

Traffic Signal Systems - Four Locations

Lowell,
Massachusetts

Prepared for **City of Lowell**
 Lowell, MA

Prepared by **Vanasse Hangen Brustlin, Inc.**
 Watertown, MA

- Items List
- Engineer's Estimate
- Special Provisions

PS&E Submission
January 31, 2014

ITEMS LIST

**Transportation
Land Development
Environmental
S e r v i c e s**

101 Walnut Street
Post Office Box 9151
Watertown
Massachusetts 02471
617 924 1770



Vanasse Hangen Brustlin, Inc.

PS&E DESIGN ITEMS LIST
Transportation Improvement Project
Four Locations
Lowell, Massachusetts
February 2014

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ENGINEER'S ESTIMATE



Vanasse Hangen Brustlin, Inc.

**Transportation
Land Development
Environmental
Services**

101 Walnut Street
Post Office Box 9151
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Lowell - 4 Locations
PS&E Construction Cost Estimate

| <u>Description</u> | <u>Unit Price</u> | <u>Quantity</u> | <u>Total Cost</u> |
|--------------------------------------|-------------------|-----------------|-------------------|
| HMA Driveway Reconstruction | \$52.00 /SY | 159 SY | \$8,244.89 |
| Cement Concrete Sidewalk at Driveway | \$60.00 /SY | 24 SY | \$1,440.00 |
| Cement Concrete Sidewalk | \$55.00 /SY | 439 SY | \$24,138.89 |
| Reset Brick Paver Sidewalk | \$150.00 /SY | 72 SY | \$10,766.67 |
| Cement Concrete Wheelchair Ramp | \$94.00 /SY | 307 SY | \$28,837.11 |
| Loam and Seed | \$8.00 /SY | 152 SY | \$1,216.89 |
| Loam and Mulch | \$11.00 /SY | 51 SY | \$559.78 |
| Steel Bollard | \$800.00 /EA | 6 EA | \$4,800.00 |
| Curb Items | \$40,654.00 /LS | 1 LS | \$40,654.00 |
| Drainage Items | \$9,354.00 /LS | 1 LS | \$9,354.00 |
| Water Items | \$11,420.00 /LS | 1 LS | \$11,420.00 |
| Sign Items | \$3,070.00 /LS | 1 LS | \$3,070.00 |
| Traffic Signals | \$479,990.00 /LS | 1 LS | \$479,990.00 |
| Soil Borings | \$1,500.00 /EA | 5 EA | \$7,500.00 |
| SUBTOTAL: | | | \$631,992.22 |
| Police/Flaggers (5%) | | | \$31,599.61 |
| Contingencies (20%): | | | \$126,398.44 |
| TOTAL: | | | \$789,990.28 |
| SAY: | | | \$790,000 |

This estimate does not consider any Right of Way acquisitions or utility pole relocations.

SPECIAL PROVISIONS

**SPECIAL PROVISIONS
TRANSPORTATION IMPROVEMENT PROJECT
FOUR LOCATIONS
LOWELL, MASSACHUSETTS**

SCOPE OF WORK

The work under this Contract includes the reconstruction of traffic control signal systems at three intersections and the construction a new traffic signal system at one intersection in Lowell, Massachusetts. These intersections are:

- University Avenue at Riverside Street
- Pawtucket Street at School Street
- Westford Street at School Street
- Church Street at Lawrence Street (New)

The work includes unclassified excavation, pavement milling, hot mix asphalt overlay, soil borings, granite curbing, cement concrete sidewalks, remove and reset brick sidewalk, high flow frame and grates, loam and seed, wheelchair ramps, traffic signals, signs, pavement markings and other incidental items required to complete the work.

Note: Pavement milling, hot mix asphalt overlay, and pavement markings will be done by the City. The Contractor under this project shall coordinate with the City to allow his work to take place prior to final paving. Coordination with the City is considered as incidental to the work being performed under this contract and there will be no additional compensation therefore.

NOTE: SIDEWALK, CURB, WHEELCHAIR RAMPS, DRAINAGE MODIFICATIONS, ROADWAY CONSTRUCTION, AND PAVEMENT MARKINGS WILL BE COMPLETED BY THE SITE ENGINEER. THE SIGNAL CONTRACTOR SHALL COORDINATE WITH THE SITE CONTRACTOR TO ALLOW THE INSTALLATION OF THE RELEVANT TRAFFIC SIGNAL EQUIPMENT (i.e. CONDUIT, PULL BOXES, FOUNDATIONS) PRIOR TO FINAL SIDEWALK AND ROADWAY CONSTRUCTION. COORDINATION WITH THE SITE CONTRACTOR IS CONSIDERED AS INCIDENTAL TO THE WORK BEING PERFORMED UNDER THE CONTRACT AND THERE WILL BE NO ADDITIONAL COMPENSATION THEREFORE.

All work done under this contract shall be in conformance with the Massachusetts Highway Department Standard Specifications for Highways and Bridges dated 1988, as amended; the supplemental specifications dated February 25, 2010; the 2012 Construction Standards Details; the 1996 Construction and Traffic Standard Details (as relates to traffic standard details only); the current version of the Manual on Uniform Traffic Control Devices (MUTCD) with Massachusetts Amendments; the 1990 Standard Drawings for Signs and Supports, as amended; the 1968 Standard Drawings for Traffic Signals and Highway Lighting; the latest edition of American Standard for Nursery Stock; the Plans and these Special Provisions.

The General Conditions, Supplementary Conditions and Special Provisions shall take precedence over the General Requirements of Division I of the Standard Specifications.

THE PAYMENT CLAUSES CONTAINED IN THE MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS DO NOT APPLY TO THIS CONTRACT.

THIS WORK SHALL BE BID ON A LUMP SUM BASIS. THE CONTRACT LUMP SUM PRICE SHALL INCLUDE ALL LABOR, MATERIALS, EQUIPMENT AND INCIDENTAL COSTS REQUIRED TO COMPLETE THIS WORK, EXCEPT FOR POLICE SERVICES, WHICH WILL BE PAID FOR ON A REIMBURSABLE BASIS.

WORK SCHEDULE

No work that will disrupt travel on the existing roadways (lane closures, lane shifts, trenching, etc.) shall be done from 7:00AM to 9:00AM and from 3:00PM to 4:00PM. The normal hours of operation shall be dictated by the City of Lowell. A written request shall be issued by the Contractor for any requested deviation to the work day or times indicated in the access permit.

COOPERATION OF THE CONTRACTOR **(Supplementing Subsections 5.05 and 5.06)**

Agents of various public service agencies, municipal and State Departments, and private site contractors may be entering on the work site to remove existing utilities, to construct or place new facilities or to make alterations to existing facilities.

The Contractor shall perform the work in cooperation with the various agencies in a manner which causes the least interference with the operations of the aforementioned agencies and shall have no claim for delay which may be due, or result, from said work of these agents.

CONSTRUCTION STAKING **(Supplementing Subsection 5.07)**

The Contractor will be furnished tie plans, which can be found in the contract plans. The Contractor shall perform all survey required for the work.

BUY AMERICA PROVISIONS (23 CFR 635.410) **(Supplementing Subsection 6.01 Source of Supply and Quality)**

Federal law 23 CFR 635.410 requires that all manufacturing processes, including application of the coating, for steel and iron materials to be permanently incorporated in Federal-aid highway construction projects must occur in the United States. Coating includes all processes which protect or enhance the value of a material to which the coating is applied.

Foreign steel and iron may be used if the cost of the materials as they are delivered to the jobsite does not exceed 0.1% of the total contract cost or \$2,500 whichever is greater.

PUBLIC SAFETY AND CONVENIENCE
(Supplementing Subsection 7.09)

The Contractor shall provide necessary access for fire apparatus and other emergency vehicles through the work zones to abutting properties at all times.

Sweeping and cleaning of surfaces beyond the limits of the project required to clean up material caused by spillage or vehicular tracking during the various phases of the work shall be considered as incidental to the work being performed under the Contract and there will be no additional compensation.

NOTICE TO OWNERS OF UTILITIES
(Supplementing Subsection 7.13)

Written notice shall be given by the Contractor to all public service corporations or municipal and State officials owning or having charge of publicly or privately owned utilities at least one week in advance of the commencement of operations that will affect the utilities. The Contractor shall, at the same time, file a copy of such notice with the Engineer.

Before commencing work on service connections, the Contractor shall be responsible for contacting the Electric Company servicing the area to obtain construction requirements, standards, and to give adequate notice of commencement of work. The Contractor's attention is further directed to the requirements of Work in the Immediate Vicinity of Certain Underground Structures and Poles herein included in these Special Provisions.

The following are the names of owners and representatives of the principal utilities affected, but completeness of this list is not guaranteed:

CITY OF LOWELL

Lowell Engineering Department
City Hall - Room 61
375 Merrimack Street
Lowell MA 01852

Lisa DeMeo, P.E.
City Engineer
Phone:(978) 674-1206

Lowell Fire Department
99 Moody Street
Lowell, MA 01852

Chief Edward Pitta
Phone:(978) 674-4588

Lowell Police Department
50 Arcand Drive

Chief Kenneth Lavallee
Phone:(978) 937-3225

Lowell, MA 01852

Details: (978) 937-3205

Lowell Parking Department
75 John Street
Lowell, MA 01852

James Troup
Phone:(978) 674-4014

WATER

Lowell Regional Water Utility
815 Pawtucket Blvd.
Lowell, MA 01854

Tony Capactietti
Phone:(978) 674-1691

SEWER

Lowell Regional Wastewater Utility
451 First Street
Lowell, MA 01850

Michael Stuer
Phone:(978) 674-4248

FIRE ALARM

Lowell City Electrician
1365 Middlesex Street
Lowell, MA 01851

Steve Coutu
Phone:(978) 674-1813

ELECTRIC

National Grid
25 Research Drive
Westborough, MA 01582

Dave Gendall
Phone:(978) 725-1353

TELEPHONE

Verizon

Phone:(877) 686-7007

GAS

National Grid Gas
52 Second Avenue
Waltham, MA 02451

Mike Floyd
Phone: (978) 322-3676

CABLE

Comcast

Phone: (877) 633-4266

OTHER AFFECTED PARTIES ARE:

Department of Planning & Development
JFK Civic Center
50 Arcand Drive
Lowell, MA 01852

Eric B. Eby, P.E. Traffic Engineer
Phone: (978) 674-1417
eeby@lowellma.gov

Vanasse Hangen Brustlin, Inc.
101 Walnut Street
Watertown, MA 02471-9151

David Greenberg, P.E.
Phone: (617)924-1770
dgreenberg@vhb.com

The Contractor shall notify the controlling utility agency at least 72 hours in advance of its intent to excavate in any way or manner, within six feet of any existing utility agency owned pole, anchor guy, underground duct, conduit, pipe, valve or manhole. No excavation shall take place within six feet of any existing utility agency owned pole, anchor guy, underground duct, conduit, pipe, valve or manhole owned by a utility agency without this notification.

The Contractor shall make his own investigation to assure that no damage to existing structures, drainage lines, traffic signal conduits, and other utilities will occur as a result of construction operations.

The Contractor shall notify "Mass. DIG SAFE" and procure a DIG SAFE number of each location prior to disturbing ground in any way.

"DIG-SAFE" Call Center: Telephone 1-888-344-7233

PROTECTION OF UTILITIES AND PROPERTY
(Supplementing Subsection 7.13)

The Contractor, in constructing or installing facilities alongside or near sewers, drains, water or gas pipes, electric or telephone conduits, poles, sidewalks, walls, vaults or other structures shall sustain them securely in place. The Contractor shall coordinate with the officers and agents of the various utility companies and municipal departments to assure that the services of these structures are maintained. The Contractor shall also be responsible for the repair or replacement, at no additional cost to the Owner (City of Lowell), of any damage to such structures caused by construction operations. The Contractor is responsible to leave them in the same condition as they existed prior to commencement of the work. In case of damage to utilities, the Contractor shall promptly notify the utility owner and shall, if requested by the Engineer, furnish labor and equipment to work temporarily under the utility owner's direction. Pipes or other structures damaged by the operation of the Contractor may be repaired by the City or by the utility owner which suffers the loss. The cost of such repairs shall be borne by the Contractor, without compensation therefor.

If during construction there is an existing utility and/or structure found to be in conflict with the proposed work under this Contract, the Contractor shall protect and maintain the services to the

utilities and structures. The Engineer will, as soon as possible identify the utilities to be relocated or other such activities deemed suitable for resolution.

If live service connections are to be interrupted by excavations of any kind, the Contractor shall not break the service until new services are provided. Abandoned services shall be plugged off or otherwise made secure.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals for doing all the work involved in protecting or repairing property as specified in this Section, shall be considered included in the prices paid for the various Contract items of work and no additional compensation will be allowed therefor.

WORK IN THE IMMEDIATE VICINITY OF CERTAIN UNDERGROUND STRUCTURES AND UTILITY POLES

For overhead connections, the Electric Company servicing the area will make the connection from the top of the riser on the utility pole to the power source. The Contractor shall supply all labor, materials and equipment to install the service connection, complete in place and in accordance with the Electric Company procedures, from the controller to and including the riser with enough wire coiled above the riser to permit the Electric Company servicing the area to make the final connection.

For underground connections, the Electric Company servicing the area will perform the actual wiring of the service connections from its power source to the sweep at the local controllers, but all steel sweeps, ducts, entrance holes into manholes, patching and all other necessary labor, materials and equipment required to install the electric service, complete in place, shall be furnished by the Contractor.

The Contractor shall pay the Electric Company servicing the area for their services rendered for the connection of overhead and underground service connections.

Before starting work at existing manholes, the Contractor shall test for gas and blow out the manholes.

TEMPORARY ACCESS TO AREA MERCHANTS AND BUSINESSES **(Supplementing Subsections 8.02 and 8.06)**

The work is in predominantly residential/commercial sections of the City and access to all properties must be maintained at all times.

The Contractor shall provide safe and ready means of ingress and egress to all stores and shops, public and private and professional offices and any other businesses or residences in the project area, both day and night, for the duration of the project.

SAFETY CONTROLS FOR CONSTRUCTION OPERATIONS
(Supplementing Subsection 850.21)

Safety controls for construction operations shall be done in accordance with the relevant provisions of Section 850 of the Standard Specifications, the Manual on Uniform Traffic Control Devices, the Traffic Management Plan and the following:

The providing of safety controls for construction operations shall be considered incidental to this contract and the costs for safety controls shall be included in the unit bid price for those contract items requiring such controls.

Positioning, adjusting and re-positioning of all devices such as traffic cones, high level warning devices, etc., not otherwise classified and paid for under other items in this contract, is considered incidental and no separate payment will be made.

WORK DONE BY OTHERS

Relocation and/or resetting to new grades of all private utilities, including utility poles, made necessary by the construction of this project, will be accomplished by the respective utility companies.

MATERIAL REMOVED AND STACKED

The Contractor shall carefully remove, transport and stack all material that, in the opinion of the Engineer, is salvageable. The Contractor shall coordinate with the City of Lowell to schedule drop-off time and location. For traffic signal items, the Contractor shall coordinate with the City Electrician and transport items to the landfill for storage. For all other materials, the Contractor shall coordinate with the City of Lowell Engineering Department.

DISPOSAL OF SURPLUS MATERIALS

Surplus materials obtained from any type of excavation, and not needed for further use as determined by the Engineer shall become the property of the Contractor and shall be removed from the site during the construction period and legally disposed of. The removal and disposal of surplus material shall adhere to the regulations and requirements of local authorities governing the disposal of such materials, at no additional compensation.

SAWCUTS

Existing pavements to remain shall be sawcut at all openings for utility work, for new or reset curb and at all joints with proposed hot mix asphalt pavement and driveways, as shown on the plans and as directed by the Engineer.

MAINTENANCE OF TRAFFIC SIGNALS

It shall be the responsibility of the Contractor to provide all labor, equipment and material required for the total maintenance and repair of all existing and proposed traffic signal control equipment, including damage by automobile accidents until final completion and acceptance of the project, unless otherwise specified under Subsection 7.17 "Traffic Accommodation: of the Standard Specifications as amended, in which case Subsection 7.17 will govern. These provisions will apply to the signalized locations included as part of this construction Contract from the date of written notice given to the Engineer that the Contractor will work on or adjacent to an existing signal until the date when the City accepts the complete project. This written notice must be given before the Contractor may proceed with any work on a specified traffic signal location. For the purpose of these Special Provisions, the phrase "Traffic Signal Control Equipment" is intended to include, but is not limited to, controllers, signal housings, supporting structures, cabinet accessories and panels, wires, conduit and all other ancillary electrical equipment used for traffic control.

The cost of the maintenance of signals shall be deemed to be included in the various traffic signal Contract items and no additional payments will be made.

FINE TUNING, ADJUSTMENT, AND TESTING PERIOD

After the Contractor has finished installing the controller and all other associated signal equipment and after the Contractor has set the signal equipment to operate as specified in the Contract documents, the fine tuning, adjusting and testing period shall begin. The Contractor shall advise the Engineer, in writing, of the date of the beginning of the fine tuning and testing period. This period shall not start until the work at the intersection is complete. During this period, the Contractor, under the direction of the Engineer, shall make necessary adjustments and tests to insure safe and efficient operation of the equipment. This period shall not last for more than 30 days and the Contract completion date has taken this testing period into consideration. No request for final acceptance will be considered until successful completion of the testing period.

The Contractor shall notify the Engineer in writing of the starting date of the fine tuning period prior to the starting date.

FINAL INSPECTION AND ACCEPTANCE

Upon successful completion of the 30 day testing period wherein the traffic signal systems has operated for 30 days without failure, the Contractor shall notify the City. The Engineer will make a final inspection of the installation in the presence of the City and the Contractor. An inspection check will be made to ensure that all equipment, materials, installations and operations are in accordance with the construction contract, plans and specifications. Items to be checked will include, but not be limited to, traffic signal systems operation, cabinet equipment, documents (wiring diagrams, as-built plans, instruction manuals, parts list, warranties, grounding resistivity test report, etc.), signs, and pavement markings, and street hardware (posts, bases, housings, brackets, etc.).

The Engineer will notify the Contractor in writing of any items in which the inspection reveals that the work is incomplete, defective, or does not otherwise meet the project specifications. The Contractor shall perform the corrective actions necessary to achieve final acceptance by the City. These corrective actions shall be done by and at the expense of the contractor and within 15 days of the date of the inspection report, unless otherwise approved in writing by the City.

GUARANTEE AFTER FINAL ACCEPTANCE

The Contractor shall diagnose (troubleshoot) the system and replace any part of the traffic signal systems found to be defective in workmanship, material or manner of functioning within six months from date of final acceptance of all the installations under this Contract. This requirement does not affect the one-year warranty period on equipment specified in Subsection 815.20 of the Standard Specifications.

Upon the date of acceptance of the project by the City, the Contractor shall turn over all guarantees and warranties to the City of Lowell.

QUALIFIED ELECTRICIANS

Within 10 days after opening of bids, the low bidder shall submit a list of the Journeyman Electricians (Massachusetts License) who will perform the electrical work in this contract.

Also, the low bidder shall submit copies of each Journeyman Electrician's current Massachusetts License.

PROPERTY BOUNDS

The Contractor shall exercise due care when working around all property bounds which are to remain. Should any damage to a bound result from the actions of the Contractor, the bound shall be replaced and/or realigned by a registered land surveyor at cost to the Contractor as directed by the Engineer at no cost to the Owner.

ARCHITECTURAL ACCESS BOARD TOLERANCES

The Contractor is hereby notified that they are ultimately responsible for constructing all project elements in strict compliance with the current AAB/ADA rules, regulations and standards.

All construction elements in this project associated with sidewalks, walkways, wheelchair ramps and curb cuts are controlled by 521CMR – Rules and Regulations of the Architectural Access Board.

The AAB Rules and Regulations specify maximum slopes and minimum dimensions required for construction acceptance. There is no tolerance allowed for slopes greater than the maximum slope nor for dimensions less than the minimum dimensions.

All wheelchair ramp joints and transition sections which define grade changes shall be formed, staked and checked prior to placing cement concrete. All grade changes are to be made at joints.

PERMITS

The Contractor shall apply for street opening permits in the City Engineers Office for streets being constructed.

SCHEDULES

The Contractor shall provide the Owner/Engineer in writing a three week work schedule at the start of the project. The Contractor shall then provide an updated three week work schedule in writing every Friday thereafter, this shall continue until the project is completed.

NOTIFICATIONS

The Contractor shall notify in writing any residence or business abutting each work area three days before work is to begin. The notices shall include the nature of the work to take place and the expected time of completion. They shall be distributed to all units of all buildings as well as all vehicles parked along street.

WATER SUPPLY FOR CONSTRUCTION

Water may be obtained from a newer hydrant in the area of construction after approval from the Water Utility's General Forman and the Engineer in charge.

NOTE: There will be a fee for the water usage and it shall be set by the City of Lowell Water Department. The associated fee shall be paid by the Contractor.

LIMITS FOR INSURANCE

The limits for the various types of insurance required under the Insurance Subsection of the General Conditions shall be as follows:

- a) For Workman’s Compensation, as required by State Statue;
- b) Minimum amounts of Public Liability, Bodily Injury Liability and Property Damage Liability Insurance are as follows:
- | | |
|--|----------------|
| Injury or death of one person: | \$500,000.00 |
| Injury to more than one person in a single accident: | \$1,000,000.00 |
| Property damage in one accident: | \$250,000.00 |
| Property damage in all accidents: | \$500,000.00 |
- c) Minimum amounts of Automobile and Truck (Vehicular) Public Liability, Bodily Injury Liability, and Property Damage Liability are as follows:
- | | |
|--|--------------|
| Injury or death of one person: | \$500,000.00 |
| Injury to more than one person in a single accident: | \$500,000.00 |
| Property damage in one accident: | \$250,000.00 |
| Property damage in all accidents: | \$500,000.00 |
- d) Builder’s Risk Insurance shall be procured and maintained by the Contractor covering loss by fire and extended coverage in the completed value form in the amount of the total insurance value for all structures, materials, and equipment to be built and installed. The policy shall indicate the Owner, the Contractor, and all subcontractors as the named insured with loss payable to the Owner as Trustee, the policy shall provide for a thirty (30) day notice to the Owner of cancellation or restrictive amendment. A copy of the policy shall be furnished to the Owner and a Certificate of Insurance shall be furnished to the engineer.
- The builder’s Risk Insurance shall be obtained before the work is started and shall be maintained until the date of completion of the work as stated in the final estimate, or until the Owner occupies or otherwise takes possession of the project, whichever comes first.
- e) Contractual Liability Insurance covering the liability assumed by the Contractor as outlined under section (d) of the Insurance Section of the General Conditions to the amounts required under Section (b) above.
- f) The Contractor shall have a \$2,000,000 insurance umbrella for this contract.

ITEM 120.1**UNCLASSIFIED EXCAVATION**

The work under this item shall conform to the relevant provisions of Section 120 of the Standard Specifications and the following:

The work shall include the disposal of existing materials shown on the drawings to be removed and reset, but which in the judgment of the Engineer are unsuitable for reuse in the proposed work and their disposal is not paid for under a separate item.

The work shall also include the excavation of material of every description, not paid for elsewhere in the construction documents, regardless of the type encountered, from within the project limits as shown on the drawings and as directed by the Engineer. No separate payment will be made for the off-site disposal of all existing material unsuitable for reuse in the proposed work, but all costs in connection therewith shall be included in the lump sum price bid.

ITEM 129.

PAVEMENT MILLING

Note: Pavement milling under this project will be done by the City

The work under this item shall conform to the relevant provisions of Section 120 of the Standard Specifications and the following:

The work shall include the pavement milling of existing asphalt pavement surface to various depths to produce a uniform surface for the application of the pavement overlay, as shown on the plans and as directed by the Engineer.

The Contractor shall obtain accurate elevations of the existing pavements and compare them with the proposed elevations shown on the drawings to determine the extent and depth of milling and/or leveling course required within the proposed pavement overlay areas.

Pavement areas abutting utility structures and other areas which cannot be planed by the principal milling machine shall be excavated with smaller mechanical milling equipment designed for this purpose or by manual methods.

No pavement cuttings shall remain on the project site at the end of each work day, except as approved by the Engineer.

ITEM 153. **CONTROLLED DENSITY FILL - EXCAVATABLE**

Controlled density fill (CDF) shall be used to backfill excavations and trenches for utilities and conduits constructed in existing pavement areas that are to remain or be milled and overlaid.

Controlled density fill shall conform to the requirements of Section M4.08.0 Type 1E.

ITEM 191.

DRIVE SAMPLE BORING

ITEM 191.10

HOLLOW STEM AUGER BORING

ITEM 191.11

CORE BORING

ITEM 193.

**MOBILIZATION AND DISMANTLING OF
BORING EQUIPMENT**

The work under these Items shall conform to the relevant provisions of Section 190 of the Standard Specifications and the following:

The work under these items shall include mobilization and set-up of boring equipment, the drilling of hollow stem auger borings, drive sample borings and rock core borings, the retrieval of soil samples, the visual classification of the soil, the recording of boring logs and samples, and the dismantling and transporting of the equipment to and from each site.

General

Hollow stem auger borings shall be taken at the locations of the proposed traffic signal foundations as shown on the plans and as directed by the Engineer. The Engineer shall be notified a minimum of 72 hours before borings are taken.

Two types of samples will be required in vertical soil borings:

1. **Standard Sample.** A standard penetration test using a split spoon sampler shall be made at the ground surface and at every change in soil stratum, but the sampling intervals shall not exceed 5 feet in a continuous stratum. The auger hole shall terminate at the required bottom elevation and a split spoon sample shall be taken at the bottom of the hole.
2. **Supplement Sample.** A volume sample shall be taken at 5 feet intervals in order to classify the subsurface soils with respect to grain size and visual classification as required. Each sample shall consist of the remainder of the spoon sample and shall be contained in liter jars appropriately labeled.

The purpose of this method along with its sampling procedure is to determine the visual properties, arrangement and thickness of the various soil strata as they exist in the ground. The elevations/depths at which any change in stratification occurs shall be located and recorded on the log by the driller. Detection of stratum changes should be made by careful observation of the soil as it exists in the augered hole and by the rate of penetration of the auger during drilling.

The auger casing I.D. shall be a minimum of 3 inches for all holes in which split spoon samples are required. The O.D. shall be a maximum of 7 inches to limit the size of the resulting hole.

Supplement Samples

The liter jar samples shall have positive identification of the contents by typewritten glued-on label.

The following information shall be shown:

1. Name and address of boring contractor
2. Date sample was taken
3. Location and name of project.
4. Location of borehole by station and offset or identifying number of borehole, if so identified on the plan.
5. Depth below ground surface at which sample was obtained and recorded blow counts of 6 inches of penetration of the sampler.

Upon completion of all borings, the Contractor shall submit two copies of the typewritten boring logs to the Engineer and deliver the jarred samples plus two copies of the typewritten logs to Vanasse Hangen Brustlin, Inc., Watertown, Massachusetts.

Obstructions

Obstructions other than ledge shall be considered in accordance with Section 190.60E of the Standard Specifications. The actual location of the additional boring will be specified by the Engineer. When ledge is encountered, a rock core boring will be made in accordance with Section 190.63 of the Standard Specifications.

Rock Core

If rock is encountered at an elevation above the specified highest bottom elevation, then a rock core boring will be made in accordance with Section 190.63 of the Standard Specification. The core hole shall be large enough to accommodate the required auger casing so that sampling may be continued past the rock obstruction. The minimum cored depth shall be 10 feet.

Practical Refusal

Practical refusal of the sample spoon or "refusal" is as defined by Section 190.60F of the Standard Specifications.

Due to the size of the resulting auger hole, it is particularly important that upon completion, all borings shall be backfilled with clean, well-graded sand and tamped to fill all voids created during the augering procedure.

Advancing the Boring for Soil Sampling

As the boring is advanced, care shall be taken to note and record the depth where wet soil is encountered if this should occur.

If groundwater is encountered then the water level in the hollow stem shall be maintained at the top of the casing at all times during the sampling operation to avoid unequal hydrostatic pressure that could result in blow-in of fine-granular soils and inaccurate blow counts.

In each boring the driller shall record the water level prior to backfilling and whenever possible, prior to the start of each day's work.

Each boring shall be advanced by using a hollow stem auger with cutting head and center rod and plug assembly. The hollow stem auger will advance and case the hole simultaneously to the required sampling levels. The center rod and plug assembly is held in place by the cap and inside drill rod connecting the auger and its assembly to the rotating spindle on the drilling machine to prevent soil from entering the mouth of the auger. Upon reaching the sampling level, the plug is to be retreated by withdrawing the center rod to permit lowering of the sampler through the auger.

The sample shall be obtained by driving the sampler 18 inches into the undisturbed material below the bottom of the auger. The sampling and handling procedure shall be as specified under Section 190.61 of the Standard Specifications.

After the sampling operations are completed and the sampler has been retracted, the plug is re-inserted and held in place by the center rod; another auger section is connected to the first, together with one additional center rod section to secure the plug to the cap and the hole is advanced.

This procedure shall be repeated until the required bottom elevation is reached. The auger shall be stopped at any depth level to allow normal sampling practices upon request by the Engineer.

If, in the judgment of the Engineer, the borehole cannot be advanced by the hollow stem auger method due to the material encountered (with the exception of bedrock) and every attempt has been made by the driller to complete the boring using the conventionally cased, drive sample, wash boring method as specified in Section 190 of the Standard Specifications, then the borehole shall be cored.

ITEM 222.3

FRAME AND GRATE (OR COVER)
MUNICIPAL STANDARD

The work performed under this item shall conform to the relevant provisions of Section 200 and the following:

Materials shall conform to the City of Lowell standard detail as shown on the Plans and included in the Specification.

Payment for the installation of frame and grate (or cover) on existing structures will be in the Contract lump sum bid price.

The cost to remove and discard the existing frames and grates will be included in the Contract lump sum bid price, with no specific compensation being made.

ITEM 303.06

**6 INCH DUCTILE IRON WATER
PIPE (MECHANICAL JOINT)**

ITEM 309.

DUCTILE IRON FITTINGS FOR WATER PIPE

ITEM 370.1

8 X 6 TAPPING SLEEVE, VALVE AND BOX

ITEM 376.2

HYDRANT - REMOVED AND RESET

ITEM 376.5

HYDRANT - ADJUSTED

The work under these items shall conform to the relevant provisions of Section 300 of the Standard Specifications and the following:

Coordination with the Municipality

The Lowell Water Department shall be notified prior to starting construction of any portion of the municipal water system.

The closing of valves necessary for making connections with existing municipal system will be done by the Water Department employees, assisted by the Contractor. Sufficient notice shall be given the Water Department of planned connection. No allowance will be made for any delay in closing of valves. A 48-hour notice shall be given to residents or businesses affected by the shut-down, and shall be done by the Contractor under the direction of the Utility Department.

The City of Lowell Water Department may establish the time of shutdown to be within the normal daily low demand period.

FM Global Requirements

The installation of the underground fire system mains should conform to FM Global Data Sheet 3-10 Installation and Maintenance of Private Service Mains and Their Appurtenances, and FM Approved components should be used. Manufacturer's specifications for all components shall be provided prior to installation. (See attached FM Global Data Sheet).

Approval of Materials

The Contractor shall submit the names of the material suppliers, shop drawings and certificates of compliance to the Engineer for approval prior to ordering any materials, including Contractor's Material and Test Certificate (FM Global Form 85B).

ITEMS 303.06 through 376.5 (Continued)

As-Built Drawings

The Contractor shall submit As-Built Drawings upon completion and acceptance of work. As-Built Drawings shall be complete and shall indicate the true measurements and locations, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three ties to each gate valve box from fixed permanent objects. As-Built Drawings shall also contain any additional information required by the municipality, and shall be stamped with the seal of a Licensed Land Surveyor and Licensed Professional Engineer.

Pipe, Insulation and Fittings

Pipe shall be ductile iron, Class 52, conforming to ANSI A21.50/AWWA C150 and ANSI A21.51/AWWA C151.

Pipe shall be supplied in lengths not exceeding 20 feet. Each pipe and fitting shall markings casted into the metal in accordance with ANSI A21.10/AWWA C110, including manufacturer's identification, country material was made in, pressure rating, nominal diameter and degrees or fraction of circle (for bends).

Fittings shall be ductile iron, Class 250 minimum, conforming to applicable ANSI, NEWWA, and AWWA specifications. All fittings (bends, tees, solid sleeve connectors, reducers, etc.) and valves shall be mechanical joint and restrained.

Pipe and fittings shall have a cement mortar lining and bituminous seal coat on the inside and a coal tar enamel coat on the outside in accordance with ANSI A21.4 (AWWA C104) and ANSI A21.6 (AWWA C106), as amended, except that the cement mortar lining shall be 1/8-inch in thickness for pipe 2 inches to 12 inches in diameter. Bituminous seal coat shall be a product acceptable to the National Sanitation Foundation (NSF) for use in potable water and shall be so listed in the most current NSF summary of approved products under ANSI/NSF Standards 61.

Pipe shall be either the rubber-ring type push-on joint or standard restrained mechanical joint pipe.

Mechanical joints shall conform to ANSI A21.11/AWWA C111.

Flanged pipe shall be Class 52 as per AWWA C115, supplied in standard lengths with flanged joints. Flange shall be flat face type, unless otherwise noted, meeting ANSI B16.1, Class 125. Flange gasket shall be full face type per AWWA C111, Appendix B, to provide positive sealing for the flanged ductile iron joints. Thickness shall be 1/8 inch. Assembly bolts shall be square-headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Thread shall conform to ANSI B1.1. Bolt length shall be such that after joints are assembled, the bolts shall protrude through the nuts, but not more than 1/2 inch.

ITEMS 303.06 through 376.5 (Continued)

Pipe and Fittings Installation

Care shall be taken in loading, transporting, and unloading to prevent injury to the pipes, fittings or coatings. Pipe and fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer. Any pipe found to be defective, before or after laying, shall be satisfactorily removed and replaced with sound pipe at no additional cost to the Owner.

All pipe and fittings shall be installed in conformance with AWWA Standard Specifications C600, except as otherwise provided herein. All pipe and fittings shall be sound and clean before laying and shall be laid on a shaped bedding providing uniform, firm support over the entire length of each section barrel. **BLOCKING WILL NOT BE PERMITTED.** The select bedding material shall be placed and tamped along the sides of the pipe to complete the bedding.

Pipe shall be laid with good alignment and at a uniform 5-foot depth to top of pipe below proposed grade except where extra depth is required to clear other utilities and to connect to existing pipes, valves or fittings. Joint deflection shall not exceed that recommended by the manufacturer. Additional fittings shall be furnished and installed as required to cross existing utilities. Solid sleeves shall be used only where approved by the Engineer.

When pipe laying is stopped for any length of time, including short periods, the open ends of the pipe and fittings shall be closed with a watertight plug or cap as approved by the Engineer.

Necessary pipe cutting shall be accomplished by power saw and shall leave a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

Push-on joints shall be made in strict accordance with the manufacturer's instructions. The rubber gasket shall be inserted in the groove of the bell end of the pipe, the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a jack or by other means. After jointing the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

Mechanical joints shall be installed in accordance with the "Notes of Method of Installation" of ANSI A21.11 and the instructions of the manufacturer. The Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tight to the specified torques. Extension wrenches or pipe over handle or ordinary ratchet wrench shall not be used to secure greater leverage.

ITEMS 303.06 through 376.5 (Continued)

Polyethylene Encasement

All proposed ductile iron water pipe shall be encased with Class A polyethylene film, 8 mil. thick, conforming to ANSI/AWWA C105/A21.5 for Polyethylene Encasement for Ductile-Iron Piping. Polyethylene encasement of ductile iron pipe shall be installed in accordance with ANSI/AWWA C105/A21.5.

Water/Sewer Separation

When a water pipe crosses above or below a sewer pipe, the following procedures shall be utilized. The Contractor shall comply with these following procedures:

Whenever possible, water mains shall be laid at a minimum at least 10 feet, horizontally, from any existing or proposed sewer. Should local conditions prevent a lateral separation of 10 feet, a water main may be laid closer than 10 feet to a sewer if:

- a. It is laid in a separate trench, or if;
- b. It is laid in the same trench with the sewer located at one side on a bench of undisturbed earth, and if;
- c. In either case, the elevations of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.

Whenever water mains must cross under sewers, the water main shall be laid at such an elevation that the top of the water main is at least 18 inches below the bottom of the sewer. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impossible to obtain horizontal and/or vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cement lined ductile iron pipe or other equivalent based on water tightness and structural soundness. Both pipes shall be pressure tested by an approved method to assure water tightness or both pipes shall be encased in concrete.

ITEMS 303.06 through 376.5 (Continued)

Valves

Gate valves shall be resilient wedge valves conforming to AWWA C509 and shall be rated for 200 psi minimum working pressure and shall be shell tested at a minimum of 400 psi. Valves shall be Underwriters Laboratory (UL) and Factory Mutual (FM) approved. Stuffing boxes shall be of the O-ring type. The operating nut shall be standard AWWA 2-inch square. Buried valves shall have mechanical joint ends conforming to AWWA C111. Exposed valves in vaults shall have flanged joint ends conforming to AWWA C111 unless shown as mechanical joints on plans.

All valves shall open right (clockwise) as required by the local water and fire departments.

All valves shall be of the iron body type, bronze mounted, double disc parallel seal, non-rising stem type. All ferrous parts of the valves, except finished or bearing surfaces, shall be given two coats of asphalt varnish.

After the valves are assembled and tested, a third coat shall be applied on the exterior.

Tapping Sleeve and Valve

Tapping sleeves shall conform to AWWA C500 and shall be 200 psi minimum working pressure with cadmium plated cast iron nuts and bolts. Sleeves shall be caulked type for ductile iron pipe and shall be furnished with a bead at the base of each bell to provide a step for caulking. Sleeve flanges shall be fitted with combination lead and rubber gaskets covering the entire surface area of each flange.

The valves shall be flanged by mechanical joint outlet with non-rising stem, designed for vertical burial and shall open right (clockwise) unless specified otherwise by the local water and fire departments. Stuffing boxes shall be the O-ring type. The operating nut shall be AWWA standard 2-inch square. The valve shall be provided with an overload set to permit the use of full size cutters.

Valve Boxes

Valve boxes shall be two-section, cast iron, heavy pattern adjustable type, with cast iron cover. The upper sections shall have a bottom flange of sufficient bearing area to prevent settling. The bottom section shall enclose the valve stuffing box and operating nut. Boxes shall be of lengths adapted to 5-foot pipe cover or more and have a minimum of 6 inches of overlap in the most extended position. Covers shall have the word "WATER" cast in the top and shall be held in place with bronze bolts.

ITEMS 303.06 through 376.5 (Continued)

Couplings

Couplings shall be used to:

- (1) repair split pipe or replace sections of damaged pipe;
- (2) install or cut-in hydrants or valves into a water main;
- (3) couple different pipe types; and
- (4) correct misaligned pipe ends.

Couplings shall have a pressure rating of 250 psi or greater. Materials shall be manufactured in accordance with the following:

- (1) Center and end rings: ASTM-A536
- (2) Gaskets: ASTM D2000
- (3) Bolts & Hex Nuts: AWWA C111

Couplings shall be epoxy-coated.

Pipe Insulation

Pipe insulation shall be installed in locations indicated on the plans and when water main cannot be installed with at least 5 feet of cover. Pipe insulation shall be installed with waterproof jacket in accordance with MHD M11.0 and MHD Section 301.60. Insulation thickness shall be as indicated on the plans and as directed by the Engineer. Work shall include insulation, jacket and jacket fasteners. Work shall be coordinated with heat tracing installation and bridge construction.

Hydrants

Hydrants shall be set plumb with the steamer nozzle facing the roadway.

Hydrants to be removed and reset or adjusted shall be carefully removed and set on blocks temporarily. The contractor shall install a riser extension of the appropriate length on the existing riser and reset the hydrant. Extension sections used to adjust hydrants shall be ductile iron only and shall adapt readily to the existing hydrant and fittings. Extensions shall be a minimum of 6-inch long. The final height of the adjusted hydrant shall be between 2'-6" and 2'-9" as measured from the proposed finished grade to the top of the hydrant.

Hydrants shall be set with the center of the operating nut 18 inches back from the face of the curb. Hydrants shall be set so that manufacturers "bury" mark or ground line is at finish grade. If there is no bury mark on the hydrant, the bottom of the breakaway feature shall be a minimum of 2 inches and a maximum of 4 inches above finished grade. The depth off bury shall be either 5 1/2 or 6 feet.

ITEMS 303.06 through 376.5 (Continued)

Hydrants shall be set on either a flat stone or concrete base at least 14 inches square and 4 inches thick.

Hydrants shall be restrained by using mechanical joint follower glands, rods and clamps, thrust blocks or any combination thereof as required by the Engineer and Lowell Water Department.

A drainage pit shall be excavated below and around each hydrant and backfilled to a height of at least six (6) inches above all drain ports with at least 12 cubic feet of 1 inch to 2 inch crushed stone. This shall be covered with 4-mil thick plastic sheeting.

Hydrant Installation

Hydrants shall be set at the locations shown on the drawings, or as directed by the Engineer, and bedded on a firm foundation. A drainage pit 2 feet 6 inches in diameter shall be back-filled with crushed stone in conformance to M2.01.1 and satisfactorily compacted. Additional stone shall be brought up and around 6 inches over the drain ports. Each hydrant shall be set in true vertical alignment and properly braced. A concrete thrust block shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Felt roofing paper shall be placed around hydrant elbow before placing concrete. Care shall be taken to insure that concrete does not plug the drain ports. Hydrant paint shall be touched up as required after installation.

Thrust Restraints

Thrust restraints shall be installed at all tees, bends, plugs, caps, tapping sleeves and other locations as directed by the Engineer in accordance with the dimensions and details shown on the plans.

Whenever water pipes can be placed against undisturbed earth, concrete thrust blocks may be installed. The back of thrust blocks shall be placed against undisturbed earth and the sides shall be formed. Felt roofing paper shall be placed to protect pipe joints. Concrete shall not be placed over bolts or nuts, or in a manner which prevents the removal of joints.

Concrete shall have a minimum strength Class of 3,000 psi.

Whenever water pipes are installed within fill sections, the Contractor shall use mechanical restrained joint pipe and wedge-type mechanical joint restraints rated for 350 psi.

ITEMS 303.06 through 376.5 (Continued)

Restrained Joints

Pipe with restrained joints shall be installed in all areas where the pipe is within fill materials and also at locations shown on the Drawings. Restrained joints shall be installed at bends, reducers, tees, valves, dead ends, and hydrants. The minimum length of pipe to be restrained on either side of the joint shall be as shown on the table below. The fittings of the new piping shall be for restrained joints, as marked on the Drawings.

| <u>Fitting</u> _____ | <u>Number of Joints to Restrain on Either Side of Fitting (Based on 18-Foot Pipe Length)</u> |
|----------------------|--|
| 90 degree bend | 3 |
| 45 degree bend | 2 |
| 22-1/2 degree bend | 2 |
| Tee: | |
| Branch | 3 |
| Run | 2 |

No restraining is required in the direction of the existing pipe if only a short length of it is exposed in the trench for making a connection.

Restrained joint assemblies for push-on pipe and fittings shall be made in strict accordance with the manufacturer's recommended installation procedures.

Restrained joint assemblies for mechanical joint pipe shall be EBAA Iron Sales MEGALUG or approved equivalent.

Approval of Pressure Testing and Disinfection Plan

The Contractor shall submit a plan and description of the procedures for pressure testing and disinfection for approval by the Lowell Water Department and the Engineer prior to performing the work.

Pressure Testing

Pressure testing shall be conducted by a certified independent water testing company after thrust block have cured to the required 3000 psi strength. The Contractor shall provide all necessary equipment and conduct hydrostatic pressure and leakage tests on the new water system installed under the Contract in conformance with AWWA 600, the regulations of the Massachusetts State Board of Health and the following:

ITEMS 303.06 through 376.5 (Continued)

Prior to testing, the entire pipe section shall be flushed to remove any rocks or debris which may have inadvertently entered the pipe during construction. The water system shall be subjected to a hydrostatic pressure of 200 psi and this pressure shall be maintained for at least one hour. The leakage test shall be conducted at a pressure of 150 psi and this pressure shall be maintained for at least two hours.

Permitted leakage shall conform to AWWA C600. Leaks exceeding this standard shall be located and all defective pipes, fittings, pipe joints, valves and other material removed and replaced with new material to correct the leak, as directed by the Engineer, at no additional cost to the Owner.

All testing shall be done in a manner which prevents the entrance of contaminated water or pollutants into the existing water system.

Disinfection

Before being placed in service, all new water pipe shall be chlorinated in accordance with ANSI/AWWA C651 Standard for Disinfecting Water Mains.

The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor. The Contractor shall uncover and backfill the taps as required.

The pipe section being disinfected shall be flushed to remove discolored water and sediment from the pipe. A 25 mg/l chlorine solution in approved dosages shall be inserted through a tap at one end while water is being withdrawn at the other end of the pipe section. The chlorine concentration in the water in the pipe shall be maintained at minimum 25 mg/l available chlorine during filling. To assure that this concentration is maintained, the chlorine residual shall be measured at regular intervals in accordance with procedures described in Standard Methods and AWWA M12, Simplified Procedure for Water Examination, Section K.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the pipe supplying the water. Chlorine application shall not cease until the entire pipe section is filled with chlorine solution. The chlorinated water shall be retained in the pipe for at least a twenty-four hour period. The treated water shall contain a chlorine residual throughout the length of the pipe section as indicated in AWWA C651.

Following the chlorination period, all treated water shall be flushed from the pipe section and replaced with water from the distribution system in accordance with the FM Global Data Sheet, section 2.1.5.8, Flushing Underground Mains. Prior to disposal of treated water the Contractor shall check with local authorities to determine if the discharge will cause damage to the receiving body or sewer and, if required, the Contractor shall neutralize the chlorinated water in

ITEMS 303.06 through 376.5 (Continued)

accordance with Appendix B, AWWA C650. Bacteriological sampling and analysis of the replacement water may then be made by the Contractor in full accordance with AWWA Specification C651. A minimum of three samples shall be taken by the Contractor at locations directed by the Engineer along the length of water pipe being chlorinated and sent to a State approved private laboratory for analyses. The Contractor shall rechlorinate if the samples show presence of Coliform, and the pipe section shall not be placed in service until all of the repeat samples show no presence of Coliform.

Furnish two copies of a Certificate of Disinfection Report to the Engineer.

The Contractor shall pay all costs for all testing, flushing, chlorinating; laboratory analyses, sampling, water supply and municipal charges.

Measurement and Payment

No separate payment will be made for excavation, concrete, gravel borrow and crushed stone bedding and backfill, dewatering, sampling, flushing, testing and disinfection, but all costs in connection therewith shall be included in the Contract lump sum bid price.

No separate payment will be made for the removal, transporting and stacking of existing salvaged materials, but all costs in connection therewith shall be included in the Contract lump sum bid price.

ITEM 460.

HOT MIX ASPHALT

ITEM 460.1

HOT MIX ASPHALT DENSE BINDER

Note: Paving under this project will be done by the City

The work under these items shall conform to the relevant provisions of Section 460 of the Standard Specifications and the following:

At least 48 hours prior to paving, the Contractor shall submit a plan and schedule of the proposed paving operations. The plan and schedule shall contain detailed information of the following: width and direction of each pass, number of trucks and plant location, number of rollers, method of staggering joints and typical traffic control measures to be utilized. The plan and schedule shall be submitted to, and approved by, the Engineer prior to the beginning of paving operations.

The pavers shall operate while the asphalt pavement is being spread at a speed that will produce a uniform surface texture free of any rippling or unevenness. Paving speeds shall in no case exceed 60 feet per minute. The Engineer may reduce the speed of paving and rolling when, in his opinion, the finished surface appears open in texture.

A minimum of one roller for each 500 tons of mixture spread in one day of eight hours working time shall be required.

The work under Item 460. and 460.1 shall also include the furnishing and placement of leveling courses of top or binder material, as directed by the Engineer, prior to the placement of the pavement overlay on existing pavements.

All leveling shall be a separate operation before the regular paving operation.

Existing Pavement Overlay

As directed by the Engineer, areas of existing pavement and pavement patches that are settled, loose, rocking or excessively deteriorated shall be removed and replaced with an equivalent depth of hot mix asphalt, binder or top course, before placement of the pavement overlay.

After removal of the existing pavement or pavement patch, the underlying subbase material shall be graded to provide a uniform pavement replacement depth and compacted to not less than 95 percent of the maximum dry density of the material before placement of the new hot mix asphalt material.

The edges of existing pavement in removal areas shall be cut to provide a vertical uniform face and shall be sprayed or painted with a uniform thin coat of RS-1 asphalt emulsion immediately before placement of the new hot mix asphalt material.

ITEM 472. HOT MIX ASPHALT FOR MISCELLANEOUS WORK

The work under this item shall conform to the relevant provisions of Section 420, 460 and 470 of the Standard Specifications and the following:

The work shall include the furnishing and placing of various hot mix asphalt mixtures to provide temporary pavements for temporary access to and egress from properties abutting the work area, for temporary patching, for permanent patching in pavement overlay areas, and for any necessary traffic maintenance or detouring of existing roadways to provide continuous travel for each direction of traffic on each roadway.

Asphalt mixtures under this Item shall be placed only where and as directed by the Engineer.

The Contractor is advised that this material will have to be placed primarily by hand methods.

The mixture selected shall determine the applicable specification section and the relevant provisions therein.

The price for this item used for temporary work shall include the subsequent removal and disposal.

ITEM 482.3

SAWING ASPHALT PAVEMENT

ITEM 482.4

SAWING CEMENT CONCRETE

The work under these items shall conform to the relevant provisions of Section 120 of the Standard Specifications and the following:

The work shall include the sawcutting of existing asphalt and cement concrete pavements where shown on the plans, and as directed by the Engineer.

Sawcut equipment shall be approved by the Engineer prior to commencing work.

The existing pavement shall be sawcut through its full depth, or to the elevation of the abutting proposed pavement subgrade, whichever is lesser, at all joints between existing and proposed pavements, and at all utility trenches through existing pavement to remain, to provide a uniform, vertical surface for the proposed pavement joint with the existing pavement.

Sawcut edges which become broken, ragged or undermined as a result of the Contractor's operations shall be re-sawcut prior to the placement of abutting proposed pavement at no additional cost to the Owner.

Sawcut surfaces in asphalt pavement shall be sprayed or painted with a uniform, thin coat of RS-1 asphalt emulsion immediately before placement of hot mix asphalt material against the surfaces.

ITEM 580.

CURB REMOVED AND RESET

ITEM 594.

CURB REMOVED AND DISCARDED

Work under these items shall conform to the relevant provisions of Section 500 of the Standard Specifications and the following:

Existing granite curb shall be cleaned by sandblasting to remove any paint, joint mortar, asphalt material or other undesirable material adhered to the granite before resetting, as required by the Engineer.

Curved granite curb with different radius than the proposed curb are unsuitable for reuse. Damaged curb stones are unsuitable for reuse.

All stones to be reused which have damaged curb ends shall be sawcut square with the top plane so when stones are placed end to end the joint opening does not exceed one half inch.

Reset curb stones shall be reset contiguously. New curb stones shall be installed contiguously. Alternating new and old stones shall not be permitted.

The Contractor is advised that granite curb removed may be reset elsewhere at a different location within the Contract limits and all costs incurred for handling and transporting existing curb and edging shall be included in the Contract lump sum bid price.

No separate payment will be made for storage, transporting and handling of existing granite curb to be reused; no separate payment will be made for concrete and other incidental work, but all costs in connection therewith shall be included in the Contract lump sum bid price.

Any excess granite curb that is remaining shall be the property of the Contractor.

Remaining existing granite curb not acquired by the City or required to be removed and reset, shall become the property of the Contractor and removed from the site during the construction period and legally disposed of at no additional cost to the City.

ITEM 697.1**SILT SACK**

Work under this item shall conform to the relevant provisions of Section 670 of the Standard Specifications and the following:

The work under this item includes the furnishing, installation, maintenance and removal of a reusable fabric sack to be installed in drainage structures for the protection of wetlands and other resource areas and the prevention of silt and sediment from the construction site from entering the storm water collection system. Devices shall be ACF Environmental (800)-448-3636; Reed & Graham, Inc. Geosynthetics (888)-381-0800; The BMP Store (800)-644-9223; or approved equal.

CONSTRUCTION

Silt sacks shall be installed in retained existing catch basins and drop inlets within the project limits and as required by the Engineer.

The silt sack shall be as manufactured to fit the opening of the drainage structure under regular flow conditions, and shall be mounted under the grate. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure. The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Silt sacks shall remain in place until the placement of the pavement overlay or top course and the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of silt sacks after each rainstorm and during major rain events. Silt sacks shall be cleaned periodically to remove and disposed of accumulated debris as required. Silt sacks, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the City.

When emptying the silt sack, the contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractors expense. The silt and sediment from the silt sack shall be legally disposed of offsite. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

ITEM 701.2

CEMENT CONCRETE WHEELCHAIR RAMP

The work under this item shall conform to the relevant provisions of Section 701 of the Standard Specifications and the following:

Cement concrete wheelchair ramps shall be constructed at locations shown on the Plans and in conformance with the Architectural Access Board’s Rules and Regulations dated February 23, 1996, as amended and the MassDOT Wheelchair Ramp Standards, as shown in the 2010 Construction Standard details. Concrete score lines as specified in Section 701 shall be continuous throughout the wheelchair ramps.

Detectable Tactile warning surface shall conform to the requirements shown in the 2010 MassDOT Construction details.

Detectable tactile warning surface shall be “Replaceable Wet-Set Truncated Dome Detectable Warning System”, as manufactured by ADA Solutions, Inc., headquartered in Chelmsford, Massachusetts, www.adatile.com, or approved equal.

The color of the detectable warning surface shall be as follows:

| Intersection | Color | Color Number* |
|---------------------------------------|--------------|----------------------|
| University Avenue at Riverside Street | Clay Red | 22144 |
| Pawtucket Street at School Street | Clay Red | 22144 |
| Westford Street at School Street | Clay Red | 22144 |
| Church Street at Lawrence Street | Black | 37938 |

*per Federal Standard 595B Table IV

The Contractor shall submit to the Engineer, and the City for approval, two detectable warning surface samples minimum 8”x 8” for each of the colors noted above.

The Contractor shall submit to the Engineer, and the City for approval, shop drawings showing all pertinent characteristics of the detectable warning system, including profile, sound on cane contact amplification feature and installation methods.

No separate payment will be made for the detectable warning panels, but all costs in connection therewith shall be included in the Contract lump sum bid price.

ITEM 707.8**STEEL BOLLARDS**

The work under this Item shall conform to the following:

The work shall include providing all labor, equipment, materials, incidental work, and construction methods necessary to furnish and install steel pipe bollards with concrete caps and removable bollard covers in accordance with the plans and as directed by the Engineer.

The bollards shall be Schedule 40, hot dipped, galvanized steel pipe with a 6 inch outside diameter and filled with concrete.

The bollards shall have removable, plastic covers. These covers shall be manufactured using 1/8" thick HDPE plastic, and shall contain ultraviolet and antistatic additives that withstand extreme temperatures and resist fading. The covers shall be black in color with two reflective white stripes located near the top.

Shop Drawings

Within 30 days following execution of the Contract, the Contractor shall submit shop drawings for the steel bollards and removable covers, and manufacturer's equipment specifications to the Engineer in accordance with the relevant provisions of Section 815.20.

No work shall be commenced by the Contractor until approval of the shop drawings and manufacturer's data has been received in writing from the Engineer. Approval of these drawings will be general in character and shall not relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship conforming to the plans and specifications.

The Contractor shall deliver to the Engineer a certificate of compliance with the manufacturer for all materials purchased from the manufacturer.

Construction Methods

The Contractor shall inspect all work areas at the project site to assure that proper conditions exist to receive delivery of bollard items fabricated under this Item. Notify the Engineer in writing before delivery should any condition exists that requires correction. Failure to make such a report shall be construed as acceptance of the existing conditions at the project site and the responsibility for delays of work and damage to bollard items.

Installation - The Contractor shall install the bollards as shown in the contract drawings.

ITEM 804.3

3-INCH ELECTRICAL CONDUIT
TYPE NM PLASTIC (UL)

The work under this Item shall conform to the relevant provisions of Section 801 of the Standard Specifications and the following:

The work shall include the furnishing and installation of 3-inch non-metallic conduit for traffic signal systems in accordance with the plans and as directed by the Engineer.

The conduit material shall be Schedule 80 polyvinyl chloride (PVC) plastic conduit.

Where conduit is installed in existing sidewalk or paved median areas to remain, the work shall include replacement of the gravel base material and the surface pavement to match preconstruction conditions. No separate payment will be made for this work, but all costs in connection therewith shall be included in the Contract lump sum bid price.

Trenches in existing HMA pavements not subject to full depth reconstruction shall be sawcut to an 18 inch width. The existing pavements shall be sawcut through their full depth and the pavement removed.

After conduit installation, the trench shall be backfilled with controlled density fill (CDF). CDF shall be Type 2E and shall be specified in Section M4.08.0 of the Standard Specifications. The finished grade of the CDF shall be below the existing pavement surface as shown on the construction details.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Existing Installations

Existing signal installations to be reconstructed under Item 816.01 through 816.03 shall be maintained in operation throughout the construction period and until the new signal is ready for operation. The Contractor may use temporary supports for signal heads as necessary to allow construction activities.

Any temporary installations shall be in conformance with the MUTCD at all times. If an existing signal is to be turned off temporarily to allow controllers switch overs or rewiring, police detail shall be used to control traffic at the intersection.

Once construction is completed and the new signal is in operation, unused items of the old signal shall be completely removed and stacked as directed by the Engineer in accordance with Section 815.65. Old cable and unusable materials shall be disposed of by the Contractor.

Service Connections

Under these Items service connections shown on the plans are approximate only. The Contractor shall determine exact locations from the servicing utility, arrange to complete the service connection, and be responsible for all charges incidental thereto.

Flashing Operation

Changes from automatic flashing to stop-and-go operation and from stop-and-go to automatic flashing operation shall occur as set forth in the MUTCD.

Traffic Signal Equipment

The traffic signal controller units (CU), malfunction management units (MMU), cabinet power supply, bus interface units (BIUs) and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the National Electrical Manufacturers Association (NEMA) Standard No. TS 2-1998, Traffic Controller Assemblies with National Transportation Communications for ITS Protocol (NTCIP) Requirements.

Traffic Signal Controllers

The traffic controllers supplied shall conform to Section 3 “Controller Units” of the NEMA TS 2 Standard. The traffic controllers shall be supplied in a TS 2 Type 1 Configuration as required in the list of major traffic signal items included on the plans for each intersection location. Specifically, the controller units (CU) shall be supplied as actuated controllers with NTCIP capabilities; defined as Type A1N in Subsection 3.2 of the NEMA TS 2 Standard.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

The TS 2 Type 1 cabinet shall, at a minimum, meet the requirements of configuration 3 as defined in Table 5-2, "Type 1 Configurations" of the NEMA TS 2 Standard and according to the Item numbers listed above and on the traffic signal plans.

The controller units shall utilize an interface conforming to Subsection 3.3 of the NEMA TS 2 Standard. The controller units shall utilize an input/output interface conforming to the requirements of Paragraph 3.3.1 for all input/output functions with the Terminals and Facilities (TF), Malfunction Management Unit (MMU), detector rack assemblies and auxiliary devices. The controllers units shall also meet the requirements of Paragraph 3.3.6 "NTCIP Requirements" of the NEMA TS 2 Standard.

The controller units shall be supplied with Port 1, Port 2, and Port 3 as defined by the requirements of Subsections 3.3.1, 3.3.2, and 3.3.3, respectively.

The controllers shall be a keyboard-entry menu-driven units conforming to City of Lowell Standards, with internal time base coordination, emergency preemption, and programmatic capability. The controller units shall be complete with a module for closed loop system functions (future use).

Malfunction Management Unit

The malfunction management unit (MMU) shall comply with Section 4 of the NEMA TS 2 standard. The MMU shall be capable of operating as either a Type 16 with 16 channels (8 vehicle, 4 pedestrian, 4 overlap) or a Type 12 with 12 channels (8 vehicle, 4 overlap). The MMU's supplied shall be configured to operate as Type 16 units.

The MMU's in either the Type 16 or Type 12 configuration shall be capable of operating in a NEMA TS 2 Type 1 cabinet, a NEMA TS 2 Type 2 cabinet, or a NEMA TS 1 cabinet without loss of functionality.

Single-Point Vehicle Detection

Under these Items the Contractor shall provide and install a Single-Point Video Detection (SPVD) System as shown on the plans and these special provisions. The SPVD system shall include a single ultra wide angle lens camera, video processor unit, detection algorithms, all cables, connections, mounting hardware, application software, and accessories required by the manufacturer for proper operation of the system, including but not limited to surge protection devices.

The SPVD system shall detect and monitor vehicles on approach roadways utilizing advanced, omni-directional, vehicle tracking algorithms along with three-dimensional vehicle modeling to supply accurate and consistent stop line detection.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

The SPVD system shall include all necessary software and hardware to allow the end user to program, setup, and/or modify detection zones within the video camera image.

One pointing device and one swivel mounted color monitor within the controller cabinet for future viewing of the detection camera images shall be supplied by the Contractor. The Contractor shall also supply any necessary cables, interface devices and software for monitoring video detection via laptop computers.

The camera shall be mounted at the intersection, as shown on the plan or as directed by The Engineer,

At a minimum, the SPVD shall meet the following requirements:

Camera

- Power: 48 VDC, single burial grade CAT 5e cable
- Operating Temp: -35C to +60C
- Humidity: Up to 100%
- Dimensions: 10" diameter x 9"
- Weight: less than 11 lbs.
- The camera shall include an ultra-wide-angle lens.
- The camera shall include a heater to prevent the formation of ice and condensation.
- The camera, when properly installed and configured, shall be able to concurrently observe at least 5 lanes of traffic per approach.
- The camera shall be able to concurrently observe more than one approach.

Video Processor Unit

- Power: 120-240 VAC, requiring 150 watts or less.
- Operating Temp: -34C to +74C
- Humidity: Up to 95% non-condensing
- Dimensions: 12.25" wide x 11.25" depth x 5" high
- Weight: 12 lbs.
- Enclosure: Rack mount in traffic cabinet
- The video processor unit shall save configurations and zone plans locally to maintain operation with or without monitoring equipment connected.
- The video processor unit shall be designed to function dependably in the adverse environment found in the typical roadside traffic cabinet.
- The video processor unit shall include at least 24 detector outputs.
- The video processor unit shall include an SDLC connection for TS2 type controllers
- The video processor unit shall include a USB on the front surface for simple data collection on non-networked systems.
- The video processor unit shall include both LAN and WAN RJ-45 interface ports on the front surface of the unit.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Application Software

- The application software shall support the creation and modification of at least twenty-four (24) polygonal detection zones within the graphical user interface.
- The application software will show images of the detection zones superimposed on the video image of traffic.
- The application software shall support the assignment of a detector output(s) to each zone. These assignments can be modified at any time through the software.
- The application software shall support direction of travel assignment within detection zones. The vehicle detection zone shall not activate for objects traveling any direction other than the one specified for detection. Cross-street and wrong way traffic shall not cause detection.
- The application software shall change the color of the zone within the graphical user interface as vehicles enter or exit a detection zone, changing its occupancy status. This will be required for real-time or historical monitoring, and may be turned on or off by the user at any time.
- The application software shall provide visual indication of the light state for each zone within the graphical user interface.
- The application software shall feature the ability to digitally pan, tilt, and zoom within the camera's field of view without movement of the camera.
- The application software shall maintain a database of current and historical traffic data, and allow for the user to run reports against this data to include traffic counts, turn movements, speed, and classification at a minimum.
- The application software shall feature the ability to mask objects that occlude the camera field of view and/or disrupt the camera automatic gain and exposure control.
- The application software shall feature an optional reporting interface offering point and click reporting for turning movement counts and vehicle classification.

The Contractor shall provide software that enables a technician to test all features and functions of the SPVD system, and to perform all set-up procedures. This software shall be delivered on a CD so that it can be installed on other laptops. The City shall have the right to make and use an unlimited number of copies of this software.

The SPVD system shall be installed in accordance with the manufacturer's recommended procedure for installation.

The SPVD system shall be installed by factory certified installers and as recommended by the manufacturer and documented in installation materials provided by the manufacturer. Proof of the factory certification shall be provided. Installation includes connecting the SPVD to the traffic signal controller and power supply in the associated controller cabinet assembly. When the setup is complete and the SPVD system is ready for operation, the values of all parameters that were set during the process shall be delivered to the Engineer in printed and computer-readable form. All equipment, such as software, laptop computer, tools and cables, needed for setup work shall be provided by the Contractor.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

The Contractor shall be responsible for the proper programming of the SPVD, orientation of the SPVD, and all other work necessary to provide a complete vehicle detection system. The Contractor may be required to field adjust the location of the SPVD system in the presence of the Engineer to properly detect approaching vehicles.

The cabinet documentation (box prints) shall show all wiring between the SPVD system and the controller cabinet.

Warranty: The supplier shall provide a three-year warranty on the SPVD system following installation and warranty registration. The camera shall include an additional warranty to require no aiming or focusing for a period of five years. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers. During the warranty period, updates to SPVD software shall be available from the supplier without charge.

Training: The Contractor shall provide four (4) hours of personnel training in the use of the traffic SPVD system and software. This training is to be conducted with the City. The Contractor is to coordinate with the City as to the exact location and time of the training. It is the responsibility of the Contractor to provide training manuals, class notes, and other instructional materials for up to four attendees at the training sessions.

No training shall begin unless and until the final inspection process indicates, in the opinion of the Engineer, that the SPVD system is sufficiently complete and operational such that training would be useful at the time.

Loop Detector Rack Assemblies

The detector rack assemblies shall conform to Paragraph 5.3.4 of the NEMA TS 2 Standard. The detector rack assembly shall be supplied in a Type 2 configuration as defined in Table 5-9 of the NEMA TS 2 Standard.

GPS Time Reference Synchronization Unit

Under these Items the Contractor shall supply and install a GPS Time Reference Synchronization Unit in each of the controller cabinets for future use. These devices will be used specifically for keeping the local controller time clocks accurate for use in time based coordination.

The GPS Time Reference Units shall consist of two basic components. The first component is the GPS receiver itself. The GPS receiver shall be mounted to the top of the traffic signal control cabinet with all mounting holes sealed with weatherproof caulking.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

The second component is the GPS time reference device. The GPS receiver shall be connected to the GPS time reference device via a serial cable. The GPS time reference device shall be mounted inside the traffic control cabinet on either of the side walls of the cabinet. The GPS time reference device shall be initially programmed with current time zone, time of day to reset clock, and which day(s) to reset the clock. The GPS time reference unit shall initially be programmed to output the time once a day on every day of the week. At this specific time, the GPS time reference device will provide an output (contact closure) to reset the controller time. The controllers shall be initially programmed to allow a contact closure to reset the time clock once per day. The installation of GPS time reference unit shall include all necessary wiring, additional Bus Interface Units (BIUs), and programming to ensure a fully operating system.

The cabinet documentation (box prints) shall show all wiring between the GPS time reference unit and the control cabinet. This documentation shall include all programming in the local controllers.

Cabinet Power Supply

A separate power supply shall be supplied and installed in each of the TS 2 cabinets. As a minimum, the power supply shall meet all requirements of Paragraph 5.3.5 of the NEMA TS 2 Standard. The unit shall be AC line powered and provide regulated DC power, unregulated AC power, a line frequency reference for the rack mounted loop amplifiers, bus interface units, load switches and other auxiliary cabinet equipment as required.

The power supply shall be either shelf mounted or installed as part of the loop detector rack assembly.

The unit shall contain four LED indicators on the front panel to indicate the four outputs;

1. + 12 VDC +/- 1 VDC @ 2.0 amps,
2. + 24 VDC +/- 2 VDC @ 2.0 amps,
3. 12 VAC @ 250 milliamps, and
4. 60 Hz line frequency reference.

A test point terminal shall also be located on the units front panel for + 24VDC and logic ground testing.

Load Switches

Load switches shall comply with Subsection 6.2 of the NEMA TS 2 standard. All load switches shall utilize optically isolated encapsulated modular solid state relays. Discrete components on circuit boards are not acceptable.

Load switch indicator lights shall be LED-type and wired on the input side of the device.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Flasher

Flashers shall comply with Subsection 6.3 of the NEMA TS 2 standard and be equipped with two output indicator lights which will show flashing power out to the cabinet assembly.

Flash Transfer Relays

Flash transfer relays shall comply with Subsection 6.4 of the NEMA TS 2 standard.

The field electrical loading for flash operation shall be wired through the transfer relays such that the load on the 2 circuit flasher is as balanced as possible within the limitations of the signal phasing.

Traffic Controller Cabinets

Controller Cabinets shall conform to the NEMA TS 2 Standards, Section 7. Cabinet sizes shall be as indicated on the plans and as shown below.

TS 2 Type 1 Configuration Table

| Item Number | NEMA TS 2 Cabinet Size | Nominal Cabinet Size (HxWxD)* | Configuration Type Table 5-2 | Load Switch Positions | Flash Transfer Relays | BIUs Required | Detector Rack Type Table 5-9 | MMU (Channels) |
|--------------------|-------------------------------|--------------------------------------|-------------------------------------|------------------------------|------------------------------|----------------------|-------------------------------------|-----------------------|
| 815.1 | 5 (Modified) | 50x30x18 | 3 | 12 | 6 | 3 | 2 | 16 Channel |
| 816.01 | 5 (Modified) | 50x30x18 | 3 | 12 | 6 | 3 | 2 | 16 Channel |
| 816.02 | 5 (Modified) | 50x30x18 | 3 | 12 | 6 | 3 | 2 | 16 Channel |
| 816.03 | 5 (Modified) | 50x30x18 | 3 | 12 | 6 | 3 | 1 | 16 Channel |

* **Approximate cabinet dimensions are provided in inches.**

Cabinets shall be made of aluminum.

Controller cabinet foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is impaired.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Bus Interface Units

The Bus Interface Units (BIU) shall comply with Section 8 of the NEMA TS 2 Standard. The BIU shall be fully interchangeable with any other manufacturer's unit and interchangeable in a NEMA TS 2 Type 2 cabinet assembly.

At a minimum the BIU shall perform the interface function between port 1 at the controller unit, the malfunction management unit (MMU), the loop detector rack assembly, and the terminal facilities. The cabinets shall be supplied with the appropriate number of BIUs required to provide an operating traffic control signal according to the plans and these specifications.

As a minimum, two LED indicators shall be provided on the BIU front panel. One indicator shall serve a dual use; as a power on indication and as a diagnostic indicator for proper operation of the device. The second indicator shall serve as a transmit indicator illuminating each time data is transmitted.

Surge Suppression

The Contractor shall supply and install surge suppression on all outputs and inputs in all of the traffic signal controller cabinets in accordance with MassDOT Standards. Contractor shall contact MassDOT Electrical Systems Unit directly for requirements and/or questions.

Spare Equipment

The Contractor shall provide the following spare signal equipment in each of the proposed traffic signal controller cabinets:

- A full complement of load switches to accommodate each available position of the back panel.
- A full complement of flash transfer relays to accommodate each available position of the back panel.
- Two (2) Bus Interface Units.
- A 25 foot RS-232 cable for communication function with a laptop

Testing of Grounding System

The Contractor shall perform testing of the equipment grounding system in the presence of the Engineer in accordance with MassDOT Standard Specifications.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Emergency Preemption

The emergency vehicle preemption system shall be installed in the same cabinet as the controllers and shall conform to City of Lowell Standards,

The emergency vehicle preemption control system shall consist of a data-encoded phase selector to be installed within the traffic control cabinet in the detector racks. This unit will serve to validate, identify, classify, and record the signal from the optical detectors located on support structures at the intersections.

Upon receiving a valid signal from the detector, the phase selector shall generate a preempt call to the controller initiating a preemption operation as shown on the plans.

The optical detector shall be single input, single output unit used to control one approach. All traffic signal installations shall be supplied with a minimum of two optical detectors unless otherwise noted in the major items list.

The phase selector shall be a rack-mounted plug-in four channel dual priority device. The phase selector shall plug into an empty slot in the detector rack. Programming the phase selector shall be via a PC-based computer utilizing unit specific software. One copy of software on a CD shall be supplied and licensed to the City of Lowell. A hard copy of final programming data shall be left in the control cabinet. A complete set of interface cables for phase selector to laptop connection shall be supplied in the cabinet.

The Contractor shall install a confirmation strobe at the traffic signal location as shown on the plans. The confirmation strobe shall serve to validate to the driver of the emergency vehicle that the traffic signal has recognized the preemption call and will initiate the proper preemption sequence. The confirmation strobe shall be a white lens.

The Contractor shall be responsible for the proper programming of the phase selector, orientation of the optical detectors, and all other work necessary to provide a complete and operating emergency vehicle preemption system. The Contractor may be required to field adjust the location of the optical detectors in the presence of the Engineer to properly detect preemption calls from approaching vehicles.

Mast Arms (35-Foot and smaller), Poles and Foundations

Mast arm poles shall be fabricated and constructed in conformance with the MassDOT Standard Drawings included in the plans and as stated below.

All mast arm poles shall be Type 2 galvanized steel monolevers with shoe bases.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Acceptance of Type 2 mast arm poles will be contingent upon review and approval of shop drawings submitted by the Contractor. Longhand design calculations shall be submitted by the Contractor with the shop drawings for all Type 2 mast arm poles.

Please note – soil boring information has not been provided within these specifications and associated design plans. The Contractor must perform soil borings at the locations of the proposed traffic signal mast arm foundations in order to determine the existing soil conditions.

Prior to installation, the Contractor shall notify the Engineer in writing of his selection of mast arm foundation footing sizes.

The Contractor is wholly responsible for the design of all foundations regardless of soil conditions and/or ledge found at the proposed foundation locations.

In the event that soil conditions or ledge prevent the use of MassDOT standard foundation type, the Contractor is responsible to select and design alternative foundation types. Alternative foundation types could include spread footings, coring and socketing into rock or other foundations previously used to support similar loads, within reason.

The Contractor shall provide a set of calculations, stamped by a Structural Engineer registered in the Commonwealth of Massachusetts, along with plans and specifications for review by the Project Engineer.

No separate payment will be made for work considered incidental to the excavation, including but not limited to, mast arm foundation, dewatering, etc. but all costs in connection therewith shall be included in the Contract lump sum price.

Foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is not impaired.

Mast Arms (40-Foot), Poles and Foundations

Mast arm poles shall be fabricated and constructed as stated below.

The mast arm poles shall be Type 2 galvanized steel monolever with shoe base.

Acceptance of Type 2 mast arm poles will be contingent upon review and approval of shop drawings submitted by the Contractor. Longhand design calculations shall be submitted by the Contractor with the shop drawings for the Type 2 mast arm pole.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Please note – soil boring information has not been provided within these specifications and associated design plans. The Contractor must perform soil borings at the locations of the proposed traffic signal mast arm foundations in order to determine the existing soil conditions.

Prior to installation, the Contractor shall notify the Engineer in writing of his selection of mast arm foundation footing sizes.

The mast arm pole and foundation shall be designed in accordance with Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals – 1994, American Association of State and Transportation Officials (AASHTO) criteria for a wind zone of 90 M.P.H. with a 30% Gust Factor and in accordance with MassDOT Specifications and loading criteria.

For the all mast arm pole foundation, the standard mast arm pole foundation (SD3.040) shall be modified to a concrete cored foundation as shown on the Standard Drawings for 40-foot Type 2 Mast Arm Cored Pier Foundations included in the plans. The Design sheet included in the plans details foundation sizes for 40-foot Type 2 Mast Arm for three soil conditions; Dry Sandy soil, Wet Sandy Soil, Clay Soil(medium stiff).

In the event that soil conditions or ledge prevent the use of the foundation type indicated on the design sheets for the 40-foot Type 2 Mast Arm, the Contractor is responsible to select and design alternative foundation types. Alternative foundation types could include spread footings, coring and socketing into rock or other foundations previously used to support similar loads, within reason.

The Contractor is wholly responsible for the design of all foundations regardless of soil conditions and/or ledge found at the proposed foundation location.

The Contractor shall provide a set of calculations, stamped by a Structural Engineer registered in the Commonwealth of Massachusetts, along with plans and specifications for review by the Project Engineer.

No separate payment will be made for work considered incidental to the excavation, including but not limited to, mast arm foundation, dewatering, etc. but all costs in connection therewith shall be included in the Contract lump sum price.

Foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is not impaired.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Pedestrian Push Buttons

Pedestrian push button controls shall be raised from or flush with their housings and shall be a minimum of 2 inches in the smallest dimension. The force required to activate the controls shall be no greater than 5 pounds.

Pedestrian push buttons shall be located as close as practicable to the sidewalk curb ramp serving the controlled crossing and shall permit operation from a clear ground space. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian pushbuttons and/or legends on the pedestrian push button signs should clearly indicate which crosswalk signal is actuated by each pedestrian push button.

A maximum mounting height of 42 inches above the finish sidewalk grade shall be used for pedestrian push buttons.

Signal Posts and Bases

Signal posts and bases shall be anodized aluminum shafts and transformer bases.

Signal base foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is impaired.

Signal Heads

Signal heads mounted on mast arms shall be rigidly attached to the mast arms. All signal heads mounted overhead on mast arms shall be installed, with the bottom of the signals at the same height. All traffic signal lenses shall be 12 inches in diameter. Louvered backplates shall be 5 inches provided on all signal heads as noted on the plans. All signal heads shall be equipped with ball and/or arrow light emitting diode (LED) modules and tunnel visors.

Red, Yellow, And Green LED Vehicle Signal Module

Any equipment that has been type-tested and approved according to Section 815.21 of the Standard specifications prior to the date of award of this contract will be considered as meeting these specifications.

All Red and Green Light Emitting Diode (LED) signal modules shall conform to "Interim LED Purchase Specification of the Institute of Transportation Engineers, Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules", July 1998 Version or most current version, Institute of Transportation Engineers (ITE), 1099 14th Street NW, Suite 300 West, Washington, DC 20005-3438.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Yellow LED signal modules shall conform to the above specifications with the exception that yellow modules shall meet maintained Minimum Luminous Intensity values of Table 1, Section 4 of the above referenced ITE specification of compliant green signal modules at 25 degrees Celsius at 120 volts AC, throughout the useful life based on normal use in traffic signal operation over the operating temperature range.

All signal modules shall conform to the following: (In case of a conflict, the following special provision shall overrule.)

An independent laboratory shall certify that the LED signal module complies with Section 6 Quality Assurance of the above stated ITE LED Purchase Specification.

LED signal modules must be type tested and approved by the City of Lowell according to the requirements of Subsection 815.21 of the Standard Specifications for Highways and Bridges.

On the backside of the LED signal module there shall be a permanently marked “up” arrow to aid in the proper orientation of the module during installation.

The manufacturer’s name, trademark, serial number and other necessary identification shall be permanently marked on the backside of the LED signal module.

Physical and Mechanical Requirement: LED signal modules shall fit without modifications into existing traffic signal housings conforming to “Vehicle Traffic Control Signal Heads” (VTCSH) published in the Equipment and Materials Standards of the Institute of Transportation Engineers. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation. The LED signal assembly construction shall conform to the applicable ASTM specifications for the materials used to fabricate the module.

Each Red LED signal module shall comprise a smooth surfaced Red, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Each Yellow LED signal module shall comprise a smooth surfaced Yellow, or transparent, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Each Green LED signal module shall comprise a smooth surfaced Green, or transparent, UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Optical and Light Output Requirement: The minimum luminous intensity values and light output shall be maintained within the rated input voltage of 117 Volts AC. Red and Green LED signal modules shall not be allowed to fall short of the minimum intensity values at any of the 44

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

measuring points of the standard when lamp is turned on cold for measurements and after a 30 minute warm-up time period at 100% duty cycle. Yellow LED signal modules shall not be allowed to fall short of a minimum intensity values for green modules as described above, at any of the 44 measuring points of the standard.

Electrical: The maximum wattage for red and green 12 inch balls shall be 20 Watts and 10 Watts for the 12 inch red and green arrows. The maximum wattage for 12 inch yellow balls shall be 24 Watts and 12 Watts for the 12 inch yellow arrows.

The LED sources shall not be powered above 70% of the manufacturer's specified rated load. This shall be clearly shown in layman's terms through calculations, schematics, catalogue cuts, etc.

Red LED sources shall be made of the AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Yellow LED sources shall be made of the AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Green LED sources shall be made of the InGaN (Indium Gallium Nitride) type shown clearly in a catalogue cut or similar literature.

Warranty: The LED signal module will be replaced or repaired by the manufacturer if it exhibits a failure due to workmanship or material defects within the first 60 months of field operation.

The LED signal module will be replaced or repaired by the manufacturer if it exhibits either a greater than 40 percent light output degradation or a fall below the minimum intensity levels within the first 36 months of field operation.

Pedestrian Push Buttons

Pedestrian push button controls shall be raised from or flush with their housings and shall be a minimum of 2 inches in the smallest dimension. The force required to activate the controls shall be no greater than 5 pounds.

Pedestrian push buttons shall be located as close as practicable to the sidewalk curb ramp serving the controlled crossing and shall permit operation from a clear ground space. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian pushbuttons and/or legends on the pedestrian push button signs should clearly indicate which crosswalk signal is actuated by each pedestrian push button.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

A maximum mounting height of 42 inches above the finish sidewalk grade shall be used for pedestrian push buttons.

Signal Posts and Bases

Signal posts and bases shall be anodized aluminum shafts and transformer bases.

Signal base foundations shall not obstruct a sidewalk or crosswalk so that passage by physically-challenged persons is impaired.

Pedestrian Heads

All pedestrian heads shall be 16 inch, single units, with countdown timers conforming to City of Lowell Standards. Pedestrian head indications shall be illuminated L.E.D. type displaying graphical symbols of a walking person and/or upraised hand. The countdown module shall display the number of seconds remaining throughout the pedestrian “WALK” interval, continue counting down through the flashing “DON’T WALK” interval, and blank out during the steady “DON’T WALK” interval. The countdown module shall be automatically set by the intersection controller based upon the “WALK” and “DON’T WALK” signal intervals only. The countdown module shall continuously monitor the intersection controller for any changes to the pedestrian phase timing, and reprogram itself automatically. All LED indications on the pedestrian signal shall have an automatic dimming circuit for night illumination to reduce long-term degradation to the LEDs.

Note: Countdown displays shall not be used during the “WALK” interval nor during the yellow change interval of a concurrent change interval.

Software

All local controller, malfunction management unit, camera unit, and preemption unit software shall be supplied with the latest available revision. Any software upgrades released by the manufacturer shall be supplied at no charge to the Owner for a period of five years after acceptance of the traffic signal installations.

Data Base Programming

Each programmable local hardware component (i.e., controller, malfunction management unit, preemption unit) shall be initially programmed by the Contractor based on information contained on the plans. Three sets of hard copy programming per device shall be supplied by the Contractor.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Equipment Finish and Color

All proposed traffic signal equipment including but not limited to signal posts, bases, signal heads, visors (outside), doors, mast arms, pushbutton saddles, service meter socket box, optical preemption detectors, hardware, and rigid mounting brackets for signals and signs shall be colored:

- **GLOSS BLACK for Items 815.1, 816.01, and 816.02**
- **POPPY for Item 816.03**

and subject to the approval of the City of Lowell. **The Contractor shall submit to the Engineer, and the City for approval, paint chips and sample finishes on steel and aluminum of the intended color prior to any work being done under this heading.**

Signal heads, doors, visors, mounting brackets, and hardware supplied direct from the manufacturer in the color stipulated above may be acceptable provided it meets or exceeds the finish process for the material indicated below.

Steel Equipment

Galvanizing

All bolts, screws, nuts, rods and washers shall be galvanized in accordance with AASHTO M232 and the Standard Specifications. The hardened machine screws may be electroplate galvanized. Stainless steel studs, bolts, screws, nuts, straps and washers shall not be galvanized. Galvanized hardware need not be painted; however, the ends of bolts, nuts, and washers shall be painted in the field according to section "Touch-up and Repairs." Immediately prior to galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The dry kettle galvanizing process shall be used.

All steel components, other than above, shall be galvanized after fabrication in accordance with AASHTO M111. The galvanizing bath shall contain nickel (0.05% to 0.09% by weight).

Galvanized members requiring shop assembly shall be welded and drilled prior to galvanizing.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Coating Over Galvanized Steel

Prior to painting, the applicator shall ensure that all components are smooth and without sharp protrusions that would present and injury hazard to pedestrians. Also, the fabricator shall ensure that all welds shall be cleaned thoroughly in accordance with good practice and according to AWD D1.5 and ASTM A123-89a and shall have a suitable surface to accept the galvanizing.

In preparation for the two coat painting system, the surface shall be blast cleaned in accordance with the requirements of SSPC SP7 “Brush-Off Blast Cleaning” or other method producing equivalent results and uniform profile, to achieve a 1.0 to 1.5 mils anchor profile as indicated by a Keane Tator profile comparator or similar device. The creation of the anchor profile shall be performed prior to the formation of “white rust” on the galvanized surface.

Following blast cleaning, the zinc coating thickness shall be measured to verify that the coating thickness is in accordance with AASHTO M111.

A two-coat painting system shall be applied by the Galvanizer in his own facility within twelve hours of galvanizing the steel components.

The prime coat material shall be a polyamide epoxy applied to minimum dry film thickness of 2.0 to 4.0 mils (0.002-0.004 in.) and force cured as given below for the finish coat.

The finish coat material shall be a two component, catalyzed aliphatic urethane applied by airless spray to a minimum dry film thickness of 4.0 mils.

The color shall be **GLOSS BLACK or POPPY** as noted above. The fabricator shall submit to the Engineer for approval, paint chips of the intended color prior to any work being done under this heading.

All finish coat material shall be applied under conditions within the following tolerances:

Air Temperature 50°F min., 90°F max.

Surface Temperature 50°F min., 100°F max.

Surface temperature must be at least 5°F above the dew point.

The finish coat shall be cured in a booth capable of maintaining 150°F for 2-4 hours.

Items 815.1, 816.01, 816.02, and 816.03 (Continued)

Touch-up and Repairs

Should any damage occur to the galvanized coating during shipping or handling at the job site, the Contractor shall repair and touch-up any damaged areas to the satisfaction of the Engineer and the following:

Touch-up of galvanizing before the finish coat is applied shall be accomplished by applying galvanizing repair paint. The dry film thickness of the applied repair paint shall not be less than 4.0 mils.

Applications shall be in accordance with the manufacturer's instruction.

Field touch-up procedures shall conform to the recommendations of the Galvanizer. Touch-up of the finish coat shall be by applying a coating of a two-part urethane, as supplied by the Galvanizer, to achieve a dry film thickness of at least 4.0 mils. Prior to the application of the paint, remove all damaged coatings down to a solidly adhered coating and apply galvanizing repair paint as primer.

Allow the primer to dry for at least 4 hours prior to top coating.

The Contractor shall also use the touch-up paint material and procedures to paint the galvanized hardware used in field erection that has not been finish coated previously.

Aluminum Equipment

All aluminum equipment called for shall have a powder coat finish **GLOSS BLACK or POPPY**, as noted above, in color. The coating shall be a polyester-TGIC (triglycidyl isocyanurate) resin system conforming to the following:

| Quality | Test | Limits |
|-----------------------|---|---|
| Abrasion | Taber abraser CS-10, 1000 gram load, 1000 cycle, ASTM D4060 | 100 mg. Maximum weight loss |
| Adhesion | ASTM D .59 Initial 1000 hours | 5A 5A |
| Gloss | ASTM D 523 60° - 600 hours 60° - 1000 hours | 82% retention 90% retention (washed) |
| Hardness | ASTM D 3363 | 2H – No Gouge |
| Impact | ASTM D 2794 Direct | Pass 80 inch-lb. |
| Salt Spray Resistance | ASTM B 177 ASTM D 1654 | |

| | | |
|-------------------|---|---|
| | 1000 hours unscribed 400 hours scribed | Table 2-10 Table 1-10 |
| Weather Resistant | ASTM G 23, 1000 hours, 18 min. waterspray, 102 min. light | No film failure |
| Color | Gloss Black or Poppy as noted above | |
| Identify | Infrared fingerprint | Match |
| Flexibility | 180° bend; ½” dia, mandrel within 10 seconds | No breaks, flaking or cracks. Tested with a Q-panel with 2 mils or less of coating |
| Humidity | ASTM D 2247, 1000 hours | No blister or film failure |
| Thickness | | 4 mils +/- 1 mils |
| Mar Resistance | | Good |

A Certificate of Compliance of the powder coating system is required for the Engineer’s approval.

Manuals and Keys

The Contractor shall supply two (2) copies of operating and maintenance manuals (i.e., controller, malfunction management unit, preemption unit, video unit) and two (2) sets of cabinet keys to the City.

Ownership and Maintenance

Upon acceptance of the traffic signal systems by the City of Lowell, the Contractor shall turn over all guarantees and warranties to the City, where applicable. In turn, the City shall assume ownership and maintenance of the signal systems.

ITEM 874.2**TRAFFIC SIGN REMOVED AND RESET**

The work under this item shall conform to the relevant provisions of Section 828 of the Standard Specifications and the following:

The Contractor shall carefully remove and reset at new locations all existing signs, attachment hardware and sign support posts not included under other sign items as shown on the drawings and as directed by the Engineer.

Signs, attachment hardware and sign support posts shall be satisfactorily stored and protected until reset in the proposed work.

Signs, attachment hardware and sign support posts lost, damaged or otherwise made unsuitable for reuse while being removed, transported, stored or reset shall be replaced with new materials at no additional cost to the Owner. New attachment hardware shall be furnished and installed as necessary to replace any missing or unusable existing hardware.

Included under Item 874.2 are Warning-Regulatory and Route Marker signs, and miscellaneous directional signs.

Traffic sign removed and reset will be paid under the Contract lump sum bid price, which price shall include all labor, material, equipment and incidental costs required to complete the work.

ITEM 999.1**POLICE SERVICES****ALLOWANCE**

The Contractor shall furnish police services required to direct traffic on existing roadways where traffic is maintained.

The Contractor shall provide such police officers as may be deemed necessary by either the Engineer or the City for the direction and control of all traffic traveling within and through the project area. The police officers shall be obtained from the City of Lowell Police Department as applicable. The police officers shall be paid by the Contractor at the prevailing rate of wages established by the City of Lowell.

Police employed by the Contractor on a temporary basis are considered to be employees of the Contractor, and the Contractor shall issue W-2 "Statements of Earnings and Taxes Withheld" to the employees and must submit copies thereof to the Massachusetts Department of Taxation and Corporations in the usual manner prescribed by law.

Allowance for Police Services

An allowance of Thirty One Thousand and Two Hundred Dollars (\$31,200) for the furnishing of police services has been included in all bids. This allowance is determined by multiplying the number of hours estimated as necessary by the prevailing hourly rate of wages established for such services. The Contractor shall submit certified copies of itemized bills of services rendered for review and approval by the Engineer. The allowance will be adjusted to the actual amount paid for authorized and approved police services as stipulated and shall include other payments due to any legal requirements of the State and Federal governments.