PART 1 GENERAL

1.01 - Section Includes
A. Storm Sewer Mains.
B. Subdrains.
C. Culverts.
D. Flared End Sections.
E. Storm Sewer Manholes.
F. Storm Sewer Service Lines.
G. Subdrain Cleanouts.
H. Storm Sewer Intakes.
I. Manhole Tee Sections.
J. Storm Sewer Check Valve.

1.02 - Description Of Work
A. Storm Sewer Mains: includes furnishing and installing storm sewer pipe and all trenching, bedding and backfilling.
B. Subdrains: includes furnishing and installing subdrain pipe and all trenching, bedding and backfilling.
C. Culverts: includes furnishing and installing culvert pipe and all trenching, bedding and backfilling.
D. Flared End Sections: includes furnishing and installing, flared end sections with pipe ties, pipe guards and toe walls and all trenching, bedding and backfilling.
E. Storm Sewer Manholes: includes furnishing and installing storm sewer manholes and all excavation and backfilling.
F. Storm Sewer Service Lines: includes furnishing and installing pipe for storm sewer services with gravity flow, and furnishing and installing a storm sewer service connection to an existing storm sewer main, subdrain, or storm sewer manhole.
G. Subdrain Cleanouts: includes furnishing and installing subdrain cleanouts and all excavation and backfilling.
H. Storm Sewer Intakes: includes furnishing and installing storm sewer intakes and all excavation and backfilling.
I. Manhole Tee Sections: includes furnishing and installing manhole tee sections and excavation.
J. Storm Sewer Check Valve: includes furnishing and installing storm sewer check valves and all excavation.
K. All work shall be in accordance with the Contract Documents.

1.03 - Submittals
A. Shop Drawings and test reports of all materials to be used shall be submitted to the Engineer prior to delivery.
B. Test Reports: Tests of pipe shall be made by the pipe manufacturer in accordance with ASTM or AASHTO. Certified copies of the tests made by the manufacturer, or by a competent, commercial laboratory shall be submitted to the Engineer prior to delivery of pipe.

1.04 - Delivery, Storage And Handling
Store materials in accordance with the manufacturers’ recommendations and in locations which will minimize the interference with operations, minimize environmental damage, minimize inconvenience to the general public, and protect adjacent areas from flooding, runoff and sediment disposition.

1.05 - Scheduling And Conflicts
Schedule Work to minimize disruption of public streets and facilities.

1.06 - Special Requirements
A. Do not use explosives unless provided for in the special provisions of the Contract Documents.
B. Unless noted otherwise, only reinforced concrete pipe shall be used within City right-of-way.
C. For warranty purposes, intake inserts, boxouts and flumes shall be considered part of the intake.
D. Cast-in-place concrete and reinforcing steel are according to Section 02600.
PART 2   PRODUCTS

2.01 - Storm Sewer Mains

A. Reinforced Concrete Pipe (RCP).
   1. Pipe shall conform to ASTM C76, with a strength of Class III, and a B wall, unless otherwise noted in the Contract Documents.
   2. Pipe to be installed in a boring and jacking operation shall meet the strength and wall thickness requirements set forth herein unless indicated otherwise in the Contract Documents.
   3. The joints shall be tongue and groove without O-ring, unless otherwise noted.
   4. O-ring joints when specified shall conform to ASTM C-443.

B. Reinforced Concrete Arch Pipe
   1. Conform to ASTM C506, with Class III strength and B wall, unless otherwise noted.
   2. The joints shall be tongue and groove without O-ring, unless otherwise shown.

C. Precast Reinforced Concrete Box Sections
   1. Sections shall conform to ASTM C789 and ASTM C850.
   2. Lift holes will be allowed. The holes shall be placed in the top of the box and shall be filled with a manufactured plug prior to backfilling the trench.

D. High Density Polyethylene Pipe (HDPE), 12-inch to 48-inch diameter (where approved).
   1. Pipe and fittings shall be corrugated with integrally formed smooth interior conforming to AASHTO M 294, Type S and ASTM F667.
   2. The pipe and fittings shall be made of polyethylene compounds which conform with the requirements of cell class 324420C (min.), as defined and described in ASTM D3350, except the carbon black content shall not exceed 5 percent.
   3. The minimum parallel plate stiffness per ASTM D2412 shall be:

<table>
<thead>
<tr>
<th>Pipe diameter (inches)</th>
<th>12</th>
<th>15</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>36</th>
<th>42</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel plate stiffness, min. (psi)</td>
<td>50</td>
<td>42</td>
<td>40</td>
<td>34</td>
<td>28</td>
<td>22</td>
<td>19</td>
<td>17</td>
</tr>
</tbody>
</table>

   There shall be no evidence of splitting, cracking, or breaking at 60 percent flattening.
   4. The pipe and fittings shall be free of foreign inclusions and visible defects.
   5. The joints shall be integral bell-type with gaskets meeting ASTM D3212 and F477, respectively. Split couplers are prohibited.
   6. 5 percent maximum deflection testing (after 30 days installation) of average inside diameter is required on 15-inch diameter pipe and larger (less than 46 psi stiffness).

E. Precast Reinforced Concrete Horizontal Elliptical Pipe (HE)
   1. Pipe shall conform to ASTM C507 Class HE-III.
   2. The joints shall be tongue and groove without O-ring, unless otherwise shown on Contract Documents.

F. Polyvinyl Chloride (PVC) Pipe with Smooth Interior and Corrugated Exterior according to ASTM F949, 12-inch to 36-inch diameter (where approved).
   1. The thermoplastic material for pipe and fittings shall be a rigid PVC plastic meeting requirements of ASTM D1784 for a minimum cell classification of 12454. Minimum parallel plate stiffness in accordance with ASTM D2412 shall be 46 psi. There shall be no evidence of splitting, cracking or breaking at 60 percent flattening.
   2. Pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects.
   3. Pipe dimensions shall meet the requirements of ASTM F949 when measured in accordance with ASTM D2122.
   4. Gasketed pipe joints shall show no leakage when tested in accordance with ASTM D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM F477.

G. Sewer joint sealer for RCP shall be cold applied mastic meeting requirements of AASHTO M198.

2.02 - Subdrains
A. PVC Pipe.
   1. Conform to 2.01 F, 1 through 3, of this Section.
   2. All joints shall be made with integrally formed bell and spigot gasketed connections. Elastomeric seals (gaskets) shall meet the requirements of ASTM F477.
   3. Perforation dimensions and patterns shall be subject to prior approval by the Engineer.
   4. Pipe fittings shall conform to ASTM F949, Section 5.2.3.
   5. Each pipe segment shall be clearly marked showing nominal pipe stiffness.

B. High Density Polyethylene Pipe (HDPE).
   1. Pipe and fittings shall be rigid, type S corrugated with integrally formed smooth interior, with class 2 perforations conforming to AASHTO M 252 and ASTM F405.
   2. The pipe and fittings shall be made of polyethylene compounds which conform with the requirements of cell class 324420C (min.), as defined and described in ASTM D3350, except the carbon black content shall not exceed 5 percent.
   3. The minimum parallel plate stiffness shall be in accordance with ASTM D2412, and shall be 46 psi. There shall be no evidence of splitting, cracking, or breaking at 60 percent flattening.
   4. The pipe and fittings shall be free of foreign inclusions and visible defects.
   5. Pipe shall be perforated in accordance with AASHTO M252 and ASTM F405.
   6. Joints shall be made with PVC couplings, conforming to ASTM D3212 and ASTM F477, respectively.

2.03 - Culverts

A. Reinforced Concrete Pipe (RCP).
   1. Conform to requirements of 2.01 A. of this Section.
   2. Joints shall be sealed with approved mastic sealer.
   3. Pipe ties shall be installed as noted in the Contract Documents.

B. Reinforced Concrete Arch Pipe: Conform to requirements of 2.01 B. of this Section.

C. Precast Reinforced Concrete Box Sections: Conform to requirements of 2.01 C. of this Section.

D. High Density Polyethylene Pipe (HDPE), 12-inch to 48-inch diameter: Conform to requirements of 2.01 D. of this Section.

E. Precast Reinforced Concrete Horizontal Elliptical Pipe (HE): Conform to requirements of 2.01 E. of this Section.

F. PVC Pipe with Smooth Interior and Corrugated Exterior according to ASTM F949, 12-inch to 36-inch diameter.
   1. Conform to requirements of 2.01 F. of this Section.
   2. 5 percent mandrel testing shall be required on all pipes less than 46 psi.

2.04 - Flared End Sections

A. Reinforced Concrete Pipe (RCP): Pipe shall conform to ASTM C76, with a strength of Class III, and a B wall, unless otherwise noted in the Contract Documents. Tongue and groove joints, without O-ring, unless otherwise shown in Contract Documents.

B. Reinforced Concrete Arch Pipe: Conform to requirements of 2.01 B. of this Section.

C. Provide pipe guards as indicated in the Contract Documents.

D. Lift holes will be allowed. The holes shall be placed at or near the crown of the pipe and shall be filled with a manufactured plug prior to backfilling the trench.

2.05 - Storm Sewer Manholes

A. Storm sewer manholes shall be of the size and depth as set forth in the Contract Documents.

B. Precast Storm Sewer Manholes:
   1. All precast storm sewer manholes shall be in conformance with ASTM C478. There may be one or two cages of circumferential reinforcement in the manhole pipe, but the minimum sectional area of reinforcement steel shall be 0.187 square inches per foot of manhole height.
2. All precast storm sewer manholes shall have 48-inch minimum inside diameter sections, unless otherwise noted in the Contract Documents. Appropriate manhole precast riser sections shall be used, as necessary, to arrive at the specified rim elevation. Oversize manhole diameters shall be used as directed in the Contract Documents.

3. Approved cold-applied plastic bituminous joint material shall be filled in the joint between precast riser sections. When O-ring gaskets are specified, all joints between precast riser sections shall be fitted with a watertight O-ring gasket between the bell and spigot ends in conformance with ASTM C478, ASTM C361, and AWWA C302.

4. The riser sections shall be terminated with an eccentric reducer (cone section) of 3 feet minimum height, with a minimum inside diameter of 24 inches, which shall be fitted to the precast riser section, as specified herein. A reinforced concrete flattop of 8-inch minimum thickness may be used instead of the eccentric reducer, at the direction of the Engineer.

5. Manhole adjusting rings:
   a. Manhole adjusting rings shall be as specified in Section 02300 of these specifications.
   b. Height shall be 2 to 6 inches above the eccentric reducer, as necessary. The combined vertical height of the adjusting rings shall be a maximum of 12 inches.

6. Manhole steps are required in all precast manholes, intakes, and junction boxes with a height from the lowest flow line to the top of rim in excess of 5 feet. They are not required between precast adjusting rings. Steps shall be an approved plastic-coated 10-inch steel step securely anchored into the riser section. The steel step shall be a ½-inch bar, Grade 60, in accordance with ASTM A615. The plastic coating on the steel bar shall be a copolymer polypropylene coating in accordance with ASTM 2146 under Type II, Grade 16906.

7. Manhole frame and lid castings shall be of uniform quality, free from defects, from a source to be approved in advance by the Engineer. Metal used in the manufacture of gray iron castings shall conform to ASTM A48, Class 35, or ASTM A536, Grade 65-45-12 for ductile iron. The surface finish shall be clean and smooth. Frame and lid castings shall have continuously machined bearing surfaces to prevent rocking and rattling. Cast dimensions may vary a maximum of 1/16 inch per foot. Storm sewer casting manufacturer and model shall conform to Appendix A at the end of this section.

8. External chimney seals, if specified in the Contract Documents, shall be in conformance with Section 02300. 
   C. Material for concrete fillets shall be as set forth in Section 02600.
   D. All manhole components shall be capable of withstanding AASHTO HS-20 live loading with the appropriate impact loading and the applicable dead loads.

2.06 - Storm Sewer Services

4-inch (minimum) dual-wall corrugated HDPE or materials conforming to the requirements for sanitary sewer services in Section 2300 of these Specifications.

2.07 - Subdrain Cleanouts

Construct cleanouts of 24-inch diameter Class III storm sewer pipe conforming with this section.

2.08 - Storm Sewer Intakes

A. Storm sewer intakes shall be of a type, size, and depth as set forth in the Contract Documents.

B. Storm sewer intakes may be precast when approved by the Engineer. They shall conform to ASTM C478, if precast. The Contractor shall be responsible for any additional reinforcement necessary to prevent cracking during transportation and installation.

C. The mortar incorporated in the intakes at the job site shall be as set forth in Section 02600. The intake shall be in conformance with the standard details.
2.09 - Manhole Tee Sections

The barrel section shall conform to ASTM C 76 and shall be of the same strength class as the adjacent pipe being placed. The riser section shall conform to ASTM C 478 having a minimum internal diameter of 48 inches.

2.10 - Storm Sewer Check Valve

Check valves shall be Tideflex TF-2. The diameter and head condition shall be as set forth in the Special Provisions.

2.11 - Miscellaneous

A. Engineering fabric incorporated into the Work as part of this section shall meet the requirements of the Iowa DOT Standard Specification 4196.01B (IM 496.01).

B. O-ring joints for reinforced concrete sewer pipe shall be as required in the Contract Documents and shall conform to ASTM C-443.

C. Manufactured plugs for sealing lift holes and pipe ends shall be as approved by the Engineer.

D. Apron Guards: Grade 40, smooth or deformed steel, conforming to ASTM A615; hot dip galvanized according to ASTM A123.

E. Miscellaneous castings shall be as set forth in the Contract Documents and shall be of uniform quality and free from defects. The metal used in the manufacture of castings shall conform to ASTM A48 or AASHTO M105. The lid shall fit in the frame such that it does not rock. All castings shall withstand the AASHTO HS-20 loading.

F. Mastic used as joint material shall be cold-applied bituminous or other material approved by the Engineer.

G. Rodent guards shall be as approved by the Engineer.

H. Pipe ties shall conform to Iowa DOT Standard Road Plan RF-14.

PART 3 EXECUTION

3.01 - Storm Sewers – General

A. Storm sewer materials shall not be installed until trench excavation and bedding has been completed according to Section 02200.

B. The Contractor shall furnish and install storm sewer materials according to the Contract Documents.

C. The Contractor shall inspect storm sewer materials for defects. Do not install damaged or defective materials.

D. The pipe interior, and pipe and manhole joints shall be kept clean during installation and between periods of installations.

E. If bottom of excavation is wet, dewater according to Section 2200.

F. The Contractor shall provide uniform bearing for the full pipe barrel length when installed.

G. Manhole section and pipe joints shall be assembled according to the Manufacturer’s instructions and verified by the Contractor.

H. The Contractor is responsible to block or anchor pipe as necessary to prevent joint displacement when using movable trench boxes or shields.

I. The Contractor shall backfill the pipe or structure according to Section 02200 and the Contract Documents.

3.02 - Storm Sewer Mains

A. The pipe installation shall begin at the lowest point of the pipe reach unless approved otherwise by the Engineer.

B. The joints shall be furnished and installed in accordance with the Contract Documents.

1. Unless otherwise noted, joints in concrete pipe within 5 ft of curb line shall be open-jointed.

2. Open joints shall be wrapped in sections of 18-inch wide engineering fabric, with 12-inch overlap between fabric sections.

3. Where not specified or required to be open, joints in concrete pipe shall be sealed with cold-applied bituminous sealer, preformed plastic gaskets, or flexible, watertight, rubber-type gaskets conforming to the requirements given herein. Portland cement mortar shall not be
3.02 - Jointing of Storm Sewer Piping

A. Use a mastic or bituminous sealer for sealing pipe except as directed by the Engineer. Jointing method shall be specified in the Contract Documents.

4. When cold-applied bituminous sealer is used, the bell and spigot or tongue-and-groove pipe shall be wiped clean and dry before applying the bituminous sealer to the pipe joint. Before the pipes are placed in contact with each other, the spigot or tongue end shall be completely covered with an excess of bituminous sealer; then the pipe shall be laid to line and grade so the inside surface of the abutting pipes are flush. The joints shall be completely filled with bituminous sealer. All excess joint sealant shall be removed from inside of the pipe.

5. PVC and HDPE pipe and fittings shall be protected during storage and handling against ultraviolet light, impact, shock, and free fall. Pipe and fittings shall be kept clean at all times.

6. Installation of coupling bands and fittings shall follow the manufacturer’s recommendations.

C. Cut the pipe at the inside wall of structures.

D. Install water stops in the trench at the locations set forth in the Contract Documents. They shall be constructed of clayey excavated material compacted to 95 percent of optimum density (ASTM D698) in accordance with the Contract Documents.

E. Any lift holes in the pipe shall be plugged.

F. In situations where the storm sewer pipe discharges to a surface drainage, the three joints nearest the end of pipe shall be tied in accordance with the Contract Documents.

G. Install pipe plugs, manufactured or otherwise, as directed by to the Engineer or the Contract Documents.

H. Anchor pipes installed on grades in excess of 20 percent but less than 35 percent securely with concrete anchors spaced at 36 ft (maximum) on center. For slopes greater than 35 percent, submit a pipe anchoring plan to the jurisdictional engineer for review prior to installation.

3.03 - Subdrains

A. Installed subdrain prior to placing subbase, or paving if subbase is not required, unless approved otherwise by the Engineer. Use construction stakes to verify proper installation.

B. Slope subgrade to provide positive gravity drainage.

C. Engineering Fabric.
   1. Remove and replace fabric areas damaged during construction. Map or sew replaced fabric, as specified for the class of fabric used.
   2. Install geotextiles in accordance with manufacturer’s recommendation.
   3. Provide smooth side and bottom trench surfaces so the fabric does not bridge depressions in the soil and is not damaged by rock projections. Use fabric of a width to permit a 1-foot overlap across the backfill at the trench top. Lay the fabric flat in the prepared trench without stretching. Lay the top of the fabric back on the sides to allow for the placement of the aggregate backfill and pipe. Overlap ends of rolls a minimum of 1 foot. Where pockets or cavities occur in the trench bottom or sides, fill then with acceptable granular material to prevent distortion or damage to the fabric.
   4. Backfill aggregate and install pipe in a manner to prevent damage to the fabric. Compact aggregate backfill and overlap the fabric across the trench top. If the top overlap is not 1 foot wide, place a piece of fabric, minimum of 1 foot wide, on top of the overlap. Do not allow the fabric to be exposed for more than 2 weeks without covering with backfill.

D. The pipe installation shall begin at the lowest point of the pipe reach unless approved otherwise by the Engineer.

E. Install the pipe with the perforations down, at a maximum depth of 6 feet.

F. Cap subdrain connections to intakes at the upstream intake, and place a rodent screen on the subdrain at the downstream intake.

G. In non-paved areas, the granular backfill in the subdrain trenches shall be capped with a minimum of 12 inches of properly compacted cohesive fill.
3.04 - Culverts
   A. Install joints in accordance with 3.02 B of this Section.
   B. When open pipe joints are not used, pipe joints shall be installed in accordance with the manufacturer’s instructions and verified by the Contractor.
   C. Cut the pipe at the inside wall of structures.
   D. Furnish and install appurtenances as set forth in the Contract Documents.

3.05 - Flared End Sections
   A. Install pipe joints in accordance with 3.02 B of this Section.
   B. Furnish and install appurtenances as set forth in the Contract Documents.
   C. Install toe walls according to Section 02600.

3.06 - Storm Sewer Manholes
   A. Construct each manhole to subgrade elevation. Work promptly and provide protection from the inflow of water and debris.
   B. Concrete fillets shall be constructed according to Standard Details.
   C. Manhole cover shall not rock under the weight of traffic. Provide shims as necessary according to Standard Details.

3.07 - Storm Sewer Services
   A. Storm sewer services shall be installed by open cut method. Tunneling, pushing, or jacking under sidewalks, curbs, driveways, or other paved areas shall be allowed only with prior approval of Engineer.
   B. Connection may be made by:
      1. Tap to main or subdrain: Tap to main shall conform to requirements for a sanitary sewer tap in Section 2300 of these Specifications.
      2. Directly to storm sewer manhole or intake: Make opening in manhole or intake by sawcutting or in such other way as not to damage structure, then grout pipe into manhole using nonshrink grout.
   C. Bedding and backfill – conform to requirements of Standard Details and Standard Specifications Section 2200.

3.08 - Subdrain Cleanouts
   The Contractor shall provide protection from sediment entering into the storm sewer system.

3.09 - Storm Sewer Intakes
   A. If unit is cast in place, storm sewer pipe shall be installed before intake sidewall construction is started. Sidewalls shall be constructed with openings for storm sewer pipe(s) smoothly shaped and inlet pipe(s) not projecting unnecessarily into well. Outlet pipe(s) shall not project beyond inside face of sidewall.
   B. Top of intake shall be installed parallel to curb line or as shown in the Contract Documents.
   C. Concrete fillets shall be constructed according to Standard Details.

3.10 - Manhole Tee Sections
   Install according to Section 02400, 3.01, and/or Manufacturer’s instructions.

3.11 - Storm Sewer Check Valve
   Install in accordance with manufacturer’s requirement.

END OF SECTION 02400, EXCEPT APPENDIX A
### APPROVED STORM SEWER CASTINGS

<table>
<thead>
<tr>
<th>Type of Installation</th>
<th>Neenah Foundry</th>
<th>East Jordan Works</th>
<th>Deeter Foundry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curb-and-Apron Intake (3-ft Opening)</td>
<td>R3246</td>
<td>7030</td>
<td>2045</td>
</tr>
<tr>
<td>Curb-and-Apron Intake (6-ft Opening)</td>
<td>R3296-A</td>
<td>7032</td>
<td>2045 DBL</td>
</tr>
<tr>
<td>Curb-and-Apron Intake (9-ft Opening)</td>
<td>R3296-B</td>
<td>---</td>
<td>2045 TRP</td>
</tr>
<tr>
<td>Flat Grate Intake (2 ft by 2 ft) (Paved Area)</td>
<td>R3403-A1</td>
<td>7031</td>
<td>2335</td>
</tr>
<tr>
<td>Subdrain Cleanout (Shoulder Area)</td>
<td>R5900-E</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Heavy Duty Junction Box Deck-on-Grade Drop-in Casting</td>
<td>R1642-1S</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Storm Manhole (Heavy Duty) Paved Area</td>
<td>R1642</td>
<td>1045</td>
<td>1268</td>
</tr>
<tr>
<td>Stool-type Area Drain Intake, 24-Inch Diameter</td>
<td>R4341-A</td>
<td>6488</td>
<td>---</td>
</tr>
<tr>
<td>Area Drain Intake (Beehive Intake) 24-Inch Diameter</td>
<td>R2560</td>
<td>1130</td>
<td>4495</td>
</tr>
<tr>
<td>IRA-3, RA-5 and RA-8 Intakes</td>
<td>IDOT RA-55 (Formerly RA-27)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Cedar Rapids only, all round stormwater manhole lids shall be grated, Neenah Type C or D (R-4370), East Jordan Type M1, or approved equal.