

Cottonwood Mutual Water Company

Construction Specifications

SECTION 5. SITE WORK REQUIREMENTS

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## SECTION 5 – SITE WORK REQUIREMENTS

### SECTION 5.1 PIPELINE TRENCH EXCAVATION AND BACKFILL

**5.1.1 DESCRIPTION:** The CONTRACTOR shall furnish all labor, materials, tools and equipment, and perform all work necessary to complete required excavations and backfills. Work shall also include required grading for completion of water lines and associated appurtenances all in accordance with the plans and these specifications.

The work shall include: clearing the site; loosening, loading, removing, transporting and disposing of materials, wet and dry, necessary for construction; sheeting and bracing; draining and dewatering; backfill of trenches, excavations, and pits; compaction, compaction testing, leveling, signing, detours, mobilization, and clean up.

#### 5.1.2 MATERIALS:

**5.1.2.1 PIPE FOUNDATION MATERIAL:** Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, where water must be drained to maintain a dry bottom for pipe installation, or where solid rock intrudes into the bottom of the trench, the subgrade shall be excavated to a minimum depth of 6 inches below pipe bedding and replaced with crushed rock or pit run gravel.

Gravel for pipe stabilization material shall be clean crushed rock or pit run gravel conforming to the following gradation:

<u>Screen</u>	<u>Percent Passing</u>
3"	100
3/4"	5

The gravel material shall be deposited over the entire trench width and compacted by tamping, rolling, or other suitable methods. In addition, the material shall be graded to produce a uniform and continuous support for pipe bedding material or installed pipe as specified.

**5.1.2.1 PIPE BEDDING MATERIAL:** Pipe bedding is fill material in the pipe zone. The pipe zone is defined as the envelope area 6 inches below the bottom of the pipe to 12 inches above the top of the pipe, and any lateral area within 9 inches of any pipe, pipeline structure or appurtenance.

Pipe bedding material may be excavated or imported material consisting of loose earth and sand or gravel conforming to the following gradation specifications:

- PIPE BEDDING MATERIAL

	<u>Screen</u>	<u>Percent Passing</u>
(If Ductile Iron or Concrete Pipe)	1"	100
(If PVC or HDPE Pipe)	¾"	100
	No. 4	85-95
	No. 30	20-30
	No. 200	5-15

**5.1.2.3 SELECT BACKFILL MATERIAL:** Select backfill material shall be granular, readily compactable and shall be free from alkali, salt, and petroleum products, roots, sod, limbs, and other vegetative matter, slag, cinders, ashes and rubbish, or other material that in the opinion of the ENGINEER may be objectionable.

Conforming to the following gradation specifications:

<u>Screen</u>	<u>Percent Passing</u>
6 inch	100
No. 10	50 max.
No. 40	30 max.
No. 200	15 max.

Material from excavation may be used if it will meet all requirements of select backfill, including compaction requirements as specified for type of surface improvement above trench.

**5.1.3 CONSTRUCTION:**

**5.1.3.1 TRENCH EXCAVATION:** Trench excavation shall be described as the excavation of quicksand, sand, crushed slag, clay, loam, earth, hardpan, boulder-clay, boulders, bituminous or gravel roadway surface, together with removal of old timber, railroad ties, stone-filled or stone abutments and piers, boundaries, concrete and stone masonry, and every other class of material.

**5.1.3.2 SOLID ROCK EXCAVATION AND BLASTING:** Blasting will not be permitted, except by written permission from the ENGINEER on a case by case basis. If the CONTRACTOR seeks blasting permission, and is granted that permission by the ENGINEER, he must exercise great care and will be held responsible for and will assume all liability connected with the blasting and use of explosives. He will be liable for all damage to work on adjacent property, all injuries, lawsuits, complaints, and any other actual or alleged damages.

- **BLASTING EXPERTS:** Blasting shall be done only by experienced, qualified blasters. Blasting shall be done in accordance with the recommendations for best practice in Section 9 of AGC Manual of Accident Prevention in Construction and in accordance with the recommendations for best practice of the Institute of Makers of Explosives. Blasting shall comply with State and OSHA requirements.
- **COVERED BLASTING:** All blasting near dwellings must be covered with heavy mats to prevent flying rock fragments. No blasting shall be done within 15 feet of completed work.
- **SAFETY RULES:** The CONTRACTOR shall observe all safety rules for the handling of explosives, and in no case shall blasting caps be stored near the explosives. No blasting shall be done outside the regular working hours except with special approval.
- **BLASTING NOT BID ITEM:** Solid rock excavation is not a bid item. Should the CONTRACTOR choose to blast, the cost will be negotiated through a work directive and change order.

**5.1.3.4 TRENCH WIDTH:** The trench shall be excavated such that the new pipe is always centered in the trench. The clear trench width at the horizontal diameter of the pipe must not be less than the outside diameter of the pipe plus 18 inches. The maximum clear width of trench at the top of the pipe must not be more than the outside diameter of the pipe plus 24 inches.

Backfill with earth under structures or valves will not be permitted. Any unauthorized excess excavation below the elevation indicated for foundation of any structures shall be backfilled in accordance with these specifications for "Select Backfill Material" and "Pipe Foundation Material", as appropriate, at the CONTRACTOR's expense.

**5.1.3.5 SHEETING, BRACING AND SHORING OF EXCAVATIONS:** Excavations shall be sheeted, braced, and shored as required to support the walls of the excavations, to eliminate sliding and settling and as may be required to protect the workmen, the work in progress, and existing utilities, structures and improvements. All such sheeting, bracing, and shoring shall comply with the requirements of the Utah State Industrial Commission, Occupational Safety and Health Act (OSHA), and accident prevention and safety provisions of the contract.

The CONTRACTOR shall be fully responsible for the adequacy of methods and materials used in trench sheeting, bracing, shoring, and/or other systems provided to protect workmen. Injury to or death of workmen resulting from inadequate trench safety measures shall be the full and complete responsibility of the CONTRACTOR.

All damages resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the CONTRACTOR, and the CONTRACTOR shall complete all necessary repairs or reconstruction at his own expense resulting from such damage.

Sheeting or shoring that does not extend below the centerline of the pipe may be removed at the discretion and responsibility of the CONTRACTOR after the trench backfill has been placed and compacted to a level 12 inches above the top of the pipe. Following removal of the sheeting or bracing, the trench shall be immediately backfilled and compacted.

**5.1.3.6 PIPE FOUNDATION AND BEDDING MATERIAL INSTALLATION:** Pipe foundation and bedding material installation consists of preparing an acceptable pipe foundation, excavating the pipe groove in the prepared foundation and backfilling from the foundation to 12 inches above the top of the pipe. All piping shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

- **PIPE FOUNDATION:** Shall consist of undisturbed natural soil in the bottom of the trench, or a built-up foundation of bedding material if conditions and these specifications so warrant. Wherever the trench subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and/or where groundwater must be drained, or where solid rock intrudes into the trench bottom the trench shall be excavated below the bottom of the pipe bedding approximately 6 inches, and filled with clean, compacted pipe foundation material.
- **PIPE BEDDING FROM PIPE FOUNDATION TO 12 INCHES ABOVE TOP OF PIPE:** Bedding material shall be deposited and compacted in layers not to exceed 8 inches in uncompacted depth. Deposition and compaction of bedding materials shall be done

simultaneously and uniformly on both sides of the pipe. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses.

- **PIPE GROOVE:** A pipe groove shall be excavated in the pipe bedding material to receive the bottom quadrant of the pipe so that the installed pipe will be true to line and grade. Bell holes shall be dug after the trench bottom has been graded. Bell holes shall be excavated so that only the barrel of the pipe bears on the pipe foundation.

**5.1.3.7 TRENCH BACKFILL:** The trench shall be backfilled from 12 inches above the top of the pipe to the bottom of the required surface improvement section indicated on the Drawings, with select backfill material. No bituminous pavement, concrete, rock, or other lumpy material may be used in the backfill unless these materials are scattered and do not exceed 6 inches in any dimension. Decomposable or vegetative material shall not be used in backfilling.

**5.1.3.8 EXCAVATED WASTE MATERIAL:** All excess material shall be hauled away from the construction site and legally disposed of in an area obtained by the CONTRACTOR. The CONTRACTOR shall be responsible for all rights-of-way, easements, and access associated with the disposal of excess excavated material. The CONTRACTOR shall further be responsible to obtain permission from the property owner or person(s) controlling the property where the CONTRACTOR plans to dispose of excavated material. No separate compensation will be made to the CONTRACTOR for disposal of excess excavated material.

Excavated material shall be piled in a manner that will not endanger the work and will avoid obstructing sidewalks and driveways. Gutters and irrigation ditches shall be kept clear or other satisfactory provisions made for street drainage.

Grading of the area surrounding the trenches, including excavated materials, shall be performed as necessary to prevent surface water from flowing into trenches, or other excavations.

**5.1.3.9 COMPACTION:** Compaction shall be the responsibility of the CONTRACTOR. He shall select the methods to be used and carefully perform the work of backfilling and compaction so as to prevent damage to new or existing piping. Any new or existing piping damaged during the CONTRACTOR's work shall be replaced as directed by the ENGINEER with new piping.

**5.1.3.10 COMPACTION TESTING:** Compaction testing requirements called for herein are only minimum and are required for the purpose of indicating, during construction, the quality of materials and compaction. Dips or uneven surface caused by post settlement of any trenches, excavation, fill, or embankment that show up within the 1 year warranty period shall be repaired by the CONTRACTOR at no additional cost to the OWNER.

- **MAXIMUM DENSITY:** Maximum density as used in these specifications shall be defined as the maximum density obtained in the laboratory by an AASHTO T-180 test. In place density of compacted backfill will be determined by use of nuclear density determining equipment.
- **COMPACTION PERCENTAGE:** Unless otherwise specified, fills shall be compacted as indicated in the following tabulation:

<u>Location</u>	<u>Percent of Maximum Density</u>
Backfill adjacent to structure	90
Fill under structure	95
Fill areas for pipeline construction	95
Pipe bedding	90
Trench backfill (Outside roadway right-of-way)	90
Trench backfill (Inside roadway right-of-way)	97

- **COMPACTION CONFIRMATION:** It shall be the responsibility of the CONTRACTOR to accomplish the specified compaction for backfill, fill, etc., and to control all earthwork operations by tests or other means approved by the ENGINEER to verify and confirm that the CONTRACTOR is complying at all times with the requirements of the specifications.
  
- **INDEPENDENT TESTING:** Material tests are required and shall be made by an independent testing laboratory hired and paid for by the entity commissioning the waterline installation, with primary responsibility for coordinating said testing being borne by the CONTRACTOR (e.g., if the Company retains a contractor to install a waterline, the Company will retain and pay for testing services; if a developer commissions the installation of a waterline, it will retain and pay for testing services; in either case, the contractor would be responsible for coordination with the testing service so that work may proceed at the contractor's coordination). In areas where compacted backfill material is specified for pipeline trenches or around structures, the following amounts of satisfactory field density tests are required:
  - Street crossings, every 50 feet of crossing length, or portion thereof:  
2 Tests per 50-foot segment (18" above top of pipe and top of subbase).
  
  - Trenches running parallel to the roadway:  
2 Tests per 500 feet (18" above top of pipe and top of subbase).
  
- **PROCTOR TESTS:** Earth material specified in this section having specific gradation requirements shall have a soil gradation and proctor analysis performed to verify compliance and used as a basis for compaction tests. The number of times each type of material shall be tested is as follows:
  - When material is being imported:
    - 1 Test per borrow site.
    - 1 Additional test per material change.
  
  - When native material is approved:
    - 1 Test per geographical area where the composition and material gradation visually remains unchanged.

The term "test" shall mean a single test with acceptable results, i.e., equal to or greater than the specified minimums. In the event compaction tests results fall below the required minimum, the CONTRACTOR shall recompact and test the material until a test with acceptable results is obtained.

- **TEST RESULTS:** Copies of test results prepared by the independent testing laboratory will be transmitted to the CONTRACTOR at the same time they are transmitted to the ENGINEER.

Successful performance of field density tests by the independent testing laboratory at any given location shall not relieve the CONTRACTOR of his responsibility to meet the specified density and warranty requirements for the complete project.

Additional tests directed by the ENGINEER shall be made at locations selected by the ENGINEER.

**5.1.3.11 RESTORATION OF CONSTRUCTION SITE:** During the progress of the Work, the CONTRACTOR shall clean up all construction debris, excess excavation, and excess materials, and shall restore all fences, irrigation structures, ditches, culverts, and similar items. The CONTRACTOR shall stockpile the excavated trench material so as to do the least damage to adjacent grassed areas, or fences, regardless of whether these are on private property or public rights-of-way. All excavated materials shall be removed from grassed and planted areas and these surfaces shall be left in conditions equivalent to their original surface and free from all rocks, gravel, boulders, or other foreign materials.

The roadway including shoulders, slopes, ditches, and borrow pits shall be smoothly trimmed, and shaped by machinery, or other satisfactory methods, to the lines, grades and cross-sections, as established, or to equal or better condition than that which existed before construction efforts started, and shall be so maintained until accepted. Any surplus material not suitable for spreading along the road to widen the existing shoulder or raise the grade shall be hauled away or disposed of.

**5.1.3.12 CONTRACTOR'S RESPONSIBILITY:** The CONTRACTOR will be responsible to see that the backfilling, consolidation and compaction are properly and adequately done. Settlement of trenches within a period of one year after final acceptance of the project, or longer period, if so required by the entity from whom excavation/cut permits were obtained for completion of the Work, shall be considered incontrovertible evidence of inadequate compaction, and the CONTRACTOR shall be responsible for correcting the condition in accordance with the provisions of these Specifications, including the replacement of the surface materials.

**5.1.4 MEASUREMENT AND PAYMENT:** As specified in Section 1.4 of the Contract Documents.

End of Section



**SECTION 5.2**  
**PLACEMENT, REMOVAL AND RESTORATION OF SURFACE IMPROVEMENTS**

**5.2.1 DESCRIPTION:** The CONTRACTOR shall be responsible for the protection and the restoration or replacement of any improvements existing on public or private property at the start of work or placed during the progress of the work. Surfacing material removed will be loaded, hauled and disposed of by the CONTRACTOR in approved disposal areas at no additional expense to the OWNER. Existing improvements shall include but not be limited to permanent surfacing, curbs, gutters, sidewalks, planted areas, ditches, driveways, culverts, fences, signing, and walls. All improvements shall be reconstructed to equal or better, in all respects than the existing improvements removed. Provide all signing, barricades, flagman or signals as necessary to provide safe travel to the public.

*Procedures may vary from those given herein, if so directed in writing by the owner of the subject improvements, and not contradictory to the Owner's interests. An example is the UDOT Excavation Handbook. Efforts have been made to incorporate the requirements of said Handbook into these Contract Documents, nevertheless, the requirements of the Handbook shall be adhered to and shall supersede the above-the-pipe-zone restoration requirements stated in the Contract Documents.*

**5.2.1.1 FIELD VERIFICATION OF IMPROVEMENTS:** In submitting a bid, the CONTRACTOR will be deemed to have carefully examined the site of the work and to have acquainted himself with all conditions relating to the protection and restoration of existing improvements. The ENGINEER does not guarantee that all improvements are shown on the Drawings, and it shall be the CONTRACTOR's responsibility to provide in his bid for the protection and restoration of all existing improvements whether or not each is provided for specifically on the Drawings and/or Bid Form.

**5.2.2 MATERIALS:**

**5.2.2.1 GRAVEL SURFACE:** If an existing gravel surface is decorative in nature, or uniquely uniform in appearance, the entity disturbing the gravel surface shall purchase and place material of the same size, type and appearance when restoring the site. Unless determined by the necessity to match existing decorative gravel, material for use on gravel surfaces shall be obtained from sound, tough, durable gravel or rock meeting the following requirements for grading:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch sieve	100
1/2-inch sieve	79 - 91
No. 4 sieve	49 - 61
No. 16 sieve	27 - 35
No. 200 sieve	7 - 11

**5.2.2.2 UNTREATED BASE COURSE:** Untreated base course shall be in accordance with Utah Department of Transportation Standard Specifications, 2012, Section 02721, Table 2:

Table 2

Gradation Limits		
Sieve Size	Job Mix Gradation Target Band	Job Mix Gradation Tolerance
1½ inch	100	
1 inch	90 - 100	±9.0
¾ inch	70 - 85	±9.0
½ inch	65 - 80	±9.0
⅜ inch	55 - 75	±9.0
No. 4	40 - 65	±7.0
No. 16	25 - 40	±5.0
No. 200	7 - 11	±3.0

**5.2.2.3 SUBBASE MATERIAL:** Subbase material gradation shall be in accordance with Utah Department of Transportation Standard Specifications, 2012, Section 02741, GRANULAR BORROW

- A. Classification A-1-a. Refer to AASHTO M 145.
- B. Non-plastic, well-graded, 3 inch maximum.

**5.2.2.4 BITUMINOUS SURFACE COURSE:** Bituminous surface course gradation shall be in accordance with Utah Department of Transportation Standard Specifications, 2012, Section 02056, Table 6:. Actual gradation to be used shall be approved by the ENGINEER.

Table 6

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)					
Sieve Size		1 inch	¾ inch	½ inch	⅜ inch
Control Sieves	1½ inch	100.0			
	1 inch	90.0 - 100.0	100.0		
	¾ inch	<90	90.0 - 100.0	100.0	
	½ inch		<90	90.0 - 100.0	100.0
	⅜ inch			<90	90.0 - 100.0
	No. 4				< 90
	No. 8	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0
	No. 200	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0

**5.2.2.5 TACK COAT:** Tack coat shall be SS-1 Diluted with an equal amount of water.

**5.2.2.6 CONCRETE:** See Section 5.8 of these specifications.

**5.2.2.7 SOD AND VEGETATION:** All materials shall be from sources approved by the ENGINEER; however, such approval does not relieve the CONTRACTOR from responsibilities for growth, maintenance and replacement as specified herein.

**5.2.2.8 TOPSOIL:** Topsoil shall be fertile, friable, natural loam, surface soil, reasonably free of clay lumps, brush, weeds, and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from naturally well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

**5.2.2.9 OTHERS:** Other materials may be required by the authorities having jurisdiction such as Local, State or Federal entities (e.g., irrigation company canals, city, county or state roads, Bureau of Reclamation canals). It is the Contractor's responsibility to ensure that the improvement owner's requirements are met.

### **5.2.3 CONSTRUCTION:**

**5.2.3.1 REMOVAL OF CONCRETE OR ASPHALT SURFACES:** CONTRACTOR shall consult with the roadway owner before removing asphalt to ensure the requirements of the roadway owner will be met. Unless otherwise directed by the roadway owner, the following specification shall be adhered to. The pavement, sidewalk, curb and gutter, driveway, etc. shall be cut vertically along the lines forming the trench, or nearest full joint, in such a manner as to not cause damage to adjoining pavement, sidewalk, curb and gutter, driveway, etc. An undercut level at the rate of 1 inch per foot of thickness or an underlap joint shall be provided at the proposed junction between old and new surfaces. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement or concrete outside the limits of the trench; however, any pavement damaged by operations outside the limits of the trench shall be replaced. Broken paving materials shall be removed immediately from the site of the work. The ENGINEER shall approve all saw cut locations.

**5.2.3.2 GRAVEL SURFACE:** Where trenches are excavated through gravel surfaced areas such as roads and shoulders, parking areas, unpaved driveways, etc., the gravel surface shall be restored to a minimum depth of 4 inches. The gravel shall be placed in the trench at the time it is backfilled. The surface shall be maintained by blading, sprinkling, rolling, adding gravel, etc., to maintain a safe, uniform surface satisfactory to the ENGINEER. Excess material shall be removed.

#### **5.2.3.3 SUBBASE:**

- A. Finish granular borrow surface within  $\pm 0.1$  ft of line and grade.
- B. Compact borrow and backfill material in 6 inch layers to the specified density, 97% AASHTO T-180 unless noted otherwise in these specifications or on the Drawings.

**5.2.3.4 BASE COURSE AND TEMPORARY GRADED SURFACE:** On paved areas, base course shall be placed in the top of the trench to a depth such that the final compacted thickness of the base course below the bottom of the pavement shall be equal to the existing base course but not less than 10 inches. This base course layer shall be brought flush with the paved surface and maintained in a smooth, rut free condition until time for the pavement to be placed.

**5.2.3.4 TACK COAT:** Tack coat shall be applied at the rate of 0.05 to 0.15 gal/SY. A hand sprayer or brush shall be used to apply tack coat to vertical faces of previously constructed bituminous pavement (over 1/2 hour hence) prior to placing an adjacent or parallel pass, curbs, gutters, slab edges, and all structures to be in actual contact with the bituminous pavement. Tack coat shall also be applied uniformly at the same rate to the horizontal top surface of each lift of bituminous pavement prior to placing the next lift of bituminous pavement to promote a bond between the two courses of pavement. None of the material shall penetrate into the pavement and for this reason the application should be limited.

Prior to applying the material, the surface to be treated shall be swept or flushed free of dust or other foreign material. Protect all surfaces not required to receive tack coat from any inadvertent application.

The temperature range of the tack coat at the time of application shall be such that the viscosity will be between 50 and 100 centistokes as determined in accordance with ASTM Designation D-2710.

Under no circumstances shall traffic be permitted to travel over the tacked surface. If detours cannot be provided, restrict operation to a width that will permit at least one-way traffic over the remaining portion of the roadbed. If one-way traffic is provided, the traffic shall be controlled in accordance with governing authority.

After application of tack coat, sufficient time shall be given to allow for complete separation of asphalt and water before paving operations begin. The tack coat shall be applied on only as many surfaces as will be paved against in the same day.

**5.2.3.5 BITUMINOUS SURFACE:** Trenches to be resurfaced shall be graded and rolled to provide a subgrade consisting of granular backfill and base course which is firm and unyielding. Density of the subgrade materials shall be 97 percent of AASHTO T-180. Mud or other soft or spongy material shall be removed and the void filled with base course and rolled and tamped thoroughly in layers not exceeding 12 inches in thickness. The edges of trenches which are broken during subgrade preparation shall be removed and trimmed neatly before resurfacing.

Mixing, placing, spreading and compaction of a minimum 3-inch bituminous surface course (greater depths may be required as shown on the Drawings) shall conform to applicable parts of Utah Department of Transportation Standard Specifications, 2012, excluding pay factor allowances.

**5.2.3.5.1 UDOT ROADWAY:** When trenching occurs within a UDOT roadway, a 2" deep mill and fill is required: 20' on each side of the trench when crossing the traveled way, and from lane stripe to lane stripe on any lane, or portion of lane with trench construction within it. Pavement markings must be restored with new material similar to that which was removed.

**5.2.3.6 CONCRETE CURBS, GUTTER, SIDEWALKS AND DRIVEWAYS:** Existing improvements shall be removed and replaced to the next joint or scoring line beyond the actually damaged or broken sections; or in the event that joints or scoring lines do not exist or are three or more feet from the removed or damaged section, the damaged portions shall be removed by saw cutting full-depth.

All new concrete shall match, as nearly as possible, the appearance of adjacent concrete improvements. Where necessary, lampblack or other pigments shall be added to the new concrete to obtain the desired results.

Concrete forms shall be true to line and of sufficient strength to ensure against bulging or displacement.

Contraction and expansion joints shall match original construction in placement and size, unless otherwise required by local jurisdiction having authority.

Reinforcement shall be replaced as in original construction, and dowelled into edges of existing concrete, unless otherwise required by local jurisdiction having authority, and shall be installed in accordance with applicable CRSI and ACI Standards.

Finishing and curing shall be in accordance with local jurisdiction having authority.

**5.2.3.7 PLANTED AREAS:** Prior to placing topsoil and/or sod, examine and repair the subgrade as necessary to assure a smooth and even surface which will match grade and contours of surrounding undisturbed ground. Finish grade construction areas to match grade prior to construction activities. Assure that a positive slope away from all building walls is maintained for at least 10 feet to prevent runoff from approaching walls.

**5.2.3.8 SPRINKLING SYSTEMS:** Restore all sprinkling systems disturbed, removed, or damaged by construction operations in a condition at least equal to that prior to construction.

**5.2.3.9 MISCELLANEOUS IMPROVEMENTS:** All other improvements interrupted or removed to permit the construction specified herein shall be restored. Miscellaneous improvements to be restored shall include, but shall not be limited to, the following:

- Traffic Signs
- Mail Boxes
- Drainage and Irrigation Ditches
- Culverts
- Canals and Canal Structures
- Bridges and Bridge Abutments
- Fences

**5.2.3.10 PROTECTION:** Protect all restored improvements from damage in accordance with these specifications, unless otherwise required by local jurisdiction having authority.

End of Section

**SECTION 5.3  
CULINARY WATERLINE AND APPURTENANCES**

**5.3.1 DESCRIPTION:** The CONTRACTOR shall install all pipe, furnish and install: Valves, valve boxes, fire hydrants, service connects, meter boxes, check valves, air release valves, pipe bedding material; furnish and install all couplings, fittings, bolts, nuts, gaskets, jointing materials, and appurtenances as shown and specified, and as required for a complete and workable piping system. It is intended that all specifications herein conform with the Utah Division of Drinking Water Rules found in the 500 series of R309 (DDW Rules). Any conflicts between these written specifications and the DDW Rules shall be resolved by adherence to the more stringent requirements.

***All products incorporated into the project shall be new. All materials and products in contact with culinary water shall be certified compliant with NSF standard 60 or 61, as applicable.***

**5.3.2 MATERIALS:**

**5.3.2.1 PVC C-900 PIPE:** (Refer to Sec. 5.5, "PVC AWWA C-900 Water Pipe").

**5.3.2.2 DUCTILE IRON PIPE:** (Refer to Sec. 5.6, "Ductile Iron Pipe").

**5.3.2.3 HDPE PIPE:** (Refer to Sec. 5.7, "AWWA C-906 Fused HDPE Piping for Potable Water").

**5.3.2.4 FIRE HYDRANTS:** Fire hydrants shall be of a "traffic model" type design conforming to AWWA C-502 Specifications. Hydrants shall be supplied with two 2-1/2-inch and one 4-1/2-inch nozzles. All nozzles shall have national standard threading. A one cubic yard gravel sump shall be provided at each hydrant for drainage. Fire hydrants shall be Mueller Super Centurion or Company-approved equal.

**5.3.2.5 ISOLATION VALVES:** All main line isolation valves shall conform to Standard AWWA C509 for Resilient-Seated Gate Valves in line sizes up to 10" or C504 for Rubber-Seated Butterfly Valves in line sizes 12" or larger, unless noted otherwise. All valves shall be designed for 150 psi working pressure or above. The valves shall be mechanical joint unless otherwise indicated on the plans.

**5.3.2.6 VALVE BOX AND COVER:** All buried valves shall be installed complete with two-piece, cast iron, screw slip, 5-1/4-inch shaft valve box with adjustable height to bring the top of the valve box flush with the ground surface. The valve box and top section shall be from the same manufacturer, intended for use together and within the published dimension tolerances. The valve box shall not be less than 5 inches in diameter and shall have a minimum thickness of 3/16 inch. Valve boxes shall be "Tyler" or equal.

All valve boxes shall be provided with suitable base cover. The word "WATER" shall be cast on the cover. An extra deep cover shall have a minimum shaft length of 4", total minimum depth of 6" and a total minimum weight of 24 lbs. The extra deep valve box cover shall be P/N 06800045 by EJ, model M-8045 by D&L Foundry or similar approved equal.

**5.3.2.7 FITTINGS:** Fittings shall be ductile iron of the short body design and shall conform to AWWA Standards C-110 or C-153. Fittings inside structures or where otherwise noted on the

drawings shall be ANSI Class 125 flanged design with full face rubber gaskets. All exterior surfaces of pipe and fittings shall be coated with a petroleum asphaltic coating.

**5.3.2.8 COUPLINGS:** Couplings shall be equal to the product of Romac, JCM, Smith-Blair, or Dresser with cast iron couplings being used on all ductile iron pipe. Couplings shall be of the straight, transition, or reducing style as required by the specific installation. All steel fittings shall be coated with a non-oxide coating and bolts shall be coated with a fluoropolymer in accordance with these specifications.

Service lateral couplings, only when lateral couplings are specifically allowed by the District, shall be all brass, with compression x compression end connections.

**5.3.2.9 SERVICE SADDLES:** Stainless steel, dual strap, nylon-coated with IPS threads, Romac 202NS, SaddleCorp 3450AS PowerJoint or approved equal.

**5.3.2.10 CORPORATION STOPS:** Connections to main lines shall be made through all-metallic ground key corporation stops with MNPT inlet by CTS compression end connections.

**5.3.2.11 PIPE FOR SERVICE CONNECTIONS:** Pipe for water services shall be minimum 1" diameter 200 PSI CTS PE4710 HDPE for potable water service.

**5.3.2.12 METER SETTER ASSEMBLY:** A typical meter assembly (for a single family dwelling) shall consist of a copper setter, FORD VBHC 72-18W-44-44QNL, 18-inch riser with angle ball valve on the inlet side and Utah State approved dual check valve on the outlet side, or equivalent from Mueller or A.Y. McDonald. Connection to service lines at the base of the setter shall be made with compression connections. The water meter shall be paid for by the customer and purchased and installed by the Company.

Non-typical meter assemblies shall be of like construction with equal components and shall be approved by the District inspector.

**5.3.2.13 METER BOXES AND LIDS:** Meter boxes for residential services in non-traffic locations shall be round, 18 inch inside diameter plastic with smooth white interior, manufactured and marketed as a meter box. Mueller Thermal Shell catalog number SV1836, Hancor meter pit product code MP NL1 18 0003, or approved equal.

Meter boxes for services in areas susceptible to vehicular traffic (roads, driveways, gravel or asphalt parking areas or others as determined by the District Inspector in the inspector's sole discretion) shall be concrete.

Lids for meter boxes shall come with a with a recess for a Neptune-system antenna and a 2" hole to accommodate meter reading ("universal" lids are not acceptable and will be rejected) and shall be cast iron with a lifter worm lock, operated by a large pentagon head bolt. Meter box lids in a non-traffic area shall be D&L L-2240-15 or approved equal.

Meter box lids in areas susceptible to vehicular traffic shall be flat, D&L B-5018-15 or approved equal.

All meter boxes shall be installed and inspected in accordance with the approved drawings.

**5.3.2.14 THRUST RESTRAINT:** The material for thrust blocks shall be concrete which shall have a compressive strength of no less than 2,000 psi in 7 days. Rebar for valve and vertical elbow tie-downs shall be 60-ksi steel. Mechanical joint restraints shall be compatible with the pipe material on which they will be installed, and of standard manufacture by EBAA Iron, ROMAC or approved equal. Fluoropolymer-coated hardware.

**5.3.2.15 UNDERGROUND WARNING TAPE AND LOCATION WIRE:** The tape shall be a 2-inch metallic core with a polyethylene cover, blue in color, and have the words "Caution Water Line Buried Below" imprinted on it. The tape shall be Style No. 2WAT as manufactured by Seton Name Plate Company of New Haven, Connecticut, or approved equal. Copper location wire shall be at least #14 plastic coated solid wire.

**5.3.2.16 CHECK VALVES:** Check valves shall prevent reverse flow in the pipelines. The check valves shall have steel or ductile iron body with bronze trim, stainless steel spring, and resilient seat. The valves shall be Class 125 or better. The check valve shall be manufactured by Val-Matic or approved equal.

**5.3.2.17 CONNECTION HARDWARE:** Except where otherwise shown or specified, acceptable bolts and nuts are:

- 1) Below grade or subject to high humidity or non-potable submergence: Carbon steel:
  - a) Conforming to the requirements of ASTM A307 Grade A or higher yield and tensile strengths. The corresponding nuts shall conform to ASTM A563 Grade A or higher yield and tensile strengths.
  - b) All bolts and nuts shall be coated with fluoropolymer, TRIPAC 2000 coating system, or approved equal. Anti-seize compound shall not be utilized with the blue nuts.
- 2) Submerged service, potable: Stainless steel:
  - a) Conforming to the requirements of ASTM F593. The corresponding nuts shall conform to ASTM F594.
  - b) Nuts shall be finished with fluoropolymer, TRIPAC 2000 coating system, or approved equal. Anti-seize compound shall not be utilized with the blue nuts.
- 3) Above-grade, non-humid, non-submerged: Carbon steel:
  - a) Conforming to the requirements of ASTM A307 Grade A or higher yield and tensile strengths. The corresponding nuts shall conform to ASTM A563 Grade A or higher yield and tensile strengths.
  - b) All bolts and nuts shall be zinc plated in accordance with ASTM F1941 (Fe/Zn 5A).
  - c) Coatings shall not be applied to nuts or bolts except with the Company's written approval.
- 4) Above-grade, weather-exposed, non-submerged: Carbon steel:
  - a) Conforming to the requirements of ASTM A307 Grade A or higher yield and tensile strengths. The corresponding nuts shall conform to ASTM A563 Grade A or higher yield and tensile strengths.
  - b) All bolts and nuts shall be hot-dip galvanized in accordance with ASTM A153.
  - c) Coatings shall not be applied to nuts or bolts except with the Company's written approval.

**5.3.2.18 SAMPLING STATION:** Sampling Stations shall be 42" bury, with a ¾" FIP inlet and a ¼" unthreaded sampling tap. All stations shall be enclosed in a lockable, non-removable aluminum-cast housing. When opened, the station shall require no key for operation, and the water will



flow in an all brass waterway. All working parts will also be of brass and be removable from above ground with no digging. Exterior piping shall be brass. A copper vent tube will enable each station to be pumped free of standing water to prevent freezing and to minimize bacteria growth. Sampling Station shall be Eclipse No. 88 by Kupferle Foundry, St. Louis, MO 63102.

**5.3.2.19 BLOW OFF:** Permanent (intended for use after construction and commissioning of the water line) blow off valves shall be premanufactured, below-grade, self-draining and non-freezing in a concrete pipe section with ring and cover labeled "WATER". Blowoffs to flush a 10" or smaller-diameter mainline shall be Model #78 (2") and for flushing a 12" to 16" mainline shall be a Model #7600 (4") by Kupferle Foundry. Temporary (limited to the duration of construction, after which they will necessarily be removed to connect another length of pipe) blowoffs may be of the contractor's manufacture and of the size needed to produce a flow of 3.0 FPS through the mainline it is intended to flush.

**5.3.2.20 OTHERS:** Other materials as specified on the drawings.

### **5.3.3 CONSTRUCTION:**

**5.3.3.1 PVC C-900 PIPE:** (Refer to Sec. 5.5, "PVC AWWA C-900 Water Pipe").

**5.3.3.2 DUCTILE IRON PIPE:** (Refer to Sec. 5.6, "Ductile Iron Pipe").

**5.3.3.3 HDPE PIPE:** (Refer to Sec. 5.7, "AWWA C-906 Fused HDPE Piping for Potable Water").

**5.3.3.4 DELIVERY, STORAGE AND HANDLING:** Load and unload pipe, fittings, specials, valves, and accessories by lifting with hoists or skidding so as to avoid shock or damage. Do not skid or roll pipe on skidways against pipe already on the ground. Lifting of pipe during unloading and placing into the trench shall be done using two nylon slings placed at the quarter points of the pipe sections. The slings shall bear uniformly against the pipe. Under no circumstances shall the pipe or accessories be dropped into the trench. When not being handled, the pipe shall be supported on timber cradles or on properly prepared ground, graded to eliminate all rock being transported, the pipe shall be supported at all times in a manner which will not permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the ENGINEER, is damaged beyond repair by the CONTRACTOR shall be removed from the site of the work and replaced with another unit. No payment will be made for damaged pipe or for repairs to such damaged pipe. The use of chains or cables for handling the pipe is not permitted.

Each length of pipe shall be unloaded opposite or near the place where it is to be laid in the trench.

**5.3.3.5 CONNECTIONS TO EXISTING MAINS:** Connections to existing mains shall be made where indicated on the plans. The CONTRACTOR shall determine the exact pipe size and material and provide applicable valves, fittings, and couplings to make a smooth and straight transition into the existing pipe line(s). All connections shall be made and visually inspected by the Company for leakage with the line under pressure prior to backfilling. Connections will normally be made with a tee, cross, or other similar type connector.

The CONTRACTOR must uncover the connection area and determine the needs for the connection prior to turning off the water. The water may be turned off Monday through Friday between the hours of 9:00 am and 4:00 pm only, with planned shutdowns starting only on

Monday through Thursday. The OWNER must be given 24 hours notice prior to turning off the water to any portion of the system. The CONTRACTOR must make reasonable efforts to avoid disruption of water service.

**5.3.3.6 WATER MAINS:** Water mains shall be installed in accordance with the AWWA standard for the type of pipe and as may be further referenced in Section 5.3.2. The open ends of all pipelines under construction shall be covered and effectively sealed at the end of the day's work. All mainlines shall terminate with either a fire hydrant or appropriately sized permanent blowoff.

Water mains in public rights-of-way shall be a minimum of 8" nominal diameter, unless written approval is given by the Company Manager for a specific location.

All water mains installed in non-public rights-of-way (e.g., in easements on private property) and intended for a perpetual transmission line without service lateral connections shall be HDPE as specified herein. Company shall be consulted to verify material type and waterline intent prior to installation.

**5.3.3.7 FIRE HYDRANTS:** All fire hydrants shall be installed with a 1 cubic yard gravel sump and concrete thrust block. See Construction Drawings for thrust blocking. Concrete shall not be placed around joints, bolts, or drain holes. Ensure that drain holes are free to drain to sump. Cover all metal contact areas with a poly wrap material prior to concrete placement. All hydrants shall be installed with the upper safety flange at least 2-1/2 inches and not more than 6 inches above ground level. All hydrants shall be installed with the steamer nozzle facing the street unless otherwise approved by the OWNER.

The location of fire hydrants shall be consistent with the requirements of the State-adopted fire code and as determined by the local fire code official.

Hydrant drains shall not be connected to, or located within, 10 feet of sanitary sewers. Where possible, hydrant drains shall not be located within 10 feet of storm drains.

**5.3.3.8 ISOLATION VALVES:** The CONTRACTOR shall furnish and install isolation valves at the locations shown on the drawings. The valves shall include either valve and valve box with lid, or valve with hand wheel as indicated on the drawings. The valves shall have flanged or mechanical joint ends, non-rising stem, O-ring, seals, operating nut and extension as required, or hand wheel, and iron body-bronze resilient seat. The valves shall meet or exceed AWWA Standard C-504 or C-509.

Valves will be inspected, cleaned, set in line, and jointed to pipe with mechanical or flanged joints as indicated on the plans. All mainline valves shall have a concrete base poured in place onto which the valve is anchored against movement by straps on both sides of the valve housing. Steel anchor rods shall be rust-proofed or painted.

Valves shall be located at not more than 500-foot intervals in commercial districts and at not more than one block or 800-foot intervals in other districts. Where customers are widely scattered and where future development is not expected, the valve spacing shall not exceed one mile.

At tees and crosses, a valve shall be installed in each main line, out of the intersection, at the extension of property lines.

An exception to the number of valves may be made by the Company when following the standard will put main line valves within 250' of each other.

An isolation valve shall be installed in main lines on each end of an easement through private property.

**5.3.3.9 VALVE BOX AND COVER:** All buried valves shall be installed complete with two-piece, cast iron, 5-1/4-inch shaft valve box with locking lid. The lid shall have the work "WATER" cast in the metal.

Valves and valve boxes shall be installed where shown on the drawings. Valves and valve boxes shall be set plumb. Valve boxes shall be centered directly over the valve. Valves shall be aligned with property lines where possible. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valve boxes shall have the interiors cleaned of all foreign matter before installation.

All valve boxes located in streets shall be installed as nearly to grade as possible. After the pavement is in place, the valve boxes shall be raised to grade, the surrounding asphalt shall be neatly cut to form a circular opening 2 feet and 6 inches in diameter with the valve box centered, and a concrete collar shall be cast around the box. Valve boxes and collars in off-road areas shall extend 2 inches above grade.

When the valve box is in a roadway with posted speeds over 40 MPH, an extra deep valve box cover shall be installed.

**5.3.3.10 FITTINGS:** Bends, tees, reducers, flange adapters, and adaptor couplings shall be inspected, cleaned, and jointed to pipe as specified by the manufacturer. Reaction or thrust blocking shall be applied at bends of 11-1/4 degrees and more, at plugs, caps, and at tees.

**5.3.3.11 COUPLINGS:** Couplings shall be installed where connecting two segments of pipe of the same nominal diameter in the same alignment, when repairing or making final connections. Mechanical restraint shall be provided at the coupling if the two pipes are different nominal diameters.

**5.3.3.12 WATER SERVICE CONNECTIONS:** Make service connections through service saddle and install service lines as shown on the Construction Drawings, or as directed by the OWNER's representative. Use teflon tape on all taps. Locate service taps in the upper quadrant of the main line, approximately 45 degrees. The minimum distance between taps is 24 inches, with a 5 degree stagger. Do not make service taps within 24 inches of the end of the main line.

Excavate and backfill in accordance with Section 5.1, "Pipeline Trench Excavation and Backfill". All work must be inspected by the Company prior to backfilling. Pressure test all services before backfilling. Make no service connections until main line is fully accepted by the OWNER. Extend service line to meter and 5 feet beyond meter and plug as indicated on the contract drawings.

Install a tracer wire with all service laterals. Ensure physical and electrical connectivity with the wire at the mainline. The wire shall be terminated with a neatly wound coil at least 4 feet long

in the meter box, with the end secured between the meter box and ring. All meter setter assemblies shall be no more than 20 inches and not less than 18 inches from finish ground level. The water meter shall be paid for by the customer and supplied and installed by the Company.

Each meter box within 20' of another meter box, identify unit being served:  
Furnish and install a 304 or 316 stainless steel tag stamped with Lot #<###>  
House #: <House # portion of street address> Text shall be no less than 1/4" tall on a tag no less than 2" x 2", no less than 0.040" thick. Secure with SS tie to meter setter.

Record station of service connection to main line and record location and depth of end of service line, tying distances to at least two surface landmarks. Sketch information on an 8-1/2 x 11 inch form and record any particular problems and submit to Company Inspector before demobilizing from site.

All meter boxes located in a traveled way (gravel- asphalt- or concrete-driveways, or roadways) shall be collared with a 4'x4'x 4" or thicker, as may be required by the authority having jurisdiction, 3,500 PSI concrete panel on a 6" thick layer of roadbase compacted to 95% maximum dry density per ASTM D-1537.

**5.3.3.13 THRUST RESTRAINT:** Thrust blocks shall be provided at reducers and valves where shown on the drawings, at all tees, plugs, and caps, and at bends deflecting 11-1/4 degrees or more. Reinforcement bar shall be pre-bent before placement around valve or elbow, then temporarily spread apart for installation. Form hooks in both ends of rebar to extend completely under the valve or fitting.

Thrust blocks shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown on the drawings. The block shall, unless otherwise shown or directed, be so located as to contain the resultant thrust force and so that the pipe and fitting joints will be accessible for repair.

Mechanical thrust restraints shall also be used at all locations where thrust blocks are called for.

Mechanical thrust restraints, fittings and connection hardware shall be securely wrapped with 8 mil or greater polywrap and taped to prevent contact with concrete.

**5.3.3.14 UNDERGROUND WARNING TAPE AND LOCATION WIRE:** The CONTRACTOR shall furnish and install an underground warning tape as the trench is backfilled. The tape shall be placed directly over the waterline and to a depth of 24 inches below the finished ground surface.

A copper trace wire shall be in the bottom of the main line or service lateral pipe trench (when a new service lateral is pulled through an existing lateral, a tracer wire shall also be pulled with the new lateral) and accessible from the surface at each valve box (bring the wire up the outside of the bottom of each box and bring it inside the top section) and adjacent to each fire hydrant and blowoff. At fire hydrants and blowoffs, a "Snake Pit" LD14BTP by Copperhead Industries, LLC, or approved equal (model CD14BTP if the "Snake Pit" must be installed in a vehicular traffic area) shall be the method of termination.

All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At

crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative. Direct bury wire connectors – shall include 2- and 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner to prevent any uninsulated wire exposure. Non- locking friction fit, twist on or taped connectors are prohibited.

**5.3.3.15 SEPARATION OF WATER MAINS FROM SANITARY SEWER:** The horizontal distance between pressure water mains and sanitary sewer lines shall be at least ten feet. Where a water main and a sewer line must cross, the water main shall be at least 18 inches above the sewer line. Separation distances shall be measured edge-to-edge (i.e. from the nearest edges of the facilities). Water mains and sewer lines shall not be installed in the same trench. Where local conditions make it impossible to install water or sewer lines at the separation distances required above, an exception to the standard may be possible. The entity seeking the exception shall initiate and pursue a request for a separation exception with the State Division of Drinking Water, in accordance with R309-550-7 of the State of Utah Administrative Rules.

**5.3.3.16 BLOW OFF:** A permanent blow off meeting Company standards shall be installed at all dead end main lines that otherwise do not terminate at a fire hydrant.

**5.3.3.17 SAMPLING STATION:** One Sampling Station shall be installed in the mow strip or other designated location within each development, as designated by the Company inspector. An 18" x 18" x 3" concrete splash pad shall be placed adjacent to the sampling station, located to dissipate energy from any water discharged during flushing and sampling.

**5.3.4 MEASUREMENT AND PAYMENT:** As specified in Section 1.4 of the Contract Documents.

End of Section

## **SECTION 5.4 DISINFECTION AND TESTING OF WATER LINES**

**5.4.1 DESCRIPTION:** Except as otherwise provided herein, the CONTRACTOR shall furnish all equipment, labor, and materials required for testing and disinfecting hydraulic structures and pipelines as specified. Water for testing and disinfecting will be furnished by the OWNER; however, the CONTRACTOR shall be responsible for coordinating with the OWNER the acquisition and use of the water for testing and disinfection procedures.

Disinfection shall be accomplished by chlorination in accordance with AWWA standard C-651. Each completed section shall be disinfected and tested prior to introduction into the drinking water system. Release of water from structures and pipelines, after completion of testing and disinfection, shall be in conformance with AWWA standard C-651.

### **5.4.2 PROCEDURES:**

**5.4.2.1 PRELIMINARY CLEANING AND FLUSHING:** Prior to both testing and disinfecting, all pipelines shall be thoroughly washed, flushed or blown out, under the direction of the OWNER. Flushing shall be accomplished through hydrants, valves, blow-offs, or other means provided by the CONTRACTOR and approved by the OWNER sufficient to provide for a 3.0 foot per second (FPS) flushing velocity in the pipeline. Where the OWNER determines that a 3.0 FPS flushing velocity is not practical, the greatest feasible flow for 2-3 volumes shall be achieved.

**5.4.2.2 HYDROSTATIC TESTS:** Prior to testing, all piping shall be flushed or blown out as appropriate. The CONTRACTOR shall test all piping either in sections or as a unit. Mortar-lined piping shall not be tested before the mortar lining has attained an age of 14 days. The test shall be made by placing temporary bulkheads in the pipe and filling the line slowly with water. Care shall be taken to see that air vents are installed at appropriate locations to evacuate air, and that all air vents are open during filling. After the piping or section thereof has been filled, it shall be allowed to stand under a slight pressure for a sufficient length of time to allow the mortar lining to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If any are found, corrective measures satisfactory to the OWNER shall be taken. The test shall consist of holding a minimum pressure of 150 psi on the section being tested for a minimum period of 2 hours. The test pressure shall be maintained within 5 PSI without the addition of makeup water for the duration of the test.

In the case of pipelines that fail to pass the prescribed leakage test, the CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines, all at no additional cost to the OWNER.

### **5.4.2.3 DISINFECTING PIPELINES:**

- **CHLORINATION:** A chlorine-water mixture shall be applied by means of a solution-feed chlorinating device. The chlorine solution shall be applied at one end of the piping or pipeline through a tap in such manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 ppm. Care shall be taken to prevent the strong chlorine solution in the line being treated from flowing back into the line supplying the water. Chlorine concentration shall be tested and verified by the OWNER.
- **RETENTION PERIOD:** Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the

chlorine-treated water has been retained for the required time, the chlorine residual at the pipe extremities and at other representative points shall be at least 25 ppm.

- CHLORINATING VALVES: During the process of chlorinating the piping and pipelines, all valves and other appurtenances where possible shall be operated while the pipeline is filled with the heavily-chlorinated water.
- Dechlorination required unless waived in writing by the District Manager. Refer to ANSI/AWWA C655 Field Dechlorination for dechlorination procedures.

**5.4.2.4 FLUSHING:** After both pressure testing and chlorination, all pipelines shall be flushed. Flushing shall be accomplished through fire hydrants, end of line blow offs with a minimum of 2-inch diameter or, the CONTRACTOR shall install a tap sufficient in size to provide for a 3-foot per second flushing velocity in the pipeline. Refer to the reproduction of Table 3 of AWWA Standard C651-14, below.

**Table 3 Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (0.91 m/sec) (40 psi [276 kPa] residual pressure in water main)\***

Pipe Diameter		Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main	Size of Tap Used, in. (mm)			Number of Hydrant Outlets		
			1 (25)	1½ (38)	2 (51)			
<i>in.</i>	<i>(mm)</i>	<i>gpm</i>	<i>(L/sec)</i>	Number of Taps Required on Pipe†			2½-in. (64-mm)	4½-in. (114 mm)
4	(100)	120	(7.4)	1	—	—	1	1
6	(150)	260	(16.7)	—	1	—	1	1
8	(200)	470	(29.7)	—	2	—	1	1
10	(250)	730	(46.3)	—	3	2	1	1
12	(300)	1,060	(66.7)	—	—	3	2	1
16	(400)	1,880	(118.6)	—	—	5	2	1

\*With a 40-psi (276-kPa) pressure in the main with the hydrant flowing to atmosphere, a 2½-in. (64-mm) hydrant outlet will discharge approximately 1,000 gpm (63.1 L/sec); and a 4½-in. (114-mm) hydrant outlet will discharge approximately 2,500 gpm (160 L/sec).

†Number of taps on pipe based on 3.0-ft/sec discharge through 5 ft (1.5 m) of galvanized iron (GI) pipe with one 90° elbow.

**5.4.2.5 BACTERIOLOGICAL TESTING:** The OWNER shall obtain three samples of water from the main line after final flushing, the failure of any one such test will result in starting the flushing and test sequence over again: 1) The first sample will be pulled and tested immediately after final flushing; 2) The second sample will be pulled and tested no less than 24 hours after the first sample is pulled from the same section of pipe; 3) If both of those tests come back negative, the tie-to-existing may take place, and a third and final sample pulled and tested; if the third sample returns a negative result, the section of pipeline will be accepted (this does not pertain to any surface improvements that may be needed).

**5.4.3 MEASUREMENT AND PAYMENT:** Payment for cleaning, pre-flushing, hydrostatic testing, disinfecting, and final flushing shall be included in the lineal foot price of installed pipe.

End of Section

**SECTION 5.5**  
**PVC AWWA C-900 WATER PIPE**

**5.5.1 DESCRIPTION:** The work includes providing and installing PVC AWWA C-900 water pipe with integral bell and spigot joints.

**5.5.2 MATERIALS:**

**5.5.2.1 PIPE:** Pipe shall comply with the latest version of AWWA Standard C-900, with material compound being 12454A, per ASTM D1784. Pipe shall be DR18 unless shown otherwise on the plans.

**5.5.2.2 JOINTS:** The Elastomeric Seal (gasket) shall conform to ASTM F477. The gasketed joint assembly shall conform to ASTM D3139, and the installation of the C900 pipe shall conform to Uni-Bell-3, AWWA M23 installation guide.

**5.5.2.3 FITTINGS:** Fittings shall be cast iron or ductile iron, iron pipe size for PVC application, and in accordance with AWWA C-110 (flanged fittings) or AWWA C-153 (MJ fittings). They shall be capable of withstanding, without bursting, hydrostatic tests of three times the rated water working pressure. The fittings shall be furnished with mechanical- or flange-joint gaskets conforming to AWWA C-111.

**5.5.2.4 SERVICE CONNECTIONS:** Service connections to PVC plastic pressure pipe shall be by nylon coated, ductile iron, double stainless-steel strap service saddles, Romac 202NS, or approved equal specifically designed for type of mainline pipe.

**5.5.2.5 QUALITY ASSURANCE:** Each standard and random length of pipe is to be tested to three times the class pressure of the pipe for a minimum of 5 seconds. The integral bell is to be tested with the pipe. Randomly selected samples shall be tested in accordance with ASTM D1599 to withstand, without failure, pressures listed below when applied in 60 to 70 seconds: DR-18, a minimum burst pressure of 775 PSI; DR-14, a minimum burst pressure of 985 psi.

**5.5.3 CONSTRUCTION:**

**5.5.3.1 INSTALLATION:** The trench bottom shall be stable, smooth and free of frozen material, clodded dirt, and stones over 3/4 inch in diameter. Bell holes should be provided at each joint for easier assembly and uniform support. Large rocks must be removed to provide 6 inches clearance in all directions from pipe and accessories. The pipe shall be installed with proper bedding providing uniform support under the pipe. Backfill materials shall be worked under the pipe to provide adequate haunching. Initial backfill material should be placed to a minimum of 12 inches over the pipe. All pipe embedment material shall be selected and placed carefully, avoiding stones over 3/4-inch, frozen lumps, and debris.

**5.5.3.2 UNDERGROUND WARNING TAPE AND LOCATION WIRE:** See 5.3.3.11.

**5.5.3.3 GRAVEL FOUNDATION FOR PIPE:** See also 5.1.3.6. Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.



**5.5.4 MEASUREMENT AND PAYMENT** Section 1.4.9 takes precedence over the following if there is a discrepancy between the two sections.

**PVC AWWA C-900 WATER PIPE:** PVC pipe measurement shall be per lineal foot installed piping of the type, size and class shown on the drawings and in the bidding schedule (payment shall be made as part of another Bid Item if PVC pipe is not specifically included as a bid item). Measurement shall be along the centerline of the pipe as measured in the field following construction. No deduct in length for payment will be made for valve & fittings.

Payment will be made per Bid Item only after the surface restoration, including, but not limited to, gravel and asphalt restoration, has been completed and accepted.

Payment to install pipelines shall be at the unit price in the Bid Schedule. Payment shall be full compensation for mobilization, cutting asphalt pavement; unclassified excavation; imported material for pipe bedding; trench backfill, location tape; tracer wire, storing and installing the pipe, fittings, elbows and couplings not specifically identified as a separate bid item; removal and disposal of excess or rejected excavated materials; compaction; thrust blocks; pressure testing; disinfecting, dechlorination, flushing and other materials, equipment and labor related to placing the line into service. Payment shall also include compensation for restoration of miscellaneous improvements damaged during construction.

End of Section

## SECTION 5.6 - DUCTILE IRON PIPE

**5.6.1 DESCRIPTION:** This section covers the requirements for ductile iron pressure pipe materials, installation and inspection.

### **5.6.2 MATERIALS:**

**5.6.2.1 DUCTILE IRON PIPE:** Ductile iron pipe shall conform to all requirements of AWWA C-151 and ANSI A-21.51 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, For Water or Other Liquids." Minimum pressure class shall be 250 PSI.

### **5.6.2.2 JOINTS:**

- **MECHANICAL JOINTS:** All mechanical joints shall meet requirements of ANSI A-21.6 and ANSI 21.11. All gaskets surfaces shall be smooth and free from imperfections. All mechanical joint gaskets shall be less than one year old. Bolts shall meet all requirements of the above specifications, honoring all characteristics, tolerances, and tests. All bolts shall be of the proper size and length to match the size of pipe fitting as per drawings.
- **PUSH-ON JOINTS:** Push-on joints shall be used for main line ductile iron pipe for this project. All push-on joints shall meet the requirements of ANSI 21.11. Gaskets shall be free from defects and not over one year old. Lubricants shall be non-toxic and have no deteriorating effects on gasket materials. It shall not impart taste, odor or flavor to water in a pipe.
- **FLANGED JOINTS:** Flanged joints shall be bolted firmly with machine, stud or cap bolts of proper size. Flanges may be cast integrally with the pipe or may be screwed or threaded pipe. Flanges shall be faced and drilled and of proper dimensions and class, for size and pressure required. All flanges shall meet requirements of ANSI A 21.10, "American National Standard for Ductile Iron and Gray Iron Fittings."

Bolts and nuts, unless otherwise specified, shall be meet the requirements of 5.3.2.16. Bolts will be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the diameter required for each flange and, when installed, shall be of length so that no more than 3/8 inch or less than 1/8 inch extends past face of nut. Gaskets shall be 1/16 inch thick, made of best quality sheet gasket material or equal and be certified to meet the requirements of NSF Standard 61. A gasket for each flange joint of proper size, ring type or full face shall be installed.

- **COMPRESSION JOINTS:** Compression joints shall be mechanical joint cast iron sleeve with armor guard gaskets, Rockwell 441 or Flange adaptor Rockwell Type 900 or approved equal, as specified on approved drawings.

### **5.6.2.3 FITTINGS:**

- **MECHANICAL JOINT FITTINGS:** Mechanical Joint Fittings shall conform to ANSI A 21.10, "American National Standard for Ductile Iron and Gray Iron Fittings."

- **PUSH-ON FITTINGS:** Push-on fittings shall conform to ANSI A 21.10 with bells, sockets, and plain ends per ANSI A 21.11.
- **FLANGED FITTINGS:** Flanged fittings shall conform to ANSI 21.10.

All flanges shall be faced and drilled. Where cap screws or stud bolts are needed, flanges shall be tapped to support cap screws or stud bolts as per approved drawings.

**5.6.2.4 CEMENT MORTAR LINING:** Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the "American National Standard for Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water" (ANSI A21.4 AWWA C104).

**5.6.2.5 ASPHALTIC COATING:** Ductile iron pipe shall be supplied with an exterior asphaltic coating approximately 1 mil thick per applicable AWWA standards for ductile iron pipe and fittings, EXCEPT THAT all pipe and fittings installed above grade or in pipe galleries shall be supplied without an asphaltic coating or otherwise prepared for a primer and 2 coats of durable epoxy coating.

**5.6.2.6 INTERIOR PIPING COATING:** All interior piping shall be prepared for and coated with a suitable primer and at least 2 coats of liquid epoxy to a DFT of at least 10 mil. TNEMEC N140 or equal. Color as determined by Owner.

**5.6.2.7 COATING OF PIPES INSIDE STORAGE TANKS:** Pipe inside storage tanks shall NOT have a coal tar coating on the exterior, but shall be externally coated with a two-part epoxy at least 12 mil DFT, meeting the requirements of NSF Standard 61. TNEMEC N140 or equal. Interior lining shall be the same as specified in 5.6.2.4 above.

### **5.6.3 CONSTRUCTION:**

**5.6.3.1 INSTALLATION:** Ductile iron pipe shall be installed in accordance with the "Installation of Ductile Iron Mains and Their Appurtenances" (ANSI/AWWA C600).

Tees, elbows, crosses, and reducers shall be used for changes in direction and outlets, unless otherwise specified on the drawings.

Anchors, thrust bolts, thrust blocks and mechanical joint restraints shall be placed at valves, elbows, tees, etc., as shown on the approved drawings or as directed by the ENGINEER.

All ductile iron pipe installation shall proceed on a stable foundation, with joints closely and accurately fitted. Joints shall be clean and dry, and a non-toxic joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint and gasket surfaces to facilitate easy, positive joint closure.

All pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells and fittings.

Bedding material shall be compacted around the pipe to firmly bed the pipe in position. If adjustment of position of a pipe length is required after being laid, it shall be removed and

rejoined as for new pipe installation. In addition to the above requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.

Each pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to the flow line. All joint offsets shall be made as specified in AWWA Standard for "Installation of Water Mains", C600. As work progresses, the interior of the pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing as set, and pipe shall not be laid when conditions of the trench or weather is unsuitable for such work. At all times when work is in progress, all open ends of the pipe and fittings shall be securely closed to the satisfaction of the ENGINEER, so that no water, earth, or other substance will enter the pipe or fittings.

**5.6.3.2 UNDERGROUND WARNING TAPE AND LOCATION WIRE:** See 5.3.3.11.

**5.6.3.3 PIPE FOUNDATION AND BEDDING MATERIAL INSTALLATION:** See 5.1.3.6.

**5.6.3.4 CLEANING AND FLUSHING:** Refer to Section 5.4, "Disinfection and Testing of Water lines".

**5.6.4 MEASUREMENT AND PAYMENT:** Section 1.4.9 takes precedence over the following if there is a discrepancy between the two sections.

Ductile iron pipe measurement shall be per lineal foot installed piping of the type, size and class shown on the drawings and in the bidding schedule. Measurement shall be along the centerline of the pipe as measured in the field following construction. No deduct in length for payment will be made for valve fittings, manholes or structures.

Payment will be made per Bid Item only after the surface restoration, including gravel and asphalt restoration, has been completed and accepted.

Payment to install pipelines shall be at the unit price in the Bid Schedule. Payment shall be full compensation for mobilization, traffic control signs, devices and flag persons; cutting asphalt pavement; unclassified excavation; imported material for pipe bedding; trench backfill; location tape; storing and installing the pipe, fittings, elbows and couplings; removal and disposal of excess or rejected excavated materials; compaction; thrust blocks; pressure testing; and disinfecting, flushing and placing the line into service. Payment shall also include compensation for restoration of miscellaneous improvements damaged during construction.

No classification of excavated materials shall be made other than solid rock requiring blasting (refer to Section 5.2, "Pipeline Trench Excavation and Backfill"). Excavation shall include the removal and subsequent handling of all water, earth, shale, loose or cemented gravel, loose rock, and other materials of whatsoever nature excavated or otherwise removed in the performance of contract work.

End of Section

**SECTION 5.7**  
**AWWA C-906 FUSED HDPE PIPING FOR POTABLE WATER**

**5.7.1 General Terms and Conditions**

- 5.7.1.1 Scope.** This specification covers requirements for PE 4710 high-density polyethylene piping for potable water distribution and transmission mains. All work shall be performed in accordance with these specifications.
- 5.7.1.2 Engineered and Approved Plans.** Potable water distribution and transmission main construction shall be performed in accordance with engineered construction plans for the work prepared under the direction of a Professional Engineer.
- 5.7.1.3 Referenced Standards.** Where all or part of a Federal, ASTM, ANSI, AWWA, etc., standard specification is incorporated by reference in these Specifications, the reference standard shall be the latest edition and revision.
- 5.7.1.4 Licenses and Permits.** A licensed and bonded Contractor shall perform all potable water distribution and transmission main construction work. The Contractor shall secure all necessary permits before commencing construction.
- 5.7.1.5 Inspections.** All work shall be inspected by an Authorized Representative of the Owner who shall have the authority to halt construction if, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, the Project Engineer or his Authorized Representative, shall, by written notice, order further construction to cease until all deficiencies are corrected. A copy of the order shall be filed with the Contractor's license application for future review. If the deficiencies are not corrected, performance shall be required of the Contractor's surety.
- 5.7.1.6 Submittals.** Pipe specifications, stamping description, manufacturer's recommended joining procedures and certification of fusing technicians by pipe manufacturer as having fused, or been trained to fuse, pipe of the size specified within the 6 months preceding the commencement of work under this contract.

**5.7.2 Polyethylene Pipe and Fittings**

- 5.7.2.1 Qualification of Manufacturers.** The Manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Owner or his Authorized Representative. The ENGINEER shall approve qualified Manufacturers.
- 5.7.2.2 Materials.** Black PE materials used for the manufacture of polyethylene pipe and fittings shall be PE 3408 or 4710 high density polyethylene meeting ASTM D 3350 cell classification 345464C or 445574C, respectively, and shall be listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at 73°F. Color material, when used, shall be the same except for meeting ASTM D 3350 cell classification 345464E. The material shall be listed and approved for potable water in accordance with NSF Standard 61. When requested on

the order, the Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

- 5.7.2.3 Interchangeability of Pipe and Fittings.** The same Qualified and Approved Manufacturer shall produce polyethylene pipe and fittings. Products such as fittings or flange adapters made by sub-contractors or distributors are prohibited.
- 5.7.2.4 Polyethylene Pipe.** Polyethylene pipe shall be manufactured in accordance with AWWA C901-96 for sizes 1-1/4" thru 3" IPS diameters and to the requirements of ASTM D3035. Pipe 4" IPS and DIPS sizes 4" and above shall be manufactured to the requirements of ASTM F714 and AWWA C906-99.
- 5.7.2.5 Optional Service Identification Stripes for IPS Sized Pipe.** IPS pipes shall be black. When requested as an option, IPS pipes shall have four, equally spaced, blue color stripes co-extruded into the pipe outside surface. Stripes printed on the pipe outside surface shall not be acceptable.
- 5.7.2.6 Service Identification Stripes for DIPS Sized Pipe.** DIPS sized pipes shall have three equally spaced pairs of longitudinal blue color stripes co-extruded into the pipe outside surface. Stripes printed on the outside surface shall not be acceptable.
- 5.7.2.7 Optional Color Shell.** When requested as an option, a blue color shell co-extruded into the pipe outer surface shall permanently identify IPS or DIPS pipes.
- 5.7.2.8 Polyethylene Fittings & Custom Fabrications.** Polyethylene fittings and custom fabrications shall be molded or fabricated by the Approved Pipe Manufacturer. All fittings and custom fabrications shall be pressure rated for the same internal pressure rating as the mating pipe.
- 5.7.2.9 Molded Fittings.** Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.
- 5.7.2.9.1 X-Ray Inspection.** The Manufacturer shall submit samples from each molded fittings production lot to x-ray inspection.
- 5.7.2.10 Fabricated Fittings.** Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.
- 5.7.2.11 Polyethylene Flange Adapters.** Flange adapters shall be made with sufficient throughbore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.
- 5.7.2.12 Back-up Rings & Flange Bolts.** Flange adapters shall be fitted with back-up rings that are pressure rated equal to or greater than the mating pipe. The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 3 or higher.

**5.7.2.13 MJ Adapters.** MJ Adapters 4" thru 16" may be provided with optional Stainless Steel Stiffener upon request. MJ Adapters 14" and above shall be provided with Heavy Duty Back-up Ring Kits. All MJ adapters 18" and above must be provided with Stainless Steel stiffeners.

**5.7.2.14 Compliance Tests.** Manufacturer's inspection and testing of the materials. In case of conflict with Manufacturer's certifications, the Contractor, Project Engineer, or Owner may request retesting by the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the requestor's expense, and shall be performed in accordance with these Specifications.

### **5.7.3 Joining**

**5.7.3.1 Heat Fusion Joining.** Joints between plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle fusion procedures used shall be procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 6 months before commencing construction. External and internal beads shall not be removed.

**5.7.3.1.1 Butt Fusion of Unlike Wall Thickness.** Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR, for example, SDR 13.5 to SDR 17, or SDR 11 to SDR 13.5. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple (a short length of the heavier wall pipe with one end machined to the lighter wall) or by mechanical means or electrofusion. SDR's for polyethylene pipe are 7.3, 9, 11, 13.5, 17, 21, 26, 32.5 and 41.

**5.7.3.1.2 Heat Fusion Training Assistance.** Upon request and at the requestor's expense, training personnel from the Manufacturer or his Representative shall be made available.

**5.7.3.2 Joining by Other Means.** Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.

**5.7.3.2.1 ID Stiffener and Restraint.** A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ Adapter is used.

**5.7.3.3 Branch Connections.** Branch connections to the main shall be made with saddle fittings or tees. Polyethylene saddle fittings shall be saddle fused to the main pipe per 3.1.



#### **5.7.4 Installation**

**5.7.4.1 General.** When delivered, a receiving inspection shall be performed and any shipping damage shall be reported to the manufacturer within 7 days. Installation shall be in accordance with ASTM D 2774, Manufacturer's recommendations and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with all applicable safety codes and standards.

**5.7.4.2 Excavation.** Trench excavations shall conform to the plans and drawings, as authorized in writing by the Project Engineer or his Approved Representative and in accordance with all applicable codes. The Contractor shall remove excess groundwater. Where necessary, trench walls shall be shored or reinforced, and all necessary precautions shall be taken to ensure a safe working environment.

**5.7.4.3 Large Diameter Fabricated Fittings.** Not more than one plain-end connection of 16" IPS and larger fabricated directional fittings (elbows, tees, etc.) shall be butt fused to the end of a pipe length before placing the assembly into the trench. The remaining fitting connections shall be made in the trench using butt fusion, flange or other connection means in accordance with 3.2. Flange and other mechanical connections shall be assembled, and tightened in accordance with the connection manufacturer's instructions and 4.4. Handling, lifting, moving or lowering a 16" IPS or larger fabricated fitting that is connected to more than one pipe length is prohibited. The installing contractor at his expense shall correct fitting damage caused by such improper handling.

**5.7.4.4 Mechanical Joint & Flange Installation.** Mechanical joint and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. Primed ductile iron backup rings shall be furnished and installed at all connections permitting such. MJ Adapters and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least 1 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be as recommended by the Manufacturer. Bolts, nuts and washers shall be stainless steel and shall be liberally coated with a rubberized undercoating prior to placing backfill.

**5.7.4.5 Foundation & Bedding.** See Section 5.1, PIPELINE TRENCH EXCAVATION AND BACKFILL.

**5.7.4.6 Pipe Handling.** When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings. Wire rope and chain are prohibited. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or damaged equipment shall not be used.

**5.7.4.7 Backfilling.** See Section 5.1, PIPELINE TRENCH EXCAVATION AND BACKFILL. During embedment placement and compaction, care shall be taken to ensure that the haunch areas below the pipe springline are completely filled and free of voids.

**5.7.4.8 Protection against shear and bending loads.** In accordance with ASTM D 2774, connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.

**5.7.4.9 Final Backfilling.** See Section 5.1, PIPELINE TRENCH EXCAVATION AND BACKFILL.

#### **5.7.5 Testing.**

**5.7.5.1 Fusion Quality.** The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

**5.7.5.2 Hydrostatic Leak Testing.** This hydrostatic leak test procedure consists of filling, an initial expansion phase, a test phase, and depressurizing. There are two alternatives for the test phase. Leak testing shall be observed by the OWNER or ENGINEER.

**5.7.5.2.1 Filling.** Fill the restrained test section completely with water.

*WARNING – Ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.*

**5.7.5.2.2 Initial Expansion Phase.** Gradually pressurize the test section to test pressure, and maintain test pressure for three (3) hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

**5.7.5.2.3 Test Phase – Alternate 1.** Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test liquid. If test pressure remains steady (within 5% of the target value) for one (1) hour, no leakage is indicated.

**5.7.5.2.4 Test Phase – Alternate 2.** This alternative is applicable when the test pressure is 150% of the system design pressure.

Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test pressure for one (1), or two (2), or three (3) hours. If the amount of make-up water needed to maintain test pressure does not exceed the amount given below, no leakage is indicated.

<i>Make-Up Water Allowance for Test Phase – Alternate 2, (U.S. Gal/100 ft of pipe)</i>			
<i>Nominal Pipe size (in.)</i>	<i>1-Hour Test</i>	<i>2-Hour Test</i>	<i>3-Hour Test</i>
8	0.50	1.00	1.50
10	0.75	1.30	2.10
12	1.10	2.30	3.40
14	1.40	2.80	4.20
16	1.70	3.30	5.00
18	2.20	4.30	6.50
20	2.80	5.50	8.00

End of Section

**SECTION 5.8**  
**PORTLAND CEMENT CONCRETE**

**5.8.1 DESCRIPTION:** This section of the specifications defines materials to be used in all portland cement concrete work and requirements for mixing, placing, finishing, and curing.

**5.8.2 MATERIALS:** Materials used in portland cement concrete and reinforcing of portland cement concrete shall meet the following requirements:

**5.8.2.1 CEMENT:** Portland cement shall be Type II or as approved by the Engineer and shall comply with the Standard Specification for Portland Cement, ASTM C-150. POZZOLANS, FLY ASH AND/OR SILICA FUME SHALL NOT BE USED.

**5.8.2.2 AGGREGATES:** Concrete aggregates shall conform to Tentative Specifications for Concrete Aggregates, ASTM C-33.

**5.8.2.3 WATER:** Water used in mixing concrete shall be clean and free from oil, acid, salt, injurious amounts of alkali, organic matter or other deleterious substances.

**5.8.2.4 ENTRAINING AGENT:** An air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM Designation C-175 and C-260.

**5.8.2.5 ADMIXTURES:** No admixtures unless approved by the Engineer. Calcium chloride shall not be used in reinforced concrete.

**5.8.2.6 FLY ASH:** No fly ash shall be added without mix design approved by the Engineer.

**5.8.2.7 REINFORCED STEEL:** All bar material used for reinforcement of concrete shall be intermediate grade steel free of rust conforming to the requirements of ASTM Designation A-615 GR-60 and shall be deformed in accordance with ASTM Designation A-305.

**5.8.2.8 WELDED WIRE FABRIC:** Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM A-185.

**5.8.3 CONSTRUCTION:** For the purpose of practical identification, concrete has been divided into three classes: Class A, B, and C. Basic requirements and use for each class are defined as follows:

Class	Minimum Cement Comp. (sacks/c.y.)	Minimum 28-day Strength (psi)	Primary Use
A	6	4000	Reinforced Structural Concrete
B	6	3500	Sidewalks, curbs, and gutters, cross gutters, pavements, and non-reinforced footings and foundations
C	5	2500	Thrust blocks, anchors, mass concrete

Note: Above specifications contain 94 pound sacks of Portland Cement.

All concrete shall also comply with the following requirements.

**AGGREGATES:** The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms within which the concrete is to be cast, nor larger than three-fourths of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For non-reinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth the slab thickness.

**WATER:** Sufficient water shall be added to the mix to produce concrete with the minimum practicable slump. The slump of mechanically vibrated concrete shall not exceed four inches. **NO** concrete shall be placed with a slump in excess of five inches. The maximum permissible water-cement ratio (including free moisture on aggregates) shall be 5 and 5-3/4 gallons per bag of cement respectively for Class A and B air entrained concrete.

**AIR-ENTRAINING:** Air content for air-entrained concrete shall comply with the following:

Course Aggregate Size (in.)	Air Content %
1-1/2 to 2-1/2	5 ± 1
3/4 or 1	6 ± 1
3/8 or 1/2	7 ± 1

The air-entraining agent shall be added as liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

**5.8.3.1 FORMS:** Forms shall be substantially built and adequately braced so as to withstand the liquid weight of concrete. All linings, studding, walling and bracing shall be such as to prevent bulging, spreading, or loss of true alignment while pouring and displacement of concrete while setting. Metal forms shall be used for sidewalk work unless otherwise specified by the Engineer. All edge forms for sidewalk pavements, curbs, and gutters shall be of sufficient rigidity and adequately braced to accurately maintain line and grade. Prior to concrete placement, all forms shall be lightly coated with oil to prevent concrete adhesion to form materials.

Exposed vertical and horizontal edges of the concrete in structures shall be chamfered by the placing of molding in the forms or as directed by the Engineer and as indicated in the plans.

FORM STRIPPING: Forms shall remain in-place for at least the following time periods after completion of a concrete pour in a given section of forms:

Walls and columns:	24 hours
Roof deck:	10 days

**5.8.3.2 JOINTS:** Joints shall be provided for sidewalk and curb and gutter as follows:

**SIDEWALKS:** Shall have scribed joints at intervals of 4 feet which joints shall be approximately 3/16" wide and be approximately 1/4 of the total slab thickness. In addition, 1/2-inch expansion joints shall be provided at 50-foot intervals and at locations where sidewalks adjoin curbs or existing sidewalks, driveways, building walls or aprons. Expansion joints shall be provided at 4-foot intervals where manholes, valve boxes or meter boxes are located.

**5.8.3.3 REINFORCEMENT AND EMBEDDED ITEMS:** Reinforcing steel shall be clean and free from rust, scale, paint, grease or other foreign matter which might impair the bond. It shall be accurately bent and shall be tied to prevent displacement when concrete is poured. Reinforcing steel shall be held in place by only metal or concrete ties, braces and supports. No steel shall extend from or be visible on any finished surface and shall have a minimum of 1 1/2" concrete cover. Bars shall be grade 60.

The Contractor shall use concrete chairs for holding the steel away from the subgrade, and spreader or other type bars for securing the steel in place. The spreader bars shall be not less than 3/8-inch in diameter.

**5.8.3.4 PREPARATIONS:** Before batching and placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be thoroughly wetted or oiled, and masonry filler units that will be in contact with concrete shall be well drenched and the reinforcements shall be thoroughly cleaned of ice or other coatings. Water shall be removed from spaces to receive concrete. When placing concrete on earth surfaces, the surfaces shall be free from frost, ice, mud, and water. When the subgrade surface is dry soil or pervious material, it shall be sprayed with water immediately before placing of concrete or shall be covered with waterproof sheathing paper or a plastic membrane. No concrete shall be placed until the surfaces have been inspected and approved by the Engineer or Inspector.

COMPACTION: All subgrade and backfill materials shall be compacted in accordance with Section 5.1.3.10.

**5.8.3.5 CONCRETE MIXING:** All concrete shall be ready-mixed and delivered in accordance with ASTM C-94. The concrete shall be mixed until there is a uniform distribution of the materials. Sufficient water shall be used in mixing concrete to produce a mixture which will flatten and quake when deposited in place, but not enough to cause it to flow. Sufficient water shall be used in concrete in which reinforcement is to be embedded, to produce a mixture which will flow sluggishly when worked and which, at the same time, can be conveyed from the mixer to the forms without segregation of aggregate. In no case shall the quantity of water used be

sufficient to cause the collection of a surplus in the forms or exceed the maximum allowable slump as specified in 5.8.3.

**5.8.3.6 DEPOSITING:** Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. The concrete placing shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the corners of forms and reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work, nor shall retempered concrete be used. No concrete shall be dropped more than 3 feet. Concrete delivered to the job site having a temperature that exceeds 90 degrees Fahrenheit shall not be placed. Concrete cooling methods during hot weather will be approved by the Engineer.

All concrete in structures shall be vibrator compacted during the operation of placing, and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms.

**CONSTRUCTION JOINTS:** All construction joints shall be located and prepared as shown on the drawings or otherwise approved in writing by the Engineer. Unanticipated cold joints may be cause for rejection of the entire poured section in which the cold joint is located, at the sole discretion of the Engineer, in consultation with others. Rejected sections shall be demolished and re-poured by the Contractor as specified at no additional cost to the Owner.

**5.8.3.7 PLACING CONCRETE IN COLD WEATHER:** No concrete shall be poured where the air temperature is lower than 40 degrees Fahrenheit, at a location where the concrete cannot be covered or protected from the surrounding air. Where concrete is poured below a temperature of 35 degrees Fahrenheit the ingredients of the concrete shall be heated so that the temperature of the mixture shall not be less than 50 degrees or more than 100 degrees Fahrenheit. Before mixing, the heated aggregates shall not exceed 125 degrees Fahrenheit and the temperature of the heated water shall not exceed 175 degrees Fahrenheit. Cement shall not be added while the temperature of the mixed aggregates and water is greater than 100 degrees Fahrenheit. When there is likelihood of freezing during the curing period, the concrete shall be protected by means of an insulating covering and/or heating the concrete for a period of not less than 7 days after placing. The temperature must be maintained at a minimum of 40 degrees Fahrenheit. Concrete shall not be placed on frozen soil. Equipment for protecting concrete from freezing shall be available at the job site prior to placing concrete. Particular care shall be exercised to protect edges and exposed corners from freezing. In the event heating is employed, care shall be taken to insure that no part of the concrete becomes dried out or is heated to temperatures above 90 degrees Fahrenheit. The housing, covering, or other protection used shall remain in place and intact at least 24 hours after the artificial heating is discontinued. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases that contain carbon dioxide.

#### **5.8.3.8 FINISHING:**

**FORMED SURFACE FINISHES** - Provide the following finishes unless indicated or shown otherwise on the drawings.

**ROUGH FORM FINISH** - Applies to all surfaces not exposed to view such as surfaces in contact with earth backfill. Repair defects and patch tie holes. Remove fins exceeding 1/4 inch in height. Otherwise leave surfaces with the texture imparted by the forms.

**SMOOTH FORM FINISH** - Applies to all exposed surfaces and interior surfaces of vaults and pits. Use form facing material to produce a smooth, hard, uniform surface. Support with backing capable of preventing specified deflection. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface. Keep the number of seams to a minimum. Repair and patch all tie holes and defects. Remove all fins.

**GROUT CLEANED FINISH** - Smooth rubbed finish shall be produced by “brush-off” sandblasting or grinding with a stone wheel or grinder on all exposed wall surfaces prior to filling holes to expose all holes near the surface of the concrete. The wall surface shall then be rubbed with a mortar consisting of one part portland cement and 1-1/2 parts of fine sand passing the 100 screen with enough water and an emulsified bonding agent to have the consistency of thick creme. The wall surface shall be thoroughly wetted. Apply the grout by rubbing it over the entire area with clean burlap, sponge rubber floats, or trowels. Surface shall be wiped clean and most cured.

**SLAB FINISHES** - Unless specified or otherwise shown on the drawings, apply finishes to slabs as follows:

**FLOATED FINISH** - Use for surfaces to be trowel finished or to be broom finished. After the concrete has been placed, consolidated, struck off, and leveled, do not work further until water sheen has disappeared and the surface has been stiffened. When water sheen has disappeared and surface has stiffened, float with a hand float or with a bladed power trowel equipped with float shoes, or with a powered disc float. During or after the first floating, planeness of surface shall be checked with a 10-ft. straightedge applied at not less than two differed angles. Cut down all high spots and fill all low spots to produce a surface level tolerance of 1/4 inch in 10 feet throughout. Then refloat immediately to a uniform sandy texture.

**TROWELED FINISH** - Use for interior floors intended as walking surfaces. The surface shall first be float-finished as specified above. Next, power trowel followed by hand troweling. The first troweling after power floating shall produce smooth surface which is free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened. Accomplish final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by the hand troweling until the finished surface is free of trowel marks, uniform in texture and appearance and level within a tolerance of 1/4 inch in 10 feet in all directions. On surfaces intended to support floor coverings, defects which show through the floor covering shall be removed by grinding.

**BROOM OR BELT FINISH** - Use for exterior horizontal walks and slabs. Immediately after the concrete has received a float finish as specified above, provide a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

**5.8.3.9 CURING AND PROTECTION:** As soon as the concrete has hardened sufficiently to prevent damage, the finished surface shall be protected for curing one of the following ways:

Application of a curing compound, conforming to “Specifications for Liquid Membrane-Forming Compounds for Curing Concrete” ASTM C-309. The compound shall be light in color and shall be applied in accordance with the manufacturers recommendations immediately after any water sheen, which may develop after finishing has disappeared from the concrete surface.



Ponding of water on the surface or continuous sprinkling. Application of light colored waterproof plastic materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" ASTM C-171, placed and maintained in contact with the surface of the concrete. The freshly finished surface shall be protected from hot sun and drying winds until it can be sprinkled or covered as above specified. The concrete surface must not be damaged or pitted by rain. The contractor shall provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours.

The Contractor shall erect and maintain suitable barriers to protect the finished surface. Any section damaged from traffic or other causes occurring prior to its official acceptance, shall be repaired or replaced by the Contractor at his own expense in accordance with these specifications.

Defective concrete conditions or surfaces shall be removed, replaced, or repaired, without further cost to the OWNER, in accordance with these specifications.

**5.8.3.10 CONCRETE TESTING:** The Engineer may order the taking of concrete test cylinders to check the required compressive strengths. If taken, samples will be made in accordance with ASTM C172 and tested as follows:

- a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
- b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 50 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
- c. Temperature: Concrete and air temperatures shall be measured and recorded with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.

#### EVALUATION AND ACCEPTANCE OF CONCRETE

- a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete, nor less than once for each 3000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.
- b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall

be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another specified test age.

- c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.
- d. Unless noted otherwise, make a minimum of four (4) concrete cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders that must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.

In-place concrete may be cored for testing. Cost of all laboratory testing shall be the responsibility of the Owner. Any retesting required because of test failures shall be the responsibility of the Contractor. All concrete delivered to the job site shall be accompanied by a ticket specifying: bag mix, air content, etc. Said ticket shall be given to the Engineer's Inspector who may field check slump and air entrainment compliance.

**5.8.3.11 Miscellaneous:** All other items, including, but not limited to, waterstops and joint sealant, shall be as shown on the Drawings.

**End of Section**

## **SECTION 5.9 EARTHWORK**

**5.9.1 DESCRIPTION:** Extent of earthwork is indicated on drawings. Preparation of bedding of pipe and trenching is included in Section 5.1 "Trench Excavation and Backfill".

"Excavation" consists of removal of material encountered to subgrade elevations indicated and subsequent relocation of materials removed. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction. "Embankment" includes compacted backfill in specified lifts and densities.

A copy of the geotechnical report prepared for this project as appended to this specification book for the information of the CONTRACTOR.

### **5.9.2 MATERIALS:**

**5.9.2.1 SATISFACTORY MATERIALS:** Materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW and SP.

**5.9.2.2 UNSATISFACTORY SOIL MATERIALS:** Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classifications groups GC, SC, ML, CL, CH, OL, OH and PT.

**5.9.2.3 STRUCTURAL FILL:** Structural fill for sub-grade shall be a well-graded material, either natural or crushed, free from vegetable material and lumps or balls of clay. The 3-inch minus structural fill shall consist of well-graded sandy gravels and 5% to 15% fines (materials passing a No. 200 sieve) by weight.

The plasticity index of the fines shall not exceed 15 and the liquid limit shall not exceed 35. Clean gravel ranging from pea gravel to 6 inches with less than 5% fines and sand combined may alternatively be used as structural fill. All fill soils shall be free of topsoil, highly organic material, frozen and other deleterious materials.

**5.9.2.4 BACKFILL AND FILL MATERIALS:** Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

**5.9.2.5 COMPACTION TESTING:** Owner may employ at Owners Expense, testing laboratory to perform soil testing and inspection service for quality control testing during earthwork operations.

**5.9.2.6 SITE CONDITIONS:** Data on indicated subsurface conditioned at the end of this section are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor. Contractor may make additional test borings and other exploratory operations at no cost to Owner.

**5.9.3 CONSTRUCTION:** Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Engineer, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site any and all existing underground utilities identified for removal. Coordinate with utility companies for shut-off of services if lines are active.

**5.9.3.1 EXPLOSIVES:** The use of explosives is not permitted without written approval of ENGINEER and OWNER and any and all Authorities Having Jurisdiction over the use of explosives.

Procedures and liabilities as outlined in Section 5.1.3.3, Solid Rock Excavation And Blasting, shall be followed if the use of explosives is necessary.

**5.9.3.2 PROTECTIONS OF PERSONS AND PROPERTY:** Barricade open excavations occurring as part of this work. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

**5.9.3.3 EXCAVATION CLASSIFICATIONS:** The following classifications of excavation will be made when rock excavation is encountered in work:

Earth Excavation - Includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

Rock Excavation in Trenches and Pits - Includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, 42 inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90 HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10' - 0" in width and pits in excess of 30' - 0" in length or width are classified as open excavation.

Rock Excavation in Open Excavations - Includes removal and disposal of materials and obstructions encountered, which cannot be dislodged and excavated with modern track-mounted heavy-duty excavation equipment without drilling, blasting or ripping.

Typical of materials classified as rock are boulders 1/2 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Engineer. Such excavation will be paid on basis of contract conditions relative to changes in work.

Rock Payment Lines are limited to the following:

Two feet outside of concrete work for which forms are required, except footings. One foot outside perimeter of footings. In pipe trenches, 6 inches below invert elevation of pipe and 2 feet wider than inside diameter of pipe, but not less than 3 feet minimum trench width. Neat outside dimensions of concrete work where no forms are required. Under slabs on grade, 6 inches below bottom of concrete slab.

Unauthorized Excavation - Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.

Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

Additional Excavation: When excavation has reached required subgrade elevations, notify Engineer who will make an inspection of conditions.

If unsuitable bearing materials are encountered at required subgrade elevation, carry excavations deeper and replace excavated material as directed by Engineer. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

**5.9.3.4 STABILITY OF EXCAVATIONS:** Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

**5.9.3.5 SHORING AND BRACING:** Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

**5.9.3.6 DEWATERING:** Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

**5.9.3.7 MATERIAL STORAGE** Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain. Dispose of excess soil material and waste materials as herein specified.

**5.9.3.8 COLD WEATHER PROTECTION:** Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F. (1°C).

**5.9.3.9 COMPACTION:** Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

Structural Fill and Sub-Ballast: Compact top 8 inches of subgrade and each layer of structural fill material or sub-ballast at 95% maximum modified proctor density (ASTM D 1557). Maximum compacted thickness of any one lift shall not exceed 6-inches.

Sub-Grade: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum modified proctor density (ASTM D 1557).

Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Apply water in manner to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

**5.9.3.10 BACKFILL AND FILL:** Place acceptable soil material in layers not exceeding 8 inches (uncompacted depth) and compact each layer prior to placement of next layer to required subgrade elevations, for each area classification listed below.

Sub-ballast, use structural fill material, or satisfactory excavated or borrow material, or combination of both.

Under Ballast, use sub-ballast material.

Backfill excavations as promptly as work permits, but not until completion of the following:

Acceptances of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

Inspection, testing, approval, and recording locations of underground utilities.

**5.9.3.11 GROUND SURFACE PREPARATION:** Remove vegetation, debris, unsatisfactory materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

**5.9.3.12 PLACEMENT AND COMPACTION:** Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

**5.9.3.13 GRADING:** Uniformly grade areas within limits of grading under this section including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

Finish surfaces free from irregular surface changes, and as follows:

Ballast and Sub-Ballast: Shape surface of areas under Ballast and Sub-Ballast to line, grade and cross-section, with finish surface not more than 2 inches above or below required subgrade elevation.

Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum dry or relative density for each area classification.

**5.9.3.14 MAINTENANCE:**

Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

Reconditioning Compacted Areas: Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

#### **5.9.3.15 DISPOSAL OF EXCESS AND WASTE MATERIALS**

Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Engineer.

Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property, in a legal manner.

End of Section