

DIVISION 02

SITE CONSTRUCTION

SECTION 02100

ROADWAY AND GENERAL EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating; filling and grading for street surfacing, concrete street improvements and appurtenances, as indicated on the drawings; removing and disposing of excess and unsuitable material; and compacting as required.
- B. Removing vegetation, topsoil material; and stockpiling material on-site.
- C. Removing and disposing of existing concrete items as indicated.
- D. Backfilling, compacting and grading around and adjacent to new concrete work and paving, as indicated on the drawings.
- E. Finish grading.
- F. Dust control.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: trenching and backfilling for pipe work.
- B. Section 02115 - Structural Excavation: Building and foundation excavating.
- C. Section 02116 - Fill and Backfill: Backfilling for project pipe lines and at structures.

1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Samples: Submit 10 pound sample (or amount required by the testing laboratory or Owner) of each type of material as required in the approved drawings and specifications.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.
- F. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with City of Saratoga Springs, Standards and Specifications Drawings.
 - 1. Maintain one copy of standards on job site.

1.05 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.

- B. Protect landscaping, such as plants, lawns, rock out-croppings, and other features, adjacent to work areas, from excavating equipment and vehicular traffic.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. See Section 02116 - Fill and Backfill.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities, where and as required.
- D. Verify that survey bench mark and intended elevations for the Work are as indicated.
- E. Identify any areas of collapsible soils within the work area, and inform the City Engineer of their locations.
- F. Compact and proof roll subgrade as per City Standards & Specification. Verify Existing soil Conditions and the removal of unsuitable materials with City inspector.

3.02 EXCAVATING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil material when wet.
- C. Excavate to lines, grades and cross-sections as indicated on the drawings.
- D. Notify City Engineer of unexpected subsurface conditions within 24 hours and discontinue affected work in area until notified by the City Engineer to resume work.
- E. All excavating shall be done according to OSHA Standards and all other applicable regulations.
- F. Excavation and grading operations shall be conducted in such a manner so as to cause minimum inconvenience to adjacent property, including dust control.
- G. Surfaces of excavated areas shall, at all times, have sufficient grade and smoothness as necessary to ensure proper drainage. If existing drainage is interrupted, provide temporary facilities to re-route and maintain drainage so that adjacent properties are not damaged. Temporary drainage facilities shall be considered incidental to work involved; and shall be removed after work is completed.
- H. When unsuitable material is encountered in excavated areas at subgrade elevations, excavate as required to remove unsuitable material and backfill areas with selected backfill material.
- I. Remove large rocks and boulders encountered at subgrade elevations to a depth of not less than 6-inches below subgrade, and fill and compact excavation with suitable material.

- J. Remove excess and unacceptable excavated material from site and dispose of in an acceptable manner.
- K. See Section 02116 for backfilling and filling procedures.
- L. Slopes: Slopes greater than 3:1 shall be stabilized with approved erosion control matting unless otherwise directed by geotechnical engineer and approved by the City Engineer.
- M. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- N. During construction, provide and maintain sufficient means and devices to promptly remove and properly dispose of all water entering excavations or other parts of the work.
 1. Dispose of water from work area in a legally acceptable manner, without damage to adjacent property.
 2. No pipe, concrete footings, foundations or floors shall be installed in water.
 3. Water shall not be allowed to rise over concrete until it has set for at least 24 hours.
 4. Water shall not be allowed to rise against walls and supporting beams for a period of 14 days after completion of walls and beams.
 5. Any damage to pipe work or concrete work caused by water shall be repaired by the Contractor, at his expense.
- O. The use of explosives will not be allowed; unless use has been specifically reviewed and accepted by the City Engineer. All blasting shall be done by a reputable contractor specializing in the use of explosives.

3.03 REMOVING MISCELLANEOUS CONCRETE ITEMS

- A. Remove existing concrete curb and gutter, sidewalk, waterways, and driveway pavement as necessary to complete work and as directed by the approved drawing.
- B. Saw-cut existing concrete items at limit of removal as necessary to complete work and as directed by the approved drawing; break up and demolish the concrete item; and load, haul and dispose of concrete debris in a legally acceptable manner.

3.04 SOIL REMOVAL

- A. Segregate excavated material at time of excavation into topsoil material, acceptable material, and unsuitable material, as determined by the City Engineer.
- B. Stockpile topsoil to be re-used on site; remove excess material from site and dispose of in an acceptable manner.
- C. Stockpile acceptable subsoil to be re-used on site; remove unacceptable and excess material from site and dispose of in a legally acceptable manner.
- D. Stockpile materials separately in areas designated on site, within 200 feet of point of excavation; pile depth not to exceed four feet and protect from erosion.

3.05 BACKFILLING AND FILLING

- A. Remove all vegetation, debris, unsuitable soil materials, obstructions and deleterious materials from designated areas prior to placement of backfills or fills.
- B. Where existing ground surfaces have density less than that specified for particular area, plow area to

required depth, pulverize existing material, moisture-condition to optimum moisture content and compact to required percentage of maximum density.

- C. Place backfill and fill material in lifts approved by a Geotechnical Engineer. Moisture-control each layer to provide optimum moisture content of material; but keep moist enough at all times to provide dust control.
- D. Compact each layer to required percentage of maximum density for each area classification.
- E. Do not place backfill or fill material on surfaces that are soft, unsuitable, frozen or contain frost or ice.
- F. See Section 02116 for backfilling and filling procedures.
- G. Correct areas that are over-excavated.
 - 1. Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- H. Park strips shall be backfilled 3 inches below TBC.

3.06 COMPACTING

- A. Compact backfill and fill material to provide not less than the following percentages of maximum density for each area classification:
 - 1. Roadways: Under paving and similar construction, compact subgrade and each layer of backfill or fill material as specified in Section 02116.
 - 2. Concrete Items: Under curb and gutter, sidewalks, and other concrete items, compact top 6-inches of subgrades and each layer of backfill or fill material as specified in section 02116.
 - 3. Non-Landscaped Unpaved Areas: Compact each layer of backfill or fill material as specified in section 02116.
- B. Moisture Control. Before compaction, moisture control subgrades or layers of backfill and fill material, as required, to achieve optimum moisture content of material.
 - 1. For dry material, apply water uniformly to surface of material in a way that will prevent free water from appearing on surface during or after compaction operations.
 - 2. For soil material that is too wet to allow compaction, remove and replace backfill or fill material, or scarify subgrade material and air dry, until desired moisture content is reached.
- C. Proof roll until surface is verified as non-yielding by City Inspector.

3.07 FINISH GRADING

- A. Grade project areas uniformly to lines and grades, as indicated, including adjacent transition areas.
- B. Finish surfaces shall be smooth and compact, with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- C. Place topsoil in areas where seeding, sodding, and planting is indicated.
 - 1. Place topsoil to the following compacted thicknesses:
 - a. Areas to be seeded with grass: 6 inches.
 - b. Areas to be sodded: 4 inches.
 - c. Areas for shrub beds: 18 inches.
 - d. Areas for flower beds: 12 inches.

2. Remove roots, weeds, rocks, and foreign material while spreading.
3. Near plants, spread topsoil manually to prevent damage.
4. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
5. Lightly compact placed topsoil.

3.08 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevations.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch from required elevations.

3.09 FIELD QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for field inspection and testing.
- B. See Section 02116 for compaction density and gradation testing.
- C. Frequency of density testing: one test for each lift at 150 linear foot spacing for roadways, curb and gutter, sidewalks and other items.
- D. Frequency of gradation testing: One test prior to first lot and then additional testing as necessary to verify the consistency of the material.
- E. Proof Roll until surface is verified as non-yielding by City Inspector.

3.10 CLEAN-UP

- A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.
- C. All disturbed areas shall be restored with native grasses to match adjacent areas, conforming to the City Standards. These areas shall be seeded with material conforming to adjacent materials, as acceptable. Restored area shall achieve 70% plant coverage, and be free of erosion and invasive species prior to acceptance.

END OF SECTION

SECTION 02112

TRENCHING FOR PIPE WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating, backfilling and compacting for project pipe lines.

1.02 RELATED SECTIONS

- A. Section 02115 - Structural Excavation: Excavating for miscellaneous structures.
- B. Section 02116 - Fill and Backfill: Backfilling for project pipe lines and at structures.

1.03 REFERENCES

- A. Use latest issue of the reference standards as of the date of the project.
- B. AASHTO T 99 - Moisture-Density Relations of Soils Using a 5.5-lb (2.5 kg) Rammer and a 12-inch Drop.
- C. AASHTO T 180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-inch Drop.
- D. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- E. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- F. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- G. ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)).
- H. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- I. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- J. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- K. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- L. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- M. Specification for Excavating on State Highways.
- N. General Safety Orders Covering Utah Industries - Section 69, Trenches.
- O. United States Department of Labor OSHA Publication 2085 - "Employer - Employee, Safe Practice for Excavation and Trenching Operations".

- P. Utah Occupational Safety and Health Rules and Regulations - General Standard (UOSHA).

1.04 DEFINITIONS

- A. Pipe Line Grades and Elevations: Indicated on drawings.
- B. Trench Cross Sections: Indicated on standard trench detail drawings.
- C. Subgrade Elevations: Bottom of road base in paved areas, as indicated on drawings.
- D. Finish Grade Elevations: Top of pavement in paved areas, as indicated on drawings.
- E. Ground Elevations: Indicated on the drawings.

1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 pound sample of each type of fill (or amount requested by the testing laboratory); submit to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.06 PROJECT CONDITIONS

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where approved by the City Engineer.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the work match design drawings.
- D. Protect plants, lawns, and other features to remain.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, curbs, and other improvements from excavating equipment and vehicular traffic.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. See Section 02116 - Fill and Backfill.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for testing and analysis of soil material.

- B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities, where and as required.
- D. Identify any areas of collapsible soils within trench areas, and inform the City Engineer of their locations.

3.02 TRENCHING

- A. Excavate trenches as required to allow project pipe to be installed to line and grade as indicated on the drawings.
- B. Notify City Engineer of unexpected subsurface conditions within 24 hours and discontinue affected Work in area until notified to resume work.
- C. All trenching shall be done according to OSHA Standards and other applicable regulations.
- D. Do not interfere with 45 degree bearing splay of adjacent foundations.
- E. Excavate trenches to width, depth and cross section as indicated on the trench detail drawings.
- F. Hand trim excavations. Remove loose matter.
- G. Remove large stones over 4 inches in diameter and other hard matter which could damage piping or impede consistent backfilling or compaction.
- H. Remove excavated material that is unsuitable for re-use on the project from site and dispose of in an acceptable manner.
- I. When unsuitable material is encountered in trenches at subgrade elevations, excavate as required to remove the unsuitable material and backfill areas with selected backfill material.
- J. Stockpile excavated material to be re-used in area designated on site.
- K. Remove excess excavated material from site and dispose of in an acceptable manner.
- L. Excavation beyond or below lines and grades indicated shall be refilled with fill material and compacted, at the Contractor's expense.
- M. During construction, provide and maintain sufficient means and devices to promptly remove and properly dispose of all water entering excavations or other parts of the work.
 - 1. Dispose of water from work area in an acceptable manner, without damage to adjacent property.
 - 2. No pipe, concrete footings, foundations or floors shall be installed in water.

3. Water shall not be allowed to rise over concrete until it has set for at least 24 hours.
 4. Water shall not be allowed to rise against walls and supporting beams for a period of 14 days after completion of walls and beams.
 5. Any damage to pipe work or concrete work caused by water shall be repaired by the Contractor, at his expense.
- N. The use of explosives will not be allowed; unless use has been specifically reviewed and accepted by the City Engineer. All blasting shall be done by a reputable contractor specializing in the use of explosives.
1. Comply with all laws, ordinances, and applicable safety code requirements and regulations relative to the handling, storage, and use of explosives and protection of life and property.
 2. Contractor shall be fully responsible for all damage attributable to his blasting operations.
 3. Excessive blasting or over shooting will not be permitted.
 4. Remove any material outside of authorized cross-section which may be shattered or loosened by blasting operation.

3.03 PREPARATION FOR PIPE LINE PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with bedding material, or stabilization material, or other acceptable material, as per section 02116.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.04 BACKFILLING

- A. Backfilling shall conform to the requirements of Section 02116 - Fill and Backfill.
- B. Backfill pipe zone with bedding material, or other acceptable material.
- C. Backfill above pipe zone, up to subgrade or finish grade elevations, as indicated on the trench detail drawings.
- D. Employ a placement method that does not disturb or damage project pipe or other work.
- E. Do not backfill with wet or frozen materials.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Granular Fill: Place and compact materials in equal continuous layers not exceeding lifts approved by Geotechnical Engineer.
- H. Soil Fill: Place and compact material in equal continuous layers not exceeding lifts approved by Geotechnical Engineer.
- I. Backfill material may be consolidated by an approved method from the City Engineer.
- J. Correct areas that are over-excavated.

1. Thrust bearing surfaces: Fill with concrete.
 2. Use structural fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- K. Compaction Density Unless Otherwise Specified or Indicated:
1. Under paving, concrete work, and similar construction: 95 percent of maximum dry density.
 2. Within street rights-of-way: 95 percent of maximum dry density.
 3. At other locations: 90 percent of maximum dry density.
- L. Reshape and re-compact fills subjected to vehicular traffic.

3.05 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Project Pipe Lines:
1. Pipe Bedding: See Section 02116.
 2. Backfill trench to subgrade or finish elevations with granular borrow. See Section 02116.
 3. Compact bedding material in lifts approved by a Geotechnical Engineer to 95 percent of maximum dry density.
 4. Compact backfill material in maximum lifts approved by a Geotechnical Engineer to 95 percent of maximum dry density.

3.06 TOLERANCES

- A. Top Surface of Backfilling in unimproved areas: Plus or minus 1 inch from required elevations.
- B. Top Surface of Backfilling in improved areas: Plus or minus 1/2 inch from required elevations.

3.07 FIELD QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for field inspection and testing.
- B. Testing is to be done as per APWA Standards and Specification; test results must be sent to the City Engineer or Inspector within 24 hours after the tests are completed.
- C. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
1. Perform gradation testing in accordance with ASTM C136.
- D. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- F. Frequency of density tests: one test per lift per 150 linear foot of trench.
- G. Frequency of Gradation test: one test prior to first lot, then 25 , or as necessary to verify the consistency of the material.

3.08 CLEAN-UP

- A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.
- C. All disturbed areas shall be restored with native grasses to match vegetation in adjacent areas, conforming to the City Standards. These areas shall be seeded with material conforming to adjacent materials, as acceptable. Restored area shall achieve 70% plant coverage, be free of erosions and invasive species prior to acceptance.

END OF SECTION

SECTION 02115

STRUCTURAL EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for structure volume below grade, footings, slabs-on-grade, paving, curb and gutter, sidewalks and other concrete work.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, backfilling and compacting for project pipe lines.
- B. Section 02116 - Fill and Backfill: Fill materials, filling, and compacting.

1.03 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Identify any areas of collapsible soils within the work areas, and inform the City Engineer of their locations.

3.02 EXCAVATING

- A. Excavate to accommodate new structures and construction operations to lines and elevations indicated.
- B. Notify City Engineer of unexpected subsurface conditions within 24 hours and discontinue affected Work in area until notified to resume work.
- C. All excavating shall be done according the OSHA Standards and other applicable safety regulations.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut excavations wide enough to allow construction of structures as indicated; bottom dimensions shall be sufficient to provide at least 12 inches clear between extreme outside of concrete work and side of excavation. No tunneling or under cutting will be permitted.
- F. Hand trim excavations. Remove loose matter.
- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 02116.

- H. When unsuitable material is encountered in excavations at subgrade elevations, excavate as required to remove unsuitable material and backfill areas with selected backfill material.
- I. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- J. Remove excavated material that is unsuitable for re-use from site and dispose of in a legally acceptable manner.
- K. Stockpile excavated material to be re-used in areas designated on site.
- L. Remove excess excavated material from site and dispose of in a legally acceptable manner.

3.03 BACKFILLING

- A. Backfilling shall conform to the requirements of Section 02116 - Fill and Backfill.
- B. Backfill under structures with granular borrow, and compact to 95 percent of maximum density.
- C. Backfill around structures with granular borrow, up to subgrade or finish grade elevations, as indicated, and compact to 95 percent of maximum density.
- D. Employ placement method that will not disturb or damage structure.
- E. Backfill shall be brought up uniformly around structures, so as to eliminate any possibility of unbalanced loading on structure which could damage or movement.
- F. No backfill shall be placed against concrete work until concrete has been inspected and approved by the City Inspector; and backfill operation has been authorized.
- G. Granular Fill: Place and compact materials in equal continuous layers not exceeding lifts approved by a Geotechnical Engineer.
- H. Structural Backfill: Place and compact materials uniformly around structures in equal continuous layers not exceeding lifts approved by a Geotechnical Engineer.
- I. Correct areas that are over-excavated with structural backfill material, compacted to minimum 95 percent of maximum dry density; at the Contractor's expense.

3.04 FIELD QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.
- C. Testing is to be done as indicated in Supplemental General Conditions; test results will be sent to the City Engineer within 24 hours after the tests are completed.
- D. Perform compaction density testing on compacted backfill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017, as listed in Section 02112.
- E. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("Standard Proctor"), ASTM D 1557 ("Modified Proctor"), or AASHTO T 180, as indicated in Section 02112.
- F. If tests indicate work does not meet specified requirements, remove work, replace and re-test.
- G. Frequency of Tests: as required by the City Standards and Specifications as necessary to verify the consistency of the material.

3.05 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

3.06 CLEAN-UP

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. All disturbed areas shall be restored with native grasses to match adjacent areas, conforming to the City Standards. These areas shall be seeded with material conforming to adjacent materials, conforming to the City Standards. Restored area shall achieve 70% plan coverage prior to acceptance.

END OF SECTION

SECTION 02116
FILL AND BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for project pipe lines.
- B. Filling, backfilling, and compacting for miscellaneous structures.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating for project pipe lines.
- B. Section 02115 - Structural Excavation: Excavating for structures.

1.03 REFERENCES

- A. AASHTO T 99 - Moisture-Density Relations of Soils Using a 5.5-lb (2.5 kg) Rammer and an 12-inch Drop.
- B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in.(457 mm) Drop; American Association of State Highway and Transportation Officials.
- C. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- D. ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- E. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- F. ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)).
- G. ASTM D 1883 - Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
- H. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- I. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- J. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- K. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- L. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- M. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

N. Use the latest issue of the above reference standards as of the date of the Project.

1.04 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.
- C. Pipe Invert Elevations: Indicated on drawings.

1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Submit source documentation and mix design as per Article 2.02 Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports per Article 1.05.

1.06 QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform quality control testing as per Table 1.

Table 1: Sampling and Testing Frequencies			
	Roadway	Flatwork/Driveways	Backfill
Gradation and Plastic Index; ASTM C136, AASHTO T 90	Every 500 Tons	1 per day or Every 500 Tons	
Density, ASTM D 5195	Every 2500 SF	Every 150 LF or 2500 SF	Every 150 LF
a. Report all sieves required for AASHTO Soil Classification and maximum particle size. b. Density target of 95% of Modified Proctor, ASTM D 1557. c. Use whichever frequency is greater.			

- C. Submit test and inspection reports to the City in accordance with Section 01400.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

1.07 ACCEPTANCE

- A. The City will perform acceptance decisions for all projects. The City may accept the lot based on results of the quality control test results defined in Article 1.06.
 - 1) A lot is equal to one day's production.
 - 2) The City will reject the lot if the Contractor QC data is outside the limits of Table 1.
 - 3) At the City's discretion, the City may perform acceptance testing in accordance with Table 1.
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Granular Borrow: Imported borrow or soil excavated on-site; conforming to **Type A-1-a** of AASHTO Classification of Soils and Soil-Aggregate Mixtures.
 - 1. Non-plastic ($PI \leq 6$), well graded as per Unified Soils Classification System (USCS) standards, 3-inch maximum
 - 2. Free of debris and organic material
 - 3. If geotechnical engineer is present during all phases and concurs, Common Borrow may be substituted for Granular Borrow in non-roadway applications.
 - 4. Do not use material that does not have determinable proctor value.
 - 5. At least 50% of granular borrow material should have fractured faces per ASTM D5821.
 - 6. Use Granular Borrow with a minimum laboratory CBR value of 30%, ASTM D 1883.
- B. Common Borrow: Imported borrow or soil excavated on-site; conforming to **Type A-1-b** of AASHTO Classification of Soils and Soil-Aggregate Mixtures.
 - 1. Well Graded as per Unified Soils Classification System (USCS) standards.
 - 2. Free of rocks larger than 3 inches, organic matter and debris.
 - 3. Do not use material that does not have determinable proctor value.
- C. Concrete for Fill: Lean concrete.
 - 1. Conforming to Flowable Fill, as per APWA Standard and Specifications section 310515 (Cement Treated Flowable Fill).
- D. 3/4" Free Draining Gravel: Angular crushed, washed stone; washed, free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM C 136, within the following limits:
 - a. 1 inch sieve: 100 percent passing.
 - b. 3/4 inch sieve: 95 to 100 percent passing.
 - c. 3/8 inch sieve: 30 to 65 percent passing.
 - d. No. 4 sieve: 5 to 25 percent passing.
 - e. No. 8 sieve: 0 to 10 percent passing.
 - f. No. 16: 0 to 5 percent passing.
 - g. No. 200 Sieve: 0 to 2 percent passing.
- E. 1" Free Draining Gravel: Free draining granular backfill material; natural or crushed aggregate.
 - 1. Graded in accordance with ASTM C-136, within the following limits:
 - a. 1½ inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 to 100 percent passing.
 - c. 1/2 inch sieve: 25 to 60 percent passing.
 - d. No. 4 sieve: 0 to 10 percent passing.
 - e. No. 200 Sieve: 0 to 2 percent passing.
- F. Sand: Non-plastic ($PI = 0$); free of silt, clay, loam, friable or soluble materials, and organic matter.
 - 1. Graded in accordance with ASTM C 136; within the following limits:

- a. No. 4 sieve: 100 percent passing.
- b. No. 16 sieve: 0 to 100 percent passing.
- c. No. 40 sieve: 0 to 100 percent passing.
- d. No. 100 sieve: 4 to 70 percent passing.
- e. No. 200 sieve: 0 to 20 percent passing.

G. Topsoil: Topsoil shall meet APWA standards & specifications (section 310513).

H. On-Site Native Soil: Material excavated during trenching or other excavating operations; free of organic matter and debris.

1. On-site native soil may only be used as fill and backfill material if recommended by the developer's geotechnical engineer of record, and if acceptable to the City Engineer or City Inspector.
 - a. Percentage of material passing the #200 sieve may be a maximum of 25 percent; based on the written recommendation of the geotechnical engineer.
 - b. Testing frequency shall be as described in the City Standards, unless the testing frequency is increased as recommended by the geotechnical engineer of record.
 - c. If backfill material is used with more than 15 percent passing the #200 sieve, the geotechnical engineer of record shall be on site during all backfill and compacting operations to ensure 95% compaction of trench backfill.
 - d. Soils shall be non-corrosive.
2. The geotechnical engineer of record shall define the moisture control, placement and compaction requirements needed for the native material to obtain 95% compaction of the trench backfill.
3. The Developers shall employ and pay for quality control services of the geotechnical engineer of record.
4. The geotechnical engineer shall prepare a letter or report summarizing:
 - a. Testing methods, test frequencies and observations.
 - b. Any non-conforming conditions and corrective actions taken to remedy the non-conformities.
 - c. Compliance of the work to the City Standard Specifications.
5. The geotechnical engineer's letter or report shall be submitted to the City Engineer or City Inspector as described in the City Standards.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Materials Sources: Submit name of imported materials source and Aggregate Composition Test Reports demonstrating compliance with Article 2.01.
 1. Submit to the City at least 10 working days before placement.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Verify structural ability of unsupported walls to support imposed loads by the fill.

- C. Proof roll until surface is verified as non-yielding by the City Inspector.

3.02 PREPARATION

- A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Granular Borrow.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to finish contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations where indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding Geotechnical Recommendations.
- H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend project slopes into existing areas.
- I. Correct areas that are over-excavated.
 - 1. In the ROW load-bearing foundation surfaces: Use granular borrow, flush to required elevation, compacted to 95 percent of maximum dry density.
 - 2. Other areas: Use common borrow, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
 - 2. Under structures: 95 percent of maximum dry density.
 - 3. At other locations: 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FILL AT SPECIFIC LOCATIONS

- A. Fill in unimproved areas: (Outside right-of-way)
 - 1. Use Common Borrow, unless otherwise specified or indicated.
 - 2. Fill to finish grade elevations

3. Maximum depth per lift: 12 inches, compacted.
 4. Consolidate to minimum 95 percent of maximum dry density.
- B. Granular Borrow around structures and embankments:
1. Use Granular Borrow as per the Geotechnical Engineer.
 2. Fill up to subgrade elevations.
 3. Maximum depth per lift: 12 inches, compacted.
 4. Compact to minimum 95 percent of maximum dry density.
 5. Foundation walls and footings, as per geotechnical Engineering Recommendations. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- C. Bedding and Backfill for Pipe Lines in Trenches:
1. Pipe Bedding: Within pipe zone - use the following:
 - a. Around and to one foot over PVC pressure pipe, use bedding sand.
 - b. Around and to one foot over ductile iron pressure pipe, use bedding sand.
 - c. Around and to one foot over PVC sewer pipe, use $\frac{3}{4}$ " free draining gravel.
 - d. Around and to the top of concrete drain pipe, use $\frac{3}{4}$ " to 1" free draining gravel.
- D. Trench Backfill: Above pipe zone - use granular borrow.
1. Fill up to subgrade elevation or natural ground level.
 2. Compact trench backfill in maximum 12 inch lifts to 95 percent of maximum dry density.
- E. At Landscaped Areas:
1. Use common borrow.
 2. Fill up to 6 inches below finish grade elevations.
 3. Compact to 90 percent of maximum dry density.

3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch from required elevations.
- C. "Red Head" staking and "string test" required for finish grade verification.

3.06 PROJECT CONDITIONS

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need
- B. When fill materials need to be stored on site, locate stockpiles where designated.
 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 2. Prevent contamination.
 3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey bench marks and intended elevations for the Work are as indicated.

3.07 CLEAN-UP

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition, grade to prevent standing surface water.
- C. All disturbed areas shall be restored with native grasses to match adjacent areas, conforming to the City Standards. These areas shall be seeded with material conforming to adjacent materials, conforming to the City Standards. Restored area shall achieve 70% plant coverage, free of erosion & invasive species, prior to acceptance.

END OF SECTION

SECTION 02235

SANITARY SEWER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewer piping, fittings and accessories.
- B. Casing pipes and accessories.
- C. Connection of project pipe to existing manholes.
- D. Sewer Service Connections.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating of trenches.
- B. Section 02116 - Fill and Backfill: Pipe bedding and trench backfilling.
- C. Section 02340 - Manholes and Covers.
- D. Section 03300 - Cast-In-Place Concrete: Concrete for manhole base construction.

1.03 REFERENCES

- A. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- B. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- C. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- D. ASTM F 679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Gravity Sewer Pipe and Fittings; 18-inch through 24-inch smooth solid wall sewer pipe.
- E. Use the latest issue of the above reference standards as of the date of the Project.

1.04 DEFINITIONS

- A. Pipe Bedding: Fill placed within the pipe zone, which is under, beside and directly over pipe, prior to subsequent backfill operations; see standard trench detail drawing.

1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and fittings.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:

1. Record location of pipe lines, connections, manholes, sewer laterals, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.

1.07 PROJECT CONDITIONS

- A. Coordinate the Work on sewer lines and connections to existing manholes with the City Engineer or City Inspector.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Plastic Pipe: ASTM D 3034, SDR 35, Type PSM, Poly (Vinyl Chloride) (PVC) material; inside nominal diameter of 4 inches through 15 inches, bell and spigot joint ends with gaskets.
- B. Plastic Pipe: ASTM F 679, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of 18 inches through 24 inches, bell and spigot joint ends with gaskets.
- C. Joint Seals for Plastic Pipe: ASTM C 477 rubber compression gaskets for positive seal.
- D. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required configurations.
 1. Clean outs shall be cast iron in non-residential applications and as specified by International Pumping Code.

2.02 CASING PIPE MATERIALS

- A. Welded Steel Pipe: AWWA C 200, steel water pipe; diameter as indicated.
- B. Casing Insulators: fusion coated steel casing insulators with 12-inch wide band and 2-inch wide glass reinforced plastic runners; Model C12G-2, manufactured by Pipeline Seal and Insulator, Inc.
- C. Casing End Seals: flexible S-shaped seals fabricated on synthetic rubber with stainless steel bands and clamps; Model S Pull-On End Seals, manufactured by Pipeline Seal and Insulator, Inc.

2.03 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Section 02116.
- B. Trench Backfill Material: As specified in Section 02116.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 02112 for trenching; Sections 02115 and 02116 for structural excavation and fill and backfill.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.

- C. Backfill pipe zone with bedding material, tamp in place and compact; then complete backfilling of trench and compact.

3.02 INSTALLATION - SEWER PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on project plan and profile drawings.
- B. Install pipe, fittings, and accessories in accordance with appropriate ASTM standards and manufacturer's instructions. Seal joints watertight.
- C. Install pipe to alignment and slope gradients noted on project drawings; with maximum variation from design alignment of 0.25 foot and from design elevations of 0.10 foot. As-built pipe slope shall meet design slope within 10% error of design grade.

3.03 INSTALLATION - CASING PIPES

- A. See Sections 02115 and 02116 for structural excavation and fill and backfill; and for additional requirements.
- B. Install casing pipes by ramming process where indicated.
- C. Install casing pipes at the line and grade as required to allow carrier pipes to be installed within the casing pipes at the design line and grade, as indicated on the drawings.
- D. Place casing insulators on carrier pipes to properly center and position carrier pipe inside the casing pipes; space insulators as recommended by the pipe manufacturer.
- E. Carrier Pipe inside of casing shall have restrained joints.
- F. Seal each end of casing with appropriate size flexible end seals; install according to manufacturer's instructions and recommendations.
- G. Seal bore holes at each end, around periphery of casing, with grout, impervious clay or brick masonry.
- H. Contractor shall be solely responsible for the accuracy, safety and adequacy of construction methods and procedures for installing casing pipes, and for any damage which may result from their failure. All operations of the Contractor for installation of casing pipes shall be subject to approval by the agency having jurisdiction over the item being crossed.
- I. Contractor shall enter any agreement with, and furnish any and all indemnity and other bonds that may be required by, the agency listed above, for their protection against injury and interference with flow of water caused by the operations of the Contractor.
- J. Contractor shall secure required permission from the agency listed above before commencing with the installation of casing pipes and related work along and across the respective areas.

3.04 CONNECT PROJECT PIPE INTO EXISTING SEWER MANHOLE

- A. See Sections 02115 and 02116 for structural excavation and fill and backfill.
- B. Connection of project pipe into existing sewer manhole shall include:
 - 1. All excavating required for the connection; and backfilling excavations after the connection is completed, and compacting backfill as required.
 - 2. Removing existing pipes where and if required.

- a. Cleaning existing hole through wall and base of existing manhole; and preparing hole for connection.
- 3. Core-cutting hole through wall and base of existing manhole, where required, with appropriate size coring machine; and preparing hole for connection.
- 4. Installing new pipe in place and connecting to manhole wall with appropriate type flexible coupling, as recommended by the coupling manufacturer.
- 5. Reforming manhole floor and invert channel to provide smooth channel transitions to accommodate new connected pipes.
- 6. Sealing around new pipe with non shrink grout where it intersects manhole wall; make connection watertight.
- 7. Perform all other operations necessary to restore existing manhole to an acceptable condition to the City Inspector.
- C. If existing manhole does not have steps, connection shall also include furnishing and installing new manhole steps. Steps shall be installed as described in Section 02340, Manholes.
- D. Provide temporary facilities to divert existing sewer flow around work areas as described in Supplemental General Conditions of these specifications.

3.05 SEWER SERVICE CONNECTIONS

- A. Sewer service lines shall extend from a 4-inch or 6-inch wye branch placed in the sewer main, as indicated on the drawings.
 - 1. Normally, a 22 1/2 degree or 45 degree bend, rotated so that proper alignment and grade is established, shall be installed in the main line wye branch.
 - 2. In some instances, the bend may be omitted; and in some instances, two bends may be required.
- B. Sewer service lines shall extend to a location designated by the City Engineer or City Inspector, which will be near the property line of the property to be served, or at the edge of a permanent easement, as indicated on the drawings.
- C. All pipe and fittings shall be heavy wall PVC sewer pipe conforming to the specifications found elsewhere in this Section.
- D. Installation:
 - 1. Pipe and fittings for sewer service lines shall be installed as described herein.
 - 2. 4-inch and 6-inch sewer laterals shall be installed at a minimum slope of 1/4-inch per foot, which is about a 2.0 percent grade.
 - 3. Sewer service lines shall be installed at a uniform grade and alignment; and shall be free of low spots or adverse grades.
- E. Cleaning and Testing.
 - 1. Sewer service lines shall be cleaned, flushed and tested in accordance with applicable requirements of this Section.
 - 2. After flushing and testing have been completed, the end of the service line shall be plugged until the home or business is connected.

3.06 CONSTRUCTING COLLARS AROUND EXISTING MANHOLE COVERS

- A. Construct collars around existing manhole covers after street pavement has been restored.
- B. Collars shall be constructed according to City standards.

3.07 FIELD QUALITY CONTROL

- A. Clean and Flush new sewer pipe as follows.
 - 1. Take every precaution to prevent dirt, grease, and all other foreign matter from entering each length of pipe before making connections in field.
 - 2. After each section of piping is installed, it shall be thoroughly cleaned to remove rocks, dirt, and other foreign matter by washing, sweeping, scraping or other methods that will not harm lining of pipe.
 - 3. For safety and to prevent rocks and other foreign matter from entering pipe, all open ends of pipe shall be plugged when workmen are not on the job or in the immediate area.
 - 4. Flushing and testing shall be completed by the Contractor.
 - 5. All temporary water connections for flushing and drainage shall be furnished, installed, and subsequently removed by the Contractor after completion of the operation.
- B. Perform field inspection and testing in accordance with Section 01400 and 02112.
- C. Pipe installation shall be inspected by the City Engineer or Inspector prior to backfilling of trench; backfilling will be done only after it is authorized by the City Engineer or City Inspector.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to City.
- E. Test for Leakage: Test all pipe, fittings and other items for leakage, in presence of City Engineer or City Inspector, after items have been cleaned. All joints, couplings, fittings shall be watertight.
 - 1. Infiltration Test. Infiltration test required when pipe is below ground water level. Amount of water leaking into pipe shall be measured. Leakage for concrete pipe shall not be more than one gallon per day per inch diameter per mile of pipe; and for PVC sewer pipe shall not be more than one gallon per day per inch diameter per mile of pipe.
 - 2. Exfiltration Test. Exfiltration test required when pipe is above ground water level. The section of pipe being tested, including upstream manhole, shall be filled with water to not less than four feet nor more than eight feet above the lowest point of section being tested. Amount of water added during test period to maintain water level shall be measured. Amount of water added for concrete pipe shall not be more than one gallon per day per inch diameter per mile of pipe; and for PVC sewer pipe shall not be more than one gallon per day per inch diameter per mile of pipe.
 - 3. Air Test: Low pressure air test may be performed. Section of pipe being tested shall be sealed; line under test shall be pressurized to approximately 3.5 psi; and pressure allowed to stabilize for a minimum of two minutes. During this period air shall be added if pressure drops below 3.5 psi. After this stabilization period, timing shall begin. The time of test, in minutes, shall be equal to the pipe diameter in inches. The maximum allowable pressure drop during specified time period shall be 1.0 psi.
- F. Deflection Test, PVC Sewer Pipe: After PVC sewer pipe has been cleaned, perform deflection test on each section of pipe line between manholes. The maximum allowable pipe deflection, the reduction in vertical inside diameter, shall be 5 percent. Maximum allowable deflection shall be applied to the base inside diameters shown in Table 63, Base Inside Diameters For Deflection Measurements of ASTM D

3034 SDR35 PVC Sewer in the Uni-Bell "Handbook of PVC Pipe", to determine minimum permissible diameter, or other appropriate sources. Testing devices shall include deflectometer, calibrated television or photography, or properly sized mandrel or sewer ball.

- G. Televiser Sewer Lines. After pipe lines have been tested for leakage and deflection, the main sewer lines shall be televised, along with appropriate narrative, by company specializing in this type work. A copy of the videotape shall be provided to the City Engineer. Video shall be provided on a CD and shall be in color by a camera capable of pan and tilt capabilities. Maximum speed shall be 20' per minute. Video shall be continuous with steady stream of water running in pipe.

3.08 PROTECTION

- A. Protect pipe and bedding material from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 02335

STORM DRAIN SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm drain pipe, fittings, and accessories.
- B. Connection of project storm drain pipe line to existing storm drains.
- C. Cleanout boxes, gutter inlet boxes, inlet boxes, diversion boxes, and appurtenant items.
- D. Storm water treatment systems.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, bedding, backfilling and compacting.
- B. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- C. Section 02116 - Fill and Backfill: Bedding and backfilling.
- D. Section 02340 - Manholes and Covers.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for miscellaneous construction.

1.03 REFERENCES

- A. ASTM C 14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
- B. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- C. ASTM C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- D. Use the latest issue of the above reference standards as of the date of the Project.

1.04 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and miscellaneous structures.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:
 - 1. Record location of pipe lines, connections, cleanouts, gutter inlet boxes, inlet boxes, and miscellaneous structures and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.

1.07 PROJECT CONDITIONS

- A. Coordinate the Work with other contractor working in the area.

PART 2 PRODUCTS

2.01 DRAIN PIPE MATERIALS

- A. Concrete Pipe: Non-reinforced, ASTM C 14 (ASTM C 14M), Class 3 minimum; inside nominal diameter as indicated, bell and spigot end joints.
- B. Concrete Pipe: Reinforced, ASTM C 76 (ASTM C 76M), Class III minimum with Wall type B; mesh reinforcement; inside nominal diameter as indicated, bell and spigot end joints.
- C. Reinforced Concrete Pipe Joint Device: ASTM C 443 (ASTM C 443M), rubber compression gasket joint.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trash Grates: shall be fabricated galvanized steel grates of design and size.

2.03 STORM DRAIN STRUCTURES

- A. Frames and Covers: Heavy duty cast iron, as indicated; designed for H-20 highway loading.
 1. Gutter Inlet Box:
 - a. Lid Design: bicycle proof design grate; size and type as indicated.
 2. Cleanout box:
 - a. Lid Design: solid, with pick holes; size and type as indicated.
 3. Inlet Box:
 - a. Lid Design: bicycle proof design grate; size and type as indicated.
 4. Manholes: see Section 02340.
- B. Precast Box: type and size as indicated; minimum floor and wall thickness of 6-inches, minimum top slab thickness of 8-inches; design for H-20 highway loading; sleeved to receive storm drain pipe sections. Concrete work shall conform to Section 03300.
- C. Cast-in-Place Box: of type and size indicated; concrete work shall conform to Section 03300; sleeved to receive storm drain pipe sections.
- D. Joint Filler: flexible, bituminous mastic, gasket type sealant.

2.04 BEDDING AND BACKFILL MATERIALS

- A. Bedding: As specified in Sections 02112 and 02116.

- B. Backfill: As specified in Sections 02112 and 02116.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 02112, Trenching for Pipe Work, and Sections 02115 and 02116 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around pipe with bedding material as indicated, tamp in place and compact; then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.
- B. Install concrete pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal Watertight and provide concrete collar on exterior of manhole or junction box. Seal with non-shrink grout on interior of manhole or box.
- C. Install pipe to slope gradients noted on drawings; with maximum variation of 10% of the design slope.
- D. Connect to existing storm drain boxes as indicated.
- E. Install trash grates over the ends of all exposed pipe, 15-inch diameter and larger.

3.03 INSTALLATION - STORM DRAIN STRUCTURES

- A. Trim bottom of excavation clean and smooth to correct elevation; place bedding as indicated.
- B. Install precast boxes plumb, according to the manufacturer's instructions, at the design elevations as indicated; connect project pipes with appropriate type flexible couplings.
- C. Construct cast-in-place concrete boxes, as indicated; connect project pipes with appropriate type flexible couplings.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Install lid and frame level in top slab of box, as indicated, according to manufacturer's instructions.
- F. Fill all joints between box sections, grade rings, and cover frames with joint sealant.

3.04 INSTALLATION - STORM WATER TREATMENT SYSTEMS

- A. Storm water treatment systems shall be constructed where and as required to meet all applicable rules and regulations.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400 and 02112.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Infiltration Test: Infiltration test required when pipe line is below groundwater level. The amount of

water leaking into the pipe shall be measured; allowable infiltration shall be one gallon per day per inch diameter of pipe per mile of pipe.

- D. Exfiltration Test: Exfiltration test required when pipe line is above groundwater level. The section of pipe to be tested, including upstream structure, shall be filled with water to not less than four feet nor more than eight feet above lowest point of pipe section being tested. The amount of water added during the test period to maintain water level shall be measured; allowable exfiltration shall be one gallon per day per inch diameter of pipe per mile of pipe. An air test per manufacturer's recommendation may be permitted in lieu of exfiltration test as accepted by the City Inspector.
- E. Deflection Test: Check alignment by sighting through pipe or by measurements. Pipe lines shall not vary from horizontal alignment shown on the drawings by more than 0.25 foot.
- F. Televiser Sewer Lines. After pipe lines have been tested for leakage and deflection, the main sewer lines shall be televised, along with appropriate narrative, by company specializing in this type work. A copy of the videotape shall be provided to the City Engineer. Video shall be provided on a CD and shall be in color by a camera capable of pan and tilt capabilities. Maximum speed shall be 20' per minute. Video shall be continuous with steady stream of water running in pipe.

3.06 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 02340

MANHOLES AND COVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Monolithic cast-in-place concrete manholes with masonry or precast transition to lid frame, covers, anchorage, and accessories.
- B. Modular precast concrete manhole sections with tongue-and-groove joints, precast transition to lid frame, covers, anchorage, and accessories.

1.02 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete.

1.03 REFERENCES

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
- C. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manholes Structures, Pipes and Laterals.
- D. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of pipe inverts.
- C. Product Data: Provide manhole covers, component construction, manhole steps, features, configuration, and dimensions.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Amcor-White, Inc.
- B. Geneva Pipe Company.
- C. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with gaskets in accordance with ASTM C 923 (ASTM C 923M).

- B. Concrete: As specified in Section 03300.
- C. Concrete Reinforcement: As specified in Section 03300.
- D. Manhole Lining: Epoxy coating in accordance to manufacturer specifications.

2.03 COMPONENTS

- A. Manhole Base: precast concrete manhole base of appropriate size.
 - 1. Provide appropriate size flexible sleeves of synthetic rubber, with stainless steel clamps and bolts, for all pipe openings in base section.
 - 2. Construct poured-in-place manhole base where manhole is to be constructed over existing sewer pipe line. Manhole base shall be constructed as indicated on the drawings.
- B. Manhole Rise Sections: precast riser sections of appropriate size and length, extending from top of base section to bottom of top section.
- C. Manhole Top Section: precast eccentric cone section of appropriate size, with 30-inch diameter top opening.
 - 1. Flat slab top sections can be used only where indicated on the plan drawings; designed for H-20 live loading and one-foot minimum earth cover.
- D. Joints: Base section, riser sections, and top section shall have lipped male/female ends, which shall provide uniform and continuous interior wall surface.
 - 1. Joints shall be sealed with pre-lubricated rubber gaskets, conforming to requirements of ASTM C 443 and C 361; Forsheda No. 114 Seal, manufactured by Forsheda Pipe Seal Company, or equal.
- E. Grade Rings: precast grade rings, as required, to adjust height of manhole lid and frame.
 - 1. Grade rings shall have key locks and use flexible, bituminous mastic, gasket-type sealer to insure watertight installation.
 - 2. Maximum height of grade rings shall be 12 inches.
- F. Lid and Frame: ASTM A 48, Class 30B Cast iron construction, machined flat bearing surface, removable lid with cleated surface and pick holes, solid lockable lids if indicated, vented lid design in improved areas and solid lid design in unimproved areas, H-20 highway load rating; lid molded with identifying name. Provide Model A-1180 manufactured by D & L Supply. Lids shall be marked with "SARATOGA SPRINGS" and with either "WATER", "SEWER", "PRESSURE IRRIGATION", or "STORM DRAIN", as applicable. Manholes with solid lids shall be epoxy lined.
- G. Manhole Steps: Formed, copolymer polypropylene-encased, steel rungs; 3/4 inch diameter minimum. Cast-in-place or vibrate into green concrete. Model PSI-FF manhole steps, manufactured by M. A. Industries, Inc.
- H. Collars: Constructed of reinforced concrete as indicated on the drawings.

2.04 CONFIGURATION

- A. Manholes shall be constructed as indicated on the Standard Manhole Detail drawing.
- B. Shaft Construction: Concentric with eccentric cone top section; lipped male/female joints; sleeved to receive pipe sections.

- C. Shape: Cylindrical, unless indicated otherwise.
- D. Clear Inside Dimensions: 48 inch, 60 inch or 72 inch diameter, as indicated.
- E. Design Depth: As indicated.
- F. Clear Lid Opening: 30 inch diameter, as indicated.
- G. Pipe Entry: Provide openings for all pipes entering manhole, as indicated.
- H. Steps: 12 inches on center vertically, set into manhole wall directly under opening.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

- A. Where native material encountered at foundation depth of manhole is considered unsuitable, remove unsuitable material; and place and compact bedding material, to limits directed by the City Engineer or City Inspector.

3.03 MANHOLES

- A. Install precast concrete manhole base level on a compacted foundation, according to manufacturer's instructions.
- B. Construct cast-in-place manhole base over existing sewer lines. Manhole base shall be constructed as indicated on the drawings.
 - 1. After new manhole has been completed, saw-cut into top of existing sewer pipe, remove section of pipe as required, and dispose of the removed material; construct watertight grout invert channels through new manhole, between new pipe and existing pipe line. Invert channel shall be formed to direct sewage flows through the manhole as indicated.
 - 2. Divert existing sewage flows around work area to allow connection to existing pipe line to be made.
- C. Forces main discharge manholes shall be epoxy lined .
 - 1. Manhole shall be prepared and liner installed as per manufacture recommendation.
 - 2. Additional manholes immediately downstream of the discharge manhole may also need to be epoxy lined as determined by the City Engineer.
- D. Place manhole riser sections plumb and level, from the manhole base to the top section, as indicated and according to manufacturer's instructions; anchor to base; align steps perpendicular to sewer line, and seal joints.
- E. Place top section, cone section or flat slab, on top riser section, with opening positioned over steps. Top of cone section or flat slab shall be from 10-inches to 18-inches below final surface elevation.

- F. Install grade rings, as required, to adjust top of lid and frame to match finish elevation.
- G. When coring a manhole a minimum of 6" shall be left between outer edge of core and top and bottom of manhole section.
- H. Connect pipe to manhole with appropriate type flexible coupling as recommended by manufacturer. Provide pipe joint or flexible coupling on all pipes approximately 18-inches from outside of manhole. Grout around pipe after installation is complete. Make connections watertight.
- I. Grout inside of manhole base sections to form channel between connected pipes, as indicated. Trowel smooth. Top of channel shall be a same elevation as top of outlet pipe.
- J. Set cast iron frames and covers level without tipping, to correct elevations. After placement, grout around the exterior of frame from top of concrete top section to top of frame, as indicated, to ensure watertight condition. No wood material shall be used to place frames in final position; only solid materials shall be used as approved by the City Inspector.
- K. After manhole base has been completed, furnish and install temporary pipe plugs to seal all interior pipe openings; plugs to be Brent DuoSeal Pipe Plug by Burke Rubber Company, Cherne Pipe Plug by Cherne Manufacturing Company. Pipe plugs shall remain in place until final review and acceptance of completed sewer . Plugs shall then be removed; and shall be property of Contractor.
- L. In paved areas, collars shall be constructed around covers as indicated. Collars shall be constructed after new pavement has been placed and accepted by the City Engineer or City Inspector.
- M. Coordinate with other sections of work to provide correct size, shape, and location.
- N. Construct 12' paved access road to all manholes; access roads are to meet all city road standards as per section 00500 (Tables 1, 2, and 3)

3.04 FIELD QUALITY CONTROL

- A. Manholes shall be tested using vacuum test method to demonstrate integrity of installed materials and construction procedures. Method and material for repair shall be approved by the City Engineer or City Inspector.
 - 1. Each manhole shall be tested immediately after assembly and backfilling.
 - 2. Plug all lift holes with a non-shrink grout.
 - 3. Plug all pipes entering manhole; securely brace plugs during test.
 - 4. Test head shall be placed at inside top of cast iron frame; and the seal shall be inflated in accordance with manufacturer's recommendations.
- B. Testing shall conform to ASTM C 1244, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
- C. If manhole fails initial test, make necessary repairs with non-shrink grout or chemical injection. Manhole shall be re-tested until satisfactory test is obtained.

END OF SECTION

SECTION 02350

STORM WATER TREATMENT SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm water treatment systems.
- B. Reinforced concrete structures.

1.02 RELATED SECTIONS

- A. Section 02115 - Structural Excavation: Excavating for structures and appurtenant items.
- B. Section 02116 - Fill and Backfill: Bedding, backfilling and compacting.
- C. Section 02335 - Storm Water System.
- D. Section 03300 - Cast-in-Place Concrete: Concrete for structures and appurtenant items.

1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data on storm water treatment system and appurtenant items including removal curves and washout testing that validate the unit selection
- C. Shop Drawings:
 - 1. Provide dimensional shop drawings; prepared at a scale of not less than 3/16-inches per foot (1:75).
 - 2. Shop drawings shall be annotated to indicate all materials to be used and all applicable standards for materials, required tests of materials, and design assumptions for structural analysis.
 - 3. Submit hard or electronic copies of equipment shop drawings to the City Engineer for review and approval.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record actual locations structures and appurtenant items. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.04 QUALITY CONTROL INSPECTION

- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the City Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places.
 - 1. The sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture.
 - 2. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once.
 - 3. All sections which have been damaged beyond repair during delivery will be rejected and, if

already installed, shall be repaired to the City Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.

- B. All sections shall be inspected for general appearance, dimensions, soundness, and related items. The surface shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.
- C. Imperfections may be repaired, subject to the acceptance of the City Engineer, after demonstration by the manufacturer that strong and permanent repairs result.
 - 1. Repairs shall be carefully inspected before final acceptance.
 - 2. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days when tested in 3 inch diameter by 6 inch long cylinders stored in the standard manner.
 - 3. Epoxy mortar may be utilized for repairs.

PART 2 PRODUCTS

2.01 STORMWATER HYDRODYNAMIC VORTEX TREATMENT STRUCTURE (HVS)

- 1. Construct the reinforced concrete structure for the treatment system as indicated on the drawings.
 - 2. Structure dimensions, wall thicknesses, and slab thicknesses shall be as indicated on the dimensional drawings.
 - 3. Concrete for structure shall conform to Section 03300; and shall meet the following additional requirements:
 - a. All concrete shall be cured in accordance with the City Standards and Specifications. Concrete sections shall not be stripped until the concrete has attained a compressive strength of 4,000 psi or 5 days after fabrication and/or repair, whichever is the longer.
 - b. Joints shall be as shown on the drawings with a butyl mastic sealant conforming to ASTM C 990.
 - 4. Pipe openings shall be sized to accept pipes of the specified size(s) and material(s), and shall be sealed with a hydraulic cement conforming to ASTM C 595M or Link-Seal.
 - 5. Internal aluminum plate components shall be aluminum alloy 5052-H32 in accordance with ASTM B 209.
 - 6. Brick or masonry used to build the manhole frame to grade shall conform to ASTM C 32 or ASTM C 139 and shall be installed in conformance with Section 02340 and all City requirements.
 - 7. Manhole frames and covers shall be in accordance with Section 02340; with the words "Storm Water Treatment System" cast in covers.
 - 8. A bitumen sealant in conformance with ASTM C 990 shall be utilized in affixing the aluminum swirl chamber to the concrete vault.
 - 9. The cast iron manhole frames and covers shall be sized as per the manufacturer's drawings and shall be in accordance with ASTM A48, CL.35B and AASHTO M105. The masonry fixing bolts shall be Type 304 stainless steel.
- B. Treatment System Components and Design.

1. Storm water treatment system shall include a tangential inlet to induce a swirling flow pattern that will accumulate and store settable solids in a manner and a location that will prevent re-suspension of previously captured particulates. Swirl chamber diameter shall be sized for the anticipated storm water flows.
2. Storm water treatment system shall be of a hydraulic design that includes flow controls designed and certified by a professional engineer, using accepted principles of fluid mechanics, that raise the water surface inside the tank to a pre-determined level in order to prevent the re-entrainment of trapped floating contaminants.
3. Storm water treatment system shall have a design treatment capacity sized for the anticipated storm water flows; and shall not re-suspend trapped sediments or re-entrain floating contaminants at flow rates up to and including the design treatment capacity.
5. Storm water treatment system shall have usable sediment storage capacity of volume designed by the manufacturer for the anticipated storm water flows.
6. The system shall be designed such that the pump-out volume is less than one-half of the total system volume.
7. The system shall be designed to not allow surcharge of the upstream piping network during dry weather Conditions and shall have a sediment sum that is protected from high flows during peak flow events.
8. A water-lock feature shall be incorporated into the design of the storm water treatment system to prevent the introduction of trapped oil and floatable contaminants to the downstream piping during routine maintenance and to ensure that no oil escapes the system during the ensuing rain events.
9. Direct access shall be provided to the sediment and floatable contaminant storage chambers to facilitate maintenance. There shall be no appurtenances or restrictions within these chambers.
10. The manufacturer shall certify that storm water treatment system conforms to the performance requirements described herein for the anticipated storm water flows.

C. Manufacturer.

1. Storm water treatment systems shall be of a type that has been installed and used successfully for a minimum of 3 years. The manufacturer of said systems shall have been regularly engaged in the engineering design and production of systems for physical treatment of storm water runoff during the aforementioned period.

2.02 SEPARATION TYPE STORM WATER TREATMENT SYSTEMS

A. Reinforced Concrete Structures.

1. Construct the reinforced concrete manholes for the treatment system as indicated on the drawings.
2. Manholes shall be sized by the manufacturer to conform with the performance requirements described herein.
3. Manholes shall be constructed as described in Section 02340.
4. Pipe openings shall be sized to accept pipes of the specified size(s) and material(s), and shall be sealed with a hydraulic cement conforming to ASTM C 595M or Link-Seal.
5. Manhole frames and covers shall be in accordance with Section 02340; with the words " Storm Water Treatment System" cast in covers.

B. Treatment System Components and Design.

1. The storm water treatment system shall include a primary manhole, separator unit, storage manhole, pipes, fittings, and appurtenant items.
2. The primary manhole will accumulate and store coarse settleable solids; and the storage manhole will accumulate and store fine settleable solids, oils and floatable contaminants. Manholes shall be designed to prevent re-suspension of previously captured particulates; and shall be sized for the anticipated storm water flows.
3. The separation unit and piping shall be designed and certified by a professional engineer, to totally treat the anticipated storm water flows. No overflow of the system will be allowed.

C. Manufacturer.

1. Storm water treatment systems shall be of a type that has been installed and used successfully for a minimum of 3 years. The manufacturer of said systems shall have been regularly engaged in the engineering design and production of systems for physical treatment of storm water runoff during the aforementioned period.

2.03 STORM WATER TREATMENT SYSTEM PERFORMANCE

A. Performance. Storm water treatment systems shall adhere to the following performance specifications at the anticipated design treatment capacities.

1. Treatment standard: 80% TSS based on a particle size with a max 110 μm average (D_{50}) particle size at the water quality flow rate
2. Detained Water Quality Flow Rate: 100-yr peak flow through the orifice during a 24 hr storm
3. Undetained Water Quality Flow Rate: 5 year peak flow through the system during a 24 hr storm
4. Peak Flow (pass through) rate: 100-yr peak flow through the system during a 24 hr. Storm

B. The design engineer shall determine the following performance requirements:

1. Total treatment capacity.
2. Sediment storage capacity.

C. The design engineer shall submit calculations used to determine anticipated storm water flows.

D. The manufacturer shall design and size the treatment system to treat the total storm water flow through the treatment system to the following requirements:

1. Treatment system shall be capable of removing 80% of the net annual Total Suspended Solids (TSS) load based on a 110-micron particle size.
 - a. Annual TSS removal efficiency models shall be based on documented removal efficiency performance from full scale laboratory tests.
 - b. Annual TSS removal efficiency models shall only be considered valid if they are corroborated by independent third party field testing. Said field testing shall include influent and effluent composite samples from a minimum of ten storms at one location.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that the storm drain pipe line sizes, locations, and invert elevations are as indicated on the drawings.

3.02 PREPARATION

- A. Prepare ends of storm drain pipe for connections to treatment system structures.

3.03 EXCAVATION

- A. See Sections 02115 and 02116 for additional requirements.
- B. Excavate to the limits as described in Section 02116.
- C. After the concrete structures have been completed, backfill around and over the structure, tamp in place and compact. See Section 02116 for requirements.

3.04 CONSTRUCTION - CONCRETE STRUCTURE

- A. Furnish all labor, materials, equipment and appurtenant items required to construct the reinforced concrete structure for the storm water treatment system, in accordance with the drawings and the specifications.
- B. Furnish, place and compact granular base of the thickness indicated; conforming to Section 02116.
- C. Construct the reinforced cast-in-place concrete structure as indicated on the drawings.
 - 1. Precast concrete vaults may be used with the following requirements.
 - a. Concrete shall conform to the requirements of Section 03300.
 - b. Precast concrete vaults shall be designed for HS20-44 loading as determined by a Licensed Professional Engineer.
 - c. Precast sections shall have tongue and groove joints with a butyl mastic sealant conforming to ASTM C990
 - d. Vaults shall conform to the dimensions indicated for the cast-in-place vault, and to the appropriate required described herein.
 - e. Precast sections shall be set in a manner that will result in a watertight joint. In all instances, installation of Stormwater Treatment Systems shall conform to ASTM specification C 891 "Standard Practice for Installation of Underground Precast Utility Structures".
 - f. Holes made in the concrete sections for handling or other purposes shall be plugged with a non-shrink grout or by using grout in combination with concrete plugs.
 - g. Where holes must be cut in the precast sections to accommodate pipes, do all cutting before setting the sections in place to prevent any subsequent jarring which may loosen the mortar joints.
The Contractor shall make all pipe connections; connections shall be watertight.
- D. The treatment system shall be installed inside of the vault before the top slab for the vault is constructed or installed.
- E. Outlet weirs shall be constructed where and as required and using manufacturer's recommendations.
- F. After constructing the roof section of the vault, set precast concrete manhole riser sections, to the height required to bring the cast iron manhole covers to grade, so that the sections are vertical and in true alignment with a 1/4-inch maximum tolerance allowed.
- G. Backfill around vault in a careful manner, bringing the fill up in 6-inch lifts on all sides.
- H. If leaks appear, clean the inside joints and caulk with lead wool.
- J. Construct 12' paved access road to storm water treatment manhole; access roads are to meet all city road standards as per section 00500 (Tables 1, 2, and 3).

3.05 CONSTRUCTION - CONCRETE MANHOLES

- A. Furnish all labor, materials, equipment and appurtenant items required to construct reinforced concrete manholes for the separation type storm water treatment system, in accordance with the drawings and the specifications.
- B. Furnish, place and compact granular base of the thickness indicated; conforming to Section 02316.
- C. Construct the reinforced concrete manholes as indicated on the drawings; conforming to Section 02640..

3.06 INSTALLATION - TREATMENT SYSTEMS

A HVS Treatment System.

- 1. Furnish all labor, materials, equipment and appurtenant items required and install storm water treatment systems and appurtenances in accordance with the Drawings and these specifications, and according to manufacturer's written instructions and recommendation.
- 2. After constructing the base and wall sections, prepare to install the swirl chamber.
 - a. Place the 3/4-inch thick by 3/4-inch wide butyl mastic seal vertically on the outside of the swirl chamber starting one inch above the bottom of the swirl chamber and continuing to a height equal to the elevation of the bottom of the upper aperture of the swirl chamber.
 - b. The butyl mastic seal should about the downstream side of the pre-drilled mounting holes that attach the swirl chamber to the long walls of the concrete vault.
 - c. Next, install the extruded EPDM seal on the bottom edge of the 180 degree downstream section of the swirl chamber by first applying a bead of Sikaflex-1a polyurethane elastomeric sealant into the extruded slot, then slide the seal onto the swirl chamber. The extruded seal should extend 3-inches upstream of the mounting holes, toward the inlet end of the vault.
 - d. Set the swirl chamber into position and keep the seal approximately 1/2-inch above the floor of the concrete vault. Apply a continuous bead of Sikaflex-1 a sealant under the cupped bottom of the seal.
 - e. Set and anchor the circular swirl chamber by bolting the swirl chamber to the side walls of the concrete vault at the three (3) tangent points and at the inlet tab using HIL TI brand stainless steel drop-in wedge anchors, or equivalent, 3/8-inch diameter by 2-3/4 inch minimum length at heights of approximately three (3) inches off the floor and at fifteen (15) inch intervals to approximately the same height of the butyl mastic sealant (at locations of pre-drilled holes in aluminum components). Apply a continuous bead of Sikaflex-1 a sealant to the intersection of the inside bottom edge of the extruded seal and the vault floor.
- 3. Prior to constructing the roof section, bitumen sealant equal to ASTM C 990 shall be placed along the top of the baffle wall, using more than one layer of mastic if necessary, to a thickness at least 1-inch greater than the nominal gap between the top of the baffle and the roof section.
 - a. The nominal gap shall be determined either by field measurement or the shop drawings.
 - b. After construction of the roof section has compressed the butyl mastic sealant in the gap, finish sealing the gap with a non-shrink grout on both sides of the gap using the butyl mastic as a backing material to which to apply the grout.
 - c. Also apply non-shrink grout or Sikaflex-1a to the joints at the side edges of the baffle walls.

B. Separation Type Treatment System.

- 1. Furnish all labor, materials, equipment and appurtenant items required and install storm water treatment systems and appurtenances in accordance with the Drawings and these specifications, and according to manufacturer's written instructions and recommendation.
- 2. Manholes shall be constructed as described herein, and according to the requirements of the treatment system manufacturer.
- 3. The separator unit, pipe and fittings, and appurtenant items, shall be installed according to the

shop drawings and as recommended by the manufacturer.

3.07 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. If tests indicate that the Work does not meet specified requirements, remove the Work and replace or repair the work as required; and retest at no cost to the City Engineer.

3.08 PROTECTION

- A. Protect the treatment systems from damage or displacement until backfilling operations have been completed.

END OF SECTION

SECTION 02355

STORM WATER DETENTION PONDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm water detention ponds.
- B. Pond pipe lines, structures, and appurtenant items.

1.02 RELATED SECTIONS

- A. Section 02100 - General Excavation: General excavating, embankments and compacting.
- B. Section 02112 - Trenching for Pipe Work: Excavating, bedding, backfilling and compacting.
- C. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- D. Section 02116 - Fill and Backfill: Bedding, backfilling and embankment material.
- E. Section 02335 - Storm Drain System.
- F. Section 02724 - Automatic Sprinkling System.
- G. Section 02726 - Landscaping.
- H. Section 03300 - Cast-in-Place Concrete: Concrete for structures.

1.03 REFERENCES

- A. See Section 02335 for storm water system materials.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, accessories and soil and embankment material.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, connections, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- E. Storm water detention ponds, structures and all appurtenant items shall be sized and designed by the developer's engineer. Ponds shall be designed and constructed according to the City's standards. The plan drawings shall be submitted to the City Engineer for review; along with all calculations required to show how the various components were sized and how they are intended to operate. No work shall be done until the plan drawings have been approved by the City Engineer.
- F. Geotechnical report and recommendations.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with City's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store materials as recommended by the manufacturers.

PART 2 PRODUCTS

2.01 EMBANKMENT AND BACKFILL MATERIALS

- A. Embankment and Backfill Materials: As specified in Sections 02112, 02115 and 02116.

2.02 PIPE LINES AND STRUCTURES

- A. Pipe lines and structures shall be constructed as specified in Section 02335.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that location and elevations are as indicated.

3.02 PREPARATION

- A. Clear and grub the pond site, as required; and dispose of cleared material in a legally acceptable manner.
- B. Remove top soil material as described in Section 02100.

3.03 POND CONSTRUCTION

- A. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- B. See Section 02335 for installation of pipe lines.
 - 1. Construct pipe lines through bottom of detention ponds to convey low flows of storm water through the ponds.
- C. Excavate for ponds and structures to the limits indicated on approved drawings; conforming to the requirements of Section 02100.
 - 1. Furnish, place and compact gravel base, as indicated on the drawings, for structures.
 - 2. Furnish, place and compact pipe bedding and backfill material for pipe trenches.
- D. Compact sub-base as described in Section 02115.
- E. Construct embankments as indicated on the drawings and as described in Section 02100.
 - 1. Embankments shall have maximum slopes of 3 horizontal to 1 vertical.
 - 2. Construct 12-foot wide (minimum) access road around perimeter of pond and embankments as well as to the bottom of pond where needed for access to outlet structure. Access road shall be capable of supporting trucks and other heavy vehicles. Access road is to meet all city road standards; see section 00500 (Tables 1, 2, and 3).
 - 3. Embankment shall provide a minimum of 1' of freeboard.
- F. Construct pond structures as indicated on approved construction drawings.

1. Bubble-up type inlet boxes shall be constructed in the pond to discharge high flows of storm water into the pond; and to allow water to drain from the pond at controlled rates, as required. Boxes shall be as indicated on the construction drawings; and shall be constructed with floor of boxes at least 6-inches below pipe inverts.
 2. Construct an overflow box or spillway in the pond as per the approved construction drawings. Overflow box shall have a trash grate of approved design; and spillway shall convey overflows to the public row or to an acceptable location as approved by the City Engineer.
- G. Construct automatic sprinkling system for pond area, as indicated on approved construction drawings; conforming to Section 02724.
- H. Landscape the pond area, as indicated on approved construction drawings; conforming to Section 02726.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to City.

END OF SECTION

SECTION 02410

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings for project water lines, to include domestic water lines, fire water lines, and culinary water lines.
- B. Valves, Fire hydrants, and appurtenant items.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, bedding, backfilling and compacting.
- B. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- C. Section 02116 - Fill and Backfill: Bedding and backfilling.
- D. Section 02415 - Disinfection of Water Distribution Systems: Disinfection of site service utility water piping.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for thrust restraints.

1.03 REFERENCES

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; The American Society of Mechanical Engineers.
- C. ASTM B 88 - Standard Specification for Seamless Copper Water Tube.
- D. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- E. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- F. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association (ANSI/AWWA C104/A21.4).
- G. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).
- H. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).
- I. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; (ANSI/AWWA C151/A21.51).
- J. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association.
- K. AWWA C502 - Dry Barrel Fire Hydrants; American Water Works Association (ANSI/AWWA C502/C502a).

- L. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- M. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; (ANSI/AWWA C508/C508a).
- N. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- O. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C515).
- P. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; (ANSI/AWWA C600).
- Q. ASTM D2774 - Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- R. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution; American Water Works Association; (ANSI/AWWA C900/C900a).
- S. AWWA C200 - Steel Water Pipe casings, 6-inches and larger as needed.
- T. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of all improvement including, pipe lines, valves, connections, thrust restraints, services and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with Owner's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151:
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints:
 - a. Push-On Joints: AWWA C111, push-on type with rubber gasket.
 - b. Mechanical Joints: AWWA C111, mechanical joint type with gasket, bolts, and nuts.
 - c. Flange Joints: AWWA C110, flange type with gasket, bolts, and nuts.

- 3. Jackets: AWWA C105 polyethylene jacket with polyethylene tape.
- B. Copper Tubing: ASTM B 88, Type K, annealed: Not allowed in right-of-ways.
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection or AWS A5.8, BCuP silver braze.
- C. PVC Pipe: AWWA C900 DR-14, as indicated:
 - 1. Fittings: AWWA C111, cast iron.
 - 2. Joints: ASTM D 3139 compression gasket ring.
- D. Polyethylene Pipe: ASTM D2737, C.T.S., 200 psi, SDR 9.
 - 1. Joints: Mueller compression type couplings.
- E. Trace Wire: #14 gauge to be installed on all buried pipe. Provide continuity test to ensure proper installation.
- F. Detector Tape: Blue plastic tape imprinted with "CULINARY WATER" in large letters, to be installed on all buried pipes.

2.02 CASING PIPE MATERIALS

- A. Welded Steel Pipe: AWWA C 200, steel water pipe; diameter as indicated.
- B. Casing Insulators: Fusion coated steel casing insulators with 12-inch wide band and 2-inch wide glass reinforced plastic runners; Model C12G-2, manufactured by Pipeline Seal and Insulator, Inc.
- C. Casing End Seals: Flexible S-shaped seals fabricated on synthetic rubber with stainless steel bands and clamps; Model S Pull-On End Seals, manufactured by Pipeline Seal and Insulator, Inc.

2.03 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 - 1. Jackets: AWWA C105 polyethylene jacket with polyethylene tape.
- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
 - 2. Product: Powell U.S. Bronze Gate Valves.
 - 3. Substitutions: See Section 01600 - Product Requirements.
- C. Gate Valves 3 Inches and Over:
 - 1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - 2. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - 3. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile

iron wedge, mechanical joint or flanged ends, as indicated, and cast iron valve box.

4. Product: Mueller Resilient Wedge Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.
- D. Butterfly Valves from 2 Inches to 24 Inches:
1. AWWA C504, iron body, bronze disc, resilient replacement seat, mechanical joint or flanged ends as indicated, manual worm gear operator, and cast iron valve box where required.
 2. Underground manual operators shall be totally enclosed, factory grease packed and sealed, bronze worm gear operators with self-locking gearing; stops shall be provided to prevent over travel of valve disc.
 3. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.
 4. Product: Mueller "Lineseal III" Butterfly Valve with appropriate type Pacific States Cast Iron Valve Box.
- E. Corporation Stops: Shall be type for connecting to copper or polyethylene pipe; Mueller No. H- 15000.
- F. Blow-Off Hydrants: shall be Non-Freeze Blow-Off Assembly.

2.04 HYDRANTS

- A. Hydrants: AWWA C502, UL 246, dry barrel type.
1. Jackets: AWWA C105 polyethylene jacket with polyethylene tape.
 2. Inside dimension: 7 inches minimum, with minimum 5 inches diameter valve seat opening.
 3. Minimum net water area of barrel not less than 190 percent of valve opening.
 4. 6 inch flanged inlet connection with accessories, gland bolts, and gaskets.
 5. Product: Mueller "Super Centurion 250", Waterous "Pacer WB 67-250" Fire Hydrants or equal.
- B. Hydrant Extensions: Fabricate with rod and coupling to increase barrel length, 1 extension maximum.
- C. Hose and Streamer Connection: Two hose nozzles, 2 1/2-inch size, one pumper nozzle, 4 1/2 inch size.
- D. Finish: Buried portion of hydrant shall be painted with two coats of CA50 coal tar enamel. Exposed portion shall be painted with Primer and two coats of enamel in red color conforming to the International Fire Code.

2.05 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Sections 02112 and 02116.
- B. Backfill: As specified in Sections 02112 and 02116.

2.06 ACCESSORIES

- A. Service Saddles: shall be bronze, double-strap type; Mueller No. H-16134.

- B. Concrete for concrete collars, slabs, and thrust restraints: Concrete type specified in Section 03300.

2.07 RESIDENTIAL WATER CONNECTIONS

- A. Meter boxes, meter setters, meters, and appurtenant items shall be as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that water main and main line tee size, location, and invert are as indicated.
- B. Verify bedding material and installation.
- C. Verify trails lines continuity.
- D. Verify thrust block installation and sizing.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or mechanical joints.

3.03 TRENCHING

- A. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide required square footage of thrust restraint bearing on subsoil as indicated on the drawings.
- D. Backfill around sides and to top of pipe with backfill material, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

- A. Maintain separation of water main from sewer piping in accordance with State code.
- B. Establish elevations of buried piping to ensure not less than four feet of cover over pipe; or as indicated on the drawings.
- C. Install pipe to indicated elevation to within tolerance of one inch.
- D. Install ductile iron piping and fittings to AWWA C600.
- E. Install PVC pressure pipe and fittings to ASTM D2774.
- F. Install pipe lines to line and grade indicated.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Install access fittings to permit disinfection of water system performed under Section 02415.
- I. Install #14 trace wire and detector tap above all pipe; coordinate with Section 02112.

3.05 INSTALLATION - CASING PIPES

- A. See Sections 02315 and 02316 for structural excavation and fill and backfill; and for additional requirements.
- B. Install casing pipes by ramming process where indicated.
- C. Install casing pipes at the line and grade as required to allow carrier pipes to be installed within the casing pipes at the design line and grade, as indicated on the drawings.
- D. Place casing insulators on carrier pipes to properly center and position carrier pipe inside the casing pipes; space insulators as recommended by the pipe manufacturer.
- E. Carrier Pipe inside of casing shall have restrain joints per City Engineer.
- F. Seal each end of casing with appropriate size flexible end seals; install according to manufacturer's instructions and recommendations.
- G. Seal bore holes at each end, around periphery of casing, with grout, impervious clay or brick masonry.
- H. Contractor shall be solely responsible for the accuracy, safety and adequacy of construction methods and procedures for installing casing pipes, and for any damage which may result from their failure. All operations of the Contractor for installation of casing pipes shall be subject to approval by the agency having jurisdiction over the item being crossed.
- I. Contractor shall enter any agreement with, and furnish any and all indemnity and other bonds that may be required by, the agency listed above, for their protection against injury and interference with flow of water caused by the operations of the Contractor.
- J. Contractor shall secure required permission from the agency listed above before commencing with the installation of casing pipes and related work along and across the respective areas.

3.06 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on concrete block.
- B. Center and plumb valve box over valve operating nut. Set box cover flush with finished grade. Valve nut not to exceed 4' in depth without valve nut extension.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- D. Set hydrants to grade, with bury mark at ground level and with nozzles at least 18 inches above ground level.
- E. Locate hydrant control valve as indicated on the approved drawings.
- F. Provide a drainage pit, 24 inches square by 12 inches deep, filled with 1/2-inch washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening

3.07 SERVICE CONNECTIONS

- A. Provide water service as indicated in detail with meter box and meter yoke with double check valve.

3.08 CONNECTIONS TO EXISTING WATER LINES

- A. Connection to existing water lines shall be made where and as indicated on the approved drawings. The sizes of pipe, fittings, valves and appurtenant items required to make connection shall correspond to the sizes of existing pipe and of project pipe.

- B. Excavate to existing pipe line at point of connection; determine actual conditions of existing pipe and all fittings and appurtenant items required to make the connection; and have all materials needed on site prior to any shut down or cutting into existing pipe lines.
- C. Connection which involve cutting into existing pipe lines include: cutting and removing sections of existing pipe and fittings as required; cleaning and preparing ends of existing pipe as required for connection; furnishing and installing all new pipe, fittings and valves required to make the connection of project pipe to the existing pipe as indicated; and all appurtenant work required to complete the connection.
- D. Connection into existing pipe lines under pressure include: furnishing and installing mechanical joint tapping sleeve of the appropriate size on the existing pipe at point of connection; furnishing and installing tapping valve, with valve box, on sleeve; tapping existing pipe with drilling machine and equipment, without interrupting flow in existing pipe line; and all appurtenant work required to complete the connection.
- E. Connection to existing pipe line shall be made at such times and within the time limits and according to the directions as agreed to between the Contractor and the Owner.
- F. Cut and plug existing pipe lines where indicated on the drawings. Excavate as required to locate existing pipe lines to be abandoned in place; cut the existing pipe, as required; and install permanent plug in end of pipe to be abandoned.
- G. Follow AWWA C651 guidelines for cutting existing pipes.

3.09 RECONNECT EXISTING WATER SERVICE LINES

- A. Reconnect existing water service lines where and as indicated on the approved drawings. The sizes of pipe, fittings, saddles, corporation stops, and appurtenant items required to make reconnections shall correspond to the sizes of existing service lines and of project pipe.
- B. Excavate as required to locate the existing service line; determine actual conditions of existing service line and all fitting and appurtenant items needed to make the reconnections; and have all materials needed on site prior to any shut down of existing service line.
- C. After project pipe line has been thoroughly tested, disinfected and put into operation, dis-connect existing water service lines from the existing water line. Excavate as required to expose the existing service line; cut the existing service line and remove back to main as required; and remove the existing corporation stop from the existing pipe and install a permanent plug in the tap in the existing water line which is to be abandoned.
- D. Tap the project pipe line with the appropriate size tapping machine and install a double strap service saddle, with corporation stop, on the project pipe. New copper tubing sized polyethylene (blue) pipe shall be furnished and installed to make the connection from the end of the existing service line to the new corporation stop. The new CTS sized poly pipe tubing shall be connected to the end of the existing service line with the appropriate type coupling and to the new corporation stop. In all reconnections, at least five feet of new tubing shall be installed, as indicated. Insulating couplings or adapters shall be used to connect pipe of dissimilar material.
- E. After the existing water service line has been disconnected from the existing water line, the reconnection work shall be pursued diligently so that the service line is reconnected to the project water line and put back into service in the shortest possible time.

3.10 REMOVING EXISTING FIRE HYDRANTS

- A. Existing fire hydrant installations shall be removed and delivered to the Owner.
- B. Excavate as required to locate the existing hydrant supply line and control valve; determine actual

conditions of existing supply line and all fitting required to complete the removal; and have all material needed at the job site prior to any shut down or cutting into existing pipe.

- C. After project pipe line has been thoroughly tested, disinfected and put into operation, cut the existing hydrant supply line and remove back to tee at main. Install a plug in the tee and secure with bolts as per manufacture recommendation. Remove the existing hydrant, control valve and valve box and deliver the material to the Owner.
- D. After the hydrant installation has been completely removed and the existing pipe plugged, backfill the excavation to match adjacent ground surfaces; and compact material as described herein.

3.11 WATER METER RELOCATION

- A. Contractor shall notify the water customer and the City 48 hours in advance before starting the water service meter relocation. Contractor will be responsible for obtaining all necessary permits from the City. Contractor shall verify size and type of materials required for the water service meter relocation before commencing work. The Contractor shall also be responsible for relocation, reconnection, and replacement of any damaged materials.
 - 1. After existing meter box is moved, the resultant void shall be backfilled, compacted, and the surface restored.
 - 2. The meter box, ring, and lid shall be installed to one inch above final grade.
 - 3. The relocated service shall be located so the meter box is centered in the park strip and the meter shall be rotated from perpendicular to parallel to the street.
 - 4. The water service meter setter shall be installed in the horizontal and up-right position and with the top of the angle stop eighteen (18) to twenty two (22) inches below the finish grade. (See Standard Details wt-6).
 - 5. Length of water service CTS poly pipe extension shall be the minimum length necessary to install the water service meter setter in its new location.
 - 6. Contractor shall replace any water service meter that is damaged or misplaced as a result of the Contractor's operation.
 - 7. Place a compression coupler over the section of CTS poly pipe at the location where the pipe was crimped.
 - 8. Extend the trace wire and splice using a grease nut.
- B. Water services may need to be upgraded to current City Construction Standards.

3.12 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Pressure test water piping to 200 PSI for 2 hours.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- D. Disinfection and bacteria testing per section 02415.

END OF SECTION

SECTION 02412

PRESSURE REDUCING VALVE STATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure regulating valve (PRV) station; including reinforced concrete vault, pipe, fittings, valves, and appurtenant items.

1.02 RELATED SECTIONS

- A. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- B. Section 02116 - Fill and Backfill: Bedding and backfilling.
- C. Section 02410 - Water Distribution System: Pipe, fittings, valves and appurtenant items.
- D. Section 02415 - Disinfection of Water Distribution Systems: Disinfection of station piping.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for concrete vault and thrust restraints.

1.03 REFERENCES

- A. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM C 858 - Standard Specification for Underground Precast Concrete Utility Structures.
- C. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- D. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- E. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C151).
- F. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with Owner's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves and appurtenant items in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE VAULT

- A. Reinforced Concrete Vault. The reinforced concrete vault is shown on the drawings as constructed of poured-in-place concrete; but a precast reinforced concrete vault may be provided at the option of the Contractor.
 - 1. The vault shall be sized to adequately accommodate all valves, pipe, fittings and appurtenant items to be enclosed in the vault.
 - 2. Poured-in-Place Concrete. A poured-in-place reinforced concrete vault, of the size indicated on the construction drawings, may be constructed; which shall conform to applicable requirements of Section 03300.
 - 3. Precast Concrete. A precast reinforced concrete vault of equal dimensional and strength characteristics, as determined by the City Engineer during shop drawing review, may be provided. Precast vault shall have wall thickness of 9-inch minimum, bottom slab thickness of 6-inch minimum, and top slab thickness of 9-inch minimum; designed for H-20 highway loading.
 - a. Precast vault shall conform to ASTM C 858; and shall be as manufactured by Amcor-White, Inc., Dura-Crete.
 - 4. Reinforcement. Reinforcing steel shall be as specified in Section 03300, using Grade 60 bar of the size(s) shown on the construction drawings.
 - 5. Steps. Plastic encased steel steps shall be installed in station walls; spaced at 12-inches on center and centered under the access opening. Steps shall be copolymer poly-propylene-encased, 60,000 tensile strength steel, Model PSI-FF manhole steps, as manufactured by M. A. Industries, Inc.
 - a. An aluminum ladder may be provided and permanently installed.
- B. Access Doors: The access door leaf and channel frame, with strap anchors, shall be constructed of steel with hot-dip galvanized finish (ASTM 123); designed for H-20 highway loading. Doors shall be provided with 316 stainless steel hardware throughout; including all parts of the latch and lifting mechanism assemblies, hold open arms and guides, and all brackets, hinges, pins and fasteners. The doors shall have recessed has covered by a hinged lid flush with the surface of the door.
 - a. The access doors shall be Type J Access Doors as manufactured by The Bilco Company of the size indicated on the drawings. The manufacturer shall guarantee the door against defects in material and workmanship for a period of five years.
- C. Proprietary Items. Provide proprietary items of the type, size and manufacture noted on the drawings or as required to complete the work.
- D. Miscellaneous Metal Work. Furnish and erect miscellaneous metal work as required to complete the pressure regulating station, as described herein and as shown on the drawings.
 - 1. Codes. Specifications for the Design, Fabrication and Erection of Structural Steel For Buildings of the American Institute of Steel Construction shall govern the work. Welding shall be done in accordance with applicable and most recent American Welding Society Standards.

2. Substitutions. Substitutions of sections or modifications of details, or both, and the reasons therefore shall be submitted for acceptance by the City Engineer.
 3. Responsibility for Errors. The Contractor shall be responsible for all errors of detailing, fabrication, erection, and correct fitting of the miscellaneous metal work.
 4. Materials. Material shall conform to their respective specifications as follows:
 - a. Bolts and Nuts: ASTM Standard A-307
 - b. Gray Iron Castings: A-48 Class 40 or Better
 - c. Structural Steel: ASTM Standard A-36
 - d. Washers: ASTM Standard B-27.2, Type B
 - e. Miscellaneous Items: Miscellaneous items shall be as indicated on the drawings or as required.
- E. Painting. All exposed pipe, valves, fittings, and metal work inside of the station shall be painted with either: four coats of alkyd paint, Painting System II (Steel Structural Painting Council - Specification No. 2); or four coats of phenolic paint, Painting System III (Steel Structural Painting Council - Specification No. 3). Painting shall include surface preparation, pretreatment, primer coat, inter-mediate coats, and finish coat, as specified; with total dry film thickness not less than 4.0 mils. Aluminum surfaces which will be in contact with concrete after erection shall be coated with bituminous mastic coating, SSPC-Paint 12, prior to erection.

2.02 VALVE STATION PLUMBING

A. Pipe and Fittings.

1. Ductile Iron Pipe: AWWA C151: See Section 02410. Exposed pipe and fittings shall not be coated with coal tar pitch varnish; but shall be painted as specified herein.
2. Copper Tubing: ASTM B 88, Type K, annealed: See Section 02410.
3. Galvanized Steel Pipe: ASTM A 53: Galvanized steel pipe shall be Schedule 80, seamless or welded pipe, with threaded ends. Fittings shall be 150 lb. galvanized malleable iron banded type, with screwed ends. Unions shall be galvanized railroad type with ground brass-to-iron seats.

B. Valves.

1. Manufacturer's name and pressure rating marked on valve body.
2. Gate Valves Up To 3 Inches:
 - a. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
 - b. Product: Powell U.S. Bronze Gate Valves.
 - c. Substitutions: See Section 01600 - Product Requirements.
3. Gate Valves 3 Inches and Over:
 - a. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends as indicated, and cast iron valve box.
 - b. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - c. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box, or accepted equal.
4. Butterfly Valves From 2 Inches to 24 Inches:
 - a. AWWA C504, iron body, bronze disc, resilient replacement seat, flanged ends as indicated, and manual worm gear operator.
 - b. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-

inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.

- c. Product: Mueller "Lineal III" Butterfly Valve with appropriate type manual worm gear operator.

5. Pressure Reducing Valves:

- a. Valves shall have cast iron or stainless steel bodies, with bronze pilot and trim; designed to reduce a higher inlet pressure to a steady lower pressure downstream, regardless of flow rate.
- b. Valves shall be hydraulically operated; capable of holding delivery pressure to within one or two psi of valve setting; and shall be adjustable, with downstream pressure range of 30 to 110 psi.
- c. Pressure reducing valves shall be Clayton Model 90G-01AB Pressure Reducing Valves, as manufactured by Cla-Val Company.
- d. Other type valves may be required for specific applications within the water system.

6. Strainers:

- a. Strainers shall have cast iron bodies and covers, stainless steel strainer and stainless steel bolts.
- b. End flanges shall be ANSI class 125 standard flanges
- c. Stainless steel strainers shall have an area of two times the nominal inlet pipe opening.
- d. Strainers shall be designed for easy access and in-line servicing of strainer element; and shall have drain plugs for periodic flushing
- e. Strainer screens to be #4 mesh

7. Combination Air-Vacuum Release Valves.

- a. Valves shall be designed to release large quantities of air from pipes during filling, admit large quantities of air into pipes during draining, and release small accumulations of air during normal operation of pipes.
- b. Valves shall be equal in quality to "Heavy-Duty Combination Air Release Valves, No. 143C", as manufactured by Valve and Primer Corp. (APCO); and shall meet the provisions of these specifications.

8. Hose Gate Valves.

- a. Hose gate valves shall be high grade brass with handwheel, inside screw ends, rising stem, screwed bonnet, taper wedge double disc. Valve shall be designed to operate at 200 psi water pressure.
- b. Hose gate valves shall be equal to Powell U.S. Bronze Hose Gate Valve No. 527.

9. Pressure Relief Valves.

C. Miscellaneous Items.

1. Flanged Coupling Adapters. The flanged coupling adapters shall be Rockwell Type 912 or Type 913, with anchor studs as recommended by the manufacturer; for connecting ductile iron pipe to flanged valves, equipment and fittings.
2. Mechanical Couplings. The mechanical couplings shall be Dresser, Rockwell; for connecting the size and type of pipe shown on the drawings. Couplings exposed to soil shall be primed and coated with a 1/4-inch layer of coal tar or rust preventing wax compound.
3. Gauges. Gauges shall be as shown on the drawings and of the size and quality equal to or better than United States Gauge "A" Line, Figure No. 5000. Gauges shall have a range of 0 to 350 psi.
4. Gauge Cocks. Gauge cocks shall be of high grade bronze with tee head; designed for 200 psi water pressure, and factory-tested to 300 psi; Crane Nos. 708, 712, 744.

5. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134, for up to 2 inch service lines.
6. Other Items. Other miscellaneous materials shall be as indicated on the drawings.

D. Hangers, Supports and Blocks.

1. Provide all hangers, supports, clamps, guides, sleeves, inserts, anchors and other such devices required for hanging or supporting pipe, preserving alignment, prevention of movement, passage of pipe through walls and floors, or securing pipe in any manner. The required number, location and detail of such items may or may not be indicated on the drawings; but, in any case, such work shall be provided as work incidental to furnishing and installing any type of pipe, fittings and appurtenances, and no extra payment will be made for this work.
 - a. Piping shall be supported or suspended in such manner as to prevent sagging or over stressing of pipe, valves, fittings or connections; and so that no pipe, fittings, valves or other items transfer load or strain to equipment of any kind.
2. Supports.
 - a. Concrete supports shall be installed under pipe and valves wherever shown on the drawings. Concrete supports shall be neatly constructed and finished. No supports shall be made until all pipe is in its final position.
 - b. All other pipe supports shall be of the adjustable type of the style and size recommended by the manufacturer; and shall be located as indicated on the drawings. Floor flanges shall be of the size required to fit the pipe attached to the saddle support and as recommended by the manufacturer. Adjustable pipe supports shall be used as kick blocks for pipe in open locations.
3. Blocks. Concrete thrust blocks shall be used wherever shown on the drawings or where thrust is great enough to cause movement of the piping.

- E. Miscellaneous. Miscellaneous appurtenant items shall be as indicated on the drawings or as required to complete the station.

2.03 BEDDING AND BACKFILL MATERIALS

- A. Bedding: As specified in Sections 02115 and 02116.
- B. Backfill: As specified in Sections 02115 and 02116.

2.04 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03300.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or mechanical joints.

3.03 EXCAVATING

- A. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide required square foot of thrust restraint bearing on undisturbed subsoil as indicated on the drawings.
- D. Backfill around sides and to top of pipe with backfill material, tamp in place and compact, then complete backfilling.

3.04 CONSTRUCTION - VALVE VAULT

- A. Construct the vault for the pressure regulating station at the location indicated on the drawings; in accordance with the details shown on the construction drawings and as specified herein.
- B. Earthwork shall be done in accordance with applicable requirements of Section 02115.
 - 1. Foundation Material. Where native material encountered at the foundation depth is found to be unable to provide adequate structural support of the vault or is determined to be moisture sensitive, the unsuitable material shall be removed and replaced by the appropriate granular borrow material as per the approved drawings or under the direction of a licensed geotechnical engineer.
 - 2. Excess Material. Unsatisfactory and excess excavated materials shall be removed from the work site and disposed of in a legally acceptable manner.
- C. Concrete Work. Comply with requirements of Section 03300, for placement, consolidation, finishing and protection of cast-in-place concrete.
- D. Precast Concrete Vault. Precast concrete vault shall be installed level and plumb, in accordance with the manufacturer's written instructions and recommendations.
- E. Access Door: Install according to manufacturer's written instructions and recommendations.
- F. Miscellaneous Metal Work.
 - 1. Miscellaneous metal work shall be fabricated and assembled in the shop to the greatest extent possible.
 - 2. Miscellaneous metal work shall be erected in conformity with AISC Code of Standard Practice.

3.05 INSTALLATION - PLUMBING

- A. All pipe, fittings, valves, equipment and appurtenant items, together with supports and anchors, shall be installed as specified herein and as indicated on the drawings; in conformity with State plumbing codes.
- B. Equipment shall be installed as shown on the drawings, and in accordance with accepted manufacturer's written instructions.
- C. Strainers shall be installed upstream of all pressure regulating valves.
- D. All material and workmanship shall conform to applicable requirements of the most recent edition of the Utah Plumbing Code.
- E. Establish elevations of buried piping to ensure not less than four feet of cover over pipe.

- F. Install pipe to indicated elevation to within tolerance of one inch.
- G. Install ductile iron piping and fittings to AWWA C600.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install access fittings to permit disinfection of water system performed under Section 02515.
- J. Set valves on concrete block.
- K. After plumbing system has been installed and completed, it shall be tested and disinfected as specified herein; including an operating test for acceptance of the work. Tests shall be performed in the presence of the City Engineer or his authorized representative.

3.06 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with section 01400.
- B. Pressure test water piping to 200 PSI for 2 hours (see section 02410).
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 02414

WATER METER VAULT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water meter stations, complete, including:
 - 1. Reinforced concrete vault.
 - 2. Pipe, fittings, valves, meter, and appurtenant items.
- B. Station testing.

1.02 RELATED SECTIONS

- A. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- B. Section 02116 - Fill and Backfill: Pipe bedding and excavation backfilling.
- C. Section 02410 - Water Distribution System: Pipe, fittings, valves and appurtenant items.
- D. Section 02415 - Disinfection of Water Distribution Systems: Disinfection of station piping.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for structures and thrust blocks.

1.03 REFERENCES

- A. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM A 234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- C. ASTM C 858 - Standard Specification for Underground Precast Concrete Utility Structures.
- D. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association; (ANSI/AWWA C104/A21.4).
- E. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; (ANSI/AWWA C105/A21.5).
- F. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; (ANSI/AWWA C111/A21.11).
- G. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; (ANSI/AWWA C151/A21.51).
- H. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association.
- I. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- J. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; (ANSI/AWWA C508/C508a).
- K. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).

- L. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C515).
- M. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; (ANSI/AWWA C600).
- N. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, meters, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, meters, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with City's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves, valves and appurtenant items in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE VAULT

- A. Reinforced Concrete Vault. The reinforced concrete vault is shown on the drawings as constructed of poured-in-place concrete; but a precast reinforced concrete vault may be provided at the option of the Contractor.
 - 1. Concrete work shall conform to applicable requirements of Section 03300.
 - 2. Poured-in-Place Concrete. A poured-in-place reinforced concrete vault, of the size indicated on the drawings, may be constructed; which shall conform to applicable requirements of Section 03300.
 - a. Poured-in-place concrete vault shall have wall thickness of 9-inch minimum, bottom slab thickness of 6-inch minimum, and top slab thickness of 9-inch minimum; designed for H-20 highway loading.
 - b. Submit construction drawings of the vault for review by the City Engineer, before any work is begun. The drawings shall be stamped by a professional licensed structural engineer.
 - 3. Precast Concrete. A precast reinforced concrete vault of equal dimensional and strength characteristics may be provided. Precast vault shall have wall thickness of 9-inch minimum, bottom slab thickness of 6-inch minimum, and top slab thickness of 9-inch minimum; designed for H-20 highway loading.
 - a. Precast vault shall conform to ASTM C 858; and shall be as manufactured by Amcor-White, Inc., Dura-Crete.
 - 4. Reinforcement. Reinforcing steel shall be as specified in Section 03300, using Grade 60 bar of the size(s) shown on the drawings.

5. Steps. Plastic encased steel steps shall be installed in station walls; spaced at 12-inches on center and centered under the access opening. Steps shall be copolymer poly-propylene-encased, 60,000 tensile strength steel, Model PSI-FF manhole steps, as manufactured by M. A. Industries, Inc.
- B. Access Doors: The access door leaf and channel frame, with strap anchors, shall be constructed of steel with hot-dip galvanized finish (ASTM 123); designed for H-20 highway loading. Doors shall be provided with 316 stainless steel hardware throughout; including all parts of the latch and lifting mechanism assemblies, hold open arms and guides, and all brackets, hinges, pins and fasteners. The doors shall have recessed hasp covered by a hinged lid flush with the surface of the door.
 - a. The access doors shall be Type J Access Doors as manufactured by The Bilco Company, of the size indicated on the drawings. The manufacturer shall guarantee the door against defects in material and workmanship for a period of five years.
 - C. Proprietary Items. Provide proprietary items of the type, size and manufacture noted on the drawings or as required to complete the work.
 - D. Miscellaneous Metal Work. Furnish and erect miscellaneous metal work as required to complete the pressure regulating station, as described herein and as shown on the drawings.
 1. Codes. Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction shall govern the work. Welding shall be done in accordance with AWS D1.1 of the American Welding Society Standards.
 2. Substitutions. Substitutions of sections or modifications of details, or both, and the reasons therefore shall be submitted for acceptance by the City Engineer.
 3. Responsibility for Errors. The Contractor shall be responsible for all errors of detailing, fabrication, erection, and correct fitting of the miscellaneous metal work.
 4. Materials. Material shall conform to their respective specifications as follows:
 - a. Bolts and Nuts: ASTM Standard A-307
 - b. Gray Iron Castings: A-48 Class 40 or Better
 - c. Structural Steel: ASTM Standard A-36
 - d. Washers: ASTM Standard B-27.2, Type B
 - e. Miscellaneous Items: Miscellaneous items shall be as indicated on the drawings or as required.
 - E. Painting. All exposed pipe, valves, fittings, and metal work inside of the station shall be painted with either: four coats of alkyd paint, Painting System II (Steel Structural Painting Council - Specification No. 2); or four coats of phenolic paint, Painting System III (Steel Structural Painting Council - Specification No. 3). Painting shall include surface preparation, pretreatment, primer coat, inter-mediate coats, and finish coat, as specified; with total dry film thickness not less than 4.0 mils. Aluminum surfaces which will be in contact with concrete after erection shall be coated with bituminous mastic coating, SSPC-Paint 12, prior to erection.

2.02 METER STATION PLUMBING

- A. Pipe and Fittings.
 1. Ductile Iron Pipe: AWWA C151: See Section 02410. Exposed pipe and fittings shall not be coated with coal tar pitch varnish; but shall be painted as specified herein.
 2. Copper Tubing: ASTM B 88, Type K, annealed: See Section 02410.
 3. Galvanized Steel Pipe: ASTM A 53: Galvanized steel pipe shall be Schedule 80, seamless or welded pipe, with threaded ends. Fittings shall be 150 lb. galvanized malleable iron banded type, with screwed ends. Unions shall be galvanized railroad type with ground brass-to-iron seats.

B. Valves.

1. Manufacturer's name and pressure rating marked on valve body.
2. Gate Valves Up To 3 Inches:
 - a. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
 - b. Product: Powell U.S. Bronze Gate Valves.
 - c. Substitutions: See Section 01600 - Product Requirements.
3. Gate Valves 3 Inches and Over:
 - a. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends as indicated, and cast iron valve box.
 - b. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - b. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.
4. Butterfly Valves From 2 Inches to 24 Inches:
 - a. AWWA C504, iron body, bronze disc, resilient replacement seat, flanged ends as indicated, and manual worm gear operator.
 - c. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.
 - d. Product: Mueller "Linesal III" Butterfly Valve with appropriate type manual worm gear operator.
5. Combination Air-Vacuum Release Valves.
 - a. Valves shall be designed to release large quantities of air from pipes during filling, admit large quantities of air into pipes during draining, and release small accumulations of air during normal operation of pipes.
 - b. Valves shall be equal in quality to "Heavy-Duty Combination Air Release Valves, No. 143C", as manufactured by Valve and Primer Corp. (APCO); and shall meet the provisions of these specifications.
6. Strainers:
 - a. Strainers shall have cast iron bodies and covers, stainless steel strainer and stainless steel bolts.
 - b. End flanges shall be ANSI class 125 standard flanges
 - c. Stainless steel strainers shall have an area of two times the nominal inlet pipe opening.
 - d. Strainers shall be designed for easy access and in-line servicing of strainer element; and shall have drain plugs for periodic flushing.

C. Meters. Meters shall be of design, type, size and manufacturer as approved by the City Engineer.

D. Miscellaneous Items.

1. Flanged Coupling Adapters. The flanged coupling adapters shall be Rockwell Type 912 or Type 913, with anchor studs as recommended by the manufacturer; for connecting ductile iron pipe to the flanged valves, equipment and fittings.
2. Mechanical Couplings. The mechanical couplings shall be Dresser or Rockwell, for connecting the size and type of pipe shown on the drawings. Couplings exposed to soil shall be primed and coated with a 1/4-inch layer of coal tar or approved rust preventing wax compound.
3. Gauges. Gauges shall be as shown on the drawings and of the size and quality equal to or better

than United States Gauge "A" Line, Figure No. 5000. Gauges shall have a range of 0 to 350 psi.

4. Gauge Cocks. Gauge cocks shall be of high grade bronze with tee head; designed for 200 psi water pressure, and factory-tested to 300 psi; Crane Nos. 708, 712, 744.
5. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134.
6. Other Items. Other miscellaneous materials shall be as indicated on the drawings.

E. Hangers, Supports and Blocks.

1. Provide all hangers, supports, clamps, guides, sleeves, inserts, anchors and other such devices required for hanging or supporting pipe, preserving alignment, prevention of movement, passage of pipe through walls and floors, or securing pipe in any manner. The required number, location and detail of such items may or may not be indicated on the drawings; but, in any case, such work shall be provided as work incidental to furnishing and installing any type of pipe, fittings and appurtenances, and no extra payment will be made for this work.
 - a. Piping shall be supported or suspended in such manner as to prevent sagging or over stressing of pipe, valves, fittings or connections; and so that no pipe, fittings, valves or other items transfer load or strain to equipment of any kind.
2. Supports.
 - a. Concrete supports shall be installed under pipe and valves wherever shown on the drawings. Concrete supports shall be neatly constructed and finished, as indicated on the drawings. No supports shall be made until all pipe is in its final position.
 - b. All other pipe supports shall be of the adjustable type of the style and size recommended by the manufacturer; and shall be located as indicated on the drawings. Floor flanges shall be of the size required to fit the pipe attached to the saddle support and as recommended by the manufacturer. Adjustable pipe supports shall be used as kick blocks for pipe in open locations.
3. Blocks. Concrete thrust blocks shall be used wherever shown on the drawings or where thrust is great enough to cause movement of the piping.

- F. Miscellaneous. Miscellaneous appurtenant items shall be as indicated on the drawings or as required to complete the station.

2.03 BEDDING AND BACKFILL MATERIALS

- A. Bedding: As specified in Sections 02115 and 02116.
- B. Backfill: As specified in Sections 02115 and 02116.

2.04 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03300.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, materials and equipment as required to construct the water meter station, complete, as described herein, and as shown on the drawings.
- B. All work shall be done according to local plumbing codes, and to manufacturer's written instructions and recommendations.

- C. The Contractor shall test the station to assure proper operation.

3.02 EXAMINATION

- A. Verify that design drawings conform to project conditions.
- B. Verify that water main size, location, and invert are as indicated.

3.03 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or mechanical joints.

3.04 EXCAVATING

- A. Excavating for the meter station shall be done to ensure proper grades and alignment as shown on the drawings.
- B. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- C. Hand trim excavation for accurate construction or placement of concrete vault to elevations indicated.
- D. Backfill around structure with backfill material, tamp in place and compact to required densities.

3.05 CONSTRUCTION - VALVE VAULT

- A. Construct the vault for the meter station at the location indicated on the drawings; in accordance with the details shown on the drawings and as specified herein.
- B. Earthwork shall be done in accordance with applicable requirements of Section 02115.
 - 1. Foundation Material. Where native material encountered at the foundation depth is found to be unable to provide adequate structural support of the vault, or is determined to be moisture sensitive, the unsuitable material shall be removed and replaced by the appropriate granular borrow material as per the approved drawings or under the direction of a licensed geotechnical engineer.
 - 2. Excess Material. Unsatisfactory and excess excavated materials shall be removed from the work site and disposed of in a legally acceptable manner.
- C. Concrete Work. Comply with requirements of Section 03300, for placement, consolidation, finishing and protection of cast-in-place concrete and reinforcement.
- D. Precast Concrete Vault. Precast concrete vault shall be installed level and plumb, in accordance with the manufacturer's written instructions and recommendations.
- E. Access Door: Install according to manufacturer's written instructions and recommendations.
- F. Miscellaneous Metal Work.
 - 1. Miscellaneous metal work shall be fabricated and assembled in the shop to the greatest extent possible.
 - 2. Miscellaneous metal work shall be erected in conformity with AISC Code of Standard Practice.

3.06 INSTALLATION - PLUMBING

- A. All pipe, fittings, meters, valves, equipment and appurtenant items, together with supports and anchors, shall be installed as specified herein and as indicated on the drawings; in conformity with the most recent edition of the Utah Plumbing Code.
- B. Equipment shall be installed as shown on the drawings, and in accordance with accepted manufacturer's written instructions.
- C. Strainers shall be installed upstream of all meters with a No. 4, 100 micron, screen.
- D. All material and workmanship shall conform to applicable requirements of the most recent edition of the Utah Plumbing Code.
- E. Establish elevations of buried piping to ensure not less than four feet of cover over pipe; or as indicated on the drawings.
- F. Install pipe to indicated elevation to within tolerance of one inches.
- G. Install ductile iron piping and fittings to AWWA C600.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install access fittings to permit disinfection of water system performed under Section 02415.
- J. Set valves on concrete block.
- K. After plumbing system has been installed and completed, it shall be tested and disinfected as specified herein; including an operating test for acceptance of the work. Tests shall be performed in the presence of the City Engineer or his authorized representative.

3.07 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Pressure test water piping to 200 PSI for 2 hours (see section 02410).
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

3.08 OPERATIONAL TESTING

- A. Provide City Engineer with seven days written notice of operational test of backflow preventer.
- B. Test shall consist of the operation of the station for propose of checking operation and assuring of absence of leaks.
 - 1. Repair pipe, fittings, valves, or connections which show evidence of leakage.
- C. After all repairs or replacements have been made, repeat the above required test.

END OF SECTION

SECTION 02415

DISINFECTION OF WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of project pipe lines specified in Section 02410.
- B. Disinfection of site domestic water lines, site fire water lines, and hydrant supply lines and water service lines specified in Section 02410.
- C. Testing and reporting results.

1.02 RELATED SECTIONS

- A. Section 02410 - Water Distribution System.

1.03 REFERENCES

- A. AWWA B300 - Hypochlorites; American Water Works Association; (ANSI/AWWA B300).
- B. AWWA B301 - Liquid Chlorine; American Water Works Association; (ANSI/AWWA B301).
- C. AWWA B302 - Ammonium Sulfate; American Water Works Association; (ANSI/AWWA B302).
- D. AWWA B303 - Sodium Chlorite; American Water Works Association; (ANSI/AWWA B303).
- E. AWWA C651 - Disinfecting Water Mains; American Water Works Association; (ANSI/AWWA C651).
- F. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- D. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and date and time of disinfectant injection completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- E. Bacteriological report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of State.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of Utah.
- C. Submit the bacteriologist's signature and the Utah certified authority associated with testing.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code or regulation for performing the work of this Section.
- B. Provide certificate of compliance from Utah certified authority having jurisdiction indicating approval of water system.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite; AWWA B301, Liquid Chlorine; AWWA B302, Ammonium Sulfate; and AWWA B303, Sodium Chlorite.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping system has been cleaned and inspected.

3.02 EXECUTION

- A. Provide and attach required equipment to perform the work of this Section.
- B. Introduce treatment into piping system if not already added during installation.
- C. Maintain disinfectant in system for 24 hours.
- D. Flush, circulate, and clean until required cleanliness in accordance with this section, is achieved; use municipal domestic water.
- E. Replace permanent system devices removed for disinfection.

- F. Perform Bacteria test at location approved by City Inspector. After receiving clean bacteria test results, pressure test system to 200 psi for 2 hours. Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 02416

AIR-VACUUM VALVE STATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-Vacuum Valve Stations; including reinforced concrete vault, pipe, fittings, valves, and appurtenant items, as indicated on the drawings and as described herein.

1.02 RELATED SECTIONS

- A. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- B. Section 02116 - Fill and Backfill: Bedding and backfilling.
- C. Section 02410 - Water Distribution System: Pipe, fittings, valves and appurtenant items.
- D. Section 02415 - Disinfection of Water Distribution Systems: Disinfection of station piping.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for concrete vault and thrust restraints.

1.03 REFERENCES

- A. ASTM B 43 - Standard Specifications for Seamless Red Brass Pipe, Standard Sizes.
- B. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM C 858 - Standard Specification for Underground Precast Concrete Utility Structures.
- D. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- E. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- F. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Associations; (ANSI/AWWA C515).
- G. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with Owner's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves and appurtenant items in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 GRAVEL BASE. Gravel shall conform to the requirements of Section 02116.

2.02 REINFORCED CONCRETE VAULT

- A. Precast Riser Sections. Riser sections shall be reinforced concrete pipe sections, class IV, with tongue and groove joints; meeting the requirements of ASTM C 76. Riser sections shall extend from the top of the base to the bottom of the cover slab.
 - 1. Joints. Joints between precast sections, except grade rings, shall be sealed with pre-lubricated rubber gaskets conforming to requirements of ASTM C443 and C361; and shall be equal to Forsheda No. 114 Seal, as manufactured by Forsheda Pipe Seal Company.
- B. Top Sections. Top sections shall be precast flat slab tops, with top opening of 30-inch diameter, minimum. Design shall be based on H-20 live loading and one-foot minimum earth cover.
- C. Grade Rings. Precast grade rings shall be provided as required to adjust height of cover slab. The maximum height of the grade rings shall be 12-inches; and shall have key locks and use mastic sealer to insure water-tightness.
- D. Concrete. Concrete, poured-in-place, and grout shall conform to applicable requirements of Section 03300.
- E. Frames and Covers. Frames and covers shall be cast iron with a 22 3/4-inch diameter clear opening; and shall be gravity, solid, non-rocking, heavy duty type meeting requirements for Salt Lake City Standard Manhole Rings and Covers. Covers shall be vented in improved areas and solid in unimproved areas; shall have cleated surfaces and pick holes; and shall be marked with "SARATOGA SPRINGS" and either "WATER" or "PRESSURE IRRIGATION".
 - 1. Castings. Castings shall be of uniform quality free of porosity, hard spots, and shrinkage defects. Exposed surfaces shall be smooth and true to pattern. Iron shall conform to ASTM A48, Gray Iron Castings, Grade B.
- F. Proprietary Items. Provide proprietary items of the type, size and manufacture noted on the drawings or as required to complete the work.

2.03 VALVE STATION PLUMBING

- A. Pipe and Fittings.
 - 1. Ductile Iron Pipe: AWWA C151: See Section 02510. Exposed pipe and fittings shall not be coated with coal tar pitch varnish; but shall be painted as specified herein.
 - 2. Copper Tubing: ASTM B 88, Type K, annealed: See Section 02410.
 - 3. Red Brass Pipe: ASTM B 53, Red brass pipe shall be Schedule 80, seamless pipe with threaded ends. Fittings shall be Schedule 80 with screwed ends.
- B. Valves.
 - 1. Manufacturer's name and pressure rating marked on valve body.

2. Gate Valves Up To 3 Inches:
 - a. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel operator.
 - b. Product: Powell U.S. Bronze Gate Valves.
 - c. Substitutions: See Section 01600 - Product Requirements.
 3. Gate Valves 3 Inches and Over:
 - a. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends as indicated and cast iron valve box.
 - b. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - c. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.
 4. Combination Air-Vacuum Release Valves.
 - a. Valves shall be designed to release large quantities of air from pipes during filling, admit large quantities of air into pipes during draining, and release small accumulations of air during normal operation of pipes.
 - b. Valves shall be equal in quality to "Heavy-Duty Combination Air Release Valves", of the appropriate type and size, as manufactured by Valve and Primer Corporation (APCO); and shall meet the provisions of these specifications.
 5. Hose Gate Valves.
 - a. Hose gate valves shall be high grade brass with handwheel, inside screw ends, rising stem, screwed bonnet, taper wedge double disc. Valve shall be designed to operate at 200 psi water pressure.
 - b. Hose gate valves shall be equal to Powell U.S. Bronze Hose Gate Valve No. 527.
- C. Miscellaneous Items.
1. Flanged Coupling Adapters. The flanged coupling adapters shall be Rockwell Type 912 or Type 913, with anchor studs as recommended by the manufacturer; for connecting ductile iron pipe to the flanged valves, equipment and fittings.
 2. Mechanical Couplings. The mechanical couplings shall be Dresser, Rockwell, for connecting the size and type of pipe shown on the drawings. Couplings exposed to soil shall be primed and coated with a 1/4-inch layer of coal tar or rust preventing wax compound.
 3. Gauges. Gauges shall be as shown on the drawings and of the size and quality equal to or better than United States Gauge "A" Line, Figure No. 5000. Gauges shall have a range of 0 to 350 psi.
 4. Gauge Cocks. Gauge cocks shall be of high grade bronze with tee head; designed for 200 psi water pressure, and factory-tested to 300 psi; Crane Nos. 708, 712, 744.
 5. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134, for up to 2 inch service lines.
 6. Other Items. Other miscellaneous materials shall be as indicated on the drawings and as required to complete the station.
- D. Hangers and Supports. Provide all hangers, supports, clamps, guides, sleeves, inserts, anchors and other such devices required for hanging or supporting pipe, preserving alignment, prevention of movement, passage of pipe through walls and floors, or securing pipe in any manner. The required number, location and detail of such items may or may not be indicated on the drawings; but, in any case, such work shall be provided as work incidental to furnishing and installing any type of pipe, fittings and appurtenances, and no extra payment will be made for this work.

- a. Piping shall be supported or suspended in such manner as to prevent sagging or over stressing of pipe, valves, fittings or connections; and so that no pipe, fittings, valves or other items transfer load or strain to equipment of any kind.

2.04 BEDDING AND BACKFILL MATERIALS

- A. Bedding: As specified in Sections 02115 and 02116.
- B. Backfill: As specified in Sections 02115 and 02116.

2.05 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03300.

PART 3 EXECUTIONS

3.01 EXAMINATION

- A. Verify that water main size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or mechanical joints.

3.03 EXCAVATING

- A. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- B. Hand trim excavation for accurate placement of station to elevations indicated.
- C. Backfill around sides and to top of valve vault with backfill material, tamp in place and compact.

3.04 CONSTRUCTION - VALVE VAULT

- A. Construct the vault for the air-vacuum valve station at the location indicated on the drawings; in accordance with the details shown on the drawings and as specified herein.
- B. Earthwork shall be done in accordance with applicable requirements of Section 02115.
 - 1. Foundation Material. Where native material encountered at the foundation depth is found to be unable to provide adequate structural support of the vault or is determined to be moisture sensitive, the unsuitable material shall be removed and replaced by the appropriate granular borrow material as per the approved drawings or under the direction of a licensed geotechnical engineer.
 - 2. Excess Material. Unsatisfactory and excess excavated materials shall be removed from the work site and disposed of in a legally acceptable manner.
- C. Concrete Work. Comply with requirements of Section 03300, for placement, consolidation, finishing and protection of cast-in-place concrete.
- D. Precast Items. Precast riser sections shall be installed, from the gravel base to the cover slab, in accordance with the manufacturer's recommendations; and shall be installed to stand plumb. Precast flat slab tops shall be installed on the top riser section; with the opening positioned as indicated on the

drawings. The top of concrete flat slab tops shall be approximately 12-inches below final surface elevations.

E. Placement of Frame and Cover.

1. Placement. After the top slab of the station has been placed, the cast iron frame and cover shall be installed into the opening in the top slab; using precast grade rings to place the cover flush with adjacent finish grade.
2. Grouting. After placement of the frame and cover, grout around the exterior of the frame from the top of concrete top slab to the top of frame, as indicated on the drawing, to insure a watertight condition.

F. Flexible Pipe Couplings. A pipe joint or flexible coupling shall be provided on all pipes connected to the stations, located approximately 18-inches from the outside of the station. The joint or coupling shall be of the same size as the pipe, and shall be as recommended by the pipe manufacturer.

G. Miscellaneous Metal Work.

1. Miscellaneous metal work shall be fabricated and assembled in the shop to the greatest extent possible.
2. Miscellaneous metal work shall be erected in conformity with AISC Code of Standard Practice.

3.05 INSTALLATION - PLUMBING

- A. All pipe, fittings, valves, equipment and appurtenant items, together with supports and anchors, shall be installed and connected to operate as specified herein and as indicated on the drawings; in conformity with the current Utah Plumbing Code, and in conformity to good and acceptable plumbing practices according to industry standards.
- B. Equipment shall be installed as shown on the drawings, and in accordance with accepted manufacturer's written instructions.
- C. All material and workmanship shall conform to applicable requirements of the Utah Plumbing Code.
- D. Establish elevations of buried piping to ensure not less than four feet of cover over pipe; or as indicated on the drawings.
- E. Install pipe as required to indicate elevation to within tolerance of one inches.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Install access fittings to permit disinfection of water system performed under Section 02415.
- H. Set valves on concrete block.
- I. Mechanical couplings exposed to soil shall be primed and coated with 1/4-inch layer of coal tar, or rust preventing wax compound.
- J. Adjustable pipe supports shall be used to support pipe and valves; and shall be equal to Grinnell Company Figure 264.
- K. After plumbing system has been installed and completed, it shall be tested to show its functional fitness by operating the station; and shall be tested for water-tightness as specified herein; and disinfected as specified herein. Tests shall be performed in the presence of the City Engineer or his authorized representative.
- L. Buried pipe or otherwise inaccessible pipe shall be tested before it is concealed, and again in

connection with the final testing.

3.06 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Pressure test water piping to 200 psi for 2 hours.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

SECTION 02580

SECONDARY WATER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe and fittings for project water lines, to include secondary water lines.
- B. Valves and appurtenant items.
- C. Water Service Connections.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, bedding, backfilling and compacting.
- B. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- C. Section 02116 - Fill and Backfill: Bedding and backfilling.
- D. Section 02340 - Manholes and Covers.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for thrust restraints.

1.03 REFERENCES

- A. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- B. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- C. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association; (ANSI/AWWA C104/A21.4).
- D. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; (ANSI/AWWA C105/A21.5).
- E. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; (ANSI/AWWA C111/A21.11).
- F. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; (ANSI/AWWA C151/A21.51).
- G. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association.
- H. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- I. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; (ANSI/AWWA C508/C508a).
- J. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- K. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C515).

- L. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; (ANSI/AWWA C600).
- M. ASTM D2774 - Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- N. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution; American Water Works Association; (ANSI/AWWA C900/C900a).
- O. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch through 3 inch, for Water Service; American Water Works Association.
- P. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch, for Water Distribution; American Water Works Association.
- Q. AWWA C200 - Steel Water Pipe Casing, 6-inches and larger as needed.
- R. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with the City's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.01 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151:
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints:
 - a. Push-On Joints: AWWA C111, push-on type with rubber gasket.
 - b. Mechanical Joints: AWWA C111, mechanical joint type with gasket, bolts, and nuts.
 - c. Flange Joints: AWWA C110, flange type with gasket, bolts, and nuts.
 - 3. Jackets: AWWA C105 polyethylene jacket with polyethelene tape; purple color.
- B. PVC Pipe: AWWA C900 Class 200, DR-18 as indicated:
 - 1. Fittings: AWWA C111, cast iron.

2. Joints: ASTM D 3139 compression gasket ring.
- C. Polyethylene Pipe: ASTM D 3035, for 200 psi pressure rating:
1. Fittings: AWWA C901, molded or fabricated.
 2. Joints: Compression.
- D. High Density Polyethylene Pipe: AWWA C906:
1. Material: PE 3408 High Density Polyethylene (HDPE) meeting ASTM D3350 cell classification of 345434C.
 2. Fittings: AWWA C906, molded or fabricated; or mechanical joint ductile iron fittings.
 3. Joints: Butt fusion.
- E. Trace Wire: Number 14 gauge detectable conductor. Provide testing for continuity. Placed on all buried pipe.
- F. Detector Tape: Purple plastic tape, imprinted with "PRESSURIZED IRRIGATION" in large letters. Placed on all buried pipe.

2.02 CASING PIPE MATERIALS

- A. Welded Steel Pipe: AWWA C 200, steel water pipe; diameter as indicated.
- B. Casing Insulators: fusion coated steel casing insulators with 12-inch wide band and 2-inch wide glass reinforced plastic runners; Model C12G-2, manufactured by Pipeline Seal and Insulator, Inc.
- C. Casing End Seals: flexible S-shaped seals fabricated on synthetic rubber with stainless steel bands and clamps; Model S Pull-On End Seals, manufactured by Pipeline Seal and Insulator, Inc.

2.03 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
 1. Jackets: AWWA C105 polyethylene jacket with polyethelene tape; purple color.
- B. Gate Valves Up To 3 Inches:
 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
 2. Product: Powell U.S. Bronze Gate Valves.
 3. Substitutions: See Section 01600 - Product Requirements.
- C. Gate Valves 3 Inches and Over:
 1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 2. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint or flanged ends as indicated, and cast iron valve box.
 3. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile

iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.

4. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.

D. Ball Valves Up To 2 Inches:

1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, compression inlet end, compression outlet, with control rod, valve key, and extension box.

E. Swing Check Valves From 2 Inches to 24 Inches:

1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.
2. Product: Mueller Swing-Type Check Valve.

F. Butterfly Valves From 2 Inches to 24 Inches:

1. AWWA C504, iron body, bronze disc, resilient replacement seat, mechanical joint or flanged ends as indicated, manual worm gear operator, and cast iron valve box where required.
2. Underground manual operators shall be totally enclosed, factory grease packed and sealed, bronze worm gear operators with self-locking gearing; stops shall be provided to prevent over travel of valve disc.
3. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.
4. Product: Mueller "Lineseal III" Butterfly Valve with appropriate type Pacific States Cast Iron Valve Box.

- G. Corporation Stops: shall be type for connecting to copper or polyethylene pipe; Mueller No. H-15000, for up to 2-inch service line.

- H. Air Release Valves: shall be combination air release valves; APCO Combination Air Release Valves, of size indicated on the drawings.

- I. Blow-Off Hydrant: shall be Non-Freezing Blow-Off Assembly.

2.04 SECONDARY WATER CONNECTIONS

- A. Secondary water connections shall be constructed as indicated on the drawings.
- B. Connections shall include meter boxes, meters, valve boxes, stop & water valves, and all appurtenant items, as indicated on the drawings.

2.05 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Sections 02112 and 02116.
- B. Backfill: As specified in Sections 02112 and 02116.

2.06 ACCESSORIES

- A. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134, for up to 2 inch service lines.

- B. Concrete for Thrust Restraints: Concrete type specified in Section 03300.
- C. Manhole and Cover: Refer to Section 02340.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that water main and main line tee size, location, and invert are as indicated.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or mechanical joints.

3.03 TRENCHING

- A. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide required sq ft of thrust restraint bearing on subsoil as indicated on the drawings.
- D. Backfill around sides and to top of pipe with backfill material, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

- A. Establish elevations of buried piping to ensure not less than 36 inches of cover over pipe; or as indicated on the drawings.
- B. Install pipe to indicated elevation to within tolerance of one inch.
- C. Install ductile iron piping and fittings to AWWA C600.
- D. Install PVC pressure pipe and fittings to ASTM D2774.
- E. Install pipe lines to line and grade indicated.
- F. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- G. Slope water pipe and position drains at low points.
- H. Install trace wire and detector tape above all pipe; coordinate with Section 02112.

3.05 INSTALLATION - CASING PIPES

- A. See Sections 02115 and 02116 for structural excavation and fill and backfill; and for additional requirements.
- B. Install casing pipes by jacking process where indicated.

- C. Install casing pipes at the line and grade as required to allow carrier pipes to be installed within the casing pipes at the design line and grade, as indicated on the drawings.
- D. Place casing insulators on carrier pipes to properly center and position carrier pipe inside the casing pipes; space insulators as recommended by the pipe manufacturer.
- E. Carrier Pipe inside of casing shall have restrain joints.
- F. Seal each end of casing with appropriate size flexible end seals; install according to manufacturer's instructions and recommendations.
- G. Seal bore holes at each end, around periphery of casing, with grout, impervious clay or brick masonry.
- H. Contractor shall be solely responsible for the accuracy, safety and adequacy of construction methods and procedures for installing casing pipes, and for any damage which may result from their failure. All operations of the Contractor for installation of casing pipes shall be subject to approval by the agency having jurisdiction over the item being crossed.
- I. Contractor shall enter any agreement with, and furnish any and all indemnity and other bonds that may be required by, the agency listed above, for their protection against injury and interference with flow of water caused by the operations of the Contractor.
- J. Contractor shall secure required permission from the agency listed above before commencing with the installation of casing pipes and related work along and across the respective areas.

3.06 INSTALLATION - VALVES

- A. Set valves on concrete block.
- B. Center and plumb valve box over valve operating nut. Set box cover flush with finished grade.

3.07 INSTALLATION - AIR RELEASE STATIONS

- A. Locate air release stations as indicated on the construction drawings.
- B. Set air valve and piping plumb according to manufacturer's written instructions and recommendations; set vault plumb on solid foundation.
- C. Set top of valve box to grade, with cover matching finish grade.

3.08 SERVICE CONNECTIONS

- A. Provide water service lines, as indicated on the drawings. Residential service lines shall include stop & waste valves with valve boxes; meter boxes, valve and appurtenant items; and valve boxes with ball valve; and all appurtenant work. The Developer is to provide meter(s) for multi-family; institutional; and commercial service connections.
- B. Water service lines shall extend to locations designated by the City Engineer, which will be near property lines of property being served and inside side-lot PUE, as indicated.
- C. All pipe, fittings and valves shall conform to the specifications found elsewhere in this Section.
- D. Pipe, fittings and valves shall be installed as described herein.
- E. Service lines shall be installed at uniform grades and alignments; and shall be free of low spots or adverse grades.
- F. Service lines shall be cleaned, flushed and tested in accordance with applicable requirements of these specifications.

3.09 CONNECTIONS TO EXISTING WATER LINES

- A. Connection to existing water lines shall be made where and as indicated on the drawings. The sizes of pipe, fittings, valves and appurtenant items required to make connection shall correspond to the sizes of existing pipe and of project pipe.
- B. Excavate to existing pipe line at point of connection; determine actual conditions of existing pipe and all fittings and appurtenant items required to make the connection; and have all materials needed on site prior to any shut down or cutting into existing pipe lines.
- C. Connections that involve cutting into existing pipe lines include: cutting and removing sections of existing pipe and fittings as required; cleaning and preparing ends of existing pipe as required for connection; furnishing and installing all new pipe, fittings and valves required to make the connection of project pipe to the existing pipe as indicated; and all appurtenant work required to complete the connection.
- D. Connection into existing pipe lines under pressure include: furnishing and installing mechanical joint tapping sleeve of the appropriate size on the existing pipe at point of connection; furnishing and installing tapping valve, with valve box, on sleeve; tapping existing pipe with drilling machine and equipment, without interrupting flow in existing pipe line; and all appurtenant work required to complete the connection.
- E. Connection to existing pipe line shall be made at such times and within the time limits and according to the directions as agreed to between the Contractor and the City Engineer or City Inspector.
- F. Cut and plug existing pipe lines where indicated on the drawing. Excavate as required to locate existing pipe lines to be abandoned in place; cut the existing pipe, as required; and install permanent plug in end of pipe to be abandoned.

3.10 CONNECTIONS TO CULINARY WATER LINES

- A. Connections of secondary water systems to culinary water systems shall be done as indicated on the drawings and as described in Section 02586 BACKFLOW PREVENTER STATION.
- B. Connections of secondary water services to culinary water systems shall be done as indicated on the drawings and as described in Section 02587 SERVICE WATER BACKFLOW PREVENTER STATION.

3.11 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400 and 02112.
- B. Pressure test water piping to 200 psi for 2 hours.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the City.

END OF SECTION

SECTION 02586

BACKFLOW PREVENTER STATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backflow preventer stations, complete, including:
 - 1. Backflow preventer valves.
 - 2. Pipe, fittings, valves, and appurtenant items.
- B. Station testing.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, pipe bedding, backfilling and compacting.
- B. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- C. Section 02116 - Fill and Backfill: Pipe bedding and excavation backfilling.
- D. Section 03300 - Cast-in-Place Concrete: Concrete for structures and thrust blocks.

1.03 REFERENCES

- A. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM A 234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- C. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association; (ANSI/AWWA C104/A21.4).
- D. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; (ANSI/AWWA C105/A21.5).
- E. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; (ANSI/AWWA C111/A21.11).
- F. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; (ANSI/AWWA C151/A21.51).
- G. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association.
- H. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- I. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; (ANSI/AWWA C508/C508a).
- J. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- K. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C515).

- L. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; (ANSI/AWWA C600).
- M. Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, controllers, sprinkler heads, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, controllers, sprinkler heads, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with City's requirements as described herein.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves and appurtenant items in shipping containers with labeling in place.

1.07 OPERATING AND MAINTENANCE DATA

- A. Provide instructions covering full operation, care and maintenance of backflow preventer valves; and manufacturer's parts catalog. Information shall be included in the manual for operation and maintenance of the backflow preventer station.
- B. Instruct Owner's designated maintenance personnel in the proper operation of the valves.
- C. Submit 3 copies of written instructions recommending procedures to be established by the City Engineer for the maintenance of the valves from year to year.
 - 1. Submit prior to expiration of required one year guarantee period.
 - 2. Provide information in the manuals that include the following:
 - a. written index near front of Manual listing location in the Manual of all emergency data regarding the installation;
 - b. complete nomenclature of all replaceable parts, their part numbers, current cost, and name and address of the nearest vendor of replacement parts; and
 - c. copy of all guarantees and warranties issued on the installation showing all dates of expiration.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. Ductile Iron Pipe: AWWA C151:
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints:
 - a. Push-On Joints: AWWA C111, push-on type with rubber gasket.

- b. Mechanical Joints: AWWA C111, mechanical joint type with gasket, bolts, and nuts.
- c. Flange Joints: AWWA C110, flange type with gasket, bolts, and nuts.

3. Jackets: AWWA C105 polyethylene jacket.

B. Steel Pipe: ASTM A 53:

- 1. Fittings: ASTM A 47.

2.03 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Gate Valves Up To 3 Inches:

- 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
- 2. Product: Powell U.S. Bronze Gate Valves.
- 3. Substitutions: See Section 01600 - Product Requirements.

C. Gate Valves 3 Inches and Over:

- 1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
- 2. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint or flanged ends as indicated, and cast iron valve box.
- 3. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
- 4. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.

D. Ball Valves Up To 2 Inches:

- 1. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, compression inlet end, compression outlet, with control rod, valve key, and extension box.

E. Swing Check Valves From 2 Inches to 24 Inches:

- 1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.
- 2. Product: Mueller Swing-Type Check Valve.

F. Butterfly Valves From 2 Inches to 24 Inches:

- 1. AWWA C504, iron body, bronze disc, resilient replacement seat, mechanical joint or flanged ends as indicated, manual worm gear operator, and cast iron valve box where required.
- 2. Underground manual operators shall be totally enclosed, factory grease packed and sealed, bronze worm gear operators with self-locking gearing; stops shall be provided to prevent over travel of valve disc.
- 3. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full

open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.

4. Product: Mueller "Lineseal III" Butterfly Valve with appropriate type Pacific States Cast Iron Valve Box.
- G. Corporation Stops: shall be type for connecting to copper or polyethylene pipe; Mueller No. H- 15000, for up to 2-inch service line.
- H. Air Release Valves: shall be combination air release valves; APCO Combination Air Release Valves, of size indicated on the drawings.

2.04 BACKFLOW PREVENTER

- A. The backflow preventer shall be a reduced pressure type valve.
 1. The backflow preventer shall be bronze for 6-inch and smaller valves, and epoxy coated ductile iron for 8-inch and larger valves.
 2. The backflow preventer shall consist of two independently acting, spring-loaded check valves with a differential pressure relief valve located between the check valves.
 3. The backflow preventer shall include inlet and outlet shutoff valves; and four test cocks, three on the backflow preventer valve bodies and one on the inlet shutoff valve.
- B. The backflow preventers shall be of the appropriate size and type, as manufactured by Febco or Conbraco.

2.05 MISCELLANEOUS METAL WORK

- A. Miscellaneous metal work shall be provided as indicated on the drawings, as required to complete the Station.

2.06 PAINTING

- A. All exposed pipe, valves, fittings, and metal work for the station shall be painted.
 1. Painting shall consist of either:
 - a. 4 coats of alkyd paint, Painting System II (Steel Structural Painting Council - Specification No. 2);
 - b. 4 coats of phenolic paint, Painting System III (S. S. P. C. - Specification No 3).
 2. Painting shall include surface preparation, pretreatment, primer coat, inter-mediate coats, and finish coat, as specified; with total dry film thickness not less than 4.0 mils.
 3. Aluminum surfaces which will be in contact with concrete after erection shall be coated with bituminous mastic coating, SSPC-Paint 12, prior to erection.

2.07 MISCELLANEOUS ITEMS

- A. Miscellaneous appurtenant items shall be as indicated on the drawings or as required to complete the station.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, materials and equipment as required to construct the backflow

preventer station, complete, as described herein and as shown on the drawings.

- B. The backflow preventer station shall be constructed on the supply line to the sprinkling system, as shown, where the supply line is connected to a culinary water line.
- C. All work shall be done according to local plumbing codes, and to manufacturer's written instructions and recommendations.
- D. The Contractor shall test the station to assure proper operation.

3.02 EXAMINATION

- A. Verify that design drawings conform to project conditions.
- B. Verify that water line sizes and locations are as indicated on the drawings.

3.03 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside of pipes before assembly.
- C. Prepare pipe connections to equipment with flanges, mechanical joints or mechanical couplings.

3.04 EXCAVATING

- A. Excavating for the backflow preventer station shall be done to ensure proper grades and alignment as shown on the drawings.
- B. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- C. Hand trim excavation for accurate placement of pipe to elevations indicated.
- D. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide required area of thrust restraint bearing on subsoil as indicated on the drawings.
- E. Backfill around sides and to top of pipe zone with pipe bedding material, tamp in place and compact to required density.
- F. Backfill trench from top of pipe zone to top of trench with trench backfill material, tamp in place and compact to required density.

3.05 INSTALLATION - PIPE

- A. Establish elevations of buried piping to ensure not less than 2 feet of cover over secondary water lines and 4 feet over culinary water lines; or as indicated on the drawings.
- B. Install pipe to indicated elevation to within tolerance of one inches.
- C. Install ductile iron piping and fittings to AWWA C600.
- D. Install pipe lines to the line and grade indicated.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Slope water pipe and position drains at low points.

3.06 INSTALLATION - VALVES

- A. Set valves level and plumb, as indicated.
- B. Install adjustable pipe supports under each valve.
- C. Reduced pressure (RP) backflow preventer assemblies shall be installed as indicated on the drawings and as described herein.
 - 1. The assemblies shall be installed in a horizontal position only.
 - 2. The assemblies shall be maintained as an intact assembly.
 - 3. The bottom of the RP assembly shall be minimum of 12-inches above the ground or floor level; and shall not be closer than 12 inches to any wall, ceiling or other encumbrance. Assemblies shall be readily accessible for testing, repair and maintenance.
 - 4. RPZ assemblies shall NOT be installed in a pit.
 - 5. The relief valve on the RP assembly shall not be directly connected to any waste disposal line, including sanitary sewer, storm drains or vents.
 - 6. RP assemblies shall be protected from freezing and vandalism where applicable.

3.07 CONCRETE WORK

- A. Construct a concrete slab for the station over a compacted gravel base, as shown on the drawing.
- B. Concrete work and reinforcing shall conform to the requirements of Section 03300 of these specifications.

3.08 MISCELLANEOUS ITEMS

- A. Miscellaneous appurtenant items shall be furnished and installed as indicated on the drawings or as required to complete the station.

3.09 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Pressure test water piping to 200 PSI for 2 hours.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to City.

3.10 OPERATIONAL TESTING

- A. Provide the City Engineer or City Inspector with seven days written notice before operational test of backflow preventer. Test must be completed by a certified backflow technician.
- B. Test shall consist of the operation of the station for propose of checking operation and assuring of absence of leaks.
 - 1. Repair pipe, fittings, valves, or connections which show evidence of leakage.
- C. After all repairs or replacements have been made and accepted by the City Engineer or City Inspector, repeat the above required test.

END OF SECTION

SECTION 02621

GRAVEL SURFACING AND ROAD BASE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. New gravel road base.
- B. Restore gravel road base.
- C. New gravel road surfacing.
- D. Restore gravel road surfacing.

1.02 RELATED SECTIONS

- A. Section 01300 - Administrative Requirements
- B. Section 01400 - Quality Requirements
- C. Section 02112 - Trenching for Pipe Work.
- D. Section 02116 - Fill and Backfill: Compacted fill under base course.
- E. Section 02641 - Bituminous Paving: Binder and finish asphalt courses.

1.03 REFERENCES

- A. APWA Standards and Specifications - 2012 Edition
- B. AASHTO T 11 - Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- C. AASHTO T 19 - Bulk Density ("Unit Weight") and Voids in Aggregate
- D. AASHTO T 27 - Sieve Analysis of Fine and Coarse Aggregates
- E. AASHTO T 89 - Determining the Liquid Limit of Soils
- F. AASHTO T 90 - Determining the Plastic Limit and Plasticity Index of Soils
- G. AASHTO T 96 - Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- H. AASHTO T 193 – The California Bearing Ratio
- I. AASHTO T 335 - Determining the Percent of Fracture in Coarse Aggregate
- J. ASTM C 117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- K. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- L. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- M. ASTM D 5195 - Standard Test Method for Density of Soil and Rock In-Place at Depths Below Surface

by Nuclear Methods

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Submit source documentation and mix design as per Article 2.02
- C. Compaction Density Test Reports per Article 1.05.

1.05 QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform quality control testing as per Table 1.

Table 1: Sampling and Testing Frequencies			
	Roadway	Flatwork/Driveways	Backfill
Gradation, ASTM C136 ^a	Every 500 Tons	1 per day or Every 500 Tons ^c	
Density, ASTM D 5195 ^b	Every 2500 SF	Every 150 LF or 2500 SF ^c	Every 150 LF
a. Report all sieves identified in Table 3. b. Density target of 95% of Modified Proctor, ASTM D 1557. c. Use whichever frequency is greater.			

- C. Submit test and inspection reports to the City in accordance with Section 01400.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

1.06 ACCEPTANCE

- A. The City will perform acceptance decisions for all projects; based on results of the quality control test results defined in Article 1.05.
 - 1) The City will reject the lot if the Contractor QC data is outside the limits of Table 1.
 - 2) At the City's discretion, the City may perform acceptance testing in accordance with Table 1.
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Untreated Base Coarse.
 - 1. Material: Angular crushed stone, rock, sand, gravel or recycled concrete.
 - a. Use material free of shale, clay, friable material, petroleum contamination and debris

Table 2. Aggregate Properties		
Dry Rodded Unit Weight	Not less than 75 lb/ft ³	AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent	AASHTO T 96
Gradation	Table 3	AASHTO T 11 AASHTO T 27

CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	AASHTO T 193
Two Fractured Faces	50% Min	AASHTO T 335

2. Gradation: Use gradation meeting Table 2, ASTM C 136 on a dry weight and percent passing basis.

Sieve Size	Job Mix Gradation Target Band	Job Mix Gradation Tolerance
1½ inch	100	
1 inch	90 - 100	±9.0
¾ inch	70 - 85	±9.0
½ inch	65 - 80	±9.0
⅜ inch	55 - 75	±9.0
No. 4	40 - 65	±7.0
No. 16	25 - 40	±5.0
No. 200	7 - 11	±3.0
NOTES		
a) It is assumed fine and course aggregate have the same bulk specific gravity.		
b) Percentage of fines passing No. 200 sieve determined by washing, ASTM C 117		

3. Recycled Asphalt Pavement (RAP)
- Limit RAP to 2% binder, by total weight of mix.
 - Meet requirements of Table 2 with final blend.
 - Mechanically blend RAP with virgin aggregates.

2.02 SOURCE QUALITY CONTROL

- See Section 01400 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- If tests indicate materials do not meet specified requirements, change material and retest.
- Provide materials of each type from same source throughout the Work.
- Materials Sources: Submit name of imported materials source and Aggregate Composition Test Reports demonstrating compliance with Article 2.01.
 - Submit to the City at least 10 working days before placement.

PART 3 EXECUTION

3.01 EXAMINATION

- For new gravel road base and gravel surfacing, verify that sub-base has been compacted, inspected and approved by the City Inspector, that gradients and elevations are correct, and that it is dry.
- Verify that all areas of collapsible soil have been identified and properly prepared for road base.
 - Submit report to the City summarizing investigative procedures and results prior to placement of base course.
- For restoration of gravel road base and gravel surfacing, verify trenches and excavations have been backfilled, compacted, inspected and approved by the City Inspector, that gradients and elevations are correct, and that they are dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.
- C. Red head staking required for grade verification.

3.03 INSTALLATION

- A. New gravel road base and surfacing.
 - 1. Place gravel road base material over prepared substrate to provide total compacted thickness as indicated on plans.
- B. Restoration of gravel road base and surfacing.
 - 1. Restore gravel road base, along with temporary gravel surfaces, within one day after trench backfill has been placed , compacted, and inspected and approved by the City Inspector.
 - 2. Temporary gravel shall be maintained by blading, sprinkling, rolling, adding additional gravel as required, and appurtenant work to provide a safe, uniform surface over trench area satisfactory to the City Inspector. The temporary surface shall be restored at least every 7 days until the final surfacing is to be placed; and sprinkled with water at least once each day, including weekends and holidays.
 - 3. When final surfacing is to be placed, remove the temporary gravel to the bottom of the surface to be restored. After removing temporary gravel, the sub-base shall be graded and rolled to provide a compact, smooth base for placement of final surfacing.
 - 4. Place gravel road base material over prepared substrate to provide total compacted thickness equal to the adjacent road base, but not less than the thickness as indicated.
- C. Place material at near optimum moisture.
- D. Level and contour surfaces to elevations and gradients indicated.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Provide red head staking and string test for finished grading verification.
- H. When aggregate materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
 - 4. Aggregate stockpiles should be placed so that the aggregate gradation is maintained and segregation of larger and smaller aggregate does not happen.
- I. Verify that survey bench marks and intended elevations for the Work are as indicated.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from Design Elevation: Within 1/2 inch.

3.05 CEASE PRODUCTION

A. Cease production when any two out of three consecutive tests meet one of the following criteria:

1. Gradation does not meet limits of Table 3
2. Density does not meet requirements of Table 1 after reworking and retesting.

B. Prior to continuing product, a corrective action plan must be submitted to the City Engineer and approved. This plan must indicate the changes in production procedures that will be implemented to correct the deficiencies.

3.06 CLEAN-UP

A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. All disturbed areas shall be restored with native grasses to match adjacent areas, conforming to the City Standards. These areas shall be seeded with material conforming to adjacent materials. Restored area shall achieve 70% plan coverage prior to acceptance.

END OF SECTION

SECTION 02631

GEOGRID

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Geogrid for use in roadway and roadway embankment applications.

1.2 RELATED SECTIONS (Not Used)

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO Recommended Practice for Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures, AASHTO PP46-01, April 2001 Interim Edition of the AASHTO Provisional Standards.
 - 2. Standard Specification for Highway Bridges (1997 Interim)
 - 3. AASHTO Guide for Design of Pavement Structures (1993)
 - 4. AASHTO Guide for Design of Pavement Structures (1993)
- B. American Society for Testing and Materials (ASTM)
 - 1. D5732-95 - Standard Test Method for Stiffness of Fabrics
 - 2. D6637-01 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-rib Tensile Method
 - 3. D4354-96 - Practice for Sampling of Geosynthetics for Testing
 - 4. D4759-92 - Practice for Determining the Specification Conformance of Geosynthetics
 - 5. D5818-95 - Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage
- C. Geosynthetic Research Institute (GRI)
 - 1. GRI-GG2-87 - Standard Test Method for Geogrid Junction Strength
- D. U.S. Department of Transportation – Federal Aviation Administration (FAA)
 - 1. Specification for Geogrid Reinforced Base Courses, Engineering Brief No. 49 (1994).
- E. U.S. Environmental Protection Agency (U.S. EPA)
 - 1. EPA 9090 - Compatibility Test for Wastes and Membrane Liners
- F. U.S. Army Corps of Engineers (U.S. COE)
 - 1. Draft specification for Grid Aperture Stability by In-Plane Rotation
 - 2. CW-02215 Determination of Percent Open Area.
- G. American Society of Civil Engineers (ASCE)
 - 1. Giroud, J.P., and Han, J. (2004). "Design method for geogrid reinforced unpaved roads. Part I – Development of design method." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 775-786.

2. Giroud, J.P., and Han, J. (2004). "Design method for geogrid reinforced unpaved roads. Part II – Calibration and applications." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 787-797. City Road Repair and Crack Seal Program 2013 02072 - 2 GEOGRID

1.4 DEFINITIONS

- A. Geogrid - A biaxial polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth to function primarily as reinforcement.
- B. Multi-Layer Geogrid - A geogrid product consisting of multiple layers of grid which are not integrally connected throughout.
- C. Woven Geogrid – A geogrid product formed by weaving discrete strips of polymer into a network.
- D. Welded Strip geogrid – A geogrid product formed by heat bonding (welding) discrete strips of polymer into a regular network.
- E. Minimum Average Roll Value (MARV) - Value based on testing and determined in accordance with ASTM D4759-92.
- F. Traffic Benefit Ratio (TBR) (also known as Traffic Improvement Factor or TIF) - A ratio comparing the performance of a pavement cross-section with a geogrid-reinforced base course to a similar cross-section without geogrid reinforcement, based on the number of cycles to failure, with failure defined as a selected depth of rut.
- G. True Initial Modulus in Use - The ratio of tensile strength to corresponding zero strain. The tensile strength is measured via ASTM D6637 at a strain rate of 10 percent per minute. Values shown are MARVs. For multi-layer geogrid products, rib tensile testing shall be performed on the multi-layer configurations, as prescribed by ASTM D6637.
- H. Junction Strength - Breaking tensile strength of junctions when tested in accordance with GRI-GG2 as modified by AASHTO Standard Specification for Highway Bridges, 1997 Interim, using a single rib having the greater of 3 junctions or 8 inches and tested at a strain rate of 10 percent per minute based on this gauge length. Values shown are minimum average roll values. For multi-layer geogrid products, junction strength testing shall be performed across junctions from each layer of grid individually, and results shall not be assumed as additive from single layers to multiple layers.
- I. Flexural Stiffness (also known as Flexural Rigidity) - Resistance to bending force measured via ASTM D5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of the MD and XMD Flexural Stiffness values. For multi-layer geogrid products, flexural stiffness testing shall be performed directly on the multi-layer configuration without using any connecting elements other than those used continuously throughout the actual product, and results shall not be assumed as additive from testing performed on a single layer of the multi-layer product.
- J. Aperture Stability Modulus (also known as Torsional Rigidity or Torsional Stiffness) - Resistance to in-plane rotational movement measured by applying a 20 kg-cm (2 m-N) moment to the central junction of a 9-inch by 9-inch specimen restrained at its perimeter. Values shown are MARVs. For multi-layer geogrid products, torsional stiffness testing shall be performed on each layer of grid individually, and results shall not be assumed as additive from single layers to multiple layers. City Road Repair and Crack Seal Program 2013 02072 - 3 GEOGRID

- K. Subgrade Improvement – Placement of a geogrid immediately over a soft subgrade soil in order to improve the bearing capacity and mitigate deformation of the subgrade soil. The goal of this application is to reduce undercut requirements, improve construction efficiency, reduce the amount of aggregate subbase/base material required, provide a stiff working platform for pavement construction, or combination of these.
- L. Base Reinforcement - Placement of a geogrid beneath or within the aggregate base course of a flexible pavement system to improve the stiffness of the system. The goal of this application may be to reduce the amount of aggregate base material required (reducing initial cost), increase the life of the pavement (reduce life-cycle cost), or a combination of the two.

1.5 SUBMITTALS

- A. Submit geogrid product sample approximately 4 inches by 7 inches or larger. Refer to ASTM D 4354.
- B. Submit geogrid product data sheet and certification from the Manufacturer that the geogrid product supplied meets the requirements of this Section.
- C. Submit Manufacturer's installation instructions and general recommendations.
- D. Submit the following to the City Engineer at least 2 days prior to bid letting for alternate geogrid materials that do not meet the requirements of this Section. The City Engineer will respond with a written justification to allow or disallow the requested alternate Geogrid.
 - 1. Full-scale laboratory and in-ground testing of pavement structures reinforced with the specific geogrid. Testing must be conducted in full-scale at an Accelerated Pavement Testing Facility in the United States. Testing must quantify the structural benefit of the submitted product. Full scale testing must be included in the submittal. The geogrid submitted must meet or exceed that of the design geogrid.
 - 2. A list of 5 comparable projects that are similar in terms of size and application, are located in the United States, and where the results of using the specific alternate geogrid material can be verified after a minimum of five years of service life.
 - 3. A sample 4 x 7 inches or larger.
 - 4. Recommended installation instructions.
 - 5. Additional information as requested by the City Engineer to fully evaluate the product.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall have at least five years continuous experience in manufacturing polypropylene geogrid or experience manufacturing at least 10,000,000 square feet of polypropylene geogrid.
- B. Geogrid installer shall be manufacturer's representative or trained to install manufacturer's product.
- C. Pre-Construction Conference - Prior to the installation of the geogrid, the Contractor shall arrange a meeting at the site with the geogrid material supplier and, where applicable, the geogrid installer. The Owner and the City Engineer shall be notified at least 3 days in advance of the time of the meeting. A representative of the geogrid supplier shall be available on an "as needed" basis during construction.

1.7 ACCEPTANCE

- A. Owner rejects geogrid at installation if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transport, handling or storage.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver geogrid to site in rolls. Each roll shall have identification tag indicating manufacturer and product type. Ship per manufacturer's recommendations.
- B. Storage and Protection
 - 1. Prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to the geogrid materials.
 - 2. Store at temperatures above -20 degrees F (-29 degrees C).
 - 3. Rolled materials may be laid flat or stood on end.
 - 4. Geogrid materials should not be left directly exposed to sunlight for a period longer than recommended by the manufacturer.

1.9 PROJECT CONDITIONS

- A. Place geogrid when ambient temperature is between 40 degrees Fahrenheit and 95 degrees Fahrenheit.
- B. Do not place geogrid during any precipitation; in presence of moisture such as fog, rain, dew; or excessive winds.

1.10 WARRANTY

- A. Provide one year written warranty for materials and workmanship for geogrid.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Geogrid General–
 - 1. Synthetic fiber net at least 85-percent by weight of polypropylene, polyethylene, or polyester.
 - 2. Resistant to chemical attack, rot and mildew.
 - 3. No tears or defects that will adversely alter properties of product.
- B. Roadway Aggregate Geogrid - Base Reinforcement
 - 1. Geogrids are a regular network of integrally connected polymer tensile elements constructed in a single layer with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. Geogrids must also be dimensionally stable and able to retain their geometry under manufacture, transport and installation.
 - 2. Geogrids shall have the following properties:

BX GEOGRID PROPERTY VALUES

Geogrid Properties	Test Method	Type 1		Type 2	
		Machine Direction MD	Perpendicular to Machine Direction CMD	Machine Direction MD	Perpendicular to Machine Direction CMD
Type of Geogrid		Punched and Drawn	Punched and Drawn	Punched and Drawn	Punched and Drawn
Rib Shape	Observation	Rectangular or Square	Rectangular or Square	Rectangular or Square	Rectangular or Square
Rib Thickness	Nominal Dimensions	Minimum - 0.05 in	Minimum – 0.05 in	Minimum - 0.07 in	Minimum – 0.07 in
Nominal Aperture Size	I.D. Callipered	1.0 in to 1.5 in	1.0 in to 1.5 in	1.0 in to 1.5 in	1.0 in to 1.5 in
Flexural Stiffness	ASTM D-5732-95b	Min. 750,000 mg-cm	NA	Min. 2,000,000 mg-cm	NA
Minimum True Initial Modulus in Use	ASTM 6637-01a	Minimum – 27,420 lb/ft	Minimum – 44,550 lb/ft	Minimum – 27,420 lb/ft	Minimum – 44,550 lb/ft
Junction Efficiency	GRI-GG2-87	93%	93%	93%	93%
Aperture Stability Modulus at 20 cm-kg	Kinney -01	0.65 m-N/deg	NA	0.75 m-N/deg	NA
Resistance to Long Term Degradation	EPA 9090 Immersion Testing	100%	100%	100%	100%

- a) Resistance to elongation when initially subjected to load measured via ASTM 6637 without deforming test materials under load before measuring such resistance or employing “secant” or “offset” tangent methods of measurement.
- b) Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a “ladder”), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.

TX GEOGRID PROPERTY VALUES

Geogrid Properties	Test Method	Type 1				Type 2			
		Longitudinal	Diagonal	Transverse	General	Longitudinal	Diagonal	Transverse	General
Type of Geogrid					Punched and Drawn				Punched and Drawn
Rib pitch	Nominal Dimensions	1.6 in	1.6 in			1.6 in	1.6 in		
Mid-rib depth	Nominal Dimensions		0.05 in	0.05 in			0.07 in	0.06 in	
Mid-rib width	Nominal Dimensions		0.04 in	0.04 in			0.04 in	0.05 in	
Rib Shape	Observation				Rectangular				Rectangular
Aperture shape	Observation				Triangular				Triangular
Junction Efficiency	GRI-GG2-87				93%				93%
Radial Stiffness	ASTM 6637-01				15,430 lb/ft @ 0.5% strain				29,500 lb/ft @ 0.5% strain
Resistance to Long Term Degradation	EPA 9090 Immersion Testing				100%				100%

- a) Load transfer capability determined in accordance with GRI-GG2-87 and expressed as a percentage of ultimate tensile strength.
 - b) Determined from tensile stiffness measured in any in-plane axis from testing in accordance with ASTM D6637-01.
 - c) Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090.
3. Using multiple layers of geogrid to meet the requirements set forth in the preceding table will not be accepted.
 4. Acceptance Requirements – Base the actual minimum average roll values furnished by the manufacturer on representative test results from the manufacturing plant which produced the geogrid. Meet or exceed each of the specified minimum values. Clearly label all geogrids as being part of the same production run certified as meeting all applicable requirements.
- C. Acceptable Manufacturers:
1. Structural Geogrid, TX5 or BX1500, Tensar Earth Technologies, (801) 789-5407 or (800) 836-7271.

2.2 SOURCE QUALITY CONTROL PREPARATION

- A. Manufacturer shall conduct inspections and testing during production to verify product meets material properties specified.

PART 3 EXECUTION

3.1 PREPARATION

- A. Subgrade shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind.
- B. Subgrade shall have no sharp changes or abrupt breaks in grade.
- C. Subgrade shall not have standing water or excessive moisture.

3.2 INSTALLATION

- A. Install geogrid in accordance with manufacturer's instructions.
- B. Layout geogrid on prepared subgrade or Granular Borrow. Place temporary anchoring such as Granular Borrow or Untreated Base Course material, pins, or staples as necessary to prevent movement.
- C. Provide 1-foot minimum overlap at edges and ends of rolls.
- D. Place overlap shingle style in direction of fill advancement to ensure stability during installation.
- E. Place and compact fill in accordance with manufacturer's recommendations and in accordance with Section 32 11 15 or 32 11 23 as applicable.

3.3 PROTECTION

- A. Protect subgrade from damage while unrolling geogrid.
- B. Protect geogrid from damage from equipment, tools, and personnel working on geogrid.
- C. Protect geogrid from damage during backfill operations.

END OF SECTION

SECTION 02641
BITUMINOUS PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous paving for new surfaces.
- B. Bituminous paving for restoration of bituminous surfaces.
- C. Bituminous paving for overlay.

1.02 RELATED SECTIONS

- A. Section 01300 – Administrative Requirements
- B. Section 01400 - Quality Requirements.
- C. Section 02100 – Roadway and General Earthwork.
- D. Section 02116 - Fill and Backfill: Compacted subgrade for paving.
- E. Section 02621- Gravel Road Base Course: Gravel road base course.

1.03 REFERENCES

- A. AASHTO M 303 – Lime for Asphalt Mixtures
- B. AASHTO R 35 – Superpave Volumetric Design for Hot-Mix Asphalt
- C. AASHTO T 19 – Bulk Density (“Unit Weight”) and Voids in Aggregate
- D. AASHTO T 89 – Determining the Liquid Limit of Soils
- E. AASHTO T 90 – Determining the Plastic Limit and Plasticity Index of Soils
- F. AASHTO T 96 – Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- G. AASHTO T 104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- H. AASHTO T 176 – Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- I. AASHTO T 195 – Determining Degree of Particle Coating of Asphalt Mixtures
- J. AASHTO T 209 – Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- K. AASHTO T 255 – Total Evaporable Moisture Content of Aggregate by Drying
- L. AASHTO T 304 – Uncompacted Void Content of Fine Aggregate
- M. AASHTO T 324 – Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)
- N. AASHTO T 335 – Determining the Percentage of Fracture in Coarse Aggregate
- O. APWA Standard Specifications – 2012 Edition

- P. Asphalt Institute Manual SP-2: Superpave Mix Design
- Q. ASTM D 4791 – Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
- R. UDOT Quality Management Plan 514: Hot Mix Asphalt (latest edition as of date of project)
- S. UDOT Standard Specifications (latest edition as of date of project)

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures
- B. Volumetric Mix Design as per Article 2.02 D.
- C. Verification of current UDOT HMA Mix Plant certification as per Article 1.05 B.
- D. Verification of Laboratory Accreditation and Technician Certification as per Article 1.05 D.
- E. Daily Plant Production records and Quality Control Data as per Article 1.05 E and Article 1.06 A.
- F. Cold weather paving plan as per Article 1.09 A.2.

1.05 QUALITY ASSURANCE

- A. Perform Mix Design and Quality Control work in accordance with Section 32 12 05 of the APWA Standard Specifications unless otherwise directed within this specification.
- B. HMA Mixing Plant: Use UDOT 514 QMP certified Asphalt Mix Plant.
 - 1. Submit plant certification and lab accreditation documentation with mix design.
- C. Obtain materials from same source throughout or submit new mix design.
- D. Independent Laboratory: Use AMRL certified laboratory and WAQTC/UDOT TTQP certified technicians.
 - 1. Submit lab accreditation documentation with mix design
 - 2. Submit field technician certification documentation at least 5 working days before paving
- E. Submit daily plant production records and Quality Control data within 1 working day after completion of each day of paving.

1.06 QUALITY CONTROL AND QUALITY DEMONSTRATION

- A. Quality Control is performed by Contractor or his representative. Perform QC sampling and testing of material in accordance with Section 01400 - Quality Requirements.
 - 1. Submit QC data and plant daily production summary to the City at least 24 hours prior to the start of paving subsequent lots.
 - a. Include component percentages and totalized quantities for the individual mix run for the following:
 - 1) Asphalt Binder
 - 2) All aggregates, including RAP
 - 3) Anti-Strip Ingredient
 - 4) Water
- B. A lot equals the number of tons of HMA placed during each production day.

C. Gradation and asphalt binder content

1. Gradation and Binder Content samples may be truck samples from the plant or windrow samples.
2. Evaluate a lot on the average of all test results for the lot.
 - a. Take at least one gradation and binder content sample for each 500 tons, or portion thereof.
3. Perform and report to the City Engineer gradation and asphalt binder content testing.
4. Lot is acceptable for Gradation/Asphalt Binder Content when test results for gradation and binder content are within the limits of Table 1.

D. Mix Volumetrics

1. Take one volumetric verification sample per 500 tons of mix, or fraction thereof.
 - a. Determine mix maximum specific gravity.
 - b. Compact in accordance with mix design parameters.
2. Calculate and report Effective Asphalt Content (by Volume), Air Void Content, VMA, VFA and Dust to Binder Ratio for each sample taken.

E. Density and Thickness Quality Demonstration

1. Demonstrate lot density and thickness based on the test results of 4 random density/thickness cores per lot.
 - a. Random location is based on use of random number table, generator or other objective measure to establish both station and off-set for each sample.
 - b. Density and thickness may be evaluated in non-destructive formats. Obtain written permission from the City for non-destructive evaluation prior paving.
 - 1) Density is based on documented summary of results of 10 **randomly** located nuclear density tests using **core-correlated gauge specific to this mix**.
 - a) Submit random density locations to the City Engineer prior to paving.
 - b) One nuclear density test is the average of two determination of at least 1 minute, taken at right angles to each other over the same location.
 - 2) Thickness is based on documented summary of minimum 10 random thickness checks with a depth probe during compaction efforts, including any corrective actions taken.
 - c. For lift thicknesses less than 2", use non-destructive format as detailed above.
2. Contractor obtains cores from random locations within two days after the pavement is placed.
 - a. Move transversely to a point 1 ft from the edge of the pavement for In-place density if the random location for coring falls within 1 ft of the edge of the overall pavement section (outer part of shoulders).
 - b. Fill core holes with HMA or high AC content cold mix and compact.
 - c. Begin testing the cores within 24 hours for density acceptance.
3. Lot is acceptable for density when test results are within the limits of Table 1.
4. Lot is acceptable for thickness when:
 - a. The average thickness of the lot is not more than ¼ inch less than the total thickness specified.
 - b. No individual core shows a deficient thickness of more than ⅜ inch.
5. Deficient Thickness: Place additional material where lots are deficient in thickness.
 - a. Use a minimum compacted lift of 3 times the nominal maximum aggregate size.

Table 1

Quality Control Acceptance Limits Gradation, Binder Content, Density	
Parameter	Acceptable Limits
½ inch sieve for ¾ inch HMA ⅜ inch sieve for ½ inch HMA <i>(percent passing by weight)</i>	Lot Average*: Target Value ± 3.0% Individual Test: Target Value ± 6.0%
No. 8 sieve <i>(percent passing by weight)</i>	Lot Average*: Target Value ± 2.5%

	Individual Test: Target Value \pm 5.0%
No. 50 sieve (percent passing by weight)	Lot Average*: Target Value \pm 2.0% Individual Test: Target Value \pm 3.0%
No. 200 sieve (percent passing by weight)	Lot Average*: Target Value \pm 1.0% Individual Test: Target Value \pm 2.0%
Total Asphalt Binder Content	Lot Average*: Target Value \pm 0.2% Individual Test: Target Value \pm 0.4%
Density Target Value: 93.5 percent of Mix Design Maximum Specific Gravity (Rice) (for design overlay thickness < 1.5" target is 92.5% of Rice)	Lot Average*: Target Value \pm 2.0% Individual Test: Target Value \pm 4.0%

* Lot Average not applicable to lots with only 1 test. Use Individual Test limits when evaluating lots with only 1 test.

1.07 ACCEPTANCE

- A. The City will make acceptance decisions for all projects. The City may accept or reject a project if it is not up to the specifications included herein.
1. Project Definitions
 - a. Capital Projects: Projects where City has contracted directly with the General Contractor for construction of the roadway.
 - b. Non-Capital Projects: All other projects, including Development, Permit and Utility work.
 2. Acceptance Practices
 - a. For Capital projects, the City, or its representative, will perform testing for gradation, asphalt binder content, density, thickness and smoothness on samples taken by the contractor in the presence of the City or its representative.
 - 1) Testing will be performed by an AMRL certified laboratory and WAQTC/UDOT TTQP certified technicians.
 - 2) For Capital projects with total tonnages equal to or larger than 1000 tons, the City will accept material based on Articles 1.07 B through 1.07 F. Projects less 1000 tons will be accepted based on Table 1 limits.
 - b. For the Non-Capital projects, the City may accept the lot based on results of the quality control test results and plant production records defined in Article 1.06.
 - 1) The City will reject the lot if the Contractor QC data for density, gradation or binder content is outside the limits of Table 1.
 - 2) The City may perform partial or full acceptance testing on non-Capital projects in accordance with Articles 1.07B through 1.07E, Article 1.07H, and Article 1.07I.
 - a) The City will reject the lot if the Acceptance data is outside the limits of Table 1, if calculated PT is less than 80%, or if True-Elevation tolerance of Article 1.07H is not met.
 - i) 80% limit for PT is not applicable for small projects with total tonnages less than 1000 tons.
- B. A lot equals the number of tons of HMA placed during each production day.
- C. Gradation and asphalt binder content

1. The City Engineer will evaluate a lot on the test results of four samples with the following exceptions:
 - a. Compute disincentive using the test results from three samples if only three samples can be taken for the production day.
 - b. Add the lot to the next day's production if three random samples cannot be taken.
 - c. Add the lot to the previous day's production for the final day's production if three random samples cannot be taken.
 - d. The lot may be increased to include up to three production days when agreed upon in advance by both the Contractor and City Engineer when less than 900 tons are anticipated per production day.
2. Take samples at locations directed by the City Engineer or their representative. The City Engineer will inform the Contractor of the time and place of sampling not more than 15 minutes before the sampling.
 - a. The City takes immediate possession of the sample(s).

D. Mix Volumetrics

1. In conjunction with the gradation and binder content samples, the City will test for, calculate and report Air Void Content, VMA, VFA and Dust to Binder Ratio.
 - a. Laboratory compaction in accordance with mix design parameters.
 - b. Calculations will be based on sample maximum specific gravity.

E. Density and Thickness

1. Density Sampling and Testing
 - a. For paving areas not containing paving Fabric: Contractor obtains cores within two days after the pavement is placed.
 - 1) The City Engineer will mark coring location for in-place density and joint density cores.
 - 2) Move transversely to a point 1 foot from the edge of the pavement for in-place density if the random location for coring falls within 1 foot of the edge of the overall pavement section (outer part of shoulders).
 - 3) Fill core holes with HMA or high AC content cold mix and compact.
 - 4) The City Engineer will witness the coring operation, take possession of the cores immediately, and begin testing the cores for density acceptance.
 - b. For paving areas with paving Fabric, the owner will perform density testing with a core-correlated nuclear gauge instead of cores.
2. Density Requirements
 - a. The limits for in-place density are in accordance with Table 3.
 - b. Use the average of the Maximum Specific Gravity tests for each lot.
3. Thickness Requirements
 - a. The City will accept a lot for thickness when:
 - 1) The average thickness of all sub-lots is not more than 1/4-inch greater, nor 1/4-inch less than the total thickness specified.
 - 2) No individual sub-lot shows a deficient thickness of more than 3/8-inch.
 - b. Excess Thickness: The City Engineer may allow excess thickness to remain in place or may order its removal.
 - 1) For excess material left in place on unit price contracts, the City will not pay for any material above the upper thickness tolerance.
 - c. Deficient Thickness: Place additional material where lots or sub-lots are deficient in thickness.
 - 1) Use Minimum compacted lift of 3 times the nominal maximum aggregate size.

- d. Thickness tolerances established above do not apply to leveling courses. Check final surfaces in stage construction.
 - e. Thickness acceptance for thin lift projects less than 2 inches consists of checking thickness regularly with a depth probe during compaction efforts and taking corrective action as necessary.
- F. For Capital Projects, the City will apply Disincentives for Gradation/Asphalt Content and In-Place Density. The City Engineer will compute Disincentive for each lot.
1. Compute disincentive for Gradation/Asphalt Binder and In-place Density according to Table 2.
 2. Base the disincentive on Percent within Limit (PT) computation using Tables 3, 4, and 5.
 - a. Evaluate with the appropriate number of tests "n" in Table 4.
 3. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content disincentive.
 4. Use Table 5 to determine PT for in-place density.

Table 2

Disincentive for Gradation, Asphalt Binder Content, and Density	
PT Based on Min. Four Samples	Disincentive (Dollars/Ton)
> 88	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
<60	Reject

Table 3

Upper and Lower Limit Determination	
Parameter	UL and LL
½ inch sieve for ¾ inch HMA ⅜ inch sieve for ½ inch HMA	Target Value ± 6.0%
No. 8 sieve	Target Value ± 5.0%
No. 50 sieve	Target Value ± 3.0%
No. 200 sieve	Target Value ± 2.0%
Asphalt Binder Content	Target Value ± 0.35%
Density	Lower Limit: Target Value - 2.0% Upper Limit: Target Value + 3.0%

Table 4

Quality Index Values for Estimating Percent Within Limits										
PU/PL	n=3	n=4	n=5	n=6	n=7	N=8	n=10	n=12	n=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
<60	≤ 0.35	≤ 0.29	≤ 0.27	≤ 0.26	≤ 0.25	≤ 0.25	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24

Enter table in the appropriate "number of tests" column and round down to the nearest value.

Table 5

Definitions, Abbreviations, and Formulas for Acceptance	
Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content are given in the Contractor's volumetric mix design. See this Section article 1.4 for density target values.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results—the arithmetic mean.
Sample Standard Deviations	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 3)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 3)
Upper Quality Index (QU)	$QU = (UL - AVE)/s$
Lower Quality Index (QL)	$QL = (AVE - LL)/s$
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot Within UL and LL (PT)	$PT = (PU + PL) - 100$
Disincentive	Determined by entering Table 2 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to at least four decimal place accuracy, which will be carried through all further calculations. Rounding to lower accuracy is not allowed.

- G. Rejected Lots: Rejected lots do not necessarily indicate bad material, rather insufficient data to perform proper acceptance. Submit an engineering analysis for all rejected lots.
1. Include in the analysis:
 - a. A summary of the specific issues leading to rejection, including identification of any specific acceptance data being disputed.
 - b. Justification for dispute of the specific acceptance data in question.
 - c. An engineering evaluation of the expected performance of the pavement based on available project quality control or acceptance data other than acceptance data in question.
 - d. Copies of all data supporting the engineering evaluation of expected performance.
 - e. Summary of recommended changes to mitigate future occurrences of disputed results.
 2. The City Engineer may allow a rejected lot to remain in place based on review and concurrence with engineering analysis.
 - a. Capital Projects: A maximum of \$25 per ton price reduction will be assessed. The City may adjust or remove the price reduction based on the results of the engineering analysis.
 - b. Non-Capital Projects: No price reduction will be assessed. The City may require additional work by the contractor to mitigate concerns of any lot allowed to remain in place.
- H Variation from True Elevation: Construct final riding surface within 1/2 inch of plan elevation.
- I. Smoothness
1. Limit all longitudinal and transverse pavement deviations to less than 1/8 inch from the lower edge of a 10-foot straightedge.
 2. Meet smoothness requirements of Table 6.

Table 6 – Roughness Tolerances

Speed Mph	Profile Roughness ^d (Inches/Mile), Maximum	Profile Deviation ^c Inches/25 feet
--------------	--	--

	IRI ^a	PI ^b	Maximum
<i>Residential</i>			
All Speeds	–	–	0.4
<i>Arterials and Collectors</i>			
0 to 30	120	50	0.4
31 to 45	90	35	0.4
45 +	70	21	0.3
NOTES			
(a) IRI (International Roughness Index), ASTM E 950. Use 1/4 car analysis.			
(b) PI (Profile Index), ASTM E 1274. Use a zero blanking band.			
(c) Profile deviation applies to bump and depression measurements.			
(d) Evaluate PR lots based on average of two traces from each lot, in the direction of travel, approximately 2.5 feet from each edge of pass.			

3. Smoothness is evaluated before the placement of preservation surfacing including: Thin Bonded Polymer Overlay, Microsurfacing, Slurry Seal, Bonded Wearing Course, Stone Matrix Asphalt or Chip Seal Coat.
4. Profile Roughness: Verify bumps and depressions are corrected so profile roughness index in each lot meets tolerance:
 - a. Lot is 0.1 mile (528 feet long) for each paving pass. Add segments shorter than 250 feet to preceding lot. Treat partial segments longer than 250 feet as a lot.
 - b. Perform trace on each paving pass, regardless of location in roadway.
 - 1) Exclude bridge decks from profile roughness evaluation. Profile deviation (bump) requirements still apply.
5. Profile Deviation: Verify “must grind” bumps and depressions are removed from the lot surface:
 - a. Lot is area of total placement. No area is excluded.
 - b. Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas (including the 50 feet end traces) exceeding profile deviation tolerances are “must grind” areas.
6. Correct all defects at no additional cost to the City.
 - a. Correct defects across the entire width of the traffic lane or shoulder either by grinding or by surface replacement.
 - b. Seal areas in HMA, and SMA that have been ground with a flush coat application.
 - 1) Use a CSS-1h, CSS-1, CQS-1, based on 2:1 dilution of emulsion concentrate (approximately 60% binder/40% water) to water.
 - 2) Apply the emulsion at 0.11 ± 0.01 gal/yd². Provide beginning and ending meter reading from applicator for application rate verification.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable City requirements for paving work on City streets.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Place asphalt mix when base/pavement surface and ambient temperatures are 50°F or higher.
 1. Submit a cold-weather paving plan to the City for any work to be performed outside the above limits. Include modified procedures and practices to ensure proper compaction will be obtained.
 2. The City determines and provides written approval if it is acceptable to place outside the above limits.
- B. Do not place on surfaces that have standing water or are frozen.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphalt Binder: Use PG 64-28 conforming to APWA Standard Specifications Section 32 12 05 or UDOT Standards Specifications Section 02745.
- B. Aggregate: Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag meeting table 8.
 - 1. Coarse aggregates
 - a. Retained on No. 4 sieve
 - 2. Fine aggregates
 - a. Clean, hard grained, and angular
 - b. Passing the No. 4 sieve

Table 8

Aggregate Properties – HMA			
Test Method	Test No.	Arterials and Collectors	Residential Streets
One Fractured Face	AASHTO T 335	95% minimum	90% minimum
Two Fractured Face	AASHTO T 335	90% minimum	80% minimum
Fine Aggregate Angularity	AASHTO T 304	45 minimum	
Flats or Elongates	ASTM D 4791, 3:1 ratio	20% maximum	
L.A. Wear	AASHTO T 96	35% maximum	
Sand Equivalent	AASHTO T 176 (Pre-wet method)	45 minimum	
Plasticity Index	AASHTO T 89 and T 90	Non-Plastic	
Unit Weight	AASHTO T 19	minimum 75 lb/cu ft	
Soundness (sodium sulfate)	AASHTO T 104	16% maximum loss with five cycles	
Clay Lumps and Friable Particles	AASHTO T 112	2% maximum	
Natural Fines	N/A	0%	

- C. Meet gradation requirements in Table 9. **Use 1/2" gradation unless specifically directed otherwise by the City Engineer.**

Table 9

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)			
Sieve Size		3/4 inch	1/2 inch
Control Sieves	1 inch	100.0	
	3/4 inch	90.0 - 100.0	100.0
	1/2 inch	<90	90.0 – 100.0
	3/8 inch		<90
	No. 4	<i>Provide target for Information Only</i>	
	No. 8	23.0 - 49.0	28.0 - 58.0
	No. 16	<i>Provide target for Information Only</i>	
	No. 30		
	No. 50		
	No. 100		
No. 200	2.0 - 8.0	2.0 – 10.0	

- C. Antistrip Agent: Hydrated Lime - AASHTO M 303, Type I in 3:1 slurry (water to lime) format.

- D. Tack Coat: Homogeneous, Cationic Emulsified Asphalt, Grade CQS-1 or CQS-1h, conforming to Section 32 12 13.13 of APWA Standard Specifications.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Perform Superpave Volumetric Mix Design according to Asphalt Institute Manual SP-2 and the following:
1. Comply with Table 10 and Table 11.
 2. Use minimum **11.5% effective asphalt binder by volume** of mix.
 3. Incorporate hydrated lime as necessary to meet Hamburg Wheel Tracker Requirements.
 4. Do not use mix designs more than 1 year old.

Table 10

Volumetric Design Gyration				
Pavement Category	Compaction Parameters			Voids Filled with Asphalt (VFA) (%)
	N _{initial} /% of G _{mm} *	N _{design} /% of G _{mm} *	N _{max} /% of G _{mm} *	
All Classes	7/ ≤ 90.5	75/ = 96.5	115/ ≤ 98	70 – 80

* G_{mm}: Theoretical maximum specific gravity of mix. Refer to AASHTO T 209.

Table 11

Volumetric Design Requirements	
HMA design mixing and compaction temperatures	As recommended by Binder Supplier, 325°F Maximum
Dust to Binder Ratio (by weight)	0.6 - 1.20 (Design) 0.6 - 1.40 (Production)
Voids in Mineral Aggregate (VMA) at N _{design} AASHTO R 35.9.2 using G _{sb} (dry). Equation based on percent of total mix.	13.5% - 15.0% for ¾ inch 14.5% - 16.0% for ½ inch <i>(report for information only – effective binder content and design air voids are primary design controls)</i>
Hamburg Wheel Tracker AASHTO T 324, 50°C	Maximum 10 mm impression at 10,000 passes

- B. Recycled Asphalt Pavement (RAP): Mix design shall contain 10% or less recycled asphalt binder from RAP by total weight of binder. Do not adjust virgin binder grade when adding RAP.
1. RAP aggregate is required to meet Table 8 with exception of Sand Equivalent
- C. Submit proposed mix design of each class of mix for review at least 10 working days prior to beginning of work. Include the following.
1. Date of mix design.
 2. Asphalt Binder source, type, chemical composition, and grade.
 3. Effective and total binder target percentages, by weight **and by volume**, and calculated dust to effective binder ratio (by weight).
 4. Compaction density at N_{initial}, N_{design}, and N_{max}.
 5. Volumetric targets including air voids, voids in the mineral aggregate (VMA), and voids filled with Bituminous Binder (VFA).
 6. Hamburg Wheel Tracker results and lime percentage

7. Target Grading Curve for aggregate, including all sieves listed in Table 9.
8. RAP properties including asphalt binder content and grade, and RAP percentage.
9. Aggregate source and physical properties as identified in Table 8. Test results shall not be older than 455 days from the date of submission.
10. Aggregate bulk and apparent specific gravities, percent absorption and blend percentage.
11. Optimum compaction temperature at the project site.

D. Warm Mix Asphalt

1. At the contractor's discretion, warm mix asphalt application based on foamed asphalt or surfactant based applications may be used.
2. In addition to meeting requirements of articles 2.02.A through 2.02.C above, include warm-mix process description and related modifications to laboratory testing procedures in submittal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads; and that the base course has been inspected and approved by the City Inspector.
- B. Perform redhead and string-line test, verify gradients and elevations of base are correct.
- C. Locate, reference, and protect all utility covers, monuments, curb and gutter and other components and street fixtures affected by the paving operations.
- D. Remove all moisture, dirt, sand, leaves, dust, mill remnants and other objectionable material from the prepared surface.

3.02 PREPARATION - TACK COAT

- A. Apply tack coat with minimum 98% coverage.
- B. Apply tack coat to all contact surfaces of curbs, gutters, existing pavement, manhole frames and other utility structures.
- C. Apply tack coat to all longitudinal joints and between lifts.
- D. Apply tack in accordance with Table 12, based on 2:1 dilution of emulsion concentrate (approximately 60% binder/40% water) to water. Provide beginning and ending meter reading from applicator for application rate verification.

Table 12

Minimum Tack Application Rates (gal/SY)	
Milled Surface	0.08
Existing HMA Surface	0.05
New HMA Surface (less than 48 hrs since placement)	0.03
Vertical and Contact Surfaces (Hand spray applications)	Minimum 98% Coverage

3.03 HMA PRODUCTION AND PLACING ASPHALT PAVEMENT

- A. Dry aggregate material to an average moisture content of not more than 0.2 percent by weight. Mix uniformly; May be verified by AASHTO T 255. Adjust burners to avoid damage or soot contamination of the aggregate

- B. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
 - 1. May be verified by AASHTO T 195.
 - 2. Discontinue operation and make necessary corrections if material is not properly coated.
- C. Maintain temperature of the HMA between identified limits for mixing and compaction as defined on Volumetric Mix Design Submittal.
 - 1. The City Engineer will reject all materials heated over the identified limits.
 - 2. Remove all material rejected by the City Engineer for overheating and dispose of in a legally acceptable manner.

3.04 CEASE PRODUCTION

- A. Cease production when any two out of three consecutive lots meet one of the following criteria:
 - 1. A net disincentive
 - 2. Air voids at N_{des} averaged for each lot are less than 2.5 or greater than 4.5 percent
 - 3. Effective binder content averaged for each lot is not within Target Value \pm 0.5 percent
 - 4. Dust to binder Ratio exceeds limits in Table 11.
- B. Submit a corrective action plan to the City Engineer before production continues indicating the changes in production procedures that will be implemented to correct the deficiencies.

3.05 PLACING ASPHALT PAVEMENT

- A. Provide a compactable sloped edge adjacent to the next lane to be paved when full-width or Echelon paving is impractical and more than one pass is required. Echelon paving is the preferred method for constructing a longitudinal joint.
- B. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.
- C. Offset longitudinal joints 6 to 12 inches in succeeding courses.
 - 1. Place top course joint within 1 ft of the centerline or lane line.
- D. Offset transverse construction joints at least 6 ft longitudinally.
- E. Do not allow construction vehicles, general traffic, or rollers to pass over the uncompacted end or edge of freshly placed mix until the mat temperature drops to a point where damage or differential compaction will not occur.
- F. Taper the end of a course subjected to traffic at approximately 50:1 (horizontal to vertical).
 - 1. Remove the portion of the pass that contains the tapered end before placing fresh mix.
- G. Use a motor grader, spreader box, or other City Engineer approved spreading method for projects under 180 yd², irregular areas, or for miscellaneous construction such as detours, sidewalks, and leveling courses.
- H. Use a minimum compacted lift is 3 times the nominal maximum aggregate size.
- I. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

- J. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.06 CONTRACTOR INITIATED CHANGES IN MIX DESIGN

- A. Changes in job mix gradation:
 - 1. Submit a written request for a change in a job-mix gradation at least 48 hours prior changing. Include basis for requesting change. Submittal must meet requirements of Article 2.02 C.
 - 2. Do not change until permission from City or its representative is received.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from injury or damage until surface temperature is less than 120 degrees F.

END OF SECTION

SECTION 02651

BITUMINOUS TYPE II SLURRY SEAL COAT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Bituminous Type II Slurry Seal coat for overlay.

1.02 RELATED SECTIONS

- A. Section 1300 – Administrative Requirements
- B. Section 1400 – Quality Requirements

1.03 REFERENCES

- A. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute – Latest Edition
- B. APWA Standards and Specifications Section – 2012 Edition
- C. ASTM C 29 - Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
- D. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- D. ASTM C 117- Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- E. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- F. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- G. ASTM D 242 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures
- H. ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- I. ASTM D 3319 - Standard Practice for Accelerated Polishing of Aggregates Using the British Wheel
- J. ASTM D 3910 - Standard Practices for Design, Testing, and Construction of Slurry Seal
- K. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- L. ASTM D 5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
- M. ISSA A105 Guidelines
- N. UDOT 2012 Standard Specifications

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures
- B. Mix Design as per Article 2.01 D.

- C. Laboratory Accreditation as per Article 2.01 B.
- D. Field Quality Control data as per Article 3.6

1.05 FIELD QUALITY CONTROL

- A. Perform Field Quality Control Sampling and Testing. Any repeatable sampling and testing approach is acceptable. Identify and correct any material not meeting the following Field Tolerances:
 - 1. Residual Asphalt Content: $\pm 1\%$ by dry weight of aggregate
 - 2. Slurry consistency (ISSA TB #106): $\pm 0.2''$ from mix design
 - 3. Application Rate: $\pm 2 \text{ lb/yd}^2$ (when surface texture does not vary significantly)
- B. ASTM C 136: If sieve analysis shows stockpile aggregate gradation non-compliance, either remove the material or blend in other aggregates to bring it into compliance. This may require a new mix design. Screening may be required at the stockpile to remove any defective material.
- C. Submit daily summary to the City within 24 hours of completion of each day's placement.

1.06 QUALITY ASSURANCE

- A. Use a paving crew foreman that has completed at least three (3) projects of similar size and nature.
- B. Use a laboratory that follows and complies with ASTM D 3740 and APWA Section 01 45 00 requirements.
- C. Do not change approved aggregate or emulsified asphalt source until City Engineer accepts new source and new mix design.
- D. Remove any product found defective after installation and install approved product at no additional cost to OWNER.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable City requirements for paving work on City streets, Section 1300 – Administrative Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Emulsified Asphalt Cement: Use quickset emulsified asphalt, CQS-1H, with minimum 2% SBR polymer solid based on mass of residual asphalt.
- B. Aggregate: Use aggregate conforming to the following:
 - 1. Material: Stone, slag, or other high quality particle or combination meeting Table 1.

Table 1 – Physical Properties			
Criterion	ASTM	Minimum	Maximum
Angularity (fractured faces), percent	D 5821	80	--
Wear (hardness or toughness), percent	C 131	--	35
Soundness (weight loss in 5 cycles), percent	C 88	--	10
Clay Content (sand equivalent) percent SS-II	D2419	55	--

Polishing, BPN	D 3319	28	--
Water absorption, percent	--	--	1.25
NOTES			
a. Angularity of aggregate retained on No. 4 sieve with at least one (1) mechanically fractured face or clean angular face. Provide 100 percent (maximum) for all non-residential roadways.			
b. Wear of aggregate retained on No. 12 sieve after 500 revolutions.			
c. Soundness for combined coarse and fine aggregate measured using five (5) cycles Na ₂ SO ₄ .			
d. Clay content before additives.			

2. Gradation: Meet requirements of Table 2, ASTM C 136 on a dry weight and percent passing basis:

Sieve	Percent Passing
3/8 in.	100
No. 4	90 – 100
No. 8	65 – 90
No. 16	45 – 70
No. 30	30 – 50
No. 50	18 – 30
No. 100	10 – 21
No. 200	6 – 15
NOTES	
a. Portion retained on the No. 4 sieve clean and free of clay coatings.	
b. Portion passing No. 200 sieve includes mineral fill, ASTM C 117.	

C. Additives:

1. Mineral Filler: ASTM D 242
2. Portland cement, hydrated lime, limestone dust, fly ash, or aluminum sulfate to regulate setting time and improve workability.
3. Limestone dust, fly ash, or rock dust to alter aggregate gradation.

D. Mix Design:

1. Use an AMRL accredited laboratory.
2. Perform mix design in accordance with Table 3.

ISSA TEST NO. (ISSA A105 Guidelines)	DESCRIPTION	SPECIFICATION
ISSA TB-106	Slurry Seal Consistency	2cm Minimum 3cm Maximum
ISSA TB-139 For quick-traffic systems	Wet Cohesion 30 Minutes Minimum (Set) Wet Cohesion 60 Minutes Minimum (Traffic)	12 kg-cm Minimum 20 kg-cm Minimum
ISSA TB-109 For heavy-traffic areas only	Excess Asphalt by LWT Sand Abrasion	50 g/ft ² Maximum (538 g/m ² Maximum)
ISSA TB-114	Wet Stripping	Pass (90% Minimum)
ISSA TB-100	Wet-Track Abrasion Loss, One-	75 g/ft ² (807 g/m ²)

	hour Soak	
ISSA TB-113	Mix Time**	Controllable to 180 Seconds Minimum

**** Perform the mixing test and set-time test at the highest temperatures expected during construction.**

- E. Submit proposed mix design for review at least 10 working days prior to beginning of work. Include the following:
1. Date of mix design
 2. Emulsion source and grade
 3. Total emulsion target percentages.
 4. Bulking effect of moisture content on unit weight – ASTM C 29
 5. Stripping test results
 6. Target Grading Curve for aggregate, including all sieves listed in Table 3.
 7. Aggregate source and physical properties as identified in Table 2. Test results shall not be older than 455 days from the date of submission.
 8. Aggregate bulk and apparent specific gravities, percent absorption and blend percentage.
- F. Temporary Raised Pavement Markers:
1. Use Temporary Raised Pavement Markers as manufactured by Davidson Plastics Company.
 2. Markers shall have polyurethane plastic bodies with reflective tape, clear flexible polyvinyl-chloride protective covers, and solid butyl rubber adhesive on bottom surface.
 3. Markers shall be 2-inches high and 4-inches wide; and of the color selected by the City Engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. General
1. Fat or bleeding pavements may require scratch course application.
 2. Cracked or porous pavements may require thin SSI slurry surface treatment.
 3. Asphalt concrete inlay may be required in rut deformations.
- B. Surface Repair: Patch holes, raveled areas, and low areas with asphalt concrete.
- C. Repair all cracks greater than 1/8" in width.
1. Remove plant material from cracks, edges and joints.
 2. Blow cracks clean.
 3. Seal cracks with crack sealant as per Article 2.3, UDOT Standard Specification 02745 – Asphalt Material. Use squeegee or other device to remove excess asphalt and provide flat surface.

4. Allow crack seal to cure a minimum of 24 hours before applying slurry seal.

D. Traffic Control:

1. Implement the notification and traffic control plan requirements. Do not proceed without certified flaggers.
2. Grind off existing pavement markings and lane striping. Use reflective tabs to mark striping location before applying slurry seal.

E. Cleaning:

1. Clean existing paved surfaces of all dirt, sand, dust and other objectionable material with use of power broom, prior to placing seal coat. Power broom shall be inspected and approved by the City Engineer or City Inspector prior to use.
2. Remove loose material that may cause drag marks.
3. Do not flush water over cracked pavement or apply pressurized water to cracked Pavement.

F. Tack Coat:

1. Apply tack coat to high-absorbent, polished, oxidized, or raveled asphalt surfaces or to concrete or brick surfaces.
2. Apply tack coat and pave over concrete Cover Collars.
3. Use the same asphalt emulsion as used in slurry seal application.

3.02 PROTECTION

- A. Protect trees, plants and other ground cover from damage.
- B. Prune trees to allow equipment passage underneath, APWA Section 32 01 93. Repair tree damage at no additional cost to OWNER.
- C. Install Invert Covers, APWA Section 01 71 13.
- D. Mask Street Fixtures.
- E. Protect curb, gutter, sidewalk and other structures from spatter, mar, or overcoat.
- F. Protect slurry seal from traffic until seal has cured. Cure time depends on type of asphalt, mixture characteristics and weather.

3.03 PLACING TEMPORARY ROAD MARKERS

- A. Prior to placing seal coat, install raised markers to mark striping location.
- B. Install raised markers in accordance with the manufacturer's written instructions and recommendations.
- C. Remove covers immediately after rolling is complete.

3.04 CONSTRUCTION EQUIPMENT

- A. Paver: Use a continuous-flow mixing unit meeting the following:
 1. Capable of applying at least 15,000 square yards of material per day.

2. Capable of accurately delivering a predetermined portion of aggregate, water, and asphalt emulsion to the mixing chamber.
 3. Prevent loss of slurry from the distributor by using a mechanical type squeegee distributor equipped with flexible material in contact with the pavement surface.
 4. Has a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the mix design application rate.
- B. Meter Calibration: On a test strip at least 500 feet long, determine the correct meter settings on the mixing equipment. The settings are to produce a product that complies with the following:
1. Thirty (30) minutes maximum initial set time. Initial set occurs when blotting of the slurry seal surface yields only water (no emulsion).
 2. No distress when exposed to traffic two (2) hours after placement.

3.05 PLACING SEAL COAT MATERIAL

- A. Place seal coat in accordance with the following:
1. Use an application rate of 15 to 18 pounds per square yard.
 2. Machine meter settings must match mix design.
 3. Pre-wet existing pavement
 4. Wait at least two (2) hours if an adjacent pass has broken and started to cure.
 5. Apply slurry seal material such that, when cured, it presents a uniform, skid-resistant appearance with all cracks filled.
 6. Do not apply lane marking tape or paint for traffic control until layout and placement has been verified with the City Engineer.
- B. During application, water and additives may be adjusted (per mix design) for better consistency or set time. All other changes require a new mix design.
- C. Operate equipment to meet the following conditions in the spreader box:
1. Do not exceed four (4) minutes total mixing time.
 2. Do not add additional water.
 3. No lumping, balling or unmixed aggregate.
 4. No segregation of the emulsion and aggregate fines from the coarse aggregate.
 5. No breaking of emulsion.
 6. Carry a sufficient amount of slurry in all parts of the spreader at all times so that full width and complete coverage is obtained with no streaks or narrow spots. Avoid overloading the spreader.
- D. Apply seal coat in accordance with the following:
1. Dampen surface immediately before application of slurry seal. All surfaces are to be uniformly damp with no free water standing on the surface or in cracks when seal coat is applied.

2. If coarse aggregate settles to bottom of mix, remove slurry from pavement.
 3. In areas where spreader box cannot be used, apply slurry by hand.
- E. Install joints in accordance with the following:
1. Make transverse joints straight-cut butt type, not over-lap type.
 2. Place longitudinal joints on lane lines. Limit overlap to three (3) inches maximum.
 3. Tolerance for joint match is 1/4 inch difference in elevation when measured with a 10 feet long straight edge over the joint.
 4. Use construction paper or comparable products so all beginning and ending joint lines from each construction pass are straight.
 5. Stop and correct paving operation if longitudinal or transverse joints have uncovered areas or unsightly appearance.
- F. Install seal with edge and end lines meeting the following:
1. Mask off end of streets and intersections to provide straight lines.
 2. Make straight lines along lip of gutter and shoulders. No runoff on these areas permitted.
 3. Vary edge lines no more than two (2) inches per 100 feet.

3.06 FINISHING DETAILS

- A. Do not create build-up when constructing longitudinal and transverse joints.
- B. Place slurry seal adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge. Do not allow over-lap on these areas. Remove slurry seal placed on concrete at no cost to the City.
- C. Maintain straight lines at all locations.
- D. Place slurry seal at side streets and intersections out to right-of-way line.
- E. Use hand squeegees to spread slurry in areas that cannot be reached with slurry seal machine.
 1. Lightly dampen areas before mix placement.
 2. Provide complete and uniform coverage.
 3. Avoid unsightly appearance by maintaining smooth surfaces and transitions during hand work.
 4. Use the same type of finish in hand worked areas as applied by the spreader box.

3.07 REPAIR

- A. Remove spatter or mar from curb and gutter, sidewalk, guard rails and guide posts at no additional cost to OWNER.
- B. Remove slurry seal from Street Fixtures.
- C. Make correction lines straight. Provide good appearance.
- D. Fill any joints or cracks that are not covered by slurry seal. Leave no streaks, holes, bare spots, or

cracks through which liquids or foreign matter could penetrate to the underlying pavement.

- E. Repair collateral damage caused by construction.

3.08 LIMITATIONS

- A. Do not apply slurry seal during rain, when standing or flowing road surface moisture is present, or during other adverse weather conditions.
- B. Do not apply slurry seal if either the pavement or air temperature is below 50 degrees F and falling. Slurry seal may be applied when both the pavement and air temperatures are above 45 degrees F and rising.
- C. Do not apply slurry seal when the temperature is projected below 35 degrees F within 24 hours of placing slurry seal.
- D. Cease slurry seal operations when weather or other conditions prolong opening road surface to traffic beyond two hours.
- E. Keep traffic off roadway surface until the slurry seal has cured.

END OF SECTION

SECTION 02652

CONCRETE STREET IMPROVEMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete curb and gutter and appurtenant items.
- B. Cast-in-place concrete waterways and appurtenant items.
- C. Cast-in-place concrete sidewalks and appurtenant items.
- D. Cast-in-place concrete driveway pavement and appurtenant items.
- E. Handicap ramps and appurtenant items.
- F. Curb-cut type driveway entrances and appurtenant items.
- G. Cast-in-place concrete speed tables.

1.02 RELATED SECTIONS

- A. Section 02100 - Roadway and General Excavation.
- B. Section 02115 - Structural Excavation.
- C. Section 02116 - Fill and Backfill.
- D. Section 02621 - Gravel Road Base.
- E. Section 03300 - Cast-In-Place Concrete.

1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete: As specified in Section 03300 - Cast-in-Place Concrete; using 3/4 inch maximum aggregate.
- B. Concrete Reinforcement: As specified in Section 03300.
- C. Gravel Base: As specified in Section 02621 - Gravel Road Base.
- D. Expansion Joint Filler: Shall be 1/2-inch thick; conforming to ASTM D 1751 or AASHTO M 213. Joint filler shall be one-piece; and shall extend full width and depth of concrete section; 1/4-inch below and conforming to finished top surfaces of concrete items.
- E. Handicap Ramp Warning Panels.
 - 1. Panels shall be detectable warning systems conforming to ADA, FHWA and all other applicable appurtenant regulations; designed for exterior use and surface application.

2. Panels shall be durable panels molded from polyurethane, with truncated domes, meeting both state and federal guidelines for handicap detection.
3. Panels shall be molded from high strength polyurethane.
 - a. Submit manufacturer's literature describing products, installation procedures and routine maintenance; and three samples of surface applied mat to be supplied.
 - b. Panels shall have slip resistance in wet and dry environments.
 - c. Panel color shall be yellow; conforming to Federal Color # 33538. Color shall be homogenous throughout the mat.
4. Panels shall comply with Americans with Disabilities Act, Title 49, Section 4.29 2.
5. Mats shall be installed according to manufacturer's written instructions and recommendations.
 - a. Mats shall be applied to concrete surfaces with heavy-duty elastomeric two-part polyurethane ground adhesive, as recommended by the manufacturer.
 - b. Edges and seams shall be sealed with cyanoacrylate sealer, as recommended by the manufacturer.
 - c. Low profile nylon expansion anchors shall be installed after mats are installed, according to the manufacturer's instructions and recommendations.
6. After mats have been installed, the mats shall be protected from damage as recommended by the manufacturer.
7. Mats shall be cleaned by method specified by manufacturer.
8. Panels shall be Detectable Warning Mats as manufactured by Detectable Warning Systems, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify excavation for concrete items is correct.
- B. Verify that sub-base has been compacted and accepted by the City Engineer or City Inspector, and that gradients and elevations are correct.
- C. Verify that all areas of collapsible soil have been identified and properly prepared for sub-base.

3.02 EARTHWORK

- A. See Section 02100 - General Excavation and Section 02115 - Structural Excavation for requirements for excavating, backfilling and compacting; See Section 02116 - Fill and Backfill for requirements for filling and backfilling; and see Section 02621 - Gravel Road Base for requirements for gravel base.
- B. Hand trim excavations for accurate placement of gravel base for concrete items.
- C. Furnish, place, grade and compact untreated base course for concrete work, as indicated on the drawings.
 1. Curb and Gutter: compacted thickness shall be 6 inches.
 2. Waterways: compacted thickness shall be 6 inches.
 3. Sidewalks: compacted thickness shall be 6 inches.
 4. Driveway Pavement: compacted thickness shall be 6 inches.

- D. Backfill around completed concrete items to required elevations, tamp in place and compact as required.

3.03 CONSTRUCTION

A. Form Work.

1. Forms shall be set to the required grade and lines, as indicated on the drawing; rigidly braced and secured.
2. Install sufficient quantity of forms to allow continuous progress of work; and so that forms can remain in place for at least 24 hours after placement of concrete.
3. Check completed form work for grade and alignment, before placing any concrete. Tolerances for form work shall not exceed 1/8-inch in 10 feet for the top of forms; and 1/4-inch in 10 feet for the vertical face.
4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

B. Concrete Placement.

1. Comply with applicable requirements of Section 03300 - Concrete for design, mixing and placement of concrete; and with the requirements herein.
2. Do not place concrete until subgrade and forms have been inspected and approved for line and grade.
3. Moisten subgrade as required to provide a uniform dampened condition at time concrete is placed.
4. Place concrete using methods which will prevent segregation of concrete mix, and with as little re-handling as possible.
5. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint.
6. Consolidate concrete along the face of forms with an internal vibrator. Keep vibrator away from joint assemblies or side frames. Consolidate with care to prevent dislocation of reinforcement and joint materials.
7. Use only square-faced shovels for hand spreading and consolidation.
8. Where handicap ramps and curb-cut type driveway entrances are to be constructed, the curb of new curb and gutter shall be eliminated down to the limits and for the width indicated on the drawings; and the curb shall be sloped on each side of the ramp and driveway entrance.

C. Expansion/Conmution Joints. Construct joints true-to-line, with face perpendicular to the surface of the concrete item and at right angle to centerline of the concrete item, unless shown otherwise. Joints shall be filled with joint filler material. The contractor must follow all included guidelines unless indicated otherwise on the drawings and as directed by the City Engineer.

1. Curb and Gutter. Provide joints at a spacing not to exceed 100 feet, on center; unless indicated

otherwise on the drawings. Construct joints by inserting a 1/8-inch thick steel division plate, matching cross-section of curb and gutter, into concrete; plate shall not extend into bottom 4-1/2 inches of the curb and gutter. Set division plate into plastic concrete and carefully remove after concrete has hardened.

2. Sidewalks. Provide joints at a spacing not to exceed 40 feet, on center; unless indicated otherwise on the drawings. Construct joints by inserting a 1/8-inch thick steel division plate into concrete; plate shall be embedded 1/4 of sidewalk thickness, measured from the top of sidewalk. Set division plate into plastic concrete and carefully remove after concrete has hardened.
3. Driveway Pavement. Provide joints as indicated on the drawings; and where pavement abuts other concrete construction.
4. Speed Tables. Provide joints as indicated on the drawings; and where speed tables abut other concrete construction.
5. Cold Joint. Provide expansion joints at all start/stop locations.

D. Construction Joints. Construct construction joints true-to-line, with face perpendicular to the surface of the concrete item and at right angle to centerline of the concrete item, unless shown otherwise. The contractor must follow all included guidelines unless indicated otherwise on the drawings and as directed by the City Engineer.

1. Provide construction joints where required.
2. Curb and Gutter. Provide construction joints at a spacing not to exceed 10 feet, on center; unless indicated otherwise on the drawings.
3. Waterways. Provide construction joints to match the width of the sidewalk, on center; unless indicated otherwise on the drawings.
4. Sidewalks. Provide construction joints at a spacing not to exceed 5 feet, on center; unless indicated otherwise on the drawings.
5. Driveway Pavement. Provide construction joints at a spacing not to exceed 6 feet, on center; unless indicated otherwise on the drawings.
6. Speed Tables. Provide construction joints at a spacing not to exceed 10 feet, on center; unless indicated otherwise on the drawings.

E. Finishing and Ruling.

1. After striking off and consolidating concrete, smooth exposed surfaces by screeding and floating; adjust floating to compact surfaces and produce uniform texture.
2. After floating, check surfaces for trueness with a 10-foot long straightedge. Distribute concrete as required to remove surface irregularities; and refloat repaired surfaces to provide smooth, continuous surfaces with a tolerance of 1/4-inch when measured by the 10-foot long straightedge.
3. Work edges of gutters, waterways, sidewalks and driveway pavement, transverse joints, and contraction joints with an edging tool; and round to 1/4-inch radius, unless indicated otherwise.
4. Work edges of top back of curbs with an edging tool; and round to 1/2-inch radius, unless indicated otherwise.
5. Finishing:
 - a. Curb and Gutter. After completion of floating and when excess moisture and surface sheen has disappeared, trowel finish exposed surfaces smooth, free of trowel marks, and uniform in

- texture and appearance.
 - b. Waterways. After completion of floating and when excess moisture and surface sheen has disappeared, trowel finish exposed surfaces smooth, free of trowel marks, and uniform in texture and appearance. Surfaces shall be warped to match flow lines of gutters at each end of waterway, as indicated on the drawings.
 - c. Sidewalks. After completion of floating and when excess moisture and surface sheen has disappeared, broom finish exposed surfaces by pulling a fine-hair broom across concrete surfaces, perpendicular to line of traffic, until uniform in texture and appearance.
 - d. Driveway Pavement. Pavement shall be finished as specified for sidewalks; with rough flat finish.
 - e. Speed Tables. After completion of floating and when excess moisture and surface sheen has disappeared, trowel finish exposed surfaces smooth, free of trowel marks, and uniform in texture and appearance.
- F. Form Removal and Repair Work.
- 1. Forms shall not be removed for at least 24 hours after concrete has been placed.
 - 2. After form removal, clean ends of joints and point-up minor honeycombed areas.
 - 3. Remove and replace areas or sections of concrete with major honeycomb areas.
- G. Curing Concrete.
- 1. Protect and cure finished concrete, complying with applicable requirements of Section 03300 - Concrete.
 - a. Use white colored cure.
 - 2. Use moist-curing methods for initial curing, whenever possible.
 - 3. A membrane-forming curing compound shall be used when required by the City Inspector; applied in accordance with the manufacturer's written instructions.

3.04 SPECIAL CONSTRUCTION

- A. Curb-Cut Type Driveway Entrances. Driveway entrances shall consist of modifying the curb of 30 inch curb and gutter and warping surfaces of 6-inch thick concrete driveway pavement or concrete sidewalk for the width and to the configuration indicated on the drawings, as described herein. Contractor must follow all included guidelines unless indicated otherwise on the drawings and as directed by the City Engineer.
- 1. Curb of curb and gutter shall be eliminated down to the limits indicated on the drawings, and to the width of the existing driveway; and the curb shall be sloped on each side of the driveway as indicated.
 - 2. Where there is a park strip between the sidewalk and back of curb and gutter, driveway pavement, 6-inches thick, shall be constructed between the sidewalk and the back of curb. The surfaces of the driveway pavement shall be shaped to form a smooth entrance from the curb-cut at the curb and gutter to the edges of the sidewalk, as indicated.
 - 3. Where the sidewalk is adjacent to the back of curb and gutter, 6-inches thick sidewalk shall be constructed at the driveway entrance, as indicated. The surfaces of the sidewalk shall be shaped to form a smooth entrance from the curb-cut at the curb and gutter to the edge of the sidewalk adjacent to the property line, as indicated.
- B. Handicap Ramps. Handicap ramps shall be constructed at curb and gutter radius sections at street intersections, as indicated on the drawings. Work shall consist of modifying the curb of 30 inch curb and gutter and warping surfaces of concrete sidewalk for the width and to the configuration indicated on the

drawings. Contractor must follow all included guidelines unless indicated otherwise on the drawings and as directed by the City Engineer.

1. Excavate as required to establish the proper sub-base for the gravel base for the ramp.
2. Furnish, place, grade and compact gravel base, 6-inches thick. Follow all current ADA requirements.
3. Curb of curb and gutter shall be eliminated down to the limits and to the width indicated on the drawings; and the curb shall be sloped on each side of the handicap ramp as indicated.
4. Where there is a park strip between the sidewalk and back of curb and gutter, concrete pavement, 5-inches thick, shall be constructed to match back of curb and gutter radius section and the ends of the sidewalk on each side of the ramp. The surfaces of the concrete pavement shall be shaped to form a smooth ramp from the curb-cut at the curb and gutter to the ends of the sidewalk, as indicated.
5. Where the sidewalk is adjacent to the back of curb and gutter, concrete pavement, 5-inches thick shall be constructed to match back of curb and gutter radius section and the ends of the sidewalk on each side of the ramp, as indicated. The surfaces of the concrete pavement shall be shaped to form the handicap ramp from the curb-cut at the curb and gutter to the ends of the sidewalk, as indicated.
6. Warning panels shall be installed as indicated on the standard drawings; according to the manufacturer's drawings, written instructions and recommendations.

C. Speed Tables. Speed tables shall be constructed as indicated on the drawings.

3.05 REPAIR AND MAINTENANCE

- A. Contractor shall repair and maintain project curb and gutter, waterways, sidewalks, driveway pavement, driveway entrances, handicap ramps, and other concrete structures as required, during the guarantee period.
 1. All repairs shall be made with materials similar and equal to those described in these specifications.
 2. All construction shall be done as described in these specifications.
- B. Contractor shall, at least one month before expiration of the guarantee period, make all such repairs as may be necessary to produce concrete items which will:
 1. Conform substantially in contour to the concrete item as first constructed.
 2. Be free from cracks or depressions showing disintegration of the concrete mixture of the concrete item.
 3. Be free from all settlement of the surface of the concrete pavement holding water, or other settlements showing variation of 3/8-inch or more from the edge of a four-foot long straightedge.
 4. Not have settled because of incomplete compaction of the subgrade.
- C. When repairs, that are necessary to be made during the guarantee period, amount to more than fifty percent of a section between two expansion joints, the entire section shall be removed and disposed of; and that section shall be reconstructed in accordance with these specifications.

3.06 PROTECTION OF CONSTRUCTED CONCRETE ITEMS

- A. Protect concrete items of this section from damage by subsequent construction activities.

- B. Replace damaged concrete items which cannot be repaired to a level approved by the City Inspector.

3.07 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01400.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design to engineer and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C 39. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cu yd or less of concrete placed.
- F. Take two additional test cylinders during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each load at point of discharge; and perform slump test with each set of test cylinders taken.
 - 1. If maximum slump for the application is exceeded, it will be assumed that the water content is excessive and the load shall be rejected.
 - 2. If slump is less than the minimum for the application, a measured quantity of water may be added to the mix; quantity shall not exceed 1/6 gallon of water per bag of cement.
 - 3. Water shall be added only in the presence of the City Engineer and after a slump test has been made.
 - 4. If concrete has been mixed for more than one hour, the loss of slump shall be considered as being caused by setting of concrete; water shall not be added, and the load shall be rejected.
- H. Perform test to determine air content in accordance with ASTM C 231; a minimum of one test shall be done each time a slump test is made. Air content shall be within specified limits.

END OF SECTION

SECTION 02724

AUTOMATIC SPRINKLING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete automatic sprinkling system, including:
 - 1. Pipe and fittings.
 - 2. Valves, valve boxes, and appurtenant items.
 - 3. Automatic controller, control valves, valve boxes, wires and appurtenant items.
 - 4. Sprinkler heads and appurtenant items.
 - 5. Connections to water main lines.
- B. System design and testing.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching for Pipe Work: Excavating, pipe bedding, backfilling and compacting.
- B. Section 02115 - Excavation: Excavating for structures and appurtenant items.
- C. Section 02116 - Fill and Backfill: Pipe bedding and excavation backfilling.
- D. Section 02586 - Backflow Preventer Station.
- E. Section 03300 - Cast-in-Place Concrete: Concrete for structures and thrust blocks.

1.03 REFERENCES

- A. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- B. ASTM A 234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- C. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.
- D. ASTM D 2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- E. ASTM D 2241 - Standard Specification for Poly(Vinyl Chloride)(PVC) Pressure-Rated Pipe (SDR Series).
- F. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
- G. ASTM D 2466 - Standard Specification for Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedules 40.

- H. ASTM D 2564 - Standard Specification for Solvent Cement for Poly(Vinyl Chloride)(PVC) Plastic Piping Systems.
- I. ASTM D 2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
- J. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- K. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- L. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water; American Water Works Association; (ANSI/AWWA C104/A21.4).
- M. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; (ANSI/AWWA C105/A21.5).
- N. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; (ANSI/AWWA C111/A21.11).
- O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; (ANSI/AWWA C151/A21.51).
- P. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; American Water Works Association.
- Q. AWWA C504 - Rubber Seated Butterfly Valves; American Water Works Association.
- R. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS; American Water Works Association; (ANSI/AWWA C508/C508a).
- S. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; (ANSI/AWWA C509/C509a).
- T. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service; American Water Works Associations: (ANSI/AWWA C515).
- U. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances; American Water Works Association; (ANSI/AWWA C600).
- V. STM D2774 - Standard Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
- W AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution; American Water Works Association; (ANSI/AWWA C900/C900a).
- X AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 4 inch through 63 inch, for Water Distribution; American Water Works Association.
- Y Use the latest issue of the above reference standards as of the date of the Project.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, controllers, sprinkler heads, and accessories.

- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of pipe lines, valves, controllers, sprinkler heads, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 SYSTEM DESIGN

- A. The sprinkling system shall be designed to provide adequate coverage to all areas to be watered.
- B. Project drawings of the system shall be submitted to the City Engineer, showing design and general layout of pipe distribution system and sprinkler heads required to provide complete coverage and uniform distribution.
 - 1. Drawings shall indicate pipe sizes, control valves, quick-coupling valves, automatic controller, control wiring, electrical service line, connections to water mains, backflow preventers, and all appurtenant items.
 - 2. Pipe system for spray heads shall have minimum pipe size of 3/4-inch; for rotor pop-up sprinklers shall have minimum pipe size of 3/4-inch; and for the impact rotor pop-up shall have minimum pipe size of 1-inch.
 - 3. Quick-coupling valves shall be placed in the system where indicated on the drawings.
 - 4. Drawings shall show system design pressures and PVC pipe classifications (either Schedule 40 or Schedule 80). A pipe size over 4" shall utilize class 200 pipe.
- C. Design a pipe distribution system to provide sufficient water to each of the heads. Spray Heads and Rotator Heads shall be on separate zones.
- D. The Contractor may modify the layout of heads to better fit project conditions; providing that complete coverage and uniform distribution is maintained.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with City's requirements as described herein.
- B. A third party audit verifying the distribution uniformity (DU) of the system is needed. Minimum requirements are 70% for the rotors and 50% for spray heads.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves, controllers, heads, and appurtenant items in shipping containers with labeling in place.

1.08 OPERATING AND MAINTENANCE DATA

- A. Provide complete As-Builts for entire system. Also Provide an 8 ½"x 11" laminated zone map illustrating each zone by color and zone number.
- B. Provide instructions covering full operation, care and maintenance of system and controls; and manufacturer's parts catalog.
- C. Instruct City's designated maintenance personnel in the proper operation of the system, including adjustment of sprinkler heads.
- D. Submit 3 copies of written instructions recommending procedures to be established by the City

Engineer for the maintenance of the system from year to year.

1. Submit at least 30 days before the expiration of required one year guarantee period.
2. Provide information in the manuals that include the following:
 - a. written index near front of Manual listing location in the Manual of all emergency data regarding the installation;
 - b. complete nomenclature of all replaceable parts, their part numbers, current cost, and name and address of the nearest vendor of replacement parts; and
 - c. copy of all guarantees and warranties issued on the installation showing all dates of expiration.

PART 2 PRODUCTS

2.01 GENERAL

- A. All sprinkler heads, control valves, quick-coupling valves, automatic controllers and appurtenant items for the sprinkling system shall be supplied by the same supplier. Materials shall be as manufactured by Rainbird Sprinkling Mfg. Corporation.

2.02 WATER SUPPLY AND DISTRIBUTION PIPE

- A. Ductile Iron Pipe: AWWA C151:
 1. Fittings: Ductile iron, standard thickness.
 2. Joints:
 - a. Push-On Joints: AWWA C111, push-on type with rubber gasket.
 - b. Mechanical Joints: AWWA C111, mechanical joint type with gasket, bolts, and nuts.
 - c. Flange Joints: AWWA C110, flange type with gasket, bolts, and nuts.
 3. Jackets: AWWA C105 polyethylene jacket.
- B. PVC Pipe: AWWA C900 Class 150 or 200, as indicated:
 1. Fittings: AWWA C111, cast iron.
 2. Joints: ASTM D 3139 compression gasket ring.
- C. Polyethylene Pipe: ASTM D 3035, for 160 psig pressure rating:
 1. Fittings: AWWA C901, molded or fabricated.
 2. Joints: Compression.
- D. High Density Polyethylene Pipe: AWWA C906:
 1. Material: PE 3408 High Density Polyethylene (HDPE) meeting ASTM D3350 cell classification of 345434C.
 2. Fittings: AWWA C906, molded or fabricated; or mechanical joint ductile iron fittings.
 3. Joints: Butt fusion.
- E. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters for all plastic pipe.

2.03 SPRINKLING SYSTEM DISTRIBUTION AND LATERAL PIPE

- A. PVC Pipe: ASTM D 1785, Schedule 40 or 80, as required.
 - 1. Fittings: ASTM D 2466, Schedule 40 or 80, as required.
 - 2. Joints: Cemented with Primer and solvent weld, as required.
 - 3. Schedule 80 pipe shall be used between stop & waste valves and master valves; and Schedule 40 pipe shall be used downstream from master valves.
- B. Polyethylene Pipe: ASTM D 3035, for 160 psi pressure rating:
 - 1. Fittings: AWWA C901, molded or fabricated.
 - 2. Joints: Compression.
- C. The minimum pipe size for distribution and lateral pipes to be 3/4-inch.

2.04 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, and handwheel.
 - 2. Product: Powell U.S. Bronze Gate Valves.
 - 3. Substitutions: See Section 01600 - Product Requirements.
- C. Gate Valves 3 Inches and Over:
 - 1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - 2. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - 3. AWWA C515, ductile iron, bronze trim, non-rising stem with square operating nut, single ductile iron wedge, mechanical joint or flanged ends as indicated, and cast iron valve box.
 - 4. Product: Mueller Gate Valves or Resilient Seat Gate Valves, or American Flow Control Series 2500 Resilient Seat Gate Valves; with appropriate type Pacific States Cast Iron Valve Box.
- D. Ball Valves Up To 2 Inches:
 - 1. Brass body, teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, compression inlet end, compression outlet, with control rod, valve key, and extension box.
 - 2. Treat the Ball Valve and Handle to prevent moisture from metal causing corrosion.
- E. Swing Check Valves from 2 Inches to 24 Inches:
 - 1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2. Product: Mueller Swing-Type Check Valve.

F. Butterfly Valves from 2 Inches to 24 Inches:

1. AWWA C504, iron body, bronze disc, resilient replacement seat, mechanical joint or flanged ends as indicated, manual worm gear operator, and cast iron valve box where required.
2. Underground manual operators shall be totally enclosed, factory grease packed and sealed, bronze worm gear operators with self-locking gearing; stops shall be provided to prevent over travel of valve disc.
3. Valve operator shall be geared to close valves slowly. Number of turns to close valve from full open position shall be: 32 turns for 10-inch and smaller valves, 52 turns for 12-inch thru 16-inch valves, and 76 turns for 18-inch thru 24-inch valves. Closing times for larger valves must first be accepted by the City Engineer.
4. Product: Mueller "Lineseal III" Butterfly Valve with appropriate type Pacific States Cast Iron Valve Box.

G. Corporation Stops: shall be type for connecting to copper or polyethylene pipe; Mueller No. H- 15000 for up to 2-inch service line.

H. Air Release Valves: shall be combination air release valves; APCO Combination Air Release Valves, or of size indicated on the drawings.

2.05 SPRINKLER HEADS

A. Part Circle Rotor Pop-Up Sprinklers.

1. Part circle rotor pop-up sprinklers shall be a single nozzle gear drive type, capable of covering the design radius at the site pressure with a discharge rate as recommended by the manufacturer; and shall have an infinitely adjustable arc of coverage from 40° to 360°.
2. Sprinkler case shall be constructed of rugged ABS plastic. The internal assembly shall include water-lubricated gear drive, pressure-activated wiper seal, SAM check device and heavy duty screen. The rotation of the sprinkler shall be accomplished by a gear drive.
3. The sprinkler nozzle shall have an outlet trajectory of 25° from the horizontal, with adjustment screw.
4. The sprinkler shall have a heavy-duty stainless steel retract spring to ensure positive pop-down. Pop-up height shall be not less than 6 inches; and the inlet shall be one-inch (FNPT).
5. The sprinkler shall be constructed so that all internal parts, including inlet screen, are accessible through the top of the sprinkler case without disturbing the soil around the case. The sprinkler shall have a rubber cover and vandal resistant cover screws.
6. Sprinklers shall be Part Circle Rotor Pop-up Sprinklers, of the appropriate size and type, as manufactured by Rain Bird Sprinkling Mfg. Corporation, Hunter Industries.

B. Full Circle Rotor Pop-Up Sprinklers.

1. Full circle rotor pop-up sprinklers shall be a single nozzle gear drive type, capable of covering the design radius at the site pressure with a discharge rate as recommended by the manufacturer.
2. Full circle sprinklers shall have the same construction as the part circle sprinklers described above.
3. Sprinklers shall be Full Circle Rotor Pop-up Sprinklers, of the appropriate size and type, as

manufactured by Rain Bird Sprinkling Mfg. Corporation or Hunter Industries.

C. Full/Part Circle Rotor Pop-Up Sprinklers.

1. Rotor pop-up sprinklers shall have full or part circle capabilities in one unit; and shall be a single nozzle, water lubricated, turbine drive type with internal impact speed reduction, capable of covering the design radius at the site pressure with a discharge rate as recommended by the manufacturer.
2. Part circle sprinkler shall have an infinitely adjustable arc of coverage from 25° to 350°. The sprinkler shall not reverse direction during continuous operation in the full circle mode. Arc adjustment shall not require any tools.
3. The sprinkler case shall be constructed of rugged ABS plastic. The sprinkler shall include a stainless steel locking set-screw at cap threads to provide vandal resistance and a "Seal-A-Matic" (SAM) device built onto the inlet screen shall hold back 8 feet of elevation change to prevent puddling. The sprinkler shall have a non-strippable drive mechanism and shall permit manual rotation of the pop-up stem; and shall have a pressure-activated, multi-function, soft elastomer wiper seal that positively seals against the nozzle flange to keep debris out of the rotor and to clean debris from the pop-up stem as it retracts. The sprinkler range nozzle shall have an outlet trajectory of 23° from the horizontal. The sprinkler shall have a screen attached to the drive housing to filter inlet water and prevent the nozzle from clogging.
4. Sprinklers shall have a heavy-duty stainless steel retract spring to ensure positive pop-down. Pop-up height shall be not less than 5 5/8-inch; and the bottom inlet shall be 3/4-inch (FNPT).
5. Sprinklers shall be constructed so that all internal parts, including inlet screen, are accessible through the top of the sprinkler case without disturbing the soil around the case. The sprinkler shall have a rubber cover and vandal resistant cover screws.
6. Sprinklers shall be Full/Part Circle Pop-up Rotor Sprinklers, of the appropriate size and type, as manufactured by Rain Bird Sprinkling Mfg. Corporation, Hunter Industries.

D. Sprinkler Types and Spacing.

1. Large Area Rotors: Hunter I-40 at 50 foot maximum spacing.
2. Medium Area Rotors: Hunter I-20 at 35 foot maximum spacing.
3. Spray Heads: Rainbird # 1806 for turf areas; # 1812 for shrub beds.
 - a. East to west park strips: provide 120 percent coverage; 12 foot spacing typical.
 - b. North to south park strips: provide 100 percent coverage; 15 foot spacing typical.
 - c. Built in check valves required if elevation changes from one head to next head.
 - d. No Adjustable Arc Nozzles, Fixed Arc Nozzles only.
 - e. No MP Rotator Nozzles.
4. Drip Systems: Hunter PCN Nozzles, series bubbler nozzles.
 - a. Compatible with Pro Spray bodies or 1800 heads.
 - b. No fixed risers for bubblers.
 - c. Pop-Ups with spray heads
5. Type of landscape areas will determine flow requirements.
 - a. P.R.V., if needed, use an individual pressure regulating device, such as an accuset.

2.06 ELECTRIC CONTROL VALVES

- A. Electric remote control valves shall be normally closed 24 VAC, 60 cycle, solenoid actuated globe pattern design capable of having a flow rate as required with a pressure loss not to exceed 1.5 psi.

The valve pressure rating shall not be less than 200 psi.

- B. Valve body and bonnet shall be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm shall be of nylon reinforced nitrile rubber.
- C. Valve shall have both internal and external manual open/close control, for manually opening and closing the valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box.
- D. Valves shall house a fully-encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a leverage handle for easy turning. The 24 VAC, 60 Hz solenoid shall open with 19.6 VAC minimum at 200 psi. At 24 VAC, average inrush current shall not exceed 0.41 amps.
- E. Valves shall have a brass flow control stem for accurate manual regulation and/or shut off of outlet flow. The valve must open or close in less than one minute at 200 psi, and less than 30 seconds at 20 psi.
- F. Valves shall have a self-cleaning stainless steel screen designed for use in dirty water applications.
- G. Valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
- H. Control valves shall be Electric Remote Control Plastic Scrubber Valves, of the appropriate size and type, as manufactured by Rain Bird Sprinkling Mfg. Corporation, Hunter ICV Control Valves with Filter Sentry.

2.07 QUICK-COUPLING VALVES

- A. Quick-coupling valves shall be a 1" minimum one piece type; constructed on heavy cast brass. The cover shall be a durable, self-closing, and locking rubber cover. The valves shall be opened and closed by a brass key of the same manufacturer, having an appropriate outlet. The valve throat shall have a keyway with detent positions for regulating flow.
- B. Quick-coupling valves shall be Model 3-RC, as manufactured by Rain Bird Sprinkling Mfg. Corp

2.08 CONTROL WIRE

- A. Control wire shall be UF No. 14 gauge or larger; conforming to the requirement of Section 05123.

2.09 SPRINKLING SYSTEM CONTROLLER

- A. Sprinkling system controller shall be capable of fully automatic or manual operation of the system.
- B. The controller shall operate on a 17 VAC, plus or minus 10%, power input; and be capable of operating four 24 VAC electric remote control valves per station. The controller shall have a reset circuit breaker to protect it from power overload.
- C. The controller shall be constructed such that all internal parts are accessible through the controller door without disturbing the cabinet installation.
- D. The controller shall be an Hunter ACC Clock Controllers, of the appropriate size and type. Including IMMS Radio, Com Module, Antenna and Cable with Raised Yagi, or as required by the City Engineer, to be installed per the Radio Gain Test.
- E. The enclosure for the controller shall be a combined 120/240 volt commercial meter socket with enclosure, as required.

1. The enclosure unit shall have a compact, double door, front and back design; to provide viewing and programming convenience.
 - a. Construction shall be 100 percent stainless steel; finish shall be brushed stainless steel.
 - b. The unit shall be weather and vandal resistant, NEMA TYPE 3R rated, with three-point locking system; and shall be UL listed.
 - c. The unit shall have a 10-year limited warranty.
2. Meter section:
 - a. UL listed, E.U.S.E.R.C. 308 approved commercial meter socket, 100 amp rated, with test block bypass provision.
 - b. Hinged viewing window to provide convenient access for metering agency.
 - c. Shall include 100 amp load center with 8 positions.
3. The enclosures shall be Strong Box Metered Stainless Steel Combination Enclosure, Model SB-24SS / 120/240 V, as required and as manufactured by V.I.T. Products, Inc.

2.10 MISCELLANEOUS ITEMS

- A. Miscellaneous appurtenant items shall be provided as indicated on the drawings or as required to complete the sprinkler system.

2.11 PIPE BEDDING AND BACKFILL MATERIALS

- A. Bedding: As specified in Sections 02112 and 02116.
- B. Backfill: As specified in Sections 02112 and 02116.

2.12 ACCESSORIES

- A. Service Clamps: shall be bronze, double-strap type; Mueller No. H-16134, for up to 2 inch service lines.
- B. Concrete for Thrust Restraints: Concrete type specified in Section 03300.
- C. Manhole and Cover: Refer to Section 02340.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, materials and equipment as required to construct the complete automatic, underground sprinkling system, as described herein and as shown on the design drawings, as indicated on the submittal drawings; and shall furnish and install all supplementary and miscellaneous items, appurtenances, and devices incidental to or necessary for a workable and complete sprinkling system installation.
- B. All material shall be installed according to the manufacturer's written instructions and recommendations.
- C. The Contractor shall test the entire sprinkling system to assure proper operation.

3.02 EXAMINATION

- A. Verify that design drawings conform to project conditions.
- B. Verify that existing water main sizes and locations are as indicated on the drawings.

3.03 PREPARATION

- A. Cut pipe ends square, ream pipe ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges, mechanical joints or mechanical couplings.

3.04 TRENCHING

- A. Trenching for the sprinkling system shall be done to ensure proper grades, slopes and alignment; and to provide minimum cover over main lines of 24-inches and 12-inches over laterals.
- B. See Section 02112 and Sections 02115 and 02116 for additional requirements.
- C. Hand trim excavation for accurate placement of pipe to elevations indicated.
- D. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide required area of thrust restraint bearing on subsoil as indicated on the drawings.
- E. Backfill around sides and to top of pipe zone with pipe bedding material, tamp in place and compact to required density.
- F. Backfill trench from top of pipe zone to top of trench with trench backfill material, tamp in place and compact to required density.

3.05 INSTALLATION - PIPE

- A. Group piping with other piping work whenever practical.
- B. Establish elevations of buried piping to ensure not less than 2 feet of cover over main lines and 12 inches over laterals; or as indicated on the drawings.
- C. Install pipe to indicated elevation to within tolerance of one inch.
- D. Install ductile iron piping and fittings to AWWA C600.
- E. Install PVC pressure pipe and fittings to ASTM D2774.
- F. Install pipe lines to line and grade indicated.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Slope water pipe and position drains at low points.
- I. Install trace wire above top of PVC and PE pipe; coordinate with Section 02112.

3.06 INSTALLATION - VALVES

- A. Set valves on concrete block.
- B. Center and plumb valve box over valve operating nut. Set box cover flush with finished grade.

3.07 INSTALLATION - CONTROL VALVES

- A. Install control valves where and as shown on the submittal drawings.
 - 1. Each control valve shall have threaded unions installed immediately upstream and downstream of all valves.
 - 2. Each control valve shall have its own isolation valve, immediately upstream of the first union. No "Action" union manifolds or "Action" union ball valves.
 - 3. Install only one control valve per rectangular box.
 - 4. Use of male adapters are prohibited.
- B. Set valves on concrete block.
- C. Center and plumb valve boxes over valves. Set box cover flush, not level, with finished grade.

3.08 INSTALLATION - QUICK-COUPLING VALVES

- A. Quick-coupling valves shall be installed where and as shown on the submittal drawings.
- B. Quick-coupling valves are to be installed in the system to provide the Owner access so that the system can be winterized by blowing out the system with compressed air; therefore, the valves shall be located as indicated on the drawings.

3.09 INSTALLATION - AUTOMATIC CONTROLLER

- A. The controller and remote control valves shall be of the same manufacturer, having similar operational and adjustment features.
- B. The controller shall have a weatherproof panel enclosure; with the controller mounted on a pedestal, where and as indicated on the drawings; in such a manner that all normal adjustments can be conveniently made by the operator.
- C. The controller shall be properly grounded in accordance with local codes.
- D. Control wire shall be installed from the controller to all control valves and other equipment as required for proper operation of the sprinkling system.

3.10 WIRE AND ELECTRICAL WORK

- A. Electrical control and ground wire shall be suitable for sprinkler control cable of sizes indicated on the drawings and as recommended by the manufacturer or supplier.
- B. Use Type "UF", 600 volt, stranded or solid copper, single conductor wire, with PVC insulation and bearing UL approval for direct underground burial, for connecting the automatic remote control valves to the automatic controller.
 - 1. Use wire with 4/64-inch insulation, minimum covering of ICC-100 compound for positive weatherproofing protection.
 - 2. For wire sizes 14, 12, 10 and 8 use a single conductor solid copper wire; and for sizes 6 and 4 use stranded copper wire.
 - 3. Control or "hot" wires shall be red and all common or "ground" wires shall be white.
- C. Make all connections with UL approval Pen-tite type seal to make a waterproof connection.

- D. Bury wires underneath main line pipe when in the same trench as the pipe.
- E. Verify that all wire types and installation procedures conform to NEC and local codes.

3.11 INSTALLATION - SPRINKLER HEADS

- A. Flush the sprinkler system thoroughly to remove all foreign materials prior to the installation of sprinkler heads.
- B. Install rotor pop-up heads with a swing joint connection, as indicated on the drawings.
 - 1. All swing joints shall consist of three 90 degree Schedule 40 PVC street ells and Schedule 80 nipples with a minimum length of 12 inches.
 - 2. Size of swing joint pipe and fittings shall be as shown on the drawings.
- C. Install spray heads as indicated on the drawings.

3.12 BACKFLOW PREVENTER STATION

- A. Provide Reduce Pressure Zone (RPZ) where and as indicated on the drawings; see Section 02586.

3.13 CONNECTIONS TO EXISTING WATER LINES

- A. Connection to existing water lines shall be made where and as indicated on the drawings. The sizes of pipe, fittings, valves and appurtenant items required to make connection shall correspond to the sizes of existing pipe and of project pipe.
- B. Excavate to existing pipe line at point of connection; determine actual conditions of existing pipe and all fittings and appurtenant items required to make the connection; and have all materials needed on site prior to any shut down or cutting into existing pipe lines.
- C. Connections that involve cutting into existing pipe lines include: cutting and removing sections of existing pipe and fittings as required; cleaning and preparing ends of existing pipe as required for connection; furnishing and installing all new pipe, fittings and valves required to make the connection of project pipe to the existing pipe as indicated; and all appurtenant work required to complete the connection.
- D. Connection into existing pipe lines under pressure include: furnishing and installing mechanical joint tapping sleeve of the appropriate size on the existing pipe at point of connection; furnishing and installing tapping valve, with valve box, on sleeve; tapping existing pipe with drilling machine and equipment, without interrupting flow in existing pipe line; and all appurtenant work required to complete the connection.
- E. Connection to existing pipe line shall be made at such times and within the time limits and according to the directions as agreed to between the Contractor and the City Engineer.

3.14 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01400.
- B. Pressure test water piping to 1.25 times pipe line working pressure in psi.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to City.

3.15 OPERATIONAL TESTING

- A. Provide the City Engineer or City Inspector with seven days written notice of sprinkling operational system test.
- B. Test shall consist of the operation of the entire system through one cycle of controller for propose of checking coverage and assuring of absence of leaks.
 - 1. Repair water lines, valves, or connections which show evidence of leakage.
- C. After all repairs or replacements have been made and accepted by the City Engineer or City Inspector, repeat the above required test.

END OF SECTION

SECTION 02725

RESTORING WETLANDS AREAS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Restoration of wetlands areas.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

1.03 REFERENCES

- A. Standards of Official Seed Analysis of North America.

1.04 DEFINITIONS

- A. Weeds: Includes Cheatgrass (Bromus Tectorum), Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Phragmites.

1.05 SUBMITTALS

- A. See appropriate sections of the Contract Documents for submittal procedures.
- B. Certification: Submit certification of grass species and location of seed source.

1.06 QUALITY ASSURANCE

- A. Seed Vendor: Company specializing in seed with minimum five years' experience, and certified by the State of Utah.
- B. Installer Qualifications: Company approved by the seed vendor.

1.07 REGULATORY REQUIREMENTS

- A. Comply with the requirements of the U.S. Army Corps of Engineer for work within wetlands areas.
- B. Comply with regulatory agencies for fertilizer and herbicide composition.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of fertilizer and herbicide mixture.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wetlands Seed Mix.
 - 1. Seed Mix. Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by the Association of Seed Analysis of North America. Provide seed of

species, mechanically premixed to the specified proportions, with minimum percentages of purity, germination and maximum percentages of weed seed as certified. Seed Mix shall be a blend of the listed seeds, as supplied by Granite Seed Company of Lehi, Utah.

2. Standards. Seed mix shall comply with "Standards of Official Seed Analysis of North America"; for 85% purity, 80% germination and 1% (maximum) weed seed.
 3. Submit seed vendor's certified statement for each seed mixture required; stating botanical and common name, percentage by weight, and percent of purity, germination and weed seed for each seed species.
 4. Provide Wetland seed mix of the following species and with proportions as approved by the Corps of Engineers:
 - a. Nebraska Sedge (*Carex nebrascensis*)
 - b. Baltic Rush (*Juncus balticus*)
 - c. Redtop (*Agrostis alba*)
 - d. Garrison Creeping Foxtail (*Alopecurus Arundinaceus*)
 5. Sow the seed mix in quantities to provide pure, live seed at the coverage rate of 20 pounds per acre.
 6. Delivery. Seed shall be delivered to the site in original unopened containers, bearing the dealer's guaranteed analysis and germination percentage and a certificate or stamp or release by a County agriculture commissioner.
- B. Fertilizer: Recommended for seed mix, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.
- C. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.02 TESTS

- A. Provide analysis of topsoil fill under provisions of Section 01400.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- C. Testing is not required if recent tests within six months are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare sub-grade in accordance with Section 02112.
- B. Place topsoil, where required, in accordance with Section 02112 and Section 02100.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.

- B. Apply after smooth raking of topsoil and prior to seeding.
- C. Apply fertilizer no more than 48 hours before installing erosion control mat and seeding.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 RESTORATION OF WETLANDS AREAS

- A. Restore existing wetlands areas that are disturbed or damaged by project trenching operations or structural excavations, as indicated on the drawings. Wetlands areas shall be as classified by the U.S. Army Corps of Engineers, following field reconnaissance and testing; and shall be to the limits designated by the City Engineer.
 - 1. Restoration shall be done according to the wetlands permit included with the approved project drawings.
 - 2. Remove the top 2 feet of top soil material and store separately from other excavated material.
 - 3. After the lower portions of trench or excavations are backfilled with acceptable materials and compacted, the stockpiled top soil material shall be placed in the upper portion of the trench or excavations and compacted.
 - 4. Top of restored top soil shall match adjacent ground surfaces.
 - 5. Restoration of wetlands areas shall include preparation of seedbeds and seeding the areas to be restored.
 - 6. Condition of restored wetlands areas shall match original conditions.
- B. Planting.
 - 1. Preparation.
 - a. Till area to be planted to a depth of not less than 4 inches prior to seeding; and to a homogeneous mixture of fine texture, free of lumps and clods.
 - b. Grade planting areas to provide smooth, even surfaces with a loose, uniformly fine texture. Roll and rake and remove ridges and fill in depressions as required.
 - c. Moisten prepared areas by sprinkling before planting, if soil is dry. Water thoroughly and allow surface to dry off before planting. Do not create muddy soil condition.
 - 2. Seeding.
 - a. Seed shall be applied by hydraulic method with a hydro-seeder at the coverage rate recommended by the seed vendor. Seeding may be done using spreader or seeding machine, at the rate indicated and as recommended by the seed vendor. Do not use wet, moldy or damaged seed.
 - b. Distribute seed evenly over entire area by sowing equal quantities in two opposite directions.
 - c. Seeding shall not be performed when the wind velocity exceeds 5 miles per hour, or is determined detrimental to the uniform distribution of seed.
 - 3. All materials must be available for inspection prior to application.

4. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
5. All landscaping will be covered by a warranty for a period of one year.
 - a. Seeded Areas. At the end of the warranty period, seeded areas shall have 70 percent coverage of full, established growth; free of all noxious weeds.
 - b. At end of warranty period, replant areas showing root growth failure, bare or thin spots, and eroded or settled areas within 10-days of written notice. Plant with materials of like kind and size, planted in the next growing season, with a new warranty commencing on the date of planting. All corrective work will be at no additional cost to the Owner.

END OF SECTION

SECTION 02726

LANDSCAPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Fertilizing.
- C. Seeding
- D. Maintenance.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- B. Section 02100- Roadway and General Excavation: Slopes protection and topsoil placement.

1.03 REFERENCES

- A. Standards of Official Seed Analysis of North America.
- B. ANSI Z60.1, American Standard for Nursery Stock.

1.04 DEFINITIONS

- A. Weeds: Includes Cheatgrass (*Bromus Tectorum*), Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Phragmites.

1.05 SUBMITTALS

- A. See appropriate sections of the Contract Documents for submittal procedures.
- B. Certification: Submit certification of grass species and location of seed source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum height; types, application frequency and recommended coverage of fertilizer.
- D. NOI permit and Erosion Control Plan per section 01700.

1.06 QUALITY ASSURANCE

- A. Seeds.
 - 1. Vendor: Company specializing in supplying seed with a minimum five years' experience, and certified by the State of Utah.
 - 2. Installer Qualifications: Company approved by the seed vendor.
- B. Trees and Shrubs.

1. Vendor: Company specializing in growing and cultivating trees and shrubs with a minimum five years' experience, and certified by the State of Utah.
2. Installer Qualifications: Company specializing in installing and planting trees and approved by tree supplier.

1.07 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of fertilizer and herbicide mixture.

1.08 MAINTENANCE AND SERVICE

- A. Furnish service and maintenance of seeded or sodded areas prior to acceptance onto warranty as well as up to the end of warranty when applicable. Seeded areas shall have a 100 percent coverage of full, established growth, free of all weeds, prior to acceptance onto warranty.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lawn Seed.
 1. Lawn Grass Mix. Lawn grass seed shall be fresh, clean, new crop seed; mechanically premixed to the specified proportions. Lawn grass seed shall be a blend of the following seeds: Kentucky Bluegrass, 80%, Rye Grass, 20%; planted at a rate of 3.0 pounds per 1000 square feet.
 2. Standards. Grass seeds shall comply with "Standards of Official Seed Analysts of North America," published by the Association of Official Seed Analysts, most recent edition; for 85% purity, 80% germination and 1% (maximum) weed seed (68% PLS).
 3. Delivery. Seed shall be delivered to the site in original unopened containers, bearing the dealer's guaranteed analysis and germination percentage and a certificate or stamp or release by a County agriculture commissioner.
 4. Seed to be applied by hydraulic method shall be mixed with wood fiber mulch, fertilizer and polymer at 50 pounds per 100 square feet.
 5. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.
 6. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- B. Trees: Shall be Grade A trees of the type acceptable to the City Engineer; with deciduous 2 ½" caliper, ornamental 1 ½" caliper, and evergreen 6' tall. Trees shall be grown in climatic conditions similar to those in locality of the Work; with branching, configuration and cane requirements as indicated in ANSI Z60.1, American Standard for Nursery Stock. Provide trees of normal growth and uniform heights, according to the species, with straight trunks and well developed leaders, laterals and roots. Provide legible labels attached to tree indicating botanical genus, species, and size. The following trees are acceptable to the City of Saratoga Springs for Landscaping Dedicated to the City, other trees may be considered on a case by case basis:

Recommended Tree & Plant Palette

PUBLIC PLANTING						
	SPECIFIC NAME (BOTANICAL)	TYPE	SIZE (H X SPREAD)	PATTERN	PRODUCE/ COLOR IN BLOOM	SPECIAL INSTRUCTIONS
Large Shade Trees > 50 ft	Bloodgood London Plane Tree (<i>Platanu Acerifolia</i> 'Bloodgood')		60' x 60'	Allee Regular Clustered	1/3" berry/ N/A	Tolerates Salt, Yellow fall color
	Bur Oak* (<i>Quercus Macrocarpa</i>)		60' x 60'	Allee Regular	Nut/ N/A	Tolerant of Urban conditions, soil adaptable
	Sycamore Maple (<i>Acer psuedoplatanus</i>)		60' x 40'	Allee Regular	Samara/ N/A	Tolerates alkaline and salt conditions
	Silver Linden* (<i>Tilia Tomentosa</i>)		60' x 40'	Allee Regular Clustered	N/A / Yellow green	Green leaf surface, silver underside. Tolerant of heat/drought.
	Expresso Kentucky Coffee Tree (<i>Gymnocladus dioica</i> 'Expresso')		60' x 40'	Allee Regular Clustered	1/3" berry / N/A	Tolerates wide range of conditions/salt
	Cimmaron Green Ash* (<i>Franxinus pennsylvanica</i> 'Cimmaron')		60' x 30'	Allee Regular Clustered	Samara / N/A	Tolerant of Urban conditions, soil adaptable
	Emerald Queen Norway Maple* (<i>Acer platanoides</i> 'Emeral Queen')		50' x 40'	Allee Regular Clustered	Smara/ N/A	Tolerant of Urban conditions, soil adaptable
	Accolade Hybrid Elm (<i>Ulmus x "Accolade"</i>)		50' x 40'	Allee Regular	Samara / N/A	Pollution/ Salt/ drought tolerant
	Crimson King Maple (<i>Acer Platanoides</i> 'Crimson King')		45' x 40'	Allee Regular Clustered	Samara/ N/A	Well adapted to extremes in soils. Withstands hot, dry condition.
	Magyar Maidenhair Tree* (<i>Ginko Biloba</i> 'Magyar') Male Species Only		50' x 30'	Regular, Clustered	N/A / N/A	Tolerates high ph, salt, urban conditions. Excellent yellow fall color.
	Catalpa (<i>catalpa speciosa</i>) Podless Only		50' x 30'	Allee Regular Clustered	White	Attractive flower, withstands dry, alkaline conditions.
	Austrian Pine (<i>Pinus nigra</i>)		50' x 30'	Clustered	Cone	Can withstand urban conditions and alkaline soils.
	Scotch Pine (<i>Pinus sylvestris</i>)		40' x 30'	Clustered	Cone	Can withstand urban conditions and alkaline soils.
	Cottonwood (<i>Populus sargentii</i>) cottonless variety		80' x 50'	Regular	N/A / N/A	Great fall color. Tolerant of poor soils/salt/drought
	Globe Willow (<i>Salix matsudana</i> <i>umbraculifera</i>)		40' x 40'	Allee Regular Clustered	N/A / N/A	Prefers wet conditions. Salt tolerant.
English Columnar Oak (<i>Quercus robur</i> "fastigiata")		60' x 15'	Allee Regular Clustered	Acorn/ Red	Prefers well drained soil and alkaline conditions.	

*-Denotes compatibility for use as a street tree.

PUBLIC PLANTING						
	SPECIFIC NAME (BOTANICAL)	TYPE	SIZE (H X SPREAD)	PATTERN	PRODUCE/ COLOR IN BLOOM	SPECIAL INSTRUCTIONS

Medium Shade Trees 45 ft to 50 ft	Queen Elizabeth Hedge Maple (<i>Acer Campestre</i> 'Queen Elizabeth')		45' x 45'	Regular Clustered	N/A / N/A	Pollution/salt/ drought tolerant
	Rocky Mountain Juniper (<i>Juniperus scopulorum</i>)		40' x 15'	Regular Clustered	Cone / N/A	Drought tolerant/native
	Shangri-La Maidenhair Tree* (<i>Ginkgo biloba</i> 'Shangri-la')		45' x 25'	Allee Regular Clustered	Seed / N/A	Males should be planted, excellent yellow fall color
	Armstrong Maple* (<i>Acer freemanii</i>)		45' x 15'	Allee Regular Clustered	Samara / N/A	Distinctly upright, soil adaptable
	Common Hackberry* (<i>Celtis occidentalis</i>)		40' x 30'	Regular Clustered	1/3" Berry / N/A	Tolerates drought/pollution/poor soils/ salt
	Little Leaf Linden* (<i>Tilia cordata</i>)		40' x 25'	Allee Regular Clustered	N/A / Yellow green	Tolerant of urban conditions, soil adaptable
	Sensation Box Elder* (<i>Acer negundo</i> 'Sensation')		30' x 30'	Allee Regular Clustered	Samara / N/A	Tolerant of urban conditions/ poor soils/ salt
	Thornless Honeylocust* (<i>Gleditsia triacanthos</i> var. <i>inermis</i>)		30' x 25'	Regular Clustered	Samara / N/A	Brilliant red fall color
	Gamble Oak (<i>Quercus gambelii</i>)		25' x 20'	Clustered	Acorns / N/A	Native/great red fall color/
	Big Tooth Maple (<i>Acer grandidentatum</i>)		30' x 20'	Clustered	Samara / N/A	Great red fall color/requires well drained soil
	Sky Rocket Juniper (<i>Juniperus scopulorum</i> 'Skyrocket')		20' x 3'	Allee Regular Clustered	Cones / N/A	Drought tolerant/withstands alkaline conditions
	Frontier Elm (<i>Ulmus</i> x 'frontier')		30' x 25'	Allee Regular Clustered	N/A / N/A	Resistant to Dutch Elm disease

*-Denotes compatibility for use as a street tree.

PUBLIC PLANTING						
	SPECIFIC NAME (BOTANICAL)	TYPE	SIZE (H X SPREAD)	PATTERN	PRODUCE/ COLOR IN BLOOM	SPECIAL INSTRUCTIONS
Small Shade Trees <25 ft	Service Berry (<i>Amelanchia</i> sp.)		25' x 20'	Regular, Clustered	Nut/ White	Cream white fragrant flower, tolerates poor soils.
	Tatarian Maple * (<i>Acer Tataricum</i>)		25' x 20'	Clustered	Samara / N/A	Tolerates cold, drought, high ph soils. Excellent red fall color.
	Lavalle Hawthorn* (<i>Crataegus</i> x <i>lavallei</i>)		25' x 20'	Clustered	1/2" berry (persistent) white	Bronzy or coppery-red fall color with bright red persistent berries into winter.
	Canada Red Chokecherry (<i>Prunus virginiana</i> 'Canada Red')		25' x 20'	Allee, Regular, Clustered	1/3" berry white	Soil adaptable, tolerant of urban conditions, very attractive foliage.
	Amur Maackia (<i>Maackia amurensis</i>)		20' x 20'	Allee, Regular, Clustered	1/3" berry / white	Bronzy or coppery-red fall color with bright red persistent berries into winter.

Flowering Plum (<i>Prunus cerasifera</i> 'Thundercloud')		20' x 15'	Allee, Regular, Clustered	N/A / pink flowers	Purple leaf. Tolerant of urban conditions.
Crabapple (<i>Malus</i> 'Indian Magic')		20' x 20'	Allee, Regular, Clustered	Orange berry/ Deep pink blossoms	Persistent fruit. Tolerates urban conditions.
Crabapple (<i>Malus</i> 'prairifire')		20' x 20'	Allee, Regular, Clustered	Red berry/ Red Blossoms	Persistent fruit. Tolerates urban conditions.

*-Denotes compatibility for use as a street tree.

PUBLIC PLANTING						
	SPECIFIC NAME (BOTANICAL)	TYPE	SIZE (H X SPREAD)	PATTERN	PRODUCE/ COLOR IN BLOOM	SPECIAL INSTRUCTIONS
Hedge	Karl Foerster Feather Reed Grass (<i>Calamagrostis x acutiflora</i> 'Karl Foerster')		4'	Formal Massing	Seed heads/ White/Gold	Very attractive as a hedge in formal massings
	Blue Mist Spirea (<i>Caryopteris x clandonensis</i>)		3 – 5'	Formal Massing	N/A / Blue/Purple	Flowers in summer/early fall
	Rubber Rabbit Brush (<i>Chrysothamnus nauseosus</i>)		4'	Informal Grouping	N/A / Yellow	Yellow fall cover/seeds and cover for birds
	Red Osier Dogwood (<i>Cornus sericea</i>)		8 – 15'	Informal Grouping	White berries / White	Attractive winter red twigs
	Hedge Cotoneaster (<i>Cotoneaster lucida</i>)		4 – 6'	Informal Grouping	Black berries / White	Dark green lustrous leaves in summer
	Mormon Tea (<i>Ephedra nevadensis</i>)		2 – 4'	Informal Grouping	N/A / N/A	Drought tolerant/evergreen
	Forsythia (<i>Forsythia</i>)		4 – 6'	Formal Massing	N/A / Yellow	Early spring flowers are powerful in large massing
	Rose of Sharron (<i>Hibiscus syriacus</i>)		6 – 12'	Formal Massing	N/A / White/Pink/ Purple/Blue	Showy flowers in summer
	Utah Honeysuckle (<i>Lonicera utahensis</i>)		3 – 5'	Formal Massing	Small red berries / white	Traditional pioneer plant
	Maiden Hair Grass (<i>Miscanthus sinensis</i>)		6'	Formal Massing	Seed heads / Bronze/Purple	Very attractive as a hedge in formal massings.
	Heavy Metal Switch Grass (<i>Panicum virgatum</i> 'Heavy Metal')		5'	Formal Massing	Seed heads / gold	Upright/stiff habit
	Mock Orange (<i>Philadelphus coronarius</i>)		8'	Formal Massing	N/A / White	Traditional pioneer plant, fragrant flowers
	Purple Leaf Sand Cherry (<i>Prunus x cistena</i>)		8'	Formal Massing	N/A / White	Red/purple leaves
	Squawbush Sumac (<i>Rhus trilobata</i>)		4 – 6'	Informal Grouping	Small red pubescent berries / White	Excellent red fall color
	Golden Currant (<i>Ribes aureum</i>)		3'	Formal Massing	Yellow spring berries / Yellow	Red fall color/fruit for birds
	Wild Rose (<i>Rosa woodsii</i>)		2 – 6'	Informal Grouping	Rosehips / Pink/magenta	Drought tolerant
	Sutherland Gold Elderberry (<i>Sambucus racemosa</i> 'Sutherland Gold')		8'	Formal Massing	Red/Black berries / White	Edible fruit/attractive yellow foliage
	Snow Berry (<i>Symphoricarpos alba</i>)		3'	Informal Grouping	White berries / White	Showy white berries
	Amur Maple (<i>Acer ginnala</i>)		10' - 20'	Formal Massing	Samara / N/A	Excellent Red Fall Color
	Utah Serviceberry (<i>Amelanchier utahensis</i>)		6 – 15'	Informal Grouping	Red/purple/ black pome / White	Important food source for wildlife
Boxwood (<i>Buxus sempervirens</i>)		2 – 4'	Formal Massing	N/A / N/A	Evergreen shrub	
River Birch (<i>Betula occidentalis</i> 'font clump')		15 – 20'	Informal Cluster	Catkin / N/A	Wet conditions/ Attractive red bark	
Hicks Yew (<i>Taxus x media</i>)		4 – 10'	Formal Massing	N/A / N/A	Evergreen shrub	

	American Cranberry Bush <i>Viburnum</i> (<i>Viburnum trilobum</i> 'Bailey Compact')		4'	Formal Massing	N/A / N/A	Rounded formal habit
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PUBLIC PLANTING						
	SPECIFIC NAME (BOTANICAL)	TYPE	SIZE (H X SPREAD)	PATTERN	PRODUCE/ COLOR IN BLOOM	SPECIAL INSTRUCTIONS
Ground Cover	Bugleweed (<i>Ajuga</i>)		4"	Formal Massing	N/A / Blue/purple	Many cultivars are well adapted to region.
	Basket of Gold (<i>Alyssum</i>)		8" to 12"	Informal Grouping	N/A / Yellow Flower	Early spring bloomer
	Compinkie Rockcress (<i>Arabis alpine 'Compinkie'</i>)		6"	Informal Grouping	N/A / Deep Rose	Evergreen foliage
	Kinnikinnik (<i>Arctostaphylos uva ursi</i>)		6" to 8"	Informal Grouping	Red Berries/ N/A	Evergreen, excellent red fall color.
	Rockcress (<i>Aubrieta</i>)		4" to 6"	Formal Massing	N/A / Magenta	Drought tolerant once established.
	Chocolate Flower (<i>Berlandiera lyrata</i>)		18"	Informal Grouping	N/A / Yellow	Drought tolerant once established.
	Poppy Mallow (<i>Callirhoe involucrata</i>)		2" to 4"	Informal Grouping	N/A / Magenta	Aggressive spreader. Attractive when paired with <i>Berlandiera</i>
	Snow in Summer (<i>Cerastium arvense</i>)		4" to 6"	Formal Massing	N/A / White	
	Dwarf Tickseed (<i>Careopsis 'nana'</i>)		6" to 8"	Formal Massing	N/A / Gold	Late spring bloomer.
	Hardy Ice Plant (<i>Delosperma</i>)		4" to 6"	Informal Grouping	N/A / Varies	
	Yarrow (<i>Achillea millefolium</i>)		2' x 2'	Informal Massing	N/A / Yellow Flowers	Drought tolerant.
	Sulphur Flowers (<i>Eriogonum umbrellatum aureum</i>)		5"	Informal Grouping	N/A / Yellow	Summer bloomer
	Goblin Blanket Flower (<i>Gaillardia 'Goblin'</i>)		12"	Informal Grouping	N/A / Yellow/Red	Heavy reseeder
	Mountain Boxwood (<i>Pachistima myrsinides</i>)		8"	Informal Grouping	N/A / N/A	Evergreen
	Sedum (<i>Sedum</i>)		4" to 12"	Informal Grouping	N/A / Varies	Many cultivars are well adapted to region
	Scarlet Globemallow (<i>Sphaeralcea coccinea</i>)		6" to 12"	Informal Grouping	N/A / N/A	
Lambs Ear (<i>Stachys Byzantine "Helen Von Stein"</i>)		8" to 10 "	Informal Grouping	N/A / Rose-purple		
Small Shrub	Silvermound Sage (<i>Artemisia schmidtiana</i>)		10" to 12"	Formal Massing	N/A / N/A	Uniform Mounding shape
	Black Sage (<i>Artemisia nova</i>)		18"	Informal Grouping	N/A / N/A	Drought tolerant once established.
	Creeping Potentilla (<i>Potentilla neumanniana</i>)		12"	Formal Massing	N/A / Yellow	Slow growing creeping form
	Dwarf Mugo Pine (<i>Pinus Mugo Mops</i>)		3' x 3'	Formal Massing	Cone/ N/A	Evergreen
Perennial	Blue Flax (<i>Linum Lewisii</i>)		15"	Formal Massing	N/A / Blue	Heavy reseeder

2.02 TESTS

- A. Provide analysis of topsoil fill under provisions of Section 01400.
- B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
- C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare sub-grade in accordance with Section 02116.
- B. Place topsoil where required.
- C. Top of sod or soil to be one-inch below edge of sidewalks, curb & gutter, ball courts, mow strips and other concrete surfaces.
- D. Place topsoil to the following compacted thicknesses:
 - a. Areas to be seeded with grass: 6 inches.
 - b. Areas to be sodded: 4 inches.
 - c. Areas for shrub beds: 18 inches.
 - d. Areas for flower beds: 12 inches.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to seeding.
- C. Apply fertilizer no more than 48 hours before installing erosion control mat and seeding.
- D. Lightly water to aid the dissipation of fertilizer.

3.04 PLANTING SEED

- A. Seeding.
 - 1. Landscaped Areas. Landscaped areas shall be seeded with grass seed and sod, as required, as described herein.
- B. Seeding shall not be performed when the wind velocity exceeds 5 miles per hour, or is determined detrimental to the uniform distribution of seed.
- C. Till areas to be planted to a depth of not less than 4-inches prior to seeding.
- D. Grade planting areas smooth, even surface with a loose, uniformly fine texture. Roll and rake and remove ridges and fill in depressions as required.
- E. Moisten prepared seeding area by sprinkling to a depth of six inches before planting; the area shall be surface dry at the time of application. Do not create a muddy soil condition.
- F. Seed shall be applied by hydraulic method with a hydro-seeder at the coverage rate recommended by the seed vendor. Seed may be applied by broadcast or drilled method at the recommended coverage by the seed vendor.
- G. Seeded areas shall have a 100 percent coverage of full, established growth that is free of all weeds.
- H. Rate of Application.

1. Lawn Grass seed mix shall be applied at rate of 3 pounds per 1000 square feet.
- I. All materials must be available for inspection prior to application.
- J. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.05 PLANTING TREES

- A. Trees. Trees shall be planted where approved by the City Engineer.
- B. Trees shall be planted during normal planting season.
 1. Excavate only for depth of root ball. The excavated area for tree planting shall be at least two times the diameter of the root ball, or as recommended by the supplier.
 2. Place trees for final orientation review by the City Engineer prior to backfilling the root ball.
 3. Installation of trees shall be done according Drawing No. LS-13; and as recommended by the supplier. Backfill material shall be acceptable to the supplier and inspected and approved by the City Inspector or City Engineer.
 4. After installation, trees shall be pruned as required, complying with ANSI A300.
 5. Trees shall be protected as recommended by the supplier.

3.06 LANDSCAPED AREAS

- A. Landscaped areas that are to be covered with landscaping bark, rocks or other materials, shall be treated with herbicide to kill weeds to control weed growth.
- B. Landscaped areas shall be watered with the most efficient type sprinkler system available that meets all other City specifications.
- C. Landscaped areas shall have a 100 percent coverage free of all weeds. Prior to acceptance, areas showing root growth failure, bare or thin spots, and eroded or settled areas shall be replanted. Plant with materials of like kind and size. All corrective work will be at no additional cost to the Owner.

3.07 MAINTENANCE REQUIREMENTS FOR LANDSCAPED AREAS DURING WARRANTY PERIODS

- A. Turf.
 1. General: Maintain seeded areas prior to acceptance as well as through the warranty period when applicable. Supply additional topsoil, where necessary, including areas affected by erosion or settlement.
 2. Watering: Water to ensure uniform seed germination and to keep surfaces of soil damp. Apply water slowly so soil will not puddle or crust.
 3. Fertilizing:
 - a. Fertilize during planting; and two weeks after planting.
 - b. Fertilize formulation to be determined from soil analysis taken yearly.
 4. Mowing:
 - a. Cut lawn grass for the first time when it reaches a height of 3-inches.
 - b. After first mowing, water to moisten soil from 3-inches to 5-inches deep.
 - c. After first mowing, mow on a 7-day cycle, preferably on Thursdays or Fridays.

- d. Use string trimmers on all hardscape edging, posts, utilities, etc. on the same day as mowing.
- e. Use metal blade edgers against concrete/turf areas one time per month.

- 5. Grading: Roll when required to remove minor depressions or irregularities.
- 6. Control Growth of Weeds: Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
 - a. Apply 2-4-D chemical for control of broadleaf weeds. Apply when conditions are most beneficial for control of weeds, usually mid-April and mid-September.
- 7. Reseeding: Immediately replace seed to areas which show deterioration or bare spots.
- 8. Protection: Protect seeded areas with warning signs during maintenance period. When necessary, erect temporary fences or barriers to control pedestrians.
- 9. Turf areas shall have 100 percent coverage of full, established growth that is free of all weeds.

B. Trees.

- 1. General: Maintain trees prior to acceptance as well as through the warranty period when applicable. Supply additional top soil where areas have been affected by erosion or settlement.
- 2. Maintain tree health immediately after planting. Trim only dead or broken branches; remove clippings and dead branches from the site. Control diseases.
 - a. Prune dead and broken branches only during first year. For deciduous trees, remove branches less than 5 feet above grade during the second year.
- 3. Watering:
 - a. After planting, keep ground continuously moist until healthy growth is established.
 - b. Thereafter, deep root water trees two times per month during first year of establishment.
 - c. Deep root watering is required for coniferous trees during winter months.
- 4. Weeding: Uproot and remove weeds completely. Do not allow growth and germination of weed seeds.
Fill in large holes caused by weeding with top soil and rake smooth.
 - a. Maintain weed free tree rings with 3-inch mulch depth. Tree rings to have 2 foot radius.
- 5. Protection: Protect trees against traffic by erecting temporary barriers and warning signs. Replant damaged trees.
- 6. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep wire tight. Repair or replace accessories where required.

C. Aeration. Aerate turf areas a minimum of two times per year; in the spring and in the fall. Core aerate; leave cores and break up if needed.

D. Irrigation System.

- 1. Repair all breaks immediately.
- 2. Perform weekly inspections and make needed adjustments.
- 3. Make seasonal adjustments to controllers as needed.

E. Erosion and Settlement. Repair trench settling, ruts, and rivulets caused by mowing equipment, irrigation and/or precipitation immediately.

3.08 WARRANTY

- A. All landscaping will be covered by a warranty for a period of one year.
- B. Seeded Areas. At the end of the warranty period, seeded areas shall have a 100 percent coverage of full, established growth; free of all noxious weeds, as defined in this section's definitions.
 - 1. At end of warranty period, replant areas showing root growth failure, bare or thin spots, and eroded or settled areas within 10-days of written notice. Plant with materials of like kind and size, planted in the next growing season, with a new warranty commencing on the date of planting. All corrective work will be at no additional cost to the Owner.
- C. Trees. Warranty for trees shall include death, unhealthy conditions, or if trees die from poor planting practices. Replace any unsatisfactory or dead tree within 10-days of written notice. Provide replacement trees of same size and species, planted in the next growing season, with a new warranty commencing on the date of planting. All corrective work will be at no additional cost to the Owner.

END OF SECTION

SECTION 02727

RESTORING NATIVE AREA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Fertilizing.
- C. Seeding
- D. Maintenance.

1.02 RELATED SECTIONS

- A. Section 02112 - Trenching: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

1.03 REFERENCES

- A. Standards of Official Seed Analysis of North America.
- B. ANSI Z60.1, American Standard for Nursery Stock.

1.04 DEFINITIONS

- A. Weeds: Includes Cheatgrass (*Bromus Tectorum*), Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Phragmites.

1.05 SUBMITTALS

- A. See appropriate sections of the Contract Documents for submittal procedures.
- B. Certification: Submit certification of grass species and location of seed source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum height; types, application frequency, and recommended coverage of fertilizer.

1.06 QUALITY ASSURANCE

- A. Seeds.
 - 1. Vendor: Company specializing in supplying seed with a minimum five years' experience, and certified by the State of Utah.
 - 2. Installer Qualifications: Company approved by the seed vendor.
- B. Trees and Shrubs.
 - 1. Vendor: Company specializing in growing and cultivating trees and shrubs with a minimum five years' experience, and certified by the State of Utah.

2. Installer Qualifications: Company specializing in installing and planting trees and approved by tree supplier.

1.07 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of fertilizer and herbicide mixture.

1.08 MAINTENANCE SERVICE

- A. Furnish service and maintenance of seeded or sod areas up to the end of warranty.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Restoring Native Grass Seed.
 1. Native Grass Mix. Native grass seed shall be fresh, clean, new crop seed; mechanically premixed to the specified proportions. Native grass seed shall be a blend of the following seeds:

<u>TYPE I: Grass & Wildflower Mix</u>	<u>PLANTING RATE</u>		
	<u>(Pounds of Pure Live Seed / Acre)</u>		
<u>PERCENTAGE</u>	<u>BROADCAST</u>	<u>DRILLED</u>	
Slender Wheat Grass (Agropyron trachucaulum)	2.75	2.06	13.75 %
Bluebunch Wheat Grass (Agropyron spicatum)	2.75	2.06	13.75 %
Sheep Fescue (Festuca ovina)	0.80	0.60	4.00 %
Sandberg Bluegrass (Poa sandbergii)	0.50	0.38	2.50 %
Western Wheat Grass (Agropyron smithii)	2.75	2.06	13.75 %
Green Needlegrass (Stipa viridula)	2.75	2.06	13.75 %
Prostrate Summer Cypress (Kochia prostata)	1.50	1.13	7.50 %
Blanket flower (Gaillardia aristata)	2.00	1.50	10.00 %
Blue flax (Linum lewisii)	1.50	1.13	7.50 %
Red Mexican Hat (Ratibida columnaris)	0.25	0.18	1.25 %
Basin Bid Sagebrush (Artemisia tridentata tridentata)	0.15	0.11	0.75 %
Rubber Rabbitbrush (Chrysothamnus nauseosus)	0.30	0.23	1.50 %
Winterfat (Ceratoides lanata)	2.00	1.50	10.00 %
Totals	20.0	15.00	100.00 %

<u>TYPE 2: Grass Mix (Tall)</u>	<u>PLANTING RATE</u>
	<u>PERCENTAGE</u>
Quick Guard (Sterile tricale hybrid)	21.74%
Crested Wheatgrass (Agropyron cristatum)	15.21%
Slender Wheatgrass (Agropyron trachcaulum)	19.57%
Bluebunch Wheatgrass (Agropyron spicatum)	13.04%
Intermediate Wheatgrass (Agropyron intermedium)	13.05%
Green Needlegrass (Stipa viridula)	5.43%
Western Wheatgrass (Agropyron smithii)	5.44%
Sheep Fescue (Fesctuca Ovina)	3.48%
Sandberg Bluegrass (Poa sandbergii)	2.61%
Sand Dropseed (Sporobolus Crytandrus)	0.43%
Totals	100.00%

<u>TYPE 3: Grass Mix (Short)</u>	<u>PLANTING RATE</u> <u>(Pounds of Pure Live Seed / Acre)</u>	
	<u>BROADCAST</u>	<u>PERCENTAGE</u>
Blue Grama (<i>Bouteloua gracilla</i>)	4.0	30.77%
Sheep fescue (<i>festuca ovina</i>)	5.0	38.46%
Sandberg Bluegrass (<i>Poa sandbergii</i>)	4.0	30.77%
Total:	13.0	100.00%

2. Standards. Grass seeds shall comply with “Standards of Official Seed Analysts of North America,” published by the Association of Official Seed Analysts, most recent edition; for 85% purity, 80% germination and 1% (maximum) weed seed (68% PLS).
3. Delivery. Seed shall be delivered to the site in original unopened containers, bearing the dealer’s guaranteed analysis and germination percentage and a certificate or stamp or release by a County agriculture commissioner.
4. Seed to be applied by hydraulic method shall be mixed with wood fiber mulch, fertilizer and polymer at 50 pounds per 100 square feet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare sub-grade in accordance with Section 02116.
- B. Place topsoil where required.

3.03 PLANTING SEED

- A. Seeding.
 1. Off-Site Restoration. All off-site work through areas that are covered with native grasses shall be reseeded with native grass seed, as required, as described herein.
- B. Seeding shall not be performed when the wind velocity exceeds 5 miles per hour, or is determined detrimental to the uniform distribution of seed.
- C. Till areas to be planted to a depth of not less than 4-inches prior to seeding.
- D. Grade planting areas smooth, even surface with a loose, uniformly fine texture. Roll and rake and remove ridges and fill in depressions as required.
- E. Moisten prepared seeding area by sprinkling to a depth of six inches before planting; the area shall be surface dry at the time of application. Do not create a muddy soil condition.

- F. Seed shall be applied by hydraulic method with a hydro-seeder at the coverage rate recommended by the seed vendor. Seed may be applied by broadcast or drilled method at the recommended coverage by the seed vendor.
- G. Rate of Application.
 - 1. Native Grass seed mix shall be applied at a supplier acceptable rate to obtain 70% growth and acceptance at end of warranty period.
- H. All materials must be available for inspection prior to application.
- I. Restore prepared areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.04 MAINTENANCE REQUIREMENTS FOR NATIVE AREA DURING WARRANTY PERIODS

- A. Furnish service and maintenance of restored area until 70% coverage is established.
- B. Area must be free of signs of erosion and evasive species.
- C. Area must be kept free of litter and mowed and trimmed as required in the fall of each year.
- D. Irrigation System may be required in order to obtain 70% vegetative coverage.
- E. Irrigation System
 - 1. Repair all breaks immediately.
 - 2. Perform weekly inspections and make needed adjustments.
 - 3. Make seasonal adjustments to controllers as needed.
- F. Erosion and Settlement. Repair trench settling, ruts, and rivulets caused by mowing equipment, irrigation and/or precipitation immediately.

3.05 WARRANTY

- A. All landscaping will be covered by a warranty for a period of one year.
- B. Seeded Areas. At the end of the warranty period, seeded areas shall have a 70 percent coverage of full, established growth; free of all noxious weeds.
 - 1. At end of warranty period, replant areas showing root growth failure, bare or thin spots, and eroded or settled areas within 10-days of written notice. Plant with materials of like kind and size, planted in the next growing season, with a new warranty commencing on the date of planting. All corrective work will be at no additional cost to the Owner.

END OF SECTION

SECTION 02752
CHIP SEAL COAT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials and procedures for applying emulsified asphalt, followed with an application of cover material and bituminous fog seal.
- B. Cover materials.

1.02 RELATED SECTIONS

- A. Section 01300 – Administrative Requirements
- B. Section 01400 – Quality Requirements

1.03 REFERENCES

- A. ASTM C 88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- B. ASTM C 117: Amount of Material Finer than 0.075 mm Sieve in Aggregate.
- C. ASTM C 131: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- D. ASTM C 136: Sieve Analysis of Fine and Coarse Aggregates.
- E. ASTM C 142: Clay Lumps and Friable Particles in Aggregates.
- F. ASTM D 5: Penetration of Bituminous Materials.
- G. ASTM D 36: Softening Point of Bitumen (Ring-and-Ball Apparatus).
- H. ASTM D 242: Mineral Filler for Bituminous Paving Mixtures.
- I. ASTM D 1664: Coating and Stripping of Bitumen-Aggregate Mixtures.
- J. ASTM D 2170: Kinematic Viscosity of Asphalts (Bitumens).
- K. ASTM D 2419: Sand Equivalent Value of Soils and Fine Aggregate.
- L. ASTM D 3319: Accelerated Polishing of Aggregates Using the British Wheel.
- M. ASTM D 3628: Selection and Use of Emulsified Asphalts.
- N. ASTM D 3740: Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- O. ASTM D 3910: Design, Testing, and Construction of Slurry Seal.
- P. ASTM D 4791: Flat or Elongated Particles in Coarse Aggregate.
- Q. ASTM D 5281: Determining the percentage of Fractured Particles in Coarse Aggregate.

R. UDOT Standard Specifications (Latest Ed.)

1.04 SUBMITTALS

- A. See Section 01300 – Administrative Requirements, for submittal procedures.
- B. Mix Design as per Article 2.04.
- C. Laboratory Accreditation as per Article 1.06 B.
- D. Field Quality Control data as per Article 1.05 C and 1.05 D.
- E. Traffic Control Plan as per APWA Section 015526
- F. Asphalt bill of ladings. Identify weight of asphalt, weight of emulsified asphalt (after water has been added) in accordance with Article 1.05 E and 1.05 F.

1.05 FIELD QUALITY CONTROL

- A. Perform Field Quality Control Sampling and Testing in accordance with the following.
 - 1. Asphalt Emulsion. Lot size is one (1) day production with 1500 SY sublots.
 - a. Perform and Document at least one visual inspection per subplot. Place binder uniformly with no ridging and no bare spots.
 - b. Perform and Document one yield test based on applicator meter readings and field measurements per subplot.
 - 2. Aggregate Gradation. Lot size is one (1) day production with 500 ton sublots. Take and test at least one gradation sample per subplot. ASTM C136.
 - 3. Aggregate Application. Lot size is one (1) day production with 1500 SY sublots.
 - a. Perform and Document at least one visual inspection per subplot. Place aggregate uniformly with no ridging and no bare spots.
 - b. Perform and Document one yield test based on delivery tonnage and field measurements per subplot.
 - 4. Aggregate Embedment. Lot size is one (1) day production with 1500 SY sublots. Perform and document at least one visual inspection per subplot.
 - a. Asphalt See-through: Not more than 15 percent black (asphalt) can be seen through the newly laid and compacted rock chip after sweeping.
 - b. Embedment: After rolling and evaporation, random sampling of at least 5 large particles reveals large particles are embedded in the asphalt binder on their flat side to a depth of 50 percent to 70 percent.
- B. Identify and correct any materials or processes not meeting requirements of this specification.
- C. Submit daily summary of Quality Control efforts to the City within 24 hours of completion of each day's placement.
- D. Submit all documentation verifying asphalt application rates, chip application rates, and other calibration verification for applied materials during the chip seal operations to the to the City within 24 hours of completion of each day's placement.
- E. Provide vendor's bill of lading certifying the emulsion meets the requirements of Article 2.01.
- F. Provide vendor's bill of lading certifying the flush coat material was diluted according to Article 2.02

1.06 QUALITY ASSURANCE

- A. Use a paving crew foreman that has completed at least three (3) projects of similar size and nature.
- B. Use an AMRL accredited laboratory that follows and complies with ASTM D 3740 and APWA Section 01 45 00 requirements.
- C. Do not change source of asphalt emulsion or aggregate until City accepts new source and new mix design.
- D. Reject product that does not meet requirements of this Section.
- E. Remove any product found defective after installation and replace at no additional cost to OWNER.

1.07 ACCEPTANCE

- A. Acceptance is by lot.
- B. Opening chip seal surface to traffic does not constitute acceptance.
- B. Lot will be acceptable if:
 - 1. Average gradation of each sieve for lot is within the Target Grading Band for that sieve, and;
 - 2. Number of samples in lot with any sieve measurement outside of the Target Grading Band does not exceed two (2), and;
 - 3. Material on 200 sieve gradation does not exceed allowable.
 - 4. Chip Seal Emulsion and Flush Coat emulsion Bills of Lading demonstrate conformance.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable City requirements for paving work on City streets, Section 01300 – Administrative Requirements.

PART 2 PRODUCTS

2.01 CHIP SEAL EMULSIONS

- A. Use the following Cationic Emulsions according to UDOT Sections 02745 – Asphalt Materials.
 - 1. Posted Speed \leq 25mph: CRS-2A
 - 2. Posted Speed \leq 45mph: LMCRS-2
 - 3. Posted Speed >45mph: CRS-2P
- C. Use HFRS-2P according to UDOT Section 02745 – Asphalt Materials if source aggregate has demonstrated historic incompatibility with cationic emulsions.

2.02 FLUSH COAT

- A. Flush Coat: Homogeneous, Cationic Emulsified Asphalt, Grade CQS-1 or CQS-1h, conforming to Section 32 12 13.13 of the APWA Standard Specifications, diluted two parts concentrate to one part water by the Manufacturer.

2.03 COVER MATERIAL

- A. Use crusher processed virgin aggregate consisting of natural stone, gravel, or slag according to Table 1.

Table 1

Chip Seal Cover Material Properties		
Unit Weight	AASHTO T 19	100 lb/ft ³ , max
One Fractured Face	AASHTO T 335	95% minimum
Two Fractured Faces	AASHTO T 335	90% minimum
LA wear	AASHTO T 96	30% maximum
Soundness	AASHTO T 104	10% maximum
Flats & Elongates (1:3)	ASTM D 4791	10% maximum
Polishing	AASHTO T 278, T 279	31 minimum
NOTES		
(a) Wear of aggregate retained on No. 8 sieve.		
(b) Soundness for combined coarse and fine aggregate measured using five (5) cycles.		

- B. Meet gradation limits in Table 2. Refer to AASHTO T 27 and T 11.

Table 2

Gradation Limits		
Sieve Size	Percent Passing	
	Type I – 1/4"	Type II – 3/8"
1/2 in		100
3/8 in	100	95-100
1/4 in	95-100	0 - 15
No. 8	0 - 3	0 - 3
No. 200	0 - 1.5	0 - 1.5

2.04 MIX DESIGN

- A. Mix Design: Provide the following. Allow CITY 10 days to evaluate the submittal.
1. Date of mix design. IF older than 60 days from date of submission, recertify mix design.
 2. Type and grade of asphalt emulsion to be used (if not specified).
 3. Target grading curve for the aggregate used.
 4. Aggregate physical properties (this section Article 2.3). The information is for suitability of source and not for project control. Test results shall not be older than 455 days from the date of submission.
 5. Asphalt and aggregate compatibility documentation.
 6. Initial asphalt and aggregate application rates.
 7. Fog seal application rate (if applicable).

2.05 BLOTTER MATERIAL

- A. Blotter material – granular materials meeting Table 3 when testing according to ASTM C136.

Table 3

Granular Materials	
Sieve Size	Percent Passing
No. 4	90 to 100
No. 10	25 to 80
No. 200	0 to 15

2.06 TEMPORARY RAISED PAVEMENT MARKERS

- A. Use Temporary Raised Pavement Markers as manufactured by Davidson Plastics Company.
- B. Markers shall have polyurethane plastic bodies with reflective tape, clear flexible polyvinyl-chloride protective covers, and solid butyl rubber adhesive on bottom surface.
- C. Markers shall be 2-inches high and 4-inches wide; and of the color selected by the City Engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean the road surface of all dirt, sand, dust, and other objectionable material to the satisfaction of the City.
- B. Protect all structures including but not limited to guardrail, guideposts, concrete barriers, all drains, and parapet walls.
- C. Cover manholes, valve boxes, drop inlets, and other service utility entrances before placing any chip seal coat.
- D. Protect curb, gutter, and sidewalk from spatter, mar or overcoat.
- E. Protect trees, plants and other ground cover from damage. Prune trees to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.
- F. Stockpile blotter material at a site within 20 minutes delivery time of each road section being chip sealed. Have application equipment on site before beginning chip seal work.
 - 1. Stockpiling of blotter material may be waived upon City approval if blotter material can be obtained and ready to spread within 20 minutes of a road section being chip sealed.
 - 2. Equipment to spread blotter material is subject to inspection by the City.
- G. Traffic Control:
 - 1. Implement the notification and traffic control plan requirements. Do not proceed without certified flaggers.
 - 2. Grind off existing pavement signs and lane striping. Use reflective tables to mark striping location before applying chip seal.
- H. Protect chip seal from traffic until seal has cured. Cure time depends on type of asphalt emulsion and weather.

3.02 LIMITATIONS

- A. Complete all work between May 15, and August 31.
- B. Do not place chip seal coat if surface moisture is present.
- C. Place seal coat when:
 - 1. Pavement temperature is between 70 and 136 degrees F.
 - 2. Air temperature is between 50 and 110 degrees F.
 - 3. Forecasted temperature is not expected to be below 40 degrees F within 3 days after placement.
- D. Do not apply any bituminous asphalt after 6:00 p.m. if temperatures in this Section, article 3. 2, paragraph C cannot be maintained throughout all night time hours.
- E. Do not open to traffic the same day chip seal coat is placed.
 - 1. Sweep and open to traffic no earlier than 6:00 a.m. the day following placement of cover material.
- F. Apply bituminous flush coat material after receiving approval from the City but no earlier than 6 days after application of the cover material.
 - 1. Apply bituminous flush coat material when the air temperature in the shade is 50 degrees F and rising and the pavement temperature is 70 degrees F and rising.
 - 2. Do not apply bituminous flush coat material during fog, rain, or other adverse conditions.
- G. Allow at least 7 calendar days after completing flush coat before applying permanent pavement markings.

3.03 TEMPORARY PAVEMENT MARKINGS

- A. Prior to placing seal coat, install raised markers to mark striping location.
- B. Install raised markers in accordance with the manufacturer's written instructions and recommendations.
- C. Remove covers immediately after rolling is complete.

3.04 EQUIPMENT

- A. Use distributor trucks according to the following requirements:
 - 1. Tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of the tank contents.
 - 2. Insulated tanks capable of storing the binder at temperatures that allow the binder to remain consistent with the appropriate viscosity for proper application rates
 - a. Use tanks equipped with baffles to prevent pressure surges resulting from the asphalt sloshing in the tank when starting and stopping.
 - b. Use trucks equipped with devices to provide for accurate and rapid correlation and control of the amount of bituminous material being applied with that of the truck or distributor gauges.
 - 3. Constant volume circulation pumps and heaters to maintain a pressurized system so binder will be uniformly heated.
 - a. Circulation pump must spray a constant volume for the entire length of the spray bar for each application.

4. Spray bar nozzles designed to provide an appropriate fan width to provide uniform transverse distribution without corrugation or streaking.
 - a. Adjust the spray bar height to provide uniform distribution of binder across the application width and triple lapping of the binder on the pavement surface
 - b. Use a fully circulating spray bar with a positive shutoff valve.
 5. Computerized rate control system allowing the operator to control all distributor operations from the cab to include:
 - a. Pressure regulation of the material application and automatic rate control adjustment to the unit ground speed.
 - 1) Hydrostatic system capable of maintaining a tolerance of +/- 0.3 gal/yd²
 - b. Spray bar height and width adjustment and shut off of individual spray bar sections.
- B. Use a self-propelled aggregate (chip) spreader specifically designed and manufactured for chip seal operations, equipped with the following:
1. Computerized controls that will apply a uniform, even layer of aggregate across the full width of the binder and adjust output to the unit ground speed.
 - a. Use gates adjustable to drop the correct amount of aggregate +/- 1 lb/yd².
 2. Variable width spreader with hydraulic control extension and adjustable discharge gates.
 3. Spreading hopper with a minimum capacity to cover a full lane of travel plus 1 ft/pass.
 4. Spinner broadcast type of aggregate spreader not allowed.
- C. Use sufficient number of dump trucks to circumvent any interruption in the supply of chips to the spreader.
1. Use tandem axle dump trucks or larger or conveyor discharge trucks to minimize the number of hook-ups.
 2. Use dump trucks with matching hitches and compatible with the aggregate spreader to provide smooth hook-ups and to minimize any spillage when loading the hopper.
 3. Use trucks in good mechanical condition and that do not leak.
 - a. Use truck tires that do not pick up binder or aggregate when driving on the new surface.
- D. Use at least three articulating type pneumatic rollers for rolling operations.
1. Use rollers weighing between 8 tons minimum and 12 tons maximum with a minimum width of 6 ft.
 2. Use rollers with pneumatic tires of equal size diameter and having treads satisfactory to the City.
 3. Inflate tires so that the entire roller width area is compacted by either the rear-axle tires or the front-axle tires.
 - a. Inflate tires to 90 psi, +/- 5 psi.
- E. Sweeping equipment:
1. Use rotary brooms with nylon or steel bristles or pickup or vacuum brooms for pavement cleaning or brooming operations.
 - a. Keep downward pressure to a minimum.
 - b. Use water as requested by the City if excessive dust is generated during sweeping operations.
 - c. Use pickup or vacuum sweepers in urban areas where aggregate accumulates in gutters or where removal is required from the edge of the shoulder.
 - d. Do not dislodge embedded aggregate when brooming chip sealed roadway.

- F. Blotter Material Equipment
 - 1. Apply blotter material using a truck mounted spinner broadcast spreader.
- G. All equipment is subject to inspection by the City.

3.05 ASPHALT MATERIAL/COVER MATERIAL APPLICATION

- A. Apply asphalt material at a rate sufficient to obtain 50 percent chip embedment before the rolling operation and 70 percent chip embedment after rolling operation.
 - 1. Adjust application rates throughout the project depending on existing conditions.
- B. Apply the asphalt emulsion at a minimum temperature of 145 degrees F.
- C. Do not apply asphalt material if material does not spray through the distributor in a uniform way and remain in place on the roadway.
- D. Place building paper adjacent to the transverse construction joint before starting each spraying operation.
 - 1. Maintain the control valve to act instantaneously both at start-up and cut-off.
- E. Locate longitudinal joints within 6 inches of the traffic lane line location.
 - 1. Construct meet lines with no skip or voids between adjacent passes.
 - 2. Do not place a double thickness of cover material.
- F. Calibrate the spreader at the beginning of each day and as often as necessary to comply with Table 4.
- G. Apply the aggregate within +1 to -2 pounds per square yard of mix design:
 - 1. Use a damp chip but not saturated. (Note: If water can be seen running out of the haul truck, the chips are too wet).
 - 2. For polymer and latex modified emulsions, apply chips immediately.
 - 3. For other emulsions, maintain a distance of not more than 100 feet between distributor and chip spreader.
 - 4. Maintain the chip spreader speed so that chips do not bounce or roll during application.
 - 5. Spread larger aggregate first.
 - 6. Hand broom cover material if necessary to distribute aggregate uniformly over the pavement surface.

Table 4

Approximate Spread Rates	
Unit Weight lbs/ft³	Application Rate lbs/yd²
60 – 65	17.0
65 – 70	18.4
70 -75	19.8

75 – 80	20.7
80 – 85	22.1
85 – 90	23.5
90 – 95	24.9
95 – 100	25.8

3.06 SURFACE ROLLING

- A. Use at least three pneumatic-tire rollers in a longitudinal direction to roll surface after the cover material has been spread.
- B. Roll at least three passes to seat the cover material.
 - 1. A pass is defined as traveling in one direction only.
- C. Control bleeding with blotter material.
- D. Set the roller speed to prevent bounding or skidding. Do not exceed 5 mph.
 - 1. Reduce roller speeds during directional changes to prevent surface tearing.
- E. Synchronize the speed of the distributor and chip spreader with that of the rolling operation.
 - 1. Begin initial rolling, consisting of one complete coverage, immediately behind the chip spreader.
 - 2. Begin secondary rolling, consisting of second and third coverage, immediately after completing initial rolling.
 - 3. Synchronize all operations to keep rolling operations within 2,500 feet of the ongoing chip seal application.
- F. Sweep excess cover material off the roadway after the emulsion has set.
 - 1. Remove excess cover material to the satisfaction of the City before opening the roadway to traffic.
- G. Repair all damage to the seal coat before opening the roadway to traffic.

3.07 BITUMINIOUS FLUSH COAT APPLICATION

- A. Clean the surface of all dirt, sand, dust, loose chips, and other objectionable material to the satisfaction of the City before applying bituminous flush coat.
- B. Apply the bituminous flush coat at a rate of 0.11, \pm 0.01 gal/yd².
 - 1. Keep traffic off the flushed surface until the bituminous material has set sufficiently to prevent tracking or pick-up.

3.08 REPAIR

- A. Remove spatter or mar from curb, gutter and sidewalk at no additional cost to OWNER.
- B. Remove chip seal from street fixtures.
- C. Remove any product found defective after installation and replace at no additional cost to OWNER.
- D. Fill any joints or cracks that are not covered by chip seal coat. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying Pavement.

E. Repair collateral damage caused by construction.

END OF SECTION

SECTION 02821

VINYL FENCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: PVC Fencing and Gates
- B. Related Sections: Section(s) related to this section include:
 - 1. Division 3: Concrete
 - 2. Division 2: Site Construction
 - a. 02300- Earthwork

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - 2. ASTM D 638 Standard Test Method for Tensile Properties of Plastics.
 - 3. ASTM D 648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
 - 4. ASTM D792 Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 5. ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforce Plastics and Electrical Insulating Materials.
 - 6. ASTM D4216 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products and Compounds.
 - 7. ASTM F694 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Exterior Profiles Used For Fencing.

1.03 DEFINITIONS

- A. Posts: Vertical structure support members of the fence/gate system.
- B. Rails: Horizontal structural support members of the fence/gate system.
- C. Pickets: Vertical members between the bottom and top rails.
- D. Aluminum Channel: Structural supports inside rails.
- E. Galvanized Steel Channel: Structural support inside rails.

1.04 SYSTEM DESCRIPTION

- A. The contractor shall provide a complete PVC fencing/gate system of the design, style and strength defined herein. Fencing and gate components are comprised of Section 02821 profiles made of extruded, rigid polyvinylchloride (PVC). This PVC material is specially formulated for outdoor use with

superior color hold and impact resistant properties after extended outdoor exposure. The system shall include all posts, rails, pickets, caps, metal inserts, and accessory items necessary to complete the installation.

1.05 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract.
- B. Product Data: Submit product data for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, and finish colors. Include details showing fabrication and installation of rails and pickets, including plans, elevations, sections, details of components, and attachments to other units of work, if required.
- D. Samples: Submit selection and verification samples for finishes, colors, and profiles if requested.
- E. Quality Assurance Submittals: Submit the following:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties. Include copies of selected test reports by independent laboratories verifying the compliance of fencing components and systems with applicable building codes upon request.
 - 2. Compliance Reports: Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction. Provide evidence that the polyvinyl chloride fencing systems are in compliance with applicable building code in effect for the project.
 - 3. Certificates: Product certificates signed by the manufacturer certifying that materials comply with specified performance characteristics and criteria and physical requirements.
- F. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals Section 02821 includes methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Polyvinyl Chloride Fencing Fabricator/Installer Qualifications: Engage a licensed fabricator to ensure successful completion of project.
 - 2. Ensure consistent quality standards of PVC fence accessories, fittings and fasteners are maintained throughout the project.
 - 3. Manufacturer Qualifications: Manufacturer should be capable of providing field service representation during construction and should be capable of approving acceptable installer and application methods.

1.07 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid

construction delays.

- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: Store materials protected from exposure to material handling damage and accumulation of dirt and grime, at temperature and humidity conditions recommended by manufacturer. Handle and store product according to recommendations. Store in original packaging whenever possible until components are required on the project.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements and openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- B. Project Warranty: Refer to Conditions of the Contract for project warranty provisions used with their permission. The manufacturer is responsible for technical accuracy.
- C. Manufacturer's Warranty: Submit, for City's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights City may have under Contract Documents.

PART 2 PRODUCTS

2.01 PVC FENCING & GATE SYSTEMS

- A. Manufacturer: Vinyl products are manufactured from 100% new vinyl. The base ingredient is rigid PVC (polyvinyl chloride) homopolymer compound with a high level of titanium dioxide pigment for long-term UV resistance and impact modifiers for strength. The formulation is similar to that of vinyl siding and windows, which have more than 20 years of proven long-term durability and structural integrity.
 - 1. Post Profile Types and Sizes: As indicated on detail.
 - 2. Rails Profile Types and Sizes: As indicated on detail.
 - 3. Pickets Profile Types and Sizes: As indicated on detail.
 - 4. Caps Profile Types and Sizes: As indicated on detail.
 - 5. Finishes: Smooth, soft gloss.
 - 6. Colors: Titanium dioxide is the main ultraviolet light inhibitor in the PVC material used to manufacture these products. Since it is a white pigment, dark colors are not practical or possible. Decorative cap rails are available with a selection of architectural accent colors in high performance acrylics.
 - 7. Product System Testing: Provide PVC fencing system that complies with the following physical and chemical properties:
 - a. ASTM D256 – Izod impact greater than 5 ft-lb/in (2.1 N*m/m) at 23 degrees C.
 - b. ASTM D638 – Tensile strength 6290 psi (43 MPa).
 - c. ASTM D638 – Tensile modulus 430,000 psi (2963 MPa).
 - d. ASTM D648 – Deflection temperature 67 degrees C.

2.02 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions of sections or modifications of details, or both, and the reasons therefor shall be submitted for acceptance by the City Engineer.

2.03 ACCESSORIES

A. PVC Fence System Materials:

1. General: Posts, rails, pickets, post caps, and picket caps shall comply with ASTM D4216, Class 143354311122.
2. Posts: One piece extruded square profile size per detail.
3. Rails: One piece extruded square profile size per detail.
4. Pickets and Panels: One piece extruded profile size per detail.
5. Post Caps Molded: Specify to fit the selected post profile
 - a. Sizes per detail
 - b. Styles per detail
6. Rail Caps Molded: Specify to fit the selected post profile.
 - a. Sizes per detail
 - b. Styles per detail
7. Picket Caps Molded: Specify to fit the selected post profile.
 - a. Sizes per detail
 - b. Styles per detail
8. Gate Components size per detail.
9. Aluminum/Galvanized Steel Reinforcement Insert type and size per detail.
10. Miscellaneous Component type and size per detail.
11. Fasteners per detail.

2.04 RELATED MATERIALS

A. Related Materials: Refer to other sections listed in Related Sections Paragraph herein for related materials.

B. Adhesive and Cement:

1. Adhesive: PVC based adhesive with the same UV properties.
2. Products: Subject to compliance with requirements, provide the following:
 - a. "Quik-Crete"

2.05 FABRICATION SECTION

A. General: Fabricate fencing systems to comply with requirements indicated for design, dimensions, details, finish and member sizes, including wall thickness, but not less than those required to support structural loads.

2.06 SOURCE QUALITY

A. Source Quality: Obtain PVC fencing system products.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with product data, including product technical bulletins, product catalog installation instructions, product carton instructions for installation, or design/detail drawings.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installing in accordance with that manufacturer's instructions.

3.03 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the consultation plans.

3.04 INSTALLATION

- A. Depending upon the style of fence being installed, set fence posts on 8' centers. Posts shall be placed 30" in the ground and set in concrete.
- B. Gate posts and corner posts on all fences and line posts on taller fences shall be reinforced with cement and two No. 4 rebar members. Concrete should not contact rails to allow for expansion.
- C. Place assembled fence sections into position and slide rails into posts. The rails are secured into posts by tabs which are notched into the rails and catch on the inside wall of the posts. Top rails may be further secured with a #8-3/4" screw through the rail, inside the post.
- D. Install gates using bolt-on hardware supplied by the manufacturer.

3.05 FIELD QUALITY REQUIREMENTS

- A. Site tests to be performed during and/or after product installation.
- B. Inspection requirements to be performed after product installation.
 - 1. Site visits: 2 site visit inspections.

3.06 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace products that have installed and are damaged. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and dispose of in a legally acceptable manner.

END OF SECTION

SECTION 02824

ORNAMENTAL IRON FENCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Ornamental Iron Fencing
 - 1. Fence framework, panels, and accessories.
 - 2. Anchoring of posts to Concrete Retaining Walls.
- B. Related Sections: Section(s) related to this section include:
 - 1. Division 2: Site Construction
 - a. 02821 - PVC Fencing
 - 2. Division 3: Concrete:
 - a. 03300 - Cast-in-Place Concrete

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM B117 Practice for Operating Salt-Spray (Fog) Apparatus.
 - 3. ASTM D523 Test Method for Specular Gloss.
 - 4. ASTM D714 Test Method for Evaluating Degree of Blistering in Paint.
 - 5. ASTM D822 Practice for Conducting Tests on Pain and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
 - 6. ASTM D1654 Test method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 - 7. ASTM D2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 - 8. ASTM D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 9. ASTM D3359 Test Method for Measuring Adhesion by Tape Test.
 - 10. ASTM F2408 Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

- C. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation, and anchor bolt templates.
- D. Proposed fencing pattern and color.

1.04 PROTECT RECORD DOCUMENTS

- A. Accurately record actual locations of property perimeter posts relative to property lines.

1.05 QUALITY ASSURANCE

- A. Contractor shall provide laborers and supervisors who are thoroughly familiar with the type of constructions involved and materials and techniques specified.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Sections with minimum five years' experience.

1.07 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 QUALIFICATIONS

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 PRODUCTS

2.01 GENERAL

- A. Fencing shall be 6-foot ornamental iron fencing.
- B. Fencing shall be Ameristar E-Coated Rakeable fencing.

2.02 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free-good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be black. The coated panels and posts

shall be capable of meeting the performance requirements in the ASTM F2408 standard.

- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

2.03 FITTINGS AND HARDWARE

- A. Use manufacturer recommended fittings and hardware.

PART 3 EXECUTION

3.01 PREPARATION

- A. Drill holes into concrete retaining wall to provide anchoring location.
- B. All new installation shall be laid out by the contractor in accordance with the construction plans.
- C. Anchor posts into concrete wall with manufacturer recommended bolting system.

3.02 FENCE INSTALLATION

- A. Fence posts shall be spaced 3-3\4" on center, plus or minus 1/2". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts, adhere to the following steps to seal the exposed steel surfaces:
 - 1. Remove all metal shaving from cut area.
 - 2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
 - 3. Apply 2 coats of custom finish paint matching fence color.
- B. Failure to seal exposed surfaces per steps 1-3 above will negate warranty.
- C. Manufacturer recommended spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that pain pens be used to prevent overspray.

END OF SECTION

SECTION 02828

MISCELLANEOUS EQUIPMENT FOR PLAYGROUNDS AND OTHER AREAS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acceptable equipment and materials for playgrounds, open space areas and miscellaneous other areas.

1.02 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on equipment, materials, and appurtenant items.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of installed equipment, materials and appurtenant items. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with City's requirements as described herein.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store all equipment, materials and appurtenant items in shipping containers with labeling in place.

1.05 OPERATING AND MAINTENANCE DATA

- A. Provide instructions covering full operation, care and maintenance of system and controls; and manufacturer's parts catalog.
- B. Instruct City's designated maintenance personnel in the proper maintenance of all equipment, materials, and appurtenant items.
- C. Submit 3 copies of written instructions recommending procedures to be established by the City Engineer for the maintenance of the equipment, materials and appurtenant items from year to year.
 - 1. Submit prior to expiration of required one year guarantee period.
 - 2. Provide information in the manuals that include the following:
 - a. written index near front of Manual listing location in the Manual of all emergency data regarding the installations;
 - b. complete nomenclature of all replaceable parts, their part numbers, current cost, and name and address of the nearest vendor of replacement parts; and
 - c. copy of all guarantees and warranties issued on the installation showing all dates of expiration.

PART 2 PRODUCTS

2.01 GENERAL

- A. All equipment, materials, and appurtenant items shall be as manufactured by manufacturers approved by the City Engineer.
- B. All equipment, materials and appurtenant items shall be inspected and approved by the City Engineer prior to installation.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, materials and equipment as required to install the equipment, materials and appurtenant items for playgrounds, open space areas, and other miscellaneous areas, as described herein and as shown on the design drawings, as indicated on the submittal drawings; and shall furnish and install all supplementary and miscellaneous items, appurtenances, and devices incidental to or necessary for completion of the installations.
- B. All material shall be installed according to the manufacturer's written instructions and recommendations.
- C. The Contractor shall test the installations to assure proper operation.
- D. All playground equipment shall be installed by personnel certified by manufacture.

3.02 EXAMINATION

- A. Verify that design drawings conform to project conditions.

3.03 ELECTRICAL WORK

- A. All required electrical work shall be done as specified in Division 5.

3.04 FIELD QUALITY CONTROL

- A. A third party certified playground safety inspector (CPSI) shall perform a field inspection and testing in accordance with Section 01400.
- B. The third party audit shall be submitted to the city in accordance with section 01400.
- C. If tests indicate that installations do not meet specified requirements, remove installations, replace and retest at no cost to City.

3.05 OPERATIONAL TESTING

- A. Where required, provide the City Engineer or City Inspector with seven days written notice of operational tests.
- B. After all repairs or replacements have been made and accepted by the City Engineer or City Inspector, repeat the required tests.

END OF SECTION