



Approved for Construction:

Deputy Public Works Director - Eng. 11/29/22
City of Pasco Date

CONTRACT DOCUMENTS

FOR

CITY OF PASCO 21237B WWTP OUTFALL REPLACEMENT

NOVEMBER 2022

VOLUME 3 OF 5

Funded in part by the Washington State Department of Ecology: 2021-00020 Clean Water Preservation Project Phase 2



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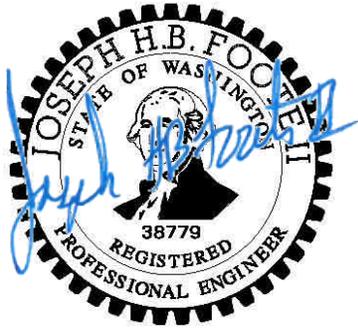
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FOR
CITY OF PASCO

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VOLUME 4**PART 5 DRAWINGS**

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VOLUME 5**PART 5 SUPPLEMENTARY INFORMATION**

1. Nationwide Permit Verification Letter, United States Army Corps of Engineers (ACOE), November 17, 2022. The Nationwide Permit Verification Letter includes the following enclosures:
 - a. Nationwide Permit (NWP) 1 Terms and Conditions, Aids to Navigation, ACOE, Effective Date: February 25, 2022.
 - b. NWP 7 Terms and Conditions, Outfall Structures and Associated Intake Structures, ACOE, Effective Date: February 25, 2022.
 - c. Clean Water Act Section 401 Water Quality Certification from Washington State Department of Ecology (Ecology)
 - d. Biological Opinion (BO), National Marine Fisheries Service (NMFS), November 17, 2022.
 - e. Letter of Concurrence (LOC), United States Fish & Wildlife Service (USFWS), September 27, 2022.
2. Hydraulic Project Approval (HPA), Washington Department of Fish & Wildlife, November 15, 2022.
3. Private Aids to Navigation (PATON) Permit, United States Coast Guard, October 25, 2022.
4. Shoreline substantial Development Permit, City of Pasco, August 18, 2022.
5. State Environmental Policy Act (SEPA) Mitigated Determination of Non-Significance (MDNS), City of Pasco, July 27, 2022.

END OF SECTION

DIVISION 31 - EARTHWORK

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SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.
- B. Section includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.

1.2 RELATED SECTIONS

- A. Section 31 05 16 - Aggregates for Earthwork.
- B. Section 31 10 00 – Site Clearing.
- C. Section 31 22 13 - Rough Grading.
- D. Section 31 23 16 – Excavation.
- E. Section 31 23 17 - Trenching.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials source.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish materials of each type from same source throughout the Work.
- B. Soil Testing:
 - 1. Soil sampling and testing to be completed by an independent laboratory approved by the Engineer.
 - 2. Frequency of testing shall be determined by the Engineer.
 - 3. All soil testing shall be paid for by the Contractor.
- C. Compaction Tests:
 - 1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).
 - 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1, Select Native Material:
 - 1. Select earth obtained from on-site excavations approved for use by Engineer.
 - 2. Graded.
 - 3. Free of peat, humus, vegetative matter, organic matter and rocks larger than 6 inches in diameter.
 - 4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.
- B. Subsoil Type S2, Imported Fill Material:
 - 1. Imported earth approved for use by Engineer.
 - 2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type TS1, Select Native Topsoil Material:
 - 1. Top 6 - 12 inches of existing soil containing organic matter.
 - 2. Engineer decision shall be final as to determination of what material is topsoil quality.
 - 3. Graded.
 - 4. Free of roots, rocks larger than 1/2-inch subsoil, debris, large weeds and foreign matter.
 - a. Screening: Single screened.
- B. Topsoil Type TS2, Imported Topsoil Material:
 - 1. Imported borrow.
 - 2. Friable loam.
 - 3. Reasonably free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SPOILS

- A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the Contractor and approved by the Engineer.
- B. Make arrangements for disposal of the material at no additional cost to the Owner.
- C. Landfill permit to be obtained by the Contractor and provided to Engineer prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D1557 (AASHTO T180).

- B. When tests indicate materials do not meet specified requirements, change material or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.
- B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.
- C. When practical, do not excavate wet topsoil.
- D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.
- F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

- A. Stockpile soils at locations as approved by Engineer for redistribution as specified.
 - 1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.
 - 2. No additional payments will be made for stockpiling excavated materials off-site.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.

2. Cover stockpiles to minimize the infiltration of water.
- F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

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SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.
- B. Section Includes:
 - 1. Coarse aggregate materials.
 - 2. Fine aggregate materials.

1.2 RELATED SECTIONS

- A. Section 31 05 13, Soils for Earthwork.
- B. Section 31 22 13, Rough Grading.
- C. Section 31 23 17, Trenching.
- D. Section 31 23 19, Dewatering.
- E. Section 32 11 23, Aggregate Base Courses.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 - 2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates.
 - 3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
 - 4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- C. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Aggregate Testing:
 1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Engineer.
 2. The frequency of testing one per aggregate per source with testing performed no greater than one year prior to aggregate use.
 3. All aggregate testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).
 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1, Dense-Graded Aggregate with material, gradation and quality as shown on the Drawings and equal to Crushed Surfacing Base Course per WSDOT Section 9-03.9(3).
- B. Coarse Aggregate Type A2: Crushed or uncrushed rock or gravel as shown on the Drawings and equal to Gravel Backfill for Pipe Zone Bedding per WSDOT Section 9-03.12(3).
- C. Top Course Aggregate Type A3, shall meet the requirements for material, grading and quality as shown on the Drawings and equal to Crushed Surfacing Top Course and Keystone per WSDOT Section 9-03.9(3).

2.2 SAND

- A. Sand: Sand material shall consist of granular material, naturally produced or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash and other deleterious material, as shown on the Drawings and equal to Backfill for Sand Drains per WSDOT Section 9-03.13.

2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).
- B. Sand - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).
- C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials imported to site as approved by Engineer for redistribution as specified.
- B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

- C. Prevent intermixing of aggregate types or contamination.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.

1.2 RELATED SECTIONS:

- A. Section 02 41 00, Demolition
- B. Section 31 22 13, Rough Grading

1.3 DEFINITIONS

- A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.
- C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- D. Limits of Disturbance: Work area boundary as shown on the Drawings.
- E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.
- F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.
- C. Certification or disposal permit for landfill and/or waste disposal site.
- D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.5 QUALITY ASSURANCE

- A. Existing Conditions: Determine the extent of Work required and limitations before proceeding with Work.
- B. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.
- C. Conform to applicable local, state, and federal codes for environmental requirements and disposal of debris,
 - 1. Burning on project site will not be permitted.
 - 2. Use of herbicides will not be permitted.
- D. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.
- E. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of laborers, other persons, and property in the vicinity of the work and requirements of the General Provisions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated on the Drawings or specifications.
- B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

- A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Remain within the property lines at all times.
- C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 811, not less than three working days before performing Work.
- C. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 2. Keep all active utilities intact and in continuous operations.
- D. Prepare Site only after:
 - 1. Erosion and sediment controls are in place.
 - a. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls and in compliance with City of Pasco Erosion and Sediment Control Manual and ESC Permits.
 - 2. Tree and vegetation protection is installed.
 - a. Protect existing site improvements, trees, and shrubs to remain to preclude damage during construction.
 - 3. Temporary security fencing is installed as shown on Drawings.
 - 4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated on the Drawings to remain from damage.
- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.

C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:

1. Avoid injury to trees, shrubs, vines, plants, grasses, and other vegetation growing outside of the areas to be cleared and grubbed and those trees and shrubs designated to be preserved.
2. Protect existing trees and shrubs against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of roots by stockpiling construction materials, excavated materials, excess foot or vehicular traffic, and parking of vehicles within drip line.
3. Provide temporary guards, as necessary, to protect trees and vegetation to be left standing.
4. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
5. Provide protection for roots and limbs over 1-1/2-inch diameter cut during construction operations. Coat cut faces with emulsified asphalt.
6. Repairable damage to trees and shrubs designated to remain shall be made by a professional tree surgeon approved by the Engineer. Cost shall be borne by the Contractor.

D. Landscaped Areas:

1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.
2. Conduct Work in a manner that will restore original conditions as nearly as practicable.
3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.
4. All shrubs or plants shall be balled by experienced workers, carefully handled and watered, and replaced in their original positions without damage. Sod shall be handled in a similar manner.
5. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.
6. Plants or shrubs killed or destroyed shall be replaced and paid for by the Contractor.

7. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, and curbs.
- F. Repair and Replacement:
1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.
 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

- A. As follows:
1. Excavation: 5 feet beyond top of cut slopes.
 2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.
 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 2 feet beyond toe of permanent fill.
 4. Structures: 15 feet outside of new structures.
 5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.
 6. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall not be permitted without written approval of Owner.

3.6 CLEARING AND GRUBBING

- A. Clear and grub areas within limits shown in approved Clearing, Grubbing, and Stripping Plan.

- B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.
- C. Clearing:
 - 1. Remove trees, saplings, snags, stumps, shrubs, brush, vines, grasses, weeds, and other vegetative growth within the clearing limits shown on the Drawings, except those trees and shrubs noted to remain on the Drawings or as directed by the Engineer.
 - 2. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the project site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.
 - 3. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:
 - 1. Future Structures and Building Areas 24 Inches
 - 2. Roads and Parking Areas 18 Inches
 - 3. All other Areas 12 Inches

3.7 TREE REMOVAL

- A. Exercise care in cutting, felling, trimming, and handling of those trees shown for removal to prevent damage to neighboring trees and structures to remain.
- B. Tree Salvage: As shown on the Drawings.
- C. No trees may be removed unless approved and permitted by the Engineer.
- D. Do not top trees unless otherwise specified or approved by Owner in writing.

3.8 REMOVAL AND DISPOSAL

- A. Native vegetation may be mulched and used on Site.
- B. Asphalt and Gravel Surfaces:
 - 1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.
 - 2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown on the Drawings or following approval of the Engineer.

3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.
- C. Remove debris, rock, abandoned piping, and extracted plant life from Site.
 - D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.
 1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.
 2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.
 - E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
 - F. Do not burn or bury materials on site. Leave site in clean condition.
 - G. Removal: All material resulting from demolition, clearing and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.
 - H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.
 - I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

- A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.
- B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.
- C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Engineer.

- D. The Work will not be considered complete or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Engineer.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes rough grading and filling associated with contouring of Site in preparation for site work.
- B. Section Includes:
 - 1. Excavating topsoil
 - 2. Excavating subsoil
 - 3. Cutting, grading, filling, and rough contouring of Site

1.2 RELATED SECTIONS:

- A. Section 31 05 13, Soils for Earthwork
- B. Section 31 05 16, Aggregates for Earthwork
- C. Section 31 10 00, Site Clearing
- D. Section 31 23 16, Excavation
- E. Section 31 23 17, Trenching

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - 3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 4. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

5. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Soils for Earthwork: As specified in Section 31 05 13, Soils for Earthwork.
- C. Aggregates for Earthwork: As specified in Section 31 05 16, Aggregates for Earthwork.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Structural Fill: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown on the Drawings.
- B. Granular Fill: Type A2, Granular Drain Backfill Material as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown on the Drawings.
- C. Granular Fill: Type A3, Top Course Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown on the Drawings.
- D. Subsoil: Type S1, Select Native Material as specified in Section 31 05 13, Soils for Earthwork.
- E. Subsoil: Type S2, Imported Fill Material as specified in Section 31 05 13, Soils for Earthwork.
- F. Topsoil: Type TS1, Select Native Topsoil Material as specified in Section 31 05 13, Soils for Earthwork.

- G. Topsoil: Type TS2 Imported Topsoil Material as specified in Section 31 05 13, Soils for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-424-5555 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Notify Engineer of any potential conflicts resulting from utility locations and the Drawings.
 - 3. Notify utility company to remove and relocate utilities, as may be necessary.
- B. Identify required lines, levels, contours, and datum.
- C. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with the Work of this Section.

3.3 TOPSOIL EXCAVATION

- A. Excavate and stockpile topsoil as specified in Section 31 05 13, Soils for Earthwork.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded as shown on the Drawings.
- B. When practical, do not excavate wet subsoil. When wet subsoil must be excavated and is to be reused on site for the Work, process wet material to obtain optimum moisture content.
- C. Stockpile excavated material in area designated onsite in accordance with Section 31 05 13, Soils for Earthwork.
- D. When excavating through roots, perform Work by hand and cut roots with sharp axe.

- E. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. General:

1. Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density.
2. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Engineer.
3. Bring all graded areas to a relatively smooth, even grade and slope by blading or dragging. Remove high spots and fill depressions.

- B. Fill areas to contours and elevations shown on the Drawings with unfrozen materials.

C. Topsoil Fill:

1. Scarify prepared subgrade to depth of 4 inches immediately prior to placing topsoil.
2. Place topsoil in areas to be seeded to depths indicated on the Drawings, minimum depth of 12 inches.
3. Place topsoil material loose; do not compact, do not place in wet or muddy conditions.

D. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 12 inches compacted depth.
3. Granular Fill: Maximum 12 inches compacted depth.

- E. Maintain optimum moisture content of fill materials to attain required compaction density.

- F. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

- G. Make grade changes gradual. Blend slope into level areas.

- H. Repair or replace items indicated on the Drawings to remain which are damaged by excavation or filling. All costs shall be borne by the Contractor.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 of a foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with AASHTO T99.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- C. Frequency and location of testing is dependent upon type of material placed.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

END OF SECTION

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SECTION 31 23 00– IN-WATER EXCAVATION, BEDDING, AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies earthwork which consists of excavation, handling and disposal, aggregate materials, bedding, backfilling and testing for in-water activities.
- B. This section includes furnishing transportation, labor, materials, equipment, and incidentals necessary to perform excavation, handling, and disposal of soils and debris as indicated in the Drawings and described in these Specifications.
- C. This section also includes furnishing transportation, labor, materials, equipment, and incidentals necessary to perform pipe bedding and backfill and final grading of the site.

1.2 QUALITY ASSURANCE

- A. Referenced Standards: This section incorporates by reference the latest revision of the following documents. These references are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM C127	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D75	Standard Practice for Sampling Aggregates
WSDOT	Washington State Department of Transportation – Standard Specifications for Road, Bridge, and Municipal Construction-Latest Revision

1.3 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Samples of imported fill materials 30 days in advance of use. Samples shall consist of minimum 0.5 cubic feet of each type of material.
- C. Laboratory test reports showing the suitability of the material as indicated herein, and certifying:
 - 1. Gradation tests for non-cohesive materials.

2. Any other requirements of the material as described in WSDOT Standard Specifications for Road, Bridge, and Municipal Construction, Latest Revision.
- D. Excavation and Backfill Plan that documents the approaches, equipment, means, and methods of accomplishing the excavation, handling, and disposal of soil and debris. The Plan shall describe the Contractor's equipment, means, and methods for excavation of the subtidal, shoreline, and upland soil and shall include the sequencing of the Work. This Plan may be combined with the Sediment Containment Plan submittal specified in Section 01 35 05, Environmental Protection and Special Controls.

1.4 DEFINITIONS

- A. Excavation slope: An inclined surface formed by removing material from below existing grade.
- B. Imported material: Select aggregate which meets the Fill Class specified and is obtained from a supplier regularly engaged in the business of supplying soil and fill material. It is not material which is obtained from on-site excavation.
- C. Native soil: Materials excavated from within the Contract limits.
- D. Suspect Material: Any material in the excavation which is potentially contaminated based on visual observation or odor; includes soils, water or foreign material found within the excavation limits.

1.5 TESTING

- A. Prior to placement, submit samples of materials to be used to a qualified testing laboratory. Submit laboratory test results to the Project Representative. Provide adequate time for test results to be received and verified for compliance.
- B. Obtain services of a qualified independent testing laboratory to perform quality control tests and to document compliance with Contract requirements during the Work.
- C. Sample and test imported aggregates for gradation and other parameters in WSDOT Standard Specifications.

1.6 SITE CONDITIONS

- A. Geotechnical Information: Reference Materials.
- B. Existing Utilities: Locate existing underground and aboveground utilities in the area of the Work. Those utilities which are to remain shall be adequately protected from damage.

- C. Debris may be encountered in excavated upland, shoreline and offshore soils. Debris encountered may include timbers, steel cables, shotcrete and concrete debris.

PART 2 PRODUCTS

2.1 GENERAL

- A. Tests necessary for the Contractor to locate an acceptable source of imported material shall be made by the Contractor. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the Project Representative for approval at least 14 days before the material is required for use. Material samples shall be furnished by the Contractor at the Contractor's sole expense. Samples shall be representative and be clearly marked to show the source of the material and the intended use in the Work. Sampling of the material source shall be done by the Contractor in accordance with ASTM D 75. Notify the Project Representative at least 2 days prior to sampling. The Project Representative may, at the Project Representative's option, observe the sampling procedures. Tentative acceptance of the material source shall be based on an inspection of the source by the Project Representative and/or the certified test results submitted by the Contractor to the Project Representative, at the Project Representative's discretion. No imported materials shall be delivered to the Site until the source and materials tests have been submitted and the submittal tentatively accepted in writing by the Project Representative.
- B. Gradation tests by the Contractor shall be made on samples taken at the place of production prior to shipment. Three samples of the finished product for gradation testing shall be taken from each barge load of prepared materials or more often as determined by the Project Representative, if variation in gradation is occurring, or if the material appears to depart from the Specifications. Test results shall be forwarded to the Project Representative within 48 hours after sampling.
- C. If tests conducted by the Contractor or the Project Representative indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material which does not conform to the Specification requirements and is placed in the Work shall be removed and replaced at the Contractor's sole expense. Sampling and testing performed by the Contractor shall be done at the Contractor's sole expense.

2.2 MATERIALS

- A. Unclassified Excavation: Excavation is unclassified. Complete excavation regardless of the type, nature, or condition of the materials encountered. Make own estimate of the kind and extent of the various materials to be excavated and safety and handling requirements in order to accomplish the Work.

- B. Gravel material shall be imported from offsite sources and shall consist of crushed, processed, or naturally occurring fractured granular material. It shall be free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact and shall meet the following specifications for grading and quality:

1. Crushed gravel backfill:

<u>U.S. Standard Sieve Size</u>	<u>Percent Weight Passing</u>
1½" square	100
1" square	80-100
¾" square	0-70
⅜" square	0-2
U.S. No. 200	0-1.5

2. Crushed gravel bedding:

<u>U.S. Standard Sieve Size</u>	<u>Percent Weight Passing</u>
1½" square	100
1" square	80-100
¾" square	0-70
⅜" square	0-2
U.S. No. 200	0-1.5

- C. Quarry Spalls:

1. Hard, sound, angular, and durable, with fractured faces evenly graded to lock in place, free from segregation, seams, cracks and other defects tending to destroy its resistance to weather.

<u>U.S. Standard Sieve Size</u>	<u>Percent Weight Passing</u>
8 inches	100
3 inches	40 maximum
¾ inches	10 maximum

- D. Fish Mix:

1. One part 8" streambed cobbles per WSDOT 9-03.11(2) to 1 part streambed sediment per WSDOT 9-03.11(1).

2.3 TEST RESULTS

- A. Submit test results prior to importing any bedding or backfill material to the Site.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Contractor shall be responsible for excavation and maintenance of trench bottom and side slopes prior to backfilling. Contractor shall remove, prior to pipe installation and again prior to backfilling, any materials above grade occurring because of inadequate excavation, sloughing, shoaling, silting, or slides.
- B. Should excavation be carried below the lines and grades indicated in the Drawings because of the Contractor's operations, the Contractor shall, at Contractor's own expense, refill such excavated space to the proper elevation in accordance with the procedure specified for placement of bedding and backfill materials. Should the natural foundation soils be disturbed or loosened because of the Contractor's operations, they shall be removed and the space refilled with crushed gravel bedding.
- C. Materials excavated from the bottom during bottom preparation shall be stockpiled above water on land or a barge in lined containers. No sidecasting is allowed. No excavated materials shall be used as fill material for this project except where noted on the Drawings. Excess excavated material shall be disposed of at a legal upland site.

3.2 SEDIMENT CONTAINMENT SYSTEM

- A. A temporary sediment containment system per Specification 01 35 05, Environmental Protection shall be installed, as required, during all sediment excavation.
- B. Temporary sediment containment system designed by the Contractor shall be installed as necessary to meet water quality criteria.
- C. The system shall be monitored daily, and any breaches shall be repaired promptly by the Contractor.
- D. See Specification Section 01 35 05 for environmental protection criteria relative to sediment and shoreline containment, fish exclusion, and turbidity standards compliance.

3.3 BOTTOM PREPARATION

- A. Excavate and smooth the trench bottom so that it conforms to the grade of the pipe and anchors shown, that the unsupported pipe length is equal to or less than the maximum specified, the pipe slope is maintained in a continuously seaward grade, and pipe deflection angles are within the allowable bending radius for HDPE pipe.

3.4 GRANULAR FILL MATERIAL

- A. Crushed Gravel Bedding: A diver shall be used to control and direct the placement of crushed gravel bedding material beneath pipe and anchors after it has been laid to final grade and elevations confirmed. The material shall be placed in a method that minimizes disturbance of the bottom, so that it flows under the haunches of the pipe and anchors resulting in a granular fill on both sides of the pipe, completely surrounding and supporting the haunches of the pipeline (4 to 8 o'clock positions) to the lines and grades indicated in the Drawings. Divers shall jet, sluice, or rod the bedding material to provide uniform and continuous support of the pipe and anchors.
- B. Crushed Gravel Backfill: Material shall be placed only after bedding placement up to the haunches of the pipe has been approved by the Project Representative, top of pipe elevations have been re-confirmed, and load lines supporting the pipe have been released from the pipeline. Material shall be placed to the minimum lines and grades indicated in the Drawings in such a manner so as to not disturb or damage the pipeline or change its elevation. No specific compaction effort is required on this material.
- C. Native Backfill: No native material shall be used as backfill except where shown on the Drawings.
- D. Material shall not be dropped through the water more than 4 feet, to minimize segregation and loss of fines. Material shall be placed to the minimum lines and grades shown.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes excavation required for site structures, or under slabs-on-grade or paving. Excavating for utilities is included in Section 31 23 17, Trenching.
- B. Section Includes:
 - 1. Excavating for paving, roads, and parking areas
 - 2. Excavating for site structures
 - 3. Excavating for landscaping

1.2 RELATED SECTIONS

- 1. Section 02 41 00, Demolition
- 2. Section 31 05 13, Soils for Earthwork
- 3. Section 31 05 16, Aggregates for Earthwork
- 4. Section 31 10 00, Site Clearing
- 5. Section 31 22 13, Rough Grading
- 6. Section 31 23 17, Trenching
- 7. Section 31 23 19, Dewatering
- 8. Section 31 50 00, Excavation Support and Protection
- 9. Supplemental Information: Geotechnical report; bore hole locations, and findings of subsurface materials.

1.3 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation.
- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation.
- C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a

trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.

- D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.
- E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.
- F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.
- G. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.
- H. Unsuitable Materials: See Spoils.

1.4 REFERENCES

- A. Local utility standards when working within 24 inches of utility lines.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.

1.6 QUALITY ASSURANCE

- A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.
- B. Provide adequate survey control to avoid unauthorized over-excavation.
- C. Weather Limitations:
 - 1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.
 - 2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Engineer as to the nature and extent of the differing conditions.
- B. Call Local Utility Line Information service at 811 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
- C. Identify required lines, levels, contours, and datum.
- D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this Contract as indicated on the Drawings or specified and shall include the cost for all earthwork in the total Unit Price Bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

- A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.
- B. Remove inactive or abandoned utilities from within the project grading limits as shown on Drawings.

- C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:
1. General:
 - a. Remove all structures to a minimum of 3 feet below subgrade, unless otherwise noted.
 - b. Cover top surface of all abandoned structures with two sheets of nonwoven geotextile, extended at least 1-foot beyond the outside walls of the abandoned manhole, sump, or basin.
 - c. Plug all abandoned pipes with permanent plugs as shown on drawings.
 2. Sumps:
 - a. Remove existing sediment, soil, and water. Properly dispose of these materials in accordance with the requirements of these specifications.
 - b. Remove top cone and first solid concrete section to a depth of approximately 8 to 10 feet below ground.
 - c. Fill sump with CLSM.
 - d. Backfill remaining voids for facilities within existing or proposed roadways with approved materials meeting the requirements of Section 32 11 23, Aggregate Base Courses.
 3. Salvaging Manhole Frames, Covers, and Grates:
 - a. Remove manhole frames, covers, and grates scheduled for salvage and store in approved location.
 - b. Frames, grates, and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the Work if of suitable size and condition.
 - c. Replace, at no additional cost to the Owner, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.
 - d. Clean salvaged components to be reused of foreign material by methods that will not harm the components.
 4. Existing Manhole Frames and Covers: Manhole frames and covers removed by the Contractor are the property of the Owner. Notify the Engineer a minimum of 48 hours before removal to arrange for pickup of the removed frames and covers, if not reused.

3.4 PRESERVATION OF EXISTING IMPROVEMENTS

- A. Protect adjacent existing structures which may be damaged by excavation work.
 - 1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.
 - 2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Engineer.
 - 3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Engineer
 - 4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

- A. General:
 - 1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.
 - 2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Engineer at no additional cost to Owner.
 - 3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.
 - 4. Provide all measures to ensure public safety.
- B. Control of Water:
 - 1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.
 - 2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
 - 3. Grade top perimeter of excavation to prevent surface water from draining into excavation.
 - 4. See additional requirements in Section 31 23 19, Dewatering.

- C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.
- D. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of the facility.
 - 1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.
 - 2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.
- E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.
 - 1. Fill:
 - a. Subsoil Type S1, Select Native Fill, as approved for use by Engineer.
 - 2. Spoils:
 - a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.
 - b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids.
 - c. Landfill permit or written permission from private property owner to be obtained by the Contractor and provided to the Engineer.
- F. Shoring:
 - 1. As specified in Section 31 50 00, Excavation Support and Protection.
 - 2. The Contractor shall be solely responsible for excavation protection and worker safety and shall provide sheeting and shoring wherever required, all in accordance with current local, state, and federal laws, codes, and ordinances.
 - 3. Where shoring, sheet piling, sheeting, bracing, lagging, or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of the Contractor to design, furnish, place, maintain, and remove such supports in accordance with applicable ordinances and safety requirements.
 - 4. The design, planning, installation, and removal of all sheeting accomplished in such a manner as to maintain the undisturbed state of the soil below and adjacent to the excavation.

- G. Slope existing banks with machine to angle of repose or less until shored.
 - 1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
 - 2. Protection of excavation side slopes:
 - a. Use excavation methods that will not shatter or loosen excavation slopes.
 - b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.
 - c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.
 - d. Excavation in rock or rocky cuts:
 - 1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.
 - 2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.
 - 3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.
 - e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
 - 3. Construct slopes free of all exposed roots.
 - 4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.
 - 5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.
 - 6. Trim all surfaces neatly and smoothly.
- H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching.
- I. Notify Engineer of unexpected subsurface conditions.

- J. Over-excavation for Unsuitable Foundation Conditions:
 - 1. Cross-sectional dimensions and depths of excavations shown on the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 - 2. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1 of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.
 - 3. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.
- K. Rock Removal:
 - 1. Solid mineral material with volume in excess 1/2 cubic yard or solid material that cannot be removed with 3/4 cubic yard capacity excavator without drilling or blasting.
 - 2. Concrete removal, as defined on the Drawings, shall be covered under demolition.
- L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

- A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.
- B. Coordinate the visual inspection and approval of all bearing surfaces by Engineer before installing subsequent work.

3.7 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.
- B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.
- B. Section includes:
 - 1. Excavating trenches for pipe, utility vaults, and other utilities.
 - 2. Compacted fill from top of utility bedding to final grades.
 - 3. Trench and utility vault backfilling and compaction.
- C. Related Sections
 - 1. Section 31 05 13, Soils for Earthwork
 - 2. Section 31 05 16, Aggregates for Earthwork
 - 3. Section 31 10 00, Site Clearing
 - 4. Section 31 22 13, Rough Grading
 - 5. Section 31 23 00, In water Excavation, Bedding, and Backfill
 - 6. Section 31 23 16, Excavation
 - 7. Section 31 23 24, Flowable Fill
 - 8. Supplemental Information: Geotechnical report; bore hole locations and findings of subsurface materials.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.
- B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.
- C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.
- D. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- E. Lift: Loose (uncompacted) layer of material.
- F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.
- G. Optimum Moisture Content:
 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.

- I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches above the top outside surface of pipe, conduit, cable, or duct bank.
- J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications. Refer to the Drawings and Specification 31 05 16, Aggregates for Earthwork and Specification 31 23 00, Inwater Excavation, Bedding, and Backfill.
- K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.
- L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.
- M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.
- N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.
- O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.
- P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.
- Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.
- R. Utility: Any buried pipe, duct, conduit, or cable.
- S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.
- C. Product Data:

1. Geotextile fabric, indicating fabric and construction
 2. Marking tapes
 3. Tracer wire
 4. Connectors for tracer wire and/or marking tapes
 5. Tracer wire locate boxes
 6. Marker balls
 7. Locator stations
 8. Ground wires
 9. Plastic or copper markers for service laterals.
- D. Imported Materials:
1. Materials Source: Submit name and location of imported fill materials suppliers.
 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- E. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CLSM:
1. In-place testing: In accordance with ASTM C403.
 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 QUALIFICATIONS

- A. NOT USED

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

- B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S1, Select Native Material as specified in Section 31 05 13, Soils for Earthwork.
- B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown on the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
 - 1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
- D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown on the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.
- F. Trench Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 MARKING TAPE

- A. Detectable:
 - 1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
 - 2. Foil Thickness: Minimum 0.35 mils.
 - 3. Laminate Thickness: Minimum 5 mils.
 - 4. Width: 6 inches.
 - 5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
 - 6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
 - 7. Manufacturers and Products:

- a. Reef Industries; Terra Tape, Sentry Line Detectable
 - b. Mutual Industries; Detectable Tape
 - c. Presco; Detectable Tape
- B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities and as specified in NEMA Z535.1, Safety Color Code.

Color	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines

2.3 ELECTRONIC LOCATING MATERIALS – (NOT USED)

2.4 VISUAL IDENTIFICATION MATERIALS – (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 811 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
 - 3. Maintain and protect above and below grade utilities indicated to remain.
- B. Identify required lines, levels, contours, and datum locations.
- C. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
- D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.

- E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.
 - 1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.
 - 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material, which is satisfactory to Owner.
- F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.
- G. Paved or Surfaced Streets:
 - 1. Wherever paved or surfaced streets are cut, saw wheel or approved cutting devices shall be used.
 - 2. Width of pavement cut shall be as shown on the Drawings.
 - 3. Any cut or broken pavement shall be removed from site during excavation.
- H. Traffic:
 - 1. Maintain street traffic at all times as required by the Drawings and as specified herein.
 - 2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.
 - 3. Provide flaggers as required during active work in roadway areas.
- I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Engineer.

3.2 EASEMENTS

- A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.
- B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.
- C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Engineer with a copy of the written approval from property owners of any such conditions.
- D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Engineer will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

- A. Existing Facilities:
 - 1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.
 - 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Engineer.
 - 3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
- B. Removal of Water:
 - 1. As specified in Section 31 23 19, Dewatering.
 - 2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.

3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
 4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.
- C. Trench Protection:
1. Provide the materials, labor, and equipment necessary to protect trenches at all times.
 2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.
 3. The method of protection shall be according to the Contractor's design.
 4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets the approval of all applicable local, state, and federal safety codes.
 5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

- A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated on the Drawings.
- B. Where grades are not shown on the Drawings, utilities shall be laid to grade between control elevations shown.
- C. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- D. Changes in the grade and horizontal alignment of the pipeline as shown on the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.
 1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.

2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown on the Drawings.

E. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

- A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.
- B. The Engineer may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

- A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.
 1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.
- B. Paved Roadways:
 1. Where paved roadways are cut as part of trenching activities, Class D trench backfill will be required to the bottom of pavement base.
 2. New pavement shall be equal to or better than the existing paved surface.
 3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.
- C. Existing Structures:
 1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown on the Drawings, the Contractor shall notify the Engineer before continuing with the Work.
 2. The Engineer may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.

3. The cost of waiting or “down time” during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Engineer.
4. If the Contractor fails to so notify the Engineer when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor’s own risk with no additional payment.

3.7 TRENCHING

- A. Excavate subsoil as required for construction of utilities to elevations shown on the Drawings.
- B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.
- C. Open Trench Limit:
 1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.
 2. A maximum length of open trench shall not exceed 100 feet at any one time.
 3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.
 4. Cover or backfill excavations at the end of each day.
 5. If the trench is not backfilled at the end of each working day:
 - a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.
 - b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.
 - c. Provide signed and stamped submittal of caving prevention system and cover system.
 6. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.

- D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.
1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
 2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.
 3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.
 4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.
- E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.
1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.
 2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Engineer, at no additional cost to the Owner.
- F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown on the Drawings.
1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.
 2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 12 inches on either side of the pipe.
 3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.
 4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.

5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.
- G. Remove water or materials that interfere with Work.
1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.
 2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.
 3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Engineer.
 4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.
 5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.
 - a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted on the Drawings or by the Engineer.
 - b. Coordinate with Engineer prior to plugging.
 - c. For plugs less than 36 inches in diameter, 8-inch-deep masonry units shall be used. For plugs in larger pipelines, 12-inch-deep masonry units shall be used.
 6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Over-excavation for Unsuitable Trench Foundation Conditions:
1. Cross-sectional dimensions and depths of excavations shown on the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 2. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.
4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.
 - a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.
 - b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.
 - c. Place laps or splices in the geotextile in the direction of the pipe laying.
- J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.
- L. Remove excess subsoil not intended for reuse from site.
- M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

- A. In lieu of open cut trenching as specified above, the Contractor may utilize tunnel methods for installation of pipe where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks and other structures.
 1. The Engineer must approve tunneling methods prior to utility installation.
 2. Where tunneling is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks, and other surface improvements whose replacement is avoided by the tunneling method.

3.9 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, new and existing structures, and adjacent and neighboring properties and to prevent caving, erosion, settlement, and loss of surrounding subsoil.

- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.
- E. Design sheeting and shoring to be removed at completion of excavation work, unless shown otherwise on the Drawings.
- F. Construction Sheeting Left in Place:
 - 1. Furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.
 - 2. Construction sheeting and bracing originally intended for temporary installation, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Engineer. All such sheeting and bracing left in place shall be included in the cost for excavation.
 - 3. Any construction sheeting and bracing which the Contractor has placed to facilitate its work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on its part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of its responsibility under the contract.
 - 4. For sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

3.10 COMPACTION

- A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.
- B. Moisture Control:
 - 1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.
 - 2. Add moisture to granular backfill by sprinkling during compaction operation.
 - 3. Compaction by ponding or jetting is not permitted.

- C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Engineer, in place by whatever equipment and method is practicable or specified, and as approved by the Engineer.
 - 1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

- A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.
- B. Unless otherwise noted on the Drawings, pipe or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.
- C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included on the Drawings.
 - 1. In lieu of a detail, the depth shall be 6 inches.
- D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.
- E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.
- G. Check grade and correct irregularities in bedding material.
- H. Center pipes horizontally in trench width.

3.12 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.

- D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.
 - 1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.
 - 2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.
 - 3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content.
- E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.
- F. Do not use power-driven impact compactors to compact pipe zone material.
- G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Engineer.
- H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.
- I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
- J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.
- K. Placement of Sand:
 - 1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.
 - 2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

- L. Placement of CLSM:
 - 1. Discharge from truck-mounted drum-type mixer into trench.
 - 2. Place in lifts not exceeding 2 feet in thickness.
 - 3. No compaction of CLSM is allowed.
 - 4. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.
- M. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- N. Do not leave trench open at end of working day.

3.13 MARKING TAPE INSTALLATION

- A. Continuously install marking tape along centerline of all buried piping, install 24 inches below finished grade.

3.14 ELECTRONIC LOCATING FACILITY INSTALLATION – (NOT USED)

3.15 VISUAL IDENTIFICATION FACILITIES – (NOT USED)

3.16 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).
- C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per **200** lineal feet of pipeline trench as measured along pipe centerline.
 - 1. The Engineer may reduce the frequency when satisfied with method of compaction.
 - 2. The Engineer may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.
 - 3. The Engineer shall determine all test locations.

- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the sole expense of the Contractor.

3.17 SURFACE RESTORATION AND CLEANUP

- A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Engineer and the local permitting agency.
 - 1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the Engineer.
 - 2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.
- B. Topsoil:
 - 1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.
 - 2. Topsoil shall not be mixed with other excavated material.
 - 3. After the trench has been backfilled, the topsoil shall be replaced.
- C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

END OF SECTION

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SECTION 31 23 19 - DEWATERING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.
- B. Section includes:
 - 1. Dewatering systems.
 - 2. Surface water control systems.
 - 3. System operation and maintenance.
 - 4. Water disposal.

1.2 RELATED SECTIONS

- A. Section 31 05 16, Aggregates for Earthwork
- B. Section 31 23 16, Excavation
- C. Section 31 23 17, Trenching

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Dewatering Plan:
 - 1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.
 - 2. Plan to be reviewed by the Engineer prior to the beginning of construction activities requiring dewatering. Review by the Engineer of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.4 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.

2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.
3. Disposing of removed water.

B. Surface Water Control: Removal of surface water within open excavations.

1.5 QUALITY CONTROL

- A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.
- C. Secure all necessary permits to complete the requirements of this Section.
- D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- E. Where the critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop.
 1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.
 2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

- A. Provide all equipment necessary for dewatering.
 - 1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.
 - 2. Have available, at all times, competent workers for the operation of the pumping equipment.
 - 3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. Site Grading:
 - 1. At all times, site grading shall promote drainage.
 - 2. Surface runoff shall be diverted from excavations.
 - 3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.
- F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent

pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.

- I. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.
- J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

END OF SECTION

SECTION 31 23 24 - FLOWABLE FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes flowable lean concrete mix used for structure backfill, utility bedding and backfill and other subgrade Site Work. Applications also include filling abandoned structures and utilities that remain in place.
- B. Section Includes:
 - 1. Structure backfill
 - 2. Utility bedding
 - 3. Utility backfill

1.2 RELATED SECTIONS

- A. Section 02 41 00, Demolition
- B. Section 31 23 16, Excavation
- C. Section 31 23 17, Trenching

1.3 DEFINITIONS

- A. Flowable Fill: Also referred to as Controlled Low Strength Material (CLSM) elsewhere in the Specifications. Lean cement concrete fill.
- B. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

1.4 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete
 - 3. ASTM C150 - Standard Specification for Portland Cement
 - 4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete
 - 5. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 6. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete

7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
9. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete in Place by Nuclear Methods
10. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.5 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field Quality-Control Submittals:
 1. Mix Design:
 - a. Furnish flowable fill mix design for each specified strength.
 - b. Furnish separate mix designs when admixtures are required for the following:
 - 1) Flowable fill Work during hot and cold weather.
 - 2) Air entrained flowable fill Work.
 - c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
 2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.
- D. Delivery Tickets:
 1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.

1.6 QUALITY ASSURANCE

- A. In-place testing of Flowable Fill: In accordance with ASTM C403.
- B. Compressive testing of Flowable Fill: In accordance with ASTM D4832.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Minimum Conditions: The following minimum conditions shall be met at time of flowable fill placement.
 - 1. Do not install flowable fill during inclement weather.
 - 2. Ambient temperature must be at least 34 degrees Fahrenheit (F) (4 degrees Celsius (C)) and rising.
 - 3. Flowable fill shall be at 40 degrees F (4 degrees C).
 - 4. Subgrade on which flowable fill is to be placed shall be free of disturbed or soft material, debris and water.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 PRODUCTS

2.1 FLOWABLE FILL

- A. Flowable Fill:
 - 1. Composed of cement, pozzolans, fine aggregate, water, and admixtures.
 - 2. Low cement content.
 - 3. Non-segregating, self-consolidating, free-flowing, and excavatable material which will result in a hardened, dense, non-settling fill.
 - 4. Compressive strength at 28 days of 100 to 200 pounds per square inch (psi), if not otherwise shown in Drawings or specified.

2.2 MATERIALS

- A. Portland Cement: ASTM C150.
- B. Fine Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical Admixture: ASTM C494.

- C. Fly Ash: ASTM C618 Class C or F, obtained from residue of electric generating plant using ground or powdered coal.

2.4 MIXES

- A. Mix and deliver flowable fill according to ASTM C94, Option C.
- B. Flowable Fill Design Mix:

ITEM	PROPERTIES
Cement Content	75 to 100 lb/cu yd
Fly Ash Content	[None]
Water Content	As specified
Air Entrainment	5 to 35 percent
28-Day Compressive Strength	Maximum 200 psi.
Unit Mass (Wet)	80 to 110 pcf
Temperature, Minimum at Point of Delivery	50 degrees F (10 degrees C)

- C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.
- D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.

2.5 SOURCE QUALITY CONTROL

- A. Test and analyze properties of flowable fill design mix and certify results for the following:
 1. Design mix proportions by weight of each material.
 2. Aggregate: ASTM C33 for material properties and gradation.
 3. Properties of plastic flowable fill design mix including:
 - a. Temperature
 - b. Slump
 - c. Air entrainment
 - d. Wet unit mass
 - e. Yield
 - f. Cement factor
 4. Properties of hardened flowable fill design mix including:
 - a. Compressive strength at 1-day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.

- b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.
- B. Prepare delivery tickets containing the following information:
 - 1. Project designation
 - 2. Date
 - 3. Time
 - 4. Class and quantity of flowable fill
 - 5. Actual batch proportions
 - 6. Free moisture content of aggregate
 - 7. Quantity of water withheld

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation specified in Section 31 23 16, Excavation and trenching specified in Section 31 23 17, Trenching is complete.
- B. Verify utility installation as specified in elsewhere in the specifications is complete and tested before placing flowable fill.
- C. Verify excavation is dry and dewatering system is operating, as may be required, prior to placement of flowable fill.

3.2 PREPARATION

- A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.
- B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.
- C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

3.3 INSTALLATION - FILL, BEDDING, AND BACKFILL

- A. Place flowable fill by chute, pumping, or other methods as approved by Engineer.
- B. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.
- C. Place flowable fill evenly on both sides of utilities to maintain alignment.
- D. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 INSTALLATION - FILLING ABANDONED UTILITIES

- A. As shown on the Drawings and specified in Section 02 41 00, Demolition.

3.5 FIELD QUALITY CONTROL

- A. Perform inspection and testing according to ASTM C94.
 - 1. Take samples for tests for every 100 cubic yards of flowable fill, or fraction thereof, installed each day.
 - 2. Sample, prepare, and test four compressive strength test cylinders according to ASTM D4832. Test one specimen at 3 days, one at 7 days, and two at 28 days.
 - 3. Measure temperature at point of delivery when samples are prepared.
- B. Further construction proceeding upon placed flowable fill will be permitted only after initial set is attained, as measured by ASTM C 403.
 - 1. Perform in place penetration (density) tests using handheld penetrometer to measure penetration resistance of hardened flowable fill.
 - 2. Perform tests at locations as directed by Engineer.
- C. Defective Flowable Fill: The Engineer reserves the right to reject all flowable fill failing to meet the following test requirements or flowable fill delivered without the following documentation.
 - 1. Test Requirements:
 - a. Minimum temperature at point of delivery.
 - b. Compressive strength requirements for each type of fill.
 - 2. Documentation: Duplicate delivery tickets.
- D. No traffic or construction equipment shall be allowed on flowable fill for a least 24 hours after placement.

3.6 CLEANING

- A. Remove spilled and excess flowable fill from Project Site.
- B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes shoring and support systems of all types necessary to protect existing utility facilities and new utility facilities.
- B. The Contractor is responsible for the selection and design of excavation support systems and the design of utility support systems in conformance with Federal, State, and City requirements and the minimum design criteria specified herein.
- C. Temporary shoring is to be installed for protection of the structures to remain, buried utilities to remain, adjacent buildings and walkways.
- D. Care must be taken during the planning and construction of earth support systems to minimize settlements and displacements of the shoring system itself and to surrounding properties.

1.2 RELATED SECTIONS

- A. Section 31 23 16, Excavation
- B. Section 31 23 17, Trenching
- C. Section 31 23 19, Dewatering

1.3 DESIGN CRITERIA

- A. Design excavation support systems and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures to minimize ground movement or settlement, and to prevent damage to adjacent structures, and utilities.
- B. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
- C. Design system so that water seepage is minimized. Provide dewatering and positive means for preventing sloughing and containing material behind lagging.
- D. Design system to prevent sloughing and to contain running sand and silt behind the lagging.

- E. Vertical support capacity shall be provided for wall systems and internal bracing elements for loads due to vertical force components and live loads on any portion of the system.
- F. Design calculations and shop drawings of all excavation support systems.
 - 1. Calculations and shop drawings shall be made and stamped by a registered Professional Civil or Structural Engineer experienced in the design of excavation support systems in the State of Washington.
 - 2. Comply with the applicable requirements of OSHA and the Washington equivalent Structural Specialty Code with respect to excavation and construction.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Excavation Support Systems
 - 1. Plans and details for trench and excavation support systems.
 - a. Shop drawings and supporting calculations shall meet the specified design criteria requirements and include the following:
 - 1) Arrangement, size, and details for individual excavation support system.
 - 2) Construction methods and sequencing to be used for the installation and removal of each excavation support system.
 - 3) Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably or if obstructions are encountered in the installation.
 - 2. Calculations and shop drawings shall be made and stamped by a Washington-registered Professional Engineer experienced in the design of excavation support systems and shall comply with the applicable requirements of OSHA and the Washington equivalent Structural Specialty Code with respect to excavation and construction.
 - 3. Provide plans, details, and calculations for Engineer review prior to the beginning of construction activities requiring such systems and to the City of Pasco as required to obtain all necessary construction permits.
 - 4. Review by the Engineer or City of Pasco of the submitted design shall not be construed as a detailed analysis of the adequacy of the support system, nor shall

any provisions of the above requirements be construed as relieving overall responsibility and liability for the work.

5. Instructions: The following paragraphs should be used to specify the requirements for more advanced systems.
 6. Include Excavation Plan, Settlement Monitoring Plan, Contingency Plan, and Site Conditions Survey.
 7. No excavations shall be started until the submittal review is complete and proper permits are obtained.
- C. Excavation Plan
1. Designed to prevent damage to existing and surrounding properties, structures and utilities.
- D. Settlement Monitoring Plan, to include the following:
1. General location of settlement monitoring points shown on the Drawings. Settlement monitoring points shall include baseline elevations of structure features, such as foundation elevations at a permanent known point, structure wall block elevations along a known row, and rebar pins. Rebar pins shall be 3-foot length steel rods driven into the ground with the upper end of the rod flush with the grade and protected with a casing that allows the surveying rod to be placed over the settlement point.
 2. The Contractor shall provide specific control benchmarks to be used for the settlement monitoring around the site, in sufficient spacing and quantity, to provide adequate coverage to all monitoring points. The benchmarks shall be located at least 100 feet away from the edge of any excavation and away from construction activity, to prevent impact from equipment or settling. These control benchmarks shall be documented with elevation and location information.
 3. Survey procedures (including name of survey crew leader and equipment to be used). At a minimum, a licensed surveyor shall record the elevations of the monitoring points at the beginning and end of construction. Monitoring and documentation of settlement points shall occur on a weekly basis during construction. If excavation has not occurred then settlement points in the vicinity of the construction does not need to occur.
 4. Approach to recording surveyed readings and means of reporting of results to the Owner.

E. Contingency Plan

1. Provide alternative procedures to be implemented if the excavation support systems are found to perform unfavorably or if obstructions are encountered in the installation of excavation support systems.
2. Contingency plan is to demonstrate a preparedness to mitigate the effects of movement or settlement.
3. The following minimum requirements for a contingency plan are:
 - a. Measures to be taken in order to protect existing facilities and neighboring properties from additional settlement or movement.
 - b. Identification of all material, manpower, equipment, and other items to be available and onsite at all times while excavations and dewatering activities are ongoing and reasonably after the work has been completed.

F. Site Conditions Survey

1. Videotape surveys, photographs, and other data significant in noting the pre-construction conditions of the existing project site, as well as the pre-construction conditions of the neighboring properties and their existing structures. Each settlement monitoring point shall be recorded twice before excavation begins to establish baseline elevations.
2. Provide to the Owner for record purposes prior to, but not more than 3 weeks before, commencement of any construction activities.
3. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the Owner and Engineer.

1.5 QUALITY ASSURANCE

- A. Contractor is solely responsible for quality assurance of temporary shoring.
- B. At each excavation support system location, provide the following:
 1. Continual verification system is planned, executed, and maintained in accordance with applicable codes, regulations, and good construction practice.
 2. Systematic observation of suitability of shoring materials.
 3. Installation, excavation, settlement, and lateral deflection monitoring.
 4. Groundwater control.

5. Adjacent construction activities.
 6. Other factors, as necessary.
- C. Continually verify installation of the shoring is in conformance with the plans prepared by the Contractor's design engineers.

1.6 CONTRACTOR QUALIFICATIONS

- A. The work of this Section shall be done by a firm specializing in this type of work. The firm shall:
1. Regularly and presently perform shoring installation as one of their principal services.
 2. Have technical qualifications, experience, training, and facilities to properly install shoring.
 3. Provide the services of a supervising engineer, registered in the State, with at least 5 years of experience in the design and construction of shoring walls.
 4. A foreman or superintendent experienced in the installation and removal shoring walls shall be present while this work is performed.

1.7 PERMITTING

- A. Secure all permits necessary to complete the requirements of this Section.

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be safe and in good condition and shall conform to local, state, and federal codes.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide sheeting, shoring, and other protection and support systems wherever required, in accordance with current local, state, and federal laws, codes, and ordinances.
- B. The Contractor is solely responsible for excavation protection and worker safety.

- C. The Contractor shall be solely responsible for the protection of existing utilities and structures. Under no circumstance shall work threaten the integrity (physical and operational) of these utilities and/or structures.

3.2 EXCAVATION SUPPORT SYSTEMS

- A. The excavation support systems shall not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom.
- B. Water control measures shall be provided at all times in accordance with the requirements specified in Section 31 23 19, Dewatering.
- C. The support system shall extend below the main excavation bottom elevation to a depth adequate to prevent hydrostatic uplift, seepage and piping, and lateral movement and to adequately support applied vertical loads.
- D. Damage to existing utilities or structures during installation of excavation support system shall be avoided. If damage occurs, it shall be repaired at no cost and to the satisfaction of the Owner and the utility owner.
- E. A company representative from the excavation support system shall be onsite during initial setup of the system. Install excavation support system in strict conformance with the representative's recommendations.

3.3 CONTINGENCY PLAN IMPLEMENTATION

- A. Excess movements or settlements: Work shall be stopped immediately and the causes of excess or detrimental movements evaluated if:
 - 1. Damage is noted to existing site features or surrounding properties.
 - 2. Shoring wall movements exceed the limits specified herein or per submitted calculations.
- B. Immediately notify the Engineer and begin the implementation of the approved contingency plan to mitigate the effects of settlement or movement occurred.

3.4 REMOVAL OF SUPPORT SYSTEMS

- A. Removal of excavation support systems shall be performed in a manner that does not disturb or damage adjacent new or existing structures or utilities.
- B. Fill all voids immediately with specified backfill material.

- C. All damage to property resulting from removal shall be promptly repaired at no cost to the Owner. The Engineer shall be the sole judge as to the extent and determination of the methods and materials for repair.

3.5 SCHEDULE

- A. An excavation support system selected by the Contractor shall be provided for the excavation of the following structures, unless otherwise approved by the Engineer:
 - 1. Plant Effluent Outfall Pipeline alignment along fence

END OF SECTION

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SECTION 31 50 00.50 – IN-WATER EXCAVATION SUPPORT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies requirements for Contractor-designed excavation shoreline and offshore support systems of trenches and open excavations greater than four feet in depth.
- B. Excavation for the outfall system shall be conducted within shored trenches where indicated on the Drawings. Comply with all provisions of the contract permits, including location, dimensions, and methods for placement and removal of trench support systems.

1.2 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
Chapter 296-155 WAC, Part N	Excavation, Trenching, and Shoring
AISC	Manual of Steel Construction, 13th Edition
AWS D1.1	Structural Welding Code
IBC	International Building Code
OSHA	Occupational Safety and Health Administration
WAC	Washington Administrative Code

- B. Qualifications:
 - 1. Designer: Professional Engineer licensed in the state of Washington with a minimum of five years of experience in designing earth retaining structures for temporary construction similar to the type and depth proposed in similar soil and groundwater conditions as this Contract.
 - 2. Contractor: Minimum of three years-of-experience with the installation of earth retaining structures for temporary construction of similar type and depth proposed in similar soil and groundwater conditions as this Contract.
 - 3. Welders shall hold current certification by AWS D1.1, for welds being performed.

1.3 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Contractor, welder and Engineer qualifications.
- C. Excavation Support System Plan prepared by a Professional Engineer licensed in the state of Washington.
- D. Designer certification that installed excavation support systems are in compliance with their design.
- E. Methods and sequence for installation and removal of support systems, including details of how water quality provisions of permits will be met.

1.4 DEFINITIONS

- A. Obstructions: A specific object (including but not limited to, boulders, logs, and man-made objects) encountered during installation of the excavation support system which prevents or hinders the construction, such that the production rate is significantly reduced relative to the production rate for other portions of the excavation support system in the geologic unit that contains the obstruction and in similar surface conditions. This definition excludes reductions in the excavation support installation rate that are related to the excavation passing under or in very close proximity to existing utilities or structures.

1.5 EXCAVATION SUPPORT SYSTEM PLAN

- A. Design documents, including:
 - 1. Detailed written description of excavation support system to be used, including materials, required equipment, work sequence, and work schedule.
 - 2. Design drawings and calculations prepared, stamped, dated, and signed by the Designer. The calculations shall demonstrate the integrity of the proposed support system to withstand ground, groundwater, sea water, and construction loads. Calculations shall clearly indicate maximum differential hydrostatic loads on shoring and describe how that differential will be maintained or limited.
 - 3. Drawings shall include:
 - a. Dimensions.
 - b. Material minimum section properties.
 - c. Details of any guides, drills, or templates to be used.

- d. Locations of existing structures, utilities, right-of-way easements, public, and private easements.
- 4. Methods and procedures for installing and removing excavation support systems.
- 5. Shop drawings and manufacturer literature for major equipment and installation systems.
- B. Information required by Chapter 296-155 WAC, Part N.
- C. Applicable requirements of OSHA for excavation and construction.

1.6 DESIGN REQUIREMENTS

- A. Be responsible to adequately size and to ensure that the excavation support system design is free of errors and omissions that may affect its safety, functionality, or performance.
 - 1. The Contractor accepts full responsibility for complying with relevant references, specifications, and standards that apply to the design including those that are not named in this Section.
- B. Be responsible to adequately size the piles, sheeting/lagging, decking and internal bracing for the temporary work bridge or trestle within the footprint and configuration indicated in the drawings.
- C. Construction and installation shall comply with all requirements for applicable agencies and permits.
- D. The design, planning, installation, and removal of excavation support systems shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
- E. Design the excavation support system in accordance with Chapter 296-155 WAC, Part N.
- F. When designing with material stresses for temporary construction higher than the allowable stresses prescribed in the AISC and the IBC, increase in such stresses shall not exceed 20 percent of the value of the prescribed stresses. Overstressing is not permitted for any element of the excavation support system, defined by the allowable loading per Contractor's design engineer.
- G. Values for pile embedment and bending moment shall be determined by checking the piles using both the Free Earth and Fixed Earth Support methods using the larger value

from either method for the toe embedment and moment. Bottom of piles shall be a minimum of 10ft below bottom of excavation.

- H. Struts are to be designed for the maximum load produced by the following methods of analysis: Free Earth Support or Fixed Earth Support method.
- I. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
- J. Where applicable, the design shall be in accordance with the IBC.
- K. Soil parameters and loading criteria:
 - 1. Use soil parameters in the Geotechnical Baseline Report for this project as design parameters. Loading shall be increased as necessary to account for construction activities, sequencing, and loading. This report is a reference material for this contract and may be accessed as described in Section 00 72 13, Standard General and Supplementary Conditions of the Construction Contract.
 - 2. Determine water pressures and surcharge loads that may result from construction methods and regulation of water levels within the shoring and design the earth support system for those additional pressures due to those loads.
 - 3. Consider sequence of excavation and placement of the lateral support elements in the design of the temporary earth support structures.
 - 4. Excavation support systems shall be designed to withstand anticipated loads from handling, ground, groundwater, surcharge, and adjacent facilities. These include earth pressure, hydrostatic pressure, surcharge loads from surface equipment, material storage, and construction loads.

1.7 SUPPORT SYSTEM REQUIREMENTS

- A. Assess existing conditions, including property rights of adjacent property whether private or public, for the possible effects of proposed temporary works and construction methods.
- B. Select and design excavation support systems, methods, and details to ensure safety to the public, adjacent property and the completed work.
- C. Remove excavation support system upon completion of intended construction activities unless indicated otherwise in the drawings.

1.8 DESIGNER RESPONSIBILITIES

- A. Excavation Support System Certification:

1. After review at the Site, the Designer shall certify in writing, at each level of bracing installed and prior to proceeding with the excavation, that each excavation support system is constructed in general compliance with the Designer's stamped, dated, and signed excavation support system design.
 2. Designer shall also review and certify in writing the acceptability of modifications made by the Contractor during construction and revise the applicable drawings and submit to the Engineer.
- B. Visit the Site of the work no less than once per week to review and confirm compliance with the approved permitted design and that it meets the requirements of this Section.
 - C. Provide inspection report of the site visit to the Contractor and Owner no less than weekly.
 - D. Meet with the Contractor on an as-needed basis to review completed work and identify items for the Contractor to modify for the constructed design to be accepted at the completion and prior to use of the excavation support system.

PART 2 PRODUCTS - (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

- A. Construct the excavation support systems in such a manner as to not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom.
- B. Construction activities shall comply with all applicable provisions of the contract permits, including the Corps of Engineers Nationwide Permit Authorization, Section 401 Water Quality Certification, WDFW Hydraulic Project Approval, and City of Pasco Shorelines Permit.
- C. Designer shall inspect the constructed excavated support system prior to use and certify that the excavation support systems were built in conformance with the design.
- D. Excavation and backfill shall be in accordance with Section 31 23 00, In-Water Excavation, Bedding, and Backfill.
- E. Perform structural welding in accordance with the applicable clauses of AWS D1.1.
- F. Site restoration shall be to a condition equal to or better than that which existed prior to construction, if not indicated.

3.2 INTERNAL BRACING SUPPORT SYSTEM

- A. All bracing support members, if required, shall be installed and maintained in tight contact with each other and with the surface being supported.
- B. Bracing members, if required, shall be preloaded by jacking the struts in accordance with loads, methods, procedures, and sequence as indicated on approved shop drawings. The Contractor shall coordinate excavation work with bracing installation and preloading. The Contractor shall weld struts in place to maintain the preloading force in the bracing after release of the jacking equipment pressure. The Contractor shall use procedures so as to produce uniform bracing member loading without appreciable eccentricities, overstressing, or support member distortion. Jacking points shall be designed by the Contractor.
- C. Bracing and web stiffeners shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly. Wales shall be installed free for twists and deformations.
- D. Excavations shall be to a depth no more than 3 feet below the elevation of any support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation. Benched excavations require pre-approval by the Engineer.

3.3 REMOVAL OF SUPPORT SYSTEMS

- A. Support systems shall be removed in their entirety after construction. Such removal shall be performed by vibrating methods in a manner that shall not disturb or damage adjacent new or existing improvements, construction, or utilities.

3.4 OBSTRUCTIONS

- A. If, during the course of the work, unanticipated obstructions are encountered, the Engineer shall be immediately notified. Corrective measures shall be provided by the Contractor to and accepted by the Engineer before further work.
- B. If unanticipated obstructions are encountered during driving for pile installation, provide alternate method suitable to break up and remove the obstruction.

3.5 DEBRIS CONTAINMENT – (NOT USED)

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

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SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes construction of an aggregate subbase and base course for placement under asphalt or concrete paving, unit paving, or placed and left exposed.
- B. Section Includes:
 - 1. Aggregate subbase
 - 2. Aggregate base course

1.2 RELATED REQUIREMENTS:

- A. Section 31 22 13, Rough Grading
- B. Section 31 23 17, Trenching
- C. Section 31 05 16, Aggregates for Earthwork
- D. Section 32 12 16, Asphalt Paving

1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications
 - 2. T11, Standard Method of Test for Materials Finer Than 75 μ m (No. 200) Sieve in Mineral Aggregates by Washing
 - 3. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - 4. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities and standing water, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform cross-section thickness.
- C. Keystone: Fine aggregate used to aid in binding of loose surface stone.

1.5 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit data for geotextile fabric and herbicide.
- C. Materials Source: Submit name of aggregate materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SHOULDER AGGREGATE

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 DENSE-GRADED BASE AGGREGATES

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork.

2.3 OPEN-GRADED BASE AGGREGATES

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A2, Granular Drain Backfill Material as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 SOURCE QUALITY CONTROL

- A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.
- B. Final approval of aggregate material will be based on test results of installed materials.
- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

2.5 EQUIPMENT

- A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

2.6 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.
- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with equipment approved by the Engineer in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

- B. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material on prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.
4. Maintain consistent gradation of material. Widely varying gradation will be cause for rejection.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.
2. Completed Course Total Thickness: As shown on the Drawings, 8-inch minimum.
3. Spread lift on preceding course to required cross-section. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.
4. Lightly blade and roll surface until thoroughly compacted.
5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
 - a. Use 3/4-inch leveling course or surfacing material as keystone.

- b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
 - c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
 - d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.
- B. Gravel Surfacing and Leveling Course:
1. Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.
 2. Spread on preceding course in accordance with cross-section shown.
 3. Blade lightly and roll surface until material is thoroughly compacted.
 4. Complete Total Thickness: As shown on the Drawings, 8-inch minimum.

3.5 ROLLING AND COMPACTION

- A. Commence compaction of each layer of base immediately after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T99.
- B. Roll each layer of material until there is no appreciable reaction or yielding under the compactor before succeeding layer is applied.
- C. Shape and maintain the surface of each layer during compaction operations. Commence rolling at outer edges and continue toward center; do not roll center of road first.
- D. Apply water as needed to obtain specified densities.
- E. Place and compact each lift to the required density before succeeding lift is placed.
- F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.
- G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

- A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.
- B. Finished Surface of Untreated Aggregate: Within plus or minus 0.04-foot of grade shown at any individual point.
- C. Overall Average: Within plus or minus 0.04-foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

- A. Quality control testing shall be performed by an independent testing laboratory provided by the Contractor.
- B. Refer to table below for minimum sampling and testing requirements for aggregate base course and surfacing. The Owner reserves the right to complete additional testing.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T99	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T310	One for each 500 ton but at least every 10,000 square feet of area	In-place completed, compacted area

3.8 CLEANING

- A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate. Restore per Specifications as applicable.

END OF SECTION

SECTION 32 12 16 - ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SCOPE

This section includes the construction of asphalt concrete pavement.

1.2 REFERENCE STANDARDS

- A. References herein to "AASHTO" shall mean Association of American State Highway Transportation Officials.
- B. Standard Specifications: Where the term "Standard Specifications" is used, such reference shall mean the current edition of the City of Pasco Design and Construction Standards and Specifications for Public Works Improvements. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.3 DEFINITIONS

- A. Maximum Density Test (MDT): Theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041 (Rice), by 62.4 pounds per cubic foot.

1.4 SUBMITTALS

- A. Aggregate Source Approval: In accordance with Standard Specifications for aggregate used in aggregate base.
- B. Aggregate Source Approval: In accordance with Standard Specifications for aggregate used in asphalt concrete.
- C. Job mix formula shall be an approved job mix formula. Submit formula, supplier, and product identification to the Engineer 30 days prior to start.
 - 1. Definite percentage for:
 - a. Each sieve fraction.
 - b. New asphalt cement.
 - c. Recycled asphalt pavement.
 - 2. Temperature of completed mix when discharged from mixer.

3. Character and quantity of anti-strip and recycling agents.

1.5 QUALITY ASSURANCE

- A. All testing to determine compliance with the specifications shall be performed by an independent testing laboratory contracted by the Contractor and approved by the Engineer. All testing costs shall be borne by the Contractor.
- B. A minimum of five (5) nuclear densometer readings shall be taken in random locations within every test area. Each test area shall not exceed 200 tons of asphalt; however, smaller areas may be designated by the Engineer.
- C. The surface smoothness of the new asphalt concrete pavement shall be such that when a 10-foot straightedge is laid longitudinally across the paved area in any direction, the new pavement shall not deviate from the straightedge more than 1/8 inch. Surface drainage shall be maintained. Additionally, paving must conform to the design grade and crown and contain no abrupt edges, low or high areas or any other imperfections as determined by the Engineer. Pavement construction not meeting these requirements will be repaired by grinding the existing pavement to a 1 1/2-inch depth and replacing with 1/2 -inch dense graded Asphaltic Concrete the full width at no cost to Owner.

1.6 PRE-PAVING CONFERENCE

- A. Any supervisory personnel of the Contractor and any subcontractors who are to be involved in the paving work shall meet with the Engineer, at a time mutually agreed upon, to discuss methods of accomplishing all phases of the paving work.
- B. The Contractor shall be prepared to review the size and type of equipment to be used and the anticipated rate of placement to determine equipment needs.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIAL

- A. Aggregate Base for Dense Graded Asphalt Concrete: The aggregate material shall be a clean, well-graded crushed base aggregate conforming to the Standard Specifications.

2.2 ASPHALT CONCRETE PAVEMENT

- A. Dense Graded Hot Mix Asphalt Concrete
 1. Use 1/2 inch-dense graded, PG 64S-28 HMA. Conform to the requirements as specified in the Standard Specifications.

2. Asphaltic concrete pavement delivered to the site shall be accompanied by a ticket with the approved "job mix formula" number shown. Loads without tickets identifying the job mix formula will not be accepted.
 3. Percent of recycled asphalt pavement used in new asphalt pavement shall not exceed 20 percent. Recycled asphalt pavement may not be used in top wearing course unless otherwise approved by the Engineer.
- B. Tack Coat
- In accordance with Standard Specifications. Use CSS-1, CSS-1h or emulsified asphalt may be diluted once with water at a rate not to exceed one part water to one part emulsified asphalt.
- C. Seal and Cover Coat
- Asphalt material shall be CRS-2 cationic emulsified asphalt. Cover stone shall conform to size ¼ -inch -#10 aggregate in the Standard Specifications.
- D. Subgrade Geotextile
1. As specified in the Standard Specifications.
- E. Subgrade Stabilization
- In the event that unstable materials are encountered during excavation, the additional excavation and installation of geotextile fabric and twelve (12) inches of rock substructure will be required, as directed. Conform to the requirements as specified in the Standard Specifications. For subgrade separation, use subgrade geotextile as specified in the Standard Specifications.

PART 3 EXECUTION

3.1 AGGREGATE PAVEMENT BASE

- A. Place pavement base to the depth shown on the plans or as specified in all cases, pavement base shall be compacted to a minimum depth of 6 inches. Bring the top of the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.
- B. Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95 percent of the maximum density, as determined by AASHTO T-99.
- C. Obtain the Engineer's acceptance of the subgrade before beginning construction of the aggregate base course.

- D. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be secured, suspend operations. Place no aggregate base course in snow or in soft, muddy, or frozen subgrade.
- E. If the required compacted depth of aggregate base course exceeds six (6) inches, construct in two or more lifts of approximately equal thickness. Maximum compacted thickness of any one lift shall not exceed six (6) inches. Compact each layer to the specified density before a succeeding lift is placed.

3.2 ASPHALT CONCRETE PAVEMENT

- A. Construct asphalt concrete pavement in accordance with Section 5 of the Standard Specifications.
- B. Conform to the requirements for prime coat and tack coat in the Standard Specifications. Tack coat all edges of existing pavement, manhole and clean out frames, inlet boxes and like items. When rate is not specified, asphalt will be applied at the rate of 0.1 gallon per square yard.
- C. Obtain the Engineer's acceptance of the aggregate base course before beginning construction of the asphalt concrete wearing course.
- D. Hot mix asphalt shall be placed on dry, prepared surfaces, when air temperature in the shade of 40° F or warmer, unless otherwise authorized by the Engineer.
- E. Placing asphalt pavement during rain or other adverse weather conditions will not be permitted unless otherwise authorized by the Engineer, except that asphalt mix in transit at the time these adverse conditions occur may be placed provided it is of proper temperature, the mix has been covered during transit, and it is placed on a foundation free from mud or free-standing water.
- F. Correct any defects in material and workmanship, as directed, when determined detrimental by the Engineer. These include segregation of materials, non-uniform texture, and fouled surfaces preventing full bond between successive spreads of mixture. The corrections or replacement of defective material or workmanship shall be at the Contractor's expense.
- G. Compact the bituminous mixture to at least 92 percent of the Theoretical Maximum Density.
- H. The finished surface of each course of layer of mixture shall be of uniform texture, smooth, and free of defects and shall closely parallel that specified for the top surface finished grade. Remove and replace boils and slicks immediately with suitable materials.

- I. The surface of each layer when tested with a Contractor-furnished 10-foot straightedge shall not vary from the testing edge by more than 0.02-foot for underlying courses of pavements and 0.015-foot for finished top courses or wearing courses of pavements. At no point shall the finished top of the wearing course vary more than 0.03-foot from the specified finished grade.
- J. Lift thickness shall be as shown on the drawings or specified, but not to exceed 3 inches.
- K. Do not place asphalt concrete pavement on emulsified asphalt (tack coat) until the asphalt separates from the water (breaks) but before it loses its tackiness.
- L. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.3 FIELD QUALITY CONTROL

- A. Job mix will be sampled immediately behind the paving machine.
- B. Temperature of the mix will be measured immediately behind the paver.
- C. The theoretical maximum specific gravity of the bituminous mixture will be determined in accordance with ASTM D2041.
- D. Properties of the job mix will be measured using ASTM D2041.
- E. Density of the compacted job mix will be measured in accordance with ASTM D2922 at a rate described in the Standard Specifications, Section 5.

3.4 ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES

Prior to placing asphalt concrete pavement, the Contractor shall make all necessary adjustments to existing manhole frames and covers and valve box covers to ensure that the tops of the manhole covers or valve box lids are flush with the finished grade of the adjoining pavement or ground surface, and that valve boxes and PVC pipes are centered and plumb over operating nut valve.

END OF SECTION

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SECTION 32 80 00 - IRRIGATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work of this section includes all labor and materials necessary to design, construct and / or modify the irrigation system for all restoration planting areas that are shown on the drawings and specified herein.
- B. The work includes, but is not limited to, the following:
 - 1. Mapping the existing irrigation system prior to construction
 - 2. Reconstructing and supplementing the existing irrigation system
 - 3. Piping
 - 4. Valves
 - 5. Electrical Control Wiring and connectors
 - 6. Sprinkler Heads
 - 7. Connection of 120V AC power source for Automatic Irrigation Controller and other electrical control devices.
- C. Related Sections include the following:
 - 1. Section 32 91 21, Finish Grading and Seeding
 - 2. Section 32 92 20, Turf and Grasses
 - 3. Section 32 93 00, Plants

1.3 DEFINITIONS

- A. American Public Works Association (APWA).
- B. American Standards for Testing and Materials (ASTM).
 - 1. D 1785-99 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2. D 2241-00 - Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
 3. D 2466-91 (1996) - Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 4. D 2564-96a - Standard Specifications for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
 5. B3-01 - Specification for Soft or Annealed Copper Wire.
 6. D2564-96a - Specification for Solvent Cements for PVC Plastic Pipe and Fittings.
- C. American Water Works Association (AWWA)
1. C500 - Gate Valves for Water and Sewerage Systems.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Delegated Design Permanent Irrigation: Design 100 percent head-to-head coverage underground irrigation system, including comprehensive hydraulic analysis by a qualified professional, using performance requirements and design criteria indicated.
- C. Delegated Design Temporary Irrigation: Design 100 percent head-to-head coverage above ground irrigation system, including comprehensive hydraulic analysis by a qualified professional, using performance requirements and design criteria indicated. The mainline shall be buried and left in place.

1.5 SUBMITTALS

- A. Product Submittals: Submit three copies of the proposed irrigation construction materials to the Owner's Representative for review and approval a minimum of 10 working days prior to commencement of work. The plan must follow the specifications and design criteria as outlined herein.
 1. Each submittal shall include manufacturer's product information ('cut') sheets for all components and materials proposed for use in fabricating and installing the irrigation system.
- B. Record Copy Drawings: During the course of installation, carefully show all field changes in red line on a print of the irrigation system as installed. This drawing shall be labeled "Record Copy", and shall be made available for inspection. The status of the 'Record Drawing' must correlate directly with the percentage of work completed

as described in the Contractor's Pay Request and may be used as a guide when approving payments.

C. As-Built Drawings: Upon completion of the work of this section and as a condition of its acceptance, the Contractor shall deliver to the Owner's Representative the following:

1. Drawings: Submit three prints and one reproducible and electronic file (AutoCAD DWG format) of complete as-built plans. As-built drawings shall clearly show all original components of the Record Copy and all changes documented in the Record Copy. Provide exact locations for all valves and any changes in location of sprinkler heads, piping, drain valves, valve boxes, valve markers, additional wires, changes in zoning, other buried equipment, and any other items required by the Owner's Representative. Submit this information for acceptance by the Owner's Representative.

Record dimensioned locations and depths for each of the following. Locate all dimensions from two permanent reference points (building, monuments, sidewalks, curbs, or pavements).

- a. Gate valves
- b. Sprinkler control valves
- c. Quick coupling valves
- d. Wire splice boxes
- e. Other related items as may be determined by the Landscape Architect.

2. Operation and Maintenance Manual: Submit three copies containing the following. Neatly assemble each copy in plastic sheet covers into one hard-cover three-ring notebook with project name on the cover. Provide the same in electronic (PDF) format.

- a. 11"x17" reductions of the finished irrigation system.
- b. Product cut sheets and operation instructions for all irrigation materials installed.
- c. Contractor's name, address and telephone number.
- d. The duration of the guarantee periods.
- e. The name and address of the local manufacturer's representative.
- f. List and description of routine maintenance procedures, including winterization, start-up, and recommended watering times for each zone.
- g. Troubleshooting guide.

3. Controller Reference Chart: Submit one chart for each controller installed on site showing the area covered by each sprinkler zone. The chart shall be a reduced copy of the as-built drawings, color coded to differentiate zone areas, and laminated between 20 mil. plastic sheets.
4. Supplemental Equipment: Submit the following:
 - a. Two keys to the quick coupling valves.
 - b. Two keys to the quick coupling valve lids.
 - c. Two keys to the valve markers.
 - d. Two keys to the manual drain valves.
 - e. Two valve box keys.
 - f. Two of each type of head installed on the project.
 - g. One hose swivel with $\frac{3}{4}$ " adapter.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide irrigation system as a complete unit produced by acceptable manufacturers indicated on drawings, including heads, valves, piping circuits, controls, and accessories. Hunter or Rainbird products only.
- B. Installer Qualifications: Contractor must have satisfactorily installed acceptable irrigation system(s) on at least three other projects of comparable complexity.
- C. Irrigation Drawings: The irrigation drawings are essentially diagrammatic. Due to the scale of the drawings, all characteristics of the system (i.e. sleeving, fittings, etc.) may not be represented. The Contractor shall carefully inspect the site and plan their work accordingly, supplying any materials and equipment necessary to install said characteristics.

The Contractor shall notify Owner's Representative of any discrepancies of site dimensions, obstructions, etc. that were not shown on the drawings and that might not have been known during preparation of irrigation drawings. If such notification is not made, Contractor shall assume all expenses and responsibility for any revisions necessary. Work called for on the Plans by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

Design locations of heads, valves, and lines are approximate. Contractor shall make minor adjustments of locations to avoid obstacles. Contractor to flag all head locations and chalk all pipe lines. Any adjustments or additional heads due to trees, lights, or other obstacles will be approved by Owner's Representative prior to any work. All finish grades shall be approved prior to installation of the irrigation system.

- D. Ordinances and Regulations: All local, municipal and state laws and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications and the Contractor shall carry out their

provisions. Any specification herein contained, shall not be construed to conflict with the above rules, regulations or requirements.

- E. Pre-Installation Conference: Schedule pre-installation conference after excavation of trenches and installation of sleeves, but before installation of pipe. Installation shall be timed to be completed prior to winter shut-down.
- F. The Contractor shall store all PVC pipe and fittings out of direct sunlight and protect from physical damage.
- G. The Contractor shall store and protect all specified components from adverse weather conditions until installation is complete.
- H. The Contractor shall handle all components as directed by the manufacturer's handling and installation instructions. Damage from transport or other handling of materials shall be the responsibility of the Contractor.

1.7 PROJECT CONDITIONS

- A. Inspection of the site: The contractor shall inspect the site prior to construction and verify the extent of the work required. Commencement of construction by the Contractor designates acceptance of the site conditions apparent at outset. The Contractor shall obtain approval to access system components for inspection prior to commencement of construction.
- B. The Contractor shall verify the locations of all existing utilities, structures, and services before commencing work. The location of utilities, structures and services shown on these plans are approximate only. Any discrepancies between these plans and the actual field conditions shall be reported to the Owner's representative immediately.
- C. Protection of Property and Utilities: All trees, shrubs, flowers, fences, buildings, walks, roadways, and other property shall be protected from damage. Any damage to said property shall be repaired or replaced to the Owner's satisfaction at the Contractor's expense. Open trenches left exposed shall be flared and barricaded as per OSHA regulations by the Contractor. Contractor shall restore all areas to their original condition. Contractor shall be responsible to contact utility companies and the Owner's Representative for staked locations of all utilities on the property. If staked utilities are damaged by the Contractor, the utilities shall be repaired at the Contractor's expense.
- D. All trenching and other work within the dripline of existing trees shall be done by hand so as not to damage tree roots or limbs. All trenches shall be no less than ten feet from the trunk of any tree. Promptly notify Owner's Representative of unexpected sub-surface conditions.

- E. Weather Limitations: Work shall be performed only when weather conditions do not detrimentally affect the quality of work as intended and shown on these plan sheets.
- F. Project Limits: Areas, as specified within which work is to be performed.
- G. If new mainline is required in areas not currently described on the construction documents, submit a shop drawing of location, hydraulics, and system layout for new extension to Owner's Representative for approval prior to commencement of construction.
- H. The Contractor shall protect all areas of work defined on the drawings and any existing on-site vegetation, structures, utilities, etc. All damage which occurs as a result of work under this contract shall be repaired at no cost to the Owner. The Contractor shall be responsible for the provision of traffic control, barricades, safety guards, and any other structures or improvements necessary for the complete protection of the public. The Contractor shall verify water sources and install labeled components as required by state and federal laws.
- I. The Contractor shall, at all times, take adequate precautions to keep rock, dirt, gravel, debris, and all other foreign materials from entering piping, valves and other irrigation equipment.

1.8 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.
- B. Verify that sleeving and other conduits, of sizes and types specified, are installed as required.
- C. Prior to the start of work the Contractor shall verify that the performance and components of the existing site systems are in accord with current jurisdictional requirements and that all necessary shop drawings are provided for components' locations.
- D. The Contractor shall protect the existing site systems and maintain their performance at all times during the work of this section unless otherwise approved by the Owner's Representative. The Contractor shall cap all lines that are cut by new construction and/or re-route to maintain existing system performance.

1.9 GUARANTEE

- A. The Contractor guarantees that all new irrigation components installed, as part of this work shall be free from defects in materials, design and workmanship for a period of one year from the Date of Substantial Completion. Contractor shall monitor the irrigation system and make adjustments to timing, position, coverage, or watering

rates that may be necessary to obtain the specified coverage (114% of area) and maintain all plant material in a healthy condition.

- B. Upon notice from the Owner's Representative of failure on any part of the installed equipment during the guarantee period, due to material fatigue, normal wear or faulty installation procedures, new replacement parts shall be promptly furnished and installed by the Contractor at no additional cost to the Owner. Damages to property or site improvements resulting from the failure of specified components shall be repaired within two (2) calendar days of discovery and/or receipt of notice of malfunction by the Owner, at no additional cost to the Owner.
- C. Any unwatered area shall be immediately corrected by the Contractor.
- D. The contractor shall be responsible for grade settlement, and/or erosion of soil surfaces resulting from defects in irrigation installation throughout the specified warranty period.
- E. Following the Date of Final Acceptance, the Contractor will maintain responsibility for the irrigation system, including start-up, winterization, and all controller settings, for the duration of the one-year maintenance period, and any optional maintenance periods. Contractor shall monitor controller settings and adjust them as necessary to maintain sod and plant material in a healthy state throughout the warranty period.

1.10 DAMAGES

- A. Any structures or facilities damaged due to work of this project shall be restored equal or better to their original condition at Contractor's expense and to the satisfaction of Owner's Representative and Project Manager.
- B. Replacement of Paving and Curbs: Damage caused by trenching, crossing existing and/or proposed roadways, paths, curbing, etc. shall be kept to a minimum and all damaged areas shall be restored equal or better to their original condition. This includes completion of subgrade to 95% relative compaction.
- C. Contractor shall be responsible for all damage caused by leaks or breaks in pipe furnished or installed in this contract for one year after date of final acceptance.

1.11 EXISTING UTILITIES

- A. Locate and identify, with visible marking, existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during excavation operations.
- B. Should uncharted piping or other utilities be encountered during excavation, consult the Project Representative and utility owner immediately for directions. Cooperate with the owner and public or private utility companies in keeping their respective

services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner. The cost of repairing charted or known utilities shall be paid by the Contractor.

- C. Do not interrupt existing utilities service facilities occupied and used by the owner or others, except when permitted in writing by the Project Manager and then only after acceptable temporary utility services have been provided

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Materials and equipment shall be new, delivered to site in original factory condition, and as specified in this section.
- B. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, those specified in the Plans. Rainbird and Hunter products only.

2.2 PLASTIC PIPE

- A. All plastic pipe shall be polyvinyl chloride (PVC) continuously bearing the seal of the National Sanitation Foundation, with the exception of polyethylene pipe specified as follows.
- B. Polyvinyl Chloride (PVC) pipe
 - 1. Lateral Lines: PVC Class 200 (SDR 21), Type 1, normal impact, must meet requirements as set forth in commercial standard CS 256, solvent weld pipe meeting the requirements of ASTM D2241. Lateral lines shall be sized per the requirements of the irrigation system.
 - 2. Main Lines: PVC Class 200 (SDR 21), bell end, ASTM D2241 or commercial standard CS 256, Type 1, white, NSF approved, normal impact as applicable. Coordinate with drawing legend. Main lines shall be sized per the requirements of the irrigation system.
 - 3. Sleeves:
 - a. Sleeves installed beneath asphalt paving: PVC Class 200 meeting the requirements of ASTM D2241.
 - b. Sleeves installed beneath walls and walkways: PVC Class 200 pipe meeting the requirements of ASTM D2241-00.
 - c. Sleeves shall be at least 2 pipe sizes larger than line carried. Wiring shall be sleeved separately in 2" minimum pipe.

- C. Risers and Nipples: PVC, Schedule 80, Type 1 – one piece gray, standard weight with molded threads, both ends, ASTM D1784-99a, D2464-99.
- D. Electrical Conduit: PVC Schedule 40 – gray electrical conduit, standard weight; minimum 2-inch minimum diameter unless otherwise required.
- E. Polyethylene Pipe and fittings: flexible, thick walled designed to withstand 400 psi burst pressure test: Quality and wall thickness equivalent to ASTM Standards, or approved equal. Sized per manufacturer's specified velocity tolerances.
- F. Pressure Compensating Inline Emitter Tubing: Rain Bird 'Landscape Dripline' XFCV-09-12, series, or previously approved equal.

2.3 PLASTIC FITTINGS

- A. For Polyethylene Pipe: As specified by manufacturer of polyethylene pipe.
- B. For PVC Class 200 Pipe: Schedule 40 molded, solvent weld type PVC, or Schedule 80 PVC if threaded. Plastic pipe fittings shall meet all the requirements of ASTM D2241 for Type 1, Grade PVC. Pressure rating and types of pipes shall be compatible with pipe being used.
- C. Joints: Plastic pipe fittings shall be molded as the pipe and shall be suitable for solvent weld.
- D. PVC Swing Joints: Install quick couplers and rotary heads on PVC triple swing joints. Assemble by using Schedule 80 elbows and nipples. Male threaded nipples shall be wrapped with Teflon tape. Rainbird, Hunter, or Lasco prefabricated swing joints.

2.4 PIPE JOINING COMPOUNDS

- A. Cement and Primer for Solvent Weld Joints: As recommended by manufacturer of PVC pipe. Primer/Cleaner and heavy bond cement shall conform to ASTM D2564.
- B. Teflon Tape for Threaded Joints (PVC or galvanized): DuPont or approved equal.

2.5 ELECTRIC CONTROL WIRE AND CONNECTORS

- A. Wire: Single strand 14 gauge copper, UL approved for direct burial. Sized in accordance with manufacturer's specifications. Control (hot) wires shall be colored and common (ground) wire shall be white. Spare control wire shall be colored or numbered.
- B. Wire Connectors and Sealant: UL approved for direct burial.

2.6 AUTOMATIC CONTROLLER

- A. Automatic Controller: Use existing and verify capacity if additional zones are required. Controller shall have ability for all zones to fully operate and meet both normal and specified low volume system requirements, and as required by site conditions.

2.7 VALVES, FILTERS, PRESSURE REGULATORS, PUMPS

- A. Manual Isolation Valves: Bronze Globe Valves: MSS SP-80, Class 125, Type 2, with bronze body and nonmetallic disc.
- B. Remote Control Valve: Hunter ICV-G temporary remote control valves or Rainbird PEB series. In-line with manual flow adjustment. Brand valve box cover with SV # and corresponding zone on time clock with 1" minimum letters. Water volumes and velocity through valve shall not exceed manufacturer's recommended optimum performance criteria.
- C. Key Operated Mainline Valves: Kennedy manual main resilient seated valve, gate type, AVK with square nut top. Brand gate valve box covers with 'GV' in 1" minimum letters.
 - 1. Furnish one (1) key (manual cross handle).
- D. Key Operated Drain Valves: Apollo manual drain valve, 1" ball type, fitted for key operation.
 - 1. Furnish two (2) valve keys, 3-foot long with tee handles and key end to fit drain.
- E. Quick Coupling Valve and Accessories: Hunter or Rainbird, 2-piece brass construction with locking rubber covers. Mounted on valve box as shown. Brand in 1" minimum letters 'QC' on valve box cover containing quick coupler.
 - 1. Install quick couplers along the mainline at a rate of one quick coupler for every 100 linear feet of mainline.
 - 2. Coupler keys:
 - a. Provide coupler keys and hose swivels for each site as noted in this specification.
 - b. Brass construction, heavy duty, double lug type.
- F. Inline Wye filters: As specified by manufacturer for low flow filtering. Utilize 150 or 200 mesh screens (0.5 GPH = 200 mesh min., (1.0 GPH + = 150 mesh) or as specified by manufacturer for appropriate emitter sizes required by site conditions.

2.8 VALVE BOXES

- A. Carson or Armor/Ametek as specified with locking cover, jumbo and standard. Provide extensions where needed. Provide 3" deep gravel sump with geotextile wrap for each box. Allow no space where soil can invade box or sump. Use jumbo boxes for any valve 1.5" or larger. One (1) valve per box. Provide a minimum of 3" clear on all sides of the valve to facilitate access, maintenance, repair or removal.

2.9 DRAIN VALVE MARKER COVER

- A. Cover as recommended by manufacturer, or approved equal.

2.10 SPRINKLERS

- A. Pop-up Rotary Gear Driven Heads: Hunter I-25 or Rainbird Falcon 6504.
 - 1. Body: High impact plastic.
 - 2. Drive: Sealed, oil packed gear assembly.
 - 3. Cover: Rubber cover kit.
 - 4. Stainless steel retraction spring.
 - 5. Stainless steel riser.
 - 6. Adjustable radius.
- B. Where necessary to control zone drainage, at the bottom of slope areas, install low head drainage bodies on lowest heads in zone.
- C. Pop-up riser heights shall be as required to adequately supply water to plants.

2.11 OTHER MATERIALS

- A. Valve Marker: Locking type, RainBird, Weathermatic, Buckner, or approved equal.
- B. Manual Drain Valve Key: Minimum length 30 inches
- C. Tracer Wire: Alarmatape or approved equal
- D. Drainage backfill: Clean gravel or crushed stone, graded from 1 ½" maximum to ¾" minimum. Seal completely in geotextile wrap. Allow no contact with soil.
- E. Pipe backfill: Clean, dry, friable topsoil void of stones larger than 1" in diameter and other material deleterious to specified pipe. Soil shall be suitable for compaction to eliminate settlement conditions of specified finish grades.
- F. All other materials, not specifically described, but required for a complete and proper irrigation system installation, shall be new and of first quality and must be approved by the Owner's Representative prior to installation on site.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to all work of this section, the Contractor shall carefully inspect all previously installed work and verify that all such work is complete to the point where specified installation may properly commence.
- B. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the accepted design, the referenced standards, and the manufacturer's specifications.
- C. Design Pressures: As indicated on Plans, at connection to main pipe and at last head in circuit. Contractor to verify existing pressure prior to starting work.
- D. Location of Heads: Design location is approximate. Make minor adjustments as necessary to avoid plantings and other obstructions. Flag head locations for approval before installation.
 - 1. Minimum Water Coverage: 114% minimum.
- E. The Contractor shall integrate new components into the existing system and maintain existing performance as specified
- F. Make arrangements for water shutoff when necessary with Owner's Representative. Notify Owner 24 hours prior to water shutoff.
- G. Layout: Provide shop drawings for location of pipe, sprinkler heads, valves, and other equipment, which shall indicate size and type. Upon approval of shop drawings, no major changes shall be made without prior approval of by Project Manager. Minor changes may be necessary to conform to ground conditions.

3.2 PIPE INSTALLATION

- A. General: Unless otherwise indicated, comply with requirements of the Uniform Plumbing Code. Excavate straight and true with bottom uniformly sloped to low points. 3"/100' run to drain valve. Pipe should be snaked in trenches to allow for expansion and contraction. Chalk all areas to be trenched for approval before excavation. Common trenching may be used for more than one pipe provided that a minimum of 6" separation is maintained and piping may cross only at 90 degree angles.
- B. Trench depths shall provide minimum covers of:
 - 1. 18 inches (300 mm) to invert of pipe for lateral lines;
 - 2. 24 inches (450 mm) to invert of pipe for main lines or sub-mains;
 - 3. 18 inches (450 mm) for sleeving beneath walkways;

4. 24 inches (600 mm) for sleeving beneath vehicular traffic (or as directed by jurisdiction).]
- C. Depth of trenching shall avoid interference with waterlines, drainage systems and other utilities (verify), and shall allow for a four-inch vertical clearance between pipes.
 - D. Trench bottoms shall have uniform slopes with one percent minimum slope towards drain valves. Trench bottom shall be free of rocks or sharp-edged objects. Stones larger than one-inch in diameter are not allowed in the backfill material. Compact to adjacent soil density. Keep trenches free of debris, during construction.
 - E. Lay pipe on solid sub-base, uniformly sloped without humps or depressions. No piping may be buried until visual inspection by Owner's Representative or Landscape Architect. Leave all trenches open until testing has been completed. Installers may be required to show knowledge of proper gluing techniques prior to beginning gluing operations.
 1. For Main Line Piping: Slope to drain valve at least $\frac{1}{2}$ " to 10' run. Install drain valve at all low points. Water cool piping before backfilling.
 2. Install PVC Pipe: Install in dry weather when temperature is above 40 degrees F (4 degrees C) in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperature above 40 degrees F (4 degrees C) before testing, unless otherwise recommended by manufacturer. No pipe joints shall be located within pipe sleeves.
 3. Install poured concrete thrust blocks according to pipe manufacturer's requirements for all main line pipe larger than 2 $\frac{1}{2}$ " and for all gasket seal pipe.
 - F. Connecting to existing main line: connect to locations indicated in the Plans.
 - G. Pipe connections: Do not use solvent cement on threaded joints. Wrap threads with minimum of three wraps of Teflon tape in accordance with manufacturer's recommendations. Tighten fittings only to manufacturer's specifications. Follow manufacturer's instructions for solvent welding of PVC pipe and fittings to achieve tight and inseparable joints.
 - H. Installation of Piping Under Paving: Contractor to match and install new paving and base with existing paving and base where cutting of paving is necessary for installation of piping. All piping under hard surfaces to be sleeved. Any cracking or breaking of the path is to be repaired at Contractor's expense.

3.3 PIPE PULLING

- A. Installation of pipe and wires by means of vibratory plow may be used as an alternate to standard trenching methods if approved by the Owner's Representative.
- B. Vibratory pipe pulling shall only be allowed on 3/4 inch and 1 inch diameter piping.
- C. Solvent weld joints shall be thoroughly cured prior to pipe pulling.
- D. The Contractor shall ensure, by means of an open pit or trench at the beginning, middle, and the end of pull, that pipe and wire is installed at the specified burial depths throughout the entire length of the pull. Burial depths shall be the same as specified for trenching.
- E. Pulling grip/bullet shall be a minimum of two-inch in diameter greater than the combined diameters of pipe joints and wire to be pulled.
- F. Wire pulling shall only occur with proper wire blade feed attachment.

3.4 PIPE CONNECTIONS

- A. Solvent weld PVC pipes only during non-freezing weather. Solvent weld PVC pipes only under cover in rainy weather. Do not allow flooding of welded piping until specified cure time has elapsed.
- B. Air temperature of PVC mating surfaces for plastic pipe and fittings shall be between 40 degrees F and 100 degrees
- C. Do not use solvent cement on threaded joints. Wrap threads with minimum of three wraps of Teflon tape in accordance with manufacturer's specifications.
- D. Follow manufacturer's instructions for solvent welding of PVC pipe and fittings to achieve tight and inseparable joints.
- E. Cementing plastic pipe:
 - 1. Cut all ends squarely with approved pipe cutting tool. Bevel ends with a deburring tool.
 - 2. Clean all pipe ends prior to assembly.
 - 3. Clear all pipe lengths of dirt and debris. Protect from contamination.
 - 4. Do not use excess primer and solvent when joining pipe ends.
 - 5. Insert pipe ends to full depth of fitting, hold tightly as necessary to insure full depth bonding.
 - 6. Allow 15 minutes curing time following joint assembly prior to moving or handling jointed pipe.

7. Install slip and/or barbed fittings for drip system components per manufacturer's specifications.
- F. Dielectric Protection: Use dielectric fittings at connections where pipes of dissimilar metals are joined. Use dissimilar metals only with Landscape Architect's approval.

3.5 SLEEVING

- A. Install all main and lateral line sleeving under all paved surfaces as indicated in the Plans.
- B. Minimum depth to top of pipe shall be determined by depth of main line and lateral lines.
- C. Lay sleeve to drain at minimum grade of 3"/100'.
- D. Ends of sleeves: Mark in manner to ensure easy location in future. Do not allow sleeves to become filled with soil or other undesirable material.

3.6 BACKFILLING

- A. The Contractor shall backfill trenches only after main and lateral line inspection and testing and after receiving written approval from Owner's Representative. The Contractor shall notify the Owner's Representative a minimum of 24 hours in advance when requesting inspection. The Contractor shall backfill with clean material from excavation or imported bedding material. Remove organic material as well as all rocks and debris larger than ¼" diameter. No angular rock of any size allowed in backfill. Place acceptable backfill in 6" lifts, compacting each lift to eliminate settling of final trench grades. Provide a minimum of 3" of clean material on sides and bottom of trench and to top of trench. In all turf areas, shrub beds and other planting areas, backfill material shall conform to the specified soil mix to the depths indicated in Division 2 requirements for soil preparation. Any settling within the first year will be repaired by the Contractor at no expense to the Owner.
- B. Drainage Backfill: Seal with geotextile wrap by extending fabric to top of the outside of 10" valve box. Use extensions as required. Create 2 cu. ft. pocket of drain rock below valve location.

3.7 DRAIN VALVE INSTALLATION

- A. Install one manual drain valve at low points on the discharge side of each remote control valve and at all low points in main line pipe to allow for complete drainage of all main lines.
- B. Install drain valves as recommended by manufacturer.

3.8 VALVE INSTALLATION

- A. Install as recommended by manufacturer.
- B. Install specified quick coupling valve, in specified box, as recommended by manufacturer.
- C. Zone valve and valve box locations shall be located in a manner so as not to interrupt plant massing or groups, or otherwise alter the character of the proposed plantings. Install one valve per valve box, arranged for easy adjustment and removal. Allow minimum of 12" between valves. Arrange adjacent valve boxes parallel to each other and the same distance apart. Brand cover in 1" minimum letters 'ZV' for section valve and the appropriate station number to controller.
 - 1. Place valves and valve boxes in low growing ground cover areas offset from adjacent paving by a minimum of 2 times the specified ground cover spacing.
 - 2. In public areas where valves or valve boxes may be readily visible to the public, verify their location with Owner's Representative prior to installation.
 - 3. Install valve boxes perpendicular to and on a line with adjacent pavement or walls.
 - 4. Place decoder units in individual jumbo valve boxes.
 - 5. Install one valve box and cover for each valve or decoder installed. Place top 1" above finished grade. Top of valve box shall follow grade.
- D. Adjust automatic control valves to provide flow at rated operating pressure required for each sprinkler and each lateral. Provide union on up and downstream sides.

3.9 ELECTRICAL WIRING INSTALLATION

- A. Install as per manufacturer's instructions or detail. Connect remote control valves to controller in numerical sequence as shown on the Plans.
- B. Bury control wiring between controller and electric valves in sprinkler main line trenches. Bury per manufacturer's recommendations. Place in sleeves when passing underneath pavement.
- C. Make all splices moisture proof using specified electrical connectors. Splices shall only be in valve boxes. Bundle wires together and wrap with electrical tape at 5 foot intervals. Provide 24 inches of coiled slack at connection to control valves. Provide one foot of slack between all splices in a series of "S" curves in trenches.
- D. Make electrical connection at valve to allow for pigtail so solenoid can be removed from valve with sufficient slack to allow ends to be pulled 12" above ground for examination and cleaning.

- E. Clearly mark ends of all wiring according to valve number with a permanent number tag. Locate one tag at each control valve inside the valve box and one tag per wire in the controller.
- F. Bundle wires at 15' to 20' intervals and lay with main line pipe below and to one side only of the trench (inside of loop on looped main).
- G. Provide an expansion loop at every decoder and every 100' formed by wrapping wire for at least twelve inches, a minimum of sixteen coils around a ¾" pipe leaving pipe in place.
- H. Make splices and connections in accordance with NEC. Locate splices and connections at valve boxes using a 3M DBY kit or per manufacturer's recommendations. Buried splices prohibited.
- I. Provide four spare wire(s) to farthest zone(s) in each direction and clearly mark as "spare." Loop spare wires through all control valve boxes.
- J. Provide any additional control wires as noted on drawings and label to correspond with controller station numbers.
- K. Install separate common wires for each controller if system contains more than one controller.
- L. Sharp bends or kinks in the wiring shall not be permitted. Wires shall be unreeled in place alongside or in trench and shall be carefully placed along bottom of trench. Wire shall not be unreeled and pulled into trench from one end.
- M. For computer control wire, follow above specifications. Connect to satellite controllers if applicable. Coil adequate slack for any future connections. Place field ends in 12" valve boxes with extensions as needed to meet 1/2" above finish grade. Place other end inside controller with adequate slack for future connection. If more than one controller, also install wire from controller to controller.
- N. All work performed as electrical installation shall conform to applicable codes. All high voltage electrical work shall be performed by a licensed electrician. The Contractor shall be responsible for the electrical connection of the controller with the metered electrical line at the base of the controller.

3.10 SPRINKLER INSTALLATION

- A. Flush circuit lines with full head of water and install heads after hydrostatic test is complete.
- B. Install in accordance with manufacturer's specifications and at manufacturer's recommended heights.

- C. Install all sprinklers on flexible risers, using flexible polyethylene pipe or PVC swing joints.
- D. Sprinklers located on slopes which are less than three percent shall be installed plumb. Those that are located on slopes greater than three percent shall be installed at an angle midway between plumb and perpendicular to the slope.
- E. Locate part-circle heads to maintain a minimum distance of 6" from walls and other boundaries, unless otherwise indicated. Allow no backwash or over spray onto walls or fences.

3.11 SYSTEM FLUSHING

- A. After piping, risers, and valves are installed, but prior to installing sprinkler heads, thoroughly flush piping system under full water head.
- B. Maintain flushing for five minutes or until water flows clearly.
- C. Cap risers immediately after flushing.

3.12 PRESSURE TESTING

- A. Conduct test in presence of Owner's Representative.
- B. Test shall be conducted with pump station, backflow prevention, quick couplers, control valves and manual drains in place and prior to backfilling. Laterals may be visually inspected for proper solvent welds and leaks prior to backfilling but no pressure test will be required.
- C. All main supply lines shall be purged of air and tested with a minimum static water pressure of 150 psi for 60 minutes without the introduction of additional service or pumping pressure. Testing shall be done with one pressure gauge installed on the line, in the location required by the Engineer. For systems using a pump, an additional pressure gauge shall be installed at the pump when required by the Engineer. Lines that show loss of pressure exceeding 5 psi at the ends of specified test periods will be rejected.
- D. Correct defects and retest until Owner's Representative approves.
- E. Notify Owner's Representative a minimum of 24 hours in advance when requesting inspection of pressure test.

3.13 SYSTEM PROGRAMMING

- A. Calculate three irrigation programs: Spring / Early Summer, Summer, Late Summer/ Fall. System operation requirements shall be based on annual precipitation rates,

plant material maturation requirements, solar exposure, and topography and soil conditions.

- B. Submit seasonal controller operation program with as-built record drawings and include laminated copy of program at controller location in controller cabinet. Include total application quantities in inches per week for all zones, for establishment period and normal system operation.

3.14 TESTING AND FINAL INSPECTION

- A. Thoroughly clean, adjust and balance the installed irrigation system. Adjust spray pattern of nozzles to reduce throw of water onto buildings, structures, vehicles, and paved surfaces. Monitor and re-adjust system operation until components operate continually as specified. Before sprinkler heads are set, thoroughly flush the lines to remove all foreign matter. Flush from dead end fittings for a minimum of five minutes under full head of pressure.
- B. Notify the Owner's Representative in writing not less than 16 working hours in advance of when testing will be conducted.
- C. The Contractor shall operate the system and conduct testing in the presence of the Owner's Representative to demonstrate satisfactory performance and coverage.
- D. The Contractor shall demonstrate complete operation of the system, including controller-operating program, start-up and winterizing procedures, and deliver all supplemental equipment to the Owner's designated operating personnel.
- E. Hydrostatic Test: Test main piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 125 psi for a period of 1 hour. Piping may be tested in sections to expedite work. Remove and repair piping, connections, or valves which do not pass hydrostatic testing.
- F. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads are adjusted to final position.
 - 1. Demonstrate to Owner's Representative that system meets coverage requirements and that automatic controls function properly.
 - 2. Coverage requirements are based on operation of one circuit at a time. Carefully adjust lawn sprinkler heads so the top of the head is ½" above final grade.
 - 3. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings.
 - 4. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, make such adjustments prior to final

acceptance at the direction of Owner's Representative. Adjustments may also include changes in nozzle sizes and degrees of arc as required.

5. Correct areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices.

3.15 MAINTENANCE

- A. The Contractor shall provide a minimum one-year maintenance period unless otherwise specified in the contract documents. The maintenance period shall start on the day following the date of written acceptance of system installation by the Owner's Representative.
- B. After two weeks of operation, flush lines and remove particulates from system. Adjust and clean all filters and/or screens bi-monthly.
- C. Review site conditions and plant vitality on a monthly basis and adjust watering schedule and components as necessary to maintain plant health.
- D. Run through controller and verify time settings, upon each inspection.
- E. Perform seasonal winterization and system start-up. Demonstrate start-up and winterizing procedures to operating personnel.
- F. Repair and adjust system throughout warranty period, and prior to turning maintenance schedule over to Owner's operating personnel.

3.16 WINTERIZATION

- A. The Contractor shall be responsible for the winterization of the automatic irrigation system. Unless modified by extremely mild weather conditions, the system may be shut down and winterized by November 25. The requirement shall remain in effect for the duration of the maintenance period(s).
- B. In the week immediately prior to closing the system, all landscape areas shall receive a minimum of 1.5" of watering (either through natural conditions or through operation of the system).
- C. Winterize the system by closing the main pressure valve opening, all stop and waste valves, removing water from the lines, de-energizing the controller, and all other actions deemed prudent.

END OF SECTION

SECTION 32 91 21 - FINISH GRADING AND SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil Preparation
2. Weed control
3. Fertilizing
4. Seeding
5. Mulching
6. Hydroseeding
7. Hydromulching
8. Erosion Control Blanket
9. Maintenance and Establishment Period

B. Related Sections:

1. Section 31 22 13, Rough Grading
2. Section 31 23 17, Trenching
3. Section 31 05 13, Soils for Earthwork

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
2. 7 USC 1551-1611 - Federal Seed Act.

1.3 DEFINITIONS

- A. Certified Seed: A grass or legume seed named variety that has been reviewed and accepted into the State Certified Seed program. Currently certified seed is individually sold in bags with a Certification Tag.
- B. Pure Live Seed (PLS): Is a measure used to describe the percentage of a quantity of seed that will germinate. PLS is obtained by multiplying the purity percentage by the percentage of total viable seed, then dividing by 100.
- C. Establishment Period: A period when planting work has been performed and initially accepted, and there is a contract requirement to care for the planted areas in some way until the period ends.

- D. Sensitive Areas: Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.
- E. Weeds: Vegetative species other than specified species to be established in given area.
- F. Invasive Plants: Any species that appears on the City of Pasco's Standard's current noxious weed list, plus known problem species including phalaris arundinacea, mentha pulegium, holcus lanatus, anthoxanthum odoratum odoratum. The last crop plants (if listed as non-native on United States Department of Agriculture (USDA) Plants Database) are considered invasive if it comprises more than 15 percent in any newly established vegetation.

1.4 SUBMITTALS

- A. Product Data: Submit data for seed mix, mulch, tackifier, erosion control blanket, soil amendment materials, pesticides, herbicides, and other accessories. The product should meet or exceeds all product requirements specified herein.
- B. Grass Seeds Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - 1. Certification of seed analysis, germination rate, and inoculation. Include the year of production and date of packaging. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing within 12 months of delivery date. Also include:
 - a. Name and address of laboratory
 - b. Date of test
 - c. Lot number for each seed certified
 - d. Test Results: Name, percentages of purity and of germination, and weed content for each seed mix.
- C. Operation and Maintenance Data: Include maintenance instructions and weed control.
- D. Load Tickets: Contractor shall provide all delivery load tickets for seed, fertilizer, and mulch. Submit to Owner prior to commencement of work under this section.

1.5 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

- B. Planting and seeding shall be done with the approval of the Owner when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting.

1.6 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum 3 years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 2 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Deliver tackifier sealed containers showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.1 GROWING MEDIA

- A. Fertilizer: Biosol Mix 7-2-3 Natural-All Purpose Fertilizer, or equivalent.
- B. Guaranteed Analysis:
 - 1. Total Nitrogen (N): 7%
 - a. 0.5 % Water Soluble Nitrogen
 - b. 6.5% Water Insoluble Nitrogen (Slowly Available Nitrogen from fermented cottonseed and fermented soybean meal).
 - 2. Available Phosphate (P₂O₅): 2%
 - 3. Soluble Potash (K₂O): 3%
- C. Plant Nutrients Derived From: Fermented Soybean Meal, Fermented Cottonseed Meal, Sulfate of Potash Magnesia.
- D. Sterilized and Free of Weed Seeds All-Natural Organic Nitrogen.

E. Application Rate: 35 lbs. per 1,000 square feet.

2.2 SEED MIXTURE

A. Seed Mixture and Application Rate: Native Seed Mix. Computations for quantity of seed required are based on the percent of purity and percent of germination: pounds of seed X purity X germination = pounds of pure live seed (PLS).

Botanical Name	PLS Lbs. per Acre
Bluebunch wheatgrass "Secar"	6
Sandberg's bluegrass	2
Thickspike wheatgrass "Critana"	2
Indian ricegrass "Nezpar"	2
Bottlebrush squirreltail	2
TOTAL:	12

2.3 SOD – (NOT USED)

2.4 ACCESSORIES

A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; non-toxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15% and a pH range of 4.5 to 6.5. Mulch Application Rate: 2,000 lbs. per acre.

B. Mulch Binder: Non-asphaltic Tackifier. Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; non-toxic and free of plant-growth or germination inhibitors. Application Rate: 50 lbs. per acre.

C. Fertilizer: Commercial grade; recommended for grass to eliminate deficiencies of

2.5 SOURCE QUALITY CONTROL

A. Analyze soil to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of soil testing.

C. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Planting Season: Plant seeds when growing conditions are conducive to seed germination and quick but thorough establishment of seedlings.
 - 1. Depending on latitude and elevation in the Pacific Northwest, these conditions occur either in September through October or April through May.
 - 2. Avoid planting seed during the heat of summer or in late fall to avoid freezes that kill sprouting grass seeds.

3.2 SOIL PREPARATION

- A. Prepare area for seeding while generally considering the following:
 - 1. Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks, or debris.
 - 2. Application rates of fertilizer or lime shall be based on soil testing results.
 - 3. Prepare a tilled, fine, but firm seedbed.
 - 4. The soil shall have a pH range of 5.5 to 8.0.

3.3 FERTILIZING

- A. Apply fertilizer hydraulically, at the same time as mulch is applied (described below). Fertilizer composition and application rates are provided above.

3.4 SEEDING

- A. Broadcast Seeding: Use a whirly-bird type spreader to broadcast seed over all bare areas, at a rate of 14 PLS pounds per acre. Apply seed in two equal applications, in perpendicular directions, to assure uniformity.
- B. Lightly rake seeded areas after seed is broadcast.
- C. Seeding will not be permitted when wind velocity is such as to prevent uniform seed distribution. No application shall be undertaken during inclement or the forecast of inclement weather. No application shall take place in the presence of free surface water or when the ground is frozen or otherwise not tillable.

3.5 MULCHING

- A. Mulch Application: Mulching of seed areas shall be accomplished using an approved hydromulcher to apply the specified fiber mulch at a rate of 2,000 pounds per acre.
- B. Fertilizer and mulch binder shall be applied at the same time and by the same machine as the fiber mulch, at application rates specified above. Prior to application, mulch, mulch binder, and fertilizer shall be well mixed to ensure a homogenous mixture is applied.
- C. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow, or other causes.
- D. Areas not properly mulched, or damaged due to the Contractor's negligence, shall be repaired and remulched in an acceptable manner at the Contractor's expense. Mulch removed by wind prior to acceptance shall be re-established by the Contractor at his own expense.
- E. The seeded area shall be mulched within 24 hours after seeding. Areas not mulched within 24 hours after seeding must be re-seeded with the specified seed mix at the Contractor's expense.
- F. Contractor shall remove all hydromulch from plant materials, fences, paved areas (including paved path), and buildings as directed by Owner.

3.6 TEMPORARY MULCH FOR EROSION CONTROL

- A. As required by the SWPPP for this project, no soils shall remain exposed and unworked for more than 30 days during the dry season (July 1 to September 30) and 15 days during the wet season (October 1 to June 30). Regardless of the time of year, all soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on weather forecast.
- B. Soil stabilization shall be provided by applying mulch and tackifier at the application rates specified above.

3.7 SOD – (NOT USED)

3.8 WORK QUALITY

- A. After application, apply water with fine spray immediately after each area has been hydroseeded. Apply water with fine spray immediately after each area has been mulched.
- B. Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used.

- C. Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.
- D. Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

3.9 CLEAN UP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition. Any damage to other work done by landscape crew is to be reported and repaired immediately.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

END OF SECTION

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SECTION 32 92 20 – TURF AND GRASSES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Work consists of providing all labor, material and equipment for installing and establishing seeded Field Grass, Sodded Lawn and other special seed mixes as indicated below.
 - 1. Install and establish lawn sod in areas shown on drawings.
 - 2. Plant and establish seed mixture(s) in areas shown on drawings.
- B. Related Section include the following:
 - 1. Section 32 80 00, Irrigation
 - 2. Section 32 91 21, Finish Grading and Seeding
 - 3. Section 32 93 00, Plants

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certifications: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.

- C. Product Certificates: For soil amendments and soil conditioners, signed by product manufacturer.
- D. Qualifications Data: For qualified landscape installer.

1.5 QUALITY ASSURANCE

- A. Work performed as described in this section shall be done under the supervision of a contractor having experience in landscape construction.
- B. Work and material supplied shall comply with applicable requirements of the United States Department of Agriculture (USDA).
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- D. Delivery, Storage, and Handling
 - 1. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.
 - 2. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
 - 3. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.6 PROJECT CONDITIONS

- A. Season: Seed between October 1 to March 15.
- B. Weather conditions: Seeding is not permitted during the following conditions:
 - 1. Cold weather: When air or surface temperature is less than 40 degrees F.
 - 2. Hot weather: When air temperature is greater than 80 degrees F.
 - 3. Soil Temperature: When soil temperature is less than 55 degrees F.
 - 4. Wet weather: When ground becomes saturated.
 - 5. Windy weather: When wind velocity is greater than 10 mph.

1.7 SUBSTANTIAL COMPLETION

- A. Substantial completion is achieved after the Contractor has installed all plants, sod, seeding and associated materials, and provides Owner with a written request to inspect said work. Plant and seed areas will be considered substantially complete when in compliance with the following conditions as directed by the Owner and documented by written acknowledgement of Owner.
 - 1. Plant Conditions: Healthy, free of pests and disease, and in vigorous condition.
 - 2. Sod Turf: Healthy, free of pests and disease, and with 90 percent cover and no bare areas greater than six square inches
 - 3. Roots: Seeding roots thoroughly knitted to the soil.

1.8 WARRANTY

- A. The warranty of plant materials furnished and planted under this contract shall be for one full year from the date of Substantial Completion and written acceptance as specified herein.
- B. At the end of the warranty period, all sodded and seeded areas not meeting requirements of these specifications shall be sodded or reseeded with the same species and size as originally specified. Such replacement shall be made in the same manner as specified for the original plantings, and at no extra cost to the Owner. The warranty on reseeded areas shall be extended for one full seasons cycle after reseeding has been completed.

PART 2 PRODUCTS

2.1 SEED MIXTURES

- A. General
 - 1. Seed shall meet or exceed Blue Tag quality according to current Oregon Certified Seed Standards published by Oregon State University.
 - 2. Seeds shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act.
 - 3. Seeds shall be furnished in sealed, standard containers unless written exception is granted.
 - 4. Noxious weed seed not to exceed 1% by weight.
 - 5. Seed that is wet or moldy or has been damaged in transit will not be accepted.

- B. Native seed mixture shall be as noted on plans.
 - 1. All seed shall be sourced from within 100 miles of the project site.
- C. Water quality swale seed mixture shall be as noted on plans.
- D. Erosion Control Seed mix shall be as noted on plans.
- E. The Contractor shall furnish suppliers certificate guaranteeing that the seed conforms to the above requirements and USDA certification. Seed shall be delivered to the contract site in unopened containers bearing the USDA and suppliers certificates.

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Approved sod complying with the requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 - 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).
 - 3. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety)
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).

2.3 WATER

- A. Water shall be free from oil, acid, alkali, salt and other substances harmful to growth of grass, and shall be from a source approved prior to use.

2.4 MULCH

- A. Straw Mulch: For use where manually or hydraulically applied seed is subject to wind or water erosion. Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley that is certified weed-free materials.

- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Wood-Cellulose Fiber Mulch: For use with the hydraulic application of grass seed and fertilizer.

Biodegradable, dyed-wood, cellulose-fiber mulch.

 - 1. Dyed an appropriate color to facilitate visual metering of application materials.
 - 2. Nontoxic and free of plant-growth or germination inhibitors.
 - 3. Maximum moisture content of 15 percent air-dry weight basis.
 - 4. pH range of 4.5 to 6.5.
- D. Tackifier: Furnish a commercial quality tackifier containing no agent toxic to plant life. Furnish a dry powder tackifier meeting the following requirements:
 - 1. Dry Powder Tackifier – Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable, and consisting of a processed organic adhesive derivative of one of the following: Gumbinder derived from guar (*Cyamopsis tetragonoloba*) or Gumbinder derived from plantain (*Plantago insularis*).

2.5 SPECIAL SEEDING AND MULCHING EQUIPMENT

- A. Hydraulic equipment used for the application of fertilizer, seed and slurry of prepared wood-cellulose fiber shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix the slurry specified. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of spray nozzles that will provide even distribution of the slurry on the various slopes.

PART 3 EXECUTION

3.1 GENERAL PREPARATION

- A. Verify that grading and soil preparation has been completed correctly.

1. Notify Owner of any discrepancies; do not proceed with work until discrepancies have been resolved.
- B. Notify Owner at least 24 hours prior to planting or seeding operations. Owner will inspect soil preparation, plant materials and plant orientation.

3.2 SEEDING (ALL SEEDED AREAS)

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 1. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
- C. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mulch and 1:4 with erosion-control blankets or mats installed and stapled according to manufacturer's written instructions.
- D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 1 ton/acre to form a continuous blanket 1/2 inch in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
- E. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch and roll to a smooth surface.

3.3 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application. The Contractor may use either the one-step process or the two-step process.
 1. Mix slurry with nonasphaltic tackifier.
 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.
 3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb/acre.

3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod: do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 ACCEPTANCE OF SEEDED AND SODDED AREAS

- A. Satisfactory Seeded Areas: Unless otherwise specified all seeded areas shall at the time of substantial completion, exhibit a healthy, uniform, close stand of the specified seed mix, free of weeds and surface irregularities, with coverage of mix in specified proportions, exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- B. Satisfactory Sodded Areas: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.6 CLEANUP, PROTECTION AND ACCEPTANCE

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.
- D. Obtain written Conditional Acceptance from the Owner after all turf areas have been mowed at least twice.

END OF SECTION

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SECTION 32 93 00 - PLANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Furnishing all labor, materials and equipment for installation of landscape planting as shown on the drawings and as specified.
- B. Related Sections include the following:
 - 1. Section 32 80 00, Irrigation
 - 2. Section 32 91 21, Finish Grading and Seeding
 - 3. Section 32 92 20, Turf and Grasses

1.3 DEFINITIONS

- A. The following publications, referred to thereafter by basic designation only, form a part of this specification to the extent indicated by references:
 - 1. AMERICAN STANDARD FOR NURSERY STOCK, 2004 (ANSI Z60.1-2004), published by American Nursery & Landscape Association (ANLA)
 - 2. STANDARDIZED PLANT NAMES, 1942 Edition, published by J. Horace McFarland Company.
 - 3. FLORA OF THE PACIFIC NORTHWEST; by Hitchcock and Cronquist, latest edition,
 - 4. Federal Standard for Fertilizers - Mixed, Commercial: FSO-F-241D
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1-2004.
- C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not

less than minimum root spread according to ANSI Z60.1-2004 for kind and size of exterior plant required.

- E. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1-2004 for kind, type, and size of exterior plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1-2004 for type and size of exterior plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- I. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

- A. Substitutions Requests: Submit certifications, or samples of material requested for substitution.
- B. Map and photograph each existing tree and shrub within the restoration planting zone prior to ground disturbing activities. Submit a report that compiles the map and photographs of each existing tree and shrub.
- C. Provide 1-gallon sample of compost mulch and a Compost Technical Data Sheet that includes the US Composting Council seal of testing assurance.
- D. Nursery Invoices: A minimum of 1 week prior to purchase, the Contractor shall submit to the Owner's Representative, copies of all invoices for plant materials to be used on site. The copies must indicate source of supply by name, address and phone number, order invoice number, and size and quantity for each species or variety ordered.
- E. Inspection certificates:
 - 1. All plant material shall meet requirements of State and Federal laws with respect to inspection for plant diseases and infestation.
 - 2. Inspection certificates required by law shall accompany each shipment of plant materials and be submitted to the Owner's Representative.

1.5 QUALITY ASSURANCE

- A. Work and material supplied shall comply with applicable requirements of the United States Department of Agriculture (USDA).
- B. The Contractor shall protect all materials, at all times during handling, shipping and storage, from extreme weather conditions, wind, drying of roots or root ball injury.
- C. Plant materials showing damage from handling, shipping or during planting shall be rejected by the Owner's Representative and shall be replaced by the Contractor at their expense.
- D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1-2004, "American Standard for Nursery Stock."
 - 1. Tree and Shrub Measurements: Measure according to ANSI Z60.1-2004 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6-inches above ground for trees up to 4-inch caliper size, and 12-inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
- E. Construction Observation: Owner's Representative may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Owner's Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
- F. Store fertilizers in a dry place and protect from intrusion of moisture.
- G. Planting
 - 1. All landscaping work shall be done under the supervision of a Contractor currently licensed in landscape construction, under respective jurisdictions, and having a minimum of two years' experience in landscape construction. All work shall be done in accordance with proper horticultural practices and hereinafter described.
 - 2. Installer's Personnel Certifications: Certified Landscape Technician, CLT-Exterior; Certified Ornamental Landscape Professional, COLP.
- H. Herbicide Application
 - 1. Application of herbicides for weed control as may be required shall be made only by an applicator currently licensed under state law.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver exterior plants freshly dug.
 - 1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- B. Do not prune trees and shrubs before delivery, except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.
- C. Handle planting stock by root ball.
- D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for two hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS AND COORDINATION

- A. Plant installation shall occur following the successful installation of a fully functioning automatic irrigation system.
- B. Planting Restrictions: Plant during one of the following periods.
 - 1. Spring Planting: February 1 – March 20
 - 2. Fall Planting: October 15 - November 30
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit. Unsuitable conditions include frozen soil, freezing weather, saturated soil, standing water, high winds, heavy rains, and high water levels.
- D. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

- E. Coordination with seeded areas: Plant trees and shrubs after finish grades are established and before seeding, unless otherwise acceptable to Landscape Architect.
 - 1. When planting trees and shrubs after seeding, protect seeded areas and promptly repair damage caused by planting operations.
- F. The Contractor shall coordinate planting work with soil preparation.

1.8 PLANT MATERIALS SUBSTITUTION

- A. Plants, not specifically named in the plant list, will not be accepted unless specifically accepted in writing by the Owner's Representative.
- B. Substitutes proposed for approval, in each case shall possess the same essential characteristics as the kind of plant actually specified in regard to appearance, ultimate height, shape, and habit of growth, general soil, native seed zone, and other requirements. Substitutions on species will likely not be approved.

1.9 SUBSTANTIAL COMPLETION

- A. Substantial completion is achieved after the Contractor has installed all plants, seeding and associated materials, and provides Owner's Representative with a written request to inspect said work. Plant and seed areas will be considered substantially complete when in compliance with the following conditions as directed by the Owner's Representative and documented by written acknowledgement of Owner's Representative.
 - 1. Plant Conditions: Healthy, free of pests and disease, and in vigorous condition.
 - 2. Branches: Free of dead and dying branches and branch tips.
 - 3. Foliage: Plants shall bear foliage of normal density, size, and color.
 - 4. Roots: Seedling roots thoroughly knitted to the soil.

1.10 WARRANTY

- A. Trees, Shrubs, and Sod: 12 months.
- B. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
- C. Prior to the end of the warranty period, the Owner's Representative will make an inspection to determine the condition of plants. All plants not in a healthy growing condition, as determined by the Owner's Representative, will be marked and noted for replacement. As soon as seasonal conditions permit, contractor shall remove the indicated plants from the site and replaced them with plants of the same species and size as originally specified. Such replacement shall be made in the same manner as specified for the original plantings, and at no extra cost to the Owner. The guarantee on plants shall be limited to one full replacement cycle.

PART 2 PRODUCTS

2.1 TREES, SHRUBS AND GROUNDCOVER

- A. Species, variety, quantity, size and condition of plant will be provided as indicated on the drawings.

Plant material shall be supplied, but not limited to form and conditions defined as follows:

Rhizome	Rhiz	Section of root or stolon
Propagules	Prop	Section of stem
Bulb	Bulb	Single bulb mass
Plug	Plug	Rooted Cutting
Aquatic container	AqCont	Water filled container for floating plants
Seedling	Sdlg	Rooted tree or shrub
Tubeling	Tblg	Rooted tree or shrub in single tube
Bare Root	BR	Shrub or tree with soil removed from root mass
Cutting	Ctng	Stem cut from parent stock
Ball and Burlap	B&B	Tree or shrub with excavated root ball wrapped and tied per ANSI Z60.1-2004 standard.
Container	Cont	Standard pot or bag, per ANSI Z60.1-2004 standard sizing.

- B. Nomenclature shall conform to "Standardized Plant Names."
- C. All nursery stock shall be sources from a reputable, regional native plant nursery. The original seed source of all woody plant material shall be from the Columbia Plateau Ecoregion (EPA Level III) and shall be sourced from populations within the following USDA Threat Resource Mapping (TRM) seed zone: 25-30 Deg. F. / 12-30 annual heat: moisture index (AHM).
- D. Quality definitions, grading tolerances, and caliper to height ratios no less than minimum specified in ANSI Z60.1-2004.
- E. Plant material shall be healthy nursery stock, well branched, full foliated when in leaf, free from disease, injury, insects, all weeds and weed roots.
- F. Cold storage plants shall not be permitted.
- G. Plant materials shall be nursery-grown unless otherwise specified. Nursery-grown plants shall have been growing continuously in licensed nurseries for the following minimum number of growing seasons:

Plant Materials	Time in Nursery
Evergreens and conifers	Two growing seasons
Deciduous	Two growing seasons
Groundcover and Vines	One growing season

- H. Balled and burlapped (B&B) stock shall be furnished with natural ball.
- I. Potted and container stock shall be well rooted, vigorous enough to ensure survival and exhibit healthy growth.
- J. Container stock shall have been growing in its container for a minimum of six (6) months and a maximum of two (2) years, with roots filling the containers but not showing evidence of being or having been root bound.
- K. Trees: Provide untapped, straight, single-leader trees. The Owner's Representative may reject any split-leader trees at any time prior to end of warranty period. Contractor shall replace any rejected, split-leader trees at their own expense.
- L. Plant materials shall be free from disease, insects, disfiguring knots, sun scale, injuries, bark abrasion, evidence of improper pruning and other objectionable disfigurements.
- M. Trees and shrubs shall have all developed branching system; shrubs shall have full foliage and shall not be leggy.
- N. Thin, weak, leggy, or misshapen plants will be rejected by the Owner's Representative.
- O. Labels: The correct horticultural name, size and caliper and/or other data, as specified in the Plant Material List, written on durable labels in weather-resistant ink, shall be securely attached to all individually shipped plants and to each box, bundle, bale and container of plant materials. Labels shall remain on representative plant materials until final acceptance of planting. Labels shall be affixed in such a manner that will not girdle the plant materials.
- P. The species (botanical and common names), size, manner in which the plants are furnished, and spacing of the required plant materials, are noted on the planting plan.
- Q. The quantities of plant materials shall be as determined by the Contractor in accordance with the specified spacing, or location on plan. Material quantities shown on plan are for Contractor convenience only and shall be verified by the Contractor prior to installation. Surplus or shortages of plant quantities shall be the responsibility of the Contractor.

2.2 TREE STAKING AND TYING MATERIALS

- A. Wood tree stakes: Stakes for tree support shall be straight, sound, roughhewn, Douglas fir, construction grade not less than 2-inches square or 2-inches in diameter if round, and 8 feet long. Stakes shall be stained dark brown, for their entirety.

2.3 WATER

- A. Water shall be suitable for irrigation, free from oil, acid, alkali, salt or other substances harmful to plant life.

2.4 FERTILIZER

- A. Commercial fertilizer shall be any standard brand, uniform in composition, dry and delivered to the site in unopened original moisture proof containers. Each container shall be fully labeled, conforming to the applicable State fertilizer laws, bearing the manufacturer's trade name or trademark, warranty of the producer and the guaranteed analysis. Duplicate copies of invoices shall be furnished to the Owner's Representative. Fertilizers shall be supplied in the following forms:

- 1. Granular-form fertilizer: Top-dressing fertilizers shall be:

- a. Slow-release, 16-20-10 formula.
- b. Ammonium nitrate.

- B. Base percentages of nitrogen, phosphorus, and potash on laboratory test recommendations as approved by Owner. For bidding assume 10 percent nitrogen, 6 percent phosphorus, and 4 percent potash by weight. At least 50 percent of total nitrogen shall contain no less than 3 percent water insoluble nitrogen. At least 60 percent of nitrogen content shall be derived from super-phosphate containing not less than 18 percent phosphoric acid or bone meal containing 25 - 30 percent phosphoric acid and 2 - 3 percent nitrogen. Potash shall be derived from muriate of potash containing 55 - 60 percent potash.

2.5 TREE AND SHRUB MATS

- A. Tree and Shrub Mats not required.

2.6 WEED-CONTROL BARRIERS

- A. Weed-Control Barriers not required.

2.7 BROWSE PROTECTION

- A. Browse protection not required.

2.8 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley that is certified weed-free materials.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-

inch sieve; soluble salt content of 5 to 10 deciSiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:
 1. Type: Rounded riverbed gravel or smooth-faced stone.
 2. Size Range: 1-1/2-inches maximum, 3/4-inch minimum.
 3. Color: Readily available natural gravel color range.

PART 3 EXECUTION

3.1 INITIAL INSPECTION OF PLANT MATERIAL

- A. All plant materials must be inspected by the Owner's Representative before planting. All plant material shall be free from insects, diseases, and injuries and sizing shall be equal to or exceeding measurements specified. Transport and handle all materials in strict accordance with proper horticultural standards. The Contractor shall provide plants with habit and growth that is normal, sound, healthy and vigorous.
- B. All plant materials not meeting specification requirements shall be rejected.
- C. All native plants shall be nursery stock except hardwood cuttings. Nursery stock shall be grown from propagules or seed collected from western Oregon or western Washington sources only. Plants from off-site collection sources shall not be allowed, unless otherwise approved by the Owner's Representative.

3.2 PLANT BED PREPARATION

- A. Prepare plant beds as directed in Section 329113, Soil Preparation.

3.3 PLANT LAYOUT AND INSPECTION

- A. Layout of major planting areas as indicated on the plans are approximate only, and the locations and identity of all trees, shrubs and ground covers shall be outlined in the field by the Contractor, subject to review and approval.
- B. Inspection: The Contractor shall notify the Owner's Representative forty-eight (48) hours prior to beginning any planting. The Owner's Representative may adjust plant material location to meet field conditions. Planting shall not occur until the Owner's Representative has approved the location and layout of all plant beds.

3.4 BROWSE PROTECTION

- A. Install browse protection devices as shown on drawings.

3.5 TREES, SHRUBS AND GROUNDCOVER PLANTING

- A. Plant trees and shrubs upright and adjust to set best appearance or relationship to adjacent plants and structures. Shrubs and groundcovers shall be planted one half the distance from curbs, sidewalks, buildings and other objects, as specified in the spacing requirements.

Native Plant material shall be planted with regard to condition specified on plan, per, but not limited to the following:

Rhizome: Cut into soil surface within 2-inches of surface

Propagule: Cut into soil surface within 2-inches of surface

Bulb: Set into soil 4-inches – 6-inches deep. point up

Plug: Placed into soil at size of root mass

Aquatic container: Dispersed into open water surface

Seedling: Cut into soil as deep as root mass, compacted

Tubeling: Cut into soil as deep as root mass, compacted

Bare Root: Placed into plant pit sufficient for root mass, compacted

Cutting: Dibble into soil per cutting installation detail on plan

Ball and Burlap: Placed into plant pit twice the size of root ball, compacted

Container: Placed into plant pit twice the size of container

- B. Planting dates:

1. Critical dates for planting operations include the following; subject to revision by Owner's Representative:
 - a. Planting of container stock: Sept.15 - Nov 15 or Feb 15-April 15.

- C. Excavation for planting

1. Stockpile all excavated topsoil for planting operations.
2. In digging pits for trees, the contractor shall separate sod, topsoil suitable for backfill, and subsoil, and shall dispose of the sod, rocks and unsuitable material off-site.

3. Diameter or minimum width of planting pit or trenches shall be as shown on the drawings.
 4. If standing water is encountered during excavation of the planting pits, the Contractor shall notify the Owner's Representative who will determine the corrective drainage measures required.
 5. If underground obstructions or rocks are encountered in excavation of planting areas making it impossible to plant materials as shown on the contract documents, an alternate location for the planting shall be selected by the Owner's Representative.
 6. Excess excavated topsoil shall be used to form saucers around plants as detailed. Soil not required or suitable for the above usage shall be properly disposed of off the project site.
- D. Cutting: Cut off cleanly all broken or frayed roots, smaller than 1/2-inch caliper.
 - E. Prior to completing backfilling, the upper two-thirds of the plant pit shall be flooded with the plant starter solution. Allow solution to soak away. Finish filling holes to finish grade and lightly compact soil around root ball.
 - F. Placement and compaction: Place and compact backfill soil mixture carefully to avoid injury to roots; fill all voids.

3.6 FORB PLANTING

- A. Forbs shall be planted as show on the drawings.

3.7 SHRUBS AND GROUNDCOVER PLANTING BED GRADES

- A. Establish finish grades and slopes in accordance with finish grades as specified.

3.8 MULCHING

- A. Mulch all shrubs and ground cover planting beds with a 3-inch deep layer of wood chip mulch material within two (2) days after planting. Cover entire bed areas; apply evenly. A 3-inch layer of mulch material shall be applied to saucer areas of trees and shrubs located outside of planting beds, or as indicated on drawings.

3.9 STAKING TREES

- A. Stake and tie trees immediately after planting as indicated on the detail drawings.
- B. Drive stakes vertically into the ground as shown on the drawings. Do not injure root or ball.

3.10 ANTIDESICCANT

- A. The application of the antidesiccant shall be prior to transplanting as a spray or during planting as a dip. The antidesiccant shall not be applied if rain is anticipated in one hour or less. If not previously applied, the Contractor shall, within 24 hours of completing backfilling, spray all evergreen and leafed-out deciduous plants with the antidesiccant thoroughly covering all leaves. The solution shall be mixed according to manufacturer's specifications.

3.11 PRUNING

- A. Pruning shall be done at or after the time of planting in accordance with proper horticultural practice.
- B. Pruning shall be limited to the minimum necessary to remove injured twigs and branches and to compensate for the loss of roots during transplanting, but shall never exceed one-half of the branching structure.
 - 1. Crossed or rubbing branches shall be removed providing the natural shape of the tree is preserved.
 - 2. All cuts shall be made flush with the parent stem leaving no stubs. Pruning cuts shall be made in a manner to favor the earliest possible covering of the wound by callus growth. Cuts that produce large wounds and weaken the tree will not be acceptable. Evergreens shall not be pruned except to remove injured branches and/or double leaders. The use of pole shears and/or hedge shears for pruning deciduous and evergreen trees will not be permitted. All trimmings and other debris left over from the planting operations shall be collected and disposed of legally off the site.
- C. With the permission of the Owner's Representative, pruning may be done before delivery of plants, but not before plants have been inspected and accepted.

3.12 CLEANUP

- A. Keep premises free from accumulation of debris.
- B. At completion of each area of work, remove all debris, equipment and surplus materials

END OF SECTION

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION

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SECTION 35 53 33 - HIGH DENSITY POLYETHYLENE OUTFALL PIPE

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies furnishing and installing high density polyethylene (HDPE) pipe assembly and fittings. It is the intent of these specifications to cover all work for a complete and successful installation of the marine portion of a replacement outfall and diffuser pipeline from the City of Pasco wastewater treatment plant to the Columbia River.
- B. Related Sections: The work of the following Sections are related to the work of this Section. Other Sections, not referenced below, may also be related to the proper performance of this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.
1. Section 01 35 05, Environmental Protection and Special Controls
 2. Section 01 78 39, Record Documents and Pre/Final Site Survey
 3. Section 03 40 10, Precast Concrete Anchor Blocks and Accessories
 4. Section 31 23 00, In-Water Excavation, Bedding, and Backfill
 5. Section 31 23 17, Trenching
 6. Section 31 50 00, Excavation Support

1.2 AQUATIC PERMITS

- A. Work conducted waterward of Ordinary High Water (OHW) is subject to permits, easements, and other authorizations from regulatory parties. Permit list and stipulations for environmental protection are provided in Section 01 35 05, Environmental Protection and Special Controls.

1.3 QUALITY ASSURANCE

- A. Referenced Standards: This section incorporates by reference the latest revision of the following documents. These references are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
49 CFR 192.285	Plastic Pipe: Qualifying Persons to Make Joints
ANSI/AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
ASTM D2122	Standard Method of Determining Dimensions of Thermoplastic

<u>Reference</u>	<u>Title</u>
	Pipe and Fittings
ASTM D3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F714	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
ISO 9001	Model for Quality Assurance in Production and Installation
PE 4710	Plastic Piping Institute designation PE 4710 resin
PP 811-TN	Performance Pipe Technical Note PP 811-TN-PE Flange Connections

B. Inspection and Testing: All HDPE materials, pipe, and fittings shall be inspected and tested in accordance with the requirements of ASTM F714 and the manufacturer's ISO 9001 stated procedures.

C. Qualifications:

1. Pipe Manufacturer: Experienced in fabricating pipe of similar diameter and wall thickness required for this work. Manufacturer shall be ISO 9001 certified.
2. Butt Fusion Welder: Shall be certified to CFR 49, Section 192.285. The Contractor shall submit to the Engineer documentation attesting to the certification, training, and experience of all fusion machine operators used in this Work.
3. Construction Divers: Divers shall have certification equivalent of:
 - a. International Diving Schools Association (ISDA) Level 2 – Surface Supplied Inshore Air Diver (30m), or
 - b. Association of Diving Contractors International (ADCI) Consensus Standards for Commercial Diving and Underwater Operations, or.
 - c. Approved equal.
4. Dive Supervisor: shall have certification of:
 - a. ADCI Surface Supplied Air Diving Supervisor, or
 - b. Or equal.

1.4 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures
- B. Qualifications:
 - 1. Manufacturer's qualifications and certifications.
 - 2. Butt fusion welders' qualifications and certification.
 - 3. Qualifications and certifications for construction divers.
- C. Product Data:
 - 1. HDPE pipe
 - 2. Affidavit of Compliance for polyethylene pipe.
 - 3. Joint fittings and hardware
- D. Pipeline Assembly and Deployment Plan.
- E. As-Recorded Data:
 - 1. Fusion testing and data-logger reports for each joint made.
 - 2. As-built survey data.
 - 3. Diver's video and audio communications.
- F. Copies of all notices to mariners and other entities.

1.5 PRODUCT DATA

- A. Name of the pipe manufacturer and a list of the piping and quantities to be provided by manufacturer.
- B. Product data and any noted deviations.
- C. Detail drawings which show the type and location of fittings, joints, and connections to structures.
 - 1. Manufacturer's cut sheets calculations and submittals for all pipe, fittings, flanges, and associated hardware and appurtenances.
 - 2. Location where pipe shall be butt fusion welded.
- D. Affidavit of Compliance:
 - 1. The manufacturer shall furnish an affidavit of compliance conforming to the requirements of AWWA C906, Section 1.5, affirming that the piping components comply with the requirements of AWWA C906 and this Section.

2. The affidavit shall be signed under penalty of perjury by an officer of the pipe manufacturer's company.

1.6 PIPELINE ASSEMBLY AND DEPLOYMENT PLAN

A. Pipeline Assembly: The Contractor shall submit for approval by the Engineer, a thorough Pipeline Assembly and Deployment Plan 30 days prior to commencement of the HDPE fusion and assembly. This plan shall detail the Contractor's plans for storing, moving, fusing, launching, testing, and mooring the HDPE pipeline, and the Contractor's method for attaching anchors and other attachments onto the pipeline. This plan shall include:

1. Detailed procedures for fusing the HDPE pipe and installation of precast concrete pipe anchors.
2. Plans for safely securing and storing the assembled pipe prior to transport to the construction site, including all necessary notification, coordination, and approvals by navigation authorities.
3. Plans for moving the assembled pipe and precast anchors from the staging area into the water.
4. Plans for safely towing the pipe assemblies to the construction site and staging and mooring the pipeline prior to final placement, including all necessary notification and coordination with navigation authorities.
5. Placement of guide piles (if used), and provisions to protect pipe from abrasion.

B. Pipeline Deployment:

1. The method of pipe installation for the outfall is to be determined by the Contractor and is the sole responsibility of the Contractor.
2. The Contractor shall submit for approval by the Engineer a thorough, project-specific, and original Pipeline Deployment Plan 30 days prior to the earliest planned date for mobilizing the pipeline and anchors to the assembly site. The purpose of this plan is as follows:
 - a. The written plan's primary purpose is to educate and coordinate all personnel involved in the deployment, to pre-plan all deployment steps, to anticipate problems, to pre-plan contingency operations, and to avoid uninformed field decisions to unanticipated problems. The primary readers and users of the plan are the Contractor's personnel.
 - b. The written plan assures the Owner that the Contractor has thoroughly and carefully planned the deployment, and therefore the overall risk to the Owner's

project is minimized. This pipeline installation may have, at times, a considerable portion of the pipe at risk. A well-prepared plan by the Contractor is intended to minimize those risks.

- c. The written plan assures the Owner that the Contractor is aware of and will comply with permit requirements, and that marine community relations and safety are well planned and coordinated.
 - d. A review of the deployment plan and the Contractor's computations provides a check that the pipeline will be properly handled during the deployment.
 - e. The Contractor shall not commence the towing of the pipeline from the assembly area without the written approval of the deployment plan.
3. The Pipeline Deployment Plan shall include, as a minimum:
- a. A clear, understandable and well-presented documentation of the Contractor's detailed process for the installation of the pipeline.
 - b. The schedule for the deployment.
 - c. Permit requirements: The Contractor shall summarize all pertinent permit, navigation and safety requirements, and identify how those requirements shall be satisfied.
 - d. Public safety plan: Identify how the Contractor plans to keep the public informed of marine operations in order to smoothly and safely coordinate deployment operations with military, commercial and public use of the assembly, tow and deployment areas.
 - e. The organization: Identify each person involved, his or her responsibility, and the chain of command. Identify the level of understanding and familiarity of each person with the plan and the level of their involvement in creating the plan. Identify and schedule any required training and coordinating sessions with Contractor personnel.
 - f. Identify how all members of the Contractor's organization are to be trained on the installation process.
 - g. Identify each piece of equipment to be used in the deployment and its role in the deployment. If the role is critical, identify suitable backup equipment.
 - h. Identify methods of restraining pipe at each end and at horizontal bend during controlled submergence of pipe. Concrete anchors shall not be used for restraining, towing, or positioning the pipeline at any time.

- i. If temporary guide piles are used, describe placement locations and how to avoid abrasion to the pipe.
- j. Weather requirements: Identify suitable criteria for weather conditions, wind waves and currents during the deployment operations and, if weather critical, identify methods of minimizing weather-related risks. Identify methods of obtaining suitable weather forecasts and identify the means by which operations are delayed or aborted due to weather issues.
- k. A communications plan: Identify the primary and backup means of communication between key individuals and groups involved in the deployment process. Demonstrate that there will be adequate coordination between the members of the deployment group.
- l. A navigation plan: Identify the methodology and required equipment for accurately aligning and positioning the pipeline. Show how this equipment and methodology will satisfy the positioning requirements as established on the Drawings.
- m. A detailed task-by-task description of the deployment. Divide the installation into a series of specific installation steps. For each step identify:
 - 1) The objective of the step.
 - 2) The person in charge.
 - 3) The necessary initial conditions in order for this step to commence.
 - 4) The sequence of tasks to accomplish this step. Specific personnel and equipment should be identified.
 - 5) Contingency plans in case any critical task or step is not successful.
- n. Engineering calculations, stamped and signed by a Professional Engineer registered in the state of Washington, including the required deployment pulls, weights, buoyancies, lifts, pipe internal pressures, pipe external pressures, pipe bending radii, pipe ovality, and pipe tensions throughout the entire deployment process. Submittal shall include input and output files for pipeline deployment modeling, including graphical output of pipe profiles and air control tables.

1.7 AS-RECORDED FUSION DATA

- A. Hardcopy printouts of fusion parameters at each fused joint shall be submitted to the Engineer at the end of each day during pipe fusion work. The recorded fusion parameters shall include:

1. Date and time.
2. Joint number.
3. Fusion technician identification.
4. Fusion machine type and size.
5. Interfacial pressure during fusion and cooling.
6. Gauge pressure during fusion and cooling.
7. Fusion temperature.

1.8 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
- B. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- C. The Contractor shall perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Pipe shall be fabricated at one company facility.
- B. Piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE4710 and that conform to the requirements of ASTM D3350 for a cell classification of PE 445474C.
- C. HDPE outfall pipe shall be 42-inch outside diameter per IPS sizing standards.
- D. Dimension Ratio (DR) shall be 17. DR measurements shall be made according to the methods specified in ASTM D2122. Variation of pipe wall thickness as measured and calculated according to ASTM D2122 in any diametrical cross section of the pipe shall not exceed 12 percent.
- E. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, and other visible deleterious faults.
- F. Pipe Markings: Conform to the requirements of AWWA C906. Also paint minimum 1-inch-wide white or yellow stripe on pipe at springline, both sides. Do not cover pipe manufacturer's pipe markings.

- G. Fittings shall conform to the applicable requirements of AWWA C906 for the joining methods specified in this Section.

2.2 PIPE JOINTS AND FITTINGS

A. General:

1. Acceptable HDPE fittings joints include butt fusion and flanged fittings as indicated in this Section.
2. Butt fusion pipe joints are preferred over flange joints.
3. Contractor may install flange joints as necessary for pipe installation. Submit stationing for flange joints in the Pipeline Assembly and Deployment Plan for approval.
4. Pre-approved stations for flange joints shown on Drawings.

B. Butt Fusion Fittings:

1. Butt fusion fittings manufactured and tested in accordance with ASTM D3261 and AWWA C906.
2. Made of HDPE material meeting the minimum material designation code, cell classification code, and pressure rating for pipe as noted in this Section.
3. HDPE spools on 42-inch pipe shall be fused by manufacturer prior to delivery to site, with backing rings installed.

C. Flanged Fittings:

1. Manufactured and tested in accordance with ASTM D3261 and AWWA C906.
2. Shall consist of a butt welded polyethylene stub end of the same DR and pressure rating as the pipe to be joined to and a Type 316 stainless steel ANSI Class 150 slip ring flange conforming to AWWA C207.
3. Made of HDPE material meeting the minimum material designation code and cell classification code for pipe as noted in this Section.
4. Back-up rings, bolts, nuts, and washers:
5. Provide a long-term service pressure rating equal to the pipe for which the flange or flange adapter assembly will be used.
6. Back-up rings, bolts, nuts, and washers shall be Type 316 stainless steel conforming to ASTM F593 and F594.

7. Gasket materials: Not required.
8. The contacting face of the HDPE flange shall be encased with a temporary cover and encased in plastic from the time of manufacture until it is connected to the adjoining flange. Any damage to the flange shall be replaced.
9. All finished surfaces of the stainless steel backup flange that will contact the HDPE shall be manufactured by a machining process and shall be smooth and free of sharp edges.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The Contractor shall review and follow the requirements of all applicable project permits and easements. If the Contractor determines a permit or easement requirement is in conflict with the Drawings or these Specifications, said conflict shall be brought to the immediate attention of the Engineer who will provide clarification and direction to the Contractor prior to proceeding with the work.
- B. The Contractor shall provide all materials as shown on the Drawings and outlined in these Specifications and perform all work necessary to assemble and install the pipeline as specified herein and as further required by the particular method of construction, in a manner that does not damage the pipe, appurtenances, or adjacent utilities, property and facilities and provides a complete and operable system.
- C. If fish are seen in distress, or if a fish kill occurs, work shall immediately cease and the Engineer and WDFW Habitat Management Program shall be notified, as specified in the project permits.
- D. The Contractor shall conduct its operation so that traffic is maintained at all times. Notify the Coast Guard, U.S. Army Corps of Engineers, or other affected agencies, when in water work is to begin and furnish a copy of the notification to the Engineer. The Contractor shall post all appropriate Notices to Mariners for all in water activities. Contractor shall abide by all applicable marine rules and requirements of permits obtained by the Owner.
- E. The Contractor shall take appropriate steps to secure the work area at nightfall, weekends, and at other times when work is stopped so that waters are open for navigation, public access areas are safe and the work in progress is secure. The Contractor shall keep proper signal lights between sunset and sunrise on all floating vessels, plants, ranges, buoys, pilings and markers so as not to endanger or obstruct navigation per United States Coast Guard.

- F. All afloat operations shall be in accordance with applicable laws, rules, and customs. All operations of floating equipment shall comply with and be coordinated with U.S. Army Corps of Engineers regulations.
- G. The Contractor shall display signal lights and conduct his operations in accordance with the general regulations of the U.S. Army Corps of Engineers and of the United States Coast Guard governing lights, day signals, and markers to be displayed by, guide piles, towing vessels, dredges, vessels engaged in construction, lights to be displayed by vessels of more than 65 feet in length moored or anchored in a fairway or channel, and the passing by other vessels of the floating plant working in navigable channels, as contained in Title 33, code of Federal Regulations, in navigable channels, as contained in Title 33, Code of Federal Regulations, parts 1-199 and other applicable federal, state or local regulations. The Contractor shall keep proper signal lights upon all ranges, buoys, and markers.

3.2 CONSTRUCTION EQUIPMENT

- A. All equipment and machinery involved in the work shall be cleaned of oils, grease, engine coolant, or any other toxic materials, before entering any waters. Equipment and machines shall be checked frequently for leaks, and if any are found, the equipment/machine will be immediately removed from the work site to an upland area or appropriate docking facility and shall be repaired or replaced. Spills of any toxic material shall be immediately cleaned up by methods approved by the Engineer and any other Regulating Authority.
- B. The Contractor shall make its own arrangements for all in water equipment and facilities, including transportation of personnel, material, and equipment to and from the work area.
- C. Only four-stroke outboard motors or two-stroke outboard motors meeting emission standards shall be used on work skiffs.
- D. Protect all adjacent port facilities, mooring dolphins, and channel navigation when anchoring and moving construction barges.

3.3 PIPE HANDLING AND STORAGE

- A. Follow all manufacturer's recommendations and procedures for storage and handling. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece shall be installed which is found to be defective or damaged. Any damage to the pipe shall be repaired or replaced as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at the Contractor's expense.

- B. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Minimum of two slings spread apart shall be used for lifting each shipped length of pipe.
- C. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be in accordance with the pipe manufacturer's recommendations and limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- D. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

3.4 OBSTRUCTIONS

- A. Boulders or other debris or obstructions may occur along the project corridor in the Columbia River.
- B. Prior to construction, the Contractor shall conduct a visual inspection of the outfall alignment using divers or ROV to assess obstructions needing to be cleared from the alignment.
- C. Removal and disposal of obstructions not shown on the Drawings or in reference materials will be considered incidental to pipe installation unless one or more of the following conditions are met:
 - 1. The object cannot be removed by the same equipment or excavation method at hand, or
 - 2. The trench width or depth must be increased by 2 feet or more to facilitate removal.
- D. Major obstructions encountered that are not shown on the Drawings, or could not have been foreseen by visual inspection of the site prior to bidding, should be immediately brought to the attention of the Engineer. The Engineer will make a determination for proceeding with the work.

3.5 RIVER BOTTOM PROTECTION

- A. General:
 - 1. All construction related waste or debris generated by the Work shall be collected and removed from the river bottom.

2. Should the Contractor, during the progress of the work, dispose of excavated materials or lose, dump, throw overboard, sink, or misplace any material, plant, or machinery which, in the opinion of the regulatory agencies, may be dangerous or obstruct navigation, the Contractor shall promptly recover and remove same.
3. Take necessary precautions to prevent damage to new or existing work in place that can be caused by anchors, currents, or the Contractor's operations.

3.6 CONSTRUCTION DIVING

- A. Divers qualified in underwater construction work shall assist the Contractor in the outfall installation. The Contractor shall submit divers' qualifications as specified earlier in this Section. The Engineer shall have access to all diver reports, and divers shall not withhold any information that affects the quality of the work.
- B. Diving operations shall include continuous communication between the diver and the surface. The Contractor shall provide a diving supervisor aboard the work vessel. Diving operations shall be governed by applicable federal, state, local and industry standards including, but not limited to, the "Consensus Standards for Commercial Diving Operations" of the Association of Diving Contractors.
- C. The Contractor shall allow the Engineer to listen to the surface diver communication and shall allow participation by the Engineer in communication with the diver by communicating to the diver through the diving supervisor. The Contractor shall provide a copy to the Engineer of any tape-recorded surface-diver communication.

3.7 PIPE INSTALLATION

- A. Pipe Handling:
 1. Impose no loads onto the pipe that could cause damage to the pipe or lead to a reduction in the pipe's function or service life.
 2. The lengths of pipe indicated on the Drawings are as accurate as possible based upon the ground and bathymetric surveys. The Contractor shall calculate all pipe lengths and provide enough pipe and associated anchors, hardware and appurtenances to install the pipe to the elevations indicated on the Drawings.
 3. Pipe temperature must be normalized to temperature of installed area to ensure the pipe does not change length due to temperature (thermal growth/shrinkage), and create unnecessary axial stresses.
- B. Butt-Fusion Joints:
 1. Unless otherwise indicated, join pipes by the butt-fusion method performed in accordance with all pipe manufacturers' recommendations and ASTM D3261. A

factory qualified and certified joining technician as designated and approved by pipe manufacturer shall perform all heat fusion joints.

2. Join pipe and fittings into one continuous length prior to installation unless alternative methods are submitted and accepted, as needed to meet Contractor selected means and methods. Alternative methods are subject to acceptance by the Engineer.
3. Consult the pipe supplier to obtain machinery and expertise for the joining by butt-fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are qualified in the techniques involved.
4. Do not use socket fusion, extrusion welding and hot gas welding, unless otherwise shown on the drawings.
5. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer.
6. The butt fusion joining shall produce a joint fusion strength equal to or greater than the tensile strength of the pipe itself.
7. On the first day of creating field fusion joints, the first joint shall be a trial fusion in the presence of the Construction Manager and Engineer. The following shall apply:
 - a. Heating plates shall be inspected for cuts and scrapes. The plate temperature shall be measured at various locations to ensure proper heating/melting per manufacturer's recommendations and approval by the Construction Manager. The Contractor shall provide one (1) calibrated infrared thermometer to be turned over to the Engineer for use. Contractor to provide submittal.
 - b. The fusion or test section shall be cut out after cooling completely for inspection.
 - c. The test section shall be 12 inches or 30 times (minimum) the wall thickness in length, with the fusion in the center, and 1 inch or 1.5 times the wall thickness in width (minimum).
 - d. The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e., joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16 inch to a maximum 3/16 inch.

C. Flange Connections:

1. All joints not made by butt-fusion method shall be flange connections.

2. Flange joint locations indicated on the Drawings are suggested, and may be modified if approved by the Engineer.
 3. Matching faces at flanged connections shall be clean and carefully checked before bolting.
 4. Gaskets are not required.
 5. Flange faces shall be positioned against each other full face before tightening any bolts. There shall be no eccentric gaps between flange faces on one side of the pipe, then drawing faces together using the bolts.
 6. Stainless steel back-up rings shall be centered on the pipeline with temporary shims, if necessary.
 7. Use marine grade anti-seize lubricant on all stainless steel bolts:
 - a. Loctite OB 8023
 - b. Or equal
 8. Flange bolts shall be drawn up with suitable wrenches and tightened in staggered sequence per PP 811-TN. Bolt torque shall be per PP 811-TN Table 2-3. Calibration of the torque wrench shall be witnessed by the Owner and Engineer before every dive where it is used.
 9. Flange bolts shall be tightened and allowed to relax before retightening.
- D. Upland Installation:
1. Pipe Laying: The pipe shall be installed in accordance with ANSI/AWWA C600.
 2. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
 3. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations.
 4. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades.
 5. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or

penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

6. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.
7. Pipe Cleanup: As pipe laying progresses, the Contractor shall keep the pipe interior free of all debris. The Contractor shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying.

E. In-Water Installation:

1. The Contractor shall propose and utilize their own methods for excavation, shoring, and installation of the outfall pipe within specified criteria, tolerances, and limitations as long as conditions of the project permits are met.
2. The Contractor shall be responsible to maintain the bottom during installation of the outfall. Any materials above the grade indicated on the Drawings that occur because of sloughing, shoaling, silting, or slides shall be removed by the Contractor as necessary for installation of the outfall to the lines and grades indicated on the Drawings.
3. The Contractor shall not allow sand, dirt, rocks, and other debris to enter the pipeline during construction. The Contractor shall cover the ends of the pipe with a suitable material to allow water to enter the pipe but not debris and/or fish during periods of no work. The Contractor shall remove any debris and/or sand, dirt, or rocks before final acceptance.
4. All straps, nets, bands or other materials utilized in moving and placing the pipe shall be removed after installation. All such items shall be removed from the project site and disposed of at an approved legal disposal site.
5. Concrete anchors shall not be used to restore or position the pipe. Rigging to surface vessels shall be connected to pipe only.

F. Temporary Guide Piles:

1. Up to six temporary guide piles may be used to keep the pipe in horizontal alignment prior to and during controlled submergence of the pipe.
2. Guide piles shall be steel pipe piles, up to 24-inch diameter.

3. Guide piles shall be installed with a vibratory hammer. Contractor shall implement soft-start procedures for guide pile installation activities occurring in October or later.
4. Piles shall be installed for a maximum duration of 30 days and will be fully removed using vibratory methods.
5. The Contractor will be responsible for marking, lighting and any other public safety provisions while the piles are present so as not to endanger or obstruct navigation per United States Coast Guard.

3.8 TOLERANCES

- A. Vertical tolerance is 0.2 feet.
- B. Confirm top of pipe elevations at minimum 20-foot sounding spacing after pipe is fully bedded.
- C. Maintain continuous negative grade (no flat sections, adverse grades, or intermediate high points).
- D. Submit top of pipe soundings to Engineer for approval.
- E. Bedding shall be placed fully beneath pipe and anchors up to the 4 and 8 o'clock positions. Divers shall rod and sluice gravel beneath pipe and anchors to achieve full bedding contact and support.
- F. Do not proceed with backfill until Engineer approves elevations and placement of bedding.
- G. Horizontal tolerance for pipe lay is 5 feet on each side of alignment shown on Drawings. Pipe may be snaked to avoid obstructions within allowable ovality and bending radius criteria. Confirm final pipe alignment at a minimum of 60-foot spacing after the pipe is fully bedded.
- H. Minimum bending radius for installed pipe shall be as shown on Drawings.

3.9 QUALITY CONTROL

- A. Submit all fusion data-logger reports and allow Engineer full access for visual inspection of fusion joints.
- B. Do not expose the HDPE material to both high stresses and high temperatures due to sun exposure. Contractor to determine if night operations are needed to reduce HDPE temperatures.

1. The Contractor shall monitor the temperature of the HDPE pipe wall immediately prior to and during the deployment. The temperature shall be monitored on a spare piece of HDPE material with similar exposure to the sun and other sources of heating and cooling as the pipeline being deployed. The mean, internal HDPE wall temperature shall be measured with a gage inserted into a hole drilled half way through the pipe wall.
2. The Contractor shall establish a cut-off temperature for each section of the deployment plan where pipe stresses are elevated and the Contractor shall monitor the pipe wall temperature to assure that this cut-off temperature is not exceeded.

3.10 INSPECTION BY OWNER

- A. Access and Inspection: The Contractor shall provide a small boat or skiff with an operator to provide access to and from the work barges for the Engineer. Transportation shall be available within one hour of request.
- B. The Owner may inspect the pipeline at its own expense. Underwater inspection of the outfall pipe installation may be made by an independent diver(s), contracted by the Owner, experienced in the inspection of submarine pipelines. Inspection diver work shall be strictly limited to inspection duty and the diver(s) shall perform no other work related to the work included in this Contract.

3.11 INSPECTION

- A. Underwater Inspection:
 1. Contractor's inspection diver shall complete a dive of the area to clearly show all areas of the installation at no additional expense to the Owner. This inspection video shall be recorded in an MPEG/AVI format and a copy provided to the Engineer on a removable USB drive. Any damage or inadequate installation found shall be rejected and corrected in a manner acceptable to the Engineer.
 2. The underwater inspection shall be performed at the Engineer's direction and shall include, but not necessarily be limited to:
 - a. Inspection of the trench prior to placement of the pipe.
 - b. Inspection of the installed and bedded pipe prior to backfill. Do not backfill pipe until the Engineer has approved the pipe installation and bedding.
 - c. Bearing and orientation of precast concrete anchors.
 - d. Inspection after backfill and final restoration.

- e. Document the area extent of fill remaining above grade for compliance with permit conditions.
3. Inspection dives shall be made in daylight during normal working hours. The Contractor shall make provisions for an inspection dive immediately following trenching, pipe installation, and backfill operations. The Contractor shall suspend Work in the area of the inspection and otherwise take appropriate safety precautions when inspection divers are working below. The Contractor shall advise the Engineer and inspection diver(s) of the schedule for each specified item of Work.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

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SECTION 40 05 71 - DUCKBILL DIFFUSER CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies elastomeric duckbill check valves for the outfall diffuser.

1.2 QUALITY CONTROL

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements in this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM B16.5	Pipe Flanges and Flanged Fittings

- B. Experience: Supplier shall have at least 10 years of experience in the manufacture of "duckbill" style elastomeric valves, and at least five years of experience with diffuser applications, and shall provide references and a list of installations upon request.
- C. Engineering: The duckbill valve manufacturer must have a registered Professional Engineer whom, at the Engineer's discretion, may be interviewed to discuss the submittals and technical knowledge of the hydraulic characteristics of variable orifice duckbill valves as they apply to the critical hydraulic operation and initial dilution characteristics of the outfall diffuser.

1.3 SUBMITTALS

- A. Procedures: Section 01 33 00, Submittal Procedures.
- B. Content of Submittals:
 1. Product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, and pressure ratings.
 2. Operation and Maintenance Manual: Submit three copies.
 3. Diffuser Dimensional Drawing: The drawing shall be a scaled version of the actual nozzle.

4. Hydraulic curves for each inlet nozzle showing headloss, jet velocity, and effective open area all versus flow rate. The hydraulic curves must accurately reflect the variable orifice characteristics inherent to duckbill valves. The backpressure rating of diffuser shall be indicated.
5. Verification of independent hydraulic testing to determine headloss and jet velocity characteristics for the specified valve. The testing must have been conducted for submerged conditions.
6. Verification of Independent Laboratory Testing for Manufacturing Consistency: The nozzle manufacturer shall provide summary documentation of a report conducted by an independent laboratory for hydraulic testing where multiple nozzles (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability and consistency of the manufacturing process to produce the same hydraulic characteristics.

PART 2 PRODUCT

2.1 MATERIALS

- A. The Diffuser Check Valves are to be all rubber and the flow operated check type with a flanged end connection. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The flange and flexible duckbill sleeve shall be one-piece rubber construction with nylon reinforcement.
- B. The flange drilling shall conform to ANSI B16.5, Class 150 standards. The valve flanges shall be furnished with Type 316 stainless steel backup rings for installation. Flange bolts, nuts, and washers shall be Type 316 stainless steel.

2.2 FABRICATION

- A. The Diffuser Check Valves shall be a variable orifice providing a non-linear jet velocity versus flow characteristic, which maximizes jet velocity at low flow rates compared to fixed orifice nozzles, and a linear headloss versus flow characteristic.
- B. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics for the specified valve. The testing must have been conducted for submerged conditions.
- C. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.

- D. Company name, plant location, valve size, and serial number shall be bonded to outside of the check valve. Valves shall be manufactured in the United States of American.

2.3 FUNCTION

- A. When line pressure inside the valve exceeds the backpressure outside the valve, the differential pressure forces the bill of the valve open, allowing flow to discharge. This restriction causes an increase in the jet velocity of the discharge, while the shape of the opening creates a flattened elliptically-shaped jet to increase dispersion. When backpressure exceeds the line pressure, the bill of the valve is forced closed preventing backflow.
- B. Hydraulic design criteria:
 - 1. Maximum flow: 2,250 gpm each valve.
 - 2. Jet velocity: 18.1 fps \pm 5% at maximum flow.
 - 3. Total headloss: 5.1 feet \pm 5% at maximum flow.
 - 4. Effective diameter: 7.1 inches \pm 5% at maximum flow.
 - 5. Minimum backflow pressure rating: 3 psi.

2.4 MANUFACTURER

- A. All valves shall be 8-inch Series 35D, HYDRAULIC CODE NUMBER 459 as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106 or equal.
- B. Approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.2 FIELD TESTS

- A. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation at the design flow condition.
- B. Contractor's diver shall be present during field test, with audio and visual links, to document performance of the valves.

3.3 MANUFACTURER'S CUSTOMER SERVICE

- A. Manufacturer's authorized representative shall be available for customer service during installation and startup, and to train personnel in the operation, maintenance, and troubleshooting of the valve.

END OF SECTION

APPENDICES

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APPENDIX 1 – INFORMATION SUBMISSION FOR PUBLIC NOTICE

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Submitting information for publication in the Local Notice to Mariners:

Please submit the following information when requesting a notice to be published in the Local Notice to Mariners (LNM). As the LNM is published weekly every Tuesday, we request that information be submitted two weeks before an event or operation is scheduled to commence. If unable to meet this deadline, please contact our office at the number listed at the bottom of this guide:

1. Company/Organization name and a point of contact (with phone and e-mail address)
2. What type of operation (drilling, dredging, construction, research, etc.)
3. Start and end dates: (be as precise as possible, but we will work with rough dates and times)
4. Days-times of operation (Mon-Sun, Mon-Fri, 24 hours a day, 0700 to 1600, etc.)
5. Location of operation (latitude & longitude, river mile, geographic point of land). Latitude and Longitude should be in the format of degrees, minutes, seconds and thousands of seconds (00-00-00.000N 000-00-00.000W)
6. Name of vessels and equipment that will be on scene and how to contact them (VHF frequencies, cell phone, etc.)
7. Any particular hazards created by the operation (cables, buoys, machinery, tows). Please describe them in detail if possible (white, 5ft buoy, flashing white light, etc.)
8. Any special requirements or requests from the operators (minimize wake, keep xx yards distance away)

Example notices:

COLUMBIA RIVER – KALAMA - Drilling operations at United Harvest Grain Facility

Diversified Marine will be conducting drilling operations at the United Harvest Grain Storage Facility south of Kalama, WA at approximate RM 77. Operations are expected to commence 12 Jul 10 and last until 16 Jul 10, from 0600 to 2100 daily. A construction barge will be on site and the tug Crown V will be monitoring VHF-FM channels 13 and 16. Mariners are requested to use caution and reduce wake when transiting the area. For additional information, contact Diversified Marine at (503) 289-2669.

Chart 18524

WASHINGTON – PUGET SOUND – THREE TREE POINT – Oceanographic Research

The University of Washington will be conducting oceanographic research in the vicinity of Three Tree Point from 25 Oct 10 until 04 Nov 10. The hours of operations for the research vessel Wecoma will be 24 hours a day, while the research vessel Clifford A. Barnes will be working variable hours. The R/V Wecoma and R/V Clifford A. Barnes will be deploying and recovering scientific instruments and conducting underway surveys. The R/V Wecoma and R/V Clifford A. Barnes will monitor VHF FM Channels 13, 14 and 16. Mariners are requested to keep a safe distance when in the vicinity of the research vessels.

Chart 18474

Submitting information for publication in the Local Notice to Mariners:

WASHINGTON – SOUTHERN PUGET SOUND – NISQUALLY FLATS – Underwater cable repairs
Harbor Offshore Inc. will be conducting underwater cable installation and repairs between Anderson Island and Nisqually Head from 25 to 30 Oct 10 during daylight hours. There will be two white mooring buoys with flashing white lights installed in approximate positions 47-06-55.5N 122-43-10.1W and 47-07-23.5N 122-42-47.4W. The tug Westpoint, tug Reliable and support vessel Bobbie T will be on station and monitoring VHF-FM Channels 16 and 68. For additional information, contact Harbor Offshore Inc. at (360) 297-2275.
Chart 18445, 18448

U.S. Coast Guard District Thirteen (dpw) contact information:

Local Notice to Mariners (LNM): 428/442/94: 2

LNM Email: F 35/UO D/F 35/NP O B wuei @ kn

Private Aids to Navigation (PATON) Manager: 428/442/94: 7

PATON Email: F 35/UO D/F 35/RCVQP B wuei @ kn

D13 Waterways Management Branch (dpw) Email: D13-SMB-D13-DPW@uscg.mil

Mailing address:

Commander (dpw)

13th Coast Guard District

915 - 2nd Avenue, Rm 3510

Seattle, WA 98174-1067

You can also find D13(dpw) on the web at:

<https://www.pacificarea.uscg.mil/Our-Organization/District-13/District-Staff/-dpw/-notices/>

APPENDIX 2 – RIGHT OF ENTRY FORM

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RIGHT OF ENTRY FORM

I/We hereby grant Contractor Name and their agents the right to enter upon our property for the purpose of performing construction work related to the City of Pasco's project 21237B WWTP Outfall Replacement.

Name: _____

Residence or Business Address:

Phone Number: _____

Signature _____

Signature _____

Date _____

APPENDIX 3 – PROPERTY OWNER RELEASE FORM

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PROPERTY OWNER RELEASE FORM

Subject Property Owner: _____

Subject Property Address: _____

CONTRACTOR CERTIFICATION

_____, hereinafter referred to as "CONTRACTOR", entered into an Agreement with the (Property Owner Name), to perform and furnish all services and work in association with the City of Pasco project 21237B WWTP OUTFALL REPLACEMENT.

CONTRACTOR review of the completed restoration work effort was performed on _____ Day of _____, 20xx at _____ (P.M.) (A.M.).

It is my opinion the area has been satisfactorily restored to a condition equal to or better than condition prior to construction.

Authorized Contractor Signature Date

PROPERTY OWNER RELEASE

I, _____ (property owner's name), have reviewed the CONTRACTOR'S restoration work operation on the subject property and it has been performed to a satisfactory condition, including, but not limited to:

- Backfill and compaction
- Repair/replacement of items damaged by CONTRACTOR
- Removal of construction debris including rocks and stones
- Utility repair
- Surface restoration completed
- Irrigation/drainage conveyance systems functional

Property Owner Name (Printed)

Property Owner Name (Signature) Date