SECTION 770
HIGHWAY LIGHTING

770.01 DESCRIPTION.

This work consists of furnishing and installing highway and street lighting.

770.02 MATERIALS.

A. **General Conditions.** All work and material shall meet the requirements of the National Electric Code, the North Dakota State Electrical Board, the local utility company, and the ordinances established by the local municipality.

All material furnished shall be new and shall meet Section 895.

B. **Shop Drawings.** Required shop drawings shall be furnished to the Engineer for approval within 50 days after the date of Contract execution by the Department. The dimensions, type of material, and the functional characteristics of the equipment to be installed shall be provided with the shop drawings.

The Contractor shall be responsible for the accuracy of the shop drawings. The Engineer's review and approval does not relieve the Contractor of full responsibility for providing a quality product that meets specifications. The approved shop drawings shall be used for materials acceptance in lieu of certification.

The Contractor shall submit 8 sets of shop drawings on the following listed items for approval:

1. Conductors
2. Pull Box
3. Feed Point Equipment including:
    a. Circuit breakers (enclosed in a load center-type panel board)
    b. Enclosed relay (normally open)
    c. Cabinet
    d. Photoelectric cell
4. Light Standard including:
    a. Luminaire

b. Fuseholder

c. All necessary calculations and drawings used in the design of these poles.

5. Sign Lighting Fixture including:

a. Loadcenter

b. Luminaire

c. Ballast

6. High Mast Lighting Assembly including:

a. Pole

b. Lowering Device

c. Head Frame Assembly

d. Luminaire Ring Assembly

e. Winch and Hoisting Assembly including all cables

f. Portable Power Unit

g. Luminaires

h. All necessary calculations and drawings used in designing high mast poles.

7. Wall Mounted Luminaires

C. **Certificates.** The certifications specified in Section 801.02 shall be furnished for "conduit."

D. **Warranties and Guarantees.** All manufacturer warranties and guarantees with respect to materials, parts, workmanship, or performance which the products bear shall be secured and included with the shop drawing submittal.

E. **Manuals.** The Engineer shall be furnished 4 operating and maintenance manuals for the high mast equipment. These manuals shall be properly indexed and cross referenced with tables of contents. They shall contain operating procedures, recommended maintenance schedules, manufacturer and catalog numbers of electrical components, equipment parts numbers, copies of all approved shop drawings, spare parts lists, lubrication charts, etc. Each manual shall be contained in a loose-leaf, hard-covered binder.

The manuals will be distributed to the Feed Point Cabinet, City, and Planning and Design Divisions of the Department.

F. **Additional Equipment.** The Department and the local municipality may order additional lighting equipment along with the Contractor's shipment for the Proj-

ect. Additional equipment shall be billed to the Department or the local municipality at the Contractor's cost. The Department or local municipality will unload and store the extra equipment ordered. The Department and the local municipality shall be notified by letter informing them of the impending equipment order. The Department or local municipality will indicate the quantity of equipment desired in the Proposal. Additional equipment ordered will be limited to 10% of the total amount of the item, or items, to be supplied under the Contract.

G. **Concrete Foundation.** Concrete used in the work shall be Class AE Portland Cement Concrete mixed and proportioned as specified in Section 802. Grout shall meet Section 806.01.

770.03 CONSTRUCTION REQUIREMENTS.

A. **General.** Various phases of the work such as foundations, conduit, conductor, standards, and feed points shall be completed as materials become available. Individual feed point lighting circuits shall be put into service as materials become available, and the system shall not be kept inoperative for the lack of a few parts.

B. **Cable Trench.** The trench for conductors shall be excavated as specified.

Cinders, broken concrete, and other hard or objectionable materials which might damage the conductors shall not be used for backfilling. The trench bottom shall be free of such materials before the conductor is placed.

All trenches shall be backfilled immediately after installation of conductor. Backfill material shall be tamped and compacted to the density of the adjacent material.

Street lighting multiple underground cable may be installed by the plowing method rather than in cable trench.

C. **Concrete Foundation.** Exact location and elevation will be established by the Engineer.

Foundations shall be formed at least 6 inches into the ground. The foundation edges on top and for a distance of 6 inches into the ground shall be chamfered.

Concrete foundations of each type shall be cast in place. The foundations shall contain the necessary ground rods, rebars, anchor bolts, and conduits.

The concrete foundation for light standards and high mast poles shall be constructed to the proper elevation. There shall be no grouting between the foundation and the pole base.

The distance from the top of the anchor bolts to the foundation shall be as recommended by the light standard manufacturer or high mast pole manufacturer. The size of the anchor bolts in each foundation shall be as recommended by the light standard manufacturer or high mast pole manufacturer. Anchor bolts shall be installed and tightened as specified in Section 754.03 E.5.

D. **Rigid Conduit.**

1. **General.** All conduit shall meet the size shown on the Plans. The inner edge of joints and the extreme ends of conduit shall be smoothed and rounded to

avoid any damage to the cable. Slip joints or running threads shall not be used for conduit couplings. When a standard coupling cannot be used, an approved threaded union shall be used. Coupling components shall be rotated until ends of conduit are brought together.

Voids from an abandoned boring hole through a roadbed shall be grouted at the Contractor's expense.

Conduit shall be installed a minimum of 24 inches below the surface. Backfill over the conduit shall be thoroughly compacted. Conduit types shall not be intermingled within a run except at feed points.

Conduit shall be laid on a slope to drain. A "tee" shall be provided where conditions permit in the highway lighting conduit line. A drainage pit shall be installed beneath each "tee". The drainage pit consists of a one-foot diameter hole 3 feet deep; filled with aggregate ranging in size from 3/4 inch to one inch; and free from clay, silt, loam, and any organic material.

The existing roadway surfacing shall remain in place and rigid conduit shall be bored or jacked under the roadway. Non-metallic conduit shall not be jacked.

Conduit runs terminating in concrete foundations shall be brought at least 2 inches above the finished grade of the foundation. Conduit runs terminating in concrete pull boxes shall be brought 2 inches beyond the inside wall of the box and be a minimum of 2 inches above the bottom. Conduit shall enter concrete foundations or pull boxes from the direction of the conduit or cable run. Conduit placed in concrete foundations for lighting circuit shall have a minimum nominal diameter of 2 inches unless continuous conduit runs are installed, of the size specified for the run.

Rigid conduit bends, except factory bends, shall have an inside radius of at least 6 times the nominal diameter of the conduit. Where field bends are made, the bending shall be accomplished without crimping or flattening the conduit. The longest practicable radius shall be used.

Whenever light standard foundations are installed and there is not a continuous run of conduit, the conduit installed in the concrete foundation shall be 2-inch diameter with rigid conduit elbows. The cost shall be included in the price bid for "Concrete Foundation."

2. **Metallic Rigid Conduit.** The terminal ends of all metallic conduit shall be fitted with grounding bushings. Metallic conduit end threads shall be painted with pipe joint compound and threaded into couplings to butt together when making up joints. Where the conduit is installed before the wiring, all open ends of metallic conduit shall be threaded and capped with standard pipe caps. Approved conduit bushings shall be installed to avoid damage to the cable when the caps are removed. Caps, bushings, exposed threads, and scuffed areas shall be painted with rust-preventative paint.

3. **Nonmetallic Rigid Conduits.** Plastic conduit ends shall be painted with a solvent weld, as recommended by the conduit manufacturer, before insertion in a coupling.

E. **Conductors.**

1. **General.**

   a. Conductors and cables shall be of the size and type shown on the Plans.

   b. Electrical installation shall be made by and supervised by licensed electricians.

   c. All cable run through conduit shall be pulled by hand and shall not be strained.

   d. Splicing of conductors will be permitted only in light standard bases and feed points. Splices shall be of the compression type. Underground splices shall not be permitted.

   e. Cables shall terminate only at the meter box, light standards, or other equipment. They shall be connected with sufficient slack to prevent any strain on the cable or connections.

   f. All electrical connections shall be made without solder.

   g. All bases, standards, control cabinets, and exposed metal parts shall be grounded. Bolted pressure connectors to all ground rods shall be provided.

   h. Cable shall be protected from moisture when it is installed before the standards are installed.

   i. All cable shall be identified as to its function.

   j. All necessary wiring connections shall be made. These connections shall be included in the price bid for conductors.

2. **Highway Lighting Circuits.**

   a. Each lighting circuit shall be installed in a separate trench.

   b. Where one lighting circuit crosses another, a 4-inch bed of sand shall be placed between the circuits at the point of crossing. Circuits installed by plowing do not require a sand bed.

   c. The continuous grounding conductor (not a neutral) shall be looped through each foundation and feed point and bonded to the light standard and feed point cabinet.

   d. Sufficient length of internal light standard conductor shall be provided so the fuse kit can be withdrawn from the standard through the hand hole.

3. **Additional Cable Quantities.** Additional cable quantities shall be installed to provide for slack and the wiring of feed points and light standards as follows:

   a. Ten feet at the feed point.

b. Four feet at each foundation for each incoming and outgoing circuit.

c. Three feet of slack for each single conductor installed in cable trench at each light standard foundation for each incoming and outgoing circuit. This extra conductor shall be installed in a series of "S" curves in the trench. This shall not apply to multiple conductor cable.

d. Six feet at pull boxes where connections are made.

F. **Pull Box.** The top surface of the pull box shall be flush with surfaced areas and approximately one inch above earth or sodded areas. The down side of pull boxes installed on inslopes shall not extend more than 4 inches above the ground.

G. **Feed Point.** The complete feed point shall be furnished including the cabinet, padlock, conduit, conductor, service entrance heads, meter sockets (if required), and ground rods.

All equipment mounted in a feed point cabinet shall be arranged, installed and wired as required.

The cabinet shall contain a photo electric cell near the top of the cabinet, and when the cabinet is installed, the cell shall face north.

The local utility company shall be contacted for specific locations of feed points. The local utility company will furnish and install the required single phase voltage service connection and any required meter. The Contractor shall lock and seal any switch box as required by the utility company or local governmental agency.

The Contractor shall provide and bear all costs for the electrical service necessary to operate and maintain the lighting system until the project is accepted by the Engineer.

H. **Light Standards.** Light standards and mast arms shall conform in style, type, and dimensions to the Contract requirements. Convenience or festoon circuits shall be provided when required.

The light standard shall be plumbed with shims or leveling nuts. The mast arms shall be perpendicular to the roadway centerline.

The assembled standard shall, under dead load and at equal ambient temperatures, be as near to true vertical alignment as practical.

The anchor bolts shall be tightened securely. A minimum of 2 threads shall be exposed above the nuts. Bolts in a multi-directional slip base shall be torqued to meet the requirements specified.

I. **Street and Sign Lighting Luminaires.** The luminaire operating voltage, lamp type, and lamp wattage shall be as specified. The street luminaire shall have the IES distribution as specified.

The ballast shall be installed as specified.

A plug of oakum shall be inserted in the luminaire wire entrance to prevent moisture and insects from entering the luminaire.

Each street light luminaire shall be fused in the light standard base. The fusing shall meet Section 895.08.

J. **High Mast Lighting Assembly Installation.** Installation and assembly drawings shall be provided by the manufacturer showing the assembly sequence, lift point, and erection procedure with suggested equipment for installation. A check list of all parts identifiable by structure type and number shall be supplied.

The structure shall be shop blast cleaned according to the Steel Structures Painting Council Surface Preparation Specification "No. 6 Commercial Blast Cleaning," SSPC-SP6. The outer surface shall not be marred by careless handling and shall be in a condition conducive to uniform weathering. The factory-cleaned surface shall be protected from being contaminated by oil, grease, paint, crayon, chalk, or other markings during transportation, storage, and erection.

Dirt, mortar leaks, spatters, and other foreign substances shall be removed by washing with clean water or other approved methods. A nonuniform appearance of these surfaces due to recleaning may require field blast cleaning after erection.

A representative of the manufacturer shall assist in the assembly and erection of the pole, lowering device, and luminaires. The luminaires shall be aligned, as required, to light the areas intended.

K. **Sodium Vapor Wall-Mounted Luminaire.** The wall-mounted luminaire shall be mounted in the location shown.

The mounting bolts shall be installed using a threaded insert. The wall-mounted luminaire shall be attached by a minimum of 3 bolts of 1/4 inch diameter.

Each luminaire shall be fused in the junction box provided. The fusing shall meet Section 895.08.

L. **Sodium Vapor Underpass Ceiling-Mounted Luminaire.** The ceiling-mounted luminaire shall be mounted in the location shown.

The mounting bolts shall be installed using a threaded insert. The ceiling-mounted luminaire shall be attached by 4 bolts of 1/4 inch diameter.

Each luminaire shall be fused in the junction box provided. The fusing shall meet Section 895.08.

M. **Sign Lighting.** All equipment including luminaire, ballast, load centers, and conduit shall be arranged, installed, and wired in a manner approved by the Engineer. Mounting on the sign structure shall be as shown on the Plans.

Conduit of the size shown on the Plans shall be installed from below ground line to the load centers. Ground rods and conductor shall be installed for new sign lighting systems.

N. **Revise Concrete Foundation.** Concrete shall be removed from an existing concrete foundation, conduit shall be installed, and the concrete shall be replaced with a commercial non-shrink mortar.

O. **Remove Existing Equipment.**

1. **General.** Before removing existing equipment, arrangements shall be made with the local utility to disconnect the power source.

   The Contractor shall disconnect all wiring to the equipment and completely remove the item from its foundation. Equipment shall be removed without damage and transported to the designated storage site. Any items damaged in removal, transportation, or storing shall be replaced at the Contractor's expense.

   The existing foundations shall be removed to a depth of 2 feet below the ground line and the surface restored to match adjacent areas. Foundation removal shall be considered incidental to removal of equipment.

   All equipment removed shall remain the property of the Department.

2. **Removal of Light Standards.** The Contractor shall disconnect the luminaire receptacle wires at the fuses and remove the luminaire from the mast arm before the equipment is stored.

3. **Remove Feed Point.** The switch box, meter trim, and conduit shall be removed for salvage. The local utility will remove the meter.

P. **Relocate Light Standard.** Light standards shall be removed from its present location and installed at a new location as specified.

The wires to the luminaire shall be disconnected at the fuses and the light standard removed as specified in Section 770.03 O. The light standard shall be installed in the new location as specified in Section 770.03 H.

Relocated light standards shall be painted with one coat of aluminum paint meeting Section 852.01 A. and application shall be as specified in Section 770.03 Q.2.

Q. **Painting.**

1. **Materials.** Feed point cabinets shall be painted with 2 coats of exterior enamel meeting Section 852.01 D. The color shall be specified on the Plans.

   The base and lower 12 feet of light standards with attached pedestrian signal heads shall be painted with 2 coats of enamel of the color specified. The paint shall meet the requirements of the latest revision of Federal Specification TT-E-489.

2. **Application.** Paint shall be applied only when the air temperature is at or above 45°F. and below 100°F. It shall not be applied when the air is misty, dusty, or otherwise unsatisfactory for work. Material painted under cover in damp or cold weather shall remain under cover until dry or until weather conditions permit its exposure.

   All surfaces that require preparation shall be sandblasted. Existing paint remaining along the edges of blast cleaned areas shall be feathered and cleaned to assure a bond of new to old paint.

Paint shall be applied during daylight hours by brushing or spraying. After application, the paint film shall be smooth and uniform without skips or areas of excessive paint. If spraying results in unsatisfactory surfaces, brushing will be required. The previously applied coat of paint shall have dried before the next coat is applied.

Only airless spray painting equipment shall be used. Paint shall be continually agitated during the spraying operation. The paint shall be applied in a fine spray so a uniform thickness is obtained when dry. If required, the paint shall be immediately brushed out to secure uniform coverage and eliminate runs, wrinkling, blistering, and air holes. If adequate coverage cannot be obtained at rivets, bolt head, nuts, corners, and edges, hand brushing will be required before spraying.

Protective shields shall be provided to protect adjacent property from drift. Spray painting shall be suspended whenever application or drift is not being properly controlled.

The Contractor shall protect all adjacent property against spatters of paint or paint materials. The Contractor shall prevent dust and dirt from coming in contact with the freshly painted surfaces.

Painted areas that become scratched or marred shall be touched up with matching paint after erection, except that galvanized equipment shall be touched up with material meeting Section 854.

R. **Repairs to Sidewalks and Roadways.** Portions of sidewalks or roadways removed for installation of conduit, cable trench, or foundations shall be refilled to the original thickness using materials equal to the material removed. When repairing sidewalks one-inch expansion board shall be installed between the existing curb and sidewalk.

Where the concrete for sidewalk repair or replacement is adjacent to concrete foundations, the concrete foundations shall be wrapped with one-inch expansion board.

Pavement openings shall be kept to a minimum, and not more than one lane of the pavement shall be closed to traffic at any time.

Provisions shall be made to cover all openings so the entire street may be opened to traffic after working hours and on holidays.

Customer access to all businesses shall be maintained.

S. **Tests and Acceptance.**

1. **Tests.** When the installation is complete and at the time designated by the Engineer, the operating test shall be conducted for approval. The Contractor shall furnish instruments and personnel required for all tests, record all test results, and shall be present during all tests and inspections. Nighttime tests and inspections may be held when directed by the Engineer.

2. **Acceptance.** Upon completion of the lighting system operating tests, the lighting system shall be put into service and any equipment that is omitted, is

improperly installed, or malfunctions during a 90-day period shall be replaced or corrected at the Contractor's expense. The lighting inspection shall be held during this period.

T. Welding applications as specified in Section 105.06 D.

770.04 METHOD OF MEASUREMENT.

A. **General.** Each item will be measured complete, in place. Some of the following pay items list specific auxiliary equipment as part of the pay item and will not be measured separately. These pay items shall not be limited to only the listed auxiliary equipment. Other equipment required for the pay item to function will not be measured separately.

Opening and repairing sidewalks and roadways shall not be measured for payment, but shall be included in the price bid for the item which necessitated the opening and repairing.

B. **Cable Trench.** Each type will be measured by the Linear Foot. Measurement will be made along the slope of the ground at the centerline of the trench. Measurement will not include the installation of conduit.

C. **Concrete Foundation.** Each type will be measured by the number installed. The anchor bolts, reinforcing rods, conduit bends, ground rods, and tightening as specified herein shall be included in the price bid for this item.

D. **Conduit.** Each specified size will be measured by the Linear Foot. Conduit that is placed in concrete foundation, at feed points, and on overhead and bridge sign structures will not be measured for payment under this item. The method used to install conduit such as boring, jacking, and trenching will not be measured, but will be included in the price bid for Conduit.

E. **Multiple Underground Cable.** Each specified size will be measured separately by the Linear Foot based on the actual measured length of the cable trench, conduit in which the cable is installed, and the additional cable required by Section 770.03 E.3.

F. **Underground Conductor.** Each specified size and type will be measured separately by the Linear Foot based on the actual measured length of cable trench, conduit in which the conductor is installed, and the additional conductor required by Section 770.03 E.3.

G. **Feed Point.** Each type will be measured by the number installed. Conduit, cabinets, padlocks, conductor, service entrance heads, meter trim, and ground rods shall be incidental to this item.

H. **Light Standard.** Each specified type and size will be measured by the number installed and will include the light standard, base, mast arm, fused disconnects, internal wiring, and required shims or leveling nuts. Festoon outlets shall be included when they are specified.

I. **High Mast Lighting Assembly.** Each type will be measured separately by the number installed and accepted. The structure, lowering device, ballast, luminaire and mounting will be incidental to this item.

J. **Light Standard Extension.** Each specified type and size will be measured by the number installed and will include the extension, mast arm, fused disconnects, internal wiring, and connecting hardware.

K. **Street Lighting Luminaire.** Each specified type and wattage will be measured by the number installed. This item will include the electrical connection.

L. **Bridge Sign Lighting and Overhead Sign Lighting.** Each of these items will be measured as a complete unit. Luminaires, ballast, conduit, conductor, load center mounting attachment, and all other necessary equipment to complete the installation will be incidental to these items.

M. **Sodium Vapor Wall-Mounted Luminaire.** This item will be measured by the number installed. The junction box, fusing, conductor, conduit from the junction box to the luminaire mounting attachment, and all other necessary equipment to complete the installation will be incidental to this bid item.

N. **Sodium Vapor Underpass Ceiling-Mounted Luminaire.** This item will be measured by the number installed. The junction box, fusing, conductor, conduit from the junction box to the luminaire mounting attachment, and all other necessary equipment to complete the installation will be incidental to this bid item.

O. **Relocate Light Standard.** This item will be measured by the number of light standards relocated. The removal from the existing location, transporting to the new location, painting, and removal of the existing foundation will be incidental to this bid item.

P. **Remove Light Standard.** This item will be measured by the number of light standards removed. Removing the foundation, transporting, and storing the light standard will be incidental to this bid item.

Q. **Remove Feed Point.** This item will be measured by the number of feed points removed. Disconnecting, transporting, and storing the feed point will be incidental to this bid item.

R. **Revise Concrete Foundation.** This item will be measured by the number of foundations revised. Removal and replacement of concrete and installation of conduit shall be incidental to this bid item.

770.05 BASIS OF PAYMENT.

Quantities measured as provided above will be paid for at the contract prices for the pay items listed on the Plans and in the Proposal Form. This payment shall be full compensation for all labor, equipment, and materials necessary to complete the work.

Payment will be made at Contract Unit Prices for the following:

Pay Item	Pay Unit
Cable Trench	Linear Foot
Concrete Foundation	Each
Conduit ____ Size	Linear Foot
Multiple Underground Cable ____ Size	Linear Foot
Underground Conductor ____ Size	Linear Foot
Feed Point	Each
Light Standard	Each
High Mast Lighting Assembly	Each
Light Standard Extension	Each
Street Lighting Luminaire	Each
Bridge Sign Lighting	Each
Overhead Sign Lighting	Each
Sodium Vapor Wall-Mounted Luminaire	Each
Sodium Vapor Underpass Ceiling-Mounted Luminaire	Each
Relocate Light Standard	Each
Remove Light Standard	Each
Remove Feed Point	Each
Revise Concrete Foundation	Each

SECTION 772
HIGHWAY TRAFFIC SIGNALS

772.01 DESCRIPTION.

This work consists of furnishing and installing flashing beacons and traffic signals.

772.02 MATERIALS.

A. **General.** All work and material shall meet the National Electric Code, the North Dakota State Electrical Board, the local utility company, and the ordinances established by the local municipality.

The word and phrase definitions shall be as defined in Section 1 “Definitions” of the National Electrical Manufacturer’s Association (NEMA) Standard Publication No. TS 2 Traffic Control Assemblies with NTCIP Requirements.

All materials shall be new and shall meet Section 896.

B. **Shop Drawings.** Required shop drawings shall be furnished to the Engineer for approval within 50 days after the date of Contract execution by the Department. The dimensions, type of material, and the functional characteristics of the equipment to be installed shall be provided with the shop drawings.