SECTION 900 TRAFFIC SIGNALS

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SECTION 1100 TRAFFIC SIGNALS

910.00 GENERAL REQUIREMENTS

910.01 Traffic Control and Street Closure

The Contractor or Developer will be required to maintain access to all properties throughout the period of construction for this project. The Contractor or Developer shall be required to erect, maintain, and remove all barricades, traffic control signs and devices necessary for any street closure including detour signs. Any signs not in use shall be turned away from traffic or removed from the job site. All traffic control devices shall be in good condition. Signs shall be clean, retro reflective, and free of scratches and graffiti.

Any street closure must be pre-approved by the Town Engineer. All such barricades and traffic control signs and devices shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways including the Colorado Supplement. Traffic control plans shall be submitted to the Town Engineer for review no later than two (2) weeks in advance of any work.

910.02 Protection of Property

The Contractor or Developer shall assume full responsibility and expense for the protection of all public and private property, structures, water mains, sewers, utilities, etc., both above and below ground, at or near the site or sites of the work being performed under the Contract, or which are in any manner affected by the prosecution of the work or the transportation of personnel and materials in connection therewith.

The Contractor or Developer shall give notice of not less than forty-eight (48) hours to the Town Engineer and to other owner or owners of public or private property or utilities when they will be affected by the work to be performed under the Contract; and shall make all necessary arrangements with the Town, owner or owners for the removal, replacement, or protection of such property or utilities.

The Contractor or Developer shall be responsible for insuring that all work sites are properly cleaned and barricaded prior to the completion of the day's activities.

910.03 Intersection Power

The Contractor or Developer shall notify the Town Engineer a minimum of three (3) weeks prior to the signal turn-on so that orders may be issued for service inspection and power connection as applicable.

910.04 Field Location

All loops, poles, control cabinets, pull boxes, pole foundations and permanent pavement markings shall be field located by the Town Engineer.

910.05 Intersection Phasing

Intersection phasing shall be as defined in the table below regardless of direction of the coordinated vehicular movements. When intersection phasing defined in the plans and/or project specials conflicts with that defined here within, the Town Engineer shall make final determination as to the intersection phasing.

Controller Phase	Vehicular Movement
1	Main Street Left Turn (SB/WB)
2	Main Street Through (NB/EB)
3	Side Street Left Turn (NB/WB)
4	Side Street Through (SB/EB)
5	Main Street Left Turn (NB/EB)
6	Main Street Through (SB/WB)
7	Side Street Left Turn (SB/EB)
8	Side Street Through (NB/WB)

910.06 License and Permits

The Contractor or Developer shall obtain any, and all, permits as necessary from the Town's Engineering Division and CDOT as may be applicable.

910.07 Utilities

All utility locations and elevations will require field verification in cooperation with the affected companies and public agencies. The Contractor or Developer shall be responsible for locating all underground utilities, valve boxes, manholes, etc., and insuring that they are properly protected and adjusted as called for in the plans and/or project specials. When utility adjustments are required, but have not been called for in the plans and/or project specials, the Contractor or Developer shall notify the Town.

910.08 Work Hours

Working hours shall be as defined in sections 131.01 and 171.00 of these STANDARDS AND SPECIFICATIONS. The Contractor or Developer, upon approval of the traffic control plan by the Town Engineer, will only be allowed lane closures in the public roadway during normal working hours and/or at other times as requested by the Contractor or Developer, and approved by the Town Engineer via written approval.

910.09 Inspection

Prior to both Construction Acceptance and Final Acceptance, the Town Engineer will employ the services of the Town's designated Traffic Signal Maintenance Contractor to assist with the said inspection. The Contractor or Developer shall reimburse the Town for the actual cost associated with the utilization of the Town's designated Traffic Signal Maintenance Contractor for the inspections.

910.10 Design and Submittal Review

The Town Engineer may elect to employ the services of the Town's designated Traffic Signal Maintenance Contractor to review design drawings, shop drawings, and specifications for equipment and materials. In such cases, the Contractor or Developer shall reimburse the Town the actual costs associated with the utilization of the Town's designated Traffic Signal Maintenance Contractor for the review.

910.11 Regulations and Code

All materials and workmanship shall conform to the standards of the latest edition of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. If conflicts arise between the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction and these STANDARDS AND SPECIFICATIONS, these STANDARDS AND SPECIFICATIONS shall take precedence. In addition to requirements of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and the Contract Documents, all material and work shall conform to the requirements of the National Electrical Line Construction of the Public Utilities Commission, the Standards of the American Society for Testing and Materials (ASTM), the American Standards Association (ASA), and any local ordinance which may apply.

910.12 Equipment Lists and Drawings

After contract award, prior to installation, and/or at the Town Engineer's request, the Contractor or Developer shall submit shop drawings and specifications for equipment and materials the Contractor or Developer proposes to furnish. The shop drawings and specifications shall be complete as to name of manufacturer, size, and catalog number of unit, and shall be supplemented by such other data as may be required. The Town Engineer's approval shall be required prior to installation.

Inspection or sampling of any materials, other than those materials already approved by the Town Engineer, must be made by the Town Engineer prior to installation. If the Contractor or Developer proposes a substitution of material called for in the plans, project specials, as specifically defined in these specifications, or as shown in approved submittals and shop drawings, the Contractor or Developer shall provide additional information to prove the substitution item is of equal or superior quality. Any material and/or equipment installed by the Contractor or Developer that is not in conformance with these specifications shall be removed and/or replaced solely at the Contractor or Developer's expense.

920.00 TRAFFIC SIGNAL CONSTRUCTION

920.01 Excavation and Backfill

Excavations for the installation of conduit, foundations, and other appurtenances shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of conduit, foundations, and other appurtenances. Excavating shall not be

performed until immediately before installation of conduit, foundations, and other appurtenances. The material from the excavation shall be placed in a position where the least interference with the surface drainage will occur and without obstruction to vehicular or pedestrian traffic. All excavations shall be done in conformance with OSHA regulations. Excavated material shall be removed at the completion of the project or as directed by the Town Engineer.

Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made. The Colorado Department of Transportation latest edition of Standard Specifications for Road and Bridge Construction shall be used for standards for compaction, except as outlined in Section 5.3 herein.

Trench excavation for conduit within the roadway shall be 2-inches wider than the outside diameter of the conduit but shall not exceed 6-inches. Backfilling and patching of roadway cuts shall refer to section 500.00 of these STANDARDS AND SPECIFICATIONS.

At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic.

Excavations in streets or highways shall be performed in such a manner that, at a minimum, one (1) lane of traffic in each direction shall be open to public traffic during the approved work hours.

When excavations remain open overnight when approved by the Town Engineer, they shall be properly marked to warn motorists and/or pedestrians. The excavation shall be properly barricaded for vehicles and/or pedestrians.

Excavating and backfilling for foundations shall be incidental to the pay item for which a foundation is required. Excavating and backfilling for conduit trenches shall be paid for under the appropriate conduit trenching pay item.

920.02 Removing, Replacing, and Resetting Improvements

The Contractor or Developer shall replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other improvements removed during construction according to section 400.00 of these STANDARDS AND SPECIFICATIONS.

Removal items shall be as indicated in the pay item list and shall consist of the items specifically identified on the plans, or in writing by the Town Engineer. It shall be the Contractor or Developer’s responsibility to assure that the Contractor or Developer has a full and complete understanding of included items prior to bidding.

Removal of poles and controllers shall include foundation removal to the depth indicated by the Town Engineer. Otherwise, removal shall consist of complete elimination of the specified items. Any conduit runs associated with the foundation shall be extended or abandoned as called for on the plans.

Where traffic signal equipment and/or materials are slated for removal, the Town shall define which traffic signal equipment and/or materials are to remain property of the Town, being kept for future reuse. All traffic signal materials and/or equipment which is to remain the property of the Town shall be delivered to the Town storage site with the address being provided by the Town.

Reset pay items shall be as indicated in the pay item list and shall consist of the items specifically identified in the plans, or in writing by the Town Engineer. It shall be the Contractor or Developer's responsibility to assure that the Contractor or Developer has a full and complete understanding of included items prior to bidding.

Reset items are to be initially removed, then adjusted or modified as directed by the Town Engineer, and finally reinstalled to full operational capability. Modifications and adjustments shall be detailed on the plans or stated in writing by the Town Engineer, and shall be incidental to the reset pay item.

930.00 TRAFFIC SIGNAL MATERIALS

930.01 Foundations

All concrete foundations shall be of a class as defined by the most recent revision of the Colorado Department of Transportation latest edition of Standard Specifications for Road and Bridge Construction or as otherwise directed by the Town Engineer.

The bottom of foundations shall rest on properly compacted ground. Cast-in-place foundations shall be poured monolithically. The exposed portions shall be formed to present a neat appearance.

Pre-cast pole footings, if used, shall be used only for roadway lighting and pedestal poles. They shall be installed in drilled holes, with tamped sand backfill material.

Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade, or as ordered by the Town Engineer. Forms shall be rigid and securely braced in place, and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and to template until the concrete sets.

Anchor bolts shall conform to the manufacturer's specifications and each individual bolt shall have a minimum of two (2) flat washers, one (1) lock washer, and two (2) nuts. Shims or other similar devices will not be allowed for plumbing or raking.

Both forms and ground, which will be in contact with the concrete, shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.

Reinforcing steel shall be installed in foundations as specified in the Construction Plans.

All foundations (concrete and fiberglass) shall be incidental to the pay item for which a foundation is required. Ground rods shall be provided as indicated in the standard details, and these shall be incidental to the installation pay item as well.

930.02 Conduit

All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or master arms. All metal conduits referred to in the specifications and shown on the plans shall be the rigid pipe type of ductile steel that is adequately galvanized. All PVC conduits shall be Schedule 80 or heavier. For new conduit installations, PVC or Schedule 80 polypipe shall be understood unless otherwise defined.

The Contractor or Developer, at his sole expense, may use larger conduit than specified in the plans, if desired. Where larger conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted underground.

The ends of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed up tight until the ends of the metal conduits are brought together.

Where a "stubout" is called for on the plans, a sweeping ell shall be installed in the direction indicated and properly capped. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least three (3) inches high cut into the face of curb, gutter or wall directly above the conduit.

Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit bends feeding pull boxes and foundations shall have an eighteen (18) inch radius as shown on the standard details.

Conduit shall be laid at a depth of not less than thirty (30) inches below the finished roadway grade and twenty-four (24) inches below the finished grade in all other areas.

Conduit under railroad tracks shall be at the minimum depth below the bottom of tie required by the particular railroad company.

Conduit shall always enter a pedestal base, pull box, pole foundation, cabinet foundation, or any other type structure from the direction of the run only. Conduit connections at junctions shall be tightly secured.

Conduit terminating in a standard or pedestal shall extend approximately two (2) inches vertically above foundations.

All conduit runs that exceed ten (10) feet in length shall have a continuous ¾” polyester mule tape pulled into the conduit along with the specified electrical cables. The line shall be firmly

secured at each end of the conduit run with three (3) feet of slack. The purpose of this line is to be able to pull future electrical cable through the existing conduit runs.

A 14 AWG locate wire shall be installed for the complete length of all new conduit runs installed as part of the project. No less than three (3) feet of slack shall remain in each pull box in which the conduit terminates. Where joint trenching is used, only one locate wire need be installed for each joint trench. Splicing of the locate wire within conduits shall not be permitted. Locate wires installed within interconnect conduits shall be spliced in each pull box as to provide an uninterrupted run between intersections.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.
New conduit runs shown on the plans are for bidding purposes only and may be changed at the direction of the Town Engineer.

Any spare or unused conduits shall be capped using industry standard end caps.

Polypipe to PVC coupling shall be completed with the use of “E-Loc” couplings or approved equal.

When a cabinet is defined as a master cabinet, a two (2) inch PVC conduit shall be installed from the controller cabinet to the designated telephone company demarcation point.

A two (2) inch PVC conduit shall be installed between the local utility company demarcation point and the electrical service, and additionally from the electrical service to the controller cabinet home run pull box.

A two (2) inch PVC conduit shall be installed to all signal poles for exclusive use in providing electrical power for luminaires. The conduit may be laid in trenches cut for signal wire conduit and shall run from the controller cabinet home run pull box to signal poles through associated signal pole pull boxes.

The following conduit schedule is in effect unless otherwise specified in the traffic signal plans.

Run Type	Qty	Size	Use
Street Crossing	1	3"	120VAC Signal Load Wiring
	1	3"	Low Voltage Signal Wiring & Interconnect
	1	2”	Spare
	1	2"	Luminaire Wiring
Signal Pole	1	2"	All Signal Wiring
	1	2"	Luminaire Wiring
Controller Cabinet	1	3"	120VAC Signal Load Wiring
	1	3"	Low Voltage Wiring & Interconnect
	1	2"	Spare
	1	2"	Public Service Utility Power Feed
Inductance Loop	1	2"	Inductance/Micro Loops
Interconnect	1	2"	Interconnect

Service Points	1	2"	Public Service Utility Power Feed
	1	2"	Telephone Service Feed

Conduit shall be measured and paid for by the linear foot of conduit installed from center of pull box to center of pull box, center of pull box to center of pole, or center of pull box to center of cabinet and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Conduit shall be paid for under the “conduit” pay item.

930.03 Pull Box

A pull box shall be installed at all locations shown on the plans and at such additional points as ordered by the Town Engineer.

Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The bottoms of all pull boxes shall be set on twelve (12) inches of crushed rock.

Pull box size shall be as shown in the Plans. With the exception of water valves, pull boxes shall be of “Quazite” or pre-cast polymer concrete type with both boxes and lids rated for 20K lb. loads. The following pull box schedule is in effect unless otherwise specified in the traffic signal plans:

Pull Box Usage	Size	Pull Box Lid Marking
Cabinet Home Run Pull Box	24" x 36" x 18"	Traffic
Signal Pole Pull Box	13" x 24" x 12"	Traffic
Detector Pull Box (Side of Road)	12" x 12" x 12"	Traffic
Detector Water Valve	Water Valve	Traffic
Interconnect (T/S Cabinet)	30” x 48” x 18”	T/S Communications
Interconnect (Intermediate Locations)	24" x 36" x 18"	T/S Communications
Telephone Demarcation	12" x 12" x 12"	T/S Communications
Electrical Demarcation	12" x 12" x 12"	Electric

Pull box lids shall be imprinted with markings as defined in the pull box schedule. Painted markings shall not be permitted.

When a new conduit run enters an existing pull box, the Contractor or Developer shall temporarily remove the pull box, or tunnel under the side at no less than eighteen inches (18”) below the pull box bottom, and enter from the direction of the run. No new conduit will be allowed to enter a new or existing pull box in any other manner than that shown on the standard details.

All interconnect pull boxes shall include wire mesh installed between the pull box and crushed rock base to prevent ingress of varmints. The wire mesh shall extend beyond the outside edges of the pull box by a minimum of 3”.

Pull boxes shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pull boxes shall be paid for under the “pull box” pay item.

930.04 Cabinet Bases

Controller cabinet bases shall be fiberglass type, sized to match with the controller cabinet, and set with approximately 50% of height extending below grade and 50% extending above grade.

Controller cabinet bases shall be set on a twelve (12) inch deep bed of crushed rock. The interior of the base shall be filled to grade level with crushed rock.

Conduits within the controller cabinet base shall extend a minimum of 6” above the crushed rock. Conduits shall be installed in such fashion as to prevent undo bend stress on cables being fed into the cabinet through these conduits.
Cabinet bases shall be incidental to the pay item for which a cabinet base is required. Ground rods shall be provided as indicated in the standard details, and these shall be incidental to the installation pay item as well.

930.05 Conductor and Cable

Wiring shall conform to appropriate articles of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and/or the National Electrical Code, as applicable. Wiring within cabinets, junction boxes, etc., shall be neatly arranged. Signal conductors shall be No.14 AWG stranded, conforming to IMSA Spec 20-1-1984.

Power feed cable shall be THHN/THWN copper, installed in conduit, and be sized for the electrical load served. The power feed cable shall have a minimum size of #8 and be sized such that the overall voltage drop, between the local utility company demarcation point and controller cabinet, does not exceed 5%. The Contractor or Developer shall install power feed cable from the local utility company power demarcation point to the controller cabinet thru an URD Mold connector located in the controller cabinet home run pull box. URD Mold connectors shall be installed in the home run pull box and shall be used to extend electrical service from the local utility company power demarcation point to the controller cabinet and to street lights on signal poles.

Whenever a raceway is not UL approved, direct burial type insulation shall be required on all associated wiring.

Power cable between the controller cabinet home run pull box and the street lights pole bases shall be type 12-2 UF. Daisy chaining of power cable thru the pole bases using SLK connectors shall be permitted. With the exception of the URD Mold connector in the controller cabinet home run pull box, power cable splices within pull boxes shall not be permitted.

Power cable from the end of each street light davit to the base of the signal pole shall be type 12-2 UF with ground. All street light feeds shall be independently fused at the base of each pole.

All signal cables shall be labeled with colored electrical tape based on the table below.

Direction	Tape Color
Northbound Thru	Red
Northbound Left Turn	Red + White
Northbound Right Turn	Red + Brown
Northbound Pedestrian	Red + Yellow
Southbound Thru	Green
Southbound Left Turn	Green + White
Southbound Right Turn	Green + Brown
Southbound Pedestrian	Green + Yellow
Eastbound Thru	Orange
Eastbound Left Turn	Orange + White
Eastbound Right Turn	Orange + Brown
Eastbound Pedestrian	Orange + Yellow
Westbound Thru	Blue
Westbound Left Turn	Blue + White
Westbound Right Turn	Blue + Brown
Westbound Pedestrian	Blue + Yellow

Signal circuit wiring shall be accomplished in the following manner:

A separate 25 conductor cable shall be installed between the cabinet and each signal pole. Cables shall be continuous with no splices. Conductor usage has been defined in the table below. All unused conductors shall become spare conductors and shall be coiled and taped back to minimize the chance for a short.

25 Conductor Color to Phase Assignment	
Main Street	
Color	Phase
Solid Green	Green
Solid Orange	Yellow
Solid Red	Red
Solid Blue	Left Turn Green
Solid Black	Left Turn Solid Yellow
Solid Black #2	Left Turn Flashing Yellow
Red with White Trace	Left Turn Red
Blue with White Trace	Walk
Black with Red Trace	Don't Walk
Side Street	
Green with Black Trace	Green
Orange with Black Trace	Yellow
Red with Black Trace	Red
Blue with Black Trace	Left Turn Green
Black with White Trace	Left Turn Solid Yellow
Solid Green #2	Left Turn Flashing Yellow
Red with Green Trace	Left Turn Red
Blue with Red Trace	Walk

Orange with Green Trace	Don't Walk
Right Turn	
Green with White Trace	Right Turn Green
Orange with Red Trace	Right Turn Yellow
AC Return	
Solid White	AC Return
Solid White #2	AC Return
White with Black Trace	AC Return
White with Red Trace	AC Return

Each signal head shall have its own signal cable to the base of the pole that it is mounted on. Cables shall be continuous with no splices. Conductor usage has been defined in the table below. All unused conductors shall become spare conductors and shall be coiled and taped back to minimize the chance for a short.

Conductor Color	7 Conductor (5 Section Head / 4 Section Head)	5 Conductor (3 Section Head)	5 Conductor (Pedestrian Head)
Red	Red Ball	Red Ball or Red Arrow	Don't Walk
Orange	Yellow Ball	Yellow Ball or Yellow Arrow	Spare
Green	Green Ball	Green Ball or Green Arrow	Walk
Blue	Green Arrow	Not Available	Not Available
Black	Solid Yellow Arrow	Spare	Spare
White/Black	Flashing Yellow Arrow	Not Available	Not Available
White	AC Return	AC Return	AC Return

Outboard signal heads shall use “7 Conductor” cable to accommodate for present or future left turns.

When a cabinet is defined as a master cabinet, phone cable shall be installed in conduit from the controller cabinet to the designated telephone company demarcation point. Phone cable shall be #REA-PE54 or equivalent for telephone service. The cable shall be continuous with no splices and run from the telephone service point to the controller cabinet. Adequate cable length shall remain on both cable ends to permit for proper termination.

Pedestrian push button wire shall be shielded single or multiple twisted pairs in polyethylene jacketed cable. Conductors shall be No. 18 AWG stranded copper, minimum. A stranded tinned copper drain wire shall be provided.

Pedestrian push button common wire shall not be connected to the signal neutral circuit.

Inductance detector loop lead-in cable shall be shielded single or multiple twisted pairs in polyethylene jacketed cable. Conductors shall be No. 18 AWG stranded copper, minimum. A stranded tinned copper drain wire shall be provided.

Emergency vehicle detection wiring, Opticom wiring, shall be of the type as specified by equipment manufacturer.

Splicing any conductor, cable or wiring, except loop detector wiring and power cable as defined in these specifications, shall not be permitted in conduit or in pull boxes. All signal conductor splices shall be in the signal pole near the hand hole above grade. Signal load splices shall utilize copper crimp sleeves that compress from four directions as manufactured by Buchanan Company, or approved equal. The crimped sleeve shall then be protected within a flexible rubber insulating cover as manufactured by Ideal Wrap Company, or approved equal. Detector loop lead-in splices in pull boxes below grade shall be fully waterproofed using a DBY-6 splice kit as manufactured by 3M, or approved equal. A minimum of 12-inches of slack shall be left at each splice.

Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit.

A small permanent tag with the direction and phase printed on it shall be securely attached near the end of each conductor in the controller cabinet. An example is “Ø1-NBLT” where Ø1 is the phase number.

Cabling shall be paid for on a lump sum basis and shall include all labor, equipment and materials necessary to install the item complete-in-place. Cabling shall be paid for under the “wiring” pay item.

930.06 Interconnect

Interconnect shall only be installed where identified in the project plans and/or specifications. Where identified, interconnect shall be of the manufacture and model number as defined or, where no manufacturer and model number is specified, meeting or exceeding material specifications.

Where identified, interconnect shall include all cabling, hardware, and communications equipment as identified in the project plans and specifications as to provide for end-to-end communications; master to local, or to the local from the central system where a Centralized system is in use.

Where communications equipment is Ethernet based, the Contractor or Developer turn the communications equipment over to the Town for setup and programming prior to field installation. Upon completion of setup and programming by the Town, the Contractor or Developer shall complete the field installation as to provide for end-to-end communications.

930.07 Video Detection

Video detection shall be installed unless otherwise defined in the project plans and specifications.

Video detection systems shall consist of one video detection camera and one video processor. The system shall be Iteris or approved equal. For Iteris systems, the camera shall be model

RZ-4 with Wide Dynamic Range (WDR) or approved equal. The processor shall be Vantage Edge 2 or approved equal.

The system shall include software that detects vehicles in multiple lanes using only the video image with the availability for up to twenty four (24) detection zones per camera.

The camera shall be mounted on the luminaire davit when luminaire davit is present, mast arm when luminaire davit is not present, or other location as defined on the plans or as directed by the Town Engineer. The camera shall view approaching vehicles at a distance not to exceed 350 feet for reliable detection.

The camera shall be housed in an environmentally sealed enclosure and shall be equipped with a sun shield that prevents sunlight from directly entering the lens. The camera shall be less than 6 inches in diameter, less than 18 inches long and shall weight less than 6 pounds when the camera and lens are mounted inside the enclosure.

The camera enclosure shall include all required environmental controls as defined by the camera manufacturer and may include a thermostatically controlled heater and/or fan to assure proper operation of the lens iris at both low and high temperatures, and prevent moisture condensation of the optical faceplate of the enclosure. The camera shall operate within the temperature range of -30 degrees Fahrenheit to +140 degrees Fahrenheit.

When a variable focal length lens with variable focus control is supplied as part of the camera, the lens shall be adjusted to suite the site geometry without opening up the camera housing.

Control and other cables required for installation, setup, and operation of the camera and/or video detection system, shall be of the size and type required per manufacturer's specifications and the National Electric Codes. Control cables shall terminate within the controller cabinet.

The power cable shall be 16 AWG three conductor cable. The cabling shall comply with local and National Electric Codes.

The complete video detection system shall be warranted to be free of defects in material and workmanship for a period of not less than three years from the date of final acceptance and warranty initiation. During the warranty period, the Contractor or Developer shall be responsible for the repair or replacement, at no charge to the Town, of any product of the video detection system which fails to operate properly with the exception of failures as a result of vandalism, accident, and/or act of God.

Video detection systems shall be paid for on a unit basis and shall include all labor, equipment and materials necessary to install a video detection system for a single approach, complete-in-place. The video detection system shall be paid for under the "Video DetectionSystem" pay item.

930.08 Inductance Loop Detection

Inductance loops shall only be installed where/when specifically defined in project plans and specifications or as otherwise directed by the Town Engineer. When defined for use,

inductance loops shall be installed in accordance with specifications approved by the Town Engineer and the construction plans.

930.09 Pedestrian Push Buttons

Pedestrian push button assemblies shall be Pelco model SE-2005-08 (ADA pedestrian push button), or approved equal. The button housing shall be black in color. A separate 9" W x 12" H decal sign, MUTCD Reference # R10-3d, or approved equal shall be installed with each pedestrian push button.

Audible and/or tactile pedestrian push buttons shall only be used where specified in the plans and project specials, and may be considered by the Town Engineer on a per project basis. When audible and/or tactile pedestrian push buttons are requested, the audible and/or tactile function shall be integrated into the pedestrian push buttons. Pedestrian push buttons shall be of the manufacturer and model number specified, and shall conform to the MUTCD.

Pedestrian push buttons shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the item complete-in-place. Pedestrian push buttons shall be paid for under the "pedestrian push button" pay item.

930.10 Emergency Vehicle Detection

Global Traffic Technologies (GTT) Opticom phase selectors and detectors shall be of the most current model, or as specified herein. Opticom Detectors shall be installed as specified in the plans and may include model numbers 711, 721, and/or 722. Opticom Phase Selectors shall be model number 762.

Opticom phase selectors and detectors shall be paid for on a unit price basis based on quantities and model numbers and shall include all labor, equipment and materials necessary to install the item complete-in-place. Opticom phase selectors shall be paid for under the "Opticom Phase Selector" pay item. Opticom detectors shall be paid for under the "Opticom Detector" pay item.

930.11 Electrical Services

Electrical services shall be installed for all new signals or as otherwise directed by the Town Engineer. Services shall be 240VAC, Single Phase, providing for two separate 120VAC, Single Phase, circuits. One circuit shall be used as the traffic signal cabinet feed. The second circuit shall be used as the street light feed.

Unless otherwise directed by the utility company and agreed upon by the Town Engineer, electrical services shall be metered.

Electrical service shall be installed as per NEC or as amended by the Town. The grounding and bonding of services shall be completed in accordance with Article #250.
Electrical service shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the electrical service, complete-in-place. The electrical service shall be paid for under the "Electrical Service" pay item.

930.12 Bonding and Grounding

Metallic cable sheaths, conduit, metal poles and pedestals shall be effectively grounded. Bonding and grounding jumpers shall be copper wire or copper strap of the same cross-sectional area, No. 8 AWG for all systems. Loop lead-in cable for inductance loops is to be grounded in controller cabinet only. The other end of the inductance loop lead-in shall remain ungrounded, being taped back.

Bonding of standards shall be by means of a bonding strap attached to a brass bolt or a 3/16-nch or larger brass or bronze bolt installed in the lower portion of the shaft.

The controller cabinet and each individual pole and/or pedestal shall be attached to its own separate ground electrode via #6 solid bare copper wire. The ground electrodes may be placed in the foundation of the item to be grounded or may be placed in an adjacent pull box located no more than 6-feet away from said foundation. Ground electrodes shall be a one piece copper weld rod of 5/8-inch diameter, 8-feet in length.

Grounding shall be incidental to the pay item for which it is associated.

930.13 Controller and Cabinet

This specification sets forth the minimum requirements for a 170/2070 traffic control modular cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections here within.

All controller cabinets shall be stretched 333SD type traffic control cabinets except when used at two phase pedestrian crossings and/or fire signals. Two phase pedestrian crossing and fire signal controller cabinets shall be pole mount 303 type traffic control cabinets unless otherwise called for on the plans.

Controller cabinets shall have a powder coated finish, “silver wheel” in color, with anti-graffiti coating. All cabinets and conduits into the cabinet shall be made to be rodent resistant.

A controller shall consist of a complete electrical mechanism to control the operation of traffic control signals, including the timing mechanism and all necessary auxiliary equipment. Controllers shall be Econolite Cobalt-C. All equipment furnished shall be the manufacturers' latest, current production model, complete with all standard accessories, tested and delivered by domestic manufacture who is regularly engaged in the construction of such equipment. Each cabinet shall be furnished with a full complement of auxiliary equipment (loop amps, load switch, etc.) regardless of specific intersection design.

For base mounted cabinets, all electrical conduits running to the control cabinet shall enter from the bottom only, except as noted on the plans. No holes shall be drilled in any part of the cabinet other than the bottom, unless otherwise called for on the plans.

All controller cabinets and control equipment shall be factory wired, ready for operation. Contractor or Developer shall test cabinet and controller in his shop prior to installation. Field work will be limited to placing cabinets and equipment and the connecting of field wiring to field terminal strips. All cabinet wiring shall be neat and firm.

Controller cabinets shall be furnished with all mounting hardware.

All controller cabinets shall be equipped for and wired for two Opticom card rack mounted Global Traffic Technologies (GTT) Model 752 phase selectors. The phase selector cards, field wiring, and detectors shall not be supplied, unless called for in the Bid Schedule.

Controllers and cabinets shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Traffic signal cabinets shall be paid under the “Traffic Signal Cabinet” pay item. Traffic signal controllers shall be paid under the “Traffic Signal Controller” pay item.

930.14 On-Street Master Controller

An on-street master controller shall only be installed where identified in the project plans and/or specifications. Where identified, an on-street master controller shall be of the manufacture and model number as defined.

930.15 Traffic Signal Heads

All vehicular traffic signal heads shall be 12-inch, 100% polycarbonate, black in color, with black, detachable, tunnel visors. Use of 8-inch signal traffic signal heads shall not be permitted.

Retro-reflective back plates shall be installed on all mast arm mounted traffic signal heads and shall be louvered, black in color, with retro-reflective strip. Back plates shall not be mounted on side-of-pole mounted traffic signal heads.

All pedestrian signal heads shall be single section, 16”, clam shell, black in color.

LED indications shall be furnished for all indications with the exception of side-of-pole red indications. Side-of-pole red indications shall be incandescent type to aid in snow melt during the winter. All LED indications shall be warranted for a minimum of seven years by the manufacturer.

LED ball modules shall be incorporate a clear front shell and be GE models DR6-GCFB-VLA, DR6-YCFB-VLA, and/or DR6-RCFB-VLA or approved equal.
LED arrow module shall be DR6-GGE models TAAN-17A, DR6-YTAAN-17A, and/or DR6-RTAAN-17A or approved equal.

Pedestrian signals shall 16” x 18”, countdown type, and be GE model PS7-CFF1-27A or approved equal.

Incandescent bulbs, as required for the side-of-pole red indications, and as otherwise directed for use by the Town Engineer, shall be Philips, Sylvania, or Town Engineer approved alternate. They shall be 116 watt, 130 volt, with a minimum life hour rating of 8,000 hour.

All signal head locations shall be approved by the Town Engineer.

Astro-brac or Sky-brac type mounting hardware shall be used to attach all traffic signal heads mounted on mast arms.

Side of pole traffic signal heads shall use industry standard side of pole hardware on both the top and bottom traffic signal head sections for mounting.

All Band-it material, including buckles, shall be ¾" stainless steel.

During construction, traffic signal heads that have been installed but are not ready for actual electrical connection shall be bagged with a dark opaque material.

Signal and pedestrian heads shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the signal head, complete-in-place. Signal and pedestrian heads shall by paid for under the "traffic signal head" and "pedestrian head" pay items respectively.

930.16 Traffic Signal Poles, Mast Arms and Luminate Davits

Traffic poles, mast arms, and luminaire davits shall meet the requirements of the standard details, which indicate the critical dimensions that must be met exactly or within stated tolerances. The intent is to provide traffic poles, mast arms, and luminaire davits that match the overall appearance as illustrated and meet the performance requirements of the details and these specifications. Traffic pole, mast arm, and luminaire davit supplier submittals shall be required and shall demonstrate conformity with this intent.

Traffic poles, mast arms, and luminaire davits shall be wrapped for shipping from the factory in heavy duty paper or plastic to protect them from scratches and abrasions in transit.

Traffic poles, mast arms, and luminaire davits shall be paint over hot-dipped galvanized, black in color. Hot-dip galvanized shall be as per ASTM A123 and A153. Prior to the installation of traffic poles, mast arms, and/or davits, the Contractor or Developer shall wipe clean the outer surfaces. Following the installation of the traffic poles, mast arms, and/or luminaire davits, the Contractor or Developer shall touch up nicks and abrasions using paint of similar color and sheen.

Nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound prior to paint touch up.

Two hand holes shall be provided on each pole; one at the base, one flush hand hole behind the signal mast arm connection. The flush covers shall be flush with the base metal giving them a hidden appearance. A "J-hook" wire support shall be provided in each pole shaft above the hand hole behind the mast arm connection. One grounding attachment shall be provided in each pole shaft near the hand hole cover at the base of the pole.

Anchor bolt base covers shall be provided in a two piece, tamper-resistant style. A locking device shall be provided to prevent lifting or creeping of the base cover.

Mast arm connecting bolts shall be of sufficient strength to conform to current AASHTO specifications.

All mast arm and pole shaft end openings shall be provided with set screw caps.

All welding shall conform to AWS D1.1 Sections 1 through 8 and shall be performed by welders certified in accordance with AWS code. All butt welds shall be ground flush with base metal to provide a uniform smooth finish.

By American Provision, all steel materials permanently incorporated into the work shall be certified to have been produced in the United States. All manufacturing processes for these materials must occur in the United States and be new domestic steel. Certifications that steel has been manufactured in the United States shall be provided to the Town by the manufacturer.

All materials shall be of the ASTM type as called for in this specification. Mill certifications shall be supplied for proof of compliance to these Specifications.

Valmont brand traffic signal poles, mast arms, and luminaire davits have been pre-approved to meet Town specifications. Other brands must be approved by the Town Engineer prior to ordering the poles, mast arms, and/or luminaire davits.

Traffic signal poles, mast arms, and luminaire davits shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Traffic signal poles, mast arms, and luminaire davits shall be paid for under the “Street Light Pole, and/or “Traffic Signal Pole” pay item as appropriate.

930.17 Pedestrian Pole

Pedestrian poles shall be designed to meet the structural requirement given in the latest edition of “Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals”, published by AASHTO, for a wind velocity of 90 MPH.

Pedestrian poles shall be aluminum of the appropriate length of 8-feet, 12-feet, or 15-feet as required for signal equipment mounting heights in compliance with the latest MUTCD standards. When aluminum poles are not of adequate strength for the given wind load to meet the above AASHTO requirements, use of a Schedule 40 galvanized steel pole shall be required. Pedestrian poles shall be painted black in color.

With the exception of beacon assemblies, top mounting of signal heads shall not be permitted.

The pole base shall be frangible, of the same material as the pole.

After installation where galvanized steel poles have been installed, nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound.

Pedestrian poles shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pedestrian poles shall be paid for under the “Pedestrian Pole” pay item.

930.18 Pedestrian Push Button Pole

Pedestrian push button pole shall be as illustrated in the standard details, constructed of Schedule 40 galvanized steel painted black. Pole base shall be frangible.

After installation, nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound.

Pedestrian push button poles shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pedestrian push button poles shall be paid for under the “Pedestrian Push Button Pole” pay item.

930.19 Illuminated Street Name SIgns

Illuminated street name signs shall be RAZOR Internally-Illuminated LED Street Name Signs as manufactured by Temple Edge-Lit or approved equal.

Illuminated street name signs shall be double sided unless otherwise defined in the project plans and/or specifications.
Illuminated street name signs housings shall be constructed of 6000 series aluminum.

Sheeting shall be 3M Electro Cut film #1178 with white lettering over a green background.

The sign shall be provided with a manufacturer approved under-hang mast arm mount.

Illuminated street name signs shall have a minimum wind load rating of 150 MPH with 1.14 gust factor and ice loading as per AASHTO LTS-4 2001.

LEDs shall be high-intensity, rated for a minimum of 60,000 hours.

Illuminated street name signs shall be warranted for a minimum or 5 years.

Illuminated street name signs shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Illuminated street name signs shall be paid for under the “Illuminated Street Name Sign” pay item.

930.20 Blank Out Regulatory/Warning SIgns

Blank out regulatory or warning sign housings shall be constructed of aluminum unless directed otherwise by the Town Engineer. All ferrous hardware parts shall be galvanized cadmium plated, or stainless steel.

The lens panel shall be capable of removal or be swung open without the use of tools.

The sign panel shall be completely blanked out when not energized. The sign color shall not fade when exposed to an accelerated test of ultraviolet light equivalent to five years of outdoor exposure.

The entire surface of the sign panel shall be evenly illuminated. All messages shall be clearly legible attracting attention under any lighting conditions for an advance distance of at least 500 feet. When illuminated, the sign shall be visible anywhere within the approximately a 60 degree cone centered about the optic axis.

Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V and shall have waterproof marking strips. No wiring splices will be permitted within the sign without the permission of the Town Engineer.

The overall weight of the complete sign assembly including mounting hardware shall not exceed 90 lbs.

Blank out regulatory or warning signs shall be of LED or fiber optic light source type as specified in the project plans and specifications.

If a fiber optic light source is specified, the lamps shall be 50 watts or less, operating at 15 volts or less and shall have an average rated life of 8,000 hours or more. The color of any message shall be changeable in the field by replacement of the color filters without removing the sign from the case.

Blank out regulatory/warning signs shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Blank out regulatory/warning signs shall be paid for under the “Blank Out Regulatory/Warning Sign” pay item.

930.21 School Flashing Beacon Assembly

A school flashing beacon assembly shall be as shown in the standard details.

LED indications shall be furnished for all indications. For 120VAC installations, LED indications shall be warranted for a minimum of seven years by the manufacturer. For solar installations, LED indications shall be warranted for a minimum of five years by the manufacturer.

Each school flasher beacon assembly shall include a NEMA Type 4 enclosure for housing the associated time clock unit and electrical connections. When solar power is used in conjunction with the school flashing beacon assembly, the NEMA Type 4 enclosure shall be of sufficient size to house all associated solar power equipment, including the battery(s), as may be applicable.

The NEMA Type 4 enclosure shall be lockable and provided with a treasury type lock Corbin number R357SGS, or exact equivalent

A time clock, RTC model number AP21T, or approved equal shall be incorporates in the school flashing beacon assembly NEMA Type 4 enclosure.

Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V. No wiring splices will be permitted within the school flasher beacon assembly or NEMA Type 4 enclosure without the permission of the Town Engineer.

Signs shall be supplied and installed by the Contractor or Developer as an integral part of the flashing assembly.

For 120VAC installations, a main circuit breaker shall be installed in the NEMA Type 4 enclosure between the service feed and school flashing beacon assembly electronics. Fuse(s) in place of the circuit breaker shall not be permitted. A main circuit breaker shall not be required for solar type installations.

For 120VAC installations, a 120VAC receptacle shall be installed within the NEMA Type 4 enclosure.

School flashing beacon assemblies shall be paid for on a unit price basis and shall include all labor, equipment, materials, and electrical service connections necessary to install a school flashing beacon assembly, complete-in-place, on a single pole. School flashing beacon assemblies shall be paid for under the “School Flashing Beacon Assembly” pay item.

930.22 Warning or Regulatory Sign Flashing Beacon Assembly

A warning or regulatory sign flashing beacon assembly shall be as shown in the standard details.

LED indications shall be furnished for all indications. For 120VAC installations, LED indications shall be warranted for a minimum of seven years by the manufacturer. For solar installations, LED indications shall be warranted for a minimum of five years by the manufacturer.

All terminations shall be made on a terminal block located within the signal head. Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V. No wiring splices will be permitted within the warning or regulatory sign flashing beacon assembly without the permission of the Town Engineer.

Signs shall be supplied and installed by the Contractor or Developer as an integral part of the flashing assembly.

Warning or regulatory sign flashing beacon assemblies shall be paid for on a unit price basis and shall include all labor, equipment, materials, and electrical service connections necessary to install a warning or regulatory sign flashing beacon assembly, complete-in-place, on a single pole. Warning or regulatory sign flashing beacon assemblies shall be paid for under the “Warning/Regulatory Sign Flashing Beacon Assembly” pay item.

930.23 Solar Power System

The solar power system shall be of sufficient size to adequately support the power requirements of the attached equipment year-round. It shall incorporate a solid-state solar controller including a high output solar regulator and low voltage disconnect. The system shall operate on input voltages ranging from 11.5 VDC to 25 VDC. The solar regulator's minimum rating shall be 25A at 12 VDC, temperature compensation.

The solar panel position shall be field settable to the correct degree required at the location and shall use automatic night dimming to conserve power.

The solar power system shall not be paid for separately but shall be included in the cost for the equipment it is powering and shall include all labor, equipment, and materials necessary to install a solar power system, complete-in-place, on a single pole.

930.24 Uninterruptable Power Supply (UPS)

A UPS shall be installed for all new traffic signals and shall be a Clary SP1250LX or approved equal. It shall include a bypass switch by which the user can manually bypass the UPS and power the signal via utility power.

The UPS shall include a weatherproof generator receptacle accessible via the exterior of the traffic signal cabinet. The UPS generator receptacle shall be mounted at a minimum height of two feet as measured from the bottom of the cabinet.

The UPS shall be configured such that the UPS provides regulated 120VAC, 60 Hz, single phase output power to run the signal in full operation and recharges the UPS batteries while under generator power. The unit shall automatically sense when generator power is applied, and when generator power fails. When generator power is applied, the UPS unit shall be configured such that it automatically reverts to generator power. The unit shall be configured such that it automatically reverts back to either utility power or UPS battery power respectively, based upon the availability at the time, when the generator power falls outside of acceptable signal tolerances.

The UPS shall be supplied with a minimum of six (6) 12V, sealed, maintenance free batteries as approved for use by the manufacturer.

Programming software and manuals shall be supplied with each UPS and shall become the property of the Town at the completion of the project.

UPS units shall be initially programmed to provide two (2) hours of normal operation before transitioning to flash mode.

A UPS shall include all labor, equipment, and materials necessary to install the item complete-in-place.

UPS shall be measured by the units installed and shall include all labor, equipment, and materials necessary to install a UPS, complete-in-place. UPS shall be paid for under the pay item "Uninterruptible Power Supply".

930.24 Miscellaneous Hardware

All ferrous mounting hardware and weather heads shall be galvanized, cadmium plated, or made of stainless steel to resist corrosion.

940.00 POST CONSTRUCTION

940.01 Field Testing

Prior to completion of the work, the Contractor or Developer shall cause the following tests to be made on all traffic signals in the presence of the Town Engineer:

Each circuit shall be tested for continuity and for grounds.

A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for the traffic signal installation shall consist of not less than fourteen (14) days of continuous, satisfactory operation following a three to five day mandatory flashing period, or other flash period as directed by the Town Engineer.

Signal turn-on, following the mandatory flashing period to transition into the functional test, shall be scheduled with the Town Engineer, completed Monday-Thursday during normal business hours.

940.02 Maintenance and Emergency Repairs During and After Construction

During the construction, reconstruction, fourteen-day test period, and until signal Construction Acceptance by the Town, the Contractor or Developer shall maintain the system or systems on a 24 hour basis. The cost of any maintenance necessary except electrical energy, and maintenance due to damage by public traffic, shall not be paid for separately but shall be included in the cost of the work.

Acceptance by the Town of the work performed by the Contractor or Developer shall only take place after all punch list items have been satisfactorily completed and inspected by the Town.

The Contractor or Developer shall provide the Town with a 24 hour one call phone number for reporting of any and all signal malfunctions. Fees incurred for such service shall not be paid for separately but shall be included in the cost of the work.

All malfunctions of a controller and its accessory equipment shall be considered an emergency unless otherwise identified by the Town. Equipment malfunctions and/or damage, which in the opinion of the Town Engineer constitutes a serious hazard or inconvenience to the public, shall be considered an emergency. The Contractor or Developer shall undertake emergency repairs no later than two (2) hours after the Town notifies the Contractor or Developer of the emergency.

Malfunctions of a controller and its accessory equipment, which are identified by the Town Engineer as non-emergency repairs shall be considered non-emergency. The Contractor or

Developer shall undertake non-emergency repairs no later than 24 hours after the Town notifies the Contractor or Developer of the non-emergency.

If the Contractor or Developer fails to respond within the defined response time, the Town Engineer may elect to employ the services of the Town's designated Traffic Signal Maintenance Contractor to perform the said maintenance work. In such cases, the Contractor or Developer shall reimburse the Town for labor, equipment, and material charges associated with the utilization of the Town's designated Traffic Signal Maintenance Contractor plus a fifteen percent administration fee.