00
0017	7252000000-E	1710	MESSENGER CABLE (1/4")	99,190 LF	1.25	123,987.50
0018	7264000000-E	1710	MESSENGER CABLE (3/8")	125 LF	5.15	643.75
0019	7279000000-E	1715	TRACER WIRE	93,225 LF	0.37	34,493.25
0020	7301000000-E	1715	DIRECTIONAL DRILL (***** (2, 2"))	41,115 LF	12.76	524,627.40

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0021	7312000000-N	1716	JUNCTION BOX (*****) (OVER-SIZED)	242 EA	530.00	128,260.00
0022	7312000000-N	1716	JUNCTION BOX (*****) (SPECIAL-SIZED)	62 EA	945.00	58,590.00
0023	7324000000-N	1716	JUNCTION BOX (STANDARD SIZE)	22 EA	215.00	4,730.00
0024	7360000000-N	1720	WOOD POLE	7 EA	1,052.00	7,364.00
0025	7372000000-N	1721	GUY ASSEMBLY	358 EA	235.00	84,130.00
0026	7384000000-E	1722	**** RISER WITH ***** (1", HEAT SHRINK TUBING)	14 EA	288.00	4,032.00
0027	7408000000-E	1722	1" RISER WITH WEATHERHEAD	16 EA	255.00	4,080.00
0028	7420000000-E	1722	2" RISER WITH WEATHERHEAD	82 EA	280.00	22,960.00
0029	7432000000-E	1722	2" RISER WITH HEAT SHRINK TUBING	217 EA	290.00	62,930.00
0030	7444000000-E	1725	INDUCTIVE LOOP SAWCUT	2,530 LF	7.50	18,975.00
0031	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (24)	312,235 LF	1.13	352,825.55
0032	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (36)	84,380 LF	1.20	101,256.00
0033	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (48)	3,520 LF	1.28	4,505.60
0034	7516000000-E	1730	COMMUNICATIONS CABLE (**FIBER) (72)	23,195 LF	1.44	33,400.80
0035	7528000000-E	1730	DROP CABLE	44,830 LF	1.40	62,762.00
0036	7540000000-N	1731	SPLICE ENCLOSURE	161 EA	1,075.00	173,075.00
0037	7552000000-N	1731	INTERCONNECT CENTER	170 EA	900.00	153,000.00
0038	7566000000-N	1733	DELINEATOR MARKER	69 EA	50.00	3,450.00
0039	7575142200-N	SP	NEW ELECTRICAL SERVICE	125 EA	1,046.00	130,750.00

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0040	7575160000-E	1734	REMOVE EXISTING COMMUNICATIONS CABLE	32,950 LF	0.60	19,770.00
0041	7575180000-N	1735	CABLE TRANSFER	5 EA	55.22	276.10
0042	7636000000-N	1745	SIGN FOR SIGNALS	24 EA	264.00	6,336.00
0043	7684000000-N	1750	SIGNAL CABINET FOUNDATION	24 EA	736.00	17,664.00
0044	7686000000-N	1752	CONDUIT ENTRANCE INTO EXISTING FOUNDATION	103 EA	361.00	37,183.00
0045	7687000000-N	1752	MODIFY FOUNDATION FOR CONTROL- LER CABINET	114 EA	585.00	66,690.00
0046	7696000000-N	1751	CONTROLLER WITH CABINET (*****) (2070L, 332, BASE MOUNTED)	146 EA	9,885.00	1,443,210.00
0047	7696000000-N	1751	CONTROLLER WITH CABINET (*****) (2070L, 336S, POLE MOUNTED)	22 EA	9,150.00	201,300.00
0048	7708000000-N	1751	DETECTOR CARD (*****) (MODEL 222)	923 EA	103.25	95,299.75
0049	7901000000-N	1753	CABINET BASE EXTENDER	142 EA	380.00	53,960.00
0050	7901010000-N	1753	CABINET BASE ADAPTER	3 EA	495.00	1,485.00
0051	7980000000-N	SP	GENERIC SIGNAL ITEM 4" RISER WITH SEAL	1 EA	112.00	112.00
0052	7980000000-N	SP	GENERIC SIGNAL ITEM 5/8" X 10' GROUNDING ELECTRODE	385 EA	210.00	80,850.00
0053	7980000000-N	SP	GENERIC SIGNAL ITEM 900MHZ ETHERNET RADIO	4 EA	2,975.00	11,900.00
0054	7980000000-N	SP	GENERIC SIGNAL ITEM AUXILIARY OUTPUT FILE	99 EA	720.00	71,280.00
0055	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET (BASE MOUNT)	1 EA	3,681.00	3,681.00
0056	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET (POLE MOUNT)	17 EA	3,220.00	54,740.00

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0057	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CABINET FOUNDATION	1 EA	750.00	750.00
0058	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV CAMERA ASSEMBLY	18 EA	3,220.00	57,960.00
0059	7980000000-N	SP	GENERIC SIGNAL ITEM CCTV WOOD POLE	15 EA	1,390.00	20,850.00
0060	7980000000-N	SP	GENERIC SIGNAL ITEM DIGITAL HARDWARE VIDEO ENCODER	18 EA	2,455.00	44,190.00
0061	7980000000-N	SP	GENERIC SIGNAL ITEM ETHERNET EDGE SWITCH	174 EA	985.00	171,390.00
0062	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 2018 ENHANCED CONFLICT MONITOR	8 EA	725.00	5,800.00
0063	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 2070L CONTROLLER	9 EA	1,770.00	15,930.00
0064	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 332 CABINET	7 EA	6,300.00	44,100.00
0065	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 336S CABINET	1 EA	5,800.00	5,800.00
0066	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH 900MHZ ETHERNET RADIO	1 EA	1,800.00	1,800.00
0067	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH CCTV CABINET (POLE MOUNT)	1 EA	3,315.00	3,315.00
0068	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH CCTV CAMERA ASSEMBLY	1 EA	3,470.00	3,470.00
0069	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH DETECTOR CARD (MODEL 222)	46 EA	65.00	2,990.00
0070	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH DIGITAL HARDWARE VIDEO ENCODER	1 EA	2,550.00	2,550.00
0071	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH ETHERNET EDGE SWITCH	9 EA	875.00	7,875.00

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0072	7980000000-N	SP	GENERIC SIGNAL ITEM FURNISH ETHERNET RADIO LIGHT- NING ARRESTOR	1 EA	300.00	300.00
0073	7980000000-N	SP	GENERIC SIGNAL ITEM GUY ASSEMBLY (AERIAL)	36 EA	231.00	8,316.00
0074	7980000000-N	SP	GENERIC SIGNAL ITEM GUY ASSEMBLY (SIDEWALK)	37 EA	350.00	12,950.00
0075	7980000000-N	SP	GENERIC SIGNAL ITEM HEAT SHRINK TUBING RETROFIT KIT	22 EA	150.00	3,300.00
0076	7980000000-N	SP	GENERIC SIGNAL ITEM HUB SPLICE CENTER (36 FIBER)	3 EA	2,145.00	6,435.00
0077	7980000000-N	SP	GENERIC SIGNAL ITEM INSTALL CONTROLLER (2070L) IN EXISTING CABINET	2 EA	3,150.00	6,300.00
0078	7980000000-N	SP	GENERIC SIGNAL ITEM IS 2" RISER WITH HEAT SHRINK TUBING	10 EA	288.00	2,880.00
0079	7980000000-N	SP	GENERIC SIGNAL ITEM IS HEAT SHRINK TUBING RETROFIT KIT	1 EA	155.00	155.00
0080	7980000000-N	SP	GENERIC SIGNAL ITEM IS JUNCTION BOX (OVER-SIZED)	1 EA	530.00	530.00
0081	7980000000-N	SP	GENERIC SIGNAL ITEM IS JUNCTION BOX (SPECIAL- SIZED)	12 EA	945.00	11,340.00
0082	7980000000-N	SP	GENERIC SIGNAL ITEM IS MODIFY EXISTING SPLICE	3 EA	640.00	1,920.00
0083	7980000000-N	SP	GENERIC SIGNAL ITEM IS SPLICE ENCLOSURE	39 EA	1,075.00	41,925.00
0084	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY EXISTING ELECTRICAL SERVICE (TRAFFIC SIGNAL)	23 EA	615.00	14,145.00
0085	7980000000-N	SP	GENERIC SIGNAL ITEM MODIFY EXISTING SPLICE	15 EA	638.00	9,570.00
0086	7980000000-N	SP	GENERIC SIGNAL ITEM POLE GROUNDING SYSTEM	22 EA	250.00	5,500.00

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0087	7980000000-N	SP	GENERIC SIGNAL ITEM REMOVE SPLICE CABINET	163 EA	182.15	29,690.45
0088	7980000000-N	SP	GENERIC SIGNAL ITEM TERMINAL SPLICE CABINET	15 EA	1,860.00	27,900.00
0089	7980000000-N	SP	GENERIC SIGNAL ITEM TEST CONTROLLER (2070L)	1 EA	2,380.00	2,380.00
0090	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY CCTV SOFTWARE	Lump Sum LS	4,940.00	4,940.00
0091	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY NETWORK MANAGEMENT SOFTWARE	Lump Sum LS	7,760.00	7,760.00
0092	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY REGIONAL ITS GUI SOFT- WARE	Lump Sum LS	2,945.00	2,945.00
0093	7985000000-N	SP	GENERIC SIGNAL ITEM MODIFY SIGNAL SYSTEM SOFTWARE	Lump Sum LS	65,930.00	65,930.00
0094	7985000000-N	SP	GENERIC SIGNAL ITEM TMC MODIFICATIONS	Lump Sum LS	1,000.00	1,000.00
0095	7985000000-N	SP	GENERIC SIGNAL ITEM TRAINING	Lump Sum LS	5,500.00	5,500.00
0096	7990000000-E	SP	GENERIC SIGNAL ITEM AERIAL CABLE PROTECTOR	13,510 LF	3.62	48,906.20
0097	7990000000-E	SP	GENERIC SIGNAL ITEM ETHERNET CABLE	2,455 LF	1.15	2,823.25
0098	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (24 FIBER)	99,850 LF	1.16	115,826.00
0099	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (48 FIBER)	195,610 LF	1.26	246,468.60
0100	7990000000-E	SP	GENERIC SIGNAL ITEM IS COMMUNICATIONS CABLE (96 FIBER)	39,780 LF	1.56	62,056.80
0101	7990000000-E	SP	GENERIC SIGNAL ITEM IS DIRECTIONAL DRILL (1, 2")	100 LF	10.75	1,075.00

Contract Item Sheets For C203195

Line #	ItemNumber	Sec #	Description	Quantity Unit	Unit Bid Price	Amount Bid
0102	7990000000-E	SP	GENERIC SIGNAL ITEM IS TRACER WIRE	100 LF	0.40	40.00
0103	7990000000-E	SP	GENERIC SIGNAL ITEM IS UNDERGROUND CONDUIT (1, 2")	100 LF	4.56	456.00
0104	7990000000-E	SP	GENERIC SIGNAL ITEM LEAD-IN CABLE	17,620 LF	1.10	19,382.00
0105	7990000000-E	SP	GENERIC SIGNAL ITEM PULL BACK AND REINSTALL COMMUNICATIONS CABLE	760 LF	2.80	2,128.00
0106	7990000000-E	SP	GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (1, 2")	1,995 LF	4.56	9,097.20
0107	7990000000-E	SP	GENERIC SIGNAL ITEM UNDERGROUND CONDUIT (2, 2")	49,260 LF	7.82	385,213.20
0108	7991000000-E	SP	GENERIC SIGNAL ITEM BRICK PAVERS	8 SF	18.41	147.28

TOTAL AMOUNT OF BID FOR ENTIRE PROJECT

\$6,239,371.08

1251/Jul30/Q1169880/D791266592200/E108

Contract No. C203195
County Forsyth

Rev. 5-19-11

**EXECUTION OF CONTRACT
NON-COLLUSION AFFIDAVIT, DEBARMENT CERTIFICATION AND GIFT BAN CERTIFICATION**

CORPORATION

The Contractor being duly sworn, solemnly swears (or affirms) that neither he, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in connection with this Contract, that the Contractor has not been convicted of violating *N.C.G.S. § 133-24* within the last three years, and that the Contractor intends to do the work with its own bonafide employees or subcontractors and did not bid for the benefit of another contractor.

By submitting this Execution of Contract, Non-Collusion Affidavit and Debarment Certification, the Contractor is certifying his status under penalty of perjury under the laws of the United States in accordance with the Debarment Certification attached, provided that the Debarment Certification also includes any required statements concerning exceptions that are applicable.

N.C.G.S. § 133-32 and Executive Order 24 prohibit the offer to, or acceptance by, any State Employee of any gift from anyone with a contract with the State, or from any person seeking to do business with the State. By execution of any response in this procurement, you attest, for your entire organization and its employees or agents, that you are not aware that any such gift has been offered, accepted, or promised by any employees of your organization.

SIGNATURE OF CONTRACTOR

Brooks-Berry-Haynie & Associates, Inc.

Full name of Corporation

600 Discovery Place Mableton, GA 30126

Address as Prequalified

Attest

Andy O'Kelley
Secretary/Assistant Secretary
Select appropriate title

By

Jason Owen
President/Vice President/Assistant Vice President
Select appropriate title

Andy O'Kelley

Print or type Signer's name

Jason Owen

Print or type Signer's name

CORPORATE SEAL

AFFIDAVIT MUST BE NOTARIZED

Subscribed and sworn to before me this the

31 day of July, 2012.

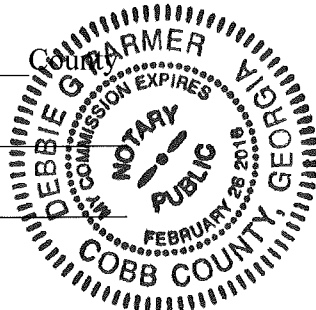
Debbie G. Farmer
Signature of Notary Public

NOTARY SEAL

of Cobb

State of Georgia

My Commission Expires: 2/26/16



DEBARMENT CERTIFICATION

Conditions for certification:

1. The prequalified bidder shall provide immediate written notice to the Department if at any time the bidder learns that his certification was erroneous when he submitted his debarment certification or explanation filed with the Department, or has become erroneous because of changed circumstances.
2. The terms *covered transaction*, *debarred*, *suspended*, *ineligible*, *lower tier covered transaction*, *participant*, *person*, *primary covered transaction*, *principal*, *proposal*, and *voluntarily excluded*, as used in this provision, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549. A copy of the Federal Rules requiring this certification and detailing the definitions and coverages may be obtained from the Contract Officer of the Department.
3. The prequalified bidder agrees by submitting this form, that he will not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in NCDOT contracts, unless authorized by the Department.
4. For Federal Aid projects, the prequalified bidder further agrees that by submitting this form he will include the Federal-Aid Provision titled *Required Contract Provisions Federal-Aid Construction Contract (Form FHWA PR 1273)* provided by the Department, without subsequent modification, in all lower tier covered transactions.
5. The prequalified bidder may rely upon a certification of a participant in a lower tier covered transaction that he is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless he knows that the certification is erroneous. The bidder may decide the method and frequency by which he will determine the eligibility of his subcontractors.
6. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this provision. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
7. Except as authorized in paragraph 6 herein, the Department may terminate any contract if the bidder knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available by the Federal Government.

DEBARMENT CERTIFICATION

The prequalified bidder certifies to the best of his knowledge and belief, that he and his principals:

- a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- b. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records; making false statements; or receiving stolen property;
- c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph b. of this certification; and
- d. Have not within a three-year period preceding this proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
- e. Will submit a revised Debarment Certification immediately if his status changes and will show in his bid proposal an explanation for the change in status.

If the prequalified bidder cannot certify that he is not debarred, he shall provide an explanation with this submittal. An explanation will not necessarily result in denial of participation in a contract.

Failure to submit a non-collusion affidavit and debarment certification will result in the prequalified bidder's bid being considered non-responsive.

☐

Check here if an explanation is attached to this certification.

Contract No. **C203195**

County (ies): **Forsyth**

ACCEPTED BY THE
DEPARTMENT OF TRANSPORTATION



Contract Officer



Date

Execution of Contract and Bonds
Approved as to Form:



Attorney General

Contract No. C203195
County Forsyth

Rev 5-17-11

Bond No. 016049541

CONTRACT PAYMENT BOND

Date of Payment Bond Execution 7/31/2013

Name of Principal Contractor Brooks Berry Haynie & Associates, Inc.

Name of Surety: Liberty Mutual Insurance Company

Name of Contracting Body: **North Carolina Department of Transportation**
Raleigh, North Carolina

Amount of Bond: \$6,239,371.08

Contract ID No.: C203195

County Name: Forsyth

KNOW ALL MEN BY THESE PRESENTS, That we, the PRINCIPAL CONTRACTOR (hereafter, PRINCIPAL) and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the Contracting Body, numbered as shown above and hereto attached:

NOW THEREFORE, if the principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Contract No.
County

C203195

Forsyth

Rev 5-17-11

CONTRACT PAYMENT BOND

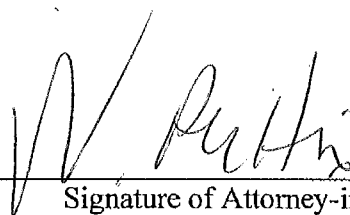
Affix Seal of Surety Company

Liberty Mutual Insurance Company

Print or type Surety Company Name

By W. Parker Hix

Print, stamp or type name of Attorney-in-Fact



Signature of Attorney-in-Fact



Signature of Witness

Holli Orr

Print or type Signer's name

PentaRisk Associates
3715 Northside Parkway
Bldg. 400, Suite 550
Atlanta, GA 30327

Address of Attorney-in-Fact

Contract No.
County

C203195
Forsyth

Rev 5-17-11

CONTRACT PAYMENT BOND

CORPORATION

SIGNATURE OF CONTRACTOR (Principal)

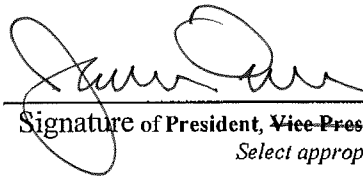
Brooks Berry Haynie & Associates, Inc.

Full name of Corporation

600 Discovery Place, Mableton, GA 30126

Address as prequalified

By



Signature of President, ~~Vice President~~, ~~Assistant Vice President~~
Select appropriate title



Print or type Signer's name

Affix Corporate Seal

Attest



Signature of Secretary, ~~Assistant Secretary~~
Select appropriate title



Print or type Signer's name

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Certificate No. 5614151

American Fire and Casualty Company
The Ohio Casualty Insurance Company
West American Insurance Company

Liberty Mutual Insurance Company
Peerless Insurance Company

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That American Fire & Casualty Company and The Ohio Casualty Insurance Company are corporations duly organized under the laws of the State of Ohio, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, that Peerless Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, David C. Eades; Holli Orr; Sandra F. Black; W. Parker Hix

all of the city of Atlanta, state of GA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 16th day of October, 2012.



American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
Peerless Insurance Company
West American Insurance Company

By: Gregory W. Davenport
Gregory W. Davenport, Assistant Secretary

STATE OF WASHINGTON ss
COUNTY OF KING

On this 16th day of October, 2012, before me personally appeared Gregory W. Davenport, who acknowledged himself to be the Assistant Secretary of American Fire and Casualty Company, Liberty Mutual Insurance Company, The Ohio Casualty Insurance Company, Peerless Insurance Company and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Seattle, Washington, on the day and year first above written.



By: KD Riley
KD Riley, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, West American Insurance Company and Peerless Insurance Company, which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS – Section 12. Power of Attorney. Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts – SECTION 5. Surety Bonds and Undertakings. Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes Gregory W. Davenport, Assistant Secretary to appoint such attorney-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and bidding upon the Company with the same force and effect as though manually affixed.

I, David M. Carey, the undersigned, Assistant Secretary, of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, West American Insurance Company and Peerless Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 21st day of July, 2013.



By: David M. Carey
David M. Carey, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, bank deposit, currency rate, interest rate or residual value guarantees.

To confirm the validity of this Power of Attorney call 1-610-832-8240 between 9:00 am and 4:30 pm EST on any business day.

Contract No. C203195
County Forsyth

Rev 5-17-11

Bond No. 016049541

CONTRACT PERFORMANCE BOND

Date of Performance Bond Execution: 7/31/2013

Name of Principal Contractor: Brooks Berry Haynie & Associates, Inc.

Name of Surety: Liberty Mutual Insurance Company

Name of Contracting Body: **North Carolina Department of Transportation**
Raleigh, North Carolina

Amount of Bond: \$6,239,371.08

Contract ID No.: C203195

County Name: Forsyth

KNOW ALL MEN BY THESE PRESENTS, That we, the PRINCIPAL CONTRACTOR (hereafter, PRINCIPAL) and SURETY above named, are held and firmly bound unto the above named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the Contracting Body, numbered as shown above and hereto attached:

NOW THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Contracting Body, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bound parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Contract No. C203195
County Forsyth

Rev 5-17-11

CONTRACT PERFORMANCE BOND

Affix Seal of Surety Company

Liberty Mutual Insurance Company

Print or type Surety Company Name

By W. Parker Hix

Print, stamp or type name of Attorney-in-Fact



Signature of Attorney-in-Fact



Signature of Witness

Holli Orr

Print or type Signer's name

PentaRisk Associates
3715 Northside Parkway
Bldg. 400, Suite 550
Atlanta, GA 30327

Address of Attorney-in-Fact

Contract No.
County

C203195
Forsyth

Rev 5-17-11

CONTRACT PERFORMANCE BOND

CORPORATION

SIGNATURE OF CONTRACTOR (Principal)

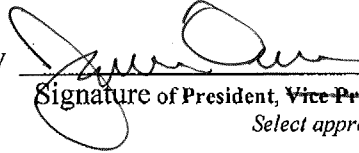
Brooks Berry Haynie & Associates, Inc.

Full name of Corporation

600 Discovery Place, Mableton, GA 30126

Address as prequalified

By



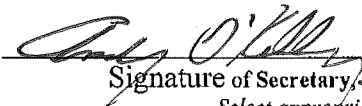
Signature of President, ~~Vice President, Assistant Vice President~~
Select appropriate title



Print or type Signer's name

Affix Corporate Seal

Attest



Signature of Secretary, ~~Assistant Secretary~~
Select appropriate title



Print or type Signer's name

THIS POWER OF ATTORNEY IS NOT VALID UNLESS IT IS PRINTED ON RED BACKGROUND.

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Certificate No. 5614150

American Fire and Casualty Company
The Ohio Casualty Insurance Company
West American Insurance Company

Liberty Mutual Insurance Company
Peerless Insurance Company

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That American Fire & Casualty Company and The Ohio Casualty Insurance Company are corporations duly organized under the laws of the State of Ohio, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, that Peerless Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, David C. Eades; Holli Orr; Sandra E. Black; W. Parker Hix

all of the city of Atlanta, state of GA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 16th day of October, 2012.



American Fire and Casualty Company
The Ohio Casualty Insurance Company
Liberty Mutual Insurance Company
Peerless Insurance Company
West American Insurance Company

By: Gregory W. Davenport
Gregory W. Davenport, Assistant Secretary

STATE OF WASHINGTON ss
COUNTY OF KING

On this 16th day of October, 2012, before me personally appeared Gregory W. Davenport, who acknowledged himself to be the Assistant Secretary of American Fire and Casualty Company, Liberty Mutual Insurance Company, The Ohio Casualty Insurance Company, Peerless Insurance Company and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Seattle, Washington, on the day and year first above written.



By: KD Riley
KD Riley, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, West American Insurance Company and Peerless Insurance Company, which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS – Section 12. Power of Attorney. Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts – SECTION 5. Surety Bonds and Undertakings. Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes Gregory W. Davenport, Assistant Secretary to appoint such attorney-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and biding upon the Company with the same force and effect as though manually affixed.

I, David M. Carey, the undersigned, Assistant Secretary, of American Fire and Casualty Company, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, West American Insurance Company and Peerless Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 31st day of July, 20 13.



By: David M. Carey
David M. Carey, Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, bank deposit, currency rate, interest rate or residual value guarantees.

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