

CONSTRUCTION SPECIFICATIONS

Section 1

EARTHWORK

1. General Description. Excavation for street pavement and/or curb and gutter shall consist of the removal of all materials within the lines, grades and slopes shown on the plans or established by the City Engineer, including all earth, stone, loose rock, sand clay, shale, hard-pan, boulders, solid rock, stone blocks, roots, brush, trees, rubbish and all other materials of whatever nature that may be encountered within the lines, grades and slopes above described or that may be required in grading approaches to intersecting streets and alleys or in providing ditches at the ends of pipes, waterways and flumes.
2. Compaction Control and Testing. Maximum density, as used in these Specifications, shall be defined as the maximum density obtained in the laboratory by ASTM D 1557. In-place density test procedures shall be in accordance with ASTM D 2922 and ASTM D 3017.

It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control his operations by confirmation tests to verify and confirm that he has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

The frequency of Contractor's confirmation tests shall be not less than as follows and each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade or as required by inspector.

(a) Trenches

- | | |
|---|----------------------------------|
| 1. Open fields | 2 every 1,000 linear feet |
| 2. Along dirt or gravel roads
or off traveled right-of-way | 2 every 500 linear feet |
| 3. Crossing paved roads | 2 locations along each crossing |
| 4. Under pavement cuts or within
2 feet of pavement edges | 1 location every 400 linear feet |

(b) Structural backfill 1 every 20 cubic yards

(c) Embankment or fill 1 every 200 cubic yards

(d) Base material 1 every 50 cubic yards

Confirmation tests shall be paid by the Contractor.

Copies of the test reports shall be submitted promptly to the inspector. The Contractor's tests shall be performed by a soils testing laboratory acceptable to the Inspector.

If compaction fails to meet the specified requirements, the Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the inspector. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by the Contractor. The Contractor's confirmation

tests shall be performed in a manner acceptable to the inspector. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.

3. Stripping. On all portions of the work, where filling is required, the entire area shall first be stripped of all undesirable materials, as designated by the Inspector. The resulting surface, after the removal of all undesirable material, shall be scarified to the extent designated by the Inspector and brought to a uniform surface by means of graders or other suitable equipment, and shall be completed as provided in these specifications, before any embankment material is placed.
4. Disposal of Excess Material. All excess or undesirable material that may be encountered in the work shall be disposed of by the contractor, in a manner approved by the Inspector, but it shall not be placed on other street or alleys without the Inspector's approval nor on private property without the approval of the owner, which approval shall be obtained by the contractor in writing.
5. Embankment. All excavated materials that have been approved by the Inspector for embankment purposes and that are needed for that purpose, shall be used at the points designated by the Inspector and in the following manner:
 - (a) The embankment shall be built by depositing approved material, in approximately level uniform layers, not exceeding six inches in thickness after compacting.
 - (b) The material in place at both ends of any embankment, or where net material is placed against material in place, shall be plowed into the new material as the work progresses and shall be thoroughly scarified and worked into the new material and brought to the proper elevation before rolling of the layer being placed is commenced.
 - (c) If the material as found in excavation is too wet, as determined by the Inspector, then it shall be permitted to dry out to the extent required before being used in the embankment; or the material may be placed to the proper thickness on the embankment and worked with satisfactory equipment until the quantity of moisture in the material has been reduced to that required for maximum compaction. If the material as found in excavation is too dry, as determined by the Inspector, then it shall be moistened to the extent required and worked with harrows or other suitable equipment until the moisture throughout the material is uniform and contains the proper percentage of moisture, as determined by the Inspector, for proper compaction.
 - (d) The embankment shall be built to the lines, grades, and slopes shown on the plans or established by the city engineer.
 - (e) All embankments shall be compacted to 95% of maximum density (AASHTO T-99 Test Procedure) unless otherwise specified by the City.
6. Excavation below Sub-Grade. If soft or otherwise undesirable material is found to exist at and below the sub-grade elevation, then such material shall be removed to the extent and in the manner designated by the Engineer.
7. Removal of, Building and/or Rebuilding of Existing Structures. Should it be found necessary to remove, build and/or rebuild existing pipelines, flumes, monuments, manholes and other structures, or to reset metal covers and frames, etc., then said work shall be done as shown on the approved plans.
8. Preparation of Sub-Grade. In excavating the required material, the work shall be so handled as to leave in place sufficient material above the finished subgrade elevation, to provide for compaction in building the sub-grade to the prescribed elevation.

After the materials have been excavated, as above described, then the sub-grade shall be scarified, after which the material shall be accurately graded to the required form of the finished sub-grade and rolled with approved rollers to compaction required. If additional moisture is required, in order to produce the compaction required, then the proper quantity shall be applied uniformly, either before or after scarifying. If necessary, the material shall be scarified after the water is applied, in order to obtain uniform distribution of moisture and bring the material to a suitable condition. All rocks, boulders, or other unsuitable material shall be removed. The quantity of material, and its distribution, before rolling, shall be such that when compacted the required form and elevation will be secured. All sub-grade shall be compacted to 95% of maximum density (AASHTO T-99 Test Procedure).

9. Completed Sub-Grade. The completed sub-grade shall accurately conform to the lines, grades and slopes shown on the plans or designated by the engineer and shall be maintained in satisfactory condition by the contractor. No driving or wheeling will be permitted on an unprotected sub-grade without the approval of the inspector.
10. Sub-Base. The depth of sub-base material shall be determined by soil exploration and load requirements. Such soil analysis shall be in accordance with acceptable engineering practices.

Section 2

SURFACING AND PAVING

1. General. This section covers the requirements for bituminous surface paving on roads. All streets shall be surfaced in accordance with the following:
 - (a) Sub-base as determined necessary upon analysis of soil characteristics and loads to be imposed on the pavement structure.
 - (b) 8-inch minimum crushed gravel base course over prepared sub-grade.
 - (c) 3-inch minimum compacted thickness plant mix asphalt surfacing on all streets.
2. Base Course. Base for all streets shall consist of hard, durable particles or fragments of stone or gravel, screened or crushed to the required size and grading. The material shall be free from balls of clay, alkali, adobe or other deleterious matter, and shall conform to the following gradation when tested in accordance with AASHTO T-27 or ASTM C 136 and AASHTO T-11 or ASTM C 117.

<u>Sieve Size</u>	<u>Percent Passing</u>
1 1/8 inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200 Sieve	3-12

The material shall be deposited and spread in a uniform layer at optimum moisture content, without segregation of size, with such depth that when compacted in layer will have the required thickness.

Each layer shall be compacted for the full width and depth by rolling with a pneumatic roller weighing at least 10 tons. Alternate blading and rolling will be required to provide a smooth even and uniformly compacted course true to cross section and grade. Places inaccessible to rolling shall be compacted with mechanically operated hand tampers.

The gravel base shall be compacted to not less than 95% maximum dry density as determined by AASHTO T-180. Surfaces shall be true to the established grade with thickness being not less than 1/4 inch from the required layer thickness and with the surface elevation varying not more than 3/8 inch in ten feet from the true profile and cross section.

3. Bituminous Prime Coat. The bituminous prime coat shall consist of an application of hot bituminous material on a previously prepared base course or other surface to be paved. Prior to the application of the prime coat, an inspection of the area to be coated will be made by the Inspector to determine its fitness to receive the bituminous priming material. That portion of the base course prepared for immediate treatment, if considered excessively dry, shall be lightly sprinkled with water immediately in advance of the application, to assure a uniform spread of the bituminous material.

Bituminous material used for the prime coat shall conform to the requirements for RC-250. RC-250 shall be applied at a temperature of 175 degrees F to 225 degrees F at a rate of 0.3 to 0.4 gallons per square yard by use of a bituminous distributor.

Immediately following the preparation of the base course, the bituminous material shall be applied by means of a bituminous distributor at the temperature previously specified. The priming material shall be so applied that uniform distribution is obtained at all points of the surface to be primed.

Following the application of prime material, the surface shall be allowed to dry for a period of not less than 48 hours without being disturbed, or for such additional period of time as may be necessary to attain penetration into the base course and drying out or evaporation of the volatiles from prime material. The Contractor shall furnish and spread sufficient acceptable sand on all areas which show an excess of bituminous material to effectively blot up and cure the excess.

The primed surface shall be maintained by the Contractor until the succeeding layer of pavement has been placed. During this interval, the Contractor shall protect the primed surface against damage and shall repair all broken spots.

The bituminous distributor shall be so designed and equipped as to distribute the bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rate with pressure range of 25 to 75 pounds per square inch.

The prime coat shall be applied only when the base course is dry or contains moisture not in excess of that which will permit uniform distribution and the desired penetration. It shall not be applied when atmospheric temperature is below 60 degrees F.

4. Tack Coat. Transitions of asphalt to concrete or asphalt that exists and is to be paved over shall be tack coated with a Grade SS-1h anionic emulsion at a rate of 0.10 gallons per square yard.(Ord 04-11)
5. Asphalt Concrete. Asphalt cement shall conform to the requirements for asphalt cement, AR-2000, AASHTO M-266 (AR-40) or ASTM D 3381. Mixing temperature shall be not lower than 275 degrees F, nor higher than 325 degrees F.

Mineral aggregate shall consist of coarse aggregate of crushed stone or gravel composed of hard, durable particles, sand, and a filler as specified in the following. The portion of the material retained on the No. 8 sieve shall be known as coarse aggregate and that portion passing a No. 8 sieve shall be known as fine aggregate. The composite material shall be uniformly graded from coarse to fine and shall meet the requirements of one of the following gradings when tested in accordance with AASHTO T-27 or ASTM C 136. Asphalt concrete shall be as indicated on the Plans, but if not indicated shall be two course plant mix. Unless otherwise indicated on the Plans, asphalt concrete having an overall thickness of over 3 inches shall be the two course plant mix.

<u>Plant Mix, Two Course</u>		<u>Plant Mix, Single Course</u>			
Seal, 3/4-Inch Thick Minimum		Base, 1 3/4-Inch Thick Minimum		3-Inch Thick Minimum	
<u>Sieve Size</u>	<u>Percent Passing</u>	<u>Sieve Size</u>	<u>Percent Passing</u>	<u>Sieve Size</u>	<u>Percent Passing</u>
1/2"	100	1-1/4"	100	3/4"	100
3/8"	95 -100	1"	87-100	1/2"	75-95
No. 4	50 - 70	3/4"	75-90	3/8"	65-85
No. 8	35 - 55	3/8"	55-72	No. 4	50-65
No. 30	15 - 30	No. 4	40-60	No. 8	35-50
No. 100	5 - 15	No. 8	30-50	No. 30	15-30
No. 200	3 - 8	No. 30	15-30	No. 100	5-15
		No 100	5-15	No. 200	3-8
		No. 200	3-8		

At least 70 percent by weight of each size of aggregate included in the coarse aggregate shall consist of particles which have at least one rough, angular surface produced by crushing.

Coarse aggregate shall have a percentage of wear of not more than 50 at 500 revolutions, as determined by AASHTO T-96 or ASTM C 131.

Plasticity index of the aggregate shall be not more than 2 as determined by AASHTO T-90 or ASTM D 431B.

Sand may be added to the crusher or pit run product to supply any deficiency in the 8-mesh size, and filler may be added to supply any deficiency in 200-mesh material. If the aggregate contains an excess of sand, wasting will be required.

Finely powdered limestones, Portland cement, or other artificially or naturally powdered mineral dust, acceptable to the inspector, shall be used for filler.

6. Construction Methods and Equipment. The methods employed in performing the work, all equipment, tools and machinery and other appliances used in handling the materials and executing the work shall be the responsibility of the contractor. The contractor shall make such changes in the methods employed and in the equipment used as are necessary whenever the bituminous mix being produced does not meet the specifications herein established.
7. Spreading and Compaction. The bituminous mixtures shall be spread with self-propelled mechanical spreading and conditioning equipment capable of distributing at least a 12-foot width. The mixture shall be spread and struck off in such a manner that the finished surface shall result in a uniform smooth surface. The longitudinal joints in succeeding courses shall be off-set at least 6-inches transversely to avoid a vertical joint through more than one course.

The temperature of the bituminous mix shall be between 250°F and 350°F when placing. At no time will the temperature of the mix exceed 350°F.

After the mixture has been spread the surface shall be rolled in the longitudinal direction commencing at the outside edge or lower side and preceding to the inner or higher side. Each pass of the roller shall overlap the preceding pass at least one-half the width of the roller. Rolling shall be continued until 95% of the laboratory density as determined in accordance with ASTM Designation D-1559 for the bituminous mixture being used has been obtained.

Rolling operations shall be conducted in such a manner that shoving or distortion will not develop beneath the roller.

The surface of the pavement, after compaction, shall be uniform and true to the established crown and grade. When tested with a ten (10) foot straight edge placed parallel to or perpendicular to the center line of the pavement the surface of the pavement at any point shall not deviate from the lower edge of the straight edge by more than one-quarter of an inch. All high and low spots shall be remedied immediately by removing the wearing course material over the affected areas and replacing it with fresh, hot wearing course and surface finish material and immediately compacting it to conform with surrounding area.

All traffic shall be kept off the completed surface for a minimum period of 24 hours.

8. Weather Limitations. No bituminous surface shall be placed when the temperature of the air or road bed is 50°F or below, during rainy weather, when the base is wet or during other unfavorable weather conditions as determined by the inspector. The air temperature shall be measured in the shade.
9. Restoring Pavements.
 - (a) Cutting and Removing: The pavement shall be cut vertically in neat lines with necessary tools by the contractor in such manner as not to damage the adjacent pavement. It shall be cut along

straight lines forming the edges of the trench. The portion to be removed shall be broken up in such manner as not to damage the pavement outside the lines of the trench. If any pavement outside the lines of the trench is damaged, it shall be removed and restored as hereinafter provided at the contractor's expense. Concrete driveways, sidewalks and curb and gutter shall be removed in a similar manner. All waste material resulting from the above operations shall be immediately removed from the site of the work and all costs to the contractor for removing and disposing of said material shall be included in the unit prices bid under the appropriate items in the schedule.

- (b) Temporary Pavement. Between street intersections, unless otherwise ordered by the engineer, the backfilling shall be built up slightly above the surface of the pavement, oiled and maintained in good condition until the contractor is ready to place the new pavement, when the backfilling shall be removed to the subgrade elevation or bottom of the pavement. This work shall be done accurately to the proper elevation and all loose material removed. If any material is removed below the established subgrade elevation, said space shall be filled with similar material to that used for pavement base, at the contractor's expense, after which the new pavement shall be placed according to the City's specifications for the type of pavement that was removed, or such other type as may have been ordered to replace it.

At street intersections a temporary pavement, satisfactory to the Inspector, shall be placed and maintained in good condition until the contractor is ready to place the new pavement, when it shall be removed accurately to the subgrade elevation of the pavement and the new pavement placed according to the City's specifications for the type of pavement that was removed, or such other type of pavement as may have been ordered to replace it.

Such temporary bridges as may be required to properly handle the traffic during the progress of the construction shall be built, maintained and removed at the contractor's expense.

- (c) Driveways, Sidewalk or Curb and Gutter. Where a trench is located under private driveways, sidewalk or curb and gutter, the subgrade shall be prepared in the same manner as described for pavement, and the concrete driveway, sidewalk or curb and gutter shall be rebuilt according to the City's specifications on file in the Inspector's office, for the type of driveway, sidewalk or curb and gutter that was removed, or such other type as may have been ordered to replace it.
- (d) Repairing Damaged Pavement, Driveway, Sidewalk or Curb and Gutter. If any pavement, concrete driveway, sidewalk, or curb and gutter has been damaged outside the lines of the trench, while trenching, damaged areas shall be removed along straight lines and at right angles, and all cut surfaces shall be vertical, and removal and rebuilding of the damaged portion shall be done by the contractor at his own expense, and to the full satisfaction of the engineer.

10. Seal Coat

- a) Slurry Seal. After allowing newly paved roads to sit for one year, the contractor shall apply a type II slurry seal coat in accordance with approved specifications and standards. The City, at its option, may allow chip and seal application to satisfy requirements of this section. Slurry seal shall consist of mixing asphalt emulsion, aggregate, and water and spreading the mixture on dedicated roadway surfaces shown on the plat and plans approved by the City, as specified in these specifications and the special provisions, and as directed by the City Inspector.
- b) The materials for slurry seal immediately prior to mixing shall conform to the following requirements:

Polymer Modified Asphalt Emulsion

Polymer emulsified asphalt shall be a quick traffic, quick cure (QT-QC) type, shall be a homogeneous brown color throughout and show no separation after thorough mixing, shall break and set on the aggregate within five (5) minutes and shall be ready for cross-traffic within forty five (45) minutes. The polymer asphalt emulsion, upon standing undisturbed for a period of twenty-four (24) hours, shall show no white or milky colored substance on its surface and conform to the requirements in Table I.

TABLE I		
Test on Emulsion	Test Method	Requirement
Viscosity, SSF, @ 77 degrees F, sec	ASTM D244	15-90
PH		1 to 3
Distillation Residue %, Minimum		60
Test on Residue from Distillation Test		
Penetration, 77 degrees F., 100g, 5s	ASTM D5	40-80
Softening Point (Ring & Ball), degrees F	ASTM	130 +
Ductility, 77 degrees. F.,(25C, 5 cm/Min., Minimum	ASTM D113	25
Fraass-Breaking Point (degrees C.) min.	DIN 52012	-18

Water shall be potable, free of harmful soluble salts and shall be of such quality that the asphalt will not separate from the emulsion before the slurry seal is in place in the work.

Aggregate shall consist of sound, durable, crushed stone or crushed gravel and approved mineral filler. The material shall be free from vegetable matter and other deleterious substances. Aggregates shall be 100% crushed with no rounded particles, volcanic in origin and black in color. The percentage composition by weight of the aggregate shall conform to the following grading:

Type II Slurry	
Sieve Sizes	Percentage Passing
3/8"(9.5- mm)	100
No. 4(4.75- mm)	90-100
No. 8(2.36- mm)	65-90
No. 16(1.18- mm)	40-70
No. 30(600- um)	25-50
No. 200 (75- um)	5-15
Theoretical asphalt content, % based on dry aggregate	7.5-13.5
Approximate application rate (Pounds/Square Yard)	14-18

(Ord. 04-11)

Section 3

PORTLAND CEMENT CONCRETE

1. Portland Cement shall conform to the "Standard Specifications for Portland Cement", A.S.T.M. designation C-150-56 and subsequent revisions or addendums and shall be Type II. In areas where there is no exposure to sulfates in the soil or ground water, Type I cement is permissible.
2. A certified analysis of the cement shall be presented to the City Engineer upon request.
3. Cement content shall not be decreased because of the addition of certain admixtures.
4. Fine and coarse aggregates shall conform to the specifications for concrete aggregates, A.S.T.M. Designation C-33-57, and subsequent revisions or addendums.
5. The maximum size of the aggregate shall not be larger than 1/5 of the narrowest dimension between forms of the member for which the concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing.
6. Water used in mixing concrete shall be clean and free from strong acids, alkalies, oils, salts, organic materials, or other deleterious materials.
7. The concrete shall contain a minimum of 6 bag (94#/bag) cement per cubic yard, and have a minimum compressive strength at 28 days of 4000 p.s.i. maximum water content 0.048. Under no circumstance will a slump in excess of 4-inches be permitted.
8. Not less than one test shall be made for each 150 cubic yards of concrete, nor less than one test for each day's concreting. These tests shall be made at the option of the Inspector.
9. Proper mixing shall be accomplished either by truck or by stationary mixers.
10. The place of deposit shall be prepared by adequate forming, proper compaction, necessary drainage, and sufficiently moistened to minimize loss from the freshly placed concrete.
11. Forms may be removed when the concrete has sufficient strength to carry its own weight and the loads upon it with safety (approximately 75% of design strength or at the discretion of the engineer.)
12. Finishing shall provide a pleasant appearing surface, as well as a protective coat against weathering effects.
13. All concrete surfaces shall be cured for a period of seven days by keeping the surface of the concrete continually visibly moist. An acceptable curing compound may be substituted for water where approved by the Inspector.
14. In all cases the contractor shall assume all responsibility arising from preparing, placing, and the removal of forms, and shall assure himself that the concrete is properly cured to sustain loads before forms are removed.
15. No frozen materials or materials containing ice shall be used. All concrete materials, forms, fillers and ground with which the concrete is to come in contact shall be free from frost. Whenever the temperature of the surrounding air is below 40 degrees F., all concrete, when placed in forms, shall have a minimum temperature of 55 degrees F., and shall be maintained at a temperature of not less than 40 degrees F. for at least 72 hours. Concrete subject to freeze/thaw shall be air entrained to a content of 6% + 1.5%

16. The City Inspector reserves the right to forbid the use of material from any plant, pit or source when the character of material, equipment in use or the method of operation is such, in his opinion as to make it doubtful that a reasonable uniform class of material will be furnished.
17. Transporting, Placing, and Compacting. The transporting equipment shall be such as to deliver the concrete to the place of use without segregation and without undue loss of moisture. If the concrete is being placed in walls or structures more than five feet high, it shall be deposited into final position by means of tremies or similar equipment, and the maximum lateral movement of the concrete from any point of deposit shall not be more than five feet. It shall be deposited in even layers, not more than 24 inches in depth, and each layer shall be thoroughly vibrated preceding lift and next to the forms to insure a smooth surface and the removal of air pockets. Particular attention shall also be given to working of the concrete around reinforcing steel and embedded fixtures in such manner as to produce a continuous homogeneous mass filling all corners and eliminating segregation of aggregate and air pockets. An internal vibrator shall be inserted vertically at intervals of from 18 inches to 30 inches, depending on the thickness of the concrete. It shall be held in position and gradually withdrawn when air bubbles no longer come to the surface, which will usually require from five to fifteen seconds. All concrete shall be vibrated within 15 minutes after being placed in the forms. The vibrator shall not be permitted to come in contact with the forms, the reinforcing steel or embedded fixtures or to over-vibrate the concrete at any point. Concrete shall not be transported laterally by means of vibrators.
18. Joining New Concrete to Old. In joining new concrete to old, the old concrete shall be thoroughly treated with concrete epoxy preceding the lacing of the new concrete. All surface film shall be removed from the old concrete, the surface roughened and thoroughly washed to remove loose particles. The methods employed to prepare the surface of the old concrete shall be approved by the inspector in advance. A layer of mortar of the same proportions and consistency as the mortar used in the new concrete shall be thoroughly boomed into the surface of the old concrete, immediately before the new concrete is placed, but no pools of water shall be permitted on the surface of the old concrete when the mortar is placed.
19. An original copy of the concrete batching ticket shall be given to the City inspector, at time of delivery. Ticket is to include the plant designation, ticket number, mix design number, slump, air entrainment, type of concrete, gallons of water added on site, time of leaving plant, time of arrival on site and bag mix. Concrete could be rejected if ticket is not available and does not meet City standards.

Section 4

STEEL REINFORCEMENT

1. General Description. (Specifications shall only apply where the Uniform Building Code does not.) All steel bars used for concrete reinforcement shall be grade 60 deformed bars conforming to ASTM A615 and shall include the supplementary requirements.
2. Cutting and Bending. All cutting and bending shall be done at the mill or shop unless provisions satisfactory to the Inspector are made for handling this work in the field. The radius of curvature of the bends shall not be less than 4 diameters. All bending shall be done cold. Heating preparatory to bending will not be permitted. All steel shall conform accurately to the dimensions shown on the plans.
3. Surface Condition. All steel shall be clean and free from mill scale, flakes of loose rust, cement, concrete, paint, oil, grease or any other foreign material, except that a thin layer of tightly adhering rust may be permitted if approved by the Inspector.
4. Placing. All reinforcement bars shall be placed accurately, as shown on the plans, wired at intersections and spaced and supported by means of metal chairs, spacers, hangers or other devices approved by the Inspector. The placing of bars on layers of fresh concrete as the work progresses will not be permitted. The reinforcement shall be securely bound together and rigidly held in the required position. Where splices are made, the base shall be tapped 40 diameters or a minimum of 20 inches and tightly wired together.
5. Inspection. No concrete shall be placed in any reinforced concrete structure until the steel and its placement have been inspected and approved by the Inspector and he has given permission to proceed with the placing of concrete. Any concrete placed in violation hereof shall be rejected and shall be removed by the contractor at his own expense.
6. Storage and Protection. All reinforcement steel shall be stored in such manner as to be protected from the elements. It shall be stored on skids or other supports approved by the Inspector, and shall be protected against physical damage. No bars that are bent, twisted, kinked or warped shall be used in the work. No bars that have been bent shall be straightened and used in the work.
7. Welded Steel Wire fabric shall conform to A.S.T.M. Designation A-185.

Section 5

SIDEWALKS

1. Excavation. All excavation required for concrete sidewalks and preparation of subgrade shall be made as provided in these specifications and shall include all applicable provisions therein contained. If the sidewalk under construction does not cover the entire area between the curb and the property line, then after the forms have been removed, the depressions along the edges of the sidewalk pavement shall be backfilled with approved material, properly moistened and hand tamped to the satisfaction of the Inspector, and the areas between the sidewalk and the curb and between the sidewalk and the property line shall be finished to a uniform slope, as shown on the plans, with fine material, free from stones and large lumps, and then neatly surfaced with hand rakes. Where the excavation extends into lawns, the sod shall be taken up, carefully preserved and relaid by the contractor.
2. Subgrade. After having excavated the area as described in paragraph 1 of this section, it shall be compacted immediately in advance of placing the base material and shall be maintained in a suitable condition until the base has been placed.
3. Base Course. The base course shall be composed of natural gravel or crushed gavel placed on the prepared subgrade. The gradation of the aggregate shall be as follows:

<u>Sieve Size</u>	<u>%Passing Gradation Band</u>
1 inch	100
1/2 inch	70-100
No. 8	40-70
No. 16	20-40
No. 50	10-27
No. 200	4-13

The base course shall be placed to a depth of 4 inches and shall be compacted to 95% of maximum laboratory density as determined by AASHTO T-180 Method D. Compaction in conformance with Section 1 shall be to the satisfaction of the City Inspector. (Ord. 04-11)

4. Forms. The forms shall comply with all applicable requirements of these specifications. the width of the material shall be equal to the full depth of the sidewalk pavement and the upper edge shall be set accurately to the required elevation of the finished surface.
5. Resetting Frames and Covers, etc. Where there are structures existing, within the area of the sidewalk being constructed, such as valve boxes, meter boxes, hydrant boxes, sewer manholes, etc., that require resetting of frames and covers, or the building up or cutting down of the structure to fit the grade of the sidewalk, this work shall be done by and at the expense of the contractor unless otherwise provided in these specifications. Work shall be done to the satisfaction of the engineer.
6. Class of Concrete to be Used. In the construction of concrete sidewalks air entrained concrete and type II cement shall be used.

The concrete materials and the proportioning, mixing, transporting, placing, protection and curing of the same shall conform to all the applicable requirements of Section 3 of these specifications. Vibration will not be required.

7. One Course Sidewalk. The concrete shall be placed on the subgrade, prepared as above described, to the full depth of the sidewalk, as shown on the plans, in one course. The full quantity of concrete required shall be deposited in as near its final position as practical in one operation, and the

placing shall be completed with shovels. Spades shall be used along the edges to bring the concrete into uniform and complete contact with the forms. Hand tampers approved by the engineer shall be used for compacting. A heavy iron shod straight edge shall be used for striking off the concrete at the proper elevation. Wood floats shall be used for bringing the material to a uniform surface, and after the surface has partially set, all edges shall be finished with an approved edging tool having a three-eighths inch radius, and the surface shall then be finished with a wood float or by floating with a steel trowel as directed by the inspector. On steep grades the surface shall be roughened as directed by the inspector.

8. Sidewalk Pavement. All concrete sidewalk shall be constructed to the lines, grades and dimensions as shown on the prepared plans, or as directed otherwise by the engineer. All concrete sidewalk shall be installed by the developer prior to the final warranty inspection. It shall be built four (4) inches thick except at and through driveways. Concrete sidewalk built at and through resident driveways that are used generally for passenger car traffic shall be six (6) inches in thickness through the entire width of driveway. At driveways, other than resident driveways, such as service stations and at all driveways used for commercial and industrial traffic, the thickness of the sidewalk through the entire driveway shall be as shown on the drawing, or as determined by the engineer; but in no case shall the thickness of the concrete walk be less than seven (7) inches. (Ord. 04-11)
9. Joints. Transverse expansion joints shall be constructed in all concrete sidewalk at intervals of approximately thirty two (32) feet. These joints shall be one-half (1/2) of an inch in thickness and shall run the full width and depth of the sidewalk pavement. Expansion joints shall also be constructed between the sidewalk and curb, between the sidewalk and buildings abutting said sidewalk, around all poles, hydrants, manhole frames and/or other structures coming within or immediately adjacent to the sidewalk area, and at such other points as shown on the plan or as directed by the engineer. The width of expansion joint at the above mentioned locations shall be as shown on the drawing, or as directed by the engineer, except that the expansion joint abutting curb shall be a special joint one (1) inch wide by eight (8) inches deep. All expansion joints shall extend the full depth of the sidewalk pavement being constructed and shall be constructed at right angles to the center line and surface of the sidewalk pavement. A metal holder shall be used to hold the expansion joint rigidly and securely in place during the sidewalk construction.
 - (a) The expansion joint filler to be used shall be prepared resilient, non-extruding joint filler conforming to the requirements of A.S.T.M. specifications, designation D544-52 T, or as last revised, and as approved by the engineer, cut or molded to proper dimensions, and it shall be so placed in relation to surface of sidewalk pavement to allow for pouring of joint sealer compound.
 - (b) In addition to the expansion joint all concrete sidewalks shall be marked transversely with a marking tool, at intervals equal to the width of the sidewalk being built, and every third marking shall be a contraction joint. Each contraction joint shall be finished with an edging tool and shall be cut to a depth of one-quarter (1/4) of the sidewalk slab thickness. Additional contraction joints shall be provided as and where shown on the drawing or as directed by the engineer, or as further described in the "Detail Specification." Ordinary markings shall not be more than one-quarter inch in depth.
 - (c) All expansion joints and contraction joints constructed in concrete sidewalks shall be sealed by a hot poured rubberized asphalt joint sealing compound that is resilient and adherent to the concrete, to prevent infiltration of water and foreign substances into and through joints. The joint sealing compound used shall first be submitted to the engineer and approved by him, and the compound shall be handled and placed as directed and to the satisfaction of the inspector.
 - (d) All above joint filler and sealer shall be furnished and properly placed at the expense of the contractor, unless otherwise provided in these specifications.

10. Wasted Concrete. Retempering concrete that has partly set will not be permitted. Concrete that for any reason has been mixed too wet shall be wasted. Concrete that is partly set shall not be used in the work. Waste concrete shall be disposed of by the contractor in a manner satisfactory to the inspector.
 - (a) All concrete surfaces not coming in direct contact with the forms shall be struck off with a straight edge to the exact form and elevation required. The surface shall then be finished with a wood float or steel trowel as shown on the plans or as ordered by the inspector, and the edges shall be finished with an approved edging tool.
 - (b) If any special type of finish is required on any of the concrete included in this section, detailed requirements will be found in the "Detail Specifications" attached hereto.
11. Curing. All Portland Cement concrete shall be cured by acceptable means and approved by the engineer. The work shall be done in an efficient and systematic manner. The curing period shall not be less than seven (7) days.
12. Concreting in Cold Weather. If the contractor desires to place concrete in cold weather he shall assume all responsibility for damage that may be caused by freezing or by any other cause, even though permission to proceed may have been given by the Engineer. In no case, however, shall concrete be placed when the temperature is 45°F. and falling, unless the contractor has complied with the following requirements and such additional precautions as he may consider to be necessary or advisable:
 - (a) Provision shall be made for heating the water and, if necessary, the aggregates, also. If the aggregates are heated, it shall preferably be done with steam by means of closed steam coils.
 - (b) The temperature of the mixed concrete when placed in the forms shall be between 50°F. and 70°F., depending on the temperature of the air.
 - (c) When the concrete has been placed, the forms and concrete shall be covered with tarpaulins or other approved covering and a sufficient number of perforated steam pipes provided under the covering to maintain the temperature needed to insure proper curing.
 - (d) The use of any admixture to lower the freezing point of the concrete is forbidden.
 - (e) No concrete shall be placed upon a frozen subgrade and no frozen materials shall be used in the concrete.
 - (f) Salamanders shall not be used without special permission from the City Engineer, and if the use of salamanders is permitted, then each salamander shall have a vessel containing water placed on it in order to maintain the necessary humidity to prevent drying of the concrete. Water shall be maintained continuously in the vessel.
 - (g) The material shall be free from ice, snow and frozen lumps when introduced into mixer.
13. Concreting in Hot and/or Dry Weather. Whenever the ambient temperature is above 80°F. or the humidity is below 10%, the City Engineer may, at his discretion, require trial batches to determine the period of initial set. If, in the opinion of the City Engineer, weather conditions are such that the initial set is accelerated, the maximum period specified for mixing, placement and compaction shall be reduced to allow at least 10 minutes time before initial set. The term "initial set" shall be construed as the time in which, in the opinion of the engineer, the concrete is no longer workable. Necessary steps will be taken at the direction of the engineer to protect the concrete from undesirable effects of heat. These steps may include:

- (a) Spraying forms, reinforcing steel and subgrade to prevent absorption of water from mix.
 - (b) Erecting sun shades and wind breaks.
 - (c) Protect slabs before final finishing by covering with waterproof or visqueen.
 - (d) Spraying outside of forms to cool concrete.
 - (e) Cooling mixing water.
 - (f) Spraying coarse aggregate to reduce temperature.
14. Temporary Stoppage of Work. If, for any reason, work is discontinued for a period long enough for the concrete to become set or partially set, then a construction joint shall be provided, preferably at a transverse expansion joint, or if that is impracticable, then at a transverse contraction joint. A bulkhead shall be placed between and at right angles to the side forms and at right angles to the surface of the pavement. It shall extend through the full depth of the pavement and the upper edge shall be set flush with the upper edge of the forms. The concrete shall be finished against this bulkhead to the full depth of the pavement and any excess concrete shall be wasted, and all work shall be done to the satisfaction of the inspector before work is stopped.

Section 6

CURB AND GUTTER

1. Excavation for Curb and Gutter; Preparation of Subgrade, Base and Backfilling. All excavation and preparation of subgrade and base required for construction of concrete curb and gutter and reinforced concrete shall be as outlined in section 7 of these specifications, as determined by the engineer. Embankment required under the concrete shall be with approved material compacted to 95% of maximum density. Base material will be required as outlined in Section 5.
2. Construction. Concrete curb and gutter and reinforced concrete drain gutter shall be constructed in conformity with the lines, grades, slopes, form and dimensions shown on the plans or as designated by the engineer. In the construction of combined curb and gutter, the entire structure will be built simultaneously and no joint or line of cleavage shall be made between the curb and the gutter.
3. Class of Concrete. The concrete used for the construction of reinforced concrete drain gutter and concrete curb and gutter shall be air entrained using type II cement and shall be as outlined in Section 3. The curb and gutter shall be constructed monolithically.
4. Joints. At intervals of ten (10) feet, joints shall be made by inserting form plates one-eighth (1/8) inch in thickness and shaped to the exact form and dimensions of the curb and gutter. Plates must be smooth and clean. They shall be oiled with mineral oil immediately before using. Any plate that has become warped or damaged shall not be used. They shall be carefully removed after the concrete has set, and any concrete broken out shall be repaired to the satisfaction of the Inspector.
 - (a) Expansion joints 1/2-inch thick shall be provided at approximately 50-foot intervals. The expansion joint filler shall be shaped to the exact form and dimensions of the curb and gutter, shall be 1/2-inch in thickness, and shall conform to A.S.T.M. Designation D544-52T, or as last revised, and as approved by the engineer.
 - (b) At the contractor's option, plates a minimum of 2 inches deep may be substituted for the full depth plates at contraction joints only. A full plate must be used at expansion joints and ends of the constructed section, such as at driveways, curved sections and/or where determined by the engineer.
 - (c) After division plates have been removed and expansion joints have been properly set, then all joints shall be sealed in a manner and with material approved by the engineer.
5. Placing, Compacting and Curing. The method of mixing, placing, compacting, finishing and curing, etc., of the concrete shall conform to all applicable requirements of Section 5 of these specifications, as determined by the Inspector.
 - (a) Curb and gutter may be placed by an approved slip form method. The slip form machine equipment shall spread, consolidate, screen and float finish the freshly placed concrete in such a manner that a minimum of hand float finishing will be required to provide a dense and homogeneous concrete section.

The concrete shall be distributed uniformly into final position by the machine without delay and competently placed true to line and grade.

The contraction joints every ten feet may be provided by cutting into the fresh concrete to a minimum depth of 1 1/2 inches to create a weakened vertical plane. The edges of such joints shall be tooled with an edger so as to provide a neat workmanlike appearance. Expansion joints will not be required except at adjacent pavement, walk or structure.

This option shall be so noted in the bid schedule by the contractor when this alternate is used in bidding this item.

6. Reinforced Concrete Drain Gutter. The reinforced concrete drain gutter shall be constructed simultaneously with the adjoining gutters and shall consist of concrete minimum eight (8) inches in thickness, unless otherwise shown, and reinforced longitudinally, and shall be built to conform to dimensions, form and to elevations as shown on the plans or as directed by the engineer.

The concrete used shall be the same as provided in paragraph 3 of this section.

The methods of placing, spading, compacting, finishing and curing, as provided in paragraph 5 of this section shall apply to the construction of the drain gutter.

Where necessary, in the opinion of the engineer, gravel shall be placed and thoroughly compacted to form a base for the drain gutter, as directed by the Inspector.

7. Protection. The contractor shall protect all curb and gutter and drain gutter from damage from traffic and all other causes until accepted by the City. Should the curb and gutter or drain gutter become damaged by weather, traffic, or during the rolling of the street, or from any other cause, it shall be repaired by reconstructing an entire section, by and at the expense of the Contractor and to the satisfaction of the inspector.

Section 7

EXCAVATION AND BACKFILL FOR PIPELINES

1. Description. Excavation of trenches for pipe lines shall include the excavation of all materials, of whatever nature, except pavement, coming within the designated lines of the trenches, as hereinafter described. It shall include the excavation of all materials required for the construction of manholes, flush tanks, cleanout boxes, meters, pressure regulators and other appurtenances as shown on the drawings or directed by the engineer. It shall include all excavation required for the removal or lowering of existing pipe lines or appurtenances and shall include all necessary clearing and grubbing, all necessary draining, pumping, timbering, sheeting and subsequent removal of these materials as directed by the inspector. It shall include the disposal of all material excavated and the backfilling of the trenches and appurtenant structures as hereinafter provided.
2. Subgrade. The subgrade for all pipeline trenches is hereby defined to be the bottom of the trench at the elevation of the outside bottom of the pipe.
3. Limits of Excavation. The trench shall be excavated 10 inches wider than the inside diameter of the pipe, except for concrete pipe, for which it shall be excavated 12 inches wider. The sides of the trench shall be vertical and the depth of the trench shall be measured from the existing ground surface to the subgrade of the trench, provided that on paved streets the depth shall be measured from the bottom of the pavement to the subgrade of the trench. All excavation required for manholes, flush tanks, cleanout boxes, meter boxes, valve boxes, pressure regulators and other appurtenances shall be made and measured as described under "Excavation for Structures"; provided, however, that such measurements shall include only such additional material as is excavated outside the designated lines of the trench.
4. Excavation in Rock. If the bottom of the trench for any pipeline is in rock or in material too hard to permit the bed to be properly formed for the pipes, the excavation shall be made not less than 4 inches below the established subgrade, and the bottom of the trench shall be brought to subgrade with approved material compacted into place as ordered by the Inspector.
5. Excavation Other than Rock. Where the bottom of the trench is composed of material other than rock, care shall be exercised to prevent any disturbance of the material beyond the prescribed lines, and if any material is so disturbed, it shall be tamped back into place in a manner satisfactory to the Inspector.
6. Undesirable Material. If any undesirable material is encountered in the bottom of the trench, the contractor shall make such additional excavation as the inspector may direct, and shall replace it with gravel of a quality that will pack, and said gravel shall be tamped into place in 4-inch layers to the satisfaction of the Inspector.
7. Bridging. The contractor shall construct suitable bridging over the trench at all street intersections and at driveways to property abutting the line of the work, and at such other points as may be required. The bridging shall be of sufficient strength to carry the loads required. For public vehicle crossings it shall be capable of supporting a 15-ton truck.
8. Disposal of Seepage, Storm Water or Sewage. The contractor shall remove all seepage, storm water or sewage that may be found or may accumulate in the excavation during the progress of the work. He shall furnish all labor, pumps and other equipment and appliances necessary therefor, and shall keep all excavations entirely free from water at all times during the construction of the work and until the Inspector shall give instructions to cease pumping.
9. Tunneling. No tunneling will be permitted unless permission is given in writing by the Inspector.

10. Protection of Pipes. All water, gas, sewer or other pipes encountered in excavating for the trench or appurtenances shall be supported and protected from injury in a manner satisfactory to the inspector.
11. Parking, Lawns, etc. Where the pipeline or structure is located on, along or across sodded parking, lawns or grass plots, the contractor shall in advance of making the excavation, remove the lawn or sod and give it proper care and attention, and shall replace the same in as nearly the original location and condition as is reasonably possible after the excavation has been backfilled and settled. Where it is necessary to deposit the excavated material on lawns or parking during the process of construction, the contractor shall first spread canvas or similar material of suitable size upon the grass to prevent any of the excavated material from coming in contact with the sod. The excavated material shall be removed as soon as possible in order to avoid injury to the grass and the contractor shall replace, at his own expense, any sod that is damaged.
12. Trench in Unpaved Street. Where the trench is in an unpaved street, the backfilling shall be slightly rounded over the trench and left to settle for such time as the inspector may direct, at which time it shall be thoroughly rolled with a five (5) ton truck loaded to capacity. The entire area of the trench shall be covered at least three times by the tread of the tires, after which any depression or irregularities shall be smoothed up to the proper elevation and re-rolled. The surface over the trench shall be left in a uniformly smooth condition, conforming to the street surface and all excess material shall be removed. During the interval of waiting for settlement of the material in the trench, the Contractor shall keep the surface over the trench oiled and shall maintain said surface in good condition until finally completed and accepted.
13. All backfill operations shall be completed within ten (10) calendar days from the starting of excavation.
14. All backfill material shall be free from cinders, ashes, refuse, organic and frozen material, boulders, stones, or other material that, in the opinion of the City Engineer, is unsuitable.
15. Backfill material under, around, and to one foot over the pipe shall consist of select earth, sand or fine gravel, free from clods, lumps or stones larger than 1 1/2-inches to their maximum dimensions. This shall be limited to 3/4" maximum around PVC, ABS or polyethylene lines. In wet or unstable conditions, material in this zone shall be free draining, non-plastic material.
16. Backfill under and around the pipe to the centerline shall be placed in maximum layers of 6-inches. Bell holes of ample dimensions shall be dug in the bottom of the trench for each pipe. Uniform bearing for each pipe barrel shall be provided for the full length of each pipe. Backfill from the centerline to one-foot above the pipe shall be placed and compacted in maximum layers of 6-inches. Backfilling under improved areas (such as paved streets) shall be placed and compacted in 6-inch layers. All layers through improved areas will be compacted to not less than ninety-five (95%) of the maximum Standard Proctor Density (T-99). Only in the zone from one-foot above the pipe to finished subgrade under unimproved areas will the use of wheel compaction be allowed. Adequate testing by the contractor shall be required to satisfy compaction requirements.
17. All subsequent settling of backfill areas will become the sole responsibility of the contractor for a period of not less than two years following the final approval of the entire project.
18. Impervious backfill shall be required at irrigation canal crossings or other waterway interferences.
19. All areas disturbed by excavation and backfilling construction shall be restored to original condition, or better, at the Contractor's expense.

SECTION 8

CULINARY WATER

1. Materials

1. Materials

- (a) Fire Hydrants. Fire hydrants shall meet the requirements of the current AWWA-Standard Specification C 502 for fire hydrants for ordinary water works service with the following supplementary qualifications:
- (1) Length for depth of trench to be as specified.
 - (2) Two hose nozzles 2 1/2 inch diameter with national standard fire hose thread.
 - (3) One steamer nozzle 4 1/2 inch diameter when ordered with national standard fire hose thread.
 - (4) Counter clockwise to open.
 - (5) Operating nut pentagon, 1 1/2 inch point to flat.
 - (6) All internal parts to be removable from top of hydrant without the use of special tools.
 - (7) Operating valve nut shall be within 6-inches of finished surface grade. (Ord. 04-11)
- (b) Flanged Fittings. All flanged fittings shall be in accordance with the current AWWA specification C110 for cast iron fittings.
- (c) Check Valves. Standard iron body swing check valves for 150 pound working pressure Crane, Ludlow or equal.
- (d) Dresser Couplings. Latest standard style with rubber gasket for water. For diameters 4 inches to 14 inches middle ring to be a minimum of 1/4 inch thick and 5 inches long with 4 5/8 inch bolts for 4 inch diameters; 6 5/8 inch bolts for 6 and 8 inch diameters and 8 5/8 inch bolts for 10, 12, and 14 inch diameters.
- (e) Steel Pipe. Steel pipe shall conform to the current AWWA Specification C 201.
- (f) Certification of all tests required by the American Water Works Association shall be provided by the manufacturer. The three-edge bearing test will be required, upon request of the Engineer.
- (g) All pipe shall be standard lengths except for making connections to valves, fittings, and other such closures.
- (h) Concrete Pipe. Concrete pipe shall conform in quality to the A.C.I. Concrete Standards. Sufficient proof of loading, bearing and sizing capacity for its intended use shall be required by the City Engineer.
- (i) Cast Iron Pipe shall conform to the provisions of American Standard Specifications ASA-A2.6 or A21.8 for Class 250 bell and spigot pipe with push-on joint. Fittings shall be mechanical or push-on joints, Class 250 conforming to ASA-A21.10 and A21.11. The interior of the pipe and fitting shall have a cement mortar lining conforming to the requirements of ASA-A21.4. The outside coating shall be a bituminous coal-tar base coating approximately 1 mil. thick.
- (j) Ductile Iron Pressure Pipe. Ductile iron pipe where designated shall be centrifugal spun ductile iron, Class 50 or better. Ductile iron pipe shall have a standard thickness cement liner and shall conform to all requirements for AWWA Standard C151 for centrifugal spun ductile iron pipe with "push-on" or bell and spigot type joints. Required glands, gaskets, bolts and nuts shall be furnished. Pipe shall be coated with bituminous coal tar base, approximately 1 mil thick. The nominal laying length of the pipe shall be eighteen feet (18'). The maximum allowable pipe

deflection shall be three degrees (3°) per joint with a recommended deflection of two degrees (2°) or less per joint. Pipe deflection shall be limited to two degrees (2°) at crosses, valves, couplings, and fire hydrants. Except where specifically noted on the plans, ductile iron pipe shall have bell and spigot ends. Ductile iron pipe underground shall be protected against external corrosion by loose polyethylene sleeves in accordance with AWWA C 105.

- (k) PVC Pressure Pipe. PVC Class 900 pipe shall meet the requirements of ASTM D 2241 except that the pipe shall have an outside diameter of ductile iron pipe sizes instead of iron pipe sizes. The PVC pipe shall meet the requirements of the AWWA C 900 with pressure class of 150 and the D.R. of not less than 18. At least 85 per cent of the total footage shall be furnished in standard 20-foot lengths. (Ord. 04-11)
 - (l) Fittings. Fittings for PVC pipe shall be cast iron fittings as specified under cast iron and ductile iron pipe, and be properly sized for the dimensions of the pipe being used. All fittings for joining pipe 4 inches in diameter and larger shall be of the push on rubber gasket or mechanical joint type of fitting.
 - (m) Replacement of Damaged Material. Any material that becomes damaged shall be replaced by the Subdivider at his own expense.
 - (n) Responsibility for Safe Storage. The Subdivider shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project.
 - (o) Handling Pipe and Accessories. Pipe, fittings, valves, hydrants, and other accessories shall, at all times, be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists or slid, or rolled on skidways in such manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of derrick, ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in a manner satisfactory to the Engineer.
 - (p) Gate Valves shall be iron body, bronze mounted, double disc with non-rising stems with design construction to AWWA C-500, and modifications herein. Stem seals shall be double O-ring seals valves shall open counterclockwise. Provide 2" square wrench nut for key operation. Operating valve nut shall be within 6-inches of finished surface grade. Install 24 inches of crushed rock from the bell top of the valve to the trench grade below the valve to provide proper drainage. Provide mechanical joint ends, except gate valves for use with fire hydrants. (Ord 04-11)
 - (q) Valve Boxes shall be buffalo type, sliding type with base as required for the valve size used and of sufficient length for the specified pipe bury. It shall have the word "water" stamped thereon.
 - (r) Locating Wire and Tape shall be provided and installed along PVC pipelines 1 foot directly above the pipe. The wire shall be 14 gauge 600 volt PVC jacketed wire manufactured for underground services. Wire shall terminate and be exposed in valve boxes as directed by the public works department for easy access. Installation contractor shall install "culinary waterline buried below" tape if pipe color does not meet City requirements. (Ord. 04-11)
2. Laying Pipe.
- (a) General. All pipe shall be laid and maintained to the required lines and grades, with fittings, valves and hydrants at the required locations, and with joints centered and spigots home, and

with all valve and hydrant stems plumb. No deviation shall be made from the required line or grade except with the written consent of the Engineer.

- (b) Permissible Deflections at Joints. Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, to plumb stems, or where long radius curves are permitted, the degree of deflection shall be approved by the Engineer.
- (c) Protecting Underground and Surface Structures. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer.
- (d) Deviations occasioned by other Utility Structures. Wherever existing utility structures or branch connections leading to main sewers or to main drains, or other conduits, ducts, pipes, or structures present obstruction to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstructure involved. In those instances where their relocation or reconstruction is impracticable, a deviation from line and grade will be ordered, and the change shall be made in the manner directed by the Engineer. Connections to private residences shall be cut and looped around the pipe line.
- (e) Pipe Kept Clean. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.
- (f) Bell Ends to Face Direction of Laying. Unless otherwise directed, pipe shall be laid with bell ends facing the direction of laying, and for lines on an appreciable slope, bells shall, at the discretion of the Engineer, face upgrade.
- (g) Preventing Trench Water from Entering Pipe. At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.
- (h) Cutting Pipe. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.
- (i) Pipe Jointing Jointing of all pipe shall be as recommended by the manufacturer. All pipes shall be handled in such a way so as to prevent damage to the coating and lining. Refer to backfilling specifications for proper bedding and compaction. Thrust blocking shall be applied at all tees, plugs, caps and at bends deflecting 22 1/2 degrees or more. Prevention of concrete adhesion by means of 10 mil plastic sheeting to protect valves or pipe material shall be directed by the City Inspector. (Ord. 04-11)

3. Setting Valve, Hydrant & Fitting.

- (a) Valves. The Contractor shall furnish all valves indicated on the plans as called for in these specifications or as called for proper operation of the water system. Valve manufacturer shall provide detailed information as required by the Engineer for evaluating the quality of the valve. The technical information shall include complete dimensions, weights and material lists. No valve will be approved for installation until the required information has been received and approved. Except as otherwise specified, all buried valves shall be painted with two coats of asphalt varnish in accordance with the requirements of AWWA C 500. Gate valves shall be iron body, resilient seat, nonrising stem conforming to AWWA C 509 with double O-ring. Valves shall open counter clockwise. Valve ends shall be flanged or mechanical joint as required for the type of pipe used. Maximum shutoff pressure shall be 200 psi.

- (b) Location. Gate valves, hydrants and fittings shall be located as shown on the plans or as directed by the Engineer or Public Works Department Director. (Ord. 04-11)
- (c) Valve Boxes and Valve Pits. Cast iron valve boxes shall be firmly supported, and maintained centered and plumb over the wrench nut of the gate valve, with box cover flush with the surface of the finished pavement or at such other levels as may be directed. The valve shall be supported by a concrete pressure block and surrounded with two (2) feet in depth of coarse gravel around the base of the valve. (Ord. 04-11)
- (d) Hydrants. Hydrants shall be located in a manner to provide complete accessibility, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. Maximum separation distance between fire hydrants shall not be greater than 500 feet. Unless otherwise directed, the setting of any hydrant shall conform to Items 4, 5, 6, and 7.
- (e) Position of Nozzles. All hydrants shall stand plumb, and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle pointing normal to the curb, except that hydrants having hose nozzles at an angle of 45 degrees shall be set normal to the curb. They shall conform to the established grade, with nozzles at least 12 inches above the ground.
- (f) Drainage at Hydrant. A drainage pit 2 feet in diameter and 2 feet deep shall be excavated below each hydrant and filled compactly with coarse gravel or broken stone, mixed with coarse sand, under and around the bowl of the hydrant and to a level of 6 inches above the waste opening. No hydrant drainage pit shall be connected to a sewer.
- (g) Anchorage for Hydrant. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing, or it shall be tied to the pipe with suitable rods or clamps.
- (g) Cleaning. Hydrants shall be thoroughly cleaned of dirt, or foreign matter before setting.
- (h) Plugging Dead Ends. Standard plugs shall be inserted into the bells of all dead ends of pipe, toes or crosses and spigot ends shall be capped.
- (i) Anchorage of Toes, Tees, and Plugs. Reaction or thrust blocking shall be applied on all pipe lines 4 inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching suitable metal rods or straps as directed by the Engineer. Thrust block size shall be determined by the subdivider's engineer and shall be shown on the plans.
- (j) Material for Reaction Backing. Reaction or thrust blocking shall be of concrete having compressive strength of not less than 2,000 psi. Blocking shall be placed between solid ground and the fitting to be anchored, the area of bearing on pipe and on ground in each instance shall be that required by the Engineer. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair. The pipe shall be protected from the thrust block by a layer of 10 mil plastic.

4. Hydrostatic Tests.

- (a) Pressure During Test. After the pipe has been laid and partially backfilled, all newly laid pipe, or any valved section of it shall, unless otherwise specified, be subjected to maximum operating pressure.
- (b) Duration of Pressure Test. The duration of each pressure test shall be at least 30 minutes at 220 psi. (Ord. 04-11)

- (c) Procedure. Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connections and all necessary apparatus shall be furnished by the Contractor.
- (d) Expelling Air before Test. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterward tightly plugged.
5. Cleaning Water Mains. After chlorination, the mains shall be flushed thoroughly. Flushing shall be done after the pressure test is made. It must be understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying.

Unless extreme care and thorough inspection is practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired.

6. Sterilizing Water Mains.

- (a) General. Disinfection of water mains shall be done in accordance with "Procedure for Disinfecting Water Mains", AWWA - C601-68. The interior of all pipe, fittings and other accessories shall be kept as free as possible from dirt and foreign matter at all times.

(b) Chlorination.

- (1) Form of Chlorine and Means of Application. Before being placed in service, all new water mains shall be chlorinated. If the available water is more alkaline than pH 8, the holding time in the main shall be increased at the discretion of the Engineer.
- (2) Form of Applied Chlorine. Either of the following forms of chlorine may be used, subject to the approval of the Engineer:

Liquid Chlorine

Calcium Hypochlorite Tablets

(3) Methods of Chlorine Application.

- (a) Continuous Feed Method. This method is suitable for general application.

TABLE 1
Chlorine required to produce 50 mg/l concentration in
100 ft. of Pipe - by Diameter

Pipe Size in.	100 per cent Chlorine lb.	1 per cent Chlorine Solutions - gal.
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water in the pipe is maintained at a minimum of 50 mg/l available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods and AWWA M12 - Simplified Procedures for Water Examination.

Table 1 gives the amount of chlorine residual required for each 100 ft. of pipe of various diameters. Solutions of 1 per cent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gal. of water.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hrs. during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hr. period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main

- (b) Tablet Method. Tablets are placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, they are either crushed and placed on the inside annular space, or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite.

The adhesive may be Permatex No. 1 or any alternative approved by the Engineer. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached.

- (c) Filling and Contact. When installation has been completed, the main shall be filled with water at a velocity of less than 1-ft/sec. This water shall remain in the pipe for at least 24 hr.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

TABLE 2
Number of Hypochlorite Tablets
Required for Dose of 50 Mg/l*

Length of Section Ft.	Diameter of Pipe Inches					
	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

*Based on 3 3/4 grams available chlorine per tablet.

- (4) Preventive Measures During Construction. Precautions must be taken to protect pipe interiors, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipe laying is not in progress, as for example at the close of the day's work, all openings in the pipeline shall be closed by water tight plugs. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

Note: Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipelaying, the less this delay.

If dirt that, in the opinion of the City engineer or inspector, will not be removed by the flushing operation enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a 5 per cent hypochlorite disinfecting solution.

- (5) Preventing Reverse Flow. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
- (6) Retention Period. Treated water shall be retained in the pipe long enough to destroy all nonsporeforming bacteria. This period should be at least 24 hours and preferably longer, as may be directed. After the chlorine-treated water has been retained for the required time, the chlorine residual at the pipe extremities and at other representative points should be at least 25 ppm.
- (7) Chlorinating Valves and Hydrants. In the process of chlorinating newly-laid pipe, all valves or other appurtenances shall be operated while the pipeline is filled with the chlorinating agent.
- (8) Final Flushing and Test. Following chlorination, all treated water shall be thoroughly flushed from the newly-laid pipeline at its extremities until the replacement water throughout its length shall, upon test, be proved comparable to the quality of water served the public from the existing water supply system and approved by the public health authority having jurisdiction. This quality of water delivered by the new main should continue for a period of at least two full days as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination. Samples should never be taken from an unsterilized hose or from a fire hydrant because such samples seldom meet current bacteriological standards.

- (9) Repetition of Procedure. Should the initial treatment fail to result in the conditions specified above, the chlorination process shall be repeated until such results are obtained.

SECTION 9

SANITARY SEWERS

1. Concrete Sewer Pipe

- (a) Description. Sanitary sewers shall include the performance of all operations necessary to lay sewer pipe mains, wye branches, individual sewer mains to manholes, test mains for leaks and all incidental work necessary to complete the work in a satisfactory manner.
- (b) Sewer Pipe. All pipe for the sanitary sewer mains shall be bell and spigot. The type of pipe the Contractor proposes to install shall have the approval of the City Engineer before work is commenced. No interchanging of type of pipe will be allowed.
- (c) Non-Reinforced Concrete Sewer Pipe. Non-Reinforced concrete sewer pipe shall conform to Concrete Sewer Pipe ASTM Designation C 14-56.
- (d) Reinforced Concrete Sewer Pipe. Reinforced concrete sewer pipe shall conform to the requirements for "Reinforced Concrete Sewer Pipe: ASTM Designation C 75556. Cement used in the pipe shall conform to Type 11A, (the air entraining agent shall be inter-ground at the mill), low alkali cement, conforming to Federal Specifications, 192a, of ASTM Designation C-15C-53.
- (e) Length of Pipe. Pipe 36" in diameter and under shall be at least 36" long except specials. Pipe over 36" in diameter shall be at least as long as the inside diameter. The maximum length of pipe shall be 24 feet.
- (f) Testing. Random samples of pipe and all fittings and specials such as short radius bands, wyes and toes shall be tested as specified for the type of pipe being used.
- (g) Laying. No pipe shall be laid under any circumstances until the pipe has been tested, and the samples selected have satisfactorily passed the requirements. All pipe shall be laid up-grade from structure, unless otherwise expressly permitted by the Engineer, with the bell end of the pipe upgrade. All pipe shall be laid true to line and grade, with a uniform bearing under the full length of the barrel of the pipe, and suitable excavation shall be made to receive the bell of the pipe. All adjustments to grade shall be made by scraping away or tamping earth under the pipe. Wedging or blocking under the hub will not be permitted. As each unit of pipe is laid a sufficient amount of selected backfill materials shall be carefully placed and thoroughly tamped about the lower portion of the pipe to hold it firmly in position. If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe. When laying is not in progress the ends of the pipe lines shall be kept closed to prevent the entrance of foreign material.
- (h) Rubber Gasket Joints. Pipe for rubber gasket joints shall be of the bell and spigot type, detail of the type the Contractor proposes to use shall be furnished and must have the approval of the City engineer before the work is to be commenced. The joint shall be so designed as to provide for self-centering and when assembled, to compress the gasket to form a water tight seal. The pipe design and gasket shall be such that movement of the pipe or hydrostatic pressure cannot displace the gasket. In order to assure water-tightness the clearance between the inner surface of the bell and the outer surface of the spigot, as well as the dimensional tolerances of this annular space, shall be such that the gasket residual deformation is neither less than 20% nor more than 45% when the spigot is seated to the full depth of the bell socket.
- (i) Rubber Gaskets. The rubber gasket for use on pipe shall be cured in such a manner that any cross section will be dense, homogeneous, and free from porosity and other imperfections. The gasket shall be extruded or molded to the specific size within a tolerance of plus or minus 1/32 of

an inch at any cross section of the gasket. The gasket shall be fabricated from a high-grade tread-type compound. The basic polymer shall be natural rubber, or a copolymer of butadiene-styrene synthetic. The compound shall contain no factice and shall have the following characteristics:

Tensile strength, pounds per square inch, minimum.....	2,300
Elongation at break, percent, minimum.....	425
Shore Durometer (Type A).....	40 to 60
Absorption of Water, by weight, 2 days at 70 degree C, percent maximum.....	5
Compression set (constant deflection), percent of original deflection, maximum.....	20
Tensile strength after oxygen bomb aging (48 hours, 158 degrees F, 300 per square inch), percent of tensile strength before aging, minimum.....	80
Increase in Shore durometer hardness after oxygen bomb aging, maximum increase over original Shore Durometer.....	8
Acetone, extract, percent, maximum.....	15

The physical properties of the rubber compound shall be determined by tests performed in accordance with appropriate section of Federal Specifications ZZ-R-601a, except for Shore Durometer and compression set. All tests for compression set shall be made in accordance with method B, ASTM Designation D395 for compression set of vulcanized rubber under constant deflection. Tests for Shore Durometer shall be made in accordance with ASTM Designation D676. The Contractor shall furnish certified copies of test reports as evidence of the rubber compound used in all rubber gaskets before any gaskets are used to join pipes. All rubber shall be stored in as cool a place as practicable, preferably at 70 degrees or less, and in no case shall the rubber for joints be stored exposed to the direct rays of the sun. All rubber gaskets shall be stored so as to permit free circulation of air about the rubber.

In all cases during the laying of the pipe extreme care must be taken to see that the rubber gaskets are properly fitted in place and at all times are free from twisting and unusual displacement.

2. Poly (Vinylchloride) Sewer Pipe (PVC)

- (a) General. This specification covers requirements for PVC pipe and fittings to be furnished for sanitary sewer.

Pipe and fittings produced to the standards below should be installed in accordance with ASTM recommended practice D-2321, underground installation of flexible thermoplastic sewer pipe. The plastics nomenclature used in the specifications is in accordance with the definitions given in nomenclature D-883, unless otherwise indicated.

- (b) Applicable Documents. PVC sewer pipe furnished under this specification shall meet the following ASTM standards: D-256, Impact Strength; D-638, Tensile Strength and Modulus of Elasticity; D-648, Deflection temperature under load of 264 psi; D-1784, Specifications for rigid Poly (VinylChloride) compounds and chlorinated Poly (VinylChloride) compounds; D-3034 (SDR 35) type PSP Poly (VinylChloride) (PVC) sewer pipe and fittings. The requirements of this specification are intended to provide pipe fittings suitable for non-pressure drainage of sewage.
- (c) Materials. Basic materials of the pipe and fittings shall be PVC plastic having a self-classification of 12454-B and shall meet the minimum physical properties and chemical resistance of the PVC compound as defined in ASTM D-1784.

- (d) Connection Joints. All sizes and classifications of PVC gravity sewer pipe shall have joints utilizing rubber gaskets for sealing. Gaskets shall meet specifications defined in ASTM D-2000-AA820, ASTM 2000-AA625 and ASTM-D-1869.
- (e) Workmanship. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, density, and other physical properties.
- (f) Requirements. All materials, dimensions, strengths, qualities, and test requirements shall meet the applicable ASTM requirements. All material used shall be new and shall be protected from any long exposure to the sun.
- (g) Inspections. Inspection of the material shall be made as agreed upon by the purchaser and the seller as part of the purchase contract.
- (h) Certification. When agreed upon in writing by the purchaser and the seller the certification shall be made the basis of the acceptance of the material. This shall consist of a copy of the manufacturers test report or a statement by the seller, accompanied by a copy of the test results, that the material has been sampled, tested, and inspected in accordance with the provisions of the specification. Each certification so furnished shall be signed by an authorized agent of the seller or manufacturer. Copies will be furnished to the City.
- (i) Marking. Pipes in compliance with this standard shall be clearly marked at intervals of five feet (5') or less. The marking on SDR-35 shall be: (1) Mfg's Quality; (2) Nominal Pipe Size; (3) PVC 12454-B; (4) SDR-(Number); (5) PSP Sewer Pipe; (6) Appropriate ASTM Number; (7) Extrusion Code

3. Sewer Appurtenances

- (a) Testing of Gravity Sewer Lines. Gravity sewer lines shall show not more than two hundred (200) gallons infiltration per day, per mile of pipe, per inch nominal diameter. In areas where the ground water level is above the top of the pipe for the entire length of the sewer being tested, the infiltration shall be measured into the pipe to determine if it meets infiltration requirements. In areas where the ground water level is below the top of the pipe the Contractor shall perform an exfiltration or leakage test to provide the City an indication of the condition of the completed system. After capping and blocking all wyes or tees, the pipe between successive manholes shall be filled with water, including the upstream manholes, to not less than four feet (4') nor more than eight feet (8') above the lowest point of the sewer section being tested. The amount of water level shall be measured, and it shall not exceed a rate of two hundred (200) gallons exfiltration per day, per mile of pipe, per inch nominal diameter. Any one individual section may exceed the rate by one and one-half (1 1/2) times if the total length does not exceed the above rate. The program of testing must be mutually determined by the Engineer and the Contractor. The Contractor shall furnish all labor, tools, and equipment necessary to make the tests and to perform any work incidental thereto. The Contractor shall take all necessary precautions to prevent any joints from separating, or other damage to the system while the pipelines or their appurtenances are being tested. He shall, at his own expense, correct any excess leakage and repair any damage to the pipe, and its appurtenances or to any structures indicated by or resulting from these tests. If any section tested fails the test, it shall be repaired or replaced and re-tested at the Contractor's expense, until the measured leakage is within the allowable limits. Prior to the issuance of building permits and preceding the final warranty release of contingency improvement funding the City will require the Developer or his selected contractor to perform a flush cleaning and CCTV video inspection of the sanitary sewer pipes to confirm pipe workmanship and perpetuation of City and American Society of Testing and Materials (ASTM) design and construction requirements. The City may require follow-up video inspections to confirm necessary repairs have been completed from previous inspections. (Ord 04-23)

- (b) Deflection and Air Testing of Sewer Lines. The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of five (5) pounds per square inch (34.5kPa) or sufficient to balance a column of mercury ten (10 inches (254 mm) in height. The pressure shall be held without introducing additional air for a period of at least fifteen minutes. In addition to the air test of the sewer line, a deflection test will also be required. The deflection test shall be made by positioning a Multi-Size and Stationary Type Deflection Test Gauge within a standard flexible sewer pipe. Each multi-size gauge utilized for testing shall be 5% smaller in diameter than the inner walls of the pipe to be tested. The gauge will be placed within the sewer pipe and then vacuum pulled from one manhole to the next to locate any deflection problems.
- (c) Wye Branches. Wye branches or junctions for house connections shall be four (4") inches in diameter, and shall be installed in the sewer at such locations as the Engineer may direct. Wye branches shall be elevated so that the flow line of the wye is level with the centerline of the pipe. Each wye, not used in connecting present laterals, shall be sealed by means of a suitable plug of the same material as the pipe and sealed with joint compound one-fourth (1/4) inch deep over the plug.

(d) Manholes.

- (1) General. This item shall consist of the construction or installation of concrete manholes of the various types and diameters shown on the plans and at the designated locations. The item shall include: Ring and cover, steps, and all other incidentals necessary to fully complete the manholes.
- (2) Precast Manholes. Precast manholes shall consist of sections of rings of tongue and grooved reinforced concrete pipe on a cast in place foundation. Both circular and conical sections shall meet the requirements of "Reinforced Concrete Sewer Pipe (ASTM Specifications C75)."

Approved eccentric manholes with rungs will be accepted. Concentric manholes will not be accepted.

The precast base section shall be recessed on the bottom edge to receive the pipe entering the manhole. The base section shall extend at least two inches into the concrete of the floor. When practical the base section shall be set in position before the floor is poured; in any case the base section shall be imbedded in the floor before the concrete has taken its initial set.

Joints between sections shall be set in (a) cement grout, or (b) asphaltic sewer joint compound. Joints shall be water tight.

- (3) Manhole Covers. The Contractor will furnish and install the cast iron frame and cover shown on the plans as a part of the manhole.
- (4) Castings, Quality of Metal. All castings shall be made of good quality cast iron, strong, tough, straight grained and free from flaws, cracks, blow holes or other defects and of exact form and dimensions shown on the plans. They shall be evenly and firmly set and imbedded as to afford the chance of any movement. The seats and bearings of all frames and covers shall be machine faced and shall fit evenly and firmly and so made as to be interchangeable. Iron shall conform to "Standard Specifications for Gray Iron Castings" ASTM Specification A 48-48 or Class 30.
- (5) Grade. Necessary adjustment to bring the cover to finished street grade shall be required.

- (6) Manhole Ladders. Manhole ladder steps as shown on manhole plans shall be formed from 3/4" mild steel bar coated with polyethylene or cast iron rungs.
- (7) Stubs in Manholes. Shall be flexible rubber boots with stainless steel straps
- (8) Revisions to Existing Manholes. All work required to revise or modify existing manholes, in connection with this project, as shown on the plans, or as directed by the Engineer, necessary to complete the project shall be done by the Contractor and no extra compensation shall be allowed for this work. This work shall include such incidentals as raising manhole floors, providing drop type inverts, new invert openings, etc.
- (e) Service Lines. Any sewer laterals that may be extended beyond the branch in the main by the Contractor during the construction shall be subject to all the requirements of these specifications for the construction of the main line sewer. Cementing of joints will be allowed.

The Contractor shall be fully responsible for any leaks in the sewer laterals, to the same extent as if such leaks were in the sewer main.

Sewer service lines shall be connected into the main line with a tee or other fitting manufactured for this purpose. The lateral shall be placed on a 2% slope and shall have cleanouts every 50 feet, at all changes in direction greater than 45° and at drop connections. In the event the main sewer is deeper than required to connect the service line at 2% slope, the service line shall be taken off on a 45° and then flattened to the minimum slope to the house or user. Service lines for residential connections shall be 4-inch. The service line will be installed in the upper half of the main line.

- (f) Workmanship. The Contractor, developer, home builder or others responsible for the work shall provide adequate means, acceptable to the City Inspector, to prevent the entrance of foreign materials into the sewer lines via the manholes and service laterals.

Unless otherwise approved the following means of protections shall be used:

Before work is started on street grading and paving jobs where there is a possibility of manhole rings and covers being displaced by equipment, the floor of the manhole shall be completely covered with wood planks, adequately secured to prevent displacement. Individual planks shall have a width greater than the diameter of the sewer pipe. Planking shall remain in place during the life of the job. Upon completion of the work any foreign material that may have entered the manhole shall be removed before the planking is removed.

On resurfacing jobs where it is required that manhole covers be adjusted to new grade, a canvas apron, properly supported or anchored may be used in lieu of wood planking. In every case such apron or planking shall be in place before the work is started and shall not be removed until the work of adjusting the manhole has been completed. (Ord. 04-11)

- (g) Final Sewer Cleaning and Inspection. Prior to final acceptance, all parts of the system shall be completely finished and cleaned by the developer. All accumulated construction debris, rocks, gravel, and other foreign material shall be removed from the sewer system at or near the closest downstream manhole. If necessary the Contractor shall use mechanical rodding or bucketing equipment. The City Public Works Department shall complete a smoke test of the system to locate cross connections, illegal connections and infiltration points. The City shall notice the home builder or developer of any illegal connections to the sewer system. The homebuilder shall undertake correction of cross connections, illegal connections, or infiltrations. This shall include cleaning of the cross-connected service pipeline acceptable to the City Public Works. (Ord. 04-11)

SECTION 10

STORM SEWERS

1. Storm Drain Calculations.

- (a) Storm drain calculations will be produced using the rational method.
- (b) Storm drain design shall follow the .2 C.F.S discharge allowable by Davis County and shall be sized for a 10 year storm without detention, a 50 year storm with minor detention, and a 100 year storm with major detention.
- (c) Hydraulic calculations shall be submitted which produce the Composit "C"
- (d) Submit copies of the storm intensity/ frequency

2. Culvert Pipe and Incidental Construction.

- (a) Material. All pipe required for the Storm Sewer shall be standard strength, tongue and groove, reinforced concrete culvert pipe. All culvert pipe shall conform to the American Society for Testing Materials Specifications for Reinforced Concrete Culvert Pipe, latest designation D-76, or as provided in the special provisions.

Pipe diameters listed in the bid schedule for which no reinforcing requirements have been determined under ASTM Specifications shall be reinforced as required for the next diameter larger.

- (b) Length of Pipe. Culvert pipe from 10" in diameter to 36" in diameter shall be at least 36" long. Pipe over 36" in diameter shall be at least as long as the inside diameter.
- (c) Testing of Pipe. Every manufacturer furnishing pipe under these specifications shall furnish all facilities necessary to carry out the tests required in these specifications.
- (d) Line and Grade. Line and grade shall be accurately maintained. Laser method preferred.
- (e) Method of Laying Pipe. The first pipe downstream shall be bedded to established line and grade with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint, this space to be filled with mortar, into which the end of the second pipe beds when laid. The groove end of the first pipe must be thoroughly cleaned with a wet brush and a layer of soft mortar applied to the inside of the groove. The tongue end of the second pipe must be thoroughly cleaned with a wet brush and while in a horizontal position a layer of soft mortar is then inserted into the groove end of the first pipe until the mortar is squeezed out on the interior and exterior surfaces. The interior surface of the pipe joint over 18" in diameter shall be brushed smooth and under 18" in diameter wiped smooth.

All concrete culvert pipe shall have gasket joints, which operation shall be carried on several joints behind the laying operation. The outer surface of the pipe must be thoroughly cleaned with a wet brush. As the band is carried up around the lower half of the pipe, an earth support is provided to prevent its falling off. At a point somewhat below spring line of the pipe, this operation may be discontinued. The band on the upper half of the pipe requires no support. Bands shall be at least one-half the thickness of the shell of the pipe and for 4" to 6" wide.

- (f) Rubber Gasket Joints. Gaskets shall conform to ASTM D-412.

3. Structures.

- (a) Definition. All items listed in the bidding schedule as cleanout boxes, inlet boxes and junction boxes shall be designated as structures.
- (b) Concrete. Concrete for all structures shall be as outlined in Section 3.5.
- (c) Finishing. Upon removal of the forms, all the tie wire holding the forms shall be cut flush with concrete face and any rough or irregular surfaces found to exist shall immediately be repaired to the satisfaction of the Engineer. Surface not exposed to view need not be finished, unless otherwise shown on the plans. Unless otherwise shown on the plans, exposed surfaces of structures shall be finished to conform to the finish of the adjacent concrete. Surfaces over which asphalt paving is to be placed shall be rodded off to the neat lines. Surfaces exposed in concrete paving shall be given a float finish and surfaces exposed in curb and gutter areas shall be finished as prescribed for curb and gutter. An edging tool shall be used on all exposed corners to properly shape and finish the concrete.

4. Waterways.

- (a) Description. Waterways shall include the construction of box culverts and flumes, the finishing and placing of concrete and metal pipe culverts and other type of culverts specified, in street sections, or in ditches paralleling streets, the construction of cleanout boxes and the furnishing and placing of cleanout frames and covers, and the construction of head gates and diversion works and all other work incidental thereto, in accordance with the plans and these specifications.
- (b) Concrete Box Culverts, Flumes and Cleanout Boxes, etc. Concrete waterways shall be constructed from concrete, to the dimensions and at the locations shown on the plans, or according to the stakes set by the Engineer. The provisions of Section 3.5 under the heading of "Portland Cement Concrete" shall apply to the construction of waterways. Concrete waterways shall be reinforced as shown on the plans.
- (c) Reinforced Concrete Pipe. Reinforced concrete pipe shall meet the requirements of "Standard Specifications for Reinforced Concrete Culvert Pipe ASTM Designation C76. (Latest ASTM Designation C76.)"
- (d) Plain Concrete Pipe. Shall not be used.
- (e) Corrugated Metal Pipe (CMP). Corrugated metal pipe in quality and sizing shall be in compliance with the regulations and design criteria in Handbook of Steel Drainage and Highway Construction Products, published by American Iron and Steel Inst., or as specified on an approved set of plans and shall meet the requirements of AASHTO specifications M-36.
- (f) Placing and Covering. Pipe shall be placed at the locations shown on the plans or as directed by the Engineer and shall be laid true to line and grade. The width of the trench in which the pipe is laid shall be sufficient to permit thorough tamping under the haunches of the pipe. The pipe shall be bedded in an earth foundation of uniform density, and carefully shaped to the proper grade. Where rock or boulders are encountered in the formation it shall be removed and replaced with granular material to a sufficient depth to provide a uniform cushion under the pipe.

Where a firm foundation is not encountered at the established grade due to spongy or unstable soil, additional excavation shall be made as directed by the Engineer, and backfilled with suitable material adequately compacted to form a firm foundation for the pipe.

Select material free from rocks and clods shall be used for backfill and shall be placed in layers not exceeding six (6) inches in thickness and thoroughly compacted by tamping to the finished grade of the street.

- (g) Cleanout Frames and Covers. Cleanout frames and covers shall be furnished and installed at the various locations shown on the plans, or as may be directed by the Engineer.
 - (h) Final Cleaning. Prior to final acceptance, all parts of the storm drain system shall be completely finished and cleaned by the developer. All accumulated construction debris, rocks, gravel, and other foreign material shall be removed from the storm drain system at or near the closest downstream manhole or clean out structure. If necessary the contractor shall use mechanical rodding or bucketing equipment. (Ord. 04-11)
5. Detention Facilities. Detention facilities shall meter water at 0.2 cfs per acre. Detention facilities shall be designed as follows:
- (a) Side slopes shall be 3:1 maximum.
 - (b) Designed for 50-year storm or as determined by City Engineer.
 - (c) Vehicular maintenance access around the entire basin (minimum 10 foot width).
 - (d) Vehicular access to basin.
 - (e) Where possible, lot shall provide normal frontage requirements.
 - (f) Pressurized irrigation system and landscaping compatible with the surrounding area.
 - (g) Flow through design that eliminates a "wet basin".
 - (h) Cross slope within basin shall provide adequate drainage.
 - (i) Inlet and outlet boxes shall be grated, with extended swale construction extending from outlet structure into the basin to eliminate nuisance flows and water accumulation. (Ord. 04-11)
 - (j) Where possible, detention basins shall be incorporated into useable park property.

SECTION 11

LAND DRAINS

1. Concrete Pipe

- (a) Description. Land drains shall include the performance of all operations necessary to lay land drain pipe mains, wye branches, individual land drain mains to manholes, test mains for leaks and all incidental work necessary to complete the work in a satisfactory manner.
- (b) Pipe All pipe for the land drain mains shall be bell and spigot. the type of pipe the contractor proposes to install shall have the approval of the city Engineer before work commences. No interchanging of type of pipe will be allowed.
- (c) Non-Reinforced Concrete Pipe. Non-reinforced concrete land drain pipe shall conform to Concrete Pipe ASTM Designation C 14-56.
- (d) Reinforced Concrete Pipe. Reinforced concrete land drain pipe shall conform to the requirements for "Reinforced Concrete Pipe: ASTM Designation C 75556. Cement used in the pipe shall conform to Type 11A, (the air entraining agent shall be inter-ground at the mill), low alkali cement, conforming to Federal Specifications, 192a, of ASTM Designation C-15C-53.
- (e) Length of Pipe. Pipe 36" in diameter and under shall be at least 36" long except specials. Pipe over 36" in diameter shall be at least as long as the inside diameter. the maximum length of pipe shall be 24 feet.
- (f) Testing. Random samples of pipe and all fittings and specials such as short radius bands, wyes and toes shall be tested as specified for the type of pipe being used.
- (g) Laying. No pipe shall be laid under any circumstances until the pipe has been tested, and the samples selected have satisfactorily passed the requirements. All pipe shall be laid up-grade from structure, unless otherwise expressly permitted by the Engineer, with the bell end of the pipe upgrade. All pipe shall be laid true to line and grade, with a uniform bearing under the full length of the barrel of the pipe, and suitable excavation shall be made to receive the bell of the pipe. All adjustments to grade shall be made by scraping away or tamping earth under the pipe. Wedging or blocking under the hub will not be permitted. As each unit of pipe is laid a sufficient amount of selected backfill materials shall be carefully placed and thoroughly tamped around the lower portion of the pipe to hold it firmly in position. If adjustment of the position of a length of pipe is required after it has been laid, it shall be removed and rejoined as for a new pipe. When laying is not in progress the ends of the pipe lines shall be kept closed to prevent the entrance of foreign material.
- (h) Rubber Gasket Joints. Pipe for rubber gasket joints shall be of the bell and spigot type, detail of the type the contractor proposes to use shall be furnished and must have the approval of the City Engineer before the work is to be commenced. The joint shall be so designed as to provide for self-centering and when assembled, to compress the gasket to form a water tight seal. The pipe design and gasket shall be such that movement of the pipe or hydrostatic pressure cannot displace the gasket. In order to assure water-tightness the clearance between the inner surface of the bell and the outer surface of the spigot, as well as the dimensional tolerances of this annular space, shall be such that the gasket residual deformation is neither less than 20% nor more than 45% when the spigot is seated to the full depth of the bell socket.
- (i) Rubber Gaskets. The rubber gasket for use on pipe shall be cured in such a manner that any cross section will be dense, homogeneous, and free from porosity and other imperfections. The gasket shall be extruded or molded to the specific size within a tolerance of plus or minus 1/32 of an inch at any cross section of the gasket. The gasket shall be fabricated from a high-grade

tread-type compound. The basic polymer shall be natural rubber, or a copolymer of butadiene-styrene synthetic. The compound shall contain no factice and shall have the following characteristics:

Tensile strength, pounds per square inch, minimum	2,300
Elongation at break, percent, minimum	425
Shore Durometer (Type A)	40 to 60
Absorption of Water, by weight, 2 days at 70 degree C, percent maximum	5
Compression set (constant deflection), percent of original deflection, maximum	20
Tensile strength after oxygen bomb aging (48 hours, 158 degrees F, 300 per square inch), percent of tensile strength before aging, minimum	80
Increase in Shore durometer hardness after oxygen bomb aging, maximum increase over original Shore Durometer	8
Acetone, extract, percent, maximum	15

The physical properties of the rubber compound shall be determined by tests performed in accordance with appropriate section of Federal Specifications ZZ-R-601a, except for Shore Durometer and compression set. All tests for compression set shall be made in accordance with method B, ASTM Designation D395 for compression set of vulcanized rubber under constant deflection. Tests for Shore Durometer shall be made in accordance with ASTM Designation D767. The contractor shall furnish certified copies of test reports as evidence of the rubber compound used in all rubber gaskets before any gaskets are used to join pipes. All rubber shall be stored in as cool a place as practicable, preferably at 70 degrees or less, and in no case shall the rubber for joints be stored exposed to the direct rays of the sun. All rubber gaskets shall be stored so as to permit free circulation of air about the rubber.

In all cases during the laying of the pipe extreme care must be taken to ensure that the rubber gaskets are properly fitted in place and continually free from twisting and unusual displacement.

2. Poly (Vinylchloride) Pipe (PVC)

- (a) General. This specification covers requirements for PVC pipe and fittings to be furnished for land drains.

Pipe and fittings produced to the standards below should be installed in accordance with ASTM recommended practice D-2321, underground installation of flexible thermoplastic land drain pipe. The plastics nomenclature used in the specifications is in accordance with the definitions given in nomenclature D-883, unless otherwise indicated.

- (b) Applicable Documents. PVC land drain pipe furnished under this specification shall meet the following ASTM standards: D-256, Impact Strength; D-638, Tensile Strength and Modulus of Elasticity; D-648, Deflection temperature under load of 264 psi; D-1784, Specifications for rigid Poly (VinylChloride) compounds and chlorinated Poly (VinylChloride) compounds; D-3034 (SDR 35) type PSP Poly (VinylChloride) (PVC) land drain pipe and fittings. The requirements of this specification are intended to provide pipe fittings suitable for non-pressure drainage of sewage.
- (c) Materials. Basic materials of the pipe and fittings shall be PVC plastic having a self-classification of 12454-B and shall meet the minimum physical properties and chemical resistance of the PVC compound as defined in ASTM D-1784.

- (d) Connection Joints. All sizes and classifications of PVC gravity land drain pipe shall have joints utilizing rubber gaskets for sealing. Gaskets shall meet specifications defined in ASTM D-2000-AA820, ASTM 2000-AA625 and ASTM-D-1869.
- (e) Workmanship. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, density, and other physical properties.
- (f) Requirements. All materials, dimensions, strengths, qualities, and test requirements shall meet the applicable ASTM requirements. All material used shall be new and shall be protected from any long exposure to the sun.
- (g) Inspections. Inspection of the material shall be made as agreed upon by the purchaser and the seller as part of the purchase contract.
- (h) Certification. When agreed upon in writing by the purchaser and the seller the certification shall be made the basis of the acceptance of the material. This shall consist of a copy of the manufacturer's test report or a statement by the seller, accompanied by a copy of the test results, that the material has been sampled, tested, and inspected in accordance with the provisions of the specification. Each certification so furnished shall be signed by an authorized agent of the seller or manufacturer. Copies will be furnished to the City.
- (i) Marking. Pipes in compliance with this standard shall be clearly marked at intervals of five feet (5') or less. The marking on SDR-35 shall be:
 - (1) Mfg's Quality
 - (2) Nominal Pipe Size
 - (3) PVC 12454-B
 - (4) SDR-(Number)
 - (5) PSP Pipe
 - (6) Appropriate ASTM Number
 - (7) Extrusion Code

3. Land Drain Appurtenances

- (a) Testing of Gravity Lines. Gravity land drain lines shall show not more than two hundred (200) gallons infiltration per day, per mile of pipe, per inch nominal diameter. In areas where the ground water level is above the top of the pipe for the entire length of the land drain being tested, the infiltration shall be measured into the pipe to determine if it meets infiltration requirements. In areas where the ground water level is below the top of the pipe the contractor shall perform an exfiltration or leakage test to provide the City with an indication of the condition of the completed system. after capping and blocking all wyes or tees, the pipe between successive manholes shall be filled with water, including the upstream manholes, to not less than four feet (4') nor more than eight feet (8') above the lowest point of the land drain section being tested. The amount of water added during the test period from the section under test to maintain the water level shall be measured, and it shall not exceed a rate of two hundred (200) gallons exfiltration per day, per mile of pipe, per inch nominal diameter. Any one individual section may exceed the rate by one and one-half (1 1/2) times if the total length does not exceed the above rate. The program of testing must be mutually determined by the engineer and the contractor. The contractor shall furnish all labor, tools and equipment necessary to make the tests and to perform any work incidental thereto. The contractor shall take all necessary precautions to prevent any joints from separating or other damage to the system while the pipelines or their appurtenances are being tested. the contractor shall at his own expense, correct any excess leakage and repair any damage to the pipe, and its appurtenances, or to any structures indicated by or resulting from

these tests. If any section of pipe fails the test, it shall be repaired or replaced and re-tested at the contractor's expense, until the measured leakage is within the allowable unites.

(b) Air Testing of Lines. The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of five (5) pounds per square inch (34.5kPa) or sufficient to balance a column of mercury ten (10) inches (254 mm) in height. The pressure shall be held without introducing additional air for a period of at least fifteen (15) minutes.

(c) Wye Branches. Wye branches or junctions for house connections shall be four (4") inches in diameter, and shall be installed in the land drains at such locations as the engineer may direct. Wye branches shall be elevated so that the flow line of the wye is level with the centerline of the pipe. Each wye, not used in connecting present laterals, shall be sealed by means of a suitable plug of the same material as the pipe and sealed with joint compound one-fourth (1/4) inch deep over the plug.

(d) Manholes.

(1) General. This item shall consist of the construction or installation of concrete manholes of the various types and diameters shown on the plans and at the designated locations. The item shall include: Ring and cover, steps, and all other incidentals necessary to fully complete the manholes.

(2) Precast Manholes. Precast manholes shall consist of sections of rings of tongue and grooved reinforced concrete pipe on a cast in place foundation. Both circular and conical sections shall meet the requirements of "Reinforced Concrete Pipe (ASTM Specifications C75)."

Approved eccentric manholes with rungs will be accepted. Concentric manholes will not be accepted.

The precast base section shall be recessed on the bottom edge to receive the pipe entering the manhole. The base section shall extend at least two inches into the concrete of the floor. When practical the base section shall be set in position before the floor is poured; in any case the base section shall be imbedded in the floor before the concrete has taken its initial set.

Joints between sections shall be set in (a) cement grout, or (b) asphaltic land drain joint compound. Joints shall be waster tight.

(3) Manhole Covers. The contractor will furnish and install the cast iron frame and cover shown on the plans as part of the manhole.

(4) Castings, Quality of Metal. All castings shall be made of good quality cast iron, strong, tough, straight grained and free from flaws, cracks, blow holes or other defects and of exact form and dimensions shown on the plans. They shall be evenly and firmly set and imbedded as to afford the chance of any movement. The seats and bearings of all frames and covers shall be machine faced and shall fit evenly and firmly and so made as to be interchangeable. Iron shall conform to "Standard Specifications for Gray Iron Castings" ASTM Specification A48-48 or Class 30.

(5) Grade. Necessary adjustment to bring the cover to finished street grade shall be required.

(6) Manhole Ladders. Manhole ladder steps as shown on manhole plans shall be formed from 3/4" mild steel bar, coated with polyethylene or cast iron rungs.

(7) Stubs in Manholes. Stubs shall be flexible rubber boots with stainless steel straps.

(8) Revisions to Existing Manholes. all work required to revise or modify existing manholes, in connection with the project, as shown on the plans, or as directed by the engineer, necessary to complete the project shall be done by the contractor and no extra compensation shall be allowed for this work. This work shall include such incidentals as raising manhole floors, providing drop type inverts, new invert openings, etc.

(e) Service Lines. Any land drain laterals that may be extended beyond the branch in the main by the contractor during construction shall be subject to all the requirements of these specifications for the construction of the main line land drains. Cementing of joints will be allowed.

All service lines shall be white in color, stubbed 10 feet beyond the property line, tagged and labeled "Land Drain", capped or plugged with a 2" x 4" clearly marking the location of the lateral stub.

The contractor shall be fully responsible for any leaks in the land drain laterals to the same extent as if such leaks were in the land drain mains.

Service lines shall be connected into the main line with a tee or other fitting manufactured for this purpose. The lateral shall be placed on a 2% slope and shall have cleanouts every 50 feet, or at all changes in direction greater than 45° and at drop connections. In the event the main land drain is deeper than required to connect the service line at 2% slope, the service line shall be taken from a 45° and then flattened to the minimum slope to the house or user. Service lines for residential connections shall be 4-inch. The service line will be installed in the upper half of the main line.

Roof drainage structures, storm gutters, or other above ground collection points are prohibited from connecting to or discharging storm water into City underground land drains or field drain main service lines.

New residential dwellings constructed within subdivisions containing a land drain system are required to make connection via a service lateral stubbed to the dwelling foundation footing and connected to the main land drain line owned by the City. (Ord. 04-11)

(f) Workmanship. The contractor or others responsible for the work shall provide adequate means, acceptable to the City Inspector, to prevent the entrance of foreign materials into the land drain lines via the manholes.

Unless otherwise approved the following means of protections shall be used:

Before work is started on street grading and paving jobs where there is a possibility of manhole rings and covers being displaced by equipment, the floor of the manhole shall be completely covered with wood planks, adequately secured to prevent displacement. individual planks shall have a width greater than the diameter of the land drain pipe. Planking shall remain in place during the life of the job. Upon completion of the work any foreign material that may have entered the manhole shall be removed before the planking is removed.

On resurfacing jobs where it is required that manhole covers be adjusted to a new grade, ad canvas apron, properly supported or anchored may be used in lieu of wood planking. In every case such apron or planking shall be in place before the work is started and shall now be removed until the work of adjusting the manhole has been completed.

Permanent fiberglass catches under land drain lids shall be installed to prevent gravel and dirt from getting into the system. (Ord. 04-11)

- (g) Final Cleaning. Prior to final acceptance, all parts of the system shall be completely finished and cleaned by the developer. All accumulated construction debris, rocks, gravel, and other foreign material shall be removed from the land drain system at or near the closest downstream manhole. If necessary the contractor shall use mechanical rodding or bucketing equipment.

SECTION 12

SECONDARY WATER

1. Materials

- (a) Flanged Fittings. All flanged fittings shall be in accordance with the current AWWA specification C110 for cast iron fittings.
- (b) Dresser Couplings. Latest standard style with rubber gasket for water. For diameters 4 inches to 14 inches middle ring to be a minimum of 1/4 inch thick and 5 inches long with 4 5/8 inch bolts for 4 inch diameters; 6 5/8 inch bolts for 6 and 8 inch diameters and 8 5/8 inch bolts for 10, 12, and 14 inch diameters.
- (c) Steel Pipe. Steel pipe shall conform to the current AWWA Specification C 201.
- (d) Certification of all tests required by the American Water Works Association shall be provided by the manufacturer. The three-edge bearing test will be required, upon request of the inspector.
- (e) All pipe shall be standard lengths except for making connections to valves, fittings, and other such closures.
- (f) PVC Pressure Pipe. Pipe shall be standard dimension riation pressure rated PVC pipe (SDR-RP-PVC) conforming to the latest revision of ASTM D2241 and the National Bureau of Standard Product Standard PS 22-70. The pipe shall be PVC Class 900 pipe shall meet the requirements of ASTM D 2241 except that the pipe shall have an outside diameter of ductile iron pipe sizes instead of iron pipe sizes. The PVC pipe shall meet the requirements of the AWWA C 900 with pressure clasp of 150 and the D.R. of not less than 18. Pipe shall be bell and spigot, twin gasket. At least 85 per cent of the total footage shall be furnished in standard 20-foot lengths.(Ord. 04-11)
- (g) Replacement of Damaged Material. Any material that becomes damaged shall be replaced by the Subdivider at his own expense.
- (h) Responsibility for Safe Storage. The Subdivider shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the work, until it has been incorporated in the completed project.
- (i) Handling Pipe and Accessories. Pipe, fittings, valves, hydrants, and other accessories shall, at all times, be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists or slid, or rolled on skidways in such manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground. All pipe, fittings, and valves shall be carefully lowered into the trench piece by piece by means of derrick, ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in a manner satisfactory to the inspector.
- (j) Gate Valves shall be iron body, bronze mounted, double disc with nonrising stems with designb construction to AWWA C-500, and modifications herein. Stem seals shall be double O-ring seals valves shall open counterclockwise. Install 24 inches of crushed rock from the bell top of the valve to the trench grade below the valve to provide proper drainage. Provide 2" square wrench nut for key operation. Operating valve nut shall be within 6-inches of finished surface grade. Provide mechanical joint ends. (Ord. 04-11)

- (k) Valve Boxes shall be buffalo type, sliding type with base as required for the valve size used and of sufficient length for the specified pipe bury. It shall have the word "sprinkler" or "irrigation" stamped thereon.

2. Laying Pipe.

- (a) General All pipe shall be laid and maintained to the required lines and grades, with fittings and valves at the required locations. No deviation shall be made from the required line or grade except with the written consent of the engineer. The contractor will install indicator tape marked "Irrigation Line Buried Below" 12 inches above the top of the irrigation pipe.
- (b) Permissible Deflections at Joints. Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, to plumb stems, or where long radius curves are permitted, the degree of deflection shall be approved by the Engineer.
- (c) Protecting Underground and Surface Structures. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the inspector.
- (d) Deviations occasioned by other Utility Structures. Wherever existing utility structures or branch connections leading to main sewers or to main drains, or other conduits, ducts, pipes, or structures present obstruction to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the City. In those instances where their relocation or reconstruction is impracticable, a deviation from line and grade will be ordered, and the change shall be made in the manner directed by the Engineer. Connections to private residences shall be cut and looped around the pipe line.
- (e) Pipe Kept Clean. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.
- (f) Bell Ends to Face Direction of Laying. Unless otherwise directed, pipe shall be laid with bell ends facing the direction of laying, and for lines on an appreciable slope, bells shall, at the discretion of the Engineer, face upgrade.
- (g) Preventing Trench Water from Entering Pipe. At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.
- (h) Cutting Pipe. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.
- (i) Pipe Jointing. Jointing of all pipe shall be as recommended by the manufacturer. All pipes shall be handled in such a way so as to prevent damage to the coating and lining. Refer to backfilling specifications for proper bedding and compaction. Thrust blocking shall be applied at all tees, plugs, caps and at bends deflecting 22 1/2 degrees or more. Prevention of concrete adhesion by means of 10 mil plastic sheeting to protect valves or pipe material shall be directed by the City Inspector. (Ord. 04-11)
- (j) Pipe shall be laid so as to drain back into the main system when system is out of service. Additional drain lines or blow off valves will be required where gravity draining may not be possible.

- (k) Indicator Tape. Indicator tape shall be placed a minimum of 12 inches above the laid pipe to identify the water line for future excavations. A 12 gauge locator wire shall be installed to aid in locating the pipe for identification. The City Public Works department shall oversee the connection points of the locator wire. (Ord. 04-11)

3. Setting Valve and Fitting.

- (a) Location. Gate valves and fittings shall be located as shown on the plans or as directed by the Engineer.
- (b) Valve Boxes and Valve Pits. Cast iron valve boxes shall be firmly supported, and maintained centered and plumb over the wrench nut of the gate valve, with box cover flush with the surface of the finished pavement or at such other level as may be directed. Valve box lid shall be stamped "Sprinkler".
- (c) Plugging Dead Ends. Standard plugs shall be inserted into the bells of all dead ends of pipe, toes or crosses and spigot ends shall be capped.
- (d) Anchorage of Toes, Tees, and Plugs. Reaction or thrust blocking shall be applied on all pipe lines 4 inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching suitable metal rods or straps as directed by the Engineer. Thrust block size shall be determined by the subdivider's engineer and shall be shown on the plans.
- (e) Material for Reaction Backing. Reaction or thrust blocking shall be of concrete having compressive strength of not less than 2,000 psi. Blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on pipe and on ground in each instance shall be that required by the Engineer. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair. The pipe shall be protected from the thrust block by a layer of 10 mil plastic.
- (f) Blow Off and Drain Valves shall be installed on deadend or low elevation point connection lines in accordance with requirements and specifications of the City. (Ord. 04-11)

4. Hydrostatic Tests.

- (a) Pressure During Test. After the pipe has been laid and partially backfilled, all newly laid pipe, or any valved section of it shall, unless otherwise specified, be subjected to maximum operating pressure.
- (b) Duration of Pressure Test. The duration of each pressure test shall be at least 30 minutes at 150 psi. (Ord. 04-11)
- (c) Procedure. Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. the pump, pipe connections and all necessary apparatus shall be furnished by the Contractor.
- (d) Expelling Air before Test. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterward tightly plugged.

5. Cleaning Water Mains The mains shall be flushed thoroughly. Flushing shall be done after the pressure test is made. It must be understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying.

Unless extreme care and thorough inspection is practiced during the laying of water mains, small stones, pieces of concrete, particles of metal, or other foreign material may gain access to mains newly laid or repaired.

Section 13

ROADWAY LIGHTING

1. General

All outdoor artificial street illuminating devices shall be installed in conformance with the provisions of this section and applicable provisions of the Zoning Ordinance, Subdivision Ordinance, and the current Electric and Electric Safety Codes adopted by the state of Utah. The spacing and arrangement of streetlights will be designed during the preliminary plat or sight plan review phases of a development and shall be a minimum of one light per every 800 feet of roadway, every 400 feet of cul-de-sac depth and at every roadway intersection. (Ord. 04-11)

2. Approved Materials & Methods of Installation

The provisions of this section are to prevent the use of any material or method of installation not specifically prescribed by this section. The City Council must approve any proposed alternatives.

(A) Type and Style of Lights. Street lights shall be purchased by the developer and may be either the "Grand Ville" with trim tabs (Series 1) with a 14-foot Charleston pole or "Grande Ville" (series 2) with a 14-foot Salem pole.

(B) Lamp Source. High Pressure Sodium is the lamp source that will be utilized throughout the City for all roadway lighting.

(C) Deviations. Any material or method of installation not specifically prescribed in this section will be evaluated by the City Council as stated above, for approval based on the following criteria:

(1) It provides equivalence to the applicable specific requirements of this section.

(2) It is otherwise satisfactory in complying with the intent of this section.

(3) The plans, and variants to this section for proposed lighting schemes, will be submitted to the Community Development Department for approval, and shall be sufficiently complete, with all variants from this section noted, to enable the City Council to readily determine whether compliance with the intent of this section will be secured.

(D) Variances. Any person desiring to install an outdoor lighting fixture in violation of this section may apply to the City Council with recommendation from the Planning Commission for a variance from the regulation in question.

3. Roadway Lighting

(A) Non-decorative Poles and Heads. Non-decorative poles and heads shall only be utilized in the City where, upon the recommendation of the Planning Commission and approval of the City Council, a specific lighting plan has been approved.

(1) All roadway pole mounted fixtures shall not be mounted above thirty (30) feet, as measured from the top of the fixture to the adjacent grade of the horizontal plane being lit by the fixture.

(2) The fixture should house a high-pressure sodium lamp, with a cut-off lens and no more than 150 watts/pole.

(B) Decorative Poles and Heads. Decorative poles and heads shall be installed as outlined on plans approved through the Community Development Department.

- (1) All decorative roadway pole mounted fixtures shall not be mounted above eighteen (18) feet, as measured from the top of the fixture to the adjacent grade of the horizontal plane being lit by the fixture.
 - (2) The fixture should house a high-pressure sodium lamp, with no more than 150 watts/pole.
 - (3) Decorative roadway application fixtures should utilize highly refractive globes, which have a minimum of 85 horizontal and 345 vertical prisms, to evenly direct the light, and evenly diffuse the light source. The fixture should have the ability to have internal light directing reflectors that can be field installed after fixture installation, to accommodate customization of the lighting output, and/or to redirect unwanted light to the traffic area.
 - (4) The fixture should have photometrics, so that when used on a 40-foot wide road and placed on opposing 180 feet spacing, mounted on an 18-foot pole with a type III distribution and 150 watt HPS head, the following horizontal foot-candles should be produced on the roadway (using a .85 light loss factor):
 - (a) Average Maintained = 1 foot-candle or more.
 - (b) Maintained minimum = .4 foot-candles or more.
 - (c) Max/Min Uniformity = 4.54 or less.
 - (5) At 40 feet away from the pole, the roadway should not have less than .1 horizontal foot-candle minimum maintained at any point on the road and 1.5 vertical foot-candles, as measured from ground level to six feet above the ground, in the middle of the road.
 - (6) The refractor should be made of acrylic, and should be available in type III, and IV distributions, with a reflector in the top to eliminate uplight and redirect the light downward toward the surface, and a house light shield. It sets in die-cast aluminum polyester powdercoated pod, which will allow easy access to all of the internal electrical components. It should have internal twist-lock style photocell receptacle when needed, and quick release wiring components on the socket, ballast, and igniter, with a Ground Fault Interrupted outlet mounted on the pod. Approved Manufacturers are as follows:
 - (a) Hadco Streetscapes Refractive Globes UT33A150SE-150HPS style or equal.
 - (7) Light posts shall be sixteen (16) foot tall, 5" x 3" smooth tapered aluminum pole with a .125" wall thickness. Bolt circle shall be 14" diameter, four (4) bolts, 90° apart, with a decorative base 12 ¾" square X 45" high, with a three (3) inch outside diameter fitter. Aluminum is to be polyester powdercoated black.
 - (a) Hadco Streetscapes Posts – 2520 style or equal.
- (C) Road Light Levels. Roadway Lighting Maximum Levels (as measured at the horizontal plane being lit).
- (1) The maximum point should not exceed 6 foot-candles within the circulation area being lit.
 - (2) The average light level should not exceed 1 foot-candle within the circulation area being lit.
 - (3) No more than 1 foot-candle will be allowed outside of 20 feet of the circulation area being lit.
 - (4) No more than .05 foot-candles will be allowed outside the property lines of the easement.
 - (5) No more than .01 foot-candles should be allowed to spill on any residential property as a result of another party lighting their own property.

4. Wiring

- (A) Lamp and Pole Wiring. All internal wiring of the lamps shall be accomplished at the manufacturer's facilities. No alterations or modifications shall be accomplished as part of the installation of the lamps.
- (B) Applicable Codes. All underground wiring shall be accomplished in accordance with the current Electric Code adopted by the State of Utah.
- (C) Wire or Cable. Wire shall be a minimum eight (8) gauge copper wire and shall have appropriate coatings as required by the current Electrical Code. Wire and cable placed in conduit or direct burial shall be rated for the applicable use.
- (D) Ground. Pole will be grounded to grounding rod set in the footing as outlined in the standard Drawings. Neutral lines shall not be connected to the pole.
- (E) Depth of Bury. Direct burial cable conductors and non-metallic raceways shall be a minimum of twenty-four inches (24") below the top back of curb or finished grade, whichever is lower. All cable or conduit shall be inside a raceway where less than twenty-four inches (24") below the top back of curb or finished grade. Cables, conductors, and raceways shall have their location identified by a warning ribbon that is placed in the trench at least twelve inches (12") above the underground installation.
- (F) Splices and Taps. Buried conductors or cables, either contained in a non-metallic raceway or direct bury shall have no splices or taps.
- (G) Backfill. Backfill that contains large rocks, paving materials, cinders, large or sharply angular substances, or corrosive materials that may damage raceway, cables, or conductors or prevent adequate compaction of fill or contribute to corrosion of raceways, cables, or conduits shall not be utilized.
- (H) Raceway Seals. Conduits or raceways through which moisture may contact energized live parts shall be sealed or plugged at both ends. (Ord 02-19)