

CITY OF WAUKESHA

STANDARD CONSTRUCTION SPECIFICATIONS

2018 EDITION

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1 GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 SCOPE OF WORK

- 1.1.1.1 All work included in these Specifications is subject to the provisions of the Instructions to Bidders, General Conditions, and the Contract, appropriate provisions of which shall apply equally to all subcontractors.
- 1.1.1.2 The Wisconsin Highway Specifications and the Wisconsin Sewer and Water Specifications shall govern all work except as superseded by the Plans, these Specifications, or the Special Provisions.
- 1.1.1.3 The Contractor shall furnish all labor, material, and equipment necessary to complete in all respects the work shown on the Plans or mentioned in the Specifications, or required in order to complete the work in accordance with the intent of the Plans and Specifications. Unless specifically stated to be the responsibility of another party, the requirements of these Specifications shall be the responsibility by the Contractor.
- 1.1.1.4 Payment under the various bid items is intended as full compensation for the work described as well as all labor, tools, equipment, and incidentals required to complete the work.

1.1.2 ABBREVIATIONS

- 1.1.2.1 Abbreviations and acronyms used in these Specifications include, but are not limited to:
- A. AASHTO – American Association of State Highway and Transportation Officials.
 - B. ADA – American with Disabilities Act.
 - C. Administrative Code – Rules of Wisconsin Code.
 - D. ANSI – American National Standards Institute.
 - E. AREMA – American Railway Engineering and Maintenance-of-Way Association.
 - F. ASME – American Society of Mechanical Engineers.
 - G. ASTM – ASTM International.
 - H. AWWA – American Water Works Association.
 - I. CCTV – Closed circuit television.
 - J. CIPP – Cured in place pipe.
 - K. DNR – Wisconsin Department of Natural Resources.
 - L. EBS – Excavation below subgrade.
 - M. FHWA – Federal Highway Administration.
 - N. HDPE – High density polyethylene.
 - O. HMA – Hot mix asphalt.
 - P. MUTCD – Manual on Uniform Traffic Control Devices for Streets and Highways.
 - Q. OSHA – Occupational Safety and Health Administration.
 - R. QMP – Quality Management Program.

- S. PVC – Polyvinyl chloride.
- T. SSPC – SSPC: The Society for Protective Coatings.
- U. USCOE – U. S. Army Corps of Engineers.

1.1.3 DEFINITIONS

- 1.1.3.1 General: Basic Contract definitions are included in the "General Terms and Conditions" of the Contract. The following additional terms have the meanings indicated.
- 1.1.3.2 Wisconsin Highway Specifications: The bound document entitled "State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction", current edition including modifications to the standard specifications (ASP-6) at the time bids are received.
- 1.1.3.3 Wisconsin Sewer and Water Specifications: The bound document entitled "Standard Specifications for Sewer and Water Construction in Wisconsin", current edition including addenda at the time bids are received.
- 1.1.3.4 Construction Site Representative: The authorized representative of the Engineer assigned to make a detailed review of any and all portions of work.
- 1.1.3.5 Substantial Completion: Substantial completion is the stage in the progress of the work when the work or designated portion thereof is sufficiently complete in accordance with the Contract Documents and has 95% of all applicable bid items complete, so that the City can, in the opinion of the Engineer, occupy or utilize the Work for its intended use.
- 1.1.3.6 Final Completion: Final completion is the point at which, in the opinion of the Engineer, the work is 100 percent complete and ready for final payment.

1.1.4 SUBMITTALS

- 1.1.4.1 Traffic Control Plan: Submit a traffic control plan and any other information on the traffic control procedures being used to the Engineer for approval three days prior to the pre-construction meeting. The plan shall detail each phase of the project. The traffic control procedures shall be approved and in place prior to the start of any work. Subsequent revisions to the traffic control plan shall be submitted to the Engineer for review at least three days prior to proposed implementation.
- 1.1.4.2 Work Schedule: Submit a schedule detailing the timeline for all phases of the project for approval by the Engineer. The work schedule shall be updated as needed (ex., when delays occur) or as requested by the Engineer. At a minimum, the work schedule shall be updated and submitted weekly.

1.1.4.3 The Engineer will not issue the Notice to Proceed until the Traffic Control Plan, Work Schedule, and permits and notices for which the Contractor is responsible have been submitted and approved. The Substantial Completion date will not be adjusted due to Contractor's failure to submit and receive approval of the Traffic Control Plan, Work Schedule, and applicable permitting requirements.

1.1.5 WARRANTIES

1.1.5.1 All work included in this Contract shall be warranted by the Contractor as specified in the "General Terms and Conditions" of the Contract. Additional special warranties may also apply as specified in the individual Specification sections or the Special Provisions.

1.1.6 MEASUREMENT AND PAYMENT

1.1.6.1 The cost of complying with these general requirements shall be included in the prices of the various bid items for the project except where a specific bid item is included in the Schedule of Prices.

1.1.6.2 Mobilization:

- A. Measurement: The City will measure Mobilization as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Mobilization". The City will make incremental payments in accordance with the provisions Section 619 of the Wisconsin Highway Specifications. Payment is full compensation for furnishing and installing materials, facilities, and services, and for performing all work necessary to complete this bid item.

1.1.6.3 Traffic Control:

- A. Measurement: The City will measure Traffic Control as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Traffic Control". Payment is full compensation for furnishing, installing, maintaining, and removing all barricading, signing, temporary markings, staging, and traffic control necessary throughout this Contract, except where separate bid items are included for specific work.

1.1.6.4 Detour Route:

- A. Measurement: The City will measure Detour Route as a single lump sum acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Detour Route". Payment is full compensation for furnishing, installing, maintaining, and removing all signing associated with detour route(s).

1.1.6.5 Traffic Control Sign – Portable Changeable Message:

- A. Measurement: The City will measure Traffic Control Sign – Portable Changeable Message as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Traffic Control Sign – Portable Changeable Message". Payment is full compensation for furnishing, installing, operating, maintaining, relocating, and removing changeable message sign(s).

1.1.6.6 Temporary Safety Fence:

- A. Measurement: The City will measure Temporary Safety Fence by the linear foot along the base of the fence, center-to-center of posts, acceptably completed. Temporary safety fence will only be measured for payment where use of the fence is specifically called for on the Plans or in the Special Provisions.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Temporary Safety Fence". Payment is full compensation for furnishing and installing fence and posts; maintaining the fence and posts in satisfactory condition; and for removing and disposing of fence and posts at project completion.

1.2 PRODUCTS (NOT USED)

1.3 EXECUTION

1.3.1 CONSTRUCTION REQUIREMENTS

1.3.1.1 Prosecution and Progress:

- A. Unless otherwise provided in the Special Provisions, the Contractor shall not begin the work to be performed under the Contract before receiving the Notice to Proceed from the Engineer.
- B. Except as provided in the Special Provisions, all work under the Contract shall be prosecuted to completion thereof without suspension. The Contractor shall employ an ample force of workers and provide a construction plant properly adapted to the work and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress specified. All plants shall be maintained in good working order and provision shall be made for immediate emergency repairs.

- C. When the Contract is divided into several streets or sections, work on another section shall not begin until the Notice to Proceed has been issued by the Engineer.

1.3.1.2 Plans and Specifications:

- A. The work shall be executed in strict conformity with the Plans and Specifications, and the Contractor shall do no work without proper drawings and instructions. In case of difference between the Plans and Specifications, the Specifications shall govern.

1.3.1.3 Shop Drawings and Other Submittals:

- A. The Contractor shall submit to the Engineer or Engineer's representatives all shop or setting drawings, schedules, and other submittals required for the work. Follow the submittal procedures specified in the "Submittal Procedures" article below. The Contractor shall make any corrections in the drawings or other submittals required by the Engineer or Engineer's representatives and resubmit same without delay.
- B. The Contractor shall keep at the site of the work an approved or conformed copy of the Plans and Specifications. The Engineer shall have access to these on-site Plans and Specifications at all times.

1.3.1.4 Materials and Workmanship:

- A. Unless otherwise stipulated in the Specifications, all workmanship, equipment, materials, and articles incorporated in the work covered by this Contract are to be new and of the best grade of their respective kinds for the purpose. When required by the Specifications or when called for by the Engineer, the Contractor shall furnish the Engineer for approval full information concerning the materials or articles which it contemplates incorporating in the work. Samples of materials shall be submitted for approval when so directed. Machinery, equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection.
- B. If not otherwise provided, material or work called for in this Contract shall be furnished and performed in accordance with well known established practice and standards recognized by architects, engineers, and the trade.

1.3.1.5 Inspection:

- A. The Engineer and its representative shall at all times have access to the work wherever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and for inspection.

- B. The Engineer shall have the right to reject materials and workmanship which are defective or require correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the City. If the Contractor does not correct such non-conforming work and remove rejected materials within a reasonable time, fixed by written notice, the City may remove them and charge the expense to the Contractor.
- C. Should it be considered necessary or advisable by the Engineer at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any material respect due to fault of the Contractor or its subcontractors, it shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the actual cost of labor and material necessarily involved in the examination and replacement plus fifteen percent (15%) shall be allowed the Contractor.

1.3.1.6 Engineer to Supervise Work; Changes in Plans:

- A. The work done under this Contract shall be done in accordance with the Plans and Specifications under the administration of the Engineer. Anything mentioned in the Specifications and not shown on the Plans or shown on the Plans and not mentioned in the Specifications shall be of like effect as if shown or mentioned in both. Any doubt as to the meaning of the terms of this Contract or the annexed Specifications, or any obscurity or discrepancy in the Plans shall be explained by the Engineer. The Contractor shall not adjust any apparent discrepancy without the decision of the Engineer, except at its own risk. The Engineer shall have the option of making changes in the Plans relating to positions, dimensions, or materials which become necessary to properly and safely construct the work, either before or after construction has begun.

1.3.1.7 Orders Must Be in Writing:

- A. No extras of any kind will be allowed unless ordered in writing by the Engineer. Extra work shall be performed only in the presence of an employee of the City whose account of the labor performed and materials furnished will be taken in making up the Engineer's estimate for the extra work. The unit prices to be charged for extra work based upon the cost of labor and materials shall be determined by the Engineer who, for the purpose of determining such cost, may request and shall be furnished copies of the original bills, invoices, and vouchers of the Contractor which will disclose such costs.

1.3.1.8 Verbal Orders:

- A. No verbal order or suggestion given by an employee of the City shall be construed as authorizing or laying the basis for any claim on the part of the Contractor for extra compensation either for extra work or for materials or for damages because of the Contractor's compliance the verbal orders.
- B. Such verbal orders or suggestions as to the performance of the work will be freely given but, in case they appear to the Contractor to involve extra work for which it should receive extra compensation, it shall ask for a regular written order. In case of dispute as to what does or does not constitute extra work, a decision will be made by the Engineer, and the Contractor shall act in conformity with the decision. The Contractor may request, if it desires, a written order to do the work without the designation of the work as "extra work".

1.3.1.9 Engineer's Instructions to be Obeyed:

- A. The Contractor hereby agrees to at all times follow, without unreasonable delay, all orders and instructions given in compliance with the terms of this Contract by the Engineer during the progress of the work, and to have upon the work at all times a duly qualified person to look after the work and to receive the instructions of the Engineer. The Engineer shall, under usual conditions, give its directions to the superintendent and the foreman who may have immediate charge of the workers employed in the particular work in relation to which the order be given.

1.3.1.10 Discharge of Incompetents:

- A. If at any time anyone employed or engaged upon work shall wrongfully or ignorantly perform the work assigned to him or her after proper directions have been given by the Engineer, or shall be disobedient, disrespectful, or conduct himself or herself in an improper manner, the Contractor, upon notice from the Engineer, shall immediately dismiss such person or persons from the work and shall not again employ him or her upon any part of it.

1.3.1.11 Contractor Responsible:

- A. The presence of the Engineer or its representative upon the work during its construction shall in no way relieve the Contractor of the responsibility for the work or by any excuse for it to furnish workmanship or materials not in compliance with these Specifications. The Contractor shall assume all risks and casualties of every description and shall have charge of and be responsible for the entire work until its final completion and acceptance.

1.3.1.12 Delays

- A. If the Contractor is delayed in the completion of the work by any act or neglect of the Owner or by any other Contractor employed by the Owner or by causes beyond the Contractor's control including labor strikes, lock-outs, fire or unavoidable casualties, then the Contract Time of completion or Date of Substantial Completion may be extended for such reasonable time as may be agreed upon by the Owner and Contractor after a written notice is provided detailing the cause and duration of said delay. Such Notice must be provided to the Owner within five (5) days of the beginning of such delay.

1.3.1.13 Site Cleaning

- A. The Contractor shall at all times keep the premises free from accumulations of waste materials, rubbish or garbage caused by his employees or work and at the completion of the work, shall remove all rubbish and construction materials from the site including tools, equipment, scaffolding, packing materials and surplus material, and shall leave the work clean and ready for use. In case of dispute, the Owner may remove the rubbish and surplus materials, equipment, etc., and charge the cost to the Contractor. Burning of waste materials is prohibited.

1.3.1.14 Final Estimate

- A. The Final Estimate, to which shall be attached a Certificate of Acceptance, dated and signed by the Engineer, stating that the work has been fully completed in substantial compliance with the terms of the agreement, specifications, and plans or authorized modifications of the same, and to the satisfaction, shall be filed with the Board and a copy furnished to the Contractor within thirty (30) days of the certificate and acceptance.
- B. Within fifteen (15) days thereafter, the Board shall give the Contractor an opportunity to file any objections to such Final Estimate. All such objections shall be in writing so that they may be comprehensively considered by said Board.
- C. Within thirty (30) days thereafter, the whole amount shown upon such Final Estimate as accruing the Contractor shall be due and payable to the Contractor, provided however that there shall be retained from such Final Estimate or from any payments due to the Contractor under this agreement all amounts which may be expended by the Board for work done or materials furnished in carrying out any work under this agreement which the Contractor has failed to do to the satisfaction of the Engineer, and all amounts which the Contractor has failed to pay, and all sums which the City is entitled to retain as liquidated damages in case the work is not completed within the time specified, and all other sum or sums as by the terms of this agreement or by any act of the Legislature of the State of Wisconsin now in force, it is or may be authorized to reserve or retain.

1.3.1.15 Deduction for Uncorrected Work

- A. If the Owner deems necessary or expedient to correct incomplete, defective, damaged or work not performed in accordance with the Contract Documents, the difference in value combined with a fair allowance for the costs to perform such corrective work shall be deducted from the contract.

1.3.1.16 Contractor Precluded from Suing City

- A. The acceptance of the Final Payment by the Contractor shall be and shall operate as a release to the City from all claims and liabilities to the Contractor for anything done or furnished for or relating to the work, or for any act, neglect, fault, or default of the City.
- B. Neither the Final Payment nor any provision in the Contract Documents shall relieve the Contractor of the responsibility for negligence of faulty materials or workmanship within the extent and period provided by law, and upon written notice, shall remove any defects and shall pay for any damage to other work resulting the corrective action.

1.3.2 WORK HOURS

- 1.3.2.1 Typical work hours shall be 7:00 a.m. to 7:00 p.m. Monday through Friday, with hours of 7:00 a.m. to 5:00 p.m. on Fridays of Holiday weekends.
- 1.3.2.2 If the Contractor or Subcontractors deem it necessary to work on Saturdays, Sundays, or Holidays, they shall make a request to the Engineer 48 hours in advance to obtain permission and inspection for such work. If said work is approved, the work hours shall be 8:00 a.m. to 4:00 p.m. If said work is approved and the Contractor does not work or does work which, in the opinion of the Engineer, did not require inspection, the Contractor will be charged a \$500.00 inspection and supervision fee for each occurrence.
- 1.3.2.3 If the Contractor or Subcontractors deem it necessary to work overnight or outside the regularly scheduled hours, they shall submit a request to the Engineer at least 7 days prior to such work. The Contractor shall submit a detailed schedule of the work, the reason why the work is required to be performed outside of normal hours, and shall be responsible for all additional costs of traffic control, lighting, inspection, testing, and/or monitoring during the work.

1.3.3 MEASUREMENT OF WORK

- 1.3.3.1 All quantities or verification of materials (haul or scale tickets) from the Contractor shall be submitted or claimed within 30 calendar days of delivery or placement of materials. Late tickets will not be paid.

1.3.3.2 On request, the Contractor shall submit written documentation showing how quantities on its Application / Request for Payment were measured or calculated.

1.3.3.3 Where the City has surveyed quantities of work in the field, the measurements shall be accepted as final without dispute unless the Contractor submits satisfactory documentation of differing quantities.

1.3.4 SUBMITTAL PROCEDURES

1.3.4.1 Submit items for review as indicated in the individual specification sections. Unless otherwise indicated, submit the following quantities for each type of submittal (electronic files are preferred):

A. Shop Drawings: PDF electronic file or minimum 3 paper copies (2 retained, 1 returned).

B. Product Data: PDF electronic file or minimum 3 paper copies (2 retained, 1 returned).

C. Appearance Samples: 2 samples (1 retained, 1 returned).

D. Certificates of Compliance: PDF electronic file or 2 paper copies.

E. Permits and Approvals: PDF electronic file or 1 paper copy.

F. Test Reports: PDF electronic file or 2 paper copies.

G. Operation and Maintenance (O/M) Manuals: 2 paper copies.

H. Warranties: PDF electronic file or 2 paper copies.

1.3.4.2 Shop drawing and product data submittals shall bear the stamp of approval of the Contractor as evidence of accuracy, compatibility, and conformance with contract requirements. Drawings and product data not so stamped will be returned without being examined. Where manufacturer's standard literature includes multiple products or options, identify the specific products and options as required for this project. Specific written notice shall be given of each variation that shop drawings and product data may have from requirements of the Plans or Specifications.

- 1.3.4.3 Products subject to shop drawing, product data, or sample review shall not be used in the work until submittals have been reviewed and bear the stamp and signature of the City. Submittals will only be reviewed for general conformance with the design concept of the project and general compliance with the information given in the Plans and Specifications. The Contractor shall be responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and the means and methods of construction, coordinating its work with that of all other trades, and performing all work in a safe and satisfactory manner. Corrections or comments made on submittals shall not relieve the Contractor from compliance with requirements of Plans and Specifications and shall not be considered an order for extra work.

1.3.5 TESTING PROCEDURES

- 1.3.5.1 Provide testing as indicted in the individual specification sections.
- 1.3.5.2 All required tests are to be made in conformance with the latest ASTM methods of tests or other applicable procedures.
- 1.3.5.3 Where required, test reports shall be supplied. The test reports shall provide satisfactory documentary evidence that the materials or procedures which have been incorporated into the project are acceptable for the intended use. Materials which have not met the appropriate standards shall be immediately removed from the job site and replaced with acceptable materials at the Contractor's expense.

1.3.6 PROTECTION

- 1.3.6.1 Protect improvements on site and on adjoining properties. Provide barricades, coverings, or other types of protection as necessary to prevent damage and to safeguard against injury. Restore to original condition improvements damaged by the work or improvements which required temporary removal during construction.
- 1.3.6.2 New concrete shall not be painted or marked except as shown or specified for the project. The Contractor shall remove and replace at its own expense, concrete that it has painted or marked with extraneous information.

1.3.7 LOCATING EXISTING UTILITIES

- 1.3.7.1 Location and description of underground utilities and structures shown on drawings are approximate and are based on records available to the City or surface features indicating their existence. There may be other utilities within project area that are not shown.
- 1.3.7.2 Notify all affected utility companies of construction operations at least three working days before beginning work near their facilities. Do not begin excavation work until underground utility locations have been marked. Field verify all utilities before beginning work.

- 1.3.7.3 Use caution when excavating so that exact location of underground utilities, both known and unknown, may be determined. Provide adequate protection and support for utilities during construction operations.
- 1.3.7.4 If uncharted or incorrectly charted utilities are encountered during excavation work, or if proposed construction conflicts with existing utilities, give prompt notice and submit proposed solution to the Engineer for approval. Cooperate with the City and public and private utility companies to keep their services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

1.3.8 TRAFFIC CONTROL

- 1.3.8.1 Provide traffic control in accordance with part VI of the "Manual on Uniform Traffic Control Devices", published by the Federal Highway Administration, and supply any personnel necessary to flag traffic. Supply and maintain adequate barricades and signs to properly close off the construction area.
- 1.3.8.2 As part of this Contract, provide signs, flashers, and barricades along the project in the following manner:
- A. Type III Barricades at all construction limits.
 - B. Temporary stop signs at all intersections as needed.
 - C. Road Closed and Advance warning signs for any side streets that intersect the street under construction.
 - D. Road Work Ahead signs at any side streets that intersect the street under construction.
 - E. One flasher for each end of radius at intersections along the excavated ditch for curb and gutter.
 - F. One flasher for every two hundred feet within a block along the excavated ditch for curb and gutter.
 - G. One flasher at each end of all walk excavations, and "Walk Closed" signs as necessary.
 - H. One temporary (movable) sign board or Class III barricade on each primary approach to the project for businesses to post private signage when businesses are within the work zone or affected by the work and if requested by a business.
 - I. Other signs as directed by the Engineer if required to comply with the requirements of this Contract.
 - J. If included in the Contract, provide portable changeable message sign(s) complying with the requirements of Section 643 of the Wisconsin Highway Specifications.

- 1.3.8.3 During the work on this Contract, the following traffic control requirements shall be met:
- A. Access shall be maintained for fire trucks, ambulances, police cars, and other emergency vehicles at all times.
 - B. Safe access shall be maintained through the construction site for pedestrians at all times. The walking paths shall be a smooth, hard surface meeting ADA requirements and shall be maintained as necessary. Provide flashers and “Walk Closed” signs as necessary. Phasing of the sidewalk construction will be necessary. A walk along one side of the street through the work zone shall be open at all times, unless otherwise approved by the Engineer.
 - C. Access shall be maintained to all non-residential driveways at all times during construction unless other arrangements are made by the Contractor to coordinate the closure. Phase the construction of underground utilities, concrete pavement, curb, drive approaches, and sidewalk as necessary to maintain access to non-residential driveways.
 - D. Access to residential driveways shall be maintained until the day concrete pavement or curb and gutter is placed. Drive approaches should be poured as soon as possible after the concrete road and/or curbs are poured to minimize the time residents will not have access to their driveways. Residents shall be allowed to park in front of their residence after work hours.
 - E. As requested by the Engineer, construct temporary drive approaches with dense aggregate after removing the existing drive approaches. This temporary approach shall be constructed immediately following the removal of the existing drive approach and shall be wide enough to get traffic in or out of the existing driveway. This temporary drive approach shall be maintained until the concrete pavement or curb and gutter is placed.
 - F. On-street parking may be removed by the Contractor to facilitate construction and maintain traffic flow if approved by the Engineer. The Contractor shall obtain from the City and place "No Parking" signs for the particular street. Temporary "No-Parking" signs shall not be attached to street trees. Signs shall be returned to the City following use.

1.3.9 WORKING WITHIN CITY RIGHT-OF-WAY

1.3.9.1 Procedures for Obtaining Permission to Work in the City Right-of-Way:

- A. All Contractors or Utilities working within the street right-of-way shall apply for an Excavation Within Public Right-of-Way Permit prior to the beginning of work. This permit may be obtained from the Public Works Department.

- B. All Contractors or Utilities shall notify the City Emergency Services of any street closing prior to the beginning of work, and upon completion of the work.
- C. All Contractors and Utilities shall apply to the Public Works Department for a Street Occupancy Permit before obstructing any sidewalk or street for the purpose of storage of equipment and materials or the erection of a scaffolding.

1.3.9.2 General Provisions for Working Within Right-of-Way:

- A. No opening that will in any way obstruct a moving lane of traffic on any arterial street in the City will be permitted without 24 hours notice to the Engineering Division and Police Department.
- B. If a vehicular detour route is required, it shall be constructed, maintained, and signed by the Contractor or Utility as directed by the Police Department or the Engineering Division.
- C. If a pedestrian detour route is required, it shall be constructed, maintained, and signed by the Contractor or Utility as directed by the Police Department or the Engineering Division.
- D. When a street or intersection is closed to through traffic, the Contractor or Utility shall provide barricades and signs as specified in the "Traffic" article above.
- E. A Contractor or Utility shall not use construction equipment for the purpose of barricading its work. In addition, any equipment parked in the street right-of-way shall be appropriately barricaded so as not to create a hazard.
- F. The Contractor, Job Superintendent, or Foreman on the job at any given time shall be responsible for providing, placing, and maintaining such barricades, drums, rubber cones, signs, lights, flashers, delineators, flags, and flagmen as may be required by the Police Department and Engineering Division.
- G. Signs and flashers shall conform to Wisconsin Highway Specifications minimum standards.
- H. In areas of high volume traffic, bridging of trenches may be required. Where required, the bridging of trenches is to be accomplished with steel plates which are anchored against movement and ramped at the edges.
- I. Signs and barricades which are owned by the City of Waukesha are not available for use by Contractors or Utilities.

1.3.10 TEMPORARY SAFETY FENCE

1.3.10.1 General: Furnish and install temporary fence at the locations shown on the Plans.

1.3.10.2 Materials:

- A. General: Unless otherwise indicated in the Special Provisions, the Contractor may furnish either plastic or chain link temporary fence, at its option. Furnish new or used materials intended to last for the duration of the project construction. Salvaged and used materials may be from other project sites, the Contractor's inventory, or from rental companies provided they meet the intentions and requirements of this specification.

- B. Plastic Fence:
 - 1. Posts: Furnish notched conventional metal "T" or "U" shaped fence posts.

 - 2. Fabric: Furnish fence fabric meeting the following requirements:
 - a. Color: International orange (UV stabilized).
 - b. Roll Height: 4 feet.
 - c. Mesh Opening: 1-inch min. to 3-inch max.
 - d. Resin/Construction: High density polyethylene mesh.
 - e. Service Temperature: -60° F to 200° (ASTM D648).
 - f. Tensile Yield: Avg. 2000 lb. per 4 ft. width (ASTM D638).
 - g. Ultimate Tensile Strength: Avg. 3000 lb. per 4 ft. width (ASTM D638).
 - h. Elongation at Break (%): Greater than 100% (ASTM D638).
 - i. Chemical Resistance: Inert to most chemicals and acids.

- C. Chain Link Fence:
 - 1. Posts and Framework: Furnish posts of metal construction, in round, square, roll formed, U-channel, angle, or other common metal shapes at the Contractor's option. Furnish all braces, supports, anchors, pedestals, rails, tension wires, fasteners, and other such items needed for the fence to be self-supporting for perpendicular wind loads up to 90 mph.

 - 2. Fabric: Fabric shall be galvanized steel or aluminum with 2-inch openings. Height of fence fabric shall be 4 feet unless otherwise indicated in the Special Provisions or on the Plans.

1.3.10.3 Construction:

- A. Posts to support the fence in pavement and other hard surface areas shall be pedestal mounted and weighed down with sand bags so as not to damage the existing pavement. Posts to support the fence in soil and non-hard surface areas may be driven. Drive posts into the ground a minimum of 12 to 18 inches, or deeper if required to proper support fence. Space posts at a maximum of 8 feet on center. All posts shall be secure and reasonably vertical and uniformly spaced.

- B. Use a minimum of three wire ties to secure the fence at each post. For plastic fence, weave tension wire through the top row of strands to provide a top stringer that prevents sagging.

- C. Overlap fabric rolls at a post and secure with wire ties.
- D. Maintain fencing as required during the work. After the project is completed, remove all fencing and clean up all debris which may have accumulated at the fencing. Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this Contract.

1.3.11 DRAINAGE

- 1.3.11.1 Provide and maintain adequate drainage facilities as may be necessary to effectively protect both public and private property. The sanitary sewer system shall not be used to facilitate adequate drainage.
- 1.3.11.2 All ditches and drains shall be in such condition as to provide effective drainage. When berms of earth are placed along the shoulders, proper provision shall be made for surface drainage.

1.3.12 DUST AND NOISE CONTROL

1.3.12.1 Dust Control:

- A. Take appropriate dust control measures so as to keep the dispersion of dust to an absolute minimum.
- B. When necessary or required by the Engineer, water or calcium chloride shall be applied to the subgrade or gravel base of the project in a sufficient amount to prevent or limit the amount of dust and dirt rising from the construction area. Calcium Chloride shall be applied dry and have an Anhydrous Chloride content of not less than 77% by weight.
- C. Apply dust control measures within 24 hours of being so directed by the Engineer.
- D. The cost of applying dust control, including materials, shall be included in the prices of other items in the project. If dust control measures are not applied within 24 hours of the Engineer's direction to apply the materials, the City reserves the right to apply its own dust control measures and to back-change the Contractor for all costs.

1.3.12.2 Noise Control:

- A. Conduct operations in such a manner to cause the least amount of nuisance to residents in the vicinity of the work site.

1.3.13 WATER AND SANITARY PROVISIONS

- 1.3.13.1 City water for use on this Contract may be obtained from City fire hydrants, providing the Contractor obtains a hydrant meter from the Waukesha Water Utility. The Contractor shall pay all deposits and rental fees for the meter and shall also pay any water usage fees. The Water Utility can be contacted at 262.521.5272.
- 1.3.13.2 The Contractor shall provide and maintain in a neat and sanitary condition such sanitary accommodations for the use of its employees as may be necessary to comply with the requirements of the State Department of Health Services and the City of Waukesha.

1.3.14 RAILROAD COORDINATION

- 1.3.14.1 Comply with Section 107.17 of the Wisconsin Highway Specifications and the Special Provisions for all work affecting railroad property and any existing tracks.

1.3.15 HAZARDOUS SUBSTANCES

- 1.3.15.1 Whenever the construction operations encounter or expose an abnormal condition that may indicate the presence of a hazardous substance, immediately discontinue construction operations near the abnormal condition and notify the Engineer. Treat all abnormal conditions with extreme caution. Abnormal conditions include, but are not limited to, the following:
 - A. The presence of a tank or barrel.
 - B. An obnoxious odor.
 - C. Excessively hot earth.
 - D. Smoke.
 - E. Visible fumes.
 - F. Discolored earth or sheen on groundwater.
- 1.3.15.2 Do not resume construction operations in this area until the Engineer so directs. The Contractor may continue work in other areas of the project unless the Engineer otherwise directs.
- 1.3.15.3 Take actions to prevent the hazardous substance from spreading into an uncontaminated area.
- 1.3.15.4 Dispose of hazardous substances conforming to the requirements and regulations of the responsible state or federal agencies. If the Engineer requires the Contractor to dispose of the hazardous substance and the contract does not provide for this work, the work will be considered extra work. If the responsible state or federal agency requires special procedures for the disposal, the City will arrange with qualified persons to dispose of the substance.

1.3.16 ARCHAEOLOGICAL AND HISTORICAL FINDINGS

- 1.3.16.1 For construction operations on the project, if encountering human remains or if encountering artifacts of potential archaeological or historical significance, immediately stop operations at the encounter site and notify the Engineer. Cooperate, as necessary, by moving construction operations from the encounter site and complying with the Engineer's directions.
- 1.3.16.2 Do not resume operations at the encounter site without the Engineer's permission. The Contractor may continue work elsewhere on the project unless the Engineer directs otherwise.

1.3.17 MAINTENANCE

- 1.3.17.1 The Contractor shall be responsible for and maintain the work until final acceptance thereof, except as provided under Sections 104.6 and 105.11 of the Wisconsin Highway Specifications.
- 1.3.17.2 When the Contract provides that the road or portions thereof undergoing improvement will be closed to through traffic, the Contractor will be responsible for providing or constructing, maintaining and protecting adequate barriers, special warning signs, watchmen and/or lights at intersecting roads or streets and at other points of public access to the project.
- 1.3.17.3 When the Contract provides for maintenance of traffic over or along the road while undergoing improvement or reconstruction, the road shall be kept open to all traffic, by and at the expense of the Contractor. The Contractor shall keep the portions of the road being used by public traffic in such condition that traffic will be reasonably and adequately accommodated. It shall provide and maintain in safe and adequate condition temporary approaches, crossings, and intersections with roads and necessary driveways.
- 1.3.17.4 The Contractor shall keep clean all streets over which it hauls equipment and materials.
- 1.3.17.5 The Contractor shall bear all of the expense of maintaining traffic over the section of road undergoing improvement and the construction and maintaining of such approaches, crossings, intersections and other features as may be necessary without direct compensation except as to those features of such work which are a part of planned completed construction work.

- 1.3.17.6 Regardless of whether the Contract specifies that the road undergoing improvement is to be closed or open to through traffic, the Contractor shall at all times conduct the work in such a manner as to ensure the least possible obstruction to local service traffic to residents along the street being improved and to that end shall, at its own expense, provide and maintain in reasonable passable conditions such temporary roads or trails and temporary approaches as are deemed reasonable and practical by the Engineer. Should the Contractor fail to maintain a passable road after being notified by the Engineer to make corrections, the City shall have the right to return the road to a passable condition and the Contractor shall be responsible for the City's costs to make such corrections.
- 1.3.17.7 Upon specific approval of the Engineer prior to final inspection and acceptance, the Contractor may be relieved of maintenance of portions of the completed work when such portions of work are so situated that such parts can be opened and advantageously used for traffic and when such parts of the work can be conveniently maintained by the maintenance forces of the City.
- 1.3.17.8 The assumption of maintenance by the City, however, will not relieve the Contractor of any responsibility for defective workmanship or materials, or for damage caused by its own operations. Such action will not be construed to be final inspection or acceptance of any part of the work, nor to be waiver of any legal rights.

1.3.18 TRADE NAMES

- 1.3.18.1 Wherever a particular manufacturer's product is named, it is mentioned for descriptive purposes and to indicate the type, quality, and function of the article which will meet the intent of the Specifications.
- 1.3.18.2 Unless otherwise indicated, equivalent products of other manufacturers may be used only if approved by the Engineer in writing.

1.3.19 LINES AND GRADES

- 1.3.19.1 Give the Engineer at least 72 hours notice of the need to lay out any portion of the work. Clearly state in such notice the exact location where stakes are needed. Make staking requests using the City's Construction Staking Request Form.
- 1.3.19.2 Before commencing work, the Contractor shall review the stakes and marks for completeness and correctness. No claim will be considered by the City because any alleged inaccuracies or for alterations subsequently necessary because such alleged inaccuracies, unless the Contractor notifies the Engineer of the inaccuracies in writing before commencing work. The Contractor is responsible for preserving of all stakes and marks in their proper position. Notify the Engineer in writing if stakes are disturbed. Use care to see that the work is constructed according to the required line and grade. If an error in line or grade is discovered, discontinue work and notify the Engineer immediately. No claim will be allowed on account of any delay caused by the need to review line and grade.

1.3.19.3 Furnish the Engineer with any reasonable assistance which it may required to help in driving stakes or in setting out the work.

1.3.19.4 The City will not stake grades for new ADA sidewalk ramps. Layout forms for ADA ramps to comply with ADA ramp requirements.

1.3.19.5 The City will provide a one-time staking of the project at no expense to the Contractor. Any additional staking requirements, changes, or re-staking costs will be the responsibility of the Contractor.

1.3.20 BLASTING

1.3.20.1 In all blasting operations, comply with the requirements of Administrative Code, Chapter SPS 307 – Explosives and Fireworks.

1.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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2 EROSION CONTROL, STORMWATER MANAGEMENT, AND WATER RESOURCES

2.1 GENERAL

2.1.1 SUMMARY

2.1.1.1 This section describes:

- A. Erosion control measures at and adjacent to the project site.
- B. Protection of wetlands, streams, and drainageways.
- C. Construction dewatering.

2.1.2 RELATED SECTIONS

2.1.2.1 Section 4 – Earthwork, Excavation, and Boring.

2.1.3 SUBMITTALS

- 2.1.3.1 Product Data: Submit product data for silt fence, inlet protection fabric, silt curtain, turbidity barrier, and polymer stabilizer.
- 2.1.3.2 Inspection Reports: Submit one copy of weekly inspection reports for erosion and sediment controls in accordance with DNR requirements.
- 2.1.3.3 Dewatering Procedures: Submit proposed procedures of dewatering, including anticipated pumping rates.
- 2.1.3.4 Permits: Submit one copy of all permits obtained for dewatering.

2.1.4 TESTING (NOT USED)

2.1.5 WARRANTIES

2.1.5.1 The work included in this section shall be warranted as specified in Section 01 – General Requirements.

2.1.6 MEASUREMENT AND PAYMENT

2.1.6.1 Silt Fence:

- A. Measurement: The City will measure Silt Fence by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Silt Fence". Payment is full compensation for furnishing, installing, maintaining, and removing silt fence.

2.1.6.2 Erosion Bales:

- A. Measurement: The City will measure Erosion Bales by the number of standard size bales acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Erosion Bales". Payment is full compensation for furnishing, installing, maintaining, and removing erosion bales.

2.1.6.3 Inlet Protection:

- A. Measurement: The City will measure Inlet Protection by the number of standard size inlets acceptably protected.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Inlet Protection". Payment is full compensation for furnishing, installing, maintaining, and removing inlet protection.

2.1.6.4 Silt Curtain:

- A. Measurement: The City will measure Silt Curtain by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Silt Curtain". Payment is full compensation for furnishing, installing, maintaining, and removing silt curtain.

2.1.6.5 Turbidity Barrier:

- A. Measurement: The City will measure Turbidity Barrier by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Turbidity Barrier". Payment is full compensation for furnishing, installing, maintaining, and removing turbidity barrier.

2.1.6.6 Construction Entrance:

- A. Measurement: The City will measure Construction Entrance by the number of construction entrances acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Construction Entrance". Payment is full compensation for furnishing, installing, maintaining, and removing construction entrances.

2.1.6.7 Polymer Stabilization:

- A. Measurement: The City will measure Polymer Stabilization by the square yard acceptably applied.

- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Polymer Stabilization". Payment is full compensation for furnishing and applying polymer stabilizer.

2.1.6.8 Dewatering: The cost for dewatering shall be included in the prices for the items for which dewatering is required.

2.2 PRODUCTS

2.2.1 EROSION CONTROL MATERIALS

2.2.1.1 General: Products used for erosion control shall comply with:

- A. The Wisconsin Department of Transportation (DOT) Erosion Control Product Acceptability List (PAL) available on the DOT website at:
<http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/appr-prod/default.aspx>.
- B. The Wisconsin Department of Natural Resources (DNR) Technical Standards for Construction Site Erosion Control available on the DNR website at:
http://dnr.wi.gov/topic/stormwater/standards/const_standards.html.

2.2.1.2 Silt Fence: Silt fence shall meet the requirements of Section 628 of the Wisconsin Highway Specifications.

2.2.1.3 Erosion Bales: Erosion bales shall meet the requirements of Section 628 of the Wisconsin Highway Specifications.

2.2.1.4 Inlet Protection: Inlet protection shall meet the requirements of Section 628 of the Wisconsin Highway Specifications.

2.2.1.5 Silt Curtain: Silt curtain shall meet the requirements of Section 628 of the Wisconsin Highway Specifications for silt screen.

2.2.1.6 Turbidity Barrier: Turbidity barrier shall meet the requirements of Section 628 of the Wisconsin Highway Specifications.

2.2.1.7 Construction Entrance: Construction entrance shall meet the requirements of Section 628 of the Wisconsin Highway Specifications for tracking pads.

2.2.1.8 Polymer Stabilizer: Polymer stabilizer shall meet the requirements of Section 628 of the Wisconsin Highway Specifications for soil stabilizer type B.

2.2.1.9 Temporary Seed: Temporary seed mixture shall meet the requirements of Section 630.2.1.5.1.2 of the Wisconsin Highway Specifications.

2.2.1.10 Erosion Mat: See Section 14 – Site Improvements and Restoration.

2.3 EXECUTION

2.3.1 EROSION CONTROL

- 2.3.1.1 Erosion control measures are a part of this construction contract. The Contractor shall, as a minimum, follow:
- A. The Wisconsin Department of Natural Resources (DNR) Technical Standards for Construction Site Erosion Control.
 - B. The City's Standard Construction Details for erosion control.
- 2.3.1.2 All storm inlets within the project limits and those immediately downstream from the construction project shall be protected from sedimentation by the placement of temporary filter fabric over the inlets. This work shall be done as shown in the details. The inlets shall be protected during all phases of construction.
- 2.3.1.3 The downstream project limits shall be protected by ensuring that sediment cannot leave the construction site. This shall be accomplished by the placement of silt fence, erosion bales, silt curtain, or other erosion control best management practices (BMPs).
- 2.3.1.4 Tracking of sediment onto adjacent paved roadways shall be minimized during construction. Stone tracking pads of sufficient width and length shall be constructed early in the grading process to prevent sediment from being tracked onto adjacent streets. Any sediment reaching adjacent streets shall be removed by vacuum type street sweepers (not flushing) before the end of the workday.
- 2.3.1.5 All erosion control measures in place on this contract shall be inspected within 24 hours after each rainfall or daily during prolonged rainfall. Repair or replacement shall be made immediately. Sediment deposits shall be removed when deposits reach one half the height of the barrier. The Contractor shall remove any sediment deposits reaching storm sewers as a result of construction on this contract by cleaning of the sewers.
- 2.3.1.6 The Contractor shall follow any DNR approved erosion control plan issued for the construction site. The Contractor shall also fill out the DNR's Construction Site Inspection Report (Form 3400-187) weekly or after precipitation events. A copy of this form is available on the DNR website at:
<http://dnr.wi.gov/topic/stormwater/construction/forms.html>.
- 2.3.1.7 Re-establish temporary or permanent vegetation on disturbed areas within the time limits allowed by applicable standards.
- 2.3.1.8 Remove all erosion control measures installed after the site has been sufficiently stabilized.

2.3.2 PROTECTION OF WETLANDS, STREAMS, AND DRAINAGEWAYS

- 2.3.2.1 Protect wetlands, streams, and drainageways in accordance with Sections 107.18 and 107.19 of the Wisconsin Highway Specifications.

2.3.3 CONSTRUCTION DEWATERING

2.3.3.1 Surface Drainage:

- A. The Contractor is responsible for removing surface water entering excavations or not yet fully connected storm sewer pipe or structures by using appropriate dewatering techniques. Take steps to prevent or minimize surface water entering excavations.
- B. Provide a geotextile bag for water being pumped from excavations at all times. The geotextile bag shall be appropriately sized according to DNR technical standards. The geotextile bag shall be approved by the Engineer.
- C. Water may not be discharged in a manner that causes erosion of site or receiving channels.
- D. If the project is not covered by a DNR construction site storm water discharge permit, the Contractor shall contact the DNR to obtain a pit/trench dewatering permit.

2.3.3.2 Groundwater:

- A. If groundwater is present, the Contractor is responsible for dewatering the site prior to starting excavation and for maintaining groundwater a minimum of 24-inches below the bottom of the excavation. Substantial softening or loosening of the pipe subgrade soils can be experienced in the presence of groundwater when the confining effect of overburden pressure is removed. The dewatering system shall be of a sufficient size and capacity as required to control hydrostatic pressure on the trench sides and bottom to allow material to be excavated, pipe installed and backfill placed, all in a dry condition. The use of a crushed stone working mat, may be necessary to establish a stable bearing subgrade within open cut trenches.
- B. If dewatering (dewatering wells) are necessary, the Contractor shall contact the Wisconsin DNR, Private Water Supply Section, P.O. Box 7921, Madison, WI. 53707 for a permit for all wells installed or operated for which the single or aggregate capacity may be in excess of 70 gallons per minute. If discharge from the high capacity wells is routed around or bypasses the storm water runoff control system, also obtain a pit/trench dewatering permit from DNR.

- C. The dewatering operation shall be maintained until backfilling and compaction procedures are completed. Water pumped from the site shall be treated by temporary sedimentation basins, grit chambers, sand filters, upslope chambers, hydro-cyclones, swirl concentrators, or other appropriate controls designed and used to remove particles of 100 microns or greater for highest dewatering pumping rate. If water is demonstrated to have no particles greater than 100 microns during dewatering operations, then no control is needed before discharge.
- D. Water may not be discharged in a manner that causes erosion of site or receiving channels.
- E. Contractor shall take all appropriate measures to prevent contamination of groundwater system including well-head protection, backflow prevention, and temporary grading and surface flow limitations.

2.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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3 EXISTING CONDITIONS, SUBSURFACE INVESTIGATION, AND DEMOLITION

3.1 GENERAL

3.1.1 SUMMARY

3.1.1.1 This section describes activities required to prepare the site for construction including, but not limited to:

- A. Protection of existing improvements.
- B. Clearing and grubbing.
- C. Topsoil stripping.
- D. Removals.
- E. Abandonments.
- F. Disposal of debris.

3.1.2 RELATED SECTIONS

3.1.2.1 Section 2 – Erosion Control, Storm Water Management, and Water Resources.

3.1.3 SUBMITTALS

3.1.3.1 Disposal Location: If materials or debris are disposed of on private property, the Contractor shall obtain from the property owner a written permit for such disposal, and such permit or a copy thereof shall be filed with the Engineer.

3.1.4 TESTING (NOT USED)

3.1.5 WARRANTIES

3.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

3.1.6 MEASUREMENT AND PAYMENT

3.1.6.1 General:

- A. Site preparation will be considered incidental to the work except where separate bid items are included in Schedule of Prices. Plan notes related to removals and reinstallations shall be interpreted as directives to the Contractor for such work at no extra cost except where separate bid items are provided in Schedule of Prices.

3.1.6.2 Clearing and Grubbing:

- A. Measurement:

1. General: The City will measure Clearing and Grubbing separately, either by the station, inch of diameter, square yard, or acre, or as lump sums, as the Contract indicates.
 2. Incidental Work: The City will not measure incidental clearing and grubbing operations required to perform the work as follows:
 - a. Clearing areas of light brush, shrubs, and other vegetation that the Contractor can cut with a brush scythe or mowing machine.
 - b. Clearing areas containing logs, tree roots, roots of brush and shrubs, and other vegetation having a woody structure that the Contractor can remove with a rooter.
 - c. Clearing small trees of less than the minimum number and size specified for measurement.
 - d. Trimming overhanging limbs and branches to provide required clearance.
 - e. Clearing and grubbing borrow pits.
 3. By the Station: The City will measure Clearing and Grubbing by the full 100-foot station acceptably completed, measured as specified in Section 201.4 of the Wisconsin Highway Specifications.
 4. By the Square Yard: The City will measure Clearing and Grubbing by the square yard acceptably completed, measured as specified in Section 201.4 of the Wisconsin Highway Specifications.
 5. By the Acre: The City will measure Clearing and Grubbing by the acre acceptably completed, measured as specified in Section 201.4 of the Wisconsin Highway Specifications.
 6. By the Inch of Diameter: The City will measure Clearing and Grubbing by the inch of diameter acceptably completed, measured as specified in Section 201.4 of the Wisconsin Highway Specifications.
 7. As Lump Sums: The City will measure Clearing as a single lump sum and Grubbing as a single lump sum, each acceptably completed.
- B. Payment: Payment for measured quantities will be made at the applicable contract unit price for "Clearing" and for "Grubbing". Payment is full compensation for all clearing and for all grubbing actually required and performed within the clearing and grubbing limits on those portions of the work where clearing and grubbing is designated on the Plans or authorized; and for all handling, piling, rehandling and disposal of debris.

3.1.6.3 Topsoil Stripping:

- A. Topsoil stripping will not be paid for directly, but will be measured as part of excavation cut work.
- B. If topsoil is stripped in excess of the quantities required under the Contract for foundation preparation or for required topsoiling work, a deduction will be made from the measured quantity of excavation cut to account for the excess wasted topsoil.

3.1.6.4 Sawcutting at Pavement Limits:

- A. Measurement: The City will measure Sawcutting at Pavement Limits by the linear foot acceptably completed.
 - 1. Measurement will be made for sawcutting asphalt and concrete pavements at the construction limits and for driveways behind the sidewalk.
 - 2. Measurement will only be made for final sawcutting at the pavement limits. Any miscellaneous cutting, such as for trenches, temporary removal limits, and similar purposes, will not be measured.
 - 3. Measurement will not include sawcutting of curb and gutter, sidewalks, and similar miscellaneous surfacing. The cost of sawcutting these items will be considered incidental to the removal of the applicable item.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Sawcutting at Pavement Limits". Payment is full compensation for sawing of asphalt and/or concrete pavement at the construction limits as specified.

3.1.6.5 Remove Existing Concrete Roadway:

- A. Measurement: The City will measure Remove Existing Concrete Roadway by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Remove Existing Concrete Roadway". Payment is full compensation for removing existing concrete pavement in the street area.

3.1.6.6 Remove Existing Asphalt Roadway:

- A. Measurement: The City will measure Remove Existing Asphalt Roadway by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Remove Existing Asphalt Roadway". Payment is full compensation for removing existing asphalt pavement in the street area.

3.1.6.7 Remove Existing Roadway:

- A. Measurement: The City will measure Remove Existing Roadway by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Remove Existing Roadway". Payment is full compensation for removing existing concrete pavement, asphalt pavement, macadam pavement, brick pavement, and/or combination material pavement in the street area.

3.1.6.8 Remove Existing Curb and Gutter:

- A. Measurement: The City will measure Remove Existing Curb and Gutter by the linear foot acceptably completed, measured along the flowline of the gutter.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Remove Existing Curb and Gutter". Payment is full compensation for removing existing concrete curb and gutter.

3.1.6.9 Remove Existing Sidewalk:

- A. Measurement: The City will measure Remove Existing Sidewalk by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Remove Existing Sidewalk". Payment is full compensation for removing existing sidewalk and drive approaches.

3.1.6.10 Remove Pipe:

- A. Measurement: The City will measure Remove Pipe by the linear foot acceptably removed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Remove Pipe". Payment is full compensation for excavating, completely removing and disposing of the pipe, and backfilling the excavation.

3.1.6.11 Remove Sewer Manhole:

- A. Measurement: The City will measure Remove Sewer Manhole by the number of manholes acceptably removed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Remove Sewer Manhole". Payment is full compensation for excavating, completely removing and disposing of the manhole structure, salvaging the casting to the City, and backfilling the excavation.

3.1.6.12 Remove Inlet:

- A. Measurement: The City will measure Remove Inlet by the number of inlets acceptably removed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Remove Inlet". Payment is full compensation for excavating, completely removing and disposing of the inlet structure, salvaging the casting to the City, and backfilling the excavation.

3.1.6.13 Abandon Pipe:

- A. Measurement: The City will measure Abandon Pipe by the linear foot acceptably abandoned.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Abandon Pipe". Payment is full compensation for excavating as required, filling the pipe with CLSM and bulkheading the ends, and backfilling the excavation.

3.1.6.14 Abandon Sewer Manhole:

- A. Measurement: The City will measure Abandon Sewer Manhole by the number of manholes acceptably abandoned.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Abandon Sewer Manhole". Payment is full compensation for excavating as required, removing the required portion of manhole and filling the remaining portion, salvaging the casting to the City, and backfilling the excavation.

3.1.6.15 Abandon Inlet:

- A. Measurement: The City will measure Abandon Inlet by the number of inlets acceptably abandoned.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Abandon Inlet". Payment is full compensation for excavating as required, removing the required portion of inlet and filling the remaining portion, salvaging the casting to the City, and backfilling the excavation.

3.2 PRODUCTS

3.2.1 CLSM / FLOWABLE FILL

- 3.2.1.1 Controlled low strength material (CLSM) / flowable fill shall meet the following requirements:
 - A. Strength – 200 psi.

- B. Type I cement – 30 lbs.
- C. Fly ash – 250 lbs.
- D. Sand – 2728 lbs.
- E. Total air – 9.0% +/- 1%.
- F. Air entrainment – 35 oz.
- G. Water – 50 gal.
- H. Water/cement ratio – 1.49.
- I. Slump – 10 in +/- 1 in.

3.3 EXECUTION

3.3.1 SITE PREPARATION – GENERAL

- 3.3.1.1 Notify the various utilities in advance of construction operations as specified in Section 1 – General Requirements.
- 3.3.1.2 Remove mailboxes, fences, posts, signs, etc. encountered within the grading limits and reinstall them following grading operations.
- 3.3.1.3 Maintain mail delivery to businesses and residences during the course of the project. Provide temporary support for existing mail boxes or other temporary mailboxes as required to maintain service. All arrangements shall be acceptable to the U.S. Postal Service.

3.3.2 PRESERVATION OF TREES AND SHRUBS

- 3.3.2.1 The trees and shrubs that are to be preserved shall be thoroughly protected from scarring or other injury during grading operations. Some existing street trees may be very close to the excavation limits.
- 3.3.2.2 Do not strip the existing topsoil by “dragging” the bucket across the surface under trees. The City Forester will delineate in the field where “dragging” will not be allowed.
- 3.3.2.3 Excavation operations around trees that are to be preserved shall not disturb the original ground around the tree within a distance of 3.5 feet or twice the diameter of the tree, whichever is the greater distance. Exposed roots resulting from excavation shall be cut cleanly and covered with humus-bearing soil.
- 3.3.2.4 The stockpiling or leaning of materials against any tree is prohibited.
- 3.3.2.5 The pruning of overhead limbs or branches to accommodate construction or construction equipment is prohibited. If a branch is broken, immediately contact the City Forester.

- 3.3.2.6 All construction adjacent to street trees, where disturbance to the root zone may occur, will require the severing of roots with a sharp axe or saw or approved root cutter. Cutting with a bulldozer, grader, backhoe, etc. is not acceptable. The need for and extent of root cutting will be determined prior to construction by a meeting between the Contractor and the City Forester. All root cutting will be at the Contractor's expense.
- 3.3.2.7 Any damage to tree branches or roots, as determined by the City Forester, that causes pruning or removal of the tree will be charged to the Contractor.
- 3.3.2.8 Minimize damage to trees from the exhaust of all construction equipment by diverting the exhaust to the side and not up into the tree canopy.

3.3.3 CLEARING AND GRUBBING

- 3.3.3.1 Clearing and grubbing shall consist of cutting and disposing of all trees, brush, windfalls, logs, and other vegetation occurring within the clearing limits, or as specified on Plans or directed by the Engineer, and the removing and disposing of roots, stumps, stubs, grubs, logs and other timber from within the grubbing limits as hereinafter defined or which interfere with excavation, embankment, or designated clear vision areas, or as specified on Plans or directed by the Engineer.
- 3.3.3.2 Grubbing need not be performed on areas to be occupied by earth embankments 4 feet or more in height, unless special compaction of the foundation is required.
- 3.3.3.3 All stumps, roots, logs, or other timber more than 3 inches in diameter and all brush, matted roots, and other debris not suitable for the roadway foundation within the grubbing limits shall be removed to a depth of not less than 36 inches below new subgrade.
- 3.3.3.4 Trees and shrubs located beyond the clearing limits shall not be removed unless their removal is specially authorized.
- 3.3.3.5 Trees and shrubs to be left in place on the right-of-way shall not be damaged or injured by the Contractor.
- 3.3.3.6 Where feasible, trees shall be felled toward the center of the area to be cleared. Where trees cannot be felled without danger to traffic or injury to other trees, structures, or property, they shall be cut in sections from the top down.

3.3.4 TOPSOIL STRIPPING

- 3.3.4.1 Topsoil shall consist of the natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils adapted to the sustenance of plant life, and such topsoil shall be neither excessively acid nor excessively alkaline.

- 3.3.4.2 Clear areas from which topsoil is stripped by means of mowing and removing weeds or other vegetation to a height of approximately 6 inches. Remove litter such as brush, rock, and other foreign material that will interfere with subsequent vegetation establishment.
- 3.3.4.3 Strip humus-bearing soil to such depth as available, or as necessary to produce sufficient volumes to cover the designated areas to the required depths. Take care to avoid removing the underlying sterile soil.
- 3.3.4.4 Strip topsoil from areas to meet grades as shown on the Plans. Do not strip topsoil until City Forester is notified and has reviewed and approved areas in the proximity of City trees.
- 3.3.4.5 Stockpile topsoil where shown on the Plans, or place it directly on the designated areas provided they have been prepared to receive the topsoil.
- 3.3.4.6 Dispose of topsoil in excess of the amounts required to accomplish the specified topsoiling work.

3.3.5 REMOVALS

- 3.3.5.1 Saw the removal limits of all pavements to their full depth prior to removal.
- 3.3.5.2 Rubblization of existing concrete pavement before removal may damage existing underground utilities and is not allowed.
- 3.3.5.3 Some walk removals are shown on the Plans, however, other walk will be evaluated and marked in the field prior to construction. The City reserves the right to add or remove portions of walk to be removed and replaced as determined by the Engineer. All final removals will be marked in the field.
- 3.3.5.4 Remove all existing below-ground equipment where indicated on the Plans including concrete bases, conduit, wire, conductors, etc. and dispose of it. Conduit shall be removed or abandoned in place. Conduit can be abandoned in place only if it does not interfere with new construction or present a risk of damage to newly constructed items. The cost of removal of pull boxes, concrete bases, conduit, and conductors, shall be incidental to pavement removal. Backfill removed concrete base and pull box holes with dense aggregate placed in thoroughly compacted layers not exceeding 6 inches in depth or slurry backfill as directed by the Engineer.
- 3.3.5.5 Remove existing sewers and structures as indicated on the Plans or as necessary for construction of sewers and structures.

3.3.6 ABANDONMENTS

3.3.6.1 Sewers or manholes which are indicated to be abandoned and left in place shall be done in accordance with Chapter 3.2.24 of the Wisconsin Sewer and Water Specifications, except manholes shall be removed to a depth of 3-feet below the surface or to the bottom of the cone, whichever is deeper. Structures and sewers 15 inches and larger shall be completely filled with controlled lower-strength material (CLSM / flowable fill).

3.3.7 DISPOSAL

3.3.7.1 Except as otherwise indicated, all material removed from the project shall be disposed of by the Contractor beyond the limits of the job and prior to proceeding with grading operations. If material is placed on private property, the Contractor shall obtain from the property owner a written permit for such disposal. Burning of material from the project will not be allowed.

3.3.7.2 All frames and covers, including tree grates, that are replaced shall be salvaged and returned to the Municipal Garage.

3.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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4 EARTHWORK, EXCAVATION, AND BORING

4.1 GENERAL

4.1.1 SUMMARY

4.1.1.1 This section describes:

- A. Roadway and drainage excavation.
- B. Embankment filling.
- C. Additional fill excavation.
- D. Trenching and backfilling for utility construction.
- E. Furnishing and placing subgrade aggregate separation fabric.
- F. Furnishing and placing geotextile grid.
- G. Furnishing and placing crushed aggregate base course.

4.1.2 RELATED SECTIONS

- 4.1.2.1 Section 2 – Erosion Control, Stormwater Management, and Water Resources.
- 4.1.2.2 Section 3 – Existing Conditions, Subsurface Investigation, and Demolition.

4.1.3 SUBMITTALS

- 4.1.3.1 Geotextile Fabric and Geotextile Grid Product Data: Submit product data for geotextile fabric and geotextile grid proposed for use.
- 4.1.3.2 Crushed Aggregate Base Course Material Report: Submit sieve analysis for crushed aggregate base course proposed for use.
- 4.1.3.3 Crushed Aggregate Base Course Weight Tickets: Furnish and deliver to the Engineer with each load a ticket showing the net weight of the load. These tickets shall be printed with numbers in sequence and stamped by the weighing equipment where possible.
- 4.1.3.4 Field Test Reports: Submit test reports for trench backfill compaction to Engineer on a weekly basis.

4.1.4 TESTING

4.1.4.1 Roadway Proof-Rolling:

- A. Proof-roll prepared roadway foundation as specified in the "Roadway and Drainage Excavation" article, below, before placing fill materials.

- B. Proof-roll the roadway pavement subgrade as specified in the "Graveling" article, below, before placing crushed aggregate base course.

4.1.4.2 Trench Backfill:

- A. The Contractor shall perform all compaction testing for trenches. The cost for testing shall be incidental to construction costs.
- B. Provide at least three compaction tests each day where backfilling operations are occurring. One test shall be at the proposed final elevation of the backfill and two tests shall be located at intermediate depths. Recompact and retest areas that do not meet specifications or areas that have been damaged by weather or construction equipment before resuming backfilling operations. If test results fall out of tolerance, increase testing frequency until tested material is within specification.

4.1.5 WARRANTIES

- 4.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

4.1.6 MEASUREMENT AND PAYMENT

4.1.6.1 Excavation and Embankment Work:

- A. Shaping and Grading to Subgrade:
 - 1. Measurement: The City will measure Shaping and Grading to Subgrade by the linear foot of roadway foundation acceptably prepared, measured along the roadway centerline or reference line.
 - 2. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Shaping and Grading to Subgrade". Payment is full compensation for excavating, filling, shaping, grading, and compacting the subgrade to the width shown on the cross-sections and/or grading limits as required to prepare it for the proposed improvements.
- B. (size) Crushed Stone Backfill (Includes EBS):
 - 1. Measurement: The City will measure (size) Crushed Stone Backfill (Includes EBS) by the ton of material acceptably incorporated in the work. Aggregates obtained from wet pits or which contain total moisture in excess of 7 percent shall be stockpiled, aerated, or dried to reduce the moisture content to 7 percent or less before being weighed.

2. Payment: Payment for measured quantities will be made at the contract unit price per ton for "(size) Crushed Stone Backfill (Includes EBS)". Payment is full compensation for excavating and disposing of materials below subgrade as identified by the Engineer; and for furnishing, producing, crushing, screening, loading, hauling, placing, shaping, grading, watering, drying, compacting, maintaining crushed stone backfill to replace the removed material.

4.1.6.2 Additional Fill:

- A. Additional fill from off-site sources, if required for the work, will not be paid for separately unless indicated in the Special Provisions.

4.1.6.3 Trenching and Backfilling:

- A. Trenching and backfilling work will not be measured or paid for directly, but shall be considered as subsidiary work pertaining to and included in the various types of utility work except as otherwise specified below. The work shall include trench excavation, removal and disposal of unusable backfill material encountered during trench excavation, furnishing and placing the specified bedding and backfill materials, dewatering, and sheeting, shoring, and bracing.

B. Slurry Backfill:

1. Measurement: If use of slurry backfill is directed by the Engineer, the City will measure Slurry Backfill by the cubic yard acceptably placed.
2. Payment: Payment for measured quantities will be at the contract unit price per cubic yard for "Slurry Backfill". Payment is full compensation for furnishing and placing slurry backfill.

C. Solid Rock Excavation:

1. Measurement: If solid rock is encountered in utility trenches, the City will measure Solid Rock Excavation by the cubic yard acceptably completed.
2. Payment: Payment for measured quantities will be made at the contract unit price per cubic yard for "Solid Rock Excavation". Payment is full compensation for excavating and disposing of solid rock and for furnishing, placing, and compacting any additional bedding material needed as a result of the rock excavation.

D. Loose Rock Excavation:

1. Measurement: If loose rock is encountered in utility trenches, the City will measure Loose Rock Excavation by the cubic yard acceptably completed.

2. Payment: Payment for measured quantities will be made at the contract unit price per cubic yard for "Loose Rock Excavation". Payment is full compensation for excavating and disposing of loose rock and for furnishing, placing, and compacting any additional bedding material needed as a result of the rock excavation.

E. Frost Breaking and Removal:

1. Measurement: If thawing of frozen ground is necessary for underground construction activities, the City will measure Frost Breaking and Removal by the linear foot of trench acceptably thawed or broken.
2. Payment: Payment for measured quantities will be at the contract unit price per linear foot for "Frost Breaking and Removal". Payment is full compensation for thawing existing trench soils.

F. Geotextile Fabric Type SAS Non-Woven:

1. Measurement: The City will measure Geotextile Fabric Type SAS Non-Woven by the square yard acceptably completed. Extra fabric at areas of overlap will not be measured.
2. Payment: Payment for measured quantities will be at the contract unit price per square yard for "Geotextile Fabric Type SAS Non-Woven". Payment is full compensation for furnishing and installing geotextile fabric.

G. Geotextile Grid Type BX1100:

1. Measurement: The City will measure Geotextile Grid Type BX1100 by the square yard acceptably completed. Extra grid at areas of overlap will not be measured.
2. Payment: Payment for measured quantities will be at the contract unit price per square yard for "Geotextile Grid Type BX1100". Payment is full compensation for furnishing and installing geotextile grid.

H. Crushed Aggregate Base Course (size):

1. Measurement: The City will measure Crushed Aggregate Base Course (size) by the ton of material acceptably incorporated in the work. Aggregates obtained from wet pits or which contain total moisture in excess of 7 percent shall be stockpiled, aerated, or dried to reduce the moisture content to 7 percent or less before being weighed.

2. Payment: Payment for measured quantities will be made at the contract unit price per ton for "Crushed Aggregate Base Course (size)". Payment is full compensation for furnishing, producing, crushing, screening, loading, hauling, placing, shaping, grading, watering, drying, compacting, and maintaining base course.

4.2 PRODUCTS

4.2.1 EXCAVATION MATERIAL CLASSIFICATION

- 4.2.1.1 Unclassified Excavation: Roadway and drainage excavation will be unclassified except for materials to be undercut as described below.
- 4.2.1.2 Subgrade Undercut: Undercut shall include frost-heave material, unstable silty soils, wet and unstable soil, topsoil containing considerable humus or vegetable matter, rocks, or other undesirable foundation material that is located below the established pavement subgrade (the surface upon which the subbase, base, and/or surface courses will be constructed) as determined by the Engineer as the work is opened up and performed.

4.2.2 EMBANKMENT MATERIALS

- 4.2.2.1 Materials for embankment shall consist of suitable materials and shall contain no logs, stumps, brush or other perishable material. Sod and humus-bearing soils, in excess of the quantity needed for salvaged topsoil requirements and other soils not suitable for roadbed construction may be placed in the outside edges of the embankment, beyond the limits of an assumed one-to-one slope extending outward from the outer limits of the finished sidewalk line. Frozen lumps of soil shall not be permitted to be placed in embankments inside the above designated assumed slope limits.
- 4.2.2.2 Materials to be incorporated in the top foot of earth embankments and in portions of embankments through which it is proposed to bore holes for or to drive piling shall be earthy materials, free of any substantial quantity of gravel or broken stone which would significantly affect scarifying and finishing of the subgrade or driving of piling through the embankment. No stones shall be incorporated which would fail to pass a 3-inch ring.

4.2.3 ADDITIONAL FILL MATERIALS

- 4.2.3.1 Material for additional fill shall consist of satisfactory soil or mixture of satisfactory soil, stone, gravel or other acceptable materials which is of a character and quality satisfactory for the purpose intended. The material shall be free from sod, stumps, logs, grubs and other perishable and deleterious matter.

4.2.3.2 The Contractor shall make his own negotiations with property owners from whom he proposes to obtain material, provided, however, that in no case shall borrow when obtained from the proximity of the roadway be removed in such a manner as to create a nuisance or present an unsightly appearance.

4.2.4 TRENCH MATERIALS

4.2.4.1 Pipe Bedding and Cover Materials: Materials as required in Chapter 3.2.0 of the Wisconsin Sewer and Water Specifications for the application, unless otherwise stated in the Special Provisions.

4.2.4.2 Trench Backfill:

A. Under Existing or Proposed Pavements: Granular backfill meeting the requirements of Table 39 of Chapter 8.43.7 of the Wisconsin Sewer and Water Specifications. No excavated material will be allowed for reuse as trench backfill, unless otherwise stated in the Special Provisions.

B. In Non-Pavement Areas: Previously excavated materials meeting the requirements of Chapter 8.43.5 of the Wisconsin Sewer and Water Specifications, unless otherwise stated in the Special Provisions.

4.2.4.3 Slurry Backfill: Aggregate slurry backfill meeting the requirements of Chapter 8.43.8 of the Standard Sewer and Water Specifications.

4.2.4.4 Submit prices for alternate backfill procedures or materials within 48-hours of Engineer's request or Contractor's RFI. Do not proceed with use of alternate procedures or materials without approval of request or clarification.

4.2.5 GEOTEXTILE FABRIC TYPE SAS NON-WOVEN

4.2.5.1 Geotextile fabric shall meet the requirements of Section 645 of the Wisconsin Highway Specifications for Type SAS geotextile.

4.2.6 GEOTEXTILE GRID TYPE BX1100

4.2.6.1 Geotextile grid shall be a polymer grid structure composed of polypropylene or high-density polyethylene whose function is to reinforce roadway subgrade while allowing water to pass freely. Provide Tensar "BX1100", or approved equal.

4.2.7 CRUSHED AGGREGATE BASE COURSE

4.2.7.1 Crushed aggregate base course shall be material complying with Section 305 of the Wisconsin Highway Specifications.

4.2.7.2 The Contractor will have the option of using Crushed Stone, Crushed Gravel, or Crushed Concrete that meets the specified gradation. Reclaimed asphalt, reprocessed material, or blended material will not be acceptable.

4.2.8 CRUSHED STONE BACKFILL

- 4.2.8.1 Crushed stone backfill shall meet the requirements specified for crushed stone base course.

4.3 EXECUTION

4.3.1 ROADWAY AND DRAINAGE EXCAVATION

4.3.1.1 General:

- A. Roadway and drainage excavation shall consist of the excavation and satisfactory disposal of all materials taken from within the right-of-way for the construction of the roadway (including preparation of roadway foundation), roadbed, embankments, earth subgrade and shoulders, intersections, side ditches and dikes, channels, and waterways, and shall also include the grading of entrances, approaches, ditches and channels beyond the right-of-way in accordance with these specifications and to lines, grades and cross sections shown on the Plans. Except when otherwise provided, this work shall also include the removal and satisfactory disposal of base courses, embankment surcharge, masonry walls, foundations of buildings, or other structures that lie within the right-of-way, stone fences, stone piles and surplus and unsuitable materials; the replacement of unsuitable material with satisfactory material; the trimming and finishing of the roadway; and maintaining such work in a finished condition until acceptance.
- B. Roadway and drainage excavation does not include removing existing asphalt and concrete pavements, material obtained from borrow pits outside the right-of-way limits, nor excavation for structures or other excavation items for which separate and specific bid items are included in the Contract.
- C. If hazardous substances or archaeological or historic remains are encountered during excavation work, comply with the requirements of Section 01 – General Requirements.

4.3.1.2 Preparing Roadway Foundation:

- A. Vegetation of a height greater than 1 foot shall be cut and properly disposed of before ground is broken for excavation or before embankment is placed thereon. Heavy sod and other perishable material underlying proposed embankments within the limits of an assumed one-to-one slope extending outward from the outer limits of the sidewalk area shall be removed. Muck, peat and other unstable material shall be removed, disposed of, or otherwise treated as shown on the Plans.

- B. All suitable topsoil material from within the right-of-way limits shall be stripped and stockpiled or otherwise salvaged as shown on the Plans or as directed by the Engineer.
- C. Compact, or otherwise prepare as required, the existing ground within the roadway foundation as necessary to support the embankment and attain the specified compaction density. Prior to placing embankment materials, proof-roll the roadway foundation in the presence of the Engineer with a fully loaded tandem-axle dump truck. No material shall be placed on a soft or spongy subgrade or on a subgrade covered by ice or snow.
- D. No rocks, aggregate, or stone larger than 3 inches on any face will be allowed at surface of the subgrade.

4.3.1.3 Drainage During Construction:

- A. During construction, the roadway, ditches and channels shall be maintained in a well-drained condition at all times by keeping the excavation areas and embankments sloped to the approximate section of the ultimate earth grade. Blading or leveling operations will be required when placing embankments and during the process of excavation except when such excavation is in ledge rock or areas where leveling is not practical or necessary. Where salvaged topsoil is stored on the right-of-way during construction operations, it shall be so stockpiled to prevent interference with or obstruction to surface drainage. If it is necessary, in the prosecution of the work, to interrupt existing surface drainage, sewers, or under drainage, temporary drainage shall be provided until permanent drainage work is completed. The construction of all temporary drainage installations shall be considered as incidental to the construction of the work.
- B. Take all reasonable and necessary precautions to preserve and protect all existing tile drains, sewers and other subsurface drains, or parts thereof, which in the judgment of the Engineer may be continued in service without change. The Contractor shall repair at its own expense any and all damage to such facilities resulting from negligence or carelessness on the part of his operations.
- C. Spring or seepage water encountered shall be reported to the City Engineer if not provided for by the Plans.

4.3.1.4 Excavation Below Subgrade (EBS):

- A. Deposits of frost heave material, unstable silty soils, wet and unstable soil, topsoil containing considerable humus or vegetable matter, rocks, or other undesirable foundation material shall be removed from the area within the roadbed slopes to the depth shown on the Plans or as directed by the Engineer. Do not proceed with undercutting until authorized by the Engineer.

- B. Humus-bearing soils and other excavated materials not suitable for embankment construction shall be disposed of as outlined in "Disposal of Surplus or Unsuitable Material", below.
- C. Backfill shall be made with 1-1/4-inch or 3-inch crushed stone unless otherwise indicated on the Plans or in the Special Provisions.

4.3.1.5 Grading the Roadway, Intersections, and Entrances:

- A. All suitable material removed from excavation shall be used in the construction of the roadway, as far as practicable, and at such other places as shown on the Plans.
- B. All excavated slopes or areas and all embankment slopes or areas designated to be covered with topsoil or salvaged topsoil shall be undercut or underfilled to the necessary depth to provide for the specified amount of topsoil being placed and finished to the required grade lines and section.
- C. The excavating shall be so conducted as to avoid removing or loosening any material outside the required slopes, and any such material which may be removed or loosened shall be replaced and thoroughly compacted to the required cross section.
- D. All intersecting roads, approaches, entrances and driveways shall be graded as shown on the Plans or as laid out in the field by the Engineer. The work of constructing intersections and private entrances, trimming shoulders and slopes, finishing and blading the earth subgrade, and completing the ditches to proper alignment, grade and cross section shall follow the rough grading closely.
- E. Grading operations shall not be performed to the detriment of the work of trimming and finishing the roadway, and blading and maintaining the roadbed and earth subgrade. The Engineer shall have full authority to order the suspension of grading and other operations pending the adequate and proper performance of such trimming, finishing and maintenance work.
- F. Phase the work as to protect the subgrade from contamination, inundation or excessive water compromising the base. Areas that are found to be compromised shall be excavated below subgrade a minimum of 6 inches or as determined in the field by the Engineer, backfilled and compacted at the Contractor's expense.

4.3.1.6 Constructing Ditches, Dikes and Channels:

- A. Inlets, outlets, swamps, berms and intercepting ditches, dikes, or intercepting embankments and channels shall be constructed where and as shown on the Plans or where and as directed by the Engineer and shall be maintained to the required section until final acceptance. The work shall be performed in proper sequence with other work.
- B. Excavation from ditches and channels shall be completed as part of shaping and grading the roadway subgrade, unless otherwise specified.
- C. All suitable materials excavated from ditches and channels shall be used in the construction of the roadway and backfilling of abandoned ditches and channels, as far as practicable, or shall be otherwise disposed of as shown on the Plans or as directed by the Engineer.
- D. No waste or surplus excavation shall be deposited within 3 feet from the edge of the ditch or channel or within such greater distance, as may be required, to insure stability of the side slopes. Any such waste or surplus material shall be spread in thin uniform layers nearly leveled and shaped. Roots, stumps, logs and other objectionable material in the slopes and bottoms of ditches and channels shall be removed and the holes backfilled with suitable material, or they shall be cut to conform to the cross section shown on the Plans. Where necessary, sufficient openings shall be provided in spoil banks to permit surface drainage of adjacent lands.
- E. Intercepting ditches or dikes shall be constructed as soon as practical after clearing and grubbing operations are completed and prior to or during the operations of excavating the cuts. Suitable outlets or flumes to roadway ditches shall be provided where necessary in accordance with the details shown on the Plans.

4.3.1.7 Excavating Rock:

- A. Rock, when encountered in excavation, shall be removed to a depth of 6 inches below the earth subgrade between limits of the shoulder slopes. In the event design details covering the depth of rock excavation are incorporated in the Plans, the work shall conform thereto. When specific materials are not required by the Plans and special provisions or ordered by the Engineer, the backfill for areas of excavation below subgrade in rock excavation shall be selected material obtained from roadway and drainage excavation. When excavation methods employed by the Contractor leave undrained pockets in the rock surface, the Contractor shall, at his own expense, properly drain such depressions.

- B. Excavation of rock cuts shall be performed by such methods and with such equipment that the resulting backslopes conform to the slopes shown on the Plans or to the slopes designated by the stakes set for excavation, without creating depressions in or substantial displacement of material outside the lines, limits or slope planes defined by the stakes. The backslopes in rock cuts shall be "scaled" to dislodge loose rock, and material so removed shall be disposed of in the manner prescribed for other excavation.
- C. The slopes of rock cuts when designated to receive topsoil or salvaged topsoil shall be undercut the necessary depth to provide for placing the specified amount of topsoil and finishing to the required section.

4.3.1.8 Removing Masonry Walls, Foundations of Buildings, or Other Structures:

- A. Removing masonry walls, foundations of buildings or other structures shall consist of removal of that portion of such walls or foundations to a minimum of 2 feet below earth subgrade or 2 feet below the slopes or natural ground elevation as may be necessary due to the location of the walls or foundations. Those portions of all basements or other openings resulting from the removal of buildings or other structures, or openings resulting from the removal of walls or foundations of such buildings or structures, lying within the shoulder lines of the new roadway, shall be backfilled to subgrade elevation with granular backfill. When so provided, similar openings lying outside the ditch lines of the new roadway shall be backfilled with material secured from roadway excavation.

4.3.1.9 Disposing of Stones, Broken Rock and Boulders:

- A. All stones, broken rock and boulders not required for other construction included in the contract shall, insofar as possible, be placed in embankments outside the limits of any proposed structure or structure piling, and the voids between them shall be completely filled with satisfactory soil. All such material that cannot be incorporated in the work shall be disposed of by the Contractor at its own expense, either by burying in the ground within the right-of-way in an approved manner, or by placing at sites provided by the Contractor, not less than 300 feet outside the right-of-way or from a public street. When placed outside the right-of-way, the material shall be disposed of so as to present a neat and orderly appearance, and the Contractor shall obtain and file with the Engineer written permission from the owner on whose property the material is placed.

4.3.1.10 Disposal of Surplus or Unsuitable Material:

- A. Vegetation shall be disposed of as specified in Section 03 – Existing Conditions, Subsurface Investigation, and Demolition. Material containing humus or of a nature suitable to support vegetation but unsatisfactory for constructing embankments shall be conserved, when required, and utilized in salvaged topsoil operations. All surplus humus-bearing soils, and other excavated materials not suitable for embankment construction but suitable to uniformly widen embankments, to flatten slopes and to fill low places in the right-of-way shall be used for such purposes, unless otherwise provided.
- B. In no case shall excavated material be deposited along the roadsides above the elevation of the adjacent roadbed, unless so provided on the Plans or by authorization.
- C. Surplus excavation which is not or cannot be disposed of in a manner as herein provided shall be disposed of by the Contractor at his own expense in places specified by the Engineer within the City of Waukesha. In all cases the material shall be disposed of so as to present a neat and trim appearance, and in no case shall such material be disposed of in such a manner as to create a nuisance.
- D. Overhaul will not be allowed for the disposal of surplus or unsuitable material.

4.3.1.11 Finish Grading:

- A. The grading, trimming and finishing shall be completed prior to construction of the subbase, base or surface courses, or acceptance of the work.
- B. Adjustment in slopes, to avoid injury to standing trees or to harmonize with existing landscape features, especially at the intersection of cuts and fills, shall be made and the transition to such adjusted slopes shall be gradual.
- C. The crests of earth cut banks shall be rounded as indicated on the Plans or as directed by the Engineer.
- D. All earth slopes shall be constructed to a surface that will merge with adjacent terrain and be in substantial accordance with the cross sections.
- E. During grading operations and pending final acceptance prior to placement of base or surface courses, the Contractor shall provide continuous maintenance of the entire roadbed and perform all blading and repair work necessary to keep the grade smooth and to the required grade and cross section.
- F. Washouts caused by erosion shall be refilled and properly compacted.
- G. The shoulders shall be trimmed, shaped and restored to the finished cross section by means of a grader and other equipment, supplemented by hand work where necessary to produce smooth surfaces and slopes and uniform cross sections. In the case of a graded roadbed without surfacing the entire roadbed shall be trimmed and shaped in the same manner.

- H. Loose and waste stone not incorporated in and made a part of required construction, that would fail to pass a 3-inch ring, shall be removed from the surface of the roadway and from the surface of the ground within all areas of the clearing and grubbing limits. No 3-inch or larger stones or consolidated material shall be allowed within the top 18-inches of fill areas.
- I. The dragging, pushing or scraping of material across or along the finished pavement or surface course will not be permitted.
- J. The slopes of embankments, excavations, borrow pits and roadside pits shall be trimmed and finished to the established or specified lines and grades; ditches and channels shall be cleared of debris and obstructions and their slopes and beds trimmed smooth and true to line and grade; and excess earth, debris, spoil banks, or other waste material adjacent to culverts, bridges, ditches, channels, poles, posts, trees, or other objects, shall be removed, shaped, trimmed and left in a neat orderly condition. Stones, roots or other waste matter exposed on embankment or excavation slopes, which are liable to be loosened and dislodged, shall be removed and all slash and debris from clearing and grubbing operations disposed of and the entire roadway left in a neat, presentable condition. Holes and depressions appearing on the surface within the grubbing limits and caused by grubbing operations shall be filled with suitable material.
- K. Subgrades shall be formed in accordance with the Plans within a tolerance of minus 2 inches.
- L. Sideslopes shall be graded to a minimum of 1-1/2 feet horizontal to 1 foot vertical or as shown on the Plans or directed by the Engineer.
- M. Grade shall be cut to a vertical face at the edge of abutting pavements.
- N. Areas of unyielding or unsuitable material shall be excavated and backfilled with material as ordered by the Engineer. The right is reserved to make such minor adjustments in the Finished Grade line from that as shown on the Plans as may be necessary or desirable to maintain the characteristics of a stabilized foundation by minimizing the amount of cutting into or filling over such stabilized foundation, provided such adjustments do not impair the riding qualities, drainage or appearance of the finished pavement, or cause, in effect, a deviation from a grade established by appropriate municipal ordinance.

4.3.2 EMBANKMENTS

4.3.2.1 General:

- A. This work shall consist of placing in embankments and in miscellaneous backfill areas, material obtained from roadway and drainage excavation, additional fill excavation, or excavation for structures, all in accordance with these specifications and in conformity with the lines, grades, cross sections and dimensions shown on the Plans or as ordered by the Engineer.

4.3.2.2 Preparing Roadway Foundation:

- A. Preparing roadway foundation shall be in accordance with the requirements under the "Roadway and Drainage Excavation" article, above, provided further that where special compaction is specified, the foundation shall be compacted as provided below.
- B. Ice and snow shall be removed from the surface of the ground prior to placing embankment thereon.
- C. Unless otherwise provided in the contract, the construction of embankments shall be discontinued in the fall or early winter when weather conditions prevail which will cause substantial freezing of the materials as they are placed in the embankment, except when the materials used are from rock excavation and contain only minor quantities of silt, clay, loam or similar materials.

4.3.2.3 Placing Layers:

- A. Embankment shall, except as hereinafter specified be constructed in layers. The construction of an embankment shall begin at the lowest point of the fill below the grade, at the bottom of ravines, and shall be constructed in layers by spreading and leveling the material during placement. Individual layers shall be spread evenly to uniform thickness throughout and parallel with the finished grade for the full width of the embankment, unless otherwise directed. The thickness of the layer shall be as necessary to secure the required compaction, but shall not exceed 12 inches prior to compaction. Each layer shall be compacted as hereinafter provided.
- B. On side hills too steep to operate hauling equipment, over low, wet ground, in wet marshes, or when filling in water, a single layer may be constructed to thickness no greater than necessary to support the hauling equipment while placing subsequent layers.

4.3.2.4 Compaction:

- A. General:
 - 1. All embankments shall be compacted in accordance with the requirements for standard compaction or for special compaction. Standard compaction will be required, unless special compaction is called for on the Plans or in the Contract.

2. Embankment material shall not be compacted when the moisture content is such as to cause excessive rutting by the hauling equipment, or excessive displacement or distortion under compacting equipment. Where such conditions exist, the materials shall be allowed to dry prior to compacting. When necessary, drying of such materials shall be accelerated by aeration or manipulation by means of blade graders, harrows, discs or other similar equipment.
3. When embankment material does not contain sufficient moisture to compact properly, water shall be added in quantities deemed necessary to aid and accelerate and to secure effective compaction.

B. Standard Compaction:

1. The material for the embankment shall be deposited, spread and leveled, as hereinbefore provided, in layers not exceeding 12 inches in thickness before compaction. Each layer of the embankment shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be attained for each layer before any material for a succeeding layer is placed thereon.
2. Hauling and leveling equipment shall be routed and distributed over each layer of the fill in such a manner as to make use of the compaction afforded thereby. In addition to the compactions so attained, the compaction shall be performed by means of tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment devised for the purpose which will produce the required results in the materials encountered and be subject to the approval of the Engineer.
3. Tamping rollers, when used for compaction, shall exert a weight of not less than 150 pounds per square inch of tamping surface on each tamping foot in a transverse row.
4. Pneumatic-tired rollers, when used for compaction, shall have a weight of not less than 150 pounds per linear inch of over-all rolling width.

C. Special Compaction:

1. When special compaction is required, the work shall be performed as directed and in accordance with the provisions of Sections 207.3.6.3 and 207.3.6.4 "Special Compaction" of the Wisconsin Highway Specifications.

4.3.2.5 Slopes:

- A. Embankment slopes shall be built to the lines and section shown on the Plans or as directed by the Engineer. The slopes of rock fill embankments shall have all voids completely filled with rock fines or soil and trimmed to a smooth uniform appearance.
- B. Allowance shall be made in the construction of embankments, whose slopes are designated to receive topsoil or salvaged topsoil, whereby the placing of such topsoil will result in the finished embankment conforming to the required section.

4.3.2.6 Backfilling Structures:

- A. The work of backfilling shall consist of placing and compacting all required embankment over and adjacent to all culverts, bridges, retaining walls and other structures and shall include all backfilling which is not performed incidental to the excavation for such structures.
- B. The materials and construction methods shall be in accordance with the requirements as specified under Excavation for Structures, Section 206.3.12 of Wisconsin Highway Specifications.
- C. Where required in the Special Provisions or on the Plans, granular backfill shall be used for backfill.
- D. When special compaction of the embankment at the structure site is specified the backfill material shall also be compacted to 95% of maximum density.

4.3.2.7 Finish Grading:

- A. The earth grade shall be trimmed, finished and maintained as specified under roadway and drainage excavation construction methods.
- B. Rock, stone and boulders excavated by plowing and scarifying operations and required to be removed and disposed of will not be measured for payment.

4.3.3 ADDITIONAL FILL EXCAVATION

4.3.3.1 General:

- A. Additional fill excavation shall consist of furnishing, excavating, hauling and placing material required to complete the roadbed, embankments, subgrade, shoulders, intersections, approaches, entrances, etc., when sufficient quantities of satisfactory material for such purposes cannot be obtained from within the limits of roadway and drainage excavation, excavation for structures and other designated excavation and when such additional material is obtained from borrow pits provided by the Contractor outside the right-of-way limits.

4.3.3.2 Construction Methods:

- A. The area from which material for additional fill excavation will be obtained shall be cleared and grubbed in the same manner as specified for roadway and drainage excavation. Borrow pits shall be excavated in such a manner as to permit accurate measurement. When additional fill excavation material is obtained from pits located within sight of a public street, the available topsoil or other soil overlying such pit and of a nature as would be conducive to plant growth shall be stripped off and placed in stockpiles, in sufficient quantities to cover all surfaces of excavated areas within such pit to a depth of 4 to 6 inches. After the pit has been trimmed and finished, such salvaged material shall be uniformly spread over all excavated areas of such borrow pit.
- B. All stone, broken rock, boulders and other materials which are not satisfactory for use for the purposes intended shall be disposed of by the Contractor at its own cost and expense as specified therefore under roadway and drainage excavation.
- C. All stumps, trees, logs, brush, tops and other debris resulting from clearing and grubbing work in borrow pit areas shall be disposed of by the Contractor as specified therefore under clearing and grubbing.

4.3.4 TRENCHING AND BACKFILLING

- 4.3.4.1 Trenching and backfilling shall be in accordance with Parts II and III of the Wisconsin Sewer and Water Specifications and the following requirements.
- 4.3.4.2 Sidesloping of trenches will not be allowed where damage to sidewalk, curb, structures, underground utilities, and trees would be caused by such sidesloping.
- 4.3.4.3 The Contractor is responsible for damage to adjoining buildings and grounds caused by the construction.
- 4.3.4.4 The location of structures and obstacles shall not be taken as conclusive. Verification to the satisfaction of the Contractor shall be assumed as a condition of its bid; and therefore, the Contractor shall be solely responsible for all damages resulting from his/her activities.
- 4.3.4.5 The Contractor shall be solely responsible for providing trench support in accordance with all applicable State and Federal regulations. The City and City's representatives shall be held harmless in all matters regarding shoring and bracing.
- 4.3.4.6 Do not remove any pavement beyond what is necessary for installing the utility line than what can be expected to be installed that day. Once the utility work is complete, pavement can be removed for the road reconstruction.
- 4.3.4.7 If hazardous substances or archaeological or historic remains are encountered during trenching work, comply with the requirements of Section 01 – General Requirements.

- 4.3.4.8 Dispose of excess soil. The disposal site used shall be approved by the Engineer.
- 4.3.4.9 Compact trench backfill as specified in "Part 4 Schedules and Charts", below.
- 4.3.4.10 If required by the Engineer at some locations, slurry backfill shall be provided.
- 4.3.4.11 Rock excavation (solid and loose) in trenches shall conform to Chapter 2.2.9 of the Wisconsin Sewer and Water Specifications and the following:
 - A. Solid rock excavation shall include ledge rock which requires drilling and will be paid for under the bid item for "Solid Rock Excavation".
 - B. Loose rock excavation shall include all boulders exceeding one cubic yard in volume and will be paid for under the bid item for "Loose Rock Excavation".
 - C. Shales, hard pan, masonry and concrete rubble, boulders less than one cubic yard will not be considered rock excavation.
- 4.3.4.12 Thawing of frozen ground shall be accomplished by a method which does not emit excessive smoke or flame, or otherwise inconvenience the public. The Engineer reserves the right to prohibit burning whenever he deems it is undesirable. The method used must be approved by the Engineer and the City Fire Department. If thawing of frozen ground is necessary for underground construction activities, it will be paid for under the bid item for "Frost Breaking and Removal." The width and depth of frost thawing shall be completed to the dimensions necessary in order to complete the proposed work.

4.3.5 PLACING GEOTEXTILE FABRIC TYPE SAS NON-WOVEN

- 4.3.5.1 Install subgrade aggregate separation fabric where directed by the Engineer. Place fabric in accordance with the requirements of Section 645 of the Wisconsin Highway Specifications for Type SAS geotextile.

4.3.6 PLACING GEOTEXTILE GRID TYPE BX1100

- 4.3.6.1 Install geotextile grid where directed by the Engineer. Place grid in accordance with the requirements of Section 645 of the Wisconsin Highway Specifications for Type SR geogrid.

4.3.7 GRAVELING

4.3.7.1 General:

- A. Place crushed aggregate base course in accordance with Section 305 of the Wisconsin Highway Specifications and as specified below.

4.3.7.2 Subgrade:

- A. Prior to the placing crushed aggregate base course, proof-roll the subgrade in the presence of the Engineer with a fully loaded tandem-axle dump truck. No material shall be placed on a soft or spongy subgrade or on a subgrade covered by ice or snow.
- B. No material shall be placed on a dusty subgrade where the existing conditions would hinder or preclude proper compaction of the course or courses being placed; nor where the lack of moisture would allow such rapid dissipation of moisture from the mix that the proper moisture content of the mix cannot be maintained during compaction operations.

4.3.7.3 Construction Methods:

- A. The gravel or crushed stone base course shall be constructed to the width and section shown on the Plans or in the Special Provisions and in layers of approximately equal thickness, not to exceed the lift thickness specified in "Part 4 Schedules and Charts", below.
- B. Each layer shall be constructed as far in advance of the succeeding layer as the Engineer may direct. The work shall, in general proceed from the point on the project nearest the source of supply of the aggregate in order that the hauling equipment, will travel over the previously placed material, and the hauling equipment shall be routed as uniformly as possible over all portions of the previously constructed courses or layers of the base course.
- C. The material shall be deposited on the subgrade or previously placed layer in such a manner that it may be spread to a uniform layer of the required dimensions. Excessive manipulation or mixing which will cause segregation between the coarse and fine materials shall be avoided.
- D. Blade machines of an approved type or other equipment when producing equivalent or better results, shall be used at the point of dumping to spread the aggregate and to aid in maintaining the subgrade or previously constructed layers immediately in advance of the placing of any layer or course. Such equipment shall be available and in use at all times while material is being delivered and placed.
- E. After a layer or course has been placed and spread to the required thickness, width and contour, it shall be compacted to the extent necessary to produce a condition such that there will be no appreciable displacement of the material laterally or longitudinally under traffic.
- F. In the event the material is deficient in moisture content, to readily accomplish the result, it shall be moistened to the degree necessary during compaction operation by means of equipment adapted to the purpose.

G. All areas where proper compaction is not obtainable due to segregation of materials, excess fines, or other deficiencies in the aggregate, shall be reworked as necessary or the material in them removed and replaced with material that will yield the required results.

H. Prior to and during compaction operations, the material shall be shaped and maintained to the proper dimensions and contour by means of blade graders or other suitable equipment. The surface of each layer shall be kept true and smooth at all times.

4.3.7.4 Maintenance:

A. The Contractor shall be responsible for and maintain the work until final acceptance thereof, except as provided under Sections 104.6 and 105.10 of the Wisconsin Highway Specifications.

4.4 PART 4 SCHEDULES AND CHARTS

4.4.1 COMPACTION SCHEDULE

<u>Location</u>	<u>Lift Thickness</u>	<u>Compaction ⁽¹⁾</u>
Structure Slab Subgrade	8"	95%
Pavement and Walk Subgrade	12"	Standard Compaction
Subgrade Outside Structures, Pavements, and Walks	12"	Standard Compaction
Crushed Aggregate Base Course	12"	Standard Compaction
Trench Backfill, Top 3 Feet	12"	95%
Trench Backfill, Below Top 3 Feet		
Initial Lift	24"	90%
Additional Lifts	12"	90%

⁽¹⁾ Percent of maximum density determined in accordance with ASTM D698 (Standard Proctor test).

END OF SECTION

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5 SEWERS AND SEWER STRUCTURES

5.1 GENERAL

5.1.1 SUMMARY

5.1.1.1 This section describes:

- A. Furnishing and installing sewers and sewer structures.
- B. Repairing sewer structures.
- C. Rehabilitating sewers.
- D. Rehabilitating manholes.
- E. Furnishing and installing riprap.
- F. Televising sanitary and storm sewers.

5.1.2 RELATED SECTIONS

5.1.2.1 Section 4 – Earthwork, Excavation, and Boring.

5.1.3 SUBMITTALS

5.1.3.1 Sewer Product Data: Submit product data for pipe, fittings, valves, and couplings.

5.1.3.2 Sewer Structure Shop Drawings: Submit shop drawings for sewer manholes, inlets, and other structures.

- A. Include certification that installed steps when tested in accordance with Section 10 of AASHTO T280 can withstand a vertical load of 800 pounds and a horizontal load of 400 pounds.

5.1.3.3 Sewer Bypass Plan: For projects involving repair, rehabilitation, or replacement of existing sanitary sewer lines or appurtenances, submit a proposed sewerage diversion and pumping plan prior to the preconstruction meeting.

5.1.3.4 Sewer Structure Repair Submittals: For projects with sewer structure repair work, submit product data for all sewer structure repair materials.

5.1.3.5 Sewer Lining Submittals: For projects with sewer lining work, submit the following:

- A. Manufacturer's product literature, application, and installation requirements for materials used in liner.
- B. Manufacturer's product certification for materials used in liner.
- C. Liner pipe finished thickness design.

- D. Pre- and post-construction videos and reports.
- 5.1.3.6 Manhole Rehabilitation Submittals: For projects with manhole rehabilitation work, submit product data for all rehabilitation materials.
- 5.1.3.7 Riprap and Fabric Product Data:
 - A. Submit information on sources of riprap. Provide access to sources to enable Engineer to inspect and obtain samples. Do not deliver riprap until reviewed by Engineer.
 - B. Submit fabric product data. Include material samples, certification of physical properties, and installation procedures.
- 5.1.3.8 MSDS Information: Submit manufacturer's safety data sheets (MSDS) for each solvent, primer, coating, adhesive, and sealant material to be used at the project site.
- 5.1.3.9 Test Reports: Submit test reports for:
 - A. Plant load testing for concrete pipe.
 - B. Leakage tests for sanitary sewer.
 - C. Pressure tests for pressure sanitary sewer.
 - D. Deflection tests for ASTM D3034 PVC sewer pipe.
- 5.1.3.10 Sewer Televising Report: Submit videos and reports for the specified sewer televising.
- 5.1.3.11 Record Drawings: Accurately record locations of service laterals and field changes on a set of Plans. Prior to final application for payment, deliver record drawings to Engineer.

5.1.4 TESTING

- 5.1.4.1 Concrete Pipe Plant Testing: Three-edge bearing load test circular reinforced concrete sewer pipe per ASTM C497 is required for pipe manufactured for this project. For pipe testing frequency, pipe lot shall be defined as pipe of same diameter and class manufactured by the same process in one plant, over a period not to exceed approximately two weeks. Testing frequency shall be as follows:
 - A. For lots of 100 or more pipes, 1 percent of number of pipe in lot with a minimum of 2 pipes selected.
 - B. For lots less than 100 pipes, 1 pipe will be selected.
 - C. For lots less than 10 pipes, testing may be waived by Engineer if manufacturing plant has satisfactory specification compliance on other pipe lots.

- 5.1.4.2 Sanitary Sewer Leakage Testing: Perform sanitary sewer leakage testing using low pressure air test in accordance with Chapter 3.7.3 of the Wisconsin Sewer and Water Specifications.
- 5.1.4.3 Pressure Sanitary Sewer Pressure Testing: Perform hydrostatic pressure testing on pressure sanitary sewer in accordance with Chapter 3.2.6(n) of the Wisconsin Sewer and Water Specifications.
- 5.1.4.4 PVC Sewer Deflection Testing: Perform deflection testing on ASTM D3034 PVC sewer pipe in accordance with Chapter 3.2.6(i)4. of the Wisconsin Sewer and Water Specifications.

5.1.5 WARRANTIES

- 5.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

5.1.6 MEASUREMENT AND PAYMENT

5.1.6.1 (diameter and type) Sanitary Sewer Pipe:

- A. Measurement: The City will measure (diameter and type) Sanitary Sewer Pipe by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter and type) Sanitary Sewer Pipe". Payment is full compensation for furnishing and installing sanitary sewer; for excavating; for furnishing and installing bedding, cover, and backfill; for diverting existing flow around the work area; and for testing.

5.1.6.2 (diameter) Sanitary Sewer Lateral:

- A. Measurement: The City will measure (diameter) Sanitary Sewer Lateral by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter) Sanitary Sewer Lateral". Payment is full compensation for furnishing and installing sanitary lateral; for excavating; for connecting to existing lateral where applicable; for furnishing and installing bedding, cover, and backfill; and for testing.

5.1.6.3 (diameter and type) Pressure Sanitary Sewer Pipe:

- A. Measurement: The City will measure (diameter and type) Pressure Sanitary Sewer Pipe by the linear foot acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter and type) Pressure Sanitary Sewer Pipe". Payment is full compensation for furnishing and installing pressure sanitary sewer; for excavating; for furnishing and installing bedding, cover, and backfill; for diverting existing flow around the work area; and for testing.

5.1.6.4 (diameter) Lateral Replacement (Open Cut):

- A. Measurement: The City will measure (diameter) Lateral Replacement (Open Cut) by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter) Lateral Replacement (Open Cut)". Payment is full compensation for furnishing and installing sanitary lateral; for excavating; for connecting to existing lateral; for furnishing and installing bedding, cover, and backfill; and for testing.

5.1.6.5 (diameter) Lateral Replacement (Pipe Bursting):

- A. Measurement: The City will measure (diameter) Lateral Replacement (Pipe Bursting) by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter) Lateral Replacement (Pipe Bursting)". Payment is full compensation for furnishing and installing sanitary lateral using pipe bursting and for testing.

5.1.6.6 Excavation and Lateral Connection at Right-of-Way (Pipe Bursting):

- A. Measurement: The City will measure Excavation and Lateral Connection at Right-of-Way (Pipe Bursting) by the number of connections acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Excavation and Lateral Connection at Right-of-Way (Pipe Bursting)". Payment is full compensation for excavating, connecting to existing lateral, and backfilling.

5.1.6.7 (diameter) Sanitary Manhole:

- A. Measurement: The City will measure (diameter) Sanitary Manhole by the vertical foot acceptably completed, measured to the nearest tenth of a foot from invert of out flowing sewer to the finished surface.

- B. Payment: Payment for measured quantities will be made at the contract unit price per vertical foot for "(diameter) Sanitary Manhole". Payment is full compensation for furnishing and installing manhole including risers, base, cone/top, adjusting rings, external sealing wrap, and appurtenances; for installing the City-furnished casting; for adjusting structure to finished grade; and for excavating and backfilling. Furnish and installing chimney seal will be paid for separately.

5.1.6.8 (internal or external) Chimney Seal:

- A. Measurement: The City will measure (internal or external) Chimney Seal by the number of chimney seals acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "(internal or external) Chimney Seal". Payment is full compensation for furnishing and installing the designated type of chimney seal on an existing or new sanitary manhole chimney.

5.1.6.9 (diameter) Sanitary Sewer Outside Drop:

- A. Measurement: The City will measure (diameter) Sanitary Sewer Outside Drop by the vertical foot acceptably completed, measured to the nearest tenth of a foot between high and low inverts of drop assembly.
- B. Payment: Payment for measured quantities will be made at the contract unit price per vertical foot for "(diameter) Sanitary Sewer Outside Drop". Payment is full compensation for furnishing and installing drop pipe and associated anchoring and bedding material; and for excavating and backfilling.

5.1.6.10 (diameter and type) Storm Sewer Pipe:

- A. Measurement: The City will measure (diameter and type) Storm Sewer Pipe by the linear foot acceptably completed. Storm sewer, less than 48-in. diameter (width), will be measured horizontally from center to center of proposed or existing manholes or to end of sewer pipe not terminating in a manhole. Storm sewer, 48-in. diameter (width) or greater, will be measured horizontally from inside face to inside face of manholes or structures or to end of sewer pipe not terminating in a manhole or structure. Storm sewer leads or drains will be measured horizontally from center line of storm inlet to center line of manhole for sewer less than 48-in., or from center line of storm inlet to inside face of structures for sewers 48-in. or greater.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(diameter and type) Storm Sewer Pipe". Payment is full compensation for Payment is full compensation for furnishing and installing storm sewer; for excavating; for furnishing and installing bedding, cover, and backfill; for diverting existing flow around the work area; and for testing.

5.1.6.11 (diameter and type) Flared End Section:

- A. Measurement: The City will measure (diameter and type) Flared End Section by the number of end sections acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "(diameter and type) Flared End Section". Payment is full compensation for furnishing and installing flared end section; and for excavating and backfilling.

5.1.6.12 Flared End Section Trash Rack:

- A. Measurement: The City will measure Flared End Section Trash Rack by the number of end section trash racks acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Flared End Section Trash Rack". Payment is full compensation for furnishing and installing flared end section trash rack.

5.1.6.13 (diameter) Storm Manhole:

- A. Measurement: The City will measure (diameter) Storm Manhole by the number of storm manholes acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "(diameter) Storm Manhole". Payment is full compensation for furnishing and installing manhole including risers, base, cone/top, adjusting rings, and appurtenances; for installing the City-furnished casting; for adjusting structure to finished grade; and for excavating and backfilling.

5.1.6.14 (size) Storm Inlet:

- A. Measurement: The City will measure (size) Storm Inlet by the number of storm inlets acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "(size) Storm Inlet". Payment is full compensation for furnishing and installing storm inlet including risers, base, adjusting rings, and appurtenances; for installing the City-furnished casting; for adjusting structure to finished grade; and for excavating and backfilling.

5.1.6.15 Chimney Replacement:

- A. Measurement: The City will measure Chimney Replacement by the number of chimneys acceptably replaced.

- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Chimney Replacement". Payment is full compensation for removing the existing casting and manhole chimney; for furnishing and installing new adjusting rings; for reinstalling the existing casting or a new City-furnished casting; and for excavating and backfilling. Furnishing and installing a chimney seal on a sanitary manhole chimney will be paid for separately.

5.1.6.16 Storm Sewer Inlet Repair:

- A. Measurement: The City will measure Storm Sewer Inlet Repair by the vertical foot of inlet wall acceptably repaired.
- B. Payment: Payment for measured quantities will be made at the contract unit price per vertical foot for "Storm Sewer Inlet Repair". Payment is full compensation for furnishing and installing materials to repair the inlet walls.

5.1.6.17 Storm Sewer Manhole Repair:

- A. Measurement: The City will measure Storm Sewer Manhole Repair by the vertical foot of manhole wall acceptably repaired.
- B. Payment: Payment for measured quantities will be made at the contract unit price per vertical foot for "Storm Sewer Manhole Repair". Payment is full compensation for furnishing and installing materials to repair the manhole walls.

5.1.6.18 Sewer Rehabilitation:

- A. The City will measure and pay for acceptably completed sanitary sewer rehabilitation work under the following items:
 - 1. Per Each Sanitary Sewer Spot Repair.
 - 2. Per Linear Foot of (diameter) CIPP (type) Sewer Pipe.
 - 3. Per Each Sanitary Lateral Reinstatement.
 - 4. Per Each Storm Lateral Reinstatement.
 - 5. Per Each Sanitary Lateral Connection Test and Seal.
 - 6. Payment for each item is full compensation for the specified work.

5.1.6.19 Sewer Lateral Rehabilitation:

- A. The City will measure and pay for acceptably completed sanitary sewer lateral rehabilitation work under the following items:
 - 1. Per Each Sanitary Lateral Cleanout.
 - 2. Per Each Sanitary Lateral Cleaning and Prelining Video Inspection.

3. Per Each Sanitary Lateral Spot Repair (Up to 5 Feet of Repair at Each Spot).
4. Per Each Sanitary Lateral Lining (CIPP) Within 25 (twenty-five) Feet of Sewer Main.
5. Per Linear Foot of Sanitary Lateral Lining (CIPP) Additional Length Over 25 (twenty-five) Feet from Sewer Main.

B. Payment for each item is full compensation for the specified work.

5.1.6.20 Manhole Rehabilitation:

A. The City will measure and pay for acceptably completed manhole rehabilitation work under the following items:

1. Per Each Rehabilitate (type) Manhole w/ Cementitious Liner.
2. Per Each Sanitary Manhole Bench / Invert / Trough Work Minor.
3. Per Each Sanitary Manhole Bench / Invert / Trough Work Major.

B. Payment for each item is full compensation for the specified work.

5.1.6.21 (size) Riprap:

A. Measurement: The City will measure (size) Riprap by the cubic yard acceptably completed.

B. Payment: Payment for measured quantities will be made at the contract unit price per cubic yard for "(size) Riprap". Payment is full compensation for and for furnishing and installing riprap.

5.1.6.22 Riprap Filter Fabric (type):

A. Measurement: The City will measure Riprap Filter Fabric (type) by the square yard acceptably completed.

B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Riprap Filter Fabric (type)". Payment is full compensation for preparing the bed; and for furnishing and installing filter fabric.

5.1.6.23 Sanitary Sewer Cleaning and Televising – Prepaving:

A. Measurement: The City will measure Sanitary Sewer Cleaning and Televising – Prepaving by the linear foot acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Sanitary Sewer Cleaning and Televising – Prepaving". Payment is full compensation for televising sanitary sewer and submitting the specified documentation.

5.1.6.24 Storm Sewer Cleaning and Televising – Prepaving:

- A. Measurement: The City will measure Storm Sewer Cleaning and Televising – Prepaving by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Storm Sewer Cleaning and Televising – Prepaving". Payment is full compensation for televising storm sewer and submitting the specified documentation.

5.1.6.25 Sanitary Sewer Lateral Televising – Prepaving:

- A. Measurement: The City will measure Sanitary Sewer Lateral Televising – Prepaving by the number of laterals acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Sanitary Sewer Lateral Televising – Prepaving". Payment is full compensation for televising sanitary lateral and submitting the specified documentation.

5.1.6.26 Storm Sewer Lateral Televising – Prepaving:

- A. Measurement: The City will measure Storm Sewer Lateral Televising – Prepaving by the number of laterals acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Storm Sewer Lateral Televising – Prepaving". Payment is full compensation for televising storm lateral and submitting the specified documentation.

5.2 PRODUCTS

5.2.1 SANITARY SEWER

5.2.1.1 Materials for sanitary sewer and sanitary laterals shall conform to Part III and Part V of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.

5.2.1.2 Sewer Main Pipe:

- A. Sanitary sewer shall be:
 - 1. PVC conforming to ASTM D3034, having a dimensional ratio of SDR-35 and gasketed joints where cover over pipe is 15 feet or less.

2. PVC conforming to ASTM D3034, having a dimensional ratio of SDR-26 and gasketed joints where cover over the pipe exceeds 15 feet.
3. PVC (green in color for in-ground identification) conforming to AWWA C-900 with gasketed joints where designated on the Plans.

B. Sewer main to sewer main connections shall be:

1. Gasketed PVC connectors for PVC to PVC connections.
2. Fernco Shielded Coupling, or approved equal, for dissimilar pipe material.

5.2.1.3 Sanitary Laterals:

A. Laterals installed by open cut shall be:

1. PVC conforming to ASTM D3034, having the same dimensional ratio as the proposed sewer main and gasketed joints.
2. PVC conforming to AWWA C-900 with gasketed joints where designated on the Plans.

B. Laterals installed by pipe bursting shall be high density polyethylene pipe (HDPE) iron pipe sizing (IPS) with a dimensional ratio (DR) of 17. Alternative pipe material may be considered provided it is compatible with the bursting equipment and approved by the Engineer.

C. Sewer lateral to sewer main connections shall be:

1. Inline wye fitting for connection of new mains to new or existing laterals.
2. Inserta Tee, or approved equal, for connection of existing mains to new laterals.

D. Sewer lateral to sewer lateral connections shall be:

1. Gasketed PVC connectors for PVC to PVC connections.
2. Fernco Shielded Couplings, or approved equal, for dissimilar pipe material.

5.2.2 PRESSURE SANITARY SEWER

5.2.2.1 Materials for pressure sanitary sewer shall conform to Part III of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.

5.2.2.2 Pressure sanitary sewer shall be one of the following as designated in the Special Provisions and/or Schedule of Prices:

- A. PVC pressure pipe complying with Chapter 8.51.2 of the Wisconsin Sewer and Water Specifications.
- B. HDPE pipe complying with Chapter 8.51.3 of the Wisconsin Sewer and Water Specifications.

5.2.3 STORM SEWER

- 5.2.3.1 Materials for storm sewer shall conform to Part III and Part V of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.
- 5.2.3.2 Storm sewer shall use reinforced concrete pipe (RCP) unless noted otherwise on the Plans. All pipes shall have an approved gasket joint. Use the following pipe classes:
 - A. Class V for 12-inch diameter pipe.
 - B. Class IV for 15-inch diameter pipe.
 - C. Class III for 18-inch diameter pipe and larger.
- 5.2.3.3 Where indicated on the Plans, PVC storm sewer shall PVC pipe conforming to ASTM D3034, having a dimensional ratio of SDR-35 and gasketed joints.
- 5.2.3.4 Provide RCP storm sewer bends of the same class as adjacent pipe sections.
- 5.2.3.5 All pipe to manhole connections shall provide for a watertight seal between pipe and manhole. Connect concrete storm sewer to precast concrete manholes and inlets by means of brick and mortar connection.
- 5.2.3.6 Reinforced concrete flared end sections shall conform to the requirements for Class II Reinforced Concrete Pipe of ASTM C76 and shall be used at the outfall of the storm sewer. Unless otherwise indicated, flared end sections shall be provided with a galvanized steel trash rack.

5.2.4 SEWER STRUCTURES

- 5.2.4.1 Materials for sanitary and storm structures shall conform to Part III of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.
- 5.2.4.2 Manholes: All manholes are to be reinforced precast concrete complying with ASTM C478. Manholes shall have pre-formed troughs and benches. Troughs for all incoming pipes shall be 4 inches deep or to the springline of the pipe, whichever is greater. The chimneys on new manholes shall be a minimum of 4 inches and a maximum of 8 inches. All manholes shall be built to the proposed grades.

- 5.2.4.3 Manhole Outside Drops: Manholes with outside drops shall be constructed in accordance with File No. 19 in the Wisconsin Sewer and Water Specifications, except Class "D" concrete will not be permitted. The outside drops are not to be precast with the structure.
- 5.2.4.4 Adjusting Rings: The entire chimney on all sanitary and storm manholes shall consist of adjustment rings manufactured from ARPRO® Expanded Polypropylene (EPP), black 5000 series meeting ASTM D3575 and ASTM D4819; B6D7G4L3M24S2T17W7 having a 27-inch I.D. The rings shall be manufactured using a high compression molding process to produce a finished density of 120 g/l ((7.5 pcf). Material shall be Pro-Ring as manufactured by Cretex Specialty Products. Paving rings are not permitted.
- A. "Grade" adjustment rings may contain either an upper and lower keyway (tongue and groove) for vertical alignment and/or an adhesive trench on the underside with a flat top.
 - B. "Finish" or "Flat" rings may either have a keyway (groove) on the underside for vertical alignment and/or an adhesive trench with a flat upper surface. These rings shall be available in heights (thicknesses) which will allow final adjustment of the frame and cover or grate to finished grade within the specified tolerance (see "Sewer Structure Construction" article). "Finish" rings may also have a keyway on the upper surface of the inner diameter to facilitate installation of an "Angle" ring.
 - C. "Angle" rings may either have an upper and lower keyway (tongue and groove) for vertical alignment and/or an adhesive trench on the underside. When required, the "Angle" ring or rings shall allow final adjustment of the frame and cover or grate to finished grade within the specified tolerance (see "Sewer Structure Construction" article).
 - D. For new manholes, the minimum height of adjusting rings for a chimney section above the cone as measured from the top of the cone or slab top shall be 4-inch with the maximum height of 8-inch. If more than 8 inches of adjusting rings are needed to set the casting to finished grade, then an additional barrel section shall be installed on the manhole.
 - E. Adhesive or sealant used for watertight installation of the EPP manhole grade adjustment rings shall be M-1 Structural Adhesive/Sealant or approved equal meeting the following specifications:
 - 1. ASTM C920, Type S, Grade NS, Class 25, Uses NT, T, M, G, A and O.
 - 2. Federal Specification TT-S-00230-C Type II, Class A.
 - 3. Corps of Engineers CRD-C-541, Type II, Class A.

- 5.2.4.5 Chimney Seals: Internal or external (as designated for the Contract) frame-chimney seal for sanitary manholes shall be manufactured by Cretex Specialty Products. The width of the seal shall be the minimum that is necessary to seal the joint between the frame and the Expanded Polypropylene (EPP) rings. Storm manholes do not require chimney seals.
- 5.2.4.6 External Sealing Wrap: An external sealing wrap shall be placed at all joints between precast sanitary manhole sections. The external sealing wrap shall meet, or exceed, the requirements of ASTM C877, Type II. External joint seals shall be Cretex Wrap External Manhole Joint Seals, as manufactured by Cretex Specialties Products, or approved equal.
- 5.2.4.7 Steps: Sanitary structure step construction shall meet the following requirements.
- A. Steps shall meet AASHTO M199.
 - B. Be installed 16-inches center to center maximum spacing.
 - C. Project a minimum clear distance of 4-inches from the wall at the point of embedment.
 - D. Minimum length of 10-inches.
 - E. Minimum wall embedment of 3-inches.
 - F. Ferrous metal steps not painted or treated to resist corrosion shall have a minimum cross section dimension of 1-inch.
 - G. Steps of approved polypropylene plastic-coated reinforcement bar are acceptable. Reinforcing bar must be a minimum of 1/2-inches and meet the requirements in ASTM A615.
- 5.2.4.8 Storm Inlets: Storm inlets shall be reinforced precast concrete complying with ASTM C478. Inlets shall be 24-inch X 36-inch unless a larger size is necessary for the connecting pipes. A 2-foot sump is required in all new storm inlet structures unless shown otherwise on the Plans.
- 5.2.4.9 Castings: The City will furnish all sanitary and storm sewer manhole frames and covers and storm inlet frames and grates for installation by the Contractor. These will be stored at the Waukesha Municipal Garage, 300 Sentry Drive, Waukesha, and must be hauled from this yard to the construction site by the Contractor and placed in their proper positions at its expense. Any breakage, which occurs after delivery to the Contractor, shall be replaced and paid for by the Contractor.

5.2.4.10 Repair Mortar: Repair mortar shall be a one component, quick set, high strength, non-shrink; polymer modified cementitious patching mortar, which has been formulated for vertical or overhead use meeting the requirements of ASTM C109 for Compressive Strength, C348 and C-78 for Flexural Strength, and C882 for Slant Shear Bond Strength. Repair mortar shall not contain any chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents nor shall it promote the corrosion of any steel that it may come in contact with. Material shall be Octocrete as manufactured by IPA Systems, Inc. or approved equal.

5.2.4.11 Cementitious Grout: Cementitious grout shall be a premixed, non-metallic, high strength, non-shrink grout which meets the requirements of ASTM C191 and C827 as well as CRD-C-588 and ASTM C621. When mixed to a mortar or "plastic" consistency, it shall have minimum one day and 28-day compressive strength of 6,000 and 9,000 psi, respectively. Material shall be Ipatop-Penngrout as manufactured by IPA Systems, Inc. or approved equal.

5.2.5 SEWER STRUCTURE REPAIR MATERIALS

5.2.5.1 Use products meeting the requirements specified for new sewer structures.

5.2.6 SEWER REHABILITATION MATERIALS

5.2.6.1 Resin: The resin for sewer rehabilitation work shall be a polyester resin for general chemical applications with up to 5% by mass thixotropic agent which will not interfere with visual inspection and which may be added for viscosity control. Resins may contain pigments, dyes, or colorants which will not interfere with visual inspection of cured liner.

5.2.6.2 Reinforcing Felt: The reinforcing felt shall be non-woven, needle interlocked polyester felt formed into sheets to provide required finished thickness. Felt tubes may be made of single or multiple layer construction, with any layer not less than 1.5 mm thick. Mechanical strengthener membrane or strips may be sandwiched in between layers where required to control longitudinal stretching. Liners shall have a bonded internal polyurethane membrane, which must be left on the internal surface of liner after curing. Minimum thickness of bonded polyurethane membrane and inner liner, shall be 0.3 mm, +/- 5%, and shall not affect structural dimension requirements of cured liner.

5.2.6.3 Liner Properties: The felt content shall ensure cured finished thickness of liner as specified. The finished thickness of cured liner to be as specified (+10%-4%) and shall not include thickness of polyurethane inner liner. The resin content shall be 10 to 15% by volume greater than volume of felt in liner bag. Cured liner shall meet the following minimum structural standards:

<u>Property</u>	<u>Standard</u>	<u>Value</u>
Tensile Strength	ASTM D638	3,000 psi
Flexural Modulus of Elasticity	ASTM D790	250,000 – 400,000 psi
Flexural Strength	ASTM D790	4,500 psi

5.2.6.4 Lateral Connection Seals: The packer shall be capable of 4-inch or 6-inch laterals and facilitate sealing a minimum of two feet of the lateral. The grout used shall be for use in sewers and be an acrylic based gel, Avanti AV-100 with Avanti AC-50W Root Inhibitor and Avanti AV-257 Icoset (copolymer latex) additives incorporated per the manufacturer’s specifications, or approved equal.

5.2.6.5 Fabrication: The liner shall be fabricated such that when installed it will fit internal circumference of pipe. Allowance shall be made for circumferential stretching during insertion.

5.2.6.6 Applicable Standard: The liner shall meet the requirements of ASTM F1216.

5.2.6.7 Design Considerations:

- A. Furnish all documentation of the design of the CIPP liner. The CIPP liner thickness design shall be in accordance with Appendix XI of ASTM F1216.
- B. The existing pipe shall not be considered as providing any structural support to the liner pipe.
- C. In the liner thickness calculations, the minimum ovality of the host pipe shall be 5 percent, the enhancement factor (K) shall not be greater than 7.0.
- D. Depth of cover and water table elevation shall be the depth at the manholes.
- E. H-20 live load (except under the railroad tracks where Railway E-80 loading is to be used).
- F. The minimum safety factor shall be 2.0.
- G. The flexural modulus of elasticity shall be reduced 50% to account for long term effects and used in the design equation EL.

5.2.7 SEWER LATERAL REHABILITATION MATERIALS

5.2.7.1 Acceptable Product: The product used shall be the T-Liner and Vac-A-Tee as manufactured by LMK Technologies or an approved equal.

5.2.7.2 System Description: The rehabilitation shall be accomplished using a non-woven textile tube of particular length and a thermo-set resin with physical and chemical properties appropriate for the application. The lateral tube located within a translucent inversion bladder shall be vacuum impregnated with the synthetic resin and then placed inside of a protective carrying device. The mainline portion of the liner shall be physically attached to the lateral portion and affixed around a rigid "T" launching device. The protective "T" launching device shall be winched into the existing sewer. When the "T" launching device is properly positioned at the lateral connection, the mainline bladder shall be inflated by pressurized air that presses the main liner against the host pipe. The lateral portion shall then be inverted up through the lateral service line by the action of the inversion bladder. Once the resin-saturated liner is cured, the inversion bladder and launching/carrying devices shall be removed.

5.2.7.3 Material Liner Assembly: The liner assembly shall be continuous in length and consist of one or more layers of absorbent textile material (i.e., needle punched felt, circular knit or circular braid) that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. The textile tube and sheet shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and have flexibility to fit irregular pipe sections. The wet-out textile tube and sheet shall meet ASTM F1216, 7.2 applicable, and shall have a uniform thickness and 5 to 10 % excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

A. Bladder Assembly. The outside layer of the textile tube (before inversion) and interior of the textile sheet shall be coated with an impermeable, translucent flexible membrane. The textile sheet before insertion shall be permanently marked with a "Lateral Identification" correlating to the address of the building and the lateral pipe services. The sheet and tube shall be surrounded by a second impermeable, flexible translucent membrane (translucent bladder) that will contain the resin and facilitate vacuum impregnation while monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

B. Mainline Connection. The mainsheet and lateral tube shall be a one-piece assembly formed in the shape of a "T". No intermediate or encapsulated elastomeric layers shall be in the textile that may cause de-lamination in the cured in-place pipe. The main sheet shall be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the main pipe. The lateral tube shall be continuous in length and the wall thickness shall be uniform. The lateral tube shall be capable of conforming to offset joints, bells, and disfigured pipe sections.

5.2.7.4 Resin System:

A. The resin/liner system shall conform to ASTM D5813 Section 8.2.2 - 10,000-hour test.

- B. The resin shall be a corrosion resistant polyester, vinylester, epoxy or silicate resin and catalyst system that when properly cured within the composite liner assembly, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP, for this project.
- C. The resin shall produce CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216. The CIPP initial structural properties shall be:

<u>Property</u>	<u>ASTM</u>	<u>Test Minimum Value PSI</u>
Flexural Strength	D790	4,500
Flexural Modulus	D790	250,000

5.2.7.5 Design Considerations:

- A. The CIPP shall be designed per ASTM F1216, Appendix X1.
- B. The CIPP design for the lateral tube shall assume no bonding to the original pipe.

5.2.8 MANHOLE REHABILITATION MATERIALS

5.2.8.1 Patching Material:

- A. A quick setting, fiber-reinforced, high early strength, calcium aluminate corrosion resistant hand mixed and hand applied cementitious material for patching and filling voids and cracks.
- B. Approved products are:
 1. Quadex Hyperform.
 2. Standard Cement Fast Set Bench Repair Cement.
 3. Strong-Seal QSR.
- C. Material shall meet the following minimum requirements:

<u>Property</u>	<u>Standard</u>	<u>Value</u>
Compressive Strength:	ASTM C109	>1800 psi, 1 hr >2600 psi, 24 hrs >3000 psi, 28 days
Bond: Calcium Aluminate Cement:	ASTM C882	>1600 psi, 28 days Sulfate resistant
Applied Density:		105 pcf ± 5
Shrinkage:	ASTM C596	0% at 90% R.H.

Placement Time:	5 to 10 minutes
Set Time:	15 to 30 minutes

5.2.8.2 Infiltration Control Material:

A. A rapid setting high early strength hand-applied cementitious product specifically formulated for infiltration control and making repairs to concrete, block, brick or other masonry structures.

B. Approved products are:

1. Quadex Quadplug.
2. Standard Cement Custom Plug Cement.
3. Strong-Seal Strong-Plug.

C. Material shall meet the following minimum requirements:

<u>Property</u>	<u>Standard</u>	<u>Value</u>
Compressive Strength:	ASTM C109	>1000 psi, 1hr >2500 psi, 24 hrs
Sulfate Resistance:	ASTM C267	No Weight loss after 15 cycles @ 2000 ppm
Freeze/Thaw:	ASTM C666 "Method A"	100 cycles
Pull Out Strength:	ASTM C234	14,000 lbs.
Set Time:		<1.0 minute

5.2.8.3 Cementitious Grout Material:

A. A rapid setting cementitious grout specifically formulated for stopping very active infiltration and filling voids. The cementitious grout shall be volume stable and have a minimum 28-day compressive strength of 250 psi. The material shall be Strong-Seal Grout 250 or an approved equal.

5.2.8.4 Chemical Grout Material:

A. Unless otherwise specified by the Engineer, acrylamide and/or acrylic based grouts shall be utilized and have the following characteristics:

1. A minimum of ten percent (10%) acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material is recommended to increase strength or offset dilution during injection.

B. Material shall be Avanti AV-100, Avanti AV-118, or an approved equal.

5.2.8.5 Cementitious Liner Material:

- A. A corrosion resistant, fiber-reinforced, cementitious liner material shall be mixed and low-pressure spray applied to form the structural monolithic, cementitious liner. Material shall be factory blended requiring only the addition of water at the jobsite. Material shall be a blend of 100% pure fused aluminate clinker with a minimum aluminate content of 38% and calcium aluminate cement and shall be sulfate resistant and suitable for application in environments with pH level 1.0 or higher. Material shall be reinforced with alkaline resistant fiberglass rods not less than 1/2 inch in length.
- B. Approved products are:
1. Quadex Aluminaliner.
 2. Standard Cement Maximum CA Plus Cement.
 3. Strong-Seal High Performance Mix.

C. Material shall meet the following minimum requirements at 28 days:

<u>Property</u>	<u>Standard</u>	<u>Value</u>
Compressive Strength:	ASTM C109	>9,000 psi
Tensile Strength:	ASTM C496	>800 psi
Flexural Strength:	ASTM C293	>1,500 psi
Shrinkage:	ASTM C596	0% at 90% R.H.
Bond:	ASTM C882	>2,400 psi
Density, when applied:		140 pcf ±5
Freeze/Thaw:	ASTM C666	300 cycles, no visible damage

5.2.8.6 Water:

- A. Water shall be clean and potable.

5.2.9 RIPRAP AND GEOTEXTILE FABRIC

- 5.2.9.1 Riprap shall conform to the requirements of Section 606 of the Wisconsin Highway Specifications. Provide the riprap size (gradation) designated on the Plans or in the Special Provisions.
- 5.2.9.2 Riprap shall be placed on a geotextile fabric conforming to the requirements of Section 645 of the of the Wisconsin Highway Specifications. Provide the fabric type designated on the Plans or in the Special Provisions.

5.3 EXECUTION

5.3.1 SANITARY SEWER CONSTRUCTION

- 5.3.1.1 Construction of sanitary sewer shall conform to Part III and Part V of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.
- 5.3.1.2 Crushed limestone chips are required from 4 inches under the pipe to 12 inches over the pipe as a minimum. The remainder of the trench shall be backfilled as specified in Section 4 – Earthwork, Excavation, and Boring.
- 5.3.1.3 Provide all pumps, conduits, and other equipment required to divert the flow of sewage around the work area. Ensure that surcharging and backups do not occur on public and private property. Make a temporary connection between the existing and proposed sewers and remove any diversion methods at the end of the day.
- 5.3.1.4 All connections to manholes shall be in accordance with Chapter 3.5.7 of the Wisconsin Sewer and Water Specifications. When sewer pipes are connected to manholes with a preformed trough in the base, any pipe placed in the trough and extending beyond the interior wall of the manhole, shall have the portion of the pipe extending above the edges of the trough trimmed back to the interior wall of the manhole. The top edges of the pipe shall match in elevation the top edges of the trough.
- 5.3.1.5 The connections to the existing manholes or sewers shall be in a method approved by the Engineer. The length of pipe between the existing sewer and new structure that is removed and replaced shall be incidental to the work and shall not be included in the total payment quantity.
- 5.3.1.6 All sewer pipes shall terminate at the inside wall of the manhole. All annular spaces shall be filled with a mastic or cementitious filler to prevent the breakage of the pipe while jetting.
- 5.3.1.7 If the Contractor damages any sewer or manhole during construction, the cost of the necessary repairs including any pavement repairs shall be at the Contractor's expense. The method of repair shall be approved by the Engineer.
- 5.3.1.8 Ensure that flow is not impeded during the adjustment or repair of the sewer structures or road reconstruction. Remove any debris in the sewer structures and lines resulting from the work. If the sewer structure or lines require flushing by City crews, the cost will be assessed to the Contractor.
- 5.3.1.9 Sanitary Laterals:
 - A. Laterals shall not to be connected to a manhole, unless approved by the Engineer.

- B. On the Plans, a lateral is shown for existing properties in their approximate location. Some of the laterals shown on the plan may be determined to be inactive. All laterals which are encountered shall be inspected and verification of their use made. Laterals which are deemed to be abandoned shall be bulkheaded.
- C. In the open cut sections, replace the existing active laterals from the proposed sanitary sewer to as close to the right-of-way as possible. The actual location shall be determined by the Engineer to avoid obstacles such as landscaping, carriage walks, retaining walls, trees, etc.
- D. Connection of new laterals to new sanitary main shall be constructed using a wye fitting.
- E. Existing lateral reconnections to new sanitary main shall be constructed using a wye fitting.
- F. Connection of new sanitary laterals to existing sanitary main shall be as follows based on the existing main material:
 - 1. ABS - Truss Pipe:
 - a. Location: Not closer than 36 inches to an existing joint or fitting or closer than 48 inches to an existing lateral.
 - b. Hole: Core drill or saw-cut with appropriate cutting tools.
 - c. Connection Device: Inserta Tee.
 - 2. Concrete Pipe:
 - a. Location: Not closer than 24 inches to an existing joint or fitting or closer than 48 inches to an existing lateral.
 - b. Hole: Core with appropriate cutting tools.
 - c. Connection Device: Inserta Tee.
 - 3. PVC Pipe:
 - a. Location: Not closer than 36 inches to an existing joint or fitting or closer than 48 inches to an existing lateral.
 - b. Hole: Core drill or saw-cut with appropriate cutting tools.
 - c. Connection Device: Inserta Tee.
 - 4. Vitrified Clay Pipe:

- a. Location: Not closer than 24 inches to an existing joint or fitting or closer than 48 inches to an existing lateral.
- b. Hole: Core with appropriate cutting tools.
- c. Connection Device: Inserta Tee.

5.3.2 PRESSURE SANITARY SEWER CONSTRUCTION

- 5.3.2.1 Construction of pressure sanitary sewer shall conform to Part III of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.

5.3.3 STORM SEWER CONSTRUCTION

- 5.3.3.1 Construction of storm sewer shall conform to Part III and Part V of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.
- 5.3.3.2 Crushed limestone chips are required from 4 inches under the pipe to 12 inches over the pipe as a minimum. The remainder of the trench shall be backfilled as specified in Section 4 – Earthwork, Excavation, and Boring.
- 5.3.3.3 Provide all pumps, conduits, and other equipment required to divert existing flows around the work area. Ensure that surcharging and backups do not occur on public and private property. If pumping is required on a 24-hour basis, the equipment supplied shall be equipped to minimize noise. Pumping and other permits required for the diversion shall be the responsibility of the Contractor.
- 5.3.3.4 The connections to the existing or proposed structures or sewers shall be in a method approved by the Engineer. The cost for connecting existing sewer lines into proposed sewers or manholes will not be paid for separately, but will be included in the unit bid price for proposed sewers and manholes.

5.3.4 SEWER STRUCTURE CONSTRUCTION

- 5.3.4.1 Construction of sanitary and storm sewer structures shall conform to Part III of the Wisconsin Sewer and Water Specifications except as otherwise indicated in this Specification or on the Plans.
- 5.3.4.2 All manholes and inlets are to be built to proposed grade and alignment.
- 5.3.4.3 The Contractor shall be responsible for ensuring the correct City-furnished castings are placed on the structures.
- 5.3.4.4 The frames and covers from any structures which are removed or rebuilt shall be salvaged and returned to the City Garage by the Contractor.
- 5.3.4.5 Chimney Installation:

- A. Installation and surface preparation shall be in accordance with the manufacturer's instructions.
 - B. Repair any surface defects or irregularities of the top of the manhole using a uniform bed of non-shrink grout.
 - C. The joint between the first grade ring and manhole cone shall be sealed using an adhesive/sealant.
 - D. The joints between all manhole adjustment rings shall be sealed using an adhesive/sealant.
 - E. The joint between the top manhole adjustment ring and the frame shall not be sealed with adhesive/sealant. On sanitary manholes, this joint will be sealed with an internal frame-chimney seal. The width of the seal shall be the minimum that is necessary to seal the joint between the frame and the expanded polypropylene rings.
 - F. All castings shall be centered over the opening of the corbel and adjusting rings. The top adjusting ring upon which the casting is set shall be level from side to side unless a pitch is required to match the surface in paved areas.
- 5.3.4.6 Install chimney seals in all new sanitary manholes and those existing sanitary manholes noted in the Plans. Seals shall not be installed until the chimneys are inspected by the Engineer.
- 5.3.4.7 Adjustment to Final Grade:
- A. Adjust all manholes and inlets in concrete pavements to between 0 to 3/8 inches below final pavement grade.
 - B. Adjust all manholes and inlets in HMA pavements to between 1/4 to 3/8 inches below final pavement grade.
 - C. Adjust all manholes and inlets in turf areas to between 1/4 to 1/2 inches below finished grade.
 - D. No other material shall be used in the construction of the chimney section beyond those materials specified. This includes shims of any material, bricks, stones, etc. If after pavement placement, foreign material is discovered (i.e., shims) in a chimney, the pavement surrounding the structure shall be removed and replaced at the Contractor's expense to the limits described below:
 - 1. Required correction at manholes in concrete pavement:
 - a. Sawcut the concrete pavement along longitudinal and transverse joints in order to re-set the manhole chimney according to the specifications. The concrete areas to be removed must be full panels.

- b. Place new concrete around the manhole according to the concrete pavement section of these specifications.
2. Required correction at manholes in HMA pavement:
 - a. Sawcut the HMA pavement that is to be removed in order to re-set the manhole chimney according to the specifications.
 - b. The HMA surface shall be milled from the flange to the nearest HMA pavement joint (if the structure is in the centerline, the area to be milled is flange to flange). The length of the milled area shall be equal to the width.
 - c. The lower courses around the manhole shall be replaced and compacted.
 - d. Place a tack coat and pave a new surface lift of HMA pavement that matches the existing HMA pavement and the re-set manhole.
 - e. The seam created at the existing HMA pavement shall be infrared heated to blend and fuse the new HMA pavement to the existing.

5.3.5 SEWER STRUCTURE REPAIR

5.3.5.1 Storm Sewer Inlet Repair:

- A. Any repairs made to storm sewer inlets shall be considered storm sewer inlet repair and paid under the bid item for "Storm Sewer Inlet Repair". The Engineer will designate the depth of repairs in the field. All work on storm sewer inlets will only be completed to the walls of the structures. No work will be necessary on the storm sewer inlet base.
- B. Storm sewer inlets shall be backplastered to one course below the "repaired" or "reconstructed" area.

5.3.5.2 Storm Sewer Manhole Repair:

- A. When storm manholes need to be rebuilt and tuck pointed, they will be paid under the bid item for "Storm Sewer Manhole Repair".
- B. For storm sewer manholes requiring only chimney work, some minor tuck-pointing to the top two courses of block may be required. This work will be considered incidental to the contract and not paid for as a separate bid item.

5.3.5.3 Chimney Replacement:

- A. The replacement and adjustment of chimneys on existing sanitary and storm manholes within the paving limits shall consist of removing the entire chimney down to the cone section and replacing with the expanded polypropylene adjusting rings to the proposed elevations. This work will be paid for under the bid item for "Chimney Replacement".
- B. Install chimneys and adjust to final grade following the requirements specified for new manholes.
- C. Any repairs required to sewer pipes resulting from the chimney work of the sewer structure shall be made at the Contractor's expense. The Engineer shall approve the type of repair.

5.3.5.4 Ensure that flow is not impeded during the adjustment of the sewer structures or road reconstruction. Remove any debris in the sewer structures and lines resulting from the work. If the sewer structure or lines require flushing by City crews, the cost will be assessed to the Contractor.

5.3.5.5 Use slurry backfill around all manholes and storm inlets when the excavation for the adjustment work is deeper than 1-foot. Slurry will not be paid for separately but will be considered part of the cost for whatever is being adjusted.

5.3.6 SEWER REHABILITATION

5.3.6.1 General:

- A. Install cured-in-place pipe (CIPP) liner in the sanitary or storm sewer as indicated on the Plans. Coordinate the work to avoid any disruptions in the schedule or the integrity of the finished liner between structures.
- B. Work with the City to schedule the installation of the liner in order to avoid disruption to existing businesses and residences as much as possible. This may involve installation at night or weekends.
- C. Notifying the City at least two weeks prior to beginning any work.
- D. City water for use on this contract may be obtained from the City as specified in Section 1 – General Requirements.

- E. Televising inspection video, televising inspection reports, and original as built drawings are available for viewing at the office of the Director of Public Works. The Contractor may request a copy of this data by contacting the office of the Director of Public Works at 262-524-3600. The City accepts no responsibility for accuracy of televised data and their interpretation for construction purposes and makes no other warranties, expressed or implied. The usage of these videos in no way relieves the Contractor from performing the necessary work required under this project.
- F. The video files can be played with Windows Media Player. Preliminary inspection of these videos that reveal conditions that will prevent the proper installation of or changes in design of the CIPP shall immediately be brought to the attention of the City. Point repairs necessary due to this inspection will be paid for under the bid item "Sanitary Sewer Spot Repair". The method of repair shall be approved by the Engineer.
- G. The Plans show service connections to the mainline sewer. The Contractor is responsible for locating and verifying which service connections are active for reconnection purposes. All capped services and/or non-used connections shall be abandoned. The Contractor shall work with the City to verify which services are active or not. Non-active services that are reinstated will not be paid for and shall be repaired in a method approved by the Engineer at the Contractor's expense.
- H. Upon receipt of the two-week notice, the City will send an informational letter to the property owners and/or residents within the project limits with general information explaining the project, including the temporary sewer service disconnection, and informing that the Contractor will be notifying them with more specific information to follow.
- I. The Contractor shall notify the residents or businesses directly affected by the lining operation a minimum of 3 days prior by mailer or door hanger. For commercial properties or where multiple tenants occupy buildings, the Contractor shall notify the tenants and building owner. The City does not have information on multiple tenant or commercial buildings, so the Contractor shall work with the building owner or visit the building for contact information. This notification must include the Contractor's name, foreman's name and cell phone number, expected timeframe of the segment of work, advance notification of noise and odor related to the work, etc.

5.3.6.2 Preparation:

- A. Remove all dirt, grease, mineral deposits, rocks, roots and any other material or obstructions from the sewer lines and manholes that would affect the proper installation of the CIPP. Any protruding tap removal, gasket removal, or grouting work shall be incidental to the cost of installing the liner. Do not pass foreign materials into other pipe sections. The Contractor may dispose of any material cleaned from the sewers at the City of Waukesha Clean Water Plant, 600 Sentry Drive, Waukesha, Wisconsin.
- B. Televising and document all sewer line conditions after cleaning the lines, but prior to installing the liner. If the television inspection shows the cleaning to be unsatisfactory, re-clean and re-televising the sewer line until it is acceptable to the City. All televising shall be done to the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) standards using the PipeTech software by Peninsular Technologies.
Inspections conducted with other software packages or converted to other formats will not be accepted. The cost for this shall be included in the bid item for "Sewer Lining".
- C. For sanitary sewer relining projects, provide all pumps, conduits and other equipment required to divert the flow of sewage around the sewer segment. Ensure that surcharging and backups do not occur on public or private property. If pumping is required on a 24-hour basis, the equipment supplied shall be equipped to minimize noise.
- D. For storm sewer relining projects, provide all pumps, conduits, and other equipment required to divert existing flows around the work area. Ensure that surcharging and backups do not occur on public and private property. If pumping is required on a 24-hour basis, the equipment supplied shall be equipped to minimize noise. Pumping and other permits required for the diversion shall be the responsibility of the Contractor.

5.3.6.3 Installation:

- A. The liner shall be installed through an existing manhole by an air inversion process or the application of hydrostatic head sufficient to fully extend liner to next designated manhole or termination point and according to ASTM F1216. No pull-in-place methods shall be allowed. Lubricant may be used.
- B. Place a hydrophilic gasket at the end of each lined sewer section, defined as the length of sewer between two adjacent structures, to create a water-tight seal between the host pipe and the CIPP liner. The hydrophilic gasket shall be the Insignia End Seal Sleeve or an approved equal.

- C. Reinstatement of service connections determined to be active by means of a remote control cutting device for a minimum of 95% of the flow capacity. All reinstated connections shall be smooth. If needed, reinstated service connections shall be brushed to ensure that all edges are smooth. Sanitary services shall not be out of service for more than 24 hours during lining process. It is the City's intent NOT to reinstate laterals that are not active. Cost for this work shall be paid for under the bid item for "Sanitary Lateral Reinstatement" or "Storm Lateral Reinstatement".
- D. For laterals that are not to be lined, test and seal the lateral connections after reinstatement.
- E. Laterals shall be air tested by isolating the area to be tested with the packer and applying positive pressure into the isolated "void" area. A sensing unit shall be used for continuous monitoring of the void pressure. This sensing unit shall be located within the void area and accurately transmits pressure readout to the control panel. The test procedure shall consist of applying air pressure into each isolated void area. To isolate a void, the lateral sealing packer shall be positioned straddling the lateral. The operator shall inflate the packer ends to isolate the lateral and insert an inflatable inversion tube. The lateral shall be tested with a gauge pressure of 1/2 psi per foot of depth of sewer or a minimum of 4 psi, whichever is larger. The void pressure shall be observed during this test for a minimum of 10 seconds. If the void pressure drop is greater than 1 psi in 10 seconds, the lateral shall be considered to have failed the air test. If no pressure can be built up, the connection shall also have failed the test. Any connection failing the test shall be sealed and retested utilizing the same method and procedures until it does pass the test. The cost of retesting lateral connections shall be considered incidental and included in the cost of sealing sanitary sewer lateral connection. Cost for this work shall be paid for under the bid item for "Sanitary Lateral Connection Test and Seal".

5.3.6.4 Post Installation Requirements:

- A. If the Contractor damages any sewer during construction, including but not limited to the installation of the CIPP, the cost of the necessary repairs including any pavement repairs, shall be at the Contractor's expense. The method of repair shall be approved by the Engineer.
- B. Televiser and document using PipeTech by Peninsular Technologies all sewer line conditions after the liner is installed and the service connections are reinstated and tested. **Inspections conducted with other software packages or converted to other formats will not be accepted.** The completed liner shall be continuous over the entire length of each segment (manhole to manhole) and shall be free of defects such as foreign inclusions, dry spots, pinholes, and delamination. The completed liner pipe shall be leak proof and a tight seal shall be provided between the liner and manhole wall.

- C. Any defects in the liner that will affect the strength of the liner, its flow carrying capacity, or damage to the liner and/or pipe caused by the routing out of the lateral connections, shall be repaired at the Contractor's expense. The type of repair shall be approved by the Engineer.

5.3.7 SEWER LATERAL REHABILITATION

5.3.7.1 General:

- A. Furnish all labor, materials, tools, equipment and incidentals necessary to completely rehabilitate the existing sanitary sewer laterals within the paving limits where shown on the Plans by using a cured-in-place lining method.
- B. In order to complete the sanitary sewer lateral rehabilitation, perform the following:
 - 1. Install a cleanout near the back of walk or work with property owners to utilize an existing cleanout inside the building.
 - 2. Clean the lateral and perform a pre-lining inspection.
 - 3. Repair and/or grout the lateral if necessary.
 - 4. Rehabilitate the sanitary sewer lateral from the public sewer main to the back of walk towards the property and perform a post-lining inspection.
- C. All work shall be in accordance with the current State of Wisconsin Plumbing Code.
- D. Inspections of the sanitary mains and laterals from the main line to the property have been performed prior to this contract and are available for review. When possible, the location and depth of the lateral were obtained at the back of walk. These locations were then surveyed for future reference. Upon request, the City will relocate the laterals using the survey data collected. If additional televising work is needed to locate the laterals, this work may be coordinated with the City.

5.3.7.2 Preparation:

- A. Install a cleanout at the back of sidewalk. Make all efforts to install the sanitary sewer cleanout in a location that minimizes surface disturbance to the residents. If this is not possible, inform the City of the location of the cleanout prior to installation. No permanent structures such as stairs, sidewalks, landscaping, or trees shall be removed without the consent of the City and/or homeowner.
- B. Installation Procedure:
 - 1. In grass areas, the sod shall be neatly cut and removed. In pavement areas, the pavement shall be straight-line marked, cut, and removed. This area should be protected with a barricade at all times.

2. The vacuum excavated borehole shall be approximately twenty (20)-Inches diameter and all spoils shall be deposited in a vacuum truck.
3. A riser pipe of an appropriate length shall be solvent welded to the saddle.
4. The adhesive/sealant shall be applied to the underside of the saddle at no less than a 1/4-inch thick layer.
5. The saddle and riser pipe shall be carefully inserted into the bore hole, setting the saddle onto the pipe, applying a downward force causing the saddle to expand and snap onto the lateral pipe.
6. Immediately after the saddle has been affixed to the lateral pipe, the riser pipe should be secured by backfilling the bore hole with sand or pea-gravel to within 6-inches of the original grade.

C. Testing and Cutting:

1. An exfiltration test shall be performed by filling the riser pipe with a 6-foot column of water. The test shall be performed no less than 2-hours from the time of affixing the saddle to the pipe. The column of water shall be held for 5 minutes. The water level shall be measured from the top of the riser pipe. Zero leakage is allowed.
2. A diamond core saw shall be introduced into the riser pipe, the crown of the pipe cut, and the coupon removed.
3. An approved cap and frost sleeve shall be installed 1-foot below ground level.

5.3.7.3 Installation:

- A. The installation shall be done according to the liner manufacturer's requirements.
- B. The lateral pipe shall be remotely accessed from the main pipe and from a cleanout. This shall be accomplished by the installation of a resin impregnated one-piece main and lateral lining by means of air inflation and inversion. The liner shall be pressed against the host pipe by pressurizing a bladder that is held in place until the thermo-set resins have cured. When cured, the liner shall extend over a predetermined length of the service lateral and a particular section of the main pipe as a continuous, one-piece, tight fitting, corrosion resistant and verifiable non-leaking cured in-place pipe.
- C. The main/lateral lining shall be in accordance with ASTM F2561.
- D. Cleaning and Inspection: As per NASSCO Standards.

- E. Accessing the Lateral: A cleanout shall be located on the exterior of the building. The cleanout fitting shall be either tee shaped or back to back wye shaped where the lateral meets the cleanout riser pipe. The cleanout shall be located no less than within 2-feet of the finished liner.
- F. Plugging: The upstream side of the cleanout shall be plugged during insertion and curing of the liner assembly ensuring no flows enter the pipe and no air, steam, or odors will enter the building. When required, the main pipe flows shall be by-passed. The pumping system shall be sized for normal to peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflating system shall be incorporated so that the plugs may be removed at any time without requiring confined space entry.
- G. Inspection of Pipelines: The interior of the pipeline shall be carefully inspected to determine the location of any condition that prevents proper installation, such as roots, and collapsed or crushed pipe sections. These conditions shall be noted. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.
- H. Line Obstructions: The existing service lateral shall be clear of obstructions that prevent the proper insertion and expansion of the lining system. Changes in pipe size shall be accommodated, if the lateral tube is sized according to the pipe diameter and condition. Obstructions may include dropped or offset joints of no more than 20% of inside pipe diameter.
- I. Resin Impregnation: The lateral tube and mainline sheet to be encapsulated within the translucent bladder (liner/bladder assembly) shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5% to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe. No dry or unsaturated area in the mainline sheet or lateral tube shall be acceptable upon visual inspection.

- J. Liner Insertion: The lateral tube and inversion bladder shall be inserted into the carrying device. The mainline liner and bladder shall be wrapped around the "T" launching device and held firmly by placing four hydrophilic O-rings around the main liner. An adhesive sealant 300 ml in volume shall be applied to the main/lateral interface and shall be applied as a 2-inch wide band on the main liner. Both the launching and carrying device shall be pulled into the pipe using a cable winch. The pull shall be complete when the open port of the "T" launching device is aligned with the interface of the service connection and mainline pipe. The lateral tube shall be completely protected during the pull. The mainline liner shall be supported on a rigid "T" launcher that is elevated above the pipe invert through the use of a rotating skid system. The liner assembly shall not be contaminated or diluted by exposure to dirt, debris, or water during the pull.
- K. Bladder: The main bladder shall be inflated causing the main sheet to unwrap and expand, embedding the hydrophilic O-rings between the main liner and the main pipe as the main liner is pressed tight against the main pipe. The lateral tube shall be inverted by the action of the lateral bladder through the center of the main liner as it extends up into the lateral pipe to a termination point that shall be no less than 2-feet from the exterior cleanout. The main/lateral bladder assembly shall extend past all ends of the liner.
- L. Curing: After liner placement is complete, pressure shall be maintained pressing the liner firmly against the inner pipe wall. The liner shall be chemically cured at ambient temperatures or by a suitable heat source. The heating equipment shall be capable of delivering a mixture of steam and air throughout the liner bladder assembly to uniformly raise the temperature above the temperature required to cure the resin. The curing of the CIPP shall take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). The heat source temperatures shall be monitored and logged during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted.
- M. CIPP Processing: Curing shall be done without pressure interruption with air or a mixture of air and steam for the proper duration of time per the resin manufacturer's recommendations. When the heat source is removed and the temperature on both ends of the CIPP reaches 100 degrees Fahrenheit or less, the processing shall be finished.

5.3.7.4 Finish:

- A. The finished CIPP shall be continuous over the entire length of the rehabilitated sewer service lateral and main pipe for a minimum of 5 inches on both sides of the lateral connection. The CIPP shall be smooth with minimal wrinkling for increased flow rate. The CIPP shall be free of dry spots, lifts, and delaminated portions. The CIPP shall taper at each end providing a smooth transition for accommodating video equipment and maintaining proper flow in the mainline. After the work is completed, provide the City with video footage documenting the repair and the visual markings identifying the sewer lateral address as completed work. The finished product shall provide an airtight/ watertight verifiable non-leaking connection between the main sewer and sewer service lateral.

5.3.8 MANHOLE REHABILITATION

5.3.8.1 General:

- A. Supply all labor, materials, equipment and appliances necessary for rehabilitating the interior of sanitary and storm sewer manholes for the purpose of eliminating infiltration, exfiltration, providing corrosion protection (as necessary), repair of cracks and voids, and restoration of the structural integrity of the manhole.
- B. "Rehabilitate (type) Manhole w/ Cementitious Liner" shall consist of the application of the liner material listed under "Cementitious Liner Material" in Part 2 of this Section to all interior manhole surfaces. Chimney sections scheduled for replacement as indicated on the Plans shall be replaced prior to the manhole rehabilitation as specified in the "Chimney Replacement" requirements in the "Sewer Structure Repair" article above and shall not be lined. The application of grouting material to control active infiltration prior lining the manhole shall be incidental to this item. Manholes shall be rehabilitated after the installation of the CIPP liner (if applicable) to allow the benches to be built up and sloped to prevent water or sewage from ponding. The cost of this work will be paid for under the bid item for "Rehabilitate (type) Manhole w/ Cementitious Liner".
- C. Use, mix, apply and cure all products in accordance with the manufacturer's recommendations and instructions.

5.3.8.2 Manhole Preparation:

- A. Prepare surfaces in accordance with the manufacturer's instructions.
- B. Place covers over all pipe inverts to prevent extraneous material from entering the sewer lines.
- C. Clean the interior surfaces of the manhole with high-pressure (3,000 psi minimum) water spray, using detergent, muriatic acid, antibacterial agent, or other chemicals to remove grease, oil, and other contaminants that would prevent good bond between the existing manhole interior surface and the liner material.

- D. Remove loose, unsound, and protruding brick, mortar, and concrete using a masons hammer and chisel and/or scraper.
- E. Repair and fill voids greater than 2 inches in depth with patching materials specified in above. The patching material shall be applied in accordance with the manufacturer's instructions.
- F. Take the following steps to stop active leaks in the manholes:
 - 1. Stop active leaks with patching material or infiltration control material. Apply material in accordance with the manufacturer's instructions.
 - 2. Install weep holes as required to localize infiltration during application of patching material or infiltration control material.
 - 3. Plug weep holes after application with infiltration control material before application of liner material.
 - 4. For severe infiltration, drill as required to pressure grout using a chemical grout. Apply the grout in accordance with manufacturer's instructions.
- G. Prepare, clean and repair manhole benches and inverts in the same manner as prescribed above for manhole walls.
- H. Personnel shall be trained in appropriate and satisfactory safety methods regarding the materials used under this contract. These methods shall include handling, mixing, and transporting of the materials.

5.3.8.3 Cleaning:

- A. Protect upstream and downstream sewers from excess chemical grout and other construction debris. Clean manhole interiors and remove all construction-related materials, equipment and appliances from the manholes prior to reinstatement of the manholes to service.

5.3.8.4 Application of Cementitious Liner Material and Acceptance Testing:

- A. Saturated Surface: Ensure that the surface is damp and totally saturated with water without noticeable free water droplets or running water just before application of the liner material.
- B. Spraying and Minimum Thickness: Spray apply the liner material in one or more passes from the bottom of the wall to the bottom of frame to form a structurally enhanced monolithic liner. Minimum total thickness achieved shall be 1/2 inch.
- C. Finishing: Ensure a quality finish to the manhole or structure by following the following steps:

1. Trowel the surface of sprayed liner material to a relatively smooth finish. Care should be taken to not over trowel; and
 2. A brush finish shall be applied to the trowel finished surface.
- D. Time between Applications: Follow the manufacturer's instructions whenever more than 24 hours have elapsed between applications of the cementitious material.
- E. Application to Bench: When applying cementitious material to the bench area of the manhole:
1. Remove covers.
 2. Spray the bench with liner material mixed in accordance with the manufacturer's instructions.
 3. Spray-apply the liner material to produce a gradual slope from the walls to the edge of the channel to form a structurally enhanced monolithic liner. A minimum thickness at the edge of the channel of 1/2 inch shall be achieved. The finished invert surfaces shall be smooth and free of ridges.
 4. Round the full circumference of the intersection of the wall and the bench to a uniform radius.
- F. Upon completion of manhole rehabilitation and cleaning, all manholes shall be visually inspected by Contractor.
- G. Visual inspection shall determine if the manhole is free from leaks and defects.
- 5.3.8.5 A leak or defect shall be corrected at no additional cost to the City.
- 5.3.8.6 "Bench / Invert / Trough Work Minor" shall be determined by the Engineer and consist of repairs to the bench and invert to improve flow conditions. This shall include building up the bench from the springline of the pipe, at a minimum, and sloping up at least 2 inches per foot. The minimum channel depth shall be 4 inches. The cost of this work will be paid for under the bid item for "Sanitary Manhole Bench / Invert / Trough Work Minor".
- 5.3.8.7 "Bench / Invert / Trough Work Major" shall consist of the removal of the existing bottom and pouring a new invert and bench or substantial alterations to the existing invert and bench to improve flow conditions. The cost of this work will be paid for under the bid item for "Sanitary Manhole Bench / Invert / Trough Work Major".
- 5.3.9 RIPRAP PLACEMENT**
- 5.3.9.1 Riprap outfall stabilization shall be installed in accordance with Section 606 of the Wisconsin Highway Specifications and as indicated on the Plans.

5.3.9.2 Geotextile filter fabric shall be installed under all riprap in accordance with Section 645 of the Wisconsin Highway Specifications and as indicated on the Plans.

5.3.10 SEWER TELEVISION

5.3.10.1 The Contractor shall hire an independent television inspection service to perform a closed-circuit television inspection:

A. For all sewers, leads, and laterals (sanitary and storm) within the project limits after all underground work has been completed but before the final pavement has been placed. The underground work shall be defined as comprising any activity that could potentially damage a sewer facility, which includes but is not limited to utility installation (including third party utility work), traffic signal and street light bases and conduits, and tree planting.

B. For other sewers as specified in the Special Provisions.

5.3.10.2 The televising work shall be done in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) standards.

5.3.10.3 Equipment:

A. The televising camera used for the inspection shall be one specifically designed and constructed for sewer inspection. The camera shall be a color, pan-and-tilt type capable of radial inspection of the top, bottom, and sides of the pipe including lateral connections. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the City. If the equipment proves to be unsatisfactory, it shall be replaced with adequate equipment.

B. Lateral cameras shall be color, shall be self-leveling, and equipped with a footage counter to provide on screen display of footage measurement.

C. The Contractor shall collect all inspection data using PipeTech Software by Peninsular Technologies. Inspections conducted with other software packages or converted to other formats will not be accepted.

5.3.10.4 Procedure:

A. The main line sewer sections, defined as the length of pipe from center of manhole or structure to center of manhole or structure, shall be televised one section at a time.

- B. For the televising of laterals, the main line sewer television camera shall be used to position the lateral camera launcher. At a minimum, the lateral sewer camera shall inspect laterals to the right-of-way limits, or in the case of a lateral replacement, to the upstream limit of the replacement plus an additional 5 feet upstream. Video recording shall continue during the entire camera withdrawal sequence. The television inspection of the lateral must be from inside the main line sewer up into the lateral and shall include a spot location with depth at the curblineline and back of sidewalk. Inspections from cleanouts, excavations, or other access points will not be accepted.
- C. The Contractor shall fully televise both ends of the main line pipe so the connections at the manholes can be evaluated.
- D. Wherever possible the inspections shall be performed in the upstream to downstream direction.
- E. When sewer conditions prevent forward movement of the camera, the camera shall be withdrawn, and the Contractor shall televise the line from the opposite direction.
- F. The camera shall be directed through the sewer at a uniform, slow rate. In no case shall the video camera record while moving at a speed greater than 30 feet per minute. If the inspection is rejected due to camera speeds exceeding 30 feet per minute, the inspection recordings shall be redone at no additional cost to the City.
- G. Flow levels within existing sewers to be inspected shall not exceed 5% of the pipe diameter. If water levels prevent adequate televising of the sewer, then conducting the work during low flow periods or other methods like plugging and bypass pumping shall be implemented.
- H. For inspection of new sewers (not yet in service), the Contractor shall introduce clean water into the upstream manhole and keep water flowing until flow is observed at the downstream manhole location.
- I. The survey unit shall be slowed, stopped, or backed-up to perform detailed inspections of significant features. The camera shall be stopped at all defects; changes in material, water level, or size; side connections; manholes; junctions; or other unusual areas. When stopped at the defect or feature, the operator shall pan the camera to the area and along the circumference of the pipe.
- J. The operator shall also record audio of the type of defect or feature, clock position, footage, extent or other pertinent data.

- K. Audio shall be recorded during each inspection by the operating technician, electronic voice text recognition or approved equal on the inspection video as the sewer is inspected and shall include the sewer location, identification of beginning and terminating manholes including location (address or cross streets), inspection direction, length of inspection, side sewer identification, flow information, complete descriptions of the sewer line conditions as they are encountered, description of the rehabilitation work, reason for termination, and other relevant commentary to the inspections. Voice descriptions should be made: 1) at points of pipe failure or weakness, 2) at points of infiltration, 3) at the location of service connections, 4) at points where unusual conditions are noted, and 5) at points where digital still photos are taken.
- L. In addition, the audio reports shall include the distance traveled on the specific run, a description of abnormal conditions in the sewer and side sewer connections as they are encountered, explanations for pausing, backing up, or stopping the survey, and the final measured center to center distances between consecutive manholes. The audio portion of the composite video shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of the oral report. Audio dubbing after the inspection is prohibited.
- M. If the video and/or audio recording is of poor quality, the City has the right to require a re-submittal of the affected sewer sections and the inspection will not be deemed complete until an acceptable video and audio recording is made, submitted to, and accepted by the City.
- N. Measurement for location of defects and actual length of pipe shall be by means of a calibrated meter on the camera with a digital readout on the video monitor. This readout shall be included in the video recording. Marking on cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement will be accurate to one foot per 100 feet of inspected pipe. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the City.
- O. All inspections shall be performed by NASSCO PACP certified personnel. Use of PACP certified technicians to review/document defects in the office (post process) is not acceptable.
- P. Any structural defects found along the main line sewer and laterals shall be immediately brought to the Engineer's attention for a determination of the necessary repair.

5.3.10.5 Documentation:

- A. The inspection data shall be compatible with the City's GIS and Asset Management Systems and shall be collected with PipeTech.
- B. Television Inspection Logs: Electronic media location records shall be kept by the Contractor and shall clearly show the location, by distance in 1/10 of a foot, from the center of the starting manhole or structure to each observation during inspection. Observations shall include, but not limited to, infiltration, service connections, unusual conditions, roots, storm sewer connections, cracks, fractures, broken pipe, presence of scale and corrosion, and other discernible features, as defined in the PACP defect codes, shall be recorded on electronic media and a copy of such records shall be supplied to the City.
- C. Digital photographs of the pipe condition and all defects shall be taken by the Contractor. Photographs shall be located by distance in 1/10 of a foot, from the center of the starting manhole or structure.
- D. Electronic media recordings collected with including the digital video, images, and data files shall be created for each sewer section and lateral inspected. Files shall be submitted on DVD, flash drive, or portable hard drive. The purpose of electronic media recording shall be to supply a visual and audio record of the condition of the sewer lines that may be replayed by the City. Once recorded, the video shall become the property of the City.

5.3.10.6 The City will provide maps showing the structure and section numbers to be used.

5.3.10.7 For televising of sewer work completed under the same Contract, the Contractor will be notified in writing of any deficiencies revealed by the television inspection that will require repair, following which the Contractor shall excavate and make the necessary repairs and schedule a television re-inspection of the repaired or corrected areas. Television re-inspection shall be at the Contractor's expense.

5.3.10.8 If applicable, the Contractor may submit the post CIPP lining inspection as the Pre-Paving televising provided all other underground work is complete prior to the inspection. If the post CIPP inspection is used, the cost of inspecting those sections is incidental to the lining process and will not be paid for under separate bid items.

5.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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6 CONCRETE AND CONCRETE STRUCTURES

6.1 GENERAL

6.1.1 SUMMARY

6.1.1.1 This section describes general requirements for all concrete work.

6.1.2 RELATED SECTIONS

6.1.2.1 Section 7 – Concrete Pavement.

6.1.3 SUBMITTALS

6.1.3.1 Mix Designs: Submit proposed mix designs to Engineer ten days prior to beginning concrete work. Do not begin concrete production until mixes have been reviewed.

6.1.3.2 Product Data: Submit product data for joint filler, joint sealer, waterstops, curing compound, and other specified concrete accessories.

6.1.3.3 Reinforcement Certification: Submit fabricator's certification that reinforcement complies with the specified requirements.

6.1.3.4 Delivery Tickets: Submit delivery tickets to Engineer for each load of concrete delivered to project.

6.1.3.5 Test Reports: Submit copy of field and laboratory test results to Engineer within 24 hours of testing.

6.1.4 TESTING

6.1.4.1 The Contractor shall be responsible for testing of all concrete. Test concrete to measure slump, entrained-air content, temperature, and compressive strength to determine compliance with specifications. Furnish test apparatus and cylinders, perform on-site sampling and testing, and have compressive strength cylinders tested by a qualified laboratory.

6.1.4.2 On-site tests shall be performed under observation of Engineer unless waived. Concrete testing shall include:

- A. Slumps Test: Perform prior to concrete placement each day, and whenever there is a change in consistency of concrete.
- B. Entrained Air Test: Perform prior to concrete placement each day, and whenever there is a change in consistency of concrete.
- C. Concrete Temperature: Perform prior to concrete placement each day, and whenever there is a change in consistency of concrete.

- D. Concrete Cylinders: Made concrete cylinders daily for each mix of concrete as follows:
 - E. For every 1000 linear feet or fraction thereof of concrete curb and/or gutter, three cylinders shall be made and tested.
 - F. For the initial 100 cubic yards or fraction thereof of concrete for other uses, three cylinders shall be made and tested.
 - G. After the initial 100 cubic yards each day, for every 200 cubic yards or fraction thereof of concrete for other uses, three cylinders shall be made and tested.
 - H. If high early strength concrete is used, prepare at least two additional cylinders per high early strength location for use in determining that the required strength has been obtained for opening pavement to traffic.
- 6.1.4.3 Cure cylinders in field on top of slab, under curing blanket (if applicable).
- 6.1.4.4 Test procedures shall be in accordance with ASTM C31, C39, C143, C172, C231, and C1064.
- 6.1.4.5 At any time, the Engineer requires additional concrete tests to be performed, the Contractor shall comply. These additional tests will be at the Contractor's expense.
- 6.1.4.6 Any concrete found not to meet City requirements shall be immediately removed and replaced by the contractor at the Contractor's expense.
- 6.1.4.7 The City may perform tests to verify that concrete slump, air content, temperature, and strength meet specified requirements. However, these tests are not intended to provide Contractor with information he may need to assure that materials and workmanship meet requirements of specifications, and their performance will not relieve Contractor of responsibility of performing his own tests for that purpose.
- 6.1.4.8 Slump and Air Content Testing Evaluation:
 - A. If measured slump, air content, or temperature falls outside specified limits, immediately check another portion of same batch. In event of a second failure, the concrete shall be rejected.
- 6.1.4.9 Compressive Strength Evaluation:
 - A. All tests to be performed by an approved independent testing laboratory.
 - B. Compressive strength test shall be conducted at 7-days (one cylinder) and 28-days (two cylinders).
 - C. The average of test results for the two 28-day cylinders shall be used to determine compliance, except that neither cylinder may be less than 10 percent below required strength.

- D. If the average 28-day compressive strength is less than the specified strength, the Engineer may direct the Contractor to core the subject area to determine its structural adequacy and whether to direct removal. Cut and test cores according to AASHTO T24 as and where the Engineer directs. A certified technician shall perform and the Engineer shall observe the coring of the concrete pavement. Fill all core holes with an approved non-shrink grout, and provide traffic control during coring at the Contractor's expense.

6.1.5 WARRANTIES

- 6.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements and as follows.
- 6.1.5.2 The warranty (guarantee) period for all concrete work shall be two years from the date of Substantial Completion.
 - A. The Contractor and/or its bonding company are responsible for replacing any concrete that shows construction defects within the warranty period. (Any concrete that has been damaged after initial set shall be replaced at the Contractor's expense. Patching with epoxy or any other type of material will not be permitted.)

6.1.6 MEASUREMENT AND PAYMENT

- 6.1.6.1 Except as provided below, the City will not pay directly for the concrete specified under this section. Concrete is incidental to the various bid items using it. Payment under those bid items includes providing materials, including aggregates and associated aggregate source testing, cement, fly ash, admixtures, and other specified concrete accessories; for preparing, transporting, storing, protecting and curing concrete; and for Contractor requirements related to testing.
- 6.1.6.2 Extra Bags of Cement:
 - A. Measurement: The City will measure Engineer-requested Extra Bags of Cement by the number of extra 94-pound bags of cement acceptably added to the concrete mixture.
 - B. Payment: Payment for measured quantities will be made at the contract unit price per bag for "Extra Bags of Cement". Payment is full compensation for furnishing and mixing the extra bags of cement into the concrete mixture.

6.2 PRODUCTS

6.2.1 CONCRETE

- 6.2.1.1 Concrete shall conform to Section 501 of the Wisconsin Highway Specifications. Use air entrained concrete, Grade A, Grade A2, or Grade A-FA with Class C Fly Ash with the following modification:

A. The compressive strength of the concrete shall be a minimum of 3000 psi at 4 days and 4000 psi at 28 days.

6.2.1.2 The Engineer may designate high-early-strength concrete in locations as needed. High-early-strength concrete shall consist of one extra bag of cement per cubic yard of concrete.

6.2.1.3 The Contractor may request the use of 7-bag high-early-strength concrete, but its use shall be approved by the Engineer. All additional costs associated with the use of high-early-strength concrete as requested by the Contractor shall be at the Contractor's expense.

6.2.2 FORMS

6.2.2.1 Metal Forms:

A. Metal forms shall be of shaped steel sections. The sections shall have a length of at least 10 feet, except on curves of less than 175 feet radius, where shorter or flexible sections must be used. Metal forms shall have a depth equal to the thickness of the concrete to be placed against them. They shall not deflect more than 1/4 inch when tested as a simple beam with a span of 10 feet and a load equal to that which the finish or subgrading apparatus will put upon them. The use of bent, twisted or worn out forms will not be allowed.

B. Forms 8 inches or more in height shall be 8 inches wide at the base; forms less than 8 inches in height shall have a base width of not less than 6 inches.

C. At least three stake pockets for bracing pins or stakes shall be provided for each 10 feet of form and the bracing and support must be ample to prevent the springing of the forms under the pressure of the concrete or the weight or thrust of machinery operating on the forms.

6.2.2.2 Wood Forms:

A. To be used only in special cases with the permission and under the direction of the Engineer.

6.2.3 REINFORCEMENT

6.2.3.1 Reinforcement shall conform to Section 505 of the Wisconsin Highway Specifications.

6.2.4 JOINT FILLER AND SEALER

6.2.4.1 Joint Filler: Expansion joint filler shall conform to Section 415 of the Wisconsin Highway Specifications. Joint filler used shall be of the length, width and depth necessary to affect a full and complete separation for expansion purposes.

6.2.4.2 Joint Sealer: Shall conform to Section 415 of the Wisconsin Highway Specifications.

6.2.5 WATERSTOPS

- 6.2.5.1 If not otherwise specified in the Special Provisions, waterstops shall conform to Section 502 of the Wisconsin Highway Specifications.

6.2.6 CURING MATERIALS

- 6.2.6.1 Liquid curing compounds shall conform to the requirements of the standard specifications for Liquid Membrane-Forming Compounds for curing concrete, AASHTO M148, Type 1 or 2.
- A. Concrete pavement and concrete curb and gutter in conjunction with pavement shall be cured with an AASHTO M148, Type 2 white pigmented curing compound.
 - B. Concrete curb and gutter not in conjunction with pavement and concrete sidewalks and driveways shall be cured with an AASHTO M148, Type 1 curing compound with a white fugitive dye added.
- 6.2.6.2 Use the same curing product throughout the project for each of the above applications.

6.3 EXECUTION

6.3.1 FORMS

6.3.1.1 Setting:

- A. Forms shall be set upon the compacted base and to exact grade and alignment, for a distance of at least 300 feet in advance of the placing of the concrete. Forms shall be thoroughly cleaned and oiled before concrete is placed against them. After setting, the top of forms shall be checked with a 10 foot straightedge and any variation from that straightedge in excess on 1/8 inch shall be corrected.
- B. Particular attention shall be given to the setting of the forms and forming of the slabs at the outer edges to insure adequate drainage and freedom from depressions which may hold water.

6.3.1.2 Form Time:

- A. Pavement and curb and gutter forms shall be left in place until the concrete they enclose is at least 15 hours old, and of sufficient strength. If a machine is used for slip-forming the pavement and/or curb and gutter, or if the forms are removed after 6 hours with the permission of the Engineer, all exposed surfaces shall be cured in accordance with Subsection 415.3.12 of the Wisconsin Highway Specifications.

- B. The method of removing forms shall be such as will not damage the concrete. Any voids or rock pockets of more than casual occurrence found after the forms are removed shall be filled immediately with a well-mixed grout, composed of 1 part of Portland Cement and 3 parts of fine aggregate for concrete masonry. Sidewalk forms shall be left in place until the concrete they enclose is at least 6 hours old.

6.3.2 PLACING CONCRETE

- 6.3.2.1 Mix, deliver, and place concrete in accordance with the requirements of Sections 415 and 501 of the Wisconsin Highway Specifications except as modified in this Specification.

6.3.3 CURING OF CONCRETE

- 6.3.3.1 Unless otherwise provided in the contract, all concrete surfaces shall be cured by the impervious coating method.
- 6.3.3.2 As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete pavement surface.
- 6.3.3.3 In order to insure uniform consistency and dispersion of pigment in the curing material, it shall be well agitated in the supply drum immediately before transfer to the distributor and kept thoroughly agitated during application. The curing compound shall be applied at a rate of not less than 1 gallon per 200 square feet of surface area.
- 6.3.3.4 The curing compound may be applied in either one or two applications in accordance with the directions of the manufacturer. However, if applied in two coatings, the second shall be applied not later than 30 minutes after the first. In the event the coating is damaged within 72 hours after being applied due to joint sawing or otherwise, the affected areas shall be recoated without delay and at the same rate as prescribed above for the original application.
- 6.3.3.5 Type 2 white pigmented curing compound shall be applied by means of power spraying equipment. Should the spraying equipment fail and duplicate spraying equipment is not immediately available, further placing of concrete shall be suspended until properly operating spray equipment is provided and the portion of finished concrete not satisfactorily coated with the curing compound shall be cured by other means satisfactory to the Engineer.
- 6.3.3.6 Type 1 curing compound may be applied with a hand operated sprayer.

6.3.4 IDENTIFICATION MARK STAMP

- 6.3.4.1 An approved stamp or inlaid metal plate shall be placed in all walks, curb and gutter, and pavements constructed in the City.
- 6.3.4.2 In walk and curb and gutter construction, the stamp shall be placed every 150 feet or fraction thereof constructed.
- 6.3.4.3 In pavement construction, the stamp shall be placed at the beginning and end of every day's pour.
- 6.3.4.4 Stamps shall be placed as directed by the Engineer.

6.3.5 PROTECTION OF CONCRETE

- 6.3.5.1 Erect and maintain suitable barricades and employ personnel, if required by the Engineer, to exclude traffic from the newly constructed pavement for the period herein prescribed. Such barriers shall be so arranged as to not, in any way, interfere with or impede public traffic on any lane intended to be kept open. Signs and lights shall be maintained, if necessary, to clearly indicate the lanes open to the public. When it is necessary to provide for traffic across the pavement, construct suitable and substantial crossings to bridge over the concrete which will be adequate for the traffic, and satisfactory to the Engineer. Any part of the pavement damaged by traffic or other causes occurring prior to its final acceptance shall be immediately repaired or replaced by and at the expense of the Contractor in a manner satisfactory to the Engineer. Protect the pavement against both public traffic and the traffic caused by construction activities.
- 6.3.5.2 Fresh concrete shall be protected from rain wherever necessary by tarpaulins, waterproof paper, or other suitable means. No concrete shall be walked on or in any way defaced after being placed until it has thoroughly set to the satisfaction of the Engineer. Concrete found to be defaced shall be immediately removed and replaced at the expense of the Contractor in a manner satisfactory to the Engineer.

6.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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7 CONCRETE PAVEMENT

7.1 GENERAL

7.1.1 SUMMARY

7.1.1.1 This section describes:

- A. Furnishing and placing concrete pavement.
- B. Furnishing and placing concrete curb and gutter.
- C. Furnishing and placing concrete sidewalk, including curb ramps and drives.

7.1.2 RELATED SECTIONS

- 7.1.2.1 Section 4 – Earthwork, Excavation, and Boring: For subgrade preparation and crushed aggregate base course placement.
- 7.1.2.2 Section 5 – Sewers and Sewer Structures: For manhole and inlet final grade adjustments.
- 7.1.2.3 Section 6 – Concrete and Concrete Structures: For general concrete requirements.

7.1.3 SUBMITTALS

- 7.1.3.1 Product Data: Submit product data for detectable warning fields.
- 7.1.3.2 Smoothness Profiling Test Results: Submit documentation report for concrete roadway smoothness profiling.

7.1.4 TESTING

- 7.1.4.1 Roadway Base Course Proof-Rolling:
 - A. Proof-roll prepared roadway base course as specified in the "Preparation" article, below, before placing concrete materials.
- 7.1.4.2 Concrete Mixture Testing: Concrete mixture testing shall comply with the requirements of Section 6 – Concrete and Concrete Structures.
- 7.1.4.3 Concrete Smoothness Testing:

- A. Concrete Pavement: Test the pavement surface at Engineer-selected locations with a 10-foot straightedge or other Engineer-specified device. The Engineer may direct the Contractor to mark and grind down areas showing high spots greater than 1/8 inch but not exceeding 1/2 inch in 10 feet. Grind until there are no deviations greater than 1/8 inch when retested with the straightedge. The Engineer may direct the Contractor to remove and replace areas with deviations greater than 1/2 inch in 10 feet. If required, grinding or removal shall comply with the requirements of Section 415 of the Wisconsin Highway Specifications.
 - B. Concrete Curb and Gutter: Before performing the final surface finish, check the curb and gutter surface with a 10-foot straightedge, and correct areas that vary 1/4 inch from the testing edge by adding or removing concrete while the concrete is still plastic.
 - C. Concrete Sidewalk, Curb Ramps, and Drives: Before performing the final surface finish, check the sidewalk, ramp, or drive surface with a 10-foot straightedge, and correct areas that vary 1/4 inch from the testing edge by adding or removing concrete while the concrete is still plastic.
- 7.1.4.4 Concrete Roadway Smoothness Profiling: When the applicable bid item is included in the Schedule of Prices, perform profile testing on designated roadways in accordance with Section 440.3 of the Wisconsin Highway Specifications. Correct pavement areas not complying with the specified requirements.

7.1.5 WARRANTIES

- 7.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements and as follows.
- 7.1.5.2 The warranty (guarantee) period for all concrete work shall be two years from the date of Substantial Completion.
 - A. The Contractor and/or its bonding company are responsible for replacing any concrete that shows construction defects within the warranty period. (Any concrete that has been damaged after initial set shall be replaced at the Contractor's expense. Patching with epoxy or any other type of material will not be permitted.)

7.1.6 MEASUREMENT AND PAYMENT

7.1.6.1 (depth) Concrete Pavement:

- A. Measurement: The City will measure (depth) Concrete Pavement by the square yard acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "(depth) Concrete Pavement". Payment is full compensation for furnishing all new materials, including concrete, reinforcing tie bars (if shown or specified), and concrete accessories; for constructing pavement, including hand forming where required; and for disposing of surplus materials.

7.1.6.2 (depth) Doweled Concrete Pavement:

- A. Measurement: The City will measure (depth) Doweled Concrete Pavement by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "(depth) Doweled Concrete Pavement". Payment is full compensation for furnishing all new materials, including concrete, dowels, tie bars, other reinforcing (if shown or specified), and concrete accessories; for constructing pavement, including hand forming where required; and for disposing of surplus materials.

7.1.6.3 (width and type) Concrete Curb & Gutter:

- A. Measurement: The City will measure (width and type) Concrete Curb & Gutter by the linear foot acceptably completed. Measurement will be along the base of the curb face or along the flow line of the gutter, and such measurement will be continuous along such line extended across driveway and alley entrance returns. No deduction in length will be made for drainage structures installed in the curbing such as catch basins, drop inlets, etc.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(width and type) Concrete Curb & Gutter". Payment is full compensation for sawcutting at the limits; for furnishing all new materials, including concrete, reinforcing (if shown or specified), and concrete accessories; for constructing curb and gutter, including hand forming where required; and for disposing of surplus materials.

7.1.6.4 (depth) Concrete Sidewalk:

- A. Measurement: The City will measure (depth) Concrete Sidewalk by the square foot acceptably completed.
- B. Payment: Payment will be made at the contract unit price per square foot for "(depth) Concrete Sidewalk". Payment is full compensation for sawcutting at the limits; for furnishing all new materials, including concrete and concrete accessories; for constructing walks and curb ramps; and for disposing of surplus materials.

7.1.6.5 (depth) Concrete Sidewalk & Drive:

- A. Measurement: The City will measure (depth) Concrete Sidewalk & Drive by the square foot acceptably completed.
- B. Payment: Payment will be made at the contract unit price per square foot for "(depth) Concrete Sidewalk & Drive". Payment is full compensation for sawcutting at the limits; for furnishing all new materials, including concrete and concrete accessories; for constructing walks and drive approaches; and for disposing of surplus materials.

7.1.6.6 Pedestrian Curb:

- A. Measurement: The City will measure Pedestrian Curb by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Pedestrian Curb". Payment is full compensation for sawcutting at the limits; for furnishing all new materials, including concrete and concrete accessories; for constructing curb, including hand forming where required; and for disposing of surplus materials.

7.1.6.7 Curb Ramp Detectable Warning Fields:

- A. Measurement: The City will measure Curb Ramp Detectable Warning Fields by the square foot acceptably completed.
- B. Payment: Payment will be made at the contract unit price per square foot for "Curb Ramp Detectable Warning Fields". Payment is full compensation for furnishing and installing detectable warning fields.

7.1.6.8 Concrete Pavement Removal and Replacement:

- A. Measurement: The City will measure Concrete Pavement Removal and Replacement by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Concrete Pavement Removal and Replacement". Payment is full compensation for sawcutting at the limits; for removing existing concrete, asphalt, and other materials; for furnishing all new materials, including crushed aggregate base course, concrete, reinforcing, and concrete accessories; for preparing the foundation; for constructing pavement; and for disposing of debris and surplus materials.

7.1.6.9 Concrete Curb & Gutter Removal and Replacement:

- A. Measurement: The City will measure Concrete Curb & Gutter Removal and Replacement by the linear foot acceptably completed. Measurement will be along the base of the curb face or along the flow line of the gutter, and such measurement will be continuous along such line extended across driveway and alley entrance returns. No deduction in length will be made for drainage structures installed in the curbing such as catch basins, drop inlets, etc.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Concrete Curb & Gutter Removal and Replacement". Payment is full compensation for sawcutting at the limits; for removing existing curb and gutter and other materials; for furnishing all new materials, including crushed aggregate base course, concrete, reinforcing (if shown or specified), concrete accessories, and turf restoration materials; for preparing the foundation; for constructing curb and gutter; for restoring the disturbed turf areas; and for disposing of debris and surplus materials.

7.1.6.10 Concrete Sidewalk Removal and Replacement:

- A. Measurement: The City will measure Concrete Sidewalk Removal and Replacement by the square foot acceptably completed.
- B. Payment: Payment will be made at the contract unit price per square foot for "Concrete Sidewalk Removal and Replacement". Payment is full compensation for sawcutting at the limits; for removing existing sidewalk and other materials; for furnishing all new materials, including foundation material, concrete, concrete accessories, and turf restoration materials; for preparing the foundation; for constructing sidewalks; for restoring the disturbed turf areas; and for disposing of debris and surplus materials.

7.1.6.11 Concrete Roadway Smoothness Profiling:

- A. Measurement: The City will measure Concrete Roadway Smoothness Profiling by the linear foot of roadway acceptably profiled, measured along the roadway centerline or reference line. Measurement will not be made for each wheel track of each lane profiled.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Concrete Roadway Smoothness Profiling". Payment is full compensation for furnishing and operating the profiler; and for documenting and reporting profile results. Correcting the final surface, if required, and re-profiling corrected segments will be the Contractor's expense.

7.2 PRODUCTS

7.2.1 CONCRETE MATERIALS

- 7.2.1.1 Concrete materials and mixes shall comply with the requirements of Section 6 – Concrete and Concrete Structures.

7.2.2 DETECTABLE WARNING FIELDS

- 7.2.2.1 Neenah Foundry 2-foot x 2-foot quick concrete or 2-foot x 4-foot solid panels in construction yellow, or approved equivalent.

7.3 EXECUTION

7.3.1 PREPARATION

- 7.3.1.1 Prior to the placing of concrete, the crushed aggregate base course shall be proof-roll with a fully loaded tandem-axle dump truck. Any soft, spongy, or otherwise unsuitable areas shall be remedied as required in Section 4 – Earthwork, Excavation, and Boring.
- 7.3.1.2 Manhole and catch basin frames, valve boxes, and similar existing structures within the area to be paved shall be adjusted by the Contractor to come flush with the pavement surface, regardless of the amount of said adjustment. Comply with the requirements of Section 5 – Sewers and Sewer Structures and the Special Provisions.

7.3.2 CONCRETE PAVEMENT

7.3.2.1 General:

- A. Construct concrete pavement in accordance with Section 415 of the Wisconsin Highway Specifications and the following requirements.

7.3.2.2 Construction Methods:

- A. Construct concrete pavement with the width, thickness, and crown shown on the Plans. Joint construction and spacing shall be as detailed.
- B. Where abutting existing pavement, drilled bars shall be spaced at 15 inches on-center for a 12-foot lane and 12 inches on-center for an 11-foot lane for transverse joints. For the joints parallel to the centerline the spacing shall be 3 feet on-center. The hole for the tie bar shall be drilled to a depth of 7 inches and to a diameter as to provide a tight driven fit.
- C. Finish the concrete pavement first with a broom and then with an artificial turf drag according to Section 415.3.8.2 or the Wisconsin Highway Specifications.
- D. Test and, if necessary, correct the surface of the concrete pavement as specified under the "Testing" article, above.

- E. If sanitary and storm sewer structures cannot be set to proper elevation and slope without the use of shims and according to the requirements of Section 05 – Sewers and Sewer Structures, then the concrete pavement shall be “boxed out” with forms to nearest longitudinal and transverse joint. The entire concrete panel or panels shall be left out around the structure to the preplanned joint locations. The final placement of the slabs shall be coordinated with cure times and planned access routes for installation of concrete.
- F. Concrete paving shall not occur until all underground utility work is complete.

7.3.2.3 Opening to Traffic:

- A. Traffic shall be excluded from the newly constructed pavement for a period of 4 equivalent curing days after the concrete is placed or when the compressive strength reaches 3000psi. The pavement may be opened to traffic prior to the expiration of the 4-day period if the provisions of Section 415.3.15 of the Wisconsin Highway Specifications are met.

7.3.2.4 Concrete Pavement Removal and Replacement:

- A. Under the Concrete Pavement Removal and Replacement bid item, do the following.
- B. Sawcut the work limits, remove old concrete, asphalt, and other existing materials, clean up all debris, do any grading, and furnish all crushed aggregate base course needed to prepare the foundation. The foundation or material underlying the proposed pavement shall be compacted thoroughly and finished to a firm, true surface. The foundation shall be thoroughly moistened immediately prior to placing of the concrete. Removal of existing materials and grading shall include the removing and grubbing of roots where necessary to 2 inches below the subgrade.
- C. Where abutting existing pavement, drilled bars shall be spaced at 15 inches on-center for a 12-foot lane and 12 inches on-center for an 11-foot lane for transverse joints. For joints parallel to the centerline the spacing shall be 3 feet on-center. The hole for the tie bar shall be drilled to a depth of 7 inches and to a diameter as to provide a tight driven fit.
- D. If the Contractor should in any way damage the pavement adjacent to the pavement being replaced during the course of removal, the Contractor shall replace at its own expense the entire section or sections to which damage was done.

7.3.3 CONCRETE CURB AND GUTTER

7.3.3.1 General:

- A. Construct concrete curb and gutter in accordance with Section 601 of the Wisconsin Highway Specifications and the following requirements.

7.3.3.2 Preparation of Foundation:

- A. The foundation or material underlying the proposed curb and gutter shall be compacted thoroughly and finished to a firm, true surface. The foundation shall be thoroughly moistened immediately prior to placing of the concrete.

7.3.3.3 Forming and Placing:

- A. The profile of the curb and gutter shall conform to the Plan details.
- B. Any area around a tree that has a root zone that conflicts with the normal curb machine clearance must be hand-formed for a distance determined in the field by the City Forester (typically 10 to 15 feet). No notching, scraping or excess root removal in order to get the curb machine past the tree will be allowed.

7.3.3.4 Joints:

A. Expansion Joints:

1. If constructing curb, gutter, or curb and gutter next to asphaltic pavement, locate joints everywhere that tangent and radial curb, or curb and gutter meet; on each side of every inlet 3 feet from the inlet, but no closer than 6 feet from another joint; and on tangent sections place between 6 feet and 300 feet.
2. If constructing curb, gutter, or curb and gutter next to concrete pavement constructed with expansion joints, then place expansion joints to match the expansion joint locations in the pavement.
3. Set joints at right angles to the face of the curb and at right angles to the flow line and surface of gutters. Use 1-inch wide joint filler.
4. Place a 1/2-inch expansion joint, filled with joint filler, between the backs of all curbs and abutting the sidewalk and driveways.

B. Contraction Joints:

1. Place contraction joints constructed next to asphaltic pavement at a maximum of 20 feet on-center.
2. Place contraction joints constructed next to concrete pavement to match the joints in the pavement.

7.3.3.5 Smoothness:

- A. The top and face of the curb and also the top of the apron on combined curb and gutter shall be finished true to line and grade and without any irregularities of surface noticeable to the eye. The gutter shall not deviate from the proposed line and grade more than 1/4 of an inch, nor shall any portion of the surface or face of the curb or gutter depart more than 1/4 of an inch from a straightedge 10 feet in length when placed on the curb parallel to the centerline of the street, nor shall any part of the exposed surfaces present a wavy appearance.

7.3.3.6 Finish:

- A. For the final finishing operations, the surface shall be lightly broomed perpendicular to the direction of travel. The broom shall be a fine haired broom. The brooming shall be done at the proper time to provide brush marks the full surface of the curb and gutter without picking up excessive sand and cement. The broom shall be maintained in good usable condition.

7.3.3.7 Backfilling:

- A. Immediately upon removal of forms, curb or curb and gutter shall be backfilled to a minimum width of 12 inches and to within 4 inches of the top of the curb and flush with the top of the flange. If a machine is used for forming the curb or curb and gutter, or if the forms are removed after 6 hours with the permission of the Engineer, all exposed surfaces shall be cured as specified.

7.3.3.8 Protection:

- A. Traffic shall be excluded from the newly constructed curb and gutter for a period of 4 equivalent curing days after the concrete is placed or longer if, in the opinion of the Engineer, weather conditions make it advisable to extend this time. The pavement may be opened to traffic prior to the expiration of the 4-day period if the provisions of Section 415.3.15 of the Wisconsin Highway Specifications are met.

7.3.3.9 Concrete Curb & Gutter Removal and Replacement:

- A. Under the Concrete Curb & Gutter Removal and Replacement bid item, do the following.
- B. Sawcut the work limits, remove old concrete and other existing materials, clean up all debris, do any grading, and furnish all crushed aggregate base course needed to prepare the foundation. The foundation or material underlying the proposed curb and gutter shall be compacted thoroughly and finished to a firm, true surface. The foundation shall be thoroughly moistened immediately prior to placing of the concrete. Removal of existing materials and grading shall include the removing and grubbing of roots where necessary to 2 inches below the subgrade.

- C. Topsoil and seed all areas disturbed by the construction of curb and gutter replacement immediately after the removal of the forms. Comply with the requirements of Section 14 – Site Improvements and Restoration.
- D. If the Contractor should in any way damage the curb and gutter adjacent to the curb and gutter being replaced during the course of removal, the Contractor shall replace at its own expense the entire section or sections to which damage was done.

7.3.4 CONCRETE SIDEWALK

7.3.4.1 General:

- A. Construct concrete sidewalk, including curb ramps and drives, in accordance with Section 602 of the Wisconsin Highway Specifications and the following requirements.

7.3.4.2 Preparation of Foundation:

- A. The foundation or material underlying the proposed sidewalk shall be compacted thoroughly and finished to a firm, true surface. The foundation shall be thoroughly moistened immediately prior to placing of the concrete.

7.3.4.3 Forming and Placing:

- A. All sidewalks shall not be less than 5 feet in width, except where there are existing standard concrete sidewalks of different widths, in which case the new sidewalks shall conform to the width of the existing standard sidewalk as determined by the Engineer.
- B. All new concrete sidewalk and all sidewalk replacement shall be placed to have a minimum thickness of 4 inches and a slope perpendicular and toward the centerline of the road of 1.5 percent. In areas where new sidewalks are being installed and the location of driveways and alley lines can be determined and where concrete sidewalk is being replaced across driveways and alleys, the sidewalk shall have a minimum thickness as indicated below for driveway approaches.
- C. Sidewalk shall be constructed by a Contractor who is bonded to perform such work in the City of Waukesha.
- D. When spread on the base course, concrete shall be consolidated until a free mortar appears on the surface and the shall be surface trowel finished and broomed.
- E. Existing concrete carriage walks (between the sidewalk and curb and gutter) shall be replaced if requested in writing by the property owner.

7.3.4.4 Joints:

- A. Expansion Joints: A 1/2-inch transverse expansion joint filler shall be placed opposite each side of driveways, opposite each side of alley crossings, and at intervals not to exceed 60 feet. Sidewalks in business districts shall be separated from abutting buildings by a 1 inch expansion joint filler.
- B. Contraction Joints:
 - 1. All contraction joints in concrete sidewalks shall be constructed by the use of a double edger or groover with a minimum size being 6 inches wide, 8 inches long, and having a tongue depth of 1 inch and a tongue width of 1/4 inch at the top.
 - 2. For sidewalk of uniform width, transverse joints shall be constructed at right angles to the centerline of the sidewalk. Where required, longitudinal joints shall be constructed parallel to the centerline of the walk, unless otherwise provided. The transverse and longitudinal joints shall be at right angles to each other insofar as feasible, and the joints shall be constructed as laid out in the field by the Engineer.
 - 3. Align sidewalk and driveway approach joints if possible. Sidewalk joints shall not be spaced more than 6.5 feet, and shall not be less than 2.5 feet, on a 5-foot wide standard sidewalk.

7.3.4.5 Smoothness:

- A. The surface of the sidewalk shall be true to line and grade and without any irregularities of surface noticeable to the eye. The sidewalk shall not deviate from the proposed line and grade more than 1/4 of an inch, nor shall any portion of the surface depart more than 1/4 of an inch from a straightedge 10 feet in length when placed on the surface in any direction.

7.3.4.6 Finishing:

- A. For the final finishing operation, the surface shall be lightly broomed perpendicular to direction of travel. The broom shall be a fine haired push broom. The broom shall be dragged across the full width of the sidewalk. Brooming shall be done at the proper time to provide brush marks across the full width of the sidewalk without picking up excessive cement or sand. The broom shall be maintained in good usable condition.

7.3.4.7 Backfilling:

- A. After removal of forms, dirt shall be immediately backfilled against the new concrete to a minimum width of 12 inches.

7.3.4.8 Protection:

- A. After the walk is completed, it shall be kept moist and protected from both traffic and the weather for 3 days or longer if the weather conditions are such as to require it. Where sidewalk is constructed across driveways, it shall be kept moist and protected from both vehicular traffic and the weather for 4 equivalent curing days, or longer if the weather conditions are such as to require it.

7.3.4.9 Concrete Sidewalk Removal and Replacement:

- A. Under the Concrete Sidewalk Removal and Replacement bid item, do the following.
- B. Sawcut the work limits, remove old concrete and other existing materials, clean up all debris, do any grading, and furnish all granular materials (crushed gravel or bankrun sand) needed to prepare the foundation. The foundation or material underlying the proposed sidewalk shall be compacted thoroughly and finished to a firm, true surface. The foundation shall be thoroughly moistened immediately prior to placing of the concrete. Removal of existing materials and grading shall include the removing and grubbing of roots where necessary to 2 inches below the subgrade.
- C. Topsoil and seed all areas disturbed by the construction of sidewalk replacement immediately after the removal of the forms. Comply with the requirements of Section 14 – Site Improvements and Restoration.
- D. If the Contractor should in any way damage the sidewalk adjacent to the walk being replaced during the course of removal, the Contractor shall replace at its own expense the entire section or sections to which damage was done.

7.3.4.10 Curb Ramps:

- A. Curb ramps shall be constructed where shown on the Plans or directed by the Engineer. Curb ramps shall conform to the Detail Drawings included in the Plans. The Contractor shall make sure each ramp complies with regulations before it is poured. All curb ramps constructed shall have a detectable warning field.
- B. At intersections on this project where there are no curb ramps or where existing curb ramps do not meet current standards, the Contractor shall construct a new curb ramp by replacing sections of curb and gutter, turf and walk, as directed by the Engineer.
- C. In order to achieve the acceptable slope the adjacent walk may be lowered, which will then require additional grading and or filling adjacent to the walk and in the terrace area. Contractor shall typically set ADA ramp slope greater than 1.5%, but less than 8%, to minimize sidewalk removal and replacement distances. The City will not stake grades for ADA ramps.

- D. At curb ramps where obstacles behind the walk (i.e., walls, landscaping) will limit grading, the use of a variable height (Pedestrian) curb will be utilized. A detail for this curb is shown on the Detail Drawings included in the Plans.
- E. For the final finishing operations, the curb ramp surface shall be lightly broomed perpendicular to the direction of travel.

7.3.4.11 K. Concrete Driveways:

- A. Drive approaches within the project limits shall be replaced. Unless otherwise indicated, residential drives and alleys shall be 6-inch thick concrete and non-residential drives and alleys shall be 7-inch thick concrete. The drive approach so constructed shall conform to the “Typical Detail of Standard Drive Approach”. All drive approaches are to be placed on 4 inches of compacted crushed aggregate base course.
- B. All new walk necessary across driveways shall match the thickness specified for drive approaches above.
- C. Portions of concrete driveways behind the walk may be removed as directed by the Engineer and replaced. Unless otherwise indicated, base course and concrete shall be of the thicknesses indicated above for drives approaches.
- D. For the final finishing operations, the drive surface shall be lightly broomed perpendicular to the direction of travel, except taper sections of the approaches may be broomed parallel with the direction of travel.

7.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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8 HMA PAVEMENT

8.1 GENERAL

8.1.1 SUMMARY

8.1.1.1 This section describes:

- A. Furnishing and placing hot mix asphalt (HMA) pavement.
- B. Milling of existing asphalt pavement.
- C. Pavement crack sealing.

8.1.2 RELATED SECTIONS

- 8.1.2.1 Section 4 – Earthwork, Excavation, and Boring: For subgrade preparation and crushed aggregate base course placement.
- 8.1.2.2 Section 5 – Sewers and Sewer Structures: For manhole and inlet final grade adjustments.

8.1.3 SUBMITTALS

8.1.3.1 Asphalt Design Mix:

- A. Prior to construction, submit to the Engineer a report prepared by a current WisDOT approved testing laboratory which shall include:
 - 1. A proposed mix design utilizing bituminous material and mineral aggregate material which the Contractor intends to use in the execution of the contract. Separate test designs shall apply to binder course and wearing course mixtures. This design shall conform to the Wisconsin Highway Specifications.
 - 2. A complete sieve analysis of aggregate to be employed in the execution of the contract.
 - 3. Test information indicating performance of the design mix including specific gravity compaction data.
- B. This data shall be presented to the Engineer for approval not less than two (2) weeks prior to beginning work.
- C. The Contractor shall strictly adhere to the approved design mix while carrying out the contract. The mix for surface or binder course shall not be altered from the approved design without written approval of the Engineer.

- 8.1.3.2 Asphalt Equipment Data: At the Engineer's request, submit a list of all equipment to be used for this contract, stating name, year of manufacture, capacity, and location. At the Engineer's request, furnish a certificate of inspection from the manufacturers of the mixing machine, laying machine, and rollers to be used, which will guarantee that said equipment is in good operating order.
- 8.1.3.3 Asphalt Test Reports: Submit asphalt quality control testing results as specified in the "Testing" article, below.
- 8.1.3.4 Smoothness Profiling Test Results: Submit documentation report for HMA roadway smoothness profiling.
- 8.1.3.5 Pavement Repair Membrane Product Data: Submit product data for pavement repair membrane.
- 8.1.3.6 Crack Filling Sealant Product Data: Submit product data for crack filling sealant.

8.1.4 TESTING

- 8.1.4.1 Roadway Base Course Proof-Rolling:
 - A. Proof-roll prepared roadway base course as specified in the "Asphalt Pavement" article, below, before placing asphalt materials.
- 8.1.4.2 Asphalt Quality Control: A quality control program is defined as all activities, including mix design, process control inspection, sampling and testing, and necessary adjustments in the process that are related to the production of a HMA pavement which meets the requirements of the specifications.
 - A. Plant Testing: The Contractor shall provide and maintain a quality control program according to the State of Wisconsin Quality Management Program (QMP) for HMA pavement. QMP testing shall be in accordance with the Section 460.2.8 of the Wisconsin Highway Specifications with the following exception: *The Contractor shall test material from the plant at least once per day, and shall provide the Engineer with the test results within 24 hours of testing completion.*
 - B. Field Testing: During the placement of the lower and surface courses of HMA pavement, the Contractor shall provide Nuclear Density Testing of the pavement. Tests shall be according to Section 460.3.3 of the Wisconsin Highway Specifications with the following exception: *Random testing schedule shall be one test per 100-Tons of HMA pavement placed within a single layer. The Contractor shall provide the Engineer with the test results within 24 hours of testing completion.*
- 8.1.4.3 Asphalt Surface Tolerance Testing: The Contractor shall measure the asphalt surface tolerance at street structures as specified in the "Asphalt Pavement" article, below.

- 8.1.4.4 Asphalt Smoothness Testing: The Contractor shall measure the smoothness of asphalt as specified in the "Asphalt Pavement" article, below.
- 8.1.4.5 HMA Roadway Smoothness Profiling: When the applicable bid item is included in the Schedule of Prices, perform profile testing on designated roadways in accordance with Section 440.3 of the Wisconsin Highway Specifications. Correct pavement areas not complying with the specified requirements.
- 8.1.4.6 Asphalt Thickness Testing: For asphalt pavement paid for on a square yard basis, the City will measure the asphalt thickness as specified in the "Asphalt Pavement" article, below.

8.1.5 WARRANTIES

- 8.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements and as follows.
- 8.1.5.2 Asphalt Pavement: The warranty (guarantee) period for all asphalt pavement work shall be two years from the date of Substantial Completion. Pavement deficiencies found during the warranty period shall be addressed as follows:
 - A. All paving joints (longitudinal and transverse) that open shall be routed and crack sealed as determined by the Engineer.
 - B. All pre-mature cracks shall be crack sealed or routed and crack sealed as determined by the Engineer.
 - C. Any other pavement irregularities shall be addresses in a method approved by the Engineer.
- 8.1.5.3 Pavement Crack Sealing: The warranty (guarantee) period for all crack sealing work shall be three years from the date of Substantial Completion.
 - A. This guarantee shall consist of replacing (following the requirements of this Specification) the crack sealing material if it pulls out of the crack or if the sealed crack opens.

8.1.6 MEASUREMENT AND PAYMENT

8.1.6.1 HMA Pavement (mixture type):

- A. Measurement: The City will measure HMA Pavement (mixture type) by the ton as specified in Section 450.4 of the Wisconsin Highway Specifications.

- B. Payment: Payment for measured quantities will be made at the contract unit price per ton for "HMA Pavement (mixture type)". Payment is full compensation for furnishing and placing HMA pavement, including binder, prime coat, and tack coat; for mixture design; for preparing the foundation; for adjusting street structures; for mobilizing for the various courses required; for milling of binder course wedges, sweeping, and other binder course preparation; and for quality control, surface tolerance, and straightedge smoothness testing.

8.1.6.2 Milling Existing Asphalt Roadway - (depth):

- A. Measurement: The City will measure Milling Existing Asphalt Roadway - (depth) by the square yard of pavement acceptably milled to the average depth specified.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Milling Existing Asphalt Roadway - (depth)". Payment is full compensation for milling the pavement, providing temporary asphalt ramps as needed, and clean up and removal of the milled material.

8.1.6.3 Foundation Preparation:

- A. Measurement: The City will measure Foundation Preparation by the square yard acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Foundation Preparation". Payment is full compensation for removing any materials that has become loose from milled surfaces prior to overlay paving.

8.1.6.4 Pavement Repair Membrane:

- A. Measurement: The City will measure Pavement Repair Membrane by the square yard acceptably placed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Pavement Repair Membrane". Payment is full compensation for furnishing all materials; for cleaning, drying, and filling cracks; and for preparing the pavement surface and placing the repair membrane.

8.1.6.5 Pavement Crack Sealing:

- A. Measurement: The City will measure Pavement Crack Sealing by the ton of sealant acceptably placed.

1. The Contractor shall store all crack filling sealant at the City DPW garage at 300 Sentry Drive. Each day the Contractor shall verify the weight of the empty truck prior to first load, the truck with first load, and the truck after the final load of the day using the scale at the DPW garage. The City reserves the right to ask for additional verified loads.
 2. The Contractor shall keep the Engineer apprised of the total amount of crack filling sealant used on a daily basis.
- B. Payment: Payment for measured quantities will be made at the contract unit price per ton for "Pavement Crack Sealing". Payment is full compensation for traffic control, routing cracks to be sealed, cleaning and drying routed cracks, furnishing the specified sealant, filling and squeegeeing cracks with sealant, furnishing and installing blotting material, and cleaning the pavement surface after filling the cracks.

8.1.6.6 HMA Roadway Smoothness Profiling:

- A. Measurement: The City will measure HMA Roadway Smoothness Profiling by the linear foot of roadway acceptably profiled, measured along the roadway centerline or reference line. Measurement will not be made for each wheel track of each lane profiled.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "HMA Roadway Smoothness Profiling". Payment is full compensation for furnishing and operating the profiler; and for documenting and reporting profile results. Correcting the final surface, if required, and re-profiling corrected segments will be the Contractor's expense.

8.2 PRODUCTS

8.2.1 ASPHALT MATERIALS

- 8.2.1.1 Hot mix asphalt shall conform to Sections 450, 455, and 460 of the Wisconsin Highway Specifications except as modified in this Specification.
- 8.2.1.2 The mixture type(s) required shall be as designated on the Drawings or in the Special Provisions.

8.2.2 PAVEMENT REPAIR MEMBRANE

- 8.2.2.1 Rubberized asphalt impregnated non-woven polypropylene fabric; Propex "Petrotac", or approved equivalent.

8.2.3 CRACK FILLING SEALANT

- 8.2.3.1 Sealant shall be a premium quality rubber asphalt joint sealer complying with the requirements of ASTM D6690.

8.3 EXECUTION

8.3.1 ASPHALT PAVEMENT

8.3.1.1 General:

- A. A pre-paving meeting shall be held with the Paving Contractor, the General Contractor, and the City prior to paving to review paving procedures (i.e., to minimize cold joints).
- B. Pavement courses shall be placed on separate days unless approved by the Engineer. No claim for additional Mobilization costs, delay, or other contract time extensions will be allowed even if the Contract Deadline has expired.
- C. All landscaping and concrete pavement, curb and gutter, and sidewalks shall be completed before the surface course is placed.

8.3.1.2 Equipment:

- A. The equipment furnished and use for the work required shall conform to equipment described in Section 450.3.1 of the Wisconsin Highway Specifications.
- B. Compaction Equipment:
 - 1. Compaction equipment shall, at all times, include two self-propelled steel drum rollers and may include one self-propelled pneumatic-tired roller, of the type specified, when placing binder courses.
 - 2. Compaction equipment shall, at all times, include two self-propelled steel drum rollers, of the type specified, when placing surface courses.
- C. Scales: The City reserves the right to have any load of material delivered to a truck scale to check the weight of the load. No claim for loss or delay will be allowed on this account.

8.3.1.3 Construction Methods:

- A. Prior to the placing of a prime coat, the crushed aggregate base course shall be proof-roll with a fully loaded tandem-axle dump truck. Any soft, spongy, or otherwise unsuitable areas shall be remedied as required in Section 4 – Earthwork, Excavation, and Boring.
- B. A prime coat, of the type designated by the Engineer, shall be applied to the crushed aggregate base course at a rate of at least 0.2 of a gallon per square yard but not to exceed 0.5 of a gallon per square yard. Prime coat application dates shall follow restrictions in NR 422.16. The cost of the prime coat is to be included in the unit bid price of HMA pavement.

- C. Prior to placement of the lower course, all butt joints shall be inspected to assure a clean edge. If the edge has deteriorated, it shall be re-saw cut. The re-sawing of a butt joint at the pavement limits will not be paid for.
- D. Prior to the placement of the binder course all street structures (manholes, water valves, etc.) shall be adjusted to finished binder grade or within minus 1-1/2 inches of finished binder grade.
- E. Asphalt mixtures shall be laid only on a prepared, firm and compacted base or foundation course, which is substantially surface-dry and free of loose and foreign material.
- F. Asphalt mixtures shall not be placed over frozen subgrade or base or where the roadbed underlying the foundation or base is temporarily unstable from the effects of frost heaving.
- G. Asphalt mixtures shall not be placed when it is raining or snowing and any mixture exposed to rain or snow before final rolling which has, in the judgment of the Engineer, been adversely affected thereby shall be removed and replaced at the Contractor's expense.
- H. Asphalt mixtures shall not be placed when the air temperature approximately 3 feet above ground at the site of the work, in the shade and away from the effects of artificial heat is less than 40°F, except that binder course mixtures may be placed at a lesser temperature when approved by the Engineer.
- I. Asphalt mixture which, in the judgment of the Engineer, is not sufficiently mixed or is defective in any manner shall be rejected.
- J. Prior to the placing of the surface course, the Contractor, at its expense, shall repair any depressions or other signs of failure in the binder course as directed by the Engineer.
- K. Final approval of the lower course shall be obtained prior to the placement of the surface course.
- L. After the lower course and before the surface course is placed, all butt joints shall be inspected to assure a clean edge. A partial depth saw cut may be required to provide a clean edge, if the edge has deteriorated.
- M. Sweep the street before the placement of the next course.
- N. Following the approval of the last lift of binder course, by the Engineer, all street structures (manholes, water valves, etc.) shall be raised and adjusted to final grade. The area excavated to raise the structure shall be backfilled with high-early-strength concrete meeting the requirements of Section 416.2.5.1 of the Wisconsin Highway Specifications, to the elevation of the binder course.

- O. Manholes, valves and other street structures may be adjusted to final grade prior to the placement of the lower course. Any street structure found to be adjusted to the wrong elevation after the lower course has been placed shall be readjusted prior to the placement of the surface course. Manholes and street structures raised to final grade prior to the placement of the lower course shall be ramped with asphalt until the surface course is placed. Prior to the placement of the surface course, remove these ramps.
- P. Prior to the placing of the surface course, all foreign matter shall be removed from the binder course surface. The binder course shall then be uniformly covered with a tack coat, designated by the Engineer, and applied at a rate of 0.10 gallons per square yard. The cost for this tack coat shall be included in the unit bid price of HMA pavement.
- Q. Longitudinal joints in the surface shall, at no time, be placed immediately over similar joints in the binder course beneath. A minimum distance of six (6) inches shall be required between the location of the joints in any given course and the location of similar joints in the course placed above it.
- R. Except where the edges are supported by a curb, gutter, or similar structure, the outside edges of the binder and surface courses shall be sloped and pressed in place by means of a self-adjusting constant pressure edge plate, held in proper position on the finishing machine. The edge of the pavement shall be sloped approximately 1 inch from the vertical and no material shall extend beyond the limits of the base. Irregularities in alignment along the outside edges and along the longitudinal joint shall be corrected by adding or removing paving mixtures before the edges are rolled. Excess asphalt mixture deposited on the existing base, binder or surface course outside the limits of the lane being laid, shall be removed immediately. Contact surfaces of curbs, gutter, manholes and similar structures shall be painted with liquid asphalt before the asphalt mixture is placed.
- S. After the spreading and strike-off and while still hot, the binder and/or surface course shall be compacted according to Section 460.3.3 of the Wisconsin Highway Specifications except that self-propelled pneumatic-tired rollers shall not be required when compacting surface courses.
- T. Remove any excess asphalt from manhole lids, pickholes water valve box openings and ensure that these structures are clean and clear of HMA material.

8.3.1.4 Asphalt Surface Tolerance:

- A. Surface tolerance at concrete curb flange at curb ramp locations: The HMA Pavement surface shall be placed flush with the flange of the concrete curb at all curb ramp locations. If the surface is installed greater than 1/8-inch above the curb flange at the curb ramps, the Contractor shall be required to remedy as directed in the Pavement Deficiency Correction section of these specifications.
- B. Surface tolerance at concrete curb flange: The HMA Pavement surface shall be placed no higher than a 1/4-inch above the flange of the concrete curb and gutter at all locations other than at curb ramps. If the surface is installed greater than 3/8-inch above the curb flange, the Contractor shall be required to remedy as directed in the Pavement Deficiency Correction section of these specifications.
- C. Surface tolerance of street structures: Manholes, valves and other street structures shall be adjusted to 1/4 to 3/8 inches below the final HMA Pavement surface.
 - 1. Measure the street structure tolerance by placing the center a 6-foot straightedge over the centerline of each frame parallel to the direction of traffic. Make a measurement at each side of the frame and average the two measurements. If the frame is higher than the adjacent pavement, then make the two measurements at each end of the straightedge and average them.
 - 2. Structure below HMA Pavement: Locations where structures are found to be between flush and 3/8-inch below the pavement surface will not require remediation. Structures found to be greater than 3/8-inch below the proposed HMA Pavement surface will require correction as directed in the Pavement Deficiency Correction section of these specifications.
 - 3. Structure above HMA Pavement: Structures found to be greater than a 1/8-inch above the final HMA Pavement surface will require correction as directed in the Pavement Deficiency Correction section of these specifications.

8.3.1.5 Asphalt Smoothness Tolerance:

- A. When directed by the Engineer, immediately after the initial rolling, the Contractor shall test the surface for smoothness with a 10-foot straightedge to locate high or low areas so they may be corrected while the mixture is still hot. When directed by the Engineer, the binder course shall also be straight edged in the manner described for the surface course. The Contractor shall provide competent workers, who are capable of performing the work, incidental to the correction of pavement irregularities. One such worker shall, under the direction of the City Inspector give special attention to the straight-edging of the surface.

- B. After the binder and surface courses have been thoroughly compacted, they shall be tested for smoothness by means of a 10-foot straightedge placed parallel to the centerline of the pavement. Ordinates measured from the face of the straightedge to the binder course shall, at no place, exceed 1/4 inch. Ordinates measured from the face of the straightedge to the surface course shall, at no place, exceed 1/8 inch.
1. Variations exceeding 1/4 inch in the binder course shall be corrected as directed by the Engineer.
 2. Variations in the surface course greater than 1/8 inch but less than 1/4 inch, shall result in a deduction from the amount due the Contractor of 1/6 of the bid price per ton of surface course or an amount equal to 1/2 the bid price per square yard of pavement, for each such variation occurring within any given pass of the paving machine.

8.3.1.6 Asphalt Thickness Tolerance:

- A. All asphalt pavements that are contracted on a square yard basis will be cored to determine the actual depth constructed.
1. If the average depth of the core is between 1/4 and 1/2 inch less than the specified contract depth, the final payment shall be subject to a reduction according to the following formula: Multiply the contract unit bid price by the square of the average core depth, divided by the square of the specified contract depth.
 2. If the average depth of the core is more than 1/2 inch below the specified contract depth, the Contractor shall be required to place, at his expense, an asphalt overlay on the entire pavement, unless otherwise directed by the Engineer. All adjustment of underground street structures and appurtenances and/or removals required to provide for the overlay shall be at the Contractor's expense.
 3. The above "average depths" shall be averaged over a 500-foot street length, or one city block, whichever is the lesser length.
- B. All asphalt pavements contracted on a per ton basis shall be laid and compacted so that the average yield shall be in excess of 115 pounds per inch per square yard of measured pavement area. When the average yield on a portion of the project (500 feet in length or one city block, whichever is less) is more than the average lb./in./sq. yd. + 15% computed from the test samples taken from the compacted pavements, all tonnage over this amount shall be paid for at the rate of 1/2 the unit bid price per ton of asphalt materials.

8.3.1.7 Pavement Surface Deficiency Correction:

- A. Surface tolerance corrections along the concrete curb flange: Contractor shall be required to use infrared heating equipment to remove excess HMA pavement in areas out of tolerance.
- B. Surface tolerance corrections at manholes shall include:
 - 1. The Contractor shall sawcut the HMA pavement that is to be removed in order to re-set the manhole chimney according to the sewer sections of these specifications.
 - 2. The HMA surface shall be milled from the flange to the nearest HMA pavement joint (if the structure is in the centerline, the area to be milled is flange to flange). The length of the milled area shall be equal to the width.
 - 3. The lower courses around the manhole shall be replaced and compacted.
 - 4. Place a tack coat and pave a new surface lift of HMA pavement that matches the existing HMA pavement and the re-set manhole.
 - 5. The seam created at the existing HMA pavement shall be infrared heated to blend and fuse the new HMA pavement to the existing.
- C. Surface tolerance corrections at water valves shall include:
 - 1. The HMA pavement shall be infrared heated so the water valve can be turned up.
 - 2. If the water valve cannot be turned up, the Contractor shall follow the requirements listed under surface tolerance corrections at manholes, except that the water valve shall be re-set according to the Waukesha Water Utility Specifications.

8.3.1.8 The final determination of the corrective measures to be implemented shall be as directed by the Engineer.

8.3.2 PAVEMENT MILLING

8.3.2.1 General:

- A. Designated asphalt streets shall be milled over the entire width (flange to flange) and the depth specified in the Special Provisions.

8.3.2.2 Equipment:

- A. The milling machine shall be a power operated, self-propelled machine, having a cutting drum with lacing patterns that will attain a grooved surface and produce grinding chips of less than 2-inches in size. The milling machine shall be equipped with a pressurized watering system for dust control. The equipment shall be of the type that has successfully performed similar work.

- B. The street cleaning equipment shall be of the type to efficiently remove all loosened material and load into trucks for hauling. A belt loader followed by a power sweeper and manual sweeping is considered the preferred method. Use of front-end loaders or flushing into the City's storm sewer system will not be allowed as a means of clean-up.

8.3.2.3 Construction Methods:

- A. Mill around manholes and utility valves within the limits of the work. Any damage to manholes or valves by the milling operation shall be the responsibility of the Contractor. The Contractor shall also minimize damage to trees from the exhaust of the mill machine by diverting the exhaust to the side and not up into the tree canopy.
- B. The Contractor will be responsible for maintaining safe driving conditions after milling has taken place. This shall include immediately ramping or barricading any structures that are sticking out of the pavement and providing and maintaining signs (i.e. "Bump", "Road Construction Ahead", or "Rough Road") until the overlay has been placed. Temporary asphalt ramps shall be placed at the ends of the milling limits.
- C. Asphalt millings shall be cleaned from the pavement surface immediately after the milling operation to the satisfaction of the Engineer.
- D. After milling and prior to the overlay, the Contractor shall remove any material that has become loose.
- E. The City will retain all asphalt millings. The millings shall be delivered and stockpiled to the location indicated in the Special Provisions.
- F. For large cracks that remain after the milling operation that are 1/2-inch wide and larger (typically the transverse joints and pavement joints), or wherever the Engineer designates, the open cracks shall be properly cleaned, dried, and filled with a suitable crack sealer, then a pavement repair membrane shall be applied according to manufacturer's specifications. The crack sealer used must be compatible with the membrane and applied according to the manufacturer's specifications.

8.3.3 PAVEMENT CRACK SEALING

8.3.3.1 General:

- A. The selection of cracks to be sealed will be at the direction of the Engineer. The criterion used is that a crack must be approximately 1/4-inch or greater in width to be filled.

8.3.3.2 Equipment:

- A. The router shall use star wheel carbide tipped router blades attached to a main cutting head. It shall have in-line wheels and a cutting head capable of following random cracks. It shall have automatic depth control to insure consistent and accurate routing depths.
- B. Two air compressors will be required. They shall be of sufficient size to provide moisture free and oil free compressed air. One compressor shall be used with an air wand to blow out the crack and clean off the road. The second shall be used with the heat lance.
- C. The crack sealer material shall be heated in an oil jacketed double boiler type-melting unit with both agitation and re-circulation systems. It shall have separate temperature thermometers for both the oil bath and melting vat to insure proper temperatures for the sealant. It shall be equipped with a pump to pressure fill cracks with a wand applicator. The temperature of the melted crack sealer material shall not exceed manufacturer's specifications.

8.3.3.3 Construction Methods:

- A. Conduct operations in a manner that will cause the least interference to traffic movements. The minimum number of vehicles needed to perform the work (including employee vehicles) shall be permitted to park at the various work sites.
- B. There shall be no visible signs of moisture on the pavement surface or in the reservoir immediately prior to the time the sealant is applied.
- C. Use the following process for crack sealing:
 - 1. All cracks and joints shall be routed to minimum of a 2:1 ratio (width versus depth).
 - 2. Cracks shall be blown out with compressed air. The road surface shall also be blown off at this time to clear it of any routed debris and cleaned up the surface.
 - 3. Using the second compressor, the cracks shall be blown out using a heat lance. The heat lance shall not be applied in one area long enough to burn or scorch the asphalt.
 - 4. All cracks shall be pressure filled by a wand applicator from the bottom up. They shall be slightly over-filled and squeegeed to create an overband 1-inch wide on each side of the routed reservoir.
 - 5. All sealant filled cracks shall then have a single ply toilet paper applied to prevent any material from tracking. As an alternate to toilet paper, a de-tackifying product such as "Detack" by "CRAFECO" or approved equal may be used to prevent tracking of the crack sealer material.

- D. Immediately repair or refill any part of a sealed crack damaged by traffic.
- E. Clean the pavement surface with a self-propelled power broom, equipped with water for dust suppression. The broom shall be capable of picking up loose material and depositing it off-site. Cleaning shall be done within 24-hours of the roadway being opened to traffic.
- F. Immediately repair or refill any part of a sealed reservoir damaged by the cleaning procedure.

8.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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9 BRIDGES

9.1 GENERAL

9.1.1 SUMMARY

9.1.1.1 This section describes repairs and overlays for concrete bridges.

9.1.2 RELATED SECTIONS (NOT USED)

9.1.3 SUBMITTALS

9.1.3.1 Product Data: Submit product data for polymer overlay materials, protective surface treatment, and pigmented surface treatment.

A. Product data sheets and specifications from the manufacture consists of literature from the manufacturer showing general instructions, application recommendations/methods, product properties, general instructions, or any other applicable information

9.1.3.2 Certified Reports: Submit the following certified reports for polymer overlay materials:

A. Polymer Binder: Submit a certified report of test or analysis from an independent laboratory dated less than 3 years prior to the date of the project letting showing the polymer binder meets the specified requirements.

B. Aggregates: Submit a certified report of test or analysis from an independent laboratory dated less than 6 months prior to the date of the project letting showing the aggregates meet the specified requirements.

9.1.4 TESTING (NOT USED)

9.1.5 WARRANTIES

9.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

9.1.6 MEASUREMENT AND PAYMENT

9.1.6.1 Repairs and overlays will be measured and paid for in accordance with the applicable provisions of Sections 502 and 509 of the Wisconsin Highway Specifications and the following requirements.

9.1.6.2 Cleaning Parapets:

A. Measurement: The City will measure Cleaning Parapets in length by the linear foot of parapet acceptably cleaned.

- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Cleaning Parapets". Payment is full compensation for abrasive blast cleaning; for water cleaning; and for all additional clean-up of the concrete surface and surrounding bridge deck area.

9.1.6.3 Cleaning Railings:

- A. Measurement: The City will measure Cleaning Railings in length by the linear foot of railing acceptably cleaned.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Cleaning Railings". Payment is full compensation for abrasive blast cleaning; for water cleaning; and for all additional clean up of the concrete surface and surrounding bridge deck area.

9.1.6.4 Sawing Pavement Deck Preparation Areas:

- A. Measurement: The City will measure Sawing Pavement Deck Preparation Areas by the linear foot acceptably completed. Over-cuts and cuts made beyond the limits marked in the field will not be measured for payment.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Sawing Pavement Deck Preparation Areas". Payment is full compensation for making all saw cuts.

9.1.6.5 Concrete Masonry Deck Patching:

- A. Measurement: The City will measure the Concrete Masonry Deck Patching by the cubic foot acceptably completed. Wasted concrete will not be measured.
- B. Payment: Payment for measured quantities will be made at the contract unit price per cubic foot for "Concrete Masonry Deck Patching". Payment is full compensation for furnishing, hauling, preparing, placing, finishing, curing, and protecting all materials.

9.1.6.6 Polymer Overlay:

- A. Measurement: The City will measure Polymer Overlay in area by the square foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square foot for "Polymer Overlay". Payment is full compensation for preparing the surface; for tensile bond testing; for creating the transitional area; for providing the overlay; for cleanup; and for sweeping/vacuuming and disposing of excess materials. Concrete Deck Repair will be paid for separately.

9.2 PRODUCTS

9.2.1 CONCRETE MATERIALS

- 9.2.1.1 Concrete materials shall comply with Section 509.2 of the Wisconsin Highway Specifications and the following requirements.
- 9.2.1.2 Furnish Grade E concrete conforming to Section 501 of the Wisconsin Highway Specifications for concrete masonry deck patching.

9.2.2 POLYMER OVERLAY MATERIALS

9.2.2.1 General: Furnish materials specifically designed for use over concrete bridge decks. Furnish polymer liquid binders from the Wisconsin Dept. of Transportation’s approved product list.

9.2.2.2 Polymer Resin:

A. Furnish a polymer resin base and hardener composed of two-component, 100% solids, 100% reactive, thermosetting compound with the following properties:

Property	Requirements	Test Method
Gel Time ^A	15 - 45 minutes @ 73° to 75° F	ASTM C881
Viscosity ^A	7 - 70 poises	ASTM D2393, Brookfield RVT, Spindle No. 3, 20 rpm
Shore D Hardness ^B	60-75	ASTM D2240
Absorption ^B	1% maximum at 24 hr	ASTM D570
Tensile Elongation ^B	30% - 70% @ 7 days	ASTM D638
Tensile Strength ^B	2000 to 5000 psi @ 7 days	ASTM D638
Chloride Permeability ^B	<100 coulombs @ 28 days	AASHTO T277

^A Uncured, mixed polymer binder

^B Cured, mixed polymer binder

1. The required properties of the polymer resin when mixed with aggregate:

Property	Requirement ^C	Test Method
Minimum Compressive Strength	1,000 psi @ 8 hrs 5,000 psi @ 24 hrs	ASTM C579 Method B, Modified ^D
Thermal Compatibility	No Delaminations	ASTM C884
Minimum Pull-off Strength	250 psi @ 24 hrs	ASTM C1583

^C Based on samples cured or aged and tested at 75°F

^D Plastic inserts that will provide 2 inch by 2 inch cubes shall be placed in the oversized brass molds.

9.2.2.3 Aggregates:

A. Furnish natural or synthetic aggregates that are non-polishing, clean, free of surface moisture, fractured or angular in shape; free from silt, clay, asphalt, or other organic materials; and meet the following properties and gradation requirements:

B. Aggregate Properties:

Property	Requirement	Test Method
Moisture Content*	½ of the measured aggregate absorption, %	ASTM C566
Hardness	≥6.5	Mohs Scale
Fractured Faces	100% with at least 1 fractured face & 80% with at least 2 fractured faces of material retained on No.16	ASTM D5821
Absorption	≤1%	ASTM C128

* Sampled and tested by the department prior to placement.

2. Gradation:

Sieve Size	% Passing by Weight
No. 4	100
No. 8	30 – 75
No. 16	0 – 5
No. 30	0 – 1

9.2.3 PROTECTIVE SURFACE TREATMENT

9.2.3.1 Protective surface treatment shall comply with Section 502.2 of the Wisconsin Highway Specifications.

9.2.4 PIGMENTED SURFACE SEALER

9.2.4.1 Pigmented surface sealer shall comply with Section 502.2 of the Wisconsin Highway Specifications.

9.3 EXECUTION

9.3.1 CLEANING DECKS AND APPROACHES

- 9.3.1.1 Clean concrete decks and approach pavements in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.2 CLEANING PARAPETS AND RAILINGS

- 9.3.2.1 Blast Cleaning Operation: Blast clean the designated surfaces of the concrete parapet or railing according to SSPC SP-13 and ASTM D4259 for an abrasive blast cleaning to a surface roughness and finish as directed by the Engineer. Before abrasive blast cleaning operations are to begin for the entire bridge parapet or railing, prepare a representative trial area on the concrete surface, and have the method of blast cleaning approved by the Engineer.
- 9.3.2.2 Water Cleaning Operation: After abrasive blast cleaning operations are completed, clean the prepared parapet or railing surface with water according to ASTM D4258. Remove with this water cleaning all dust and loose material from the parapet or railing surfaces that are to be coated with pigmented surface sealer. Provide an adequate drying time of the concrete surfaces of at least 24 hours before coating with the pigmented surface sealer. Remove all loose concrete, dirt, dust, or blast material that remains on the bridge deck, as directed by the Engineer.

9.3.3 PREPARING DECKS AND APPROACHES

- 9.3.3.1 Prepare concrete decks and approach pavements in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.4 JOINT REPAIR

- 9.3.4.1 Repair concrete joints in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.5 CURB REPAIR

- 9.3.5.1 Repair concrete curbs in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.6 SAWING PAVEMENT DECK PREPARATION AREAS

- 9.3.6.1 Saw the boundaries of the existing concrete on the bridge deck that has been sounded and marked for deck preparation. These boundaries will be at least 2 inches and not greater than 6 inches outside of the unsound or disintegrated areas of concrete, as directed or marked by the Engineer in the field.
- 9.3.6.2 Make the saw cuts, a minimum of 1 inch in depth, at the locations marked.
- 9.3.6.3 Use a diamond blade for sawing that will allow the concrete to be sawed dry. Upon completion of the daily sawing, remove the dust deposits from the deck.

9.3.7 CONCRETE MASONRY DECK PATCHING

- 9.3.7.1 Neat Cement: Immediately before placing the concrete deck patching, coat the prepared surfaces with a neat cement mixture. Ensure the prepared concrete surfaces are moist without any standing water before coating with the neat cement mixture. Brush the neat cement mixture over the prepared concrete surfaces to ensure that all parts receive an even coating, and do not allow excess neat cement to collect in pockets. Apply the neat cement at a rate that ensures the cement does not dry out before being covered with the new concrete.
- 9.3.7.2 Placing Concrete: Place concrete conforming to Section 509 of the Wisconsin Highway Specifications. As determined by the Engineer, consolidate smaller areas by internal vibration, strike them off, and finish the areas with hand floats to produce plane surfaces that conform to the grade and elevation of the adjoining surfaces. Give all deck patching areas a final hand float finish.
- 9.3.7.3 Curing Concrete: Cure the concrete masonry deck patching conforming to Section 502.2.6(1) of the Wisconsin Highway Specifications.

9.3.8 CONCRETE SURFACE REPAIR

- 9.3.8.1 Repair concrete abutments, piers, girders, and other elements in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.9 FULL DEPTH DECK REPAIR

- 9.3.9.1 Perform full depth deck repair in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.10 PLACING CONCRETE OVERLAY

- 9.3.10.1 Place concrete overlays in accordance with Section 509.3 of the Wisconsin Highway Specifications.

9.3.11 PLACING POLYMER OVERLAY

9.3.11.1 General:

- A. Apply two layers of a two-component polymer overlay system to the bridge decks shown on the Plans. The minimum total thickness of the overlay system shall be 1/4 inch.
- B. Field Review: Conduct a field review of the existing deck to identify any possible surface preparation and material compatibility issues.

- C. Pre-Installation Meeting: Conduct a pre-installation meeting with the manufacturer's representative and the engineer prior to construction. Discuss the field review findings, verification testing of the surface preparation and establish procedures for maintaining optimum working conditions and coordination of work. Furnish the Engineer a copy of the recommended procedures and apply the overlay system according to the manufacturer's instructions. Supply for the Engineer's use for the duration of the project, a Concrete Surface Profile (CSP) chip set of 10 from the International Concrete Repair Institute (ICRI).
- D. Manufacturer's Representative: An experienced manufacturer's representative familiar with the overlay system installation procedures shall be present at all times during surface preparation and overlay placement to provide quality assurance that the work is being performed properly. This requirement may be reduced at the Engineer's discretion.
- E. Material Storage: Store and handle materials according to the manufacturer's recommendations. Store resin materials in their original containers in a dry area. Store all aggregates in a dry environment and protect aggregates from contaminants on the job site.

9.3.11.2 Deck Preparation:

- A. Remove all asphaltic patches and unsound or disintegrated areas of the concrete decks as the plans show, or as the engineer directs. Work performed to repair the concrete deck will be paid for under other items. Ensure that products used for deck patching are compatible with the polymer overlay system.
 - 1. NOTE: Some polymer systems require concrete patch material to be in place a minimum of 28-days before overlaying - contact polymer manufacturer before completing deck patching/repair.
- B. Determine an acceptable shotblasting machine operation (size of shot, flow of shot, forward speed, and/or number of passes) that provides a surface profile meeting CSP 5 (medium-heavy shotblast) according to the ICRI Technical Guideline No. 310.2. If the Engineer requires additional verification of the surface preparation, test the tensile bond strength according to ASTM C1593. The surface preparation will be considered acceptable if the tensile bond strength is greater than or equal to 250 psi or the failure area at a depth of 1/4 inches or more is greater than 50% of the test area. Continue adjustment of the shotblasting machine and necessary testing until the surface is acceptable to the Engineer or a passing test result is obtained.

- C. Prepare the entire deck using the final accepted adjustments to the shotblasting machine as determined above. Thoroughly blast clean with hand-held equipment any areas inaccessible by the shotblasting equipment. Do not perform surface preparation more than 24 hours prior to the application of the overlay system.
- D. Protect drains, expansion joints, access hatches, or other appurtenances on the deck from damage by the shot and sand blasting operations and from materials adhering and entering. Tape or form all construction joints to provide a clean straight edge.
- E. Prior to shot blasting, remove pavement markings within the treatment area using an approved mechanical or blasting method.
- F. Prepare the vertical concrete surfaces adjacent to the deck a minimum of 2 inches above the overlay according to SSPC-SP 13 (free of contaminants, dust, and loose concrete) by sand blasting, using wire wheels, or other approved method.
- G. Just prior to overlay placement, clean all dust, debris, and concrete fines from the prepared surfaces including the vertical surfaces with compressed air. When using compressed air, the air stream must be free of oil. Any grease, oil, or other foreign matter that rests on or has absorbed into the concrete shall be removed completely. If any prepared surfaces (including the first layer of the polymer overlay) are exposed to rain or dew, lightly sandblast (brush/breeze blast) the exposed surfaces.
- H. The Engineer may consider alternate surface preparation methods per the overlay system manufacture's recommendations. The Engineer will approve the final surface profile and deck cleanliness prior to the contractor placing the polymer overlay.
- I. If shown on the plans, create a transitional area approaching transverse expansion joints and ends of the deck using an approved mechanical or blasting method. Remove 1/4 to 5/16 inch of concrete adjacent to the joint or end of deck and taper a distance of 3 feet.
- J. If shown on the plans, create a transitional area on the approach pavement. Prep and place the first lift 3 feet beyond the end of the deck the same width as the deck. Prep and place the second lift 6 feet beyond the end of the deck the same width as the deck.

9.3.11.3 Application of the Overlay:

- A. Perform the handling and mixing of the polymer resin and hardening agent in a safe manner to achieve the desired results according to the manufacturer's instructions. Do not apply the overlay system if any of the following exists:

1. Ambient air temperature is below 50°F or above 100°F;
 2. Deck temperature is below 50°F;
 3. Moisture content in the deck exceeds 4.5% when measured by an electronic moisture meter or shows visible moisture after 2 hours when measured in accordance with ASTM D4263;
 4. Rain is forecasted during the minimum curing periods listed under C.5;
 5. Materials component temperatures below 65°F or above 99°F;
 6. Concrete age is less than 28 days unless approved by the engineer.
 7. The deck temperature exceeds 100°F.
- B. If the gel time is 10 minutes or less at the predicted high air temperature for the day.
- C. After the deck has been shotblasted or during the overlay curing period, only necessary surface preparation and overlay application equipment will be allowed on the deck. Provide appropriate protective measures to prevent contamination from equipment allowed on the deck during preparation and application operations. Begin overlay placement as soon as possible after surface preparation operations.
- D. The polymer overlay shall consist of a two-course application of polymer and aggregate. Each of the two courses shall consist of a layer of polymer covered with a layer of aggregate in sufficient quantity to completely cover the polymer. Apply the polymer and aggregate according to the manufacturer's requirements. Apply the overlay using equipment designed for this purpose. The application machine shall feature positive displacement volumetric metering and be capable of storing and mixing the polymer resins at the proper mix ratio. Disperse the aggregate using a method that provides a uniform, consistent coverage of aggregate and minimizes aggregate rolling or bouncing into final position. First course applications that do not receive enough aggregate before the polymer gels shall be removed and replaced. A second course applied with insufficient aggregate may be left in place, but will require additional applications before opening to traffic.

- E. After completion of each course, cure the overlay according to the manufacturer’s instructions. Follow the minimum cure times listed below or as prescribed by the manufacturer. Remove the excess aggregate from the surface treatment by sweeping, blowing, or vacuuming without tearing or damaging the surface; the material may be re-used if approved by the engineer and manufacturer. Apply all courses of the overlay system before opening the area to traffic. Do not allow equipment or traffic on the treated area until directed by the Engineer.
- F. After the first layer of coating has cured to the point where the aggregate cannot be pulled out, apply the second layer. Prior to applying the second layer, broom and blow off the first layer with compressed air to remove all loose excess aggregate.
- G. Prior to opening to traffic, clean expansion joints and joint seals of all debris and polymer. A minimum of 3 days following opening to traffic, remove loosened aggregates from the deck, expansion joints, and approach pavement.

9.3.11.4 Application Rates:

- A. Apply the polymer overlay in two separate courses in accordance with the manufacturer’s instructions, but not less than the following rate of application.

Course	Minimum Polymer Rate ^A (GAL/100 SF)	Aggregate ^B (LBS/SY)
1	2.5	10+
2	5.0	14+

^A The minimum total applications rate is 7.5 GAL/100 SF.

^B Application of aggregate shall be of sufficient quantity to completely cover the polymer.

9.3.11.5 Minimum Curing Periods:

- A. As a minimum, cure the coating as follows:

	Average temperature of deck, polymer and aggregate components in °F							
Course	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-99
1	6 hrs	5 hrs	4 hrs	3 hrs	2.5 hrs	2 hrs	1.5 hrs	1 hr
2	8 hrs	6.5 hrs	6.5 hrs	5 hrs	4 hrs	3 hrs	3 hrs	3 hrs

- B. If faster cure times are desired and achievable, submit to the Engineer a certified test report from an independent laboratory showing the material is able to reach a compressive strength of 1000 psi as tested per ASTM C579 Method B within the temperature ranges and cure times for which the product is proposed to be placed. Establish ambient air, material, and substrate temperatures from the manufacturer for field applications. Field applications will not be allowed below the documented temperatures.

9.3.11.6 Repair of Polymer Overlay:

- A. Repair all areas of unbonded, uncured, or damaged polymer overlay for no additional compensation. Submit repair procedures from the manufacturer to the Engineer for approval. Absent a manufacturer's repair procedures and with the approval of the Engineer, complete repairs according to the following: Saw cut the limits of the area to the top of the concrete; remove the overlay by scarifying, grinding, or other approved methods; shot blast or sand blast and air blast the concrete prior to placement of polymer overlay; and place the polymer overlay according to the requirements above.

9.3.12 APPLYING PROTECTIVE SURFACE TREATMENT

- 9.3.12.1 Apply protective surface treatment in accordance with Section 502.3 of the Wisconsin Highway Specifications.

9.3.13 APPLYING PIGMENTED SURFACE SEALER

- 9.3.13.1 Apply pigmented surface sealer in accordance with Section 502.3 of the Wisconsin Highway Specifications.

9.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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10 TRAFFIC SIGNALS

10.1 GENERAL

10.1.1 SUMMARY

10.1.1.1 This section describes:

- A. Furnishing and installing permanent traffic signals.
- B. Furnishing, installing, and removing temporary traffic signals.

10.1.2 RELATED SECTIONS (NOT USED)

10.1.3 SUBMITTALS

10.1.3.1 Product Data: Submit material lists and specifications for all traffic control equipment for approval prior to installation.

- A. For poles and arms: Along with the materials list, submit a certificate of compliance certifying that the poles and arms as furnished conform to the specified structural performance requirements. Ensure that the certificate of compliance is on the manufacturer's letterhead, signed by an authorized company officer, and notarized.

10.1.3.2 Shop Drawings: Submit two copies of the following to the City for approval prior to installation:

- A. Detection wiring diagrams, cable and routing diagrams, pole to pull box wiring diagrams, conductor layout standards and the associated head arrangements and other pertinent details.
- B. Detailed shop drawings of the control cabinet, equipment layout drawings, and wiring diagrams of all equipment installed in the controller cabinet.

10.1.3.3 Qualifications: Submit proof of factory certification for video detection camera installer.

10.1.3.4 Operation and Maintenance Manuals: At the time of delivery, furnish one set of instruction manuals and an itemized price list for each type of equipment, their subassemblies, and their replacement parts. The instruction book shall include the following information:

- A. Table of Contents
- B. Operating procedure
- C. Step-by-step maintenance and troubleshooting information for the entire assembly

- D. Circuit wiring diagrams
- E. Pictorial diagrams of parts locations
- F. Parts numbers
- G. Theory of operation
- H. The instructional manuals shall include itemized parts lists. The itemized parts lists shall include the manufacturer's name and parts number for all components (such as IC, diodes, switches, relays, etc.) used in each piece of equipment. The list shall include cross references to parts numbers of other manufacturers who make the same replacement parts.

10.1.3.5 Warranties: Submit written documentation of the warranties specified in the "Warranties" article, below.

10.1.4 TESTING (NOT USED)

10.1.5 WARRANTIES

10.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements and as follows.

10.1.5.2 Traffic Signal Controller and Cabinet Warranty:

- A. Provide a two-year warranty on traffic signal controller, cabinet, and all add-on accessory items from date of installation and acceptance by City.
- B. If a malfunction in the controller unit, or its auxiliary equipment occurs during the warranty period, the supplier shall, within 24 hours after notification (excluding Saturday and Sunday), furnish a like controller unit module, or auxiliary equipment, for use while the warranted unit is being repaired. The isolation of any malfunction during the warranty period shall be the responsibility of the supplier. After the supplier has repaired and returned the equipment, the City shall then return the spare component to the supplier.
- C. Controller Operation. Consistent with customary trade practices, the manufacturer shall furnish a warranty for all electrical or mechanical equipment described herein. The Contractor shall turn such warranty over to the City for potential dealing with the guarantor.
 - 1. If the Contractor is the guarantor, he specifically waives the requirements of Section 289.14(2), Wisconsin Statutes, and agrees as a condition of the contract that the City may maintain an action against him at any time during the warranty period for recovery of damages which the City may have sustained by reason of the failure of the Contractor to comply with the provisions of the warranty provided to the City.

10.1.5.3 Video Vehicle Detection System Warranty:

- A. Provide a three-year warranty on the video detection system from date of installation and acceptance by City.
- B. 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.
- C. During the warranty period, updates to VDP software shall be available from the supplier without charge.

10.1.6 MEASUREMENT AND PAYMENT

10.1.6.1 General:

- A. Traffic signals and related components will be measured and paid for in accordance with Sections 652 through 659 of the Wisconsin Highway Specifications except as modified in this Specification.
- B. Temporary traffic signals and related components will be measured and paid for in accordance with Section 661 of the Wisconsin Highway Specifications except as modified in this Specification.

10.1.6.2 Electrical Service Meter Breaker Pedestal:

- A. Append 656.5(3) of the Wisconsin Highway Specifications with the following:
Payment is full compensation for grading the service trench and replacing topsoil; and for fertilizing, seeding, and mulching to restore the disturbed area of the service trench if necessary.

10.1.6.3 Monotube Arms (length):

- A. Measurement: The City will measure Monotube Arms (length) as each individual arm acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Monotube Arms (length)". Payment is full compensation for furnishing and installing all materials, including all hardware, fittings, mounting devices, shims, and attachments necessary to completely install the arms.

10.1.6.4 Traffic Signal Controller and Cabinet 8-Phase Fully Actuated:

- A. Measurement: The City will measure Traffic Signal Controller and Cabinet 8-Phase Fully Actuated as each individual controller and cabinet acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Traffic Signal Controller and Cabinet 8-Phase Fully Actuated". Payment is full compensation for furnishing and installing the signal controller and conflict monitor together with cabinet, all required control units, all additional harnesses for preemption, switches for flashing operation, and fittings as are necessary to assure that the controller will perform the said functions.

10.1.6.5 Video Vehicle Detection System:

- A. Measurement: The City will measure Video Vehicle Detection System as a lump sum acceptably completed per intersection.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Video Vehicle Detection System". Payment is full compensation for furnishing and installing control units, cameras, cabling, mounting brackets, testing and setting up the system.

10.1.6.6 Emergency Vehicle Preemption System:

- A. Measurement: The City will measure Emergency Vehicle Preemption System as a lump sum acceptably completed per intersection.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Emergency Vehicle Preemption System". Payment is full compensation for furnishing and installing all equipment, cabling, necessary additional items, testing and setting up the system.

10.1.6.7 Audible Pedestrian Push Button System:

- A. Measurement: The City will measure Audible Pedestrian Push Button System as a lump sum acceptably complete per intersection.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Audible Pedestrian Push Button System". Payment is full compensation for furnishing and installing all materials.

10.1.6.8 Temporary Non-Intrusive Vehicle Detection System for Intersections (Location):

- A. Measurement: The City will measure Temporary Vehicular Video Detection System for Intersections (Location) as a single lump sum unit of work, acceptably completed.

- B. Payment: Payment will be made at the contract lump sum price for "Temporary Vehicular Video Detection System for Intersections (Location)". Payment is full compensation for furnishing and installing the temporary non-intrusive vehicle detection system, including cabling, mounting brackets, mounting hardware, terminations, interface panels, testing and set up; for periodic checking and resetting of detection zones; for periodic cleaning for dirt and dust build-up; and for removing all equipment at the completion of the project.

10.2 PRODUCTS

10.2.1 ELECTRICAL CONDUIT

- 10.2.1.1 Electrical conduit shall be in accordance with Section 652 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.2 PULL BOXES AND JUNCTION BOXES

- 10.2.2.1 Pull boxes and junction boxes shall be in accordance with Section 653 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.3 CONCRETE BASES

- 10.2.3.1 Concrete bases shall be in accordance with Section 654 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.4 ELECTRICAL WIRING

- 10.2.4.1 Electrical wiring shall be in accordance with Section 655 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.5 ELECTRICAL SERVICE PRODUCTS

- 10.2.5.1 Electrical service products shall be in accordance with Section 656 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.6 POLES

- 10.2.6.1 Poles shall be in accordance with Section 657 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.2.6.2 Description: Furnish monotube poles of the type(s) designated on the Plans.

10.2.6.3 Product Requirements:

- A. Design support structures conforming to the minimum wall thickness the plan details show and to AASHTO design and fabrication standards for structural supports for highway signs, luminaries, and traffic signals. Use a design life of 50 years. Design to withstand a 3 second gust wind speed of 90 mph. Do not use the methods of Appendix C of those AASHTO standards.

- B. Use Category III criteria for Type 9 and Type 10 Poles. Use Category II criteria for Type 12 and Type 13 Poles.
- C. For structures requiring a fatigue analysis, use 45 mph for truck-induced gusts.
- D. After welding and before zinc coating, clean the exterior surface of each steel pole free of all loose rust and mill scale, dirt, oil or grease, and other foreign substances.
- E. Apply a zinc coating conforming to the process specified for steel sign bridges in 641.2.8 of the Wisconsin Highway Specifications. Ensure that the zinc coating is tight, free from rough areas or slag, and presents a uniform appearance.
- F. After completing manufacturing, clean the exterior surfaces of each pole free of all loose scale, dirt, oil or grease, and other foreign substances.
- G. Provide a reinforced hand hole measuring 4 inches by 6 inches as the plans show. Locate the hand hole 18 inches from the bottom of the pole base to the center of the door.
- H. For the hand hole, include an access cover mounted to the pole by two $\frac{1}{4}$ "-20 x $\frac{3}{4}$ " hex-head stainless steel bolts.
- I. Provide a grounding lug complete with mounting hardware, as required, inside the pole as the plans show.
- J. Provide access to the grounding lug from the hand hole. Weld the ground lug directly opposite the hand hole on the inside wall of the pole.
- K. Equip the top of the shaft with a removable, ventilated cap held securely in place by at least 3 $\frac{1}{4}$ " -20 x $\frac{3}{4}$ " hex-head stainless steel set screws.
- L. Ensure that all castings are clean, smooth, and with all details well defined and true to pattern.
- M. Attach base plates firmly to the pole shaft by welding or other approved method.
- N. Anchor bolts are already installed in the existing concrete bases.
- O. Furnish mounting nuts, washers, and other necessary hardware to install the poles. Materials shall conform to the Wisconsin Highway Specifications for each item furnished.

10.2.7 MONOTUBE ARMS

- 10.2.7.1 Arms shall be in accordance with Section 657 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.2.7.2 Description: Furnish monotube arms of the length(s) designated on the Plans.

10.2.7.3 Product Requirements:

- A. Design support structures conforming to the minimum wall thickness the plan details show and to AASHTO design and fabrication standards for structural supports for highway signs, luminaires, and traffic signals. Use a design life of 50 years. Design to withstand a 3 second gust wind speed of 90 mph. Do not use the methods of Appendix C of those AASHTO standards.
- B. Use category III criteria for 15 to 30-foot arms. Use category II criteria for 35 to 55-foot arms.
- C. For structures requiring a fatigue analysis, use 45 mph for truck-induced gusts.
- D. Base the designs on the completed maximum loading configuration the standard detail drawing shows.
- E. Furnish monotube arms conforming to the following:
 - 1. Consist of zinc coated steel round or oval members.
 - 2. Have a mounting device welded to the pole end of the monotube arm that allows the attachment of the arm to a pole as the plans show.
 - 3. Have stiffeners or gussets if required between the arm tube and the arm mounting device to provide adequate strength to resist side loads.
 - 4. Have a clean, uniform natural finish. No paint or other corrosion preventive maintenance coating is required.
- F. After welding and before zinc coating, clean exterior surfaces of each arm free of all loose rust and mill scale, dirt, oil or grease, and other foreign substances.
- G. Apply zinc coating as specified for sign bridge components in 641.2.8 of the Wisconsin Highway Specifications. Ensure that the zinc coating is tight, free from rough areas or slag, and presents a uniform appearance.
- H. After manufacturing is complete, clean the exterior surfaces of each pole free of all loose scale, dirt, oil, or grease, and other foreign substances.

10.2.8 TRAFFIC SIGNAL FACES, 3-12 INCH VERTICAL, 4-12 INCH VERTICAL, AND 5-12 INCH VERTICAL

- 10.2.8.1 Traffic signal faces shall be in accordance with Section 658 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.2.8.2 Append 658.2.2 of the Wisconsin Highway Specifications with the following:

- A. All Light Emitting Diode (LED) traffic signal modules shall meet the Final Approved Version of the LED Circular Signal Supplement Purchase Specification produced by ITE. The manufacturer shall provide the minimum warranty as stated in the ITE Specifications. If the LED fails to function as intended due to workmanship or material defects the LED shall be replaced or repaired within the first 60 months from delivery. Also, if the LED signal modules exhibit luminous intensities less than the minimum values specified within the first 36 months the LED shall be replaced or repaired.
- B. All signal head assemblies shall be equipped with LED, cutaway visors (or tunnel visors, if so specified in the plans) and backplates. The visor and backplate shall be a dull black. Signal head housings shall be yellow.
- C. Vehicular signal indications shall be 12-inch LED modules as indicated on material list. All faces shall give an appearance of an incandescent lamp. The signal face shall be an 18 count Dialight DuraLED signal or approved equal.

10.2.9 LED LUMINAIRES

- 10.2.9.1 Luminaires shall be in accordance with Section 659 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.2.9.2 LED luminaires shall be Cooper model number LDRG-T3-E03-E to match existing City fixtures.
- 10.2.9.3 Photocontrol shorting caps are required for all luminaires.

10.2.10 TRAFFIC SIGNAL CONTROLLER AND CABINET 8-PHASE FULLY ACTUATED

10.2.10.1 General:

- A. Furnish traffic signal controller(s) and cabinet(s) as shown on the Plans and as hereinafter provided.
- B. The controller shall be Eagle Signal Control EPAC M60 Series or latest series and shall provide a functional Ethernet port.
- C. The traffic controllers and cabinets at the intersection shall include any necessary provisions to accommodate fiber optic interconnect.
- D. A ruggedized, outdoor battery powered back-up uninterruptible power supply system (UPS) shall be included in the traffic signal control cabinet. This system shall provide a seamless transition to backup power, offer long run times, are designed to withstand extreme temperatures and environments where heat, cold, dust and debris can affect equipment, and are able to withstand vibrations caused by cars, trains, trucks and buses that can interfere with system operations. Battery heater mats shall be included.

- E. The controller shall be a fully traffic actuated, solid state, digital microprocessor controller, capable of providing the number and sequence of phases, overlaps, and any special logic as described herein and shown on the accompanying plan.
- F. The controller shall be fully programmed and shall be mounted in a control cabinet to operate as a complete and functioning intersection traffic signal control system. The equipment items included shall be, but not necessarily limited to, cabinet, microprocessor controller, monitor, detector amplifiers, power supply, power distribution panel, interior cabinet wiring, and other associated electrical and electronic equipment interior to the control cabinet that is necessary to provide the type of operation described in these specifications.
- G. Dual ring, programmable for both single and dual entry concurrent timing, eight-phase frame or equivalent shall be provided. Volume density and pedestrian timing shall be provided for all phases. MUTCD flashing capability shall be provided. All controls shall be in accordance with the accompanying plans and with NEMA Standards Publication No. TS2-2003.
- H. The intersection controller unit shall be capable of up to 8-phase operation plus four (4) programmable overlaps regardless of whether preemption, coordination or the special programming is used. The intersection cabinet shall be wired for a minimum of twelve and include twelve 3 circuit load switches.

10.2.10.2 Electrical and Operational Aspects:

A. Buffering:

- 1. All logic circuit inputs shall be internally buffered to withstand transients and noise, such as might result from normal usage, without damage to any mechanism components.

B. Timing Features:

- 1. All controller timing parameters shall be fully programmable from the front panel using switches and/or keyboard inputs, and memory storage features shall be nonvolatile under power off conditions for at least 30 days. The locking, nonlocking detection mode and recall switches shall also be accessible on the front panel.

C. Minimum Green Timing:

- 1. The passage timer shall time concurrently with the minimum green timer, so that the duration of the minimum green time is directly adjustable and is independent of the passage time setting.

D. Dual Ring Timing:

1. In the dual ring application, no more than two phases shall be permitted to time concurrently, and no more than one phase per ring. The controller shall provide barrier protection against concurrent timing of two conflicting phases; no phases assigned to one side of the barrier shall be permitted to time concurrently, if a conflict will occur. The controller shall service calls on a single-entry basis, and both rings shall cross the barrier simultaneously in accordance with the following logic:
 - a. Phases timing concurrently shall terminate simultaneously if both have a gap out due to excessive time between actuations.
 - b. Phases timing concurrently shall terminate simultaneously if both have a maximum time out.
 - c. In the event that one phase has not achieved a gap out or maximum time out, the other gapped out phase shall be Permitted to leave the gapped-out condition and retime an extension when an actuation is received.

E. Manual Police Control:

1. If manual control is used, actuation of the manual control shall permit manual advance of the Walk, Pedestrian Clearance, and Green interval terminations only. Manual termination of Yellow or All Red clearance intervals shall not be permitted.

F. Red Revert:

1. An adjustable red revert control shall be provided to assure adequate red display when recycling a phase during call-away or red rest mode operation. A call for service to a different phase shall be preceded by an all-red clearance interval, as programmed.

G. Coordination:

1. The controller shall be capable of operation in progressive coordination systems and mutual coordination and shall contain, but not be limited to, the following external inputs, with all functions brought out:
 - a. Vehicle/Pedestrian Detectors per phase
 - b. Pedestrian Omit per phase
 - c. Phase Omit per phase
 - d. Hold per phase
 - e. Omit Red Clearance per ring

- f. Internal Maximum Inhibit per ring
- g. Maximum II per ring
- h. Red Rest per ring
- i. Stop Timing per ring
- j. Force-Off per ring
- k. Select Minimum Recall per controller
- l. Manual Control per controller
- m. Semi-Mode per controller
- n. External Start per controller

H. Minimum Safe Timings Control:

1. Controllers shall not accept any operator input or stored timing parameters that would result in intervals shorter than the following:
 - a. Yellow clearance - 3.0 seconds
 - b. Minimum walk - 4.0 seconds
 - c. Minimum pedestrian clearance - 6.0 seconds
2. At the beginning of each of the above intervals, the controller shall check the previously stored data against these minimums. If an operator attempts to load an incorrect timing parameter, the controller unit shall output a unique error code on the front panel display. As an alternate to minimum timing control, a coded keyboard entry security feature may be provided.

I. Indicator Lights and Switches:

1. Indicator lights shall be provided to show the status of each signal phase on. Indicator lights shall also be used to show interval status, phase termination information, and presence of vehicular and pedestrian calls for each phase. An indicator light shall also be provided to show the status of the backup battery charging circuit.
2. The controller shall have an on off switch and fuse for AC power.

J. Data Display:

1. The data panel shall be a removable hand-held unit. The panel shall contain a display panel consisting of LED display characters. The face of the display shall be scratch, chemical, and solvent resistant. In the case of writing data or parameters into the controller there shall be a visual indication that the data has been accepted. The number of characters shall be adequate to read or write all data and parameters in decimal format together with a data descriptor in either alpha numeric format, or thumbwheel switch display. A data key shall be provided.

K. Diagnostic Program:

1. A diagnostic program shall be prepared by the manufacturer of the controller unit which will demonstrate the proper operation of all the inputs, outputs, controls and indicators in the controller, and shall have visual conformation on the front panel. The diagnostic program shall be either resident in the controller or furnished as a separate plug in module. A flow chart and listing of the diagnostic routine shall be furnished with the controller unit.

L. Preemption:

1. These specifications detail a preemptor program for use with 2 through 8 phase actuated controller.
2. The preemptor shall be capable of being adaptable to meet the various types of applications such as railroad, fire station, and bridge preempts.
3. The preemptor shall be internal to the controller and shall not alter controller capability or interchangeability under normal operation. The preemptor shall be completely programmable by the user.

4. Preempt Program:

a. Preempt Registration:

- 1) The preempt call input shall initialize preempt registration and start preempt sequence unless a priority call input is activated which would treat the current controller preemptions state as normal operation and reinitiate call registration.

b. Preempt Delay:

- 1) As soon as the preempt call is registered the preempt delay will begin timing unless preempt delay is set zero or preempt delay omit was active during preempt call registration. Delay shall be programmable from 0 to 255 seconds minimum.

- 2) As soon as preempt delay is timed out, current running phases not next to be common in preempt sequence are cleared. If the running phases are green and must be cleared, special programmable values of minimum green, walk and pedestrian intervals will time normal times. Concurrently a special preempt clearance is generated. This clearance is designed for advance track signals and any overlaps that may be green and require yellow clearance.
- c. Entry Clearance Phase(s) Select:
 - 1) Two sequential phases or phase pairs shall be available to be run as programmable fixed time intervals as an entry sequence. Two entry options shall be available, each programmable. The entry sequence shall be capable of being omitted entirely.
 - d. Dwell Sequence:
 - 1) After the entry sequence, the preemptor shall enter the dwell sequence. During the dwell sequence the controller shall cycle between selected phases on a pre-timed or actuated basis. Pedestrian phasing may be normal or omitted entirely. When the dwell sequence is entered, a preempt dwell output shall be generated. The preemptor shall remain in dwell for the length of the dwell extension timer which shall be capable of being held in reset by the preempt call input. Dwell extension shall be omissible by setting the timer to zero.
 - e. Exit Sequence:
 - 1) After leaving dwell, the controller shall enter one or two programmed exit phases(s) or phase pairs sequences. The sequence will time programmed minimum green and place a vehicle call on all phases not omitted. After timing exit phase minimum green the controller shall time and sequence normally.
- M. Time Base Coordination:
1. These specifications detail a Time Base Coordinator program for use with 2 through 8 phase actuated controller.

2. The units shall allow traffic control equipment to be coordinated without requiring the use of interconnection cables. The units shall coordinate traffic control equipment based on signals from a precise time base which will allow output control signals to be changed at the proper pre-programmed time to achieve the coordinated operation of an intersection with other intersections or the desired operation of an isolated intersection. The coordinators may also use a programmer for a master intersection controller which in turn is interconnected with secondary intersection controllers. The units shall also be capable of providing a command for MUTCD flash, and shall allow a full year program to be initiated and carried out without the necessity of field adjustment for anticipated special events, etc.
3. The time base coordinator shall be internal to the controller and shall not alter controller capability or interchangeability under normal operation. The time base coordinator shall be completely programmable by the user.

10.2.10.3 Monitoring: A conflict monitor meeting the following requirements shall be provided:

A. General:

1. Each cabinet assembly shall be wired to operate with one Malfunction Management Unit (MMU). The MMU shall be a Type 16.
2. This specification sets forth the minimum requirements for a shelf-mountable, sixteen channel, solid-state Malfunction Management Unit (MMU). The MMU shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS2-2003. Where differences occur, this specification shall govern.

B. Monitoring Functions: The following monitoring functions shall be provided in addition to those required by the NEMA Standard Section 4.

1. Dual Indication Monitor:
 - a. Dual Indication monitoring shall detect simultaneous input combinations of active Green (Walk), Yellow, or Red (Don't Walk) field signal inputs on the same channel. In Type 12 mode this monitoring function detects simultaneous input combinations of active Green and Yellow, Green and Red, Yellow and Red, Walk and Yellow, or Walk and Red field signal inputs on the same channel.

- b. When voltages on two inputs of a vehicle channel are sensed as active for more than 450 msec, the MMU shall enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and indicate the DUAL INDICATION fault. The MMU shall remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input. When voltages on two inputs of a vehicle channel are sensed as active for less than 200 msec, the MMU shall not transfer the OUTPUT relay contacts to the Fault position.
 - c. When operating with Port 1 communications enabled, Bit #68 (Spare Bit #2) of the Type #129 response frame shall be set to indicate a Dual Indication fault has been detected.
 - d. Dual Indication Monitoring shall be disabled when the RED ENABLE input is not active.
 - e. Dual Indication Programming: Programming shall be provided to enable the Dual Indication monitoring function for the Green and Red, Green and Yellow, and Yellow and Red combinations for each individual channel. In the Type 12 mode, the Walk inputs shall be logically OR'ed with the Green inputs for purposes of Dual Indication programming.
2. Field Check Monitoring: The Field Check Monitor function shall provide two modes of operation, Field Check Fault and Field Check Status. Field Check Monitoring shall be disabled when the RED ENABLE input is not active.
- a. Field Check Monitor: In the Field Check Fault mode, when the field signal input states sensed by the MMU do not correspond with the data provided by the Controller Unit in the Type #0 message for 10 consecutive messages, the MMU shall enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and indicate the FIELD CHECK FAIL fault. Bit #67 (Spare Bit #1) of the Type #129 response frame shall be set to indicate a Field Check fault has been detected. The MMU shall remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input.
 - b. Field Check Status: The Field Check Status mode shall work in combination with the other fault monitoring functions of the MMU. When a Conflict, Red Fail, Clearance Fail, or Dual Indication Fail triggers the MMU, the Channel Status Display and Fault Status Display shall correspond to that detected fault. If Field Check errors were detected while the fault was being timed, the inputs on which the Field Check errors were detected shall be reported on the Channel Status display. Bit #67 (Spare Bit #1) of the Type #129 response frame shall also be set to indicate Field Check errors have been detected.

- c. Field Check Programming: Programming shall be provided to enable the Field Check monitoring function for each Green, Yellow, and Red input individually. Programming shall be provided to enable the Field Check monitoring function for channel 2, 4, 6, and 8 Walk input individually when operating in the Type 12 with SDLC mode.
3. Recurrent Pulse Monitoring:
- a. The Signal Monitor shall detect Conflict, Red Fail, and Dual Indication faults that result from intermittent or flickering field signal inputs. These recurring pulses shall result in a latching fault with the RECURRENT PULSE STATUS indicated along with the resulting Conflict, Red Fail, or Dual Indication status. An option shall be provided to disable the RP detect function for testing purposes.
 - b. When operating with Port 1 communications enabled, Bit #69 (Spare Bit #3) of the Type #129 response frame shall be set to indicate a Recurrent Pulse status has been detected.
4. External Watchdog Monitoring:
- a. The MMU shall provide the capability to monitor an optional external logic level output from a Controller Unit or other external cabinet circuitry. If the MMU does not receive a change in state on the EXTERNAL WATCHDOG input for 1500 msec (± 100 msec), the MMU shall enter the fault mode, transfer the OUTPUT relay contacts to the Fault position, and indicate the WATCHDOG fault. The MMU shall remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input. An MMU Power Failure shall reset the WATCHDOG fault state of the monitor. The EXTERNAL WATCHDOG input shall be wired to connector MSB-S.
 - b. When operating with Port 1 communications enabled, Bit #70 (Spare Bit #4) of the Type #129 response frame shall be set to indicate an External Watchdog fault has been detected.
5. Type Fault Monitor:
- a. The MMU shall verify at power-up that the Type 12 or Type 16 operating mode as determined by the TYPE SELECT input is consistent with the mode set by the last external reset.
 - b. Detection of a Type Fault shall place the MMU into the fault mode, transfer the OUTPUT relay contacts to the Fault position, and indicate the TYPE 12/16 fault. The MMU shall remain in the fault mode until the unit is reset by the RESET button or the EXTERNAL RESET input. An MMU Power Failure shall reset the Type Fault state of the monitor.

6. Flashing Yellow Arrow PPLT Support:

- a. The MMU shall be designed to monitor an intersection with up to four approaches using the four section Flashing Yellow Arrow (FYA) movement outlined by the NCHRP Research Project 3-54 on Protected/Permissive signal displays with Flashing Yellow Arrows. Two cabinet configurations shall be supported for both the MMU Type 16 and Type 12 modes depending on the number of load switches provided and the capabilities of the Controller Unit. In both modes the MMU shall be designed to provide the same fault coverage for the FYA approaches as it does for conventional protected left turn phases including Conflict, Red Fail, Dual Indication, and both Minimum Yellow and Minimum Yellow Plus Red Clearance monitoring.

C. Configuration Options:

1. RYG ONLY Red Fail Option:

- a. The MMU shall provide the capability to exclude the Walk inputs from the Red Fail fault detection algorithm when operating in the Type 12 mode. When the option is selected, the absence of signals on the Green, Yellow, and Red field outputs of a channel will place the MMU unit into the fault mode, transfer the OUTPUT relay contacts to the Fault position, and indicate the RED FAIL fault.

2. LED Signal Threshold Adjust:

- a. The MMU shall provide the capability to sense field inputs signals with the following thresholds:
 - 1) Conflict, Dual Indication Low Threshold Signal Inputs (Green, Yellow, and Red):
 - a) No Detect - less than 15 Vrms
 - b) Detect - greater than 25 Vrms
 - 2) Red Fail High Threshold Signal Inputs (Green, Yellow, and Red):
 - a) No Detect - less than 50 Vrms
 - b) Detect - greater than 70 Vrms

3. CVM LOG Disable Option:

- a. The MMU shall provide a means to disable the logging of CVM fault events.

- D. Display Functions: The following display functions shall be provided in addition to those required by the NEMA TS-2 Standard Section 4. A PC shall not be required to display the following parameters.
1. Field Signal Voltages Display: A mode shall be provided to display the RMS voltage of each field signal input. If the MMU is not in the fault mode, the displayed voltage will be the currently applied RMS voltage. If the MMU is in the fault mode, the displayed voltage will be the applied RMS voltage at the time of the fault.
 2. Cabinet Control Signal Voltages Display: A mode shall be provided to display the RMS voltage of the AC Line and Red Enable, the frequency of the AC Line, and the ambient temperature measured at the MMU. If the MMU is not in the fault mode, the displayed values will be the currently applied values. If the MMU is in the fault mode, the displayed values will be the applied values at the time of the fault.
 3. Field Check Status Display: When the MMU is in the fault mode, a display screen for the front panel display shall be provided to identify all field signal inputs with Field Check status.
 4. Recurrent Pulse Status Display: When the MMU is in the fault mode, a display screen for the front panel display shall be provided to identify all field signal inputs with Recurrent Pulse status.
 5. Configuration Display: A display mode for the front panel display shall be provided that allows the setting and viewing of all MMU configuration parameters. The configuration parameters provided on the program card shall be viewable only. A PC shall not be required to completely program or view the MMU configuration parameters.
 6. Event Logs Display: A display mode for the front panel display shall be provided to review all details of the Previous Fail log, AC Line log, and the Monitor Reset log.
 7. Clock Set Display: A display mode for the front panel display shall be provided to view and set the time and date of the MMU real time clock.
- E. Operating Modes: The MMU shall operate in both the Type 12 mode and Type 16 mode as required by the NEMA Standard.
1. Help System: A context sensitive Help system shall be provided that is activated by a separate Help button. The Main Status display shall respond with text messages relevant to the position in the menu navigation level. When the MMU is in the fault mode the Help system shall respond with the Diagnostic mode described in 3.

2. Setup Wizard: A built-in setup mode shall be provided that automatically configures the Dual Indication enable, Field Check enable, Red Fail enable, and Minimum Yellow Plus Red Clearance enable parameters from user input consisting only of channel assignment and class (vehicle, ped, pp-turn, etc) responses.
3. Diagnostic Wizard: A built-in Diagnostic Wizard shall be provided that displays detailed diagnostic information regarding the fault being analyzed. This mode shall provide a concise view of the signal states involved in the fault, pinpoint faulty signal inputs, and provide guidance on how the technician should isolate the cause of the malfunction. The Diagnostic Wizard shall be automatically invoked when the MMU is in the fault mode and the HELP button is pressed. It shall also be automatically invoked when the MMU is in the Previous Fail (PF) event log display and the HELP button is pressed.
4. TS-1 Type 12 With SDLC Mode: The MMU shall be capable of operating in the Type 12 mode with SDLC communications enabled on Port 1. The Channel Status display shall operate in the Type 12 configuration and provide the field check function for up to four pedestrian Walk inputs.

F. Hardware:

1. Enclosure:
 - a. Size: The MMU shall be compact so as to fit in limited cabinet space. It shall be possible to install on a shelf that is at least 7" deep. Overall dimensions, including mating connectors and harness, shall not exceed 10.5" x 4.5" x 11" (H x W x D).
 - b. Material: The enclosure shall be constructed of sheet aluminum with a minimum thickness of 0.062", and shall be finished with an attractive and durable protective coating. Model, serial number, and program information shall be permanently displayed on the top surface.
2. Electronics:
 - a. Microprocessor Monitor: A microprocessor shall be used for all timing and control functions. Continuing operation of the microprocessor shall be verified by an independent monitor circuit, which shall force the OUTPUT RELAY to the de-energized "fault" state and illuminate the DIAGNOSTIC indicator if a pulse is not received from the microprocessor within a defined period not to exceed 500 ms. Only an MMU Power Failure shall reset the DIAGNOSTIC fault state of the monitor.

- b. RMS Voltage Measurement: High speed sampling techniques shall be used to determine the true RMS value of the AC field inputs. Each AC input shall be sampled at least 32 times per line cycle. The RMS voltage measurement shall be insensitive to phase, frequency, and waveform distortion.
 - c. Sockets: In the interest of reliability, no IC sockets shall be used.
 - d. Battery: All user programmed configuration settings shall be stored in an electrically erasable programmable read-only memory (EEPROM). Designs using a battery to maintain configuration data shall not be acceptable. If a battery is used, it shall provide power only to the real-time clock.
 - e. Field Input Terminals: All 120 VAC field terminal inputs shall provide an input impedance of at least 150K ohms and be terminated with a discrete resistor having a power dissipation rating of 0.5 Watts or greater.
 - f. Component Temperature Range: All electrical components used in the MMU except the front panel Status LCD shall be rated by the component manufacturer to operate over the full NEMA temperature range of -34°C to +74°C.
 - g. Printed Circuit Boards: All printed circuit boards shall meet the requirements of the NEMA Standard plus the following requirements to enhance reliability:
 - 1) All plated-through holes and exposed circuit traces shall be plated with solder.
 - 2) Both sides of the printed circuit board shall be covered with a solder mask material.
 - 3) The circuit reference designation for all components and the polarity of all capacitors and diodes shall be clearly marked adjacent to the component. Pin #1 for all integrated circuit packages shall be designated on both sides of all printed circuit boards.
 - 4) All printed circuit board assemblies shall be coated on both sides with a clear moisture-proof and fungus-proof sealant.
3. Front Panel and Connectors:

- a. MMU Status Display: Four line by 20-character alpha-numeric LCD display shall be provided to report MMU status, time and date, menu navigation, etc. This display shall be separate from the full intersection channel status display.
- b. Full Intersection Channel Status Display: A separate Red, Yellow, and Green indicator shall be provided for the channel status LCD display for each channel to show full intersection status simultaneously. For Type 12 mode operation a separate Red, Yellow, Green and Walk indicator shall be provided for each channel to show full intersection status simultaneously. Individual icons shall also be provided to indicate channels involved in a fault.
- c. LED Display Indicators: The following LED display indicators shall be provided:
 - 1) Power Indicator: The green POWER indicator shall flash at a rate of 2Hz when the AC LINE voltage is below the drop-out level. It shall illuminate steadily when the AC LINE voltage returns above the restore level. It shall extinguish when the AC Line voltage is less than 75 Vrms.
 - 2) Fault Indicator: The red FAULT indicator shall illuminate when the MMU is in the fault mode and the OUTPUT relay has transferred to the Fault position.
 - 3) Port 1 Receive Indicator: The yellow RECEIVE indicator shall illuminate for a 40 msec pulse each time a Port 1 message is correctly received from the Controller Unit.
 - 4) Port 1 Transmit Indicator: The yellow TRANSMIT indicator shall illuminate for a 40 msec pulse each time a Port 1 message is transmitted from the MMU.
 - 5) EIA-232 Receive Indicator: The yellow COMM indicator shall illuminate for a 40 msec pulse each time a message is correctly received on the EIA-232 port.
 - 6) Diagnostic Indicator: The red DIAGNOSTIC indicator shall illuminate when the MMU has detected an internal diagnostic failure.
- d. Controls: All displays, controls, and connectors shall be mounted on the front panel of the MMU.
 - 1) Help Button: A momentary contact button shall be provided the initiates the context sensitive help system described in 1.

e. MS Connectors:

- 1) The MS connectors on the MMU shall have a metallic shell and be attached to the chassis internally. The connectors shall be mounted on the front of the unit in accordance with the following: Connector A shall intermate with a MS 3116 22-55 SZ, and Connector B shall intermate with a MS 3116 16-26 S.
- 2) In the interest of reliability and repair ability, printed circuit board mounted MS connectors shall not be acceptable. Internal MS harness wire shall be a minimum of AWG #22, 19 strands.

- f. EIA-232 Port: The EIA-232 port shall be electrically isolated from the MMU electronics using optical couplers and shall provide a minimum of 2500 Vrms isolation. The connector shall be an AMP 9721A or equivalent 9 pin metal shell D subminiature type with female contacts. Pin assignments shall be as shown in the following table:

<u>Pin</u>	<u>Function</u>
1	DCD*
2	TX DATA
3	RX DATA
4	DTR (Data Terminal Ready)
5	SIGNAL GROUND
6	DSR*
7	DSR*
8	CTS*
9	NC

*Jumper options shall be provided to allow the connection of Pin #4 to be made with Pin #7, and the connection of Pin #8 to be made with Pin #1 and or Pin #6.

4. Monitor Configuration Parameters:

- a. All NEMA standard configuration parameters shall be provided by a program card meeting the requirements of clause 4.3.6 of NEMA TS-2. All configuration parameters for functions and options beyond the requirements of the standard shall be stored in non-volatile memory within the MMU. This memory shall be programmable from the front panel menu driven interface, data downloaded via the EIA-232 port, or loaded from shadow memory located on the program card.

5. Program Card Memory:

- a. The program card supplied with the MMU shall provide non-volatile memory that contains the configuration parameters for the enhanced features of the MMU, such that transferring the program card to a different MMU completely configures that MMU. The non-volatile memory device used on the program card shall not utilize any I/O pins designated as "Reserved" by NEMA TS-2.

G. Event Logging Functions:

1. General:

- a. The MMU shall be capable of storing in non-volatile memory a minimum of 100 events. Each event shall be marked with the time and date of the event. These events shall consist of fault events, AC Line events, reset events, and configuration change events. The capability to assign a four digit identification number and 30 character description to the unit shall be provided. The event logs shall be uploaded to a PC using the serial port of the MMU and Windows based software provided by the manufacturer.
- b. Each event log report shall contain the following information:
 - 1) Monitor ID#: a four digit (0000-9999) ID number and 30 character description assigned to the monitor.
 - 2) Time and Date: time and date of occurrence.
 - 3) Event Number: identifies the record number in the log. Event #1 is the most recent event.

2. Reports:

- a. Monitor Status Report (CS): The Current Status report shall contain the following information:
 - 1) Fault Type: the fault type description.
 - 2) Field Status: the current GYR(W) field status and field RMS voltages if the monitor is not in the fault state, or the latched field status and field RMS voltages and fault channel status at the time of the fault.
 - 3) Cabinet Temperature: the current temperature if the monitor is not in the fault state, or the latched temperature at the time of the fault.
 - 4) C Line Voltage: the current AC Line voltage and frequency if the monitor is not in the fault state, or the AC Line voltage and frequency at the time of the fault.
 - 5) Control Input Status: the current state and RMS voltages of the Red Enable input & Load Switch Flash bit input if the monitor is not in the fault state, or the status latched at the time of the fault.
- b. Previous Fault Log (PF): The Previous Fault log shall contain the following information:

- 1) Fault Type: the fault type description.
 - 2) Field Status: the latched field status with RMS voltages, fault channel status, RP Detect status and Field Check status at the time of the fault.
 - 3) Cabinet Temperature: the latched temperature at the time of the fault.
 - 4) AC Line Voltage: the AC Line voltage & frequency at the time of the fault.
 - 5) Control Input Status: the latched state of the Red Enable input at the time of the fault.
- c. AC Line Event Log (AC): The AC Line log shall contain the following information:
- 1) Event Type: describes the type of AC Line event that occurred.
 - a) Power-up - AC on, monitor performed a cold start
 - b) Interrupt - AC Line < Brownout level
 - c) Restore - AC restored from AC brown-out or AC interruption (AC Off), no cold start
 - 2) AC Line Voltage: the AC Line voltage & frequency at the time of the event.
- d. Monitor Reset Log (MR): The Monitor Reset log shall contain the following information:
- 1) The monitor was reset from a fault by the front panel Reset button, or External Reset input, or a non-latched event clear.
- e. Configuration Change Log (CF): The Configuration Change log shall contain the following information. The log shall also indicate which items have been changed since the last log entry.
- 1) The status of all configuration programming including the contents of the Program Card.
 - 2) Any configuration programming inputs such as 24V Inhibit, Port 1 Disable, Type Select.
 - 3) Configuration Check Value: A unique check value that is based on the configuration of items #a and #b above.

- f. Signal Sequence Log (SSQ): A minimum of five logs shall be provided that graphically display all field signal states and Red Enable for up to 30 seconds prior to the current fault trigger event. The resolution of the display shall be at least 50 milliseconds.

3. Remote Monitor Configuration

- a. Setup Wizard: A setup mode shall be provided by the Windows based software that automatically configures the Dual Indication enable, Field Check enable, Red Fail enable, and Minimum Yellow Plus Red Clearance enable parameters from user input consisting only of channel assignment and class (vehicle, ped, pp-turn, etc) responses.
- b. Upload From File: All configuration parameters for functions and options beyond the requirements of the standard shall be programmable by transferring a file from a PC to the MMU via the front panel EIA-232 port. These parameters shall be stored in nonvolatile memory in the MMU.
- c. Download to File: All configuration parameters for functions and options beyond the requirements of the standard shall be downloadable to a PC by transferring a file from the MMU to a PC via the front panel EIA-232 port.

10.2.10.4 Cabinet and Cabinet Equipment

- A. Each controller shall be furnished completely housed in a door-in-door ground mounted metal cabinet that meets the requirements for a TS2 Type 2 traffic control cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-1992. Where differences occur, this specification shall govern.
- B. Each eight-phase cabinet shall consist of a size P cabinet capable of being base mounted, type three configuration main panel, 8 position (16 loop) detector rack, and auxiliary equipment as defined this specification.
- C. Cabinet Construction:
 - 1. Each cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.
 - 2. Each cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.

3. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. Each cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.
4. The top of each cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.
5. Each cabinet shall be supplied with a natural aluminum finish unless otherwise noted. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.
6. All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
7. All cabinets shall be supplied with two easily removable shelves manufactured from 5052-H32 aluminum. Shelves shall be a minimum of 10 inches deep.
8. The shelf shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelf shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The shelf shall be held in place by a nylon tie-wrap inserted through holes on the front edge of the shelf and around the front sidewall mounting studs.
9. The front edge of the upper shelf shall have holes punched every 6 inches to accommodate tie wrapping of cables/harnesses.
10. One set of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The channels shall accommodate spring-mounted nuts or studs. All mounting rails shall extend to within 7 inches of the top and bottom of the cabinets. Sidewall rail spacing shall be 7.88 inches center-to-center. Rear wall rail spacing shall be 18.50 inches center-to-center. (Size 5 and 6 cabinets) or 7.88 inches in size 3 cabinets. The rails shall be mounted to the cabinet with bolts (pressed into plates welded to interior of cabinet) to form a modular assembly.
11. The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.

12. The lower section of the cabinet door shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient airflow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall.
13. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.
14. The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.
15. The main door of a size 5 or larger cabinet shall include a mechanism capable of holding the door open at approximately 90, 125, and 150 degrees under windy conditions. Manual placement of the mechanism shall not be required by the field technician. The main door of a size 3 cabinet shall include a mechanism capable of holding the door open at approximately 90 and 150 degrees under windy conditions.
16. The main door shall be equipped with a Corbin tumbler lock number 1548-1. Two keys shall be supplied.
17. The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and one key.
18. All cabinet inside and outside surfaces shall be primed with phosphate treatment and primer. After priming, all exterior surfaces shall receive a minimum of 2 coats of rust resistant silver grey enamel and interior surfaces shall be furnished with rust resistant high gloss white enamel.
19. Each cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the minimal cabinet size is as follows:
 - a. Size P Cabinet: 52" H x 44" W x 24" D

D. Terminals and Facilities / Main Panel Design and Construction:

1. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and formed so as to minimize any flexing when plug-in components are installed.
2. All position main panels shall be hinged at the bottom to allow easy access to all wiring on the rear of the panel.
3. The main panel shall be fully wired in the following configuration:

- a. Type 3 Configuration: Twelve load switch sockets, six flash transfer relay sockets, one flasher socket and two main panel BIU rack slots.
4. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear.
5. Up to eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in two horizontal rows.
6. All load switches shall be supported by a bracket extending at least half the length of the load switch.
7. Rack style mounting shall be provided to accommodate the required BIUs per the configuration listed in section 3.3 above. A dual-row, 64-pin female DIN 41612 Type B connector shall be provided for each BIU rack position. Card guides shall be provided for both edges of the BIU. Terminal and facilities BIU mounting shall be an integral part of the main panel. Detector rack BIU mounting shall be an integral part of the detector rack.
8. All BIU rack connectors shall have pre-wired address pins corresponding to the requirements of the TS2 specification. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.
9. The 12- load switch position main panels shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.
10. All field output circuits shall be terminated on a barrier type terminal block with a minimum rating of 60 amps.
11. All field input/output (I/O) terminals shall be identified by permanent alphanumeric labels. All labels shall use standard nomenclature per the NEMA TS2 specification.
12. All field flash sequence programming shall be accomplished at the field terminals with the use of a screwdriver only.
13. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, red, flash). It shall not be necessary to de-bus field terminal blocks for flash programming.
14. It shall also be possible to program which flasher circuit the phase shall be connected to.

15. The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid state flasher. The flasher shall be supported by a bracket that extends at least half its length.
16. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.
17. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.
18. At a minimum, two 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.
19. All main panel wiring shall conform to the following wire size:
 - a. Green/Walk load switch output - 14 gauge
 - b. Yellow load switch output - 14 gauge
 - c. Red/Don't Walk load switch output - 14 gauge
 - d. MMU (other than AC power) - 22 gauge
 - e. Controller I/O - 22 gauge
 - f. AC Line (power panel to main panel, 1 for each 4 LS) - 10 gauge
 - g. AC Line (main panel) - 14 gauge
 - h. AC Neutral (power panel to main panel) - 10 gauge
 - i. Earth ground (power panel) - 8 gauge
 - j. Logic ground - 22 gauge
 - k. Flash programming, flasher terminal - 14 gauge
 - l. Flash programming, field terminal - 14 gauge
20. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.

21. All controller and Malfunction Management Unit cables shall be of sufficient length to allow the units to be placed on either shelf or the outside top of the cabinet in the operating mode. Connecting cables shall be sleeved in a braided nylon mesh. The use of exposed tie-wraps or interwoven cables are unacceptable.
22. All cabinet configurations shall be provided with enough RS-485 Port 1 communication cables to allow full capabilities of that cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications.
23. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.
24. Provide necessary terminal for video detection.
25. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.
26. All control cables shall be protected by a nylon jacket or equivalent protection to prevent any contact with cabinet metal shelves, doors and any other sharp corners.
27. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.
28. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.
29. All pedestrian pushbutton inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.
30. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

E. Power Panel Design and Construction:

1. The power panel shall consist of a separate, wholly enclosed module, securely fastened to the right sidewall of the cabinet. The power panel shall be wired to provide the necessary power to the cabinet, controller, Malfunction Management Unit, cabinet power supply and auxiliary equipment.

F. Auxiliary Cabinet Equipment:

1. The cabinet shall be provided with a thermostatically controlled (adjustable between 80-150 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute. The fan unit shall not crack, creep, warp or have bearing failure within a 7-year duty cycle. The maximum noise level shall be less than 40 decibels. The fan unit shall be corrosion resistant.
2. A 25-watt incandescent lamp shall be included. The lamp shall be wired to a door activated switch mounted near the top of the door.
3. Provide a 15-amp circuit breaker for auxiliary equipment, 20-amp circuit breaker for street lights and a non-GFI outlet for additional equipment.
4. Provide all necessary hardware to accommodate fiber optic interconnect and Ethernet communications.
5. Provide a photocell and contactor for street lighting powered from signal cabinet.
6. Provide an Ethernet switch and a fiber/Ethernet modem.
7. Install all additional control units in cabinet per plans. Control units include, but are not limited to, audible pedestrian push button control unit, emergency vehicle preemption control device including card rack, and video detection processor.
8. Provide a sealable print pouch mounted to the door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of cabinet prints.
9. Provide two sets of complete and accurate cabinet drawings with each cabinet.

G. Vehicle Detection:

1. A vehicle detector amplifier rack shall be provided in each cabinet. Detector racks shall be in the following configuration:
 - a. Shall support up to 16 channels of loop detection and one BIU.
2. Each cabinet shall contain detector interface panels for the purpose of connecting field loops and vehicle detector amplifiers. The panels shall be manufactured from FR4 G10 fiberglass, 0.062 inches thick, with a minimum of 2 oz. of copper for all traces.

3. One 16-position interface panel shall be provided for each 16-channel rack. The interface panel shall be secured to a mounting plate and attached to the left sidewall of the cabinet.
4. Each interface panel shall allow for the connection of eight or sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.
5. Lightning protection device mounting holes shall be provided to accommodate an Edco SRA-16C, or Edco SRA-6, or Edco LCA-6, or a varistor lightning protection device. Lightning protection devices shall not be provided.
6. A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color-coded red and white wires.
7. All termination points shall be identified by a unique number and silk screened on the panel.
8. Each detector rack shall be powered by the cabinet power supply (refer to requirements below).

H. Cabinet Test Switches and Police Panel:

1. A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide the following:
 - a. AUTO/FLASH SWITCH. When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash.
 - b. STOP TIME SWITCH. When applied, the controller shall be stop timed in the current interval.
 - c. CONTROL EQUIPMENT POWER ON/OFF. This switch shall control the controller, MMU, and cabinet power supply AC power.
2. The police door switch panel shall contain the following:
 - a. SIGNALS ON/OFF SWITCH. In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
 - b. FLASH/NORMAL SWITCH. In the flash position, power shall not be removed from the controller and stop time shall be applied.

3. All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
 4. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
 5. All switch functions must be permanently and clearly labeled.
 6. All wire routed to the police door-in-door and test switch pushbutton panel shall be adequately protected against damage from repetitive opening and closing of the main door.
 7. All test switch panel wiring shall be connected to the main panel via a multiple pin type connector.
- I. Auxiliary Devices:
1. Load Switches:
 - a. Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
 - b. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.
 2. Flashers:
 - a. The flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.
 3. Flash Transfer Relays:
 - a. All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.
 - b. The coil of the flash transfer relay must be deenergized for flash operation.
 4. Bus Interface Units:
 - a. All Bus Interface Units (BIUs) shall meet the requirements of Section 8 of the NEMA TS2 Standard.
 - b. The full complement of Bus Interface Units shall be supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed. BIU's shall be from the same manufacture as the controller manufacture used in the City.

- c. Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.
5. Cabinet Power Supply:
- a. The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.
 - b. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.
 - c. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.
 - d. One cabinet power supply shall be supplied with each cabinet assembly.

10.2.11 VIDEO VEHICLE DETECTION SYSTEM

10.2.11.1 Description:

- A. Furnish a system that detects vehicles on a roadway using only video images of vehicle traffic. Include all materials necessary for a completely functional vehicle detection system including but not limited to cameras, processors, video monitor, mounting hardware, power cable, and coaxial cable.

10.2.11.2 General Requirements:

- A. System Hardware:
 1. The video detection system (VDS) shall consist of up to four video cameras, a video detection processor (VDP) capable of processing from one to four video sources, either wired or wireless, wireless video transmission receiver, receiver antenna and a pointing device.
 2. The Video Vehicle Detection System shall consist of the Iteris Vantage Edge2 system.
- B. System Software:
 1. The system shall include software that detects vehicles in multiple lanes using only the video image. Detection zones shall be defined using only an on-board video menu and a pointing device to place the zones on a video image. Up to 24 detection zones per camera view shall be available. A separate computer shall not be required to program the detection zones.

10.2.11.3 Functional Capabilities:

- A. System Configuration:

1. The VDS will be deployed at locations where site conditions and roadway geometry vary. The VDS system may also be deployed at locations where existing cabinets or equipment exist. Existing site configurations will dictate the availability of cabinet space and VDS usage.
2. The proposed VDS shall be available in various configurations to allow maximum deployment flexibility. Each configuration shall have identical user interface for system setup and configuration. The communications protocol to each configuration shall be identical and shall be hardware platform independent. The proposed VDS shall have multiple configurations available for deployment.

Table 1 - VDS Configuration

Description	No. Video Inputs	No. Video Outputs	Mounting Configuration	Power Supply Requirements
Single-Channel Rack Mounted	1	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12/24 VDC Power From Rack
Dual-Channel Rack Mounted	2	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12/24 VDC Power From Rack
Quad-Channel Rack Mounted	4	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12/24 VDC Power From Rack

- a. An option to have wireless video transmission between the camera sensor and VDP shall also be available from the VDS manufacturer.
- b. Wired camera systems shall be able to transmit NTSC or PAL video signals, with minimal degradation, up to 1000 feet under ideal conditions.
- c. Wireless camera systems shall be able to transmit an NTSC video signal, with minimal signal degradation, up to 500 feet under normal conditions and up to 900 feet under ideal electromagnetic interference conditions. Adjacent sources of electromagnetic radiation, or the absence of a direct line of sight between transmitter and receiver antennas, may result in video signal degradation.

B. System Interfaces:

1. The following interfaces shall be provided for each of the configurations identified in Table 1, above.

- a. Video Input: Each video input shall accept RS170 (NTSC) or CCIR (PAL) signals from an external video source (camera sensor or VCR). The interface connector shall be BNC type and shall be located on the front of the video processing unit. The video input shall have the capability to select 75-ohm or high impedance (Hi-Z) termination.
- b. Video Lock LED: A LED indicator shall be provided to indicate the presence of the video signal. The LED shall illuminate upon valid video synchronization and turn off when the presence of a valid video signal is removed.
- c. Video Output: One video output shall be provided. The video output shall be RS170 or CCIR compliant and shall pass through the input video signal. For multi-channel video input configurations, a momentary push-button shall be provided on the front panel to toggle through each input video channel. In the absence of a valid video signal, the channel shall be skipped and the next valid video signal shall be switched. The video output shall have the capability to show text and graphical overlays to aid in system setup. The overlays shall display real-time actuation of detection zones upon vehicle detection or presence. Overlays shall be able to be turned off by the user. Control of the overlays and video switching shall also be provided through the serial communications port. The video output interface connector shall be BNC type.
- d. Serial Communications: A serial communications port shall be provided on the front panel. The serial port shall be compliant with EIA232 electrical interfaces and shall use a DB9 type connector. The serial communications interface shall allow the user to remotely configure the system and/or to extract calculated vehicle/roadway information. The interface protocol shall be documented or interface software shall be provided. The interface protocol shall support multi-drop or point-to-multipoint communications. Each VDS shall have the capability to be addressable.
- e. Contact Closure Output: Open collector contact closure outputs shall be provided. Four (4) open collector outputs shall be provided for the single, dual or quad channel rack-mount configuration. Additionally, the VDPs shall allow the use of extension modules to provide up to 24 open collector contact closures per camera input. Each open collector output shall be capable of sinking 30 mA at 24 VDC. The open collector output will be used for vehicle detection indicators as well as discrete outputs for alarm conditions.

- f. Detection LEDs: LEDs shall be provided on the front panel. The LEDs shall illuminate when a contact closure output occurs. Rack-mounted video processors shall have a minimum of four (4) LEDs. Rack-mounted extension modules shall have two (2) or four (4) LEDs to indicate detection.
- g. Mouse Port: A USB mouse shall be provided on the front panel of the rack mount video processing unit. The mouse port shall not require special mouse software drivers. The mouse port shall be used as part of system setup and configuration. A mouse shall be provided with each video processor.

C. General System Functions:

1. Detection zones shall be programmed via an on-board menu displayed on a video monitor and a pointing device connected to the VDP. The menu shall facilitate placement of detection zones and setting of zone parameters or to view system parameters. A separate computer shall not be required for programming detection zones or to view system operation.
2. The VDP shall store up to three different detection zone patterns. The VDP can switch to any one of the three different detection patterns within 1 second of user request via menu selection with the pointing device.
3. The VDP shall detect vehicles in real time as they travel across each detection zone.
4. The VDP shall have an EIA232 port for communications with an external computer. The VDP EIA232 port shall be multi-drop capable.
5. The VDP shall accept new detection patterns from an external computer through the EIA232 port when the external computer uses the correct communications protocol for downloading detection patterns. A Microsoft Windows-based software designed for local or remote connection and providing video capture, real-time detection indication and detection zone modification capability shall be provided with the system.
6. The VDP system shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.
7. The VDP shall send its detection patterns to an external computer through the EIA232 port when requested when the external computer uses the correct communications protocol for uploading detection patterns.

8. The VDP shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference with the video signal.
9. The system shall be capable of automatically detecting a low-visibility condition such as fog and respond by placing all defined detection zones in a constant call mode. A user-selected output shall be active during the low-visibility condition that can be used to modify the controller operation if connected to the appropriate controller input modifier(s). The system shall automatically revert to normal detection mode when the low-visibility condition no longer exists.

D. Vehicle Detection:

1. Up to 24 detection zones per camera input shall be supported and each detection zone can be sized to suit the site and the desired vehicle detection region.
2. The VDP shall provide up to 24 open collector output channels per camera input using one or more extension modules.
3. A single detection zone shall be able to replace multiple inductive loops and the detection zones shall be OR'ed as the default or may be AND'ed together to indicate vehicle presence on a single phase of traffic movement.
4. Placement of detection zones shall be done by using only a pointing device, and a graphical interface built into the VDP and displayed on a video monitor, to draw the detection zones on the video image from each video camera. No separate computer shall be required to program the detection zones.
5. Up to 3 detection zone patterns shall be saved for each camera within the VDP memory. The VDP's memory shall be non-volatile to prevent data loss during power outages.
6. The selection of the detection zone pattern for current use shall be done through a menu. It shall be possible to activate a detection zone pattern from VDP memory and have that detection zone pattern displayed within 1 second of activation.
7. The VDP system shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.
8. When a vehicle is detected within a detection zone, the corners of the detection zone shall activate on the video overlay display to confirm the detection of the vehicle.

9. Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, camera placement, camera quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to camera location or quality.
10. The VDP shall provide dynamic zone reconfiguration (DZR). DZR enables normal operation of existing detection zones when one zone is being added or modified during the setup process. The VDP shall output a constant call on any detector channel corresponding to a zone being modified.
11. Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.
12. The VDP shall process the video input from each camera at 30 frames per second. Multiple camera processors shall process all video inputs simultaneously.
13. The VDP shall output a constant call for each enabled detector output channel if a loss of video signal occurs. The VDP shall output a constant call during the background learning period.
14. Detection zone outputs shall be configurable to allow the selection of presence, pulse, extend, and delay outputs. Timing parameters of pulse, extend, and delay outputs shall be user definable between 0.1 to 25.0 seconds.
15. Up to six detection zones per camera view shall have the capability to count the number of vehicles detected. The count value shall be internally stored for later retrieval through the EIA232 port. The zone shall also have the capability to calculate and store average speed and lane occupancy at bin intervals of 10 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes and 60 minutes.

10.2.11.4 Hardware:

A. General:

1. The VDP and extension module (EM) shall be specifically designed to mount in a standard detector rack, using the edge connector to obtain power and provide contact closure outputs. No adapters shall be required to mount the VDP or EM in a standard detector rack. Detector rack rewiring shall not be required.

2. The EM shall be available to avoid the need of rewiring the detector rack, by enabling the user to plug an extension module into the appropriate slot in the detector rack. The extension module shall be connected to the VDP by a 8 wire cable with modular connectors, and shall output contact closures in accordance with user selectable channel assignments. The EM is available in 2, 4, or 24 channel configurations.

B. Input Power:

1. The VDP and EM shall be powered by 12/24 volts DC. VDP power consumption shall not exceed 7 watts. The EM power consumption shall not exceed 2.5 watts.

C. Detection Outputs:

1. The VDP and EM shall include detector output pin out compatibility with industry standard detector racks. The 24-channel EM shall provide output through a 37-pin “D” connector on the front panel.

D. Video Inputs:

1. VDPs shall include one, two or four BNC video input connections suitable for composite video inputs. The video input shall include a switch selectable 75-ohm or high impedance termination to allow camera video to be routed to other devices, as well as input to the VDP for vehicle detection.

E. Video Outputs:

1. The front of the VDP shall include one BNC video output providing real time video output that can be routed to other devices.

F. Mechanical and Environmental:

1. The VDP shall operate satisfactorily in a temperature range from -34 °C to +74 °C and a humidity range from 0%RH to 95%RH, non-condensing as set forth in NEMA specifications.
2. The front panel of the VDP shall have detector test switches to allow the user to place calls on each channel. The test switch shall be able to place either a constant call or a momentary call depending on the position of the switch.
3. The front face of the VDP shall contain indications, such as LED displays, to enable the user to view real time detections for each channel of detection when the system is operational.

4. The VDP shall include an EIA232 port for serial communications with a remote computer. This port shall be a 9-pin "D" subminiature connector on the front of the VDP.
5. The VDP shall utilize non-volatile memory technology to enable the loading of modified or enhanced software through the EIA232 port and without modifying the VDP hardware.

G. Video Detection Camera:

1. Video detection cameras used for traffic detection shall be furnished by the video detection processor (VDP) supplier and shall be qualified by the supplier to ensure proper system operation.
2. The camera shall produce a useable video image of the bodies of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 1.0 lux to 10,000 lux.
3. The imager luminance signal to noise ratio (S/N) shall be more than 50 dB.
4. The camera shall be digital signal processor (DSP) based and shall use a CCD sensing element and shall output color video with resolution of not less than 470 TV lines. The CCD imager shall have a minimum effective area of 768(h) x 494(v) pixels.
5. The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter.
6. The camera shall utilize automatic white balance.
7. The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening up the camera housing, to suit the site geometry by means of a portable interface device designed for that purpose and manufactured by the detection system supplier.
8. The horizontal field of view shall be adjustable from 5.4 to 50.7 degrees. This camera configuration may be used for the majority of detection approaches in order to minimize the setup time and spares required by the user. The lens shall be a 10x zoom lens with a focal length of 3.8mm to 38.0 mm.
9. The lens shall also have an auto-focus feature with a manual override to facilitate ease of setup.

10. The camera shall incorporate the use of preset positioning that store zoom and focus positioning information. The camera shall have the capability to recall the previously stored preset upon application of power.
11. The camera electronics shall include automatic gain control (AGC) to produce a satisfactory image at night.
12. The camera shall be housed in a weather-tight sealed enclosure. The enclosure shall be made of 6061 anodized aluminum. The housing shall be field rotatable to allow proper alignment between the camera and the traveled road surface.
13. The camera enclosure shall be equipped with a sunshield. The sunshield shall include a provision for water diversion to prevent water from flowing in the camera's field of view. The camera enclosure with sunshield shall be less than 6" diameter, less than 18" long, and shall weigh less than 6 pounds when the camera and lens are mounted inside the enclosure.
14. The enclosure shall be design so that the pan, tilt and rotation of the camera assembly can be accomplished independently without affecting the other settings.
15. The camera enclosure shall include a proportionally controlled heater, where the output power of the heater varies with temperature, to assure proper operation of the lens functions at low temperatures and prevent moisture condensation on the optical faceplate of the enclosure.
16. The glass face on the front of the enclosure shall have an anti-reflective coating to minimize light and image reflections.
17. The glass face shall also employ a special coating to minimize the buildup of environmental debris such as dirt and water.
18. When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -34 °C to +60 °C and a humidity range from 0% RH to 100% RH. Measurement of satisfactory video shall be based upon VDP system operation.
19. The camera shall be powered by 120-240 VAC 50/60 Hz. Power consumption shall be 45 watts or less under all conditions. An optional DC power configuration shall be available for 12 VDC operation.

20. Recommended camera placement height shall be 33 feet (or 10 meters) above the roadway, and over the traveled way on which vehicles are to be detected. For optimum detection the camera should be centered above the traveled roadway. The camera shall view approaching vehicles at a distance not to exceed 350 feet for reliable detection (height to distance ratio of 10:100). Camera placement and field of view (FOV) shall be unobstructed and as noted in the installation documentation provided by the supplier.
21. The camera enclosure shall be equipped with separate, weather-tight connections for power and video cables at the rear of the enclosure. These connections may also allow diagnostic testing and viewing of video at the camera while the camera is installed on a mast arm or pole using a lens adjustment module (LAM) supplied by the VDP supplier. Video and power shall not reside within the same connector.
22. The video signal shall be fully isolated from the camera enclosure and power cabling.

H. Video Monitor:

1. The monitor shall be a flat screen color video monitor with a minimum 9" diagonal picture display. It shall support EIA standards RS-170 composite video signal (1.0 v p-p, 75 OHM).
2. It shall have a resolution of 900 lines at center. Video bandwidth shall be >11 MHz. Loop through connectors shall be provided, and both input and output connectors shall be BNCs.
3. The monitor power source shall be 120 VAC +/- 10%, 60 Hz. Power consumption shall not be greater than 18 W. Ambient operating temperature shall be +50 to +122 degrees Fahrenheit.
4. Located on the front panel, the controls shall be on/off, contrast, bright, vertical hold, and horizontal hold. Rear panel shall have controls for vertical size, vertical linearity and scan switch.
5. Dimensions shall not exceed 9" (W), 10" (H), and 7" (D). Weight shall not exceed 10 pounds.

I. Coaxial Cable:

1. The coaxial cable to be used between the camera and the VDP in the traffic cabinet shall be Belden 8281. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. BNC plug connectors should be used at both the camera and cabinet ends. The coaxial cable, BNC connector, and crimping tool shall be approved by the supplier of the video detection system, and the manufacturer's instructions must be followed to ensure proper connection.

J. Power Cable:

1. The power cabling shall be 16 AWG three conductor cable with a minimum outside diameter of 0.325 inch and a maximum diameter of 0.490 inch. The cabling shall comply with the National Electric Code, as well as local electrical codes. Cameras may acquire power from the luminaire if necessary.

10.2.12 EMERGENCY VEHICLE PREEMPTION SYSTEM

10.2.12.1 Description:

- A. Furnish an Emergency Vehicle Preemption (EVP) System as shown on the plans and as hereinafter provided.

10.2.12.2 Product Requirements:

- A. The Emergency Vehicle Preemption System shall include GTT Opticom discriminator Model 454, Model 711 detectors, Model 138 detector cable, and LED confirmation lights.

10.2.13 AUDIBLE PEDESTRIAN PUSH BUTTON SYSTEM

10.2.13.1 Description:

- A. Furnish vandal resistant Audible Pedestrian Signal and push button assemblies that provide a vibro-tactile ADA compliant 2" push button with a raised directional arrow and custom message sounds during the walk cycle. During the "ped clearance" and "don't walk" intervals locating sounds shall be emitted from inside the unit via a weatherproof speaker. The unit shall use existing 2-pair push button wires and interface with a single control unit located in the traffic control cabinet.

10.2.13.2 Audible Pedestrian Signal Push Button:

- A. Sunlight visible "Red LED" lights when the button is pushed and remains on until the walk phase goes into effect.
- B. Audible "Tick" sound is heard each time the button is pushed, as well as tactile feedback given.

- C. Extended push button can turn on boost volumes, and/or mute all sounds except those on actuated crosswalk.
- D. All audible sounds automatically adjust in volume in relation to ambient noise level.
- E. Audio Amplifier Power Output: 15 W, 8 ohm, weatherproof.
- F. Provide separate volume controls for locator tone, walk message, Clearance and extended button volumes.
- G. Volume Control Automatic Adjustment Range: 35 dB max.
- H. Microphone For Ambient Noise approximate frequency range: 170 Hz to 2.3 kHz.
- I. Jumper Selectable Options: Chirp, Cuckoo, Walk Message, Rest In Walk, Location Message, Extended Push of Activation and Locating Tone.
- J. Audible Locating Tone: 880 Hz plus harmonic, 0.1-second duration, 1-second interval. Operates during ped clearance and don't walk interval. All tones shall meet MUTCD requirements.
- K. Option standard locating tone, custom sound or verbal count down during PED Clearance and multiple voice message languages. Provide custom walk message, direction of travel and/or emergency vehicle warning message.
- L. All sounds are synchronized. Sound alternate in front of the pedestrian and behind the pedestrian during the walking and/or ped clearance phase ("Ping Pong" feature).
- M. Temperature Range: -40° F to 165° F.
- N. Wind sensor to prevent runaway volume during windy conditions.
- O. System can self-test and fault report to a remote site for real-time monitoring and system maintenance. Conflict Detect: WALK indication is ignored in the event of a WALK/DON'T WALK conflict.
- P. Pedestrian Push Button Interface accepts 12 to 48 AC/DC. Capable of global configuration changes and/or single unit changes.
- Q. Dimensions: Length: 14.09", Width: 5.4", Depth: 2.2".
- R. Frame: cast aluminum, powder coated yellow.
- S. Face Plate: aluminum, powder coated, painted black background.
- T. Arrow Push Button: aluminum, powder coated. Direction of arrow can adjust to one of four directions.

- U. Push Button: ADA compliant, cast aluminum, nickel plated, powder coated. Vibrator Power shall be 15 VDC pulsed. Operates during walk interval only. Speaker: 8 ohm, 15 W MAX, weather proof.
- V. Comparable to Polara “EZ Communicator Navigator 2-Wire Pedestrian Push Button Station” or approved equal.

10.2.13.3 Central Control Unit:

- A. The control unit is the power supply and signaling interface between the existing intersection traffic controller and the pedestrian push button unit. The pedestrian control unit shall control up to 12 push button units and 4 pedestrian phases. The pedestrian control unit shall be housed inside the existing traffic controller cabinet and powered by the AC supply mains (115 VAC). The interface cable shall be included and considered incidental to the contract.
- B. Pedestrian Walk/Don’t Walk Inputs; Optically Isolated 80 – 150 Volts AC/DC 5mA Maximum.
- C. General Purpose Outputs and Pedestrian Outputs; Optically Isolated 36 Volts AC/DC Peak, .3A Solid State Fused Contact Closure.
- D. Fault Output; Normally Open and Closed Relay Contacts 125 Volts AC/DC 1A Maximum.
- E. 4 Phase Pedestrian Push Button Power Output; Nominal 22 Volts DC, Short Circuit Protected – Auto Recovering.
- F. General Purpose Inputs; 10 – 36 Volts AC/DC Peak 10mA Maximum, Optically Isolated.
- G. Comparable to Polara “EZ Communicator Navigator 2-Wire Central Control Unit” or approved equal.

10.2.13.4 TEMPORARY TRAFFIC SIGNAL PRODUCTS

10.2.13.5 General: Temporary traffic signal products shall comply with the requirements of Section 661 of the Wisconsin Highway Specifications except as modified in this Specification.

10.2.13.6 Temporary Non-Intrusive Vehicle Detection System for Intersections:

- A. This specification sets forth the minimum requirements for a system that detects vehicles on a roadway and provides detection outputs to a traffic signal controller. The materials shall also include all brackets, mounting hardware, cable, terminations, interface panels, and all other incidentals for the installation of the non-intrusive vehicle detection equipment. This equipment shall meet the NEMA environmental, power and surge ratings as set forth in NEMA TS2 specifications.
- B. All detection equipment, components, and terminations supplied under this item shall be fully compatible with the temporary traffic signal controller supplied for the project. The system architecture shall fully support Ethernet networking of system components. All required interface equipment needed for transmitting and receiving data shall be provided with the NIVDS.
- C. The NIVDS shall provide flexible detection zone placement anywhere and at any orientation. Preferred detector configurations shall be detection zones placed across lanes of traffic for optimal count accuracy, detection zones placed parallel to lanes of traffic for optimal presence detection accuracy of moving or stopped vehicles. Detection zones shall be able to be overlapped for optimal road coverage.

10.3 EXECUTION

10.3.1 INSTALLATION, GENERAL

- 10.3.1.1 Install traffic signal components in accordance with shop drawings, manufacturer's recommendations, and the applicable provisions of Sections 651 through 658 of the Wisconsin Highway Specifications.
- 10.3.1.2 The Contractor shall obtain the necessary electrical permits from the City of Waukesha Building Department prior to beginning the work. The Contractor is responsible for all application fees and for any fines, penalties, damage done to property, etc., billed by the City of Waukesha.
- 10.3.1.3 The Contractor is responsible for requesting the electrical service installation or relocation from the power company and the City will pay the installation costs.
- 10.3.1.4 The Contractor shall stake the proposed locations of traffic signal items 10 days prior to starting work so that the locations of the proposed facilities can be approved by the City of Waukesha. Any field changes regarding the location of the signal poles, pull boxes, etc. shall be approved by the City of Waukesha.
- 10.3.1.5 The Contractor shall request a signal inspection of the completed signal installation. This request shall be made to the City at least three working days prior to the time of the requested inspection.

10.3.2 ELECTRICAL CONDUIT INSTALLATION

- 10.3.2.1 Install electrical conduit in accordance with Section 652 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.3.2.2 Append 652.3.1.2 of the Wisconsin Highway Specifications with the following:
 - A. The Contractor shall directional bore, not trench, in areas of trees, shrubbery, and under driveways, sidewalks and streets unless otherwise noted. Boring limits in areas of trees and shrubs depend on the diameter of the tree or shrub trunk. For example, directional boring is required if a conduit will be installed within 12 inches of the face of the trunk of a 2-inch diameter tree, or installed within 15 feet of the face of the trunk of a 20-inch diameter tree. Trenching or excavation for pull boxes, signal bases and controller cabinets within the root zone of a tree shall not be permitted. The minimum depth of bored conduit within the root zone, as described above, shall be 30 inches.

10.3.3 PULL BOX AND JUNCTION BOX INSTALLATION

- 10.3.3.1 Install pull boxes and junction boxes in accordance with Section 653 of the Wisconsin Highway Specifications except as modified in this Specification.

10.3.4 CONCRETE BASE INSTALLATION

- 10.3.4.1 Install concrete bases in accordance with Section 654 of the Wisconsin Highway Specifications except as modified in this Specification.

10.3.5 ELECTRICAL WIRING INSTALLATION

- 10.3.5.1 Install electrical wiring in accordance with Section 655 of the Wisconsin Highway Specifications except as modified in this Specification.

10.3.6 ELECTRICAL SERVICE PRODUCT INSTALLATION

- 10.3.6.1 Install electrical service products in accordance with Section 656 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.3.6.2 Append 656.3.4 of the Wisconsin Highway Specifications with the following:
 - A. Electrical utility company service installation or relocation and energy cost will be billed to and paid for by the maintaining authority.
 - B. Install the cabinet base and meter breaker pedestal first, so the electrical utility company can install the service lateral. Finish grade the service trench, replace topsoil that is lost or contaminated with other materials.

10.3.7 POLE AND ARM INSTALLATION

- 10.3.7.1 Install poles and arms in accordance with Section 657 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.3.7.2 Install poles as specified in the plan details and using appropriate Contractor-furnished hardware. Secure pole to anchor assembly and document tensioning procedures conforming to 641.3.1.2 of the Wisconsin Highway Specifications.
- 10.3.7.3 After completing erection using normal pole shaft raking techniques, ensure the centerline of the shaft appears vertical.

10.3.8 TRAFFIC SIGNAL FACE INSTALLATION

- 10.3.8.1 Install traffic signal faces in accordance with Section 658 of the Wisconsin Highway Specifications.

10.3.9 LUMINAIRE INSTALLATION

- 10.3.9.1 Install luminaires in accordance with the requirements of Section 11 – Street Lighting and Communications.

10.3.10 TRAFFIC SIGNAL CONTROLLER AND CABINET INSTALLATION

- 10.3.10.1 Install signal controller and cabinet in accordance with the approved shop drawings and the manufacturer's recommendations.
- 10.3.10.2 Before installation, equipment will be examined and tests will be performed by the City of Waukesha to insure that proper and sufficient equipment is furnished as is required to complete the signal plan operation and sequence in compliance with the intent of the contract specifications.
- 10.3.10.3 All testing and equipment examination shall be in the presence of the Contractor's representative furnishing the equipment. The Contractor's representative will be notified of any needed modifications or corrections to be accomplished by the Contractor.
- 10.3.10.4 The cabinet shall not be installed until it is in proper working order and approved by City of Waukesha personnel or their designee.
- 10.3.10.5 After the Contractor has mounted the cabinet on the cabinet foundation, he shall connect all the field wiring inside the controller cabinet and test the signal circuits for correct operation. The Contractor shall connect and test the signal circuits outside the controller cabinet as directed by the Engineer. Connecting and testing signal circuits shall be considered part of this item of work.

10.3.10.6 During the installation and testing of the controller, the Contractor shall provide, at his own expense, a competent representative to oversee, direct and manage the installation and testing of the controller. In the final stages of the installation and testing, the manufacturer's representative shall be available at the job site for consultation until such time as the controller operation is tested and accepted.

10.3.11 VIDEO VEHICLE DETECTION SYSTEM INSTALLATION

10.3.11.1 Install video vehicle detection system in accordance with the approved shop drawings and the manufacturer's recommendations.

10.3.11.2 The video detection camera shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier.

10.3.11.3 Maintenance and Support:

- A. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the video detection system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.
- B. The supplier shall maintain an ongoing program of technical support for the video detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on-site technical support services.
- C. Installation and training support shall be provided by a factory-authorized representative and shall be a minimum IMSA-Level II Traffic Signal Technician certified.
- D. All product documentation shall be written in the English language.

10.3.12 EMERGENCY VEHICLE PREEMPTION SYSTEM INSTALLATION

10.3.12.1 Install emergency vehicle preemption system in accordance with the approved shop drawings and the manufacturer's recommendations.

10.3.12.2 Detectors shall be mounted on the mast arms and signal poles as shown on the Plans.

10.3.12.3 The traffic signal mast arms and poles shall be drilled, and tapped to accommodate the mounting of the detector units as shown in the Plans. The installation method shall be approved by the City traffic engineer.

10.3.12.4 In the event, at installation, a noticeable obstruction is present in line with the detector, the Contractor shall be obligated to advise the Engineer before installation.

- 10.3.12.5 Unless otherwise directed by the City, the detector shield tube shall be installed with the drain hole at the bottom.
- 10.3.12.6 There shall be NO detector cable splices from the detector assembly to the controller terminations.
- 10.3.12.7 The EVP detector cables shall be routed to the controller. Each lead shall be appropriately marked as to which street or avenue it is associated. The Contractor shall perform all terminations inside the cabinet.
- 10.3.12.8 The EVP as specified and shown in the Plans shall be complete in place, tested, and in full operation.

10.3.13 AUDIBLE PEDESTRIAN PUSH BUTTON SYSTEM INSTALLATION

- 10.3.13.1 Install audible pedestrian push button system in accordance with the approved shop drawings and the manufacturer's recommendations.

10.3.14 TEMPORARY TRAFFIC SIGNALS

- 10.3.14.1 General: Temporary traffic signal products shall be constructed in accordance with of Section 661 of the Wisconsin Highway Specifications except as modified in this Specification.
- 10.3.14.2 Temporary Non-Intrusive Vehicle Detection System for Intersections:
- A. The temporary NIVDS shall be installed by factory-certified installers and as recommended by the supplier and documented in installation materials provided by the supplier.
 - B. In the event, at installation or turn on date, a noticeable obstruction is present in line with the detection zone(s), the Contractor shall be obligated to advise the Engineer before setting the zone.
 - C. The non-intrusive vehicle detection system, as shown in the traffic signal construction plans, shall be complete, in place, tested, and in full operation during each stage of construction.
 - D. Maintain all temporary vehicle detection zones as the plans show or as the Engineer directs. The temporary vehicle detection zones shall be set near the vicinity and with approximate distance from the stop bar as shown on the plans. Check temporary vehicle detection zones every other week and at the opening of each stage of temporary traffic signal operation to ensure that they are working properly and aimed properly. Periodic adjustment of the detection zones and/or moving of the temporary vehicle detection sensors may be required due to changes in traffic control, staging, or other construction operations.

- E. Ensure the non-intrusive vehicle detection system stays in clean working order.
Periodic cleaning of the equipment may be required due to dirt and dust build-up.
- F. Remove temporary equipment when no longer needed for the project.

10.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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11 STREET LIGHTING AND COMMUNICATIONS

11.1 GENERAL

11.1.1 SUMMARY

11.1.1.1 This section describes:

- A. Furnishing and installing street lighting.
- B. Providing temporary street lighting.
- C. Removing, salvaging, and re-installing existing street lighting.
- D. Furnishing and installing communications duct and pull boxes.

11.1.2 RELATED SECTIONS (NOT USED)

11.1.3 SUBMITTALS

11.1.3.1 Product Data: Submit product data for conduit, duct, pull boxes, wiring, transformer bases, and service entrance products.

11.1.3.2 Shop Drawings: Submit shop drawings for street light controllers.

11.1.3.3 Operation and Maintenance Manuals: Submit operation and maintenance manuals for street light controllers.

11.1.3.4 Temporary Street Lighting Layout: Submit proposed temporary street lighting layout, including temporary power source or sources, prior to installing system.

11.1.4 TESTING

11.1.4.1 Upon completion, new or re-installed street lighting system shall be energized and operated for 48 hours prior to acceptance. Consecutive burning hours are not required.

11.1.5 WARRANTIES

11.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

11.1.6 MEASUREMENT AND PAYMENT

11.1.6.1 Conduit (size and type):

- A. Measurement: The City will measure Conduit (size and type) by the linear foot acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "Conduit (size and type)". Payment is full compensation for furnishing and placing the conduit; for all conduit bodies, fittings, and caps; for installing new conduit into existing bases, pull boxes, and conduit; and for excavating and backfilling. The cost of crushed aggregate base course backfill will be paid for separately.

11.1.6.2 Pull Box (size and type):

- A. Measurement: The City will measure Pull Box (size and type) by the number of pull boxes acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Pull Box (size and type)". Payment is full compensation for furnishing and installing all materials, including pipe, frame, covers, and coarse aggregate; and for excavating and backfilling.

11.1.6.3 Concrete Base (type):

- A. Measurement: The City will measure Concrete Base (type) by the number of bases acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Concrete Base (type)". Payment is full compensation for finishing and installing concrete, anchor bolts, nuts, washers, and grounding; and for excavating and backfilling, including hydro-excavation where required.

11.1.6.4 (size and type) Wire:

- A. Measurement: The City will measure (size and type) Wire by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(size and type) Wire". Payment is full compensation for furnishing, installing, and connecting wiring.

11.1.6.5 Transformer Base - Breakaway (size):

- A. Measurement: The City will measure Transformer Base - Breakaway (size) by the number of bases acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Transformer Base - Breakaway (size)". Payment is full compensation for finishing and installing transformer base and all accessories.

11.1.6.6 Install City-Furnished Street Lighting Unit:

- A. Measurement: The City will measure Install City-Furnished Street Lighting Unit by the number of lighting units acceptably installed.

- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Install City-Furnished Lighting Unit". Payment is full compensation for picking up the pole, fixture, GFCI, and weather resistant in-use cover (if required) from the City Garage and transporting to the project, assembling the GFCI, wiring in the pole to fixture and receptacle, standing the pole on the base, installing the fixture, and splicing at the base.

11.1.6.7 Meter Pedestal - Main Lug 480 Volt (location):

- A. Measurement: The City will measure Meter Pedestal - Main Lug 480 Volt (location) as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Meter Pedestal - Main Lug 480 Volt (location)". Payment is full compensation for furnishing and installing the meter pedestal; and for excavating and backfilling.

11.1.6.8 Street Light Controller (location):

- A. Measurement: The City will measure Street Light Controller (location) as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Street Light Controller (location)". Payment is full compensation for furnishing and installing photocontrol, contactor, circuit breakers, fusing, distribution blocks, enclosure, bus bars, selector switch, grounding, and electrical components.

11.1.6.9 Temporary Street Lighting:

- A. Measurement: The City will measure Temporary Street Lighting as a single lump sum acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract lump sum price for "Temporary Street Lighting". Payment is full compensation for designing the proposed temporary system including the power source; for furnishing and installing wood poles, mast arms, luminaires, luminaire wiring/fusing, insulators, and down guy; for hydro-excavation if necessary and backfill; for maintaining the temporary system; and for removing and disposing of temporary system when no longer needed.

11.1.6.10 Removing, Salvage, and Re-Installation of Existing Facilities:

- A. Measurement: The City will measure the various items of removal, salvage, and re-installation by the number of items acceptably completed.

- B. Remove and Salvage Existing Street Light Unit: Payment for measured quantities will be made at the contract unit price each. Payment is full compensation for the removal of the fixture from the pole, removal of the pole from the base, transport of each pole and fixture to the City Garage, and removal and dispose of all conductors not to remain.
- C. Remove and Reinstall Street Light Unit: Payment for measured quantities will be made at the contract unit price each. Payment is full compensation for the removal of the fixture from the pole, removal of the pole from the base, salvage of all mounting nuts and washers, storage off site, transport to and from, re-installation of street light pole, arm, and fixture utilizing existing hardware and wiring, and splice to new conductors at base.
- D. Remove and Dispose of Existing Concrete Base: Payment for measured quantities will be made at the contract unit price each. Payment is full compensation for the removal of the base, transport, and disposal.
- E. Remove and Dispose of Existing Pull Box: Payment for measured quantities will be made at the contract unit price each. Payment is full compensation for the removal of the pull box, transport, and disposal.
- F. Remove and Dispose of Existing Street Light Controller: Payment for measured quantities will be made at the contract unit price each. Payment is full compensation for removal and dispose of existing street light controller as specified.

11.1.6.11 (size and type) Communication Duct:

- A. Measurement: The City will measure (size and type) Communication Duct by the linear foot acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price per linear foot for "(size and type) Communication Duct". Payment is full compensation for furnishing and placing the duct; for all duct bodies, fittings, and caps; for installing new duct into existing pull boxes and duct; and for excavating and backfilling. The cost of crushed aggregate base course backfill will be paid for separately.

11.1.6.12 Communication Pull Box (size and type):

- A. Measurement: The City will measure Communication Pull Box (size and type) by the number of pull boxes acceptably completed.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Communication Pull Box (size and type)". Payment is full compensation for furnishing and installing all materials, including boxes, covers, and coarse aggregate; and for excavating and backfilling.

11.2 PRODUCTS

11.2.1 STREET LIGHTING PRODUCTS

11.2.1.1 Electrical Conduit:

- A. Electrical conduit shall be in accordance with Section 652 of the Wisconsin Highway Specifications except as modified in this Specification.
- B. Conduit shall be black or black with a red stripe.

11.2.1.2 Pull Boxes:

- A. Pull boxes shall be in accordance with Section 653 of the Wisconsin Highway Specifications except as modified in this Specification.
- B. Pull boxes shall be PVC pipe. PVC pipe shall comply with the applicable requirements of Section 612.2.6 of the Wisconsin Highway Specifications.
- C. The coarse aggregate shall be Size No. 2, modified to be no smaller than 3/4-inch, complying with the requirements of Section 501.2.5.4.5 of the Wisconsin Highway Specifications.

11.2.1.3 Concrete Bases:

- A. Concrete bases shall be in accordance with Section 654 of the Wisconsin Highway Specifications except as modified in this Specification.
- B. The Type L base shall be WisDOT Type L24.

11.2.1.4 Electrical Wiring:

- A. Electrical wiring shall be in accordance with Section 655 of the Wisconsin Highway Specifications except as modified in this Specification.
- B. The tracer shall be 10 AWG, stranded, and shall be green.
- C. Insulation type shall be XLP.
- D. Circuit Identification:
 - 1. Ungrounded conductors shall have a cable jacket of black, red, or blue.
 - 2. Grounded conductors shall have a cable jacket of white only.
 - 3. Grounding conductors shall have a cable jacket of green only.

11.2.1.5 Electrical Service Products:

- A. Electrical service products shall be in accordance with Section 656 of the Wisconsin Highway Specifications except as modified in this Specification.

- B. Meter Pedestal - Main Lug 480 Volt shall be an underground meter pedestal, rated at 480/240-volt single phase, and be attached to the new street light controller. Use only Listed equipment.

11.2.1.6 Transformer Bases:

- A. Transformer bases shall be in accordance with Section 657 of the Wisconsin Highway Specifications.

11.2.1.7 Poles, Arms, and Light Fixtures:

- A. Poles, arms, and light fixtures will be furnished by the City for installation by the Contractor, unless otherwise indicated.

11.2.1.8 Street Light Controllers:

- A. General: The new controller shall be pad mounted, with an underground pedestal 480-volt single phase service mounted to the specified controller. The Contractor is responsible for all coordination and paperwork with We Energies, for the removal of the existing service, and the installation of the new service. The electrical meter shall be Time-of-Day per existing City standards.
- B. Contactor: Provide an electrically held multi-pole contactor with coil capable of operating at the nominal voltage specified integral. Provide Square D, Type S series (open type) or approved equivalent by General Electric or Cutler-Hammer.
- C. Photocell: Provide a button type photocell that is rated for 240V, 1800W with 30-60 second delay between “on-off” operation.
- D. Circuit Breakers and Fuses: The circuit breakers shall be capable of surface mounting with line and load lugs by Square D, F-Frame type or approved equivalent by Cutler-Hammer or General Electric. Provide appropriate AIC ratings. Provide a 1 pole, 15 amp, control breaker for the control circuit. All breakers shall be from the same manufacturer.
- E. Bus Bars: Provide aluminum or copper ground and insulated neutral bus bars with wire range capabilities as indicated on the Plans.
- F. Hand-Off-Auto Switch: Provide a 3-position manual return selector switch in a NEMA 1 enclosure with legend plate as manufactured by Square D Type K, or equal by Cutler-Hammer or General Electric.

- G. Enclosure: Provide a NEMA 4X enclosure made from 0.125-inch Type 5052-H32 aluminum. Provide a double flanged doorframe. Provide stainless steel for all exterior hardware. Provide a 3/4-inch diameter stainless steel door handle with three-point latching system and hasp. Provide a natural aluminum mounting panel at back (interior) of enclosure. Do not provide louvers. Cabinet shall be secured by a Contractor-furnished weatherproof padlock. The enclosure shall have an aluminum mill finish. Provide an enclosure manufactured by APX Enclosures, Cleveland Manufacturing, Southern Manufacturing, or approved equivalent.
- H. Power Distribution Blocks: Provide aluminum power distribution blocks with lug wire ranges on the main and branches as indicated on the plans with clear plastic covers as manufactured by Square D Type LB or approved equivalent by Cutler-Hammer or General Electric.
- I. Fabrication:
1. Use a UL Listed Panel Builder to assemble the lighting control cabinet. The control cabinet shall have service entrance rating and be rated at 10 KVA SCCR or the minimum required by the Authority Having Jurisdiction and We Energies. Assemble the lighting control cabinet with all of its electrical components, wiring, and parts in a neat and orderly fashion and as shown on the Plans. Pretest the cabinet prior to shipment to the site.
 2. Mount all equipment to panel in enclosure. Train the cables in straight horizontal and vertical directions and parallel next to and adjacent to other cables whenever possible. Secure all wiring using screw attachment type straps; adhesive type shall not be allowed.
 3. Install photocell in the overhang of the control cabinet facing down and apply silicon caulk to maintain integrity of the enclosure.
 4. Cabinet and components shall be designed as Service Equipment. No service disconnect exterior of the Lighting Control Cabinet shall be allowed.
 5. Lighting Control Cabinet shall be 480/240 volt single phase, 100 amps.
- J. Acceptable Product: Pieper Electric, Automation Controls Division, Panel Shop No. 518083, or approved equal.

11.2.2 TEMPORARY STREET LIGHTING PRODUCTS

- 11.2.2.1 Poles: Poles shall be wood, Class V or larger with a 35-foot minimum overall length. The poles shall be northern pine in accordance with ANSI O5.1 (specifications and dimensions of wood poles). Pressure treatment shall be 5% pentachlorophenol with a minimum of 8 pounds per cubic foot net retention of the oil-borne preservative.

- 11.2.2.2 Guy Wires: The down guys shall be galvanized and meet the requirements as specified under Wood Poles.
- 11.2.2.3 Luminaires: Luminaires shall be 250W high pressure sodium or LED equivalent, with a type M-C-3 distribution. Luminaires shall be in accordance with Section 659 of the Wisconsin Highway Specifications.
- 11.2.2.4 Mast Arms: Mast arms shall be 6 feet long with a 2-foot rise suitable for attachment to a wood pole.
- 11.2.2.5 Wiring: The wiring shall consist of 3#14 with a 5A KTK fuse/fuse-holder located in the phase conductor near the pole. The wire shall be in accordance with Section 655 of the Wisconsin Highway Specifications.

11.2.3 COMMUNICATION PRODUCTS

11.2.3.1 Duct:

- A. Duct shall be smooth wall, continuous HDPE complying with the requirements of ASTM D3035, ASTM F2160, or UL 651A, wall thickness of Sch. 40, orange in color.

11.2.3.2 Pull Boxes:

- A. Pull boxes shall be manufactured of polymer concrete consisting of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two. Boxes shall comply with SCTE 77 for a design loading of 22,500 pounds.
- B. Pull boxes shall be the size indicated on the Plans. Boxes shall be designed for flush burial and shall have an open bottom. Box color shall be gray or green.
- C. Cover shall be UL listed, Tier 22, one-piece cover with stainless steel hex bolts. Cover shall be stamped "COMMUNICATIONS".
- D. The coarse aggregate shall be Size No. 2, modified to be no smaller than 3/4-inch, complying with the requirements of Section 501.2.5.4.5 of the Wisconsin Highway Specifications.

11.3 EXECUTION

11.3.1 INSTALLATION, GENERAL

- 11.3.1.1 Install street lighting and communication system components in accordance with shop drawings, manufacturer's recommendations, and the applicable provisions of Sections 651 through 657 and 659 of the Wisconsin Highway Specifications.

- 11.3.1.2 Notify the City three working days prior to the start of work so that the locations of proposed facilities can be staked by the City. Any field changes regarding the location of bases, pull boxes, conduit, etc. shall be approved by the City before digging.
- 11.3.1.3 Trenching or excavation of conduit, pull boxes, and street light bases within the root zone of a tree, as determined by the City Forester, will not be permitted.
- 11.3.1.4 Have all conduit runs and bases inspected prior to being backfilled. Contact the City of Waukesha, Department of Public Works, Engineering Division, to schedule all inspections.
- 11.3.1.5 When the work requires removal of the existing lighting system, contact the City of Waukesha, Department of Public Works, Engineering Division, to arrange to have power shut off to the existing street light system. For all removals of concrete bases, conduit, pull boxes, and wire, the Contractor is responsible for all disposals. Existing conduit may be left in place and abandoned if it does not conflict with any new facilities.

11.3.2 STREET LIGHTING INSTALLATION

11.3.2.1 Electrical Conduit:

- A. Conduit shall be installed in trenches excavated with vertical sides and a width suitable for the diameter of the conduit. The top of the conduit shall be 24 inches below the finished sidewalk grade or 30 inches below the finished surface of the proposed road.
- B. Trenches shall be filled with crushed aggregate base course. All backfill material shall be placed in 6-inch layers and thoroughly compacted.
- C. Conductors shall be installed after conduit is installed. All empty conduits shall have a #10 green tracer wire installed.

11.3.2.2 Pull Boxes:

- A. Install pull boxes as shown on the details.
- B. Install flush with grade as indicated on the Plans.

11.3.2.3 Concrete Bases:

- A. Hydro-excavation may be necessary to complete the bases due to the proximity of water lines, gas lines, other utilities, and trees.

11.3.2.4 Electrical Wiring:

- A. All wire shall extend past access points as follows:

1. 1 foot past the top of the inspection cover on a light pole.
2. To be looped with a minimum of 3 feet beyond the frame of a pull box.

B. Splices:

1. Splices of ungrounded or grounded conductors shall not be allowed in pull boxes, unless shown as on the Plans or directed by the City.
2. Splices of grounding conductors shall be made in pull boxes. A suitable sized split type bolt, copper only, may be used.
3. Splices in street light poles shall use a IlSCO PBTS series insulated one side mechanical tap or equivalent (mechanical tap shall have allen type screws). Split type bolts will not be allowed, except for the grounding conductors.
4. Break away fuse holders shall be installed on the ungrounded wire for light fixtures and receptacles (when required). Fuse shall be a midget 5 amp.

11.3.2.5 Electrical Service Products:

- A. Contractor shall verify with We Energies and Authority Having Jurisdiction that the equipment is proper for its use and installation.

11.3.3 TEMPORARY STREET LIGHTING

- 11.3.3.1 At a minimum, there shall be one street light at each intersection and spacing of no greater than 300-feet. If the existing street light circuits are not utilized by the Contractor, the Contractor is responsible for coordinating with We Energies and paying for a temporary power source.
- 11.3.3.2 Coordinate the installation of the temporary street lights with the removal of the existing street lights. Following the installation of the temporary lighting system, remove and salvage the existing street light poles and fixtures. The street lights shall be delivered to the Waukesha Municipal Garage, 300 Sentry Drive, Waukesha. If the existing street lights are to be re-installed, also schedule pick up of the poles and fixtures and bringing them back to the project to be installed.
- 11.3.3.3 The temporary lighting shall be maintained until the existing street lights have been re-installed and are operational, or until the new street lighting system has been installed and is operational.
- 11.3.3.4 Down guys shall be installed on poles that are at the end of an aerial cable run or where aerial cable tension would cause the pole to lean.
- 11.3.3.5 The mast arms shall be mounted to the wood pole within 1-foot of the top using a thru-bolt for attachment at the top and lag screws for attachment at the bottom.

- 11.3.3.6 The depth of the pole in the ground shall not be less than 5-feet or as directed by the Engineer. Install poles in accordance with the specification for Wood Poles.
- 11.3.3.7 Hydro-excavation may be needed to provide holes into which the wood poles will be installed due to the proximity to water lines, gas lines, other utilities and trees, this shall be included with the cost for Temporary Street Lighting. Provide wiring for the luminaire for a minimum length 1-foot longer than the mast arm.
- 11.3.3.8 Temporary lighting may utilize the existing power source.
- 11.3.3.9 Have the temporary lighting functional prior to the removal of the existing street lighting and maintain the temporary lighting until the new street lighting is operational.
- 11.3.3.10 The temporary lighting shall be installed in such a way that the temporary lighting does not conflict with other parts of the project. If conflict does occur, it is the responsibility of the Contractor to make adjustments at no cost to the City.

11.3.4 REMOVAL, SALVAGE, AND RE-INSTALLATION OF EXISTING FACILITIES

- 11.3.4.1 The City will direct the Contractor as to which street light poles and fixtures are to be removed and salvaged, removed and reinstalled, or replaced.
- 11.3.4.2 Where removal of existing street light controller is indicated, disconnect from We Energies power, remove and dispose of all pole mount equipment, remove and dispose of the wood utility pole, fill in the hole left by the wood utility pole with crushed stone, and remove and dispose of all conductors from the existing service to the first pull box. If a ground mount cabinet, remove all equipment and concrete pad, dispose of properly, and fill any holes with crushed stone.

11.3.5 COMMUNICATION DUCT INSTALLATION

11.3.5.1 Duct:

- A. Duct shall be installed in trenches excavated with vertical sides and a width suitable for the diameter of the conduit. The top of the duct shall be 24 inches below the finished sidewalk grade or 30 inches below the finished surface of the proposed road.
- B. Trenches shall be filled with crushed aggregate base course. All backfill material shall be placed in 6-inch layers and thoroughly compacted.
- C. Fiber cable will be installed by others at a later date and is not part of this project. Install a #10 green tracer wire in all empty ducts.

11.3.5.2 Pull Boxes:

- A. Install pull boxes as shown on the details.

- B. Duct installed into pull boxes shall extend a minimum of 3-inches but no more than 6-inches.
- C. Tracer wire shall have a 4-foot loop installed in each pull box for locating services. Strip a 3-inch section of the insulation from the tracer wire in the middle of the loop.
- D. Install flush with grade as indicated on the Plans.

11.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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12 PAVEMENT MARKINGS

12.1 GENERAL

12.1.1 SUMMARY

12.1.1.1 This section describes furnishing and applying pavement markings.

12.1.2 RELATED SECTIONS (NOT USED)

12.1.3 SUBMITTALS

12.1.3.1 Product Data: Submit a list of the specific products proposed for use on this project.

12.1.3.2 Qualifications: Submit evidence of installer training by manufacturer in proper placement and application of pavement markings.

12.1.4 TESTING (NOT USED)

12.1.5 WARRANTIES

12.1.5.1 The work included in this section shall be warranted as specified in Section 01 – General Requirements.

12.1.6 MEASUREMENT AND PAYMENT

12.1.6.1 Pavement markings will be measured and paid for in accordance with Section 646 of the Wisconsin Highway Specifications except as modified in this Specification.

12.1.6.2 Removal of existing pavement markings in conflict with proposed pavement markings will not be paid for separately and is considered incidental to the pavement marking being installed for this project.

12.2 PRODUCTS

12.2.1 PAVEMENT MARKINGS

12.2.1.1 Pavement marking materials shall comply with Section 646 of the Wisconsin Highway Specifications. Provide the material type and color indicated in the Special Provisions or on the Plans.

12.3 EXECUTION

12.3.1 PAVEMENT MARKING APPLICATION

12.3.1.1 Apply pavement markings in accordance with Section 646 of the Wisconsin Highway Specifications except as modified in this Specification.

- 12.3.1.2 Layout of pavement markings according to the Plans is the responsibility of the Contractor. Pavement markings shall be the designated width and length. Prior to applying pavement markings as laid out by the Contractor, they shall be approved by the Engineer.
- 12.3.1.3 The double yellow centerline shall be two 4-inch solid lane lines with a 4-inch gap. Each line is paid for separately.
- 12.3.1.4 The crosswalk shall be two parallel white lines, both 6-inches wide, with a minimum 6-foot separation. Each line is paid for separately.
- 12.3.1.5 The stop line shall be a solid white line, 18-inches in width, and shall be placed 4-feet in advance and parallel to the nearest crosswalk line and no more than 30-feet from the edge of intersecting roadway.
- 12.3.1.6 Dashed lane lines shall consist of 4-inch solid lines 10 feet in length with a 30-foot skip length.
- 12.3.1.7 Other pavement markings shall be as shown and described on the Plans or Special Provisions.
- 12.3.1.8 If the street has been opened to traffic, the Contractor shall submit a traffic control plan for the installation of pavement markings. If additional traffic control devices are required for this work, they will not be paid for separately.

12.3.2 REMOVING PAVEMENT MARKINGS

- 12.3.2.1 Where existing pavement markings are designated to be removed, comply with Section 646.3.4 of the Wisconsin Highway Specifications.

12.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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13 SIGNS

13.1 GENERAL

13.1.1 SUMMARY

13.1.1.1 This section describes furnishing and installing signs.

13.1.2 RELATED SECTIONS (NOT USED)

13.1.3 SUBMITTALS

13.1.3.1 Shop Drawings: Submit shop drawings for all signs. Show type of sign, materials, dimensions, colors, text, graphics, method of attachment, and type of supports.

13.1.4 TESTING (NOT USED)

13.1.5 WARRANTIES

13.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

13.1.6 MEASUREMENT AND PAYMENT

13.1.6.1 Sign, Reflective Type II:

A. Measurement:

1. General: The City will measure Sign, Reflective Type II either per each sign or by the square foot as the Contract indicates.
2. By Each: The City will measure Sign, Reflective Type II by each sign acceptably completed.
3. By the Square Foot: The City will measure Sign, Reflective Type II by the square foot acceptably completed. Two-sided street name signs will be measured as the square footage on one side of the sign. No additional payment will be made for sign message/sheathing on the other side of sign.

B. Payment: Payment for measured quantities will be made at the applicable contract unit price for "Sign, Reflective Type II". Payment is full compensation for furnishing and installing sign (attaching to post).

13.1.6.2 Sign Post, 2-3/8-Inch Round:

A. Measurement: The City will measure Sign Post, 2-3/8-Inch Round by the number of posts of the length required acceptably completed.

- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Sign Post, 2-3/8-Inch Round". Payment is full compensation for furnishing and installing post. For posts located in concrete, the cost of the PVC sleeve and/or forming a "box out" is incidental to the sign post.

13.1.6.3 Moving and Removing Signs:

- A. Measurement: The City will measure "Moving Signs", "Moving Small Sign Supports", "Removing Signs", and "Removing Small Sign Supports" by the number of signs or sign supports (posts) acceptably moved or removed, as applicable.
- B. Payment: Payment for measured quantities will be made at the contract unit price each for "Moving Signs", "Moving Small Sign Supports", "Removing Signs", and "Removing Small Sign Supports", as applicable. Payment is full compensation for the specified work under the bid item.

13.2 PRODUCTS

13.2.1 SIGNS

- 13.2.1.1 Signs shall comply with the requirements of Section 637 of the Wisconsin Highway Specifications for Type II Reflective Signs, reflective grade as required for sign type.
- 13.2.1.2 Sign layout and message shall comply with the Wisconsin Manual on Uniform Traffic Control Devices and the Wisconsin Department of Transportation Sign Plate Manual.

13.2.2 SIGN POSTS

- 13.2.2.1 Metal posts shall be 2-3/8-Inch (outside diameter) by 0.095-inch wall thickness round posts manufactured from steel having the following tensile properties:
 - A. Tensile Strength (min.): 50,000 psi.
 - B. Yield Strength (min.): 36,000 psi.
 - C. Elongation (min.): 5.0 percent in 2 inches.
- 13.2.2.2 The metal posts shall be of the length as determined by the area of signs to be mounted as shown on the Plans and in accordance with WisDOT Sign Plate A4-3. Minimum post length shall be 13 feet. Mounting holes shall be sized and spaced for mounting signs. All metal posts shall be free from defects that ill impair their strength or appearance.
- 13.2.2.3 Each post shall have a post anchoring system that will prevent sign turning.
- 13.2.2.4 The metal posts shall be hot-dipped galvanized after all forming, cutting, punching, and drilling have been completed. Galvanizing shall be in accordance with the requirements of AASHTO M111.

13.3 EXECUTION

13.3.1 SIGN INSTALLATION

- 13.3.1.1 Install signs in accordance with Section 637 of the Wisconsin Highway Specifications and the following requirements.
- 13.3.1.2 Install metal posts for supporting roadside signs at the locations shown on the Plans or as directed by the Engineer.
- 13.3.1.3 Erect metal posts in a true vertical position.
- 13.3.1.4 Install a 6-inch diameter or larger PVC sleeve in concrete for all metal posts that are located in concrete. The sleeve shall be large enough to accept the post anchor. If needed, block out the area as a square based on the anchor size.
- 13.3.1.5 Satisfactorily repair and restore other work damaged by sign installation work.

13.3.2 MOVING AND REMOVING SIGNS

- 13.3.2.1 The items Moving Signs, Moving Small Sign Supports, Removing Signs, and Removing Small Sign Supports shall conform to Section 638 of the Wisconsin Highway Specifications.
- 13.3.2.2 All signs removed on the project shall be salvaged and delivered to the City of Waukesha. The Contractor shall coordinate with City for delivery of salvaged signs and posts from the site to the Waukesha Municipal Garage. Contact the Municipal Garage (262-524-3615) to coordinate this work.

13.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION

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14 SITE IMPROVEMENTS AND RESTORATION

14.1 GENERAL

14.1.1 SUMMARY

14.1.1.1 This section describes:

- A. Restoring disturbed turf areas of the project site.

14.1.2 RELATED SECTIONS

14.1.2.1 Section 3 – Existing Conditions, Subsurface Investigation, and Demolitions: For stripping of existing topsoil.

14.1.3 SUBMITTALS

14.1.3.1 Product Data: Submit product data for topsoil, fertilizer, seed, sod, mulch, and erosion mat.

14.1.4 TESTING (NOT USED)

14.1.5 WARRANTIES

14.1.5.1 The work included in this section shall be warranted as specified in Section 1 – General Requirements.

14.1.6 MEASUREMENT AND PAYMENT

14.1.6.1 Topsoil:

- A. Measurement: The City will measure Topsoil by the square yard acceptably placed to the depth specified. Measurement will be the number of square yards of area topsoiled within the limits of construction designated on the plans or in the contract or as ordered by the Engineer.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Topsoil". Payment is full compensation for furnishing, excavating, loading, hauling, and placing topsoil.

14.1.6.2 Topsoil, Fertilizer, Seed, and Mulch:

- A. Measurement: The City will measure Topsoil, Fertilizer, Seed, and Mulch by the square yard acceptably completed. Measurement will be the number of square yards of restoration work completed within the limits of construction designated on the plans or in the contract or as ordered by the Engineer.

- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Topsoil, Fertilizer, Seed, and Mulch". Payment is full compensation for furnishing, excavating, loading, hauling, and placing topsoil; for furnishing and applying fertilizer; for furnishing seed, preparing the seed bed, and sowing the seed; for furnishing, applying, and anchoring mulch; and for maintaining and watering the seeded area as specified.

14.1.6.3 Topsoil, Fertilizer, Seed, and Erosion Mat:

- A. Measurement: The City will measure Topsoil, Fertilizer, Seed, and Erosion Mat by the square yard acceptably completed. Measurement will be the number of square yards of restoration work completed within the limits of construction designated on the plans or in the contract or as ordered by the Engineer.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Topsoil, Fertilizer, Seed, and Erosion Mat". Payment is full compensation for furnishing, excavating, loading, hauling, and placing topsoil; for furnishing and applying fertilizer; for furnishing seed, preparing the seed bed, and sowing the seed; for furnishing and installing erosion mat; and for maintaining and watering the seeded area as specified.

14.1.6.4 Topsoil and Sod:

- A. Measurement: The City will measure Topsoil and Sod by the square yard acceptably completed. Measurement will be the number of square yards of restoration work completed within the limits of construction designated on the plans or in the contract or as ordered by the Engineer.
- B. Payment: Payment for measured quantities will be made at the contract unit price per square yard for "Topsoil and Sod". Payment is full compensation for furnishing, excavating, loading, hauling, and placing topsoil; for furnishing and applying fertilizer; for furnishing and installing sod; and for maintaining and watering the sodded area as specified.

14.2 PRODUCTS

14.2.1 TOPSOIL

- 14.2.1.1 Topsoil shall consist of the natural loam, sandy loam, silt loam, silty clay loam or clay loam humus-bearing soils adapted to the sustenance of plant life, and such topsoil shall be neither excessively acid nor excessively alkaline. Topsoil shall be free of stone, gravel, and debris.

14.2.2 FERTILIZER

- 14.2.2.1 Starter fertilizer shall consist of 6% nitrogen, 24% phosphoric acid, and 24% potash.

14.2.3 SEED

- 14.2.3.1 Seed shall meet to the requirements of Section 630 of the Wisconsin Highway Specifications. Unless otherwise indicated, furnish Seed Mixture No. 40.

14.2.4 SOD

- 14.2.4.1 Sod shall meet the requirements of Section 631 of the Wisconsin Highway Specifications.

14.2.5 MULCH

- 14.2.5.1 Mulch shall meet the requirements of Section 627 of the Wisconsin Highway Specifications.

14.2.6 EROSION MAT

- 14.2.6.1 Erosion mat shall meet the requirements of Section 628 of the Wisconsin Highway Specifications. Unless otherwise indicated, furnish Urban Class I, Type B mat.

14.3 EXECUTION

14.3.1 TOPSOILING

- 14.3.1.1 All areas designated to be covered with topsoil shall be undercut or underfilled to such a degree so that when covered to the required depth with such topsoil the finished work will be in accordance with the required lines, grades, slopes and cross sections.
- 14.3.1.2 After the areas upon which the topsoil is to be placed have been prepared and finished to the required lines, grades, slopes and cross section, the topsoil shall be placed and spread thereon to a uniform depth as shown on the plans or required in the contract, or if none is so shown, to a depth of 4 inches.
- 14.3.1.3 Harrowing or discing or both will be required as necessary to assist in breaking down clods and lumps and to provide a uniform texture to this soil.
- 14.3.1.4 In the event the heavier clay-bearing loams are used on light sand soils as topsoil, the harrowing and discing shall extend to such a depth as to incorporate the heavier soils with the sand to result in a more or less homogeneous mixture of the two soil types.
- 14.3.1.5 Rocks, twigs, large clods that will not break down, and other foreign material shall be removed and the entire surface shall be dressed to present a uniform appearance. Rolling will not be required.

14.3.2 FERTILIZING

- 14.3.2.1 Apply starter fertilizer at the rate of 3.5 pounds per 1,000 square feet to the areas to be seeded or sodded.

14.3.3 SEEDING

14.3.3.1 General:

- A. Seeding when not protected with a mulch cover, shall be done at such time of the year, except during midsummer, when the climatic conditions of temperature and moisture are adapted to work of this nature.
- B. Seeding, when performed in conjunction with straw mulch may be done at any time during the growing season, including midsummer, when soil conditions are suitable.
- C. Seeding shall be done with the selected seed mixture sown at the rate of at least 3 pounds of seed per 1000 square feet of area.

14.3.3.2 Preparation of Seed Bed:

- A. Grading, shouldering, topsoiling and fertilizing items when part of the work under the contract shall be completed before seeding, except that when equipment designed for the purpose is used, the fertilizer and seed mixture may be placed in one operation.
- B. The areas to be seeded shall be disced, harrowed and dragged or hand-worked into a reasonably even and loose seed bed immediately in advance of the seeding.

14.3.3.3 Sowing:

- A. The selected seed mixture shall be sown by means of equipment adapted to the purpose, or may be scattered uniformly over the areas to be seeded, and lightly raked or dragged to cover the seed with approximately 1/4 inch of soil. After seeding, the areas shall be lightly rolled or compacted by means of suitable equipment, preferably of the cultipacker type when such equipment can be operated, or by means of light hand tampers.
- B. Scattering seed by hand shall be done only with satisfactory hand seeders and only at such times when the air is sufficiently quiet to prevent seeds from blowing away.

14.3.4 SODDING

- 14.3.4.1 Place sod in accordance with Section 631 of the Wisconsin Highway Specifications.

14.3.5 MULCHING

- 14.3.5.1 Mulch all seeded areas at a uniform rate of 1/2 to 3 ton per acre (loose depth 1/2 to 1-1/2 inch), except where use of erosion mat is designated. Anchor mulch using Method A, B, or C of Section 627 of the Wisconsin Highway Specifications.

14.3.6 EROSION MAT INSTALLATION

- 14.3.6.1 Install erosion mat in accordance with the Plans, manufacturer's recommendations, and Section 628 of the Wisconsin Highway Specifications.

14.3.7 SPECIAL REQUIREMENTS FOR REPLACEMENT WORK WITHIN TERRACE AREAS

- 14.3.7.1 At curb ramp locations, high areas shall be undercut and low areas filled to such a degree so that when covered with 4-inches of topsoil, the finished work will be in accordance with the required cross-section – no “humps” are to be left between the concrete curb and gutter and the walk.
- 14.3.7.2 Use caution when working around street trees in the terrace area. Before restoring the terrace area the Landscaper shall meet with the City Forester. Any damage to existing trees will be the responsibility of the Contractor.
- 14.3.7.3 Use caution when working around other improvements in the terrace area. Any damage to these improvements will be the responsibility of the Contractor.
- 14.3.7.4 Compact the topsoil along the new concrete work with a vibratory compactor. After compaction, low spots shall be filled in and the area raked prior to seeding or sodding (as designated).
- 14.3.7.5 Restorations shall be installed within two weeks after installation of concrete curb and gutter or sidewalk.

14.3.8 MAINTENANCE

- 14.3.8.1 Maintain the seeded and sodded areas and repair any areas damaged by erosion, traffic, or other causes.
- 14.3.8.2 Furnish and apply water to seeded and sodded areas. Keep all seeded and sodded areas thoroughly moist by watering or sprinkling if rainfall is not sufficient to achieve sod rooting to the earth bed. Water or sprinkle seed and sod for 30 days after placement. Water is to be applied in such a manner as to preclude erosion or washing out sodded areas.
- 14.3.8.3 In the Spring of the year following construction (but no later than June 20), the Contractor shall re-topsoil and re-seed or re-sod all areas that have either settled or have failed as determined by the Engineer.

14.4 SCHEDULES AND CHARTS (NOT USED)

END OF SECTION