

CITY OF EDMOND
STANDARD SPECIFICATIONS FOR CONSTRUCTION

600.00 GENERAL CONSTRUCTION

601.00 RIPRAP

601.01 DESCRIPTION. This work shall consist of furnishing and placing riprap protection of the type specified at the locations and in reasonably close conformity with the lines and dimensions shown on the Plans or established by the Engineer. The types of riprap are as follows:

Type I	Plain Riprap
Type I-A	Plain Riprap with Filter Blanket
Type II	Special Plain Riprap
Type II-A	Special Plain Riprap with Filter Blanket
Type III	Laid Up Riprap
Type IV	Grouted Riprap

601.02 MATERIALS. Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Portland Cement	701.02
Fine Aggregate	701.05
Stone for Riprap	713.02
Filter Blanket	713.03
Filter Fabric	712.04

601.04 CONSTRUCTION METHODS.

- A. General.** The slopes, ditches, and areas to be protected shall be shaped and dressed to the lines and grades shown on the Plans. Where Type III or Type IV construction is specified, the base shall be compacted in accordance with Subsection 501.04 before the riprap is placed.
- B. Filter Blanket.** Filter blanket, when specified, shall be placed in one or two layers as indicated on the Plans. When material is stockpiled at the jobsite, it shall be in accordance with Subsection 106.07. Each layer shall be spread uniformly on the prepared base, in a satisfactory manner, to the neat lines indicated. Damage to the surface of the filter blanket during placing of the blanket shall be repaired before proceeding with the work. Compaction of the filter blanket will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.
- C. Filter Fabric.** Filter fabric, when specified, shall be placed to conform to Plan details. Areas on which filter fabric is to be placed shall have a uniform slope, be reasonably smooth, free from mounds and windrows, and free of any debris or projections which could damage the filter fabric to be placed on it.

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The material shall be loosely laid (not stretched). Adjacent strips shall overlap by a minimum of 2 feet. The fabric shall be supported at all times to the extent necessary to prevent displacement of the fabric from its intended position. All methods of fabric support and all methods of holding the fabric in place shall be approved by the Engineer. Laps in filter fabric shall be made in conformance with Section 602.04 B. Any filter fabric damage or displacement before fabric placement, during fabric placement, or during riprap placement shall be replaced or repaired to the satisfaction of the Engineer at the Contractor's expense.

During all periods of shipment and storage, the filter fabric shall be protected from direct sunlight, ultraviolet rays, temperature greater than 140° F, mud, dirt, dust and debris. To the extent possible, the filter fabric shall be maintained wrapped in a heavy duty protective covering.

The work shall be scheduled so that the covering of the filter fabric is accomplished within 30 days after placement or otherwise protected. Failure to comply with this requirement shall require replacement of the fabric.

- D. Types I, I-A, II and II-A.** The areas to be protected shall be dressed approximately to the lines and grades shown on the Plans prior to placing riprap or the filter blanket, when a filter blanket is specified.

Plain riprap and special plain riprap, graded so that the smaller stone is uniformly distributed throughout the mass, may be dumped over the area designated until the required depth is attained. Hand or machine placing will be required as is necessary to deposit the stones to the general lines and to the thickness shown on the Plans.

- E. Type III.** The foundation for riprap shall be excavated below probable scour or the elevation shown on the Plans, and no stone shall be laid or concrete placed until the footing is approved by the Engineer.

The stones shall be placed with their beds at the approximate angle to the slopes as indicated on the Plans. They shall be laid in close contact and so as to break joints, and the individual stones shall be thoroughly keyed into the wall. Spaces between stones shall be filled with spalls securely rammed into place. The finished wall shall present an even, tight and reasonably plain surface of the contour required. Points of stones projecting beyond the surface of the wall shall be broken off.

- F. Type IV.** The foundation for riprap shall be excavated below probable scour or to the elevation shown on the Plans, and no stone shall be laid or concrete placed until the footing is approved by the Engineer.

The stones shall be placed with their beds at the approximate angle to the slopes, as indicated on the Plans. They shall be laid in the close contact and so

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as to break joints, and the individual stones shall be thoroughly keyed into the wall. Care shall be taken during placing to keep earth or sand from filling the spaces between the stones. After the stones are in place, they shall be thoroughly wetted immediately prior to placing grout. The spaces between the stones shall be completely filled with grout from bottom to top and the surface swept with a stiff broom. No riprap shall be grouted in freezing weather and in hot, dry weather the work shall be protected from the sun and kept moist for at least 3 days after grouting.

Grout for grouted riprap shall consist of one part of portland cement and 3 parts fine aggregate by volume, thoroughly mixed with water to produce grout having the proper consistency. Re-tempering of grout will not be permitted.

601.05 METHOD OF MEASUREMENT.

Type I and Type I-A. Plain riprap or plain riprap and filter blanket will be measured separately by the cubic yard determined by multiplying the specified thickness of each type of material by the actual area of the surfaces on which each material is acceptably placed, or by the ton.

Type II and Type II-A. Special plain riprap or special plain riprap and filter blanket will be measured separately by the cubic yard determined by multiplying the specified thickness of each type of material by the actual area of the surfaces on which each material is acceptably placed, or by the ton.

Type III. Laid up riprap will be measured by the square yard. This measurement covers the whole face area, regardless of thickness and including additional thickness at base of walls.

Type IV. Grouted riprap will be measured by the square yard. This measurement covers the whole face area, regardless of thickness, including additional thickness at the base of walls.

Scales for weighing shall meet the requirement of Subsection 109.01.

Filter Fabric. Filter fabric complete in place will be measured by the square yard as constructed to the dimension shown on the Plans or approved by the Engineer.

601.06 BASIS OF PAYMENT. Accepted riprap, measured as provided above, will be paid for at the contract unit price for:

(A)	Type I	Plain Riprap	Cu.Yd. or Ton
(A-1)	Type I-A	Plain Riprap	Cu.Yd. or Ton
(A-2)	Type I-A	Filter Blanket	Cu.Yd. or Ton
(B)	Type II	Special Plain Riprap	Cu.Yd. or Ton
(B-1)	Type II-A	Special Plain Riprap	Cu.Yd. or Ton

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(B-2)	Type II-A	Filter Blanket	Cu.Yd. or Ton
(C)	Type III	Laid Up Riprap	Sq. Yd.
(D)	Type IV	Grouted Riprap	Sq. Yd.
(E)		Filter Fabric (Riprap)	Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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602.00 GABIONS

602.01 DESCRIPTION. This work shall consist of furnishing and placing rock filled wire mesh baskets (Gabions) and filter fabric in accordance with these Specifications and in reasonably close conformity with the lines, grades dimensions and details shown on the Plans or established by the Engineer.

602.02 MATERIALS. Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Filter Sand	703.04 B.
Filter Fabric (Gabions)	712.02
Stone for Gabions	713.04.2.
Wire Baskets	732.09

602.04 CONSTRUCTION METHODS.

A. Gabions. Gabions shall be constructed in various lengths and heights shown on the Plans. The lengths shall be multiples of 2, 3, or 4 of the base width. The heights shall be equal to all of, 1/2 of, or 1/3 of the base width. The base width shall not be less than 36 inches. Gabions furnished shall be of uniform width.

Gabions may be rotated 90°, if called for on the Plans, so that the side height becomes the base.

Gabions shall be placed to conform to Plan details; otherwise, the gabions shall be installed according to the manufacturer's recommendations. The gabions shall be placed on a smooth foundation. Each row or tier of gabion baskets shall be reasonably straight and conforming to proper alignment and grade before baskets are filled. Final line and grade shall be approved by the Engineer.

Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 6 inch spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every 4 inches.

All gabion units shall be tied together to each adjacent unit along all contacting edges in order to form a continuous connecting structure. Wire ties or connecting wire shall be used to join the units together in the same manner as described for assembling each unit.

A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment of the baskets during placement of the rock. If, while being stretched, any openings in or between gabions appear, the openings shall be repaired before further placement of the rock.

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Rock fill shall be placed in close contact in the unit so that maximum fill is obtained. The units may be filled by machine with sufficient hand work to accomplish requirements of these Specifications. The rock fill shall be placed in three equal lifts. After each the first and second lift, half the connecting wires shall be placed; half of these connecting wires placed at each elevation shall be at a 90° angle to the other half of the connecting wires. Internal tie wires shall be uniformly spaced and securely fastened in each cell of the structure. Alternate placing of rocks and connection wires shall be performed until the gabion is filled. After the gabion has been filled, the lid shall be bent over until it meets the side and the edges. The lid shall then be secured to the sides, ends and diaphragms with wire ties or connecting wire in the manner described above for assembling each unit.

B. Filter Fabric. Filter fabric shall be placed for filtration and prevention of piping erosion.

Unless otherwise shown on the Plans the filter fabric shall be placed behind gabion walls and beneath gabion slope protection. The filter fabric shall be placed to conform to Plan details.

Areas on which filter fabric is to be placed shall have a uniform slope, be reasonably smooth, free from mounds and windrows, and free of any debris or projections which could damage the filter fabric to be placed on it.

The material shall be loosely laid (not stretched). Adjacent strips shall overlap by a minimum of 2 feet. The fabric shall be supported from the top at all times to the extent necessary to prevent displacement of the fabric from its intended position; the configuration of the gabion may require repositioning of the filter cloth several times during gabion construction. Other methods of holding the filter fabric in place may also be used such as securing pins, staples, or wires, but the primary support of the fabric shall be from the top. All methods of fabric support and all methods of holding the fabric in place shall be approved by the Engineer.

Vertical fabric laps shall be staggered at least 5 feet. Laps shall be made with the uphill layer on top. Full rolls shall be used whenever possible in order to minimize the number of vertical laps. When a gabion is placed adjacent to a stream, the fabric shall be placed so that the upstream strip of fabric will overlap the downstream strip.

If the configuration of the gabions requires that the gabion be placed on the filter fabric, then the rock fill shall be placed, not dropped, in the baskets to avoid damage to the filter fabric. Any filter fabric damaged or displaced before fabric placement, during fabric replacement, or during rock fill placement shall be replaced or repaired to the satisfaction of the Engineer at the Contractor's expense.

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During all periods of shipment and storage, the filter fabric shall be protected from direct sunlight, ultraviolet rays, temperatures greater than 140° F, mud, dirt, dust and debris. To the extent possible, the filter fabric shall be maintained wrapped in a heavy duty protective covering.

The work shall be scheduled so that the covering of the filter fabric is accomplished within 30 days after placement or otherwise protected. Failure to comply with this requirement shall require replacement of the fabric.

C. Filter Sand. Filter sand will not be required unless specified on the Plans. When filter sand is required, it shall be placed in accordance with the lines, dimensions and locations designated. Care shall be taken during placement of the filter sand not to damage or displace the plastic filter fabric.

D. Backfilling. Backfill behind gabions shall be placed and compacted in accordance with Subsection 202.04 C. of the Specifications.

602.05 METHOD OF MEASUREMENT. Acceptable gabions, complete in place, will be measured by the cubic yard as constructed to the dimensions shown on the Plans or approved by the Engineer.

Acceptable filter fabric, complete in place, will be measured by the square yard as constructed to the dimensions shown on the Plans or approved by the Engineer.

Rock fill for gabions will be included in the price bid per cubic yard of gabions.

Filter sand when required on the Plans will be included in the price of gabions.

Unless otherwise shown on the Plans, there will be no payment for backfilling behind gabions. If no payment for backfilling is allowed on the Plans, all cost of backfilling shall be included in the price of gabions.

602.06 BASIS OF PAYMENT. Accepted quantities of gabions, measured as provided above, will be paid for at the contract unit price for:

(A)	Gabions	Cu. Yd.
(B)	Filter Fabric (Gabions)	Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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609.00 INTEGRAL CURB, COMBINED CURB AND GUTTER AND HEADER CURBING

609.01 DESCRIPTION. This work shall consist of the construction of integral curb, combined curb and gutter, header curbing, in accordance with these Specifications and in reasonably close conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

609.02 MATERIALS. Concrete for integral curb, combined curb and gutter or header curbing shall be Class A concrete meeting the requirement of Section 701.

Sealing materials for concrete curbs shall conform to Subsection 701.08. Materials for sealing new concrete pavements and for most joint rehabilitation applications shall be in accordance with Subsection 701.08 E.; materials for sealing joints in integral concrete curb and combined curb and gutter shall be in accordance with Subsection 701.08 D., unless otherwise approved by the Engineer.

609.03 EQUIPMENT. A self-propelled or towed curb machine may be used when approved by the Engineer. The curb machine shall be capable of extruding a uniformly textured material to the shape and density specified and placing it in reasonably close conformity to the established line and grade.

609.04 CONSTRUCTION METHODS.

A. Excavation. Excavation shall be made to the required depth, and the base upon which the curb is to be set shall be compacted to a firm, even surface. All soft and unsuitable material shall be removed and replaced with suitable material which shall be thoroughly compacted.

B. Forms. Forms shall be of wood, metal or other suitable material, straight, free from warp and of such construction that there will be no interference to the inspection of grade or alignment. All forms shall extend for the entire depth of the curb or curb and gutter and shall be braced and secured sufficiently so that no deflection from alignment or grade will occur during the placing of the concrete or asphalt.

Fastening hardwood strips to the bottom of the forms not to exceed 2 inches in built-up thickness for special curb sections to provide the specified thickness may be permitted. The material and method of fastening the built-up section to the form shall be approved by the Engineer prior to use.

Forms shall be sufficiently tight as to prevent leakage. Forms shall be clean and oiled or wetted before placing concrete.

C. Placing Concrete. Checking forms, and placing and vibrating concrete shall be in accordance with Subsection 414.04.

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- D. Surface Finish.** As soon as the curb concrete has set sufficiently to retain its shape without support, the final surface finish shall be obtained by uniformly brushing the surface in a manner approved by the Engineer.

The edges of all formed concrete joints, including edges at expansion and contraction joints or planes of weakness joints, shall be neatly edged to the required radius.

- E. Joints.** All joints in curbs shall be perpendicular to the sub-grade at right angles to the longitudinal axis of the curb. Expansion and contraction joints shall be constructed at the same location as similar joints in the paving slab.

Expansion joints shall be pre-molded expansion joint filler and shall be of the thickness and placed at the locations shown on the Plans or as approved by the Engineer. Joints shall be placed in the curb, gutter, or combined curb and gutter opposite the joints in the pavement.

Contraction joints in curb and gutter, when used in conjunction with asphalt surfacing, shall be sawed as specified in Subsection 609.04 H. and sealed with the same material specified for sealing expansion joints.

- F. Curb Openings.** Where curb is to be omitted for driveways, or other cause, either all or only the top portion of the separate curb may be omitted as shown on the Plans or approved. In general, only the curb will be left off of combined curb and gutter. Where the bottom portion of separate curb or the gutter of combined curb and gutter is left in place, the concrete shall be constructed slightly higher at the back of the curb line than at the front as shown on the Plans or as approved. Such curb shall be considered as regular curb.

- G. Curing.** Concrete curbs or combined curb and gutter shall be cured in accordance with Section 414.

- H. Extruded Method.** When the extruded method is used to construct combined curb and gutter, the extrusion machine shall be operated on a string or wire line, rails or forms set at uniform depth below the predetermined finished top of curb grade.

Concrete shall be uniformly fed to the machine and shall be of such consistency that after extrusion the concrete will maintain the shape of the section without support. The finished curb or curb and gutter shall present a well-compacted mass with a surface free from voids and honeycomb and reasonably true to established shape, line and grade. Any additional surface finishing required shall be performed immediately after extrusion. Tolerances shall meet the requirements of Subsection 414.04 S.

Joints shall be constructed at the same locations as required when form

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construction is being used. Weakened joints, spaced at 20 foot intervals, shall be made by sawing unless other methods are approved by the Engineer.

I. Backfill. The back side of the curbs shall be backfilled with approved earth and thoroughly compacted in layers not exceeding 6 inches in depth and neatly graded as shown on the Plans or as approved by the Engineer. Care shall be taken not to damage the concrete in placing or compacting the backfill; any damage will be repaired at the Contractor's expense.

609.05 METHOD OF MEASUREMENT. Curbing will be measured by the linear foot along the front face of the curb for (a) concrete curb; (b) combined curb and gutter; and (c) concrete header curbing.

609.06 BASIS OF PAYMENT. The accepted quantities, measured as provided above, will be paid for at the contract unit price for:

(A)	Concrete Curb	Lin. Ft.
(B)	Combined Curt and Gutter	Lin. Ft.
(C)	Concrete Header Curbing	Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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Where the general elevation of the adjacent ground surface is lower than the top of the sidewalk or driveway, the minimum width of the backfill shall be 2 feet.

C. Protection from Traffic. Sidewalks, driveways and dividing strip shall be protected from traffic using substantial barricades for a period of 7 days, unless otherwise permitted or ordered by the Engineer.

D. Remove Relay or Extend Brick or Stone Sidewalks. Where existing brick or stone sidewalks are to be re-laid or extended, the sub-grade shall be prepared as specified for concrete sidewalks, provided that a sand cushion 1-1/2 inches in depth shall be prepared, having a uniform flat surface at the proper sub-grade elevation. All old bricks shall be satisfactorily cleaned before re-laying. The brick or stone shall be laid close together in a manner to match the existing walk and shall be uniformly tamped firmly into the sand cushion. The top surface of the walk shall be smooth and at the proper grade. All joints shall be filled with concrete sand by spreading an excess over the surface and sweeping it into the joints. The top surface of the brick shall be cleaned. The sides of the walk shall be backfilled as specified for concrete walks.

610.05 METHOD OF MEASUREMENT. Concrete sidewalks, driveways and dividing strip will be measured by the square yard. Removing, re-laying, or extending of brick or stone sidewalks will be measured by the square yard.

610.06 BASIS OF PAYMENT. The accepted quantities, measured as provided above, will be paid for at the contract unit price for:

(A)	Concrete Sidewalk	Sq. Yd.
(B)	Concrete Driveway	Sq. Yd.
	(High Early Strength)	Sq. Yd.
(C)	Concrete Dividing Strip	Sq. Yd.
(D)	Remove and Relay Brick or Stone Sidewalk	Sq. Yd.
(E)	Brick or Stone Sidewalk	Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Reinforcement, if used, excavation, backfill, expansion joint material, rolled curb on driveways and other related miscellaneous items will not be paid for separately, but the cost thereof shall be included in the cost of other items.

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611.00 MANHOLES, DROP OR CURB INLETS, AND JUNCTION BOXES

611.01 DESCRIPTION. This work shall consist of the construction of manholes, drop or curb inlets, including special curbs, junction boxes or similar structures in accordance with the Plans and these Specifications, and in reasonably close conformity with the lines, grades and elevations shown on the Plans or established by the Engineer.

The option of furnishing precast concrete units in lieu of brick masonry or cast-in-place concrete structures may be considered by the Engineer if requested in writing by the Contractor.

611.02 MATERIALS.

A. General. Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Portland Cement	701.02
Mortar Sand	701.05
Clay or Concrete Brick	714
Reinforcing Steel	723.01 & 723.02
Structural Steel	724
Steel Castings	725.03
Iron Castings	725.04
Precast Manholes	726

Portland cement concrete shall be Class A and shall meet the requirements of Subsection 701.01.

Clay or concrete brick or precast concrete units shall not be used in the construction or rebuilding of sanitary sewer manholes.

All precast structures with slab tops which may be subject to traffic, shall meet H-20 loading requirements.

Concrete for precast units shall be Class A concrete. The coarse aggregate shall conform to Subsection 701.06. Coarse aggregate for thin section concrete, No. 7 (1/2 in. - No. 4) size. Alternate material shall be concrete referenced in AASHTO M 199 (ASTM C 478).

Reinforcing steel for precast concrete units shall conform to the requirement of Subsections 723.01, 723.02 and 723.03.

Alternate material shall be steel referenced in AASHTO M 199 (ASTM C 478).

B. Portland Cement Mortar. The mortar for use with brick masonry shall be composed of one part portland cement and two parts mortar sand by volume, mixed with sufficient water to form a plastic consistency. The use of hydrated

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lime not to exceed 10 percent by volume of the amount of cement will be permitted, but when used shall be added to the cement first and in proportioning the mortar will be considered as cement.

- C. Accessories.** Accessories, such as bolts, rivets, spacers, small I-beams, channels, and plates used for assembling or supporting frames, gratings, or covers shall be of first quality standard commercial material free from defects which may affect their value for the service intended.
- D. Pipe Materials.** Pipe required for construction of manholes, inlets or junction boxes shall conform to the requirements of the type of improvement under construction. Sanitary sewer pipe shall conform to Section 615, drainage pipe to Section 613, and etc.

611.03 EQUIPMENT. Specialized equipment required for off-loading, handling and placement must be demonstrably capable of safely handling the largest single unit and/or subassemblies. Lift holes or lift rings shall be provided in each unit at the manufacturer's discretion and all lift devices and/or connection points shall provide safe handling above ground and in the inlet excavation.

611.04 CONSTRUCTION METHODS.

- A. Concrete.** In the construction of concrete bottoms for manholes and inlets, the concrete shall be rounded to the dimensions and shape, the surface shall be troweled until a uniform, smooth and impervious hard fanned finish is obtained.

All exposed concrete edges shall have a minimum 1/2 inch chamfer, or an approved rounded edging. Unless otherwise specified, all exposed concrete or brick surfaces shall be finished in accordance with Subsection 509.04 P.

- B. Concrete Brick.** Brick masonry in circular or curved walls which have a radius of less than 2 feet, shall have every fifth course stretchers, and the remainder, headers, and the thickness of joints shall not exceed 1/4 inch vertical on the inside face, or 3/8 inch horizontal. Brick masonry in straight walls and in walls where the radius of curvature is 2 feet or greater, shall have every fifth course headers, and the remainder, stretchers, and all joints shall have a thickness not exceeding 3/8 inch. Vertical joints in adjacent courses shall be broken approximately half the length or width of the brick, as the case may be.

All brick shall be laid in a full bed of mortar and all joints shall be shoved joints, completely filled with mortar. Buttered joints will not be permitted. The joints on the inside face or exposed face of the masonry shall be rubbed full and cut as the brick work is built up. The masonry shall be built up in level courses, reasonably true to line, grade and dimension. Bats shall be used only when necessary to close joints, or around irregular openings. All brick shall

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be thoroughly wet down immediately before being placed. All work shall be completed and finished in a careful, workmanlike manner. Old brick masonry shall be thoroughly cleaned and wetted before joining new masonry thereto. Where a mortar coating is required, it shall have the minimum thickness shown on the Plans, shall be applied while the brick masonry is clean and damp and shall be troweled and re-troweled until a uniform, smooth and relatively impervious surface is obtained.

C. *Pipe Connections.* Inlet and outlet pipe shall be of the size indicated on the Plans. The end of the pipe shall be flush with the inside of the wall and shall be tightly sealed in the wall with mortar throughout the circumference of the pipe. The mortar shall be pressed in and troweled off flush with the face of the wall.

D. *Special Curb.* Curbs adjacent to inlets shall be the same kind of concrete as that used in the regular curb, or where no regular curb is being built, shall be Class A concrete. The forms for the curb opening shall be accurately shaped to the dimensions specified on the Plans and securely held in true position. They shall remain in place not less than 3 days under favorable curing conditions and as much longer as approved by the Engineer under unfavorable conditions.

E. *Reinforcing Steel.* All reinforcing steel shall be placed in accordance with Section 511.

F. *Castings, Grating and Drop Inlet Gratings and Special Frames.*

All castings, gratings or special frames or supports shall be accurately and rigidly assembled and carefully placed as shown on the Plans. The frames of all manhole frames and covers, and inlet frames and gratings shall be bedded in a substantial layer of mortar, shall have a full bearing, and shall be set to the exact grade required. Unless otherwise shown on the Plans, the top of such casting shall be flush with the surrounding surface.

Exposed surfaces of special structural steel frames and supports shall be painted as provided in Section 506 except that the second field coat may be from the same paint as the first but with the addition of lamp black paste at the rate of 1½ pounds per gallon.

G. *Excavation and Backfill.* Excavation and backfill shall be in accordance with Subsection 615.04 B. and F.

H. *Precast Units.* Precast concrete units shall be bedded on a 4 inch minimum thick solid foundation of clean uniformly graded material. No clay balls or cement clumps will be allowed. The units shall be anchored securely to prevent lateral or vertical movement. Inlet excavation shall be backfilled and thoroughly compacted as soon after placement as is practicable.

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Entrance and exit conduits shall be placed with their flowlines as shown on the Plans. Under no circumstances will the elevation or angle be altered to facilitate ease of installation or to make use of an existing blackout.

Precast concrete inlet units (main boxes and additional opening boxes) may be set flush or slightly below the sub-grade to allow free travel of the paving equipment. If precast concrete inlet assemblies are set at or below sub-grade elevation, a leveling course shall be used to bring the inlet assembly to final working grade. A formed and poured concrete collar pinned to the inlet box and additional opening boxes shall be used. A rich mortar collar, formed or puddled, is not acceptable as a leveling course. All precast concrete units shall provide a watertight connection between subassemblies and at each entrance or exit conduit blackout.

If a unit is delivered with a blackout placed in error, or if the Plans are altered to render a blackout unnecessary, the hole shall be cleaned and filled with an approved concrete patch. The patch may be from a previous blackout hole securely grouted in place or poured and/or placed using a dry-mix high strength concrete.

Gasket material used between subassemblies, or between the inlet unit and entrance or exit conduits, shall be of approved adhesive materials.

When precast units are used, all joints and the base shall be properly sealed to prevent the passage of water. To prevent the passage of water wall joints shall be sealed in accordance with Subsection 613.04 E. with the following exception: joints shall be made with a single natural rubber or neoprene gasket or "O" ring, in accordance with the manufacturer's recommendations.

I. Drop Manhole Connections. The pipe shall be of the size indicated on the plans. All drop connections shall be constructed as outside drop connections. Where drop connections will be made to existing sewer works the work shall include removal of pipe, manhole walls, etc., and performance of any incidental work to complete installation.

Each drop connection shall consist of the necessary pipe, fittings, and materials to provide a complete connection. All materials shall conform with requirements specified in Section 615. No additional payment will be made for excavation, backfill, pipe, fittings, or incidental materials.

611.05 METHOD OF MEASUREMENT. The accepted items of this Section will be measured for payment in the following manner:

A. Manholes. Manholes, except special manholes, that do not exceed 6 feet in depth, as measured from the bottom of the frame cover casting to the flow line of the outlet lead will be measured for payment as manhole and shall

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include the walls and the concrete bottom.

B. Additional Depth in Manholes. Manholes, except special manholes, exceeding 6 feet in depth will be measured as set out above, and the depth in excess of 6 feet will be measured by the vertical foot of wall and classified for payment as additional depth in manhole.

C. Frames, Covers and Grates. Frames, covers and grates for manholes and junction boxes will not be measured but shall be included in price bid for each structure.

Cost of support beams for installation in junction boxes shall be included in above measured items. They shall not be measured separately.

Cost of T handles for locking manhole covers when specified shall be included in measurement for the above items. Two handles will be furnished for up to and including 20 locking manhole covers and one for every 20 thereafter.

D. Inlets. Inlets will be measured by each unit. Units for inlet boxes, single or double, and additional curb opening boxes will be measured complete in place by inlet per each unit specified by configuration.

E. Drop Manhole Connections. Drop connections shall be measured by each unit. No measurement of height will be considered or made. All pipe, concrete, and miscellaneous materials required to make a complete drop connection will be included and will not be measured for payment.

F. Frames and Grates for Inlets. Frames and grates for inlets will not be measured by each inlet frame and grate, inlet frame or inlet grate, complete in place and accepted shall be included in price bid for each structure.

Cost of support beams and/or support beams with riser plates shall be included in above-measured items. They shall not be measured separately. Bolts and nuts necessary for installation as shown on the Plans shall not be measured separately; their cost shall be included in the above-measured items.

G. Cast Steel Grate. For use with special frames, cast steel grates will not be measured for payment.

H. Special Structural Steel Frames. Special structural steel frames will be measured by each such frame, complete in place, if so provided on the Plans or in the proposal. Painting will not be measured as a separate item, but the cost of same shall be included in the price bid for the structural steel frame.

I. Junction Boxes. Junction boxes will be measured by the each.

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611.06 BASIS OF PAYMENT. Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

(A)	Manhole	Ea.
(B)	Additional Depth in Manhole	Vert. Ft.
(E)	Inlet	Ea.
(F)	Drop Manhole Connections	Ea.
(I)	Special Structural Steel Frames	Ea.
(J)	Junction Boxes	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Excavation and backfill will not be measured for payment, but the cost of same will be included in the unit price or prices bid for various pay items.

Reinforcing steel will be included as part of the cost of the structure complete and will not be measured as a pay item.

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612.00 ADJUSTMENT OF EXISTING STRUCTURES

612.01 DESCRIPTION. This work shall consist of the necessary adjustment, alterations, relocating or resetting to the required grade and alignment of existing structures, equipment or appurtenances which are not to be removed or abandoned and which are not the property of a private company, firm, or corporation required to move their own property, in accordance with these Specifications and in reasonably close conformity with the lines, grades, elevations and dimensions shown on the Plans or approved by the Engineer.

When specified on the Plans or shown in the Proposal, this work shall include refurbishing and resetting existing electrical equipment taken from storage.

612.02 MATERIALS. Materials for use in this work, including the existing item to be adjusted or reset and any new material necessary, shall be specified on the Plans, or if not specified, shall be of the same grade of material as specified elsewhere in these Specifications or for a similar type work or of a material equivalent to that in the structure being adjusted.

612.04 CONSTRUCTION METHODS.

A. General. The materials and workmanship necessary in raising, lowering or otherwise adjusting or resetting existing structures shall conform to the requirements of the Plans and Specifications for the class of work involved, or as approved by the Engineer. Existing structures shall be rebuilt in accordance with the Plans and Specifications. The final adjustment to grade shall be completed after the final surface course has been placed if the structure is in the pavement.

The Contractor shall guard against damage or breakage to any portion of the structure or appurtenance to be altered, removed or reset. Any damage or breakage due to the Contractor's failure to properly protect such structure or appurtenances shall be repaired or replaced at the Contractor's expense.

Items to be reset from storage shall be transported from the storage site and reset as shown on the Plans. The Contractor shall repair or replace any items damaged as a result of his failure to properly transport, adjust or reset the structure or appurtenance. If the Plans specify an existing item to be modified, cleaned, repaired or otherwise made ready for reuse, this work shall be in accordance with the Plan requirements, prior to being reset at the planned location.

B. Manholes. Where the tops of the manholes are to be lowered to a new grade, the walls shall be removed and rebuilt to an elevation far enough below the new grade so that the maximum batter of the walls does not exceed 4 inches per foot.

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Where manholes are to be built up a distance of one foot or less to a new grade, the walls may be carried up vertically. Where the walls are to be built up a distance exceeding one foot, the existing walls shall first be removed to the bottom of the batter section of the walls, or to such elevation that the inside diameter of the manhole is not less than 3.5 feet. The manhole shall then be rebuilt in conformity with the size and shape requirements for new manholes.

- C. *Catch Basins, Inlets, Manholes.*** Where inlets, catch basins, manholes or similar structures are to be revised to grade or rebuilt, the work shall be done in conformity with the requirements for new construction of this class of work as provided elsewhere in these Specifications.
- D. *Valve Boxes, Meter Boxes.*** Care shall be taken in removing and resetting to grade, valve boxes, meter boxes, etc., to avoid breaking and any breakage shall be replaced by the Contractor at his expense.
- E. *Fire Hydrants, Valves, Water Meters, Waterlines, Manholes and Etc.*** Where adjustment or relocation of waterlines and appurtenances is to be done by the City, the Contractor shall be responsible for coordinating the arrangements with the City for lowering or relocating of all waterlines and the resetting of water valves, meters, manholes, and fire hydrants. When the alteration is part of the work to be performed by the Contractor as a part of his contract, such work shall be done in conformity with the requirements of the City and in accordance with the requirements of these Specifications for new work of this type.
- F. *Traffic Signal or Highway Lighting Systems.*** When the adjustment or relocation of traffic signal or highway lighting systems require new concrete footing or other concrete appurtenances, these concrete structures shall be in accordance with the details shown on the Plans and shall be paid for in other items of work, unless otherwise specified.

Items to be reused such as signal heads, luminaries, and etc., shall be inspected for damage, thoroughly cleaned and re-lamped with a new lamp of the original size and type before reinstalling the item.

Materials that are not reusable, such as wiring, connectors, fuses, conduit, and etc., shall be disposed of in a manner approved by the Engineer. All additional new materials necessary to complete the installation as specified and make the system operational shall be furnished by the Contractor and paid for in other items of work.

After adjusting and/or resetting the items specified in this work and after the electrical connections have been completed, the traffic signal or highway lighting system shall be energized and tested in a manner approved by the Engineer. Any item that fails to function as specified shall be corrected, by the

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Contractor, to the satisfaction of the Engineer.

G. Pipe Sewers. Pipe sewers and appurtenances which are to be removed and re-laid shall be re-laid in conformity with the requirements for new sewers.

H. Waterlines. Waterlines and appurtenances which are to be removed and re-laid, or to be lowered shall be re-laid in conformity with the requirements for new waterlines.

612.05 METHOD OF MEASUREMENT. Structures to be adjusted and/or reset, or re-laid will be measured by each unit of the type and size specified or on the lump sum basis, if stipulated, complete with all necessary accessories and operationally tested.

612.06 BASIS OF PAYMENT. The accepted quantities of items, measured as provided above, will be paid for at the contract unit price for:

(A)	Manholes Adjust to Grade	Ea.
(B)	Manholes Rebuilt	Ea.
(C)	Catch Basins Adjust to Grade	Ea.
(D)	Catch Basins Rebuilt	Ea.
(E)	Inlets Adjust to Grade	Ea.
(F)	Inlets Rebuilt	Ea.
(G)	Valve Boxes Adjust to Grade	Ea.
(H)	Meter Boxes Adjust to Grade	Ea.
(I)	Lampholes Adjust to Grade	Ea.
(J)	Fire Hydrant Reset	Ea.
(K)	Valves Reset	Ea.
(L)	Water Meters Reset	Ea.
(M)	Waterline Lowered	Lin. Ft.
(N)	Waterline Removed and Re-laid	Lin. Ft.
(O)	Remove & Relocate Traffic Signal (Specific Item)	Lump Sum
(P)	Reset Light Poles (Specific Item)	Ea.
(Q)	Electric Cable Re-laid	Lin. Ft.
(R)	Electric Cable Conduit Re-laid	Lin. Ft.
(S)	Pipe Sewer Removed and Re-laid	Lin. Ft.
(T)	Remove and Reset Manhole Frame and Cover	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Valve boxes, meter boxes, etc., in connection with valves or meters to be reset will be considered as part of the valve or meter and will not be paid for as a separate item.

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Valves in waterlines or fire hydrant leads will not be considered as a separate pay item, but the cost of resetting same shall be included in the contract unit price for the waterline or lead.

When the valve is under pavement, adjustment of valve box will be a separate pay item.

Extensions to fire hydrant leads, when separately classified for payment, will be paid for as set out for the new waterlines under Section 616, otherwise cost of pipe for extending lead shall be included in the contract unit price for fire hydrants reset.

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613.00 DRAINAGE CONDUITS

613.01 DESCRIPTION. This work shall consist of the construction of pipe conduits of the type shown on the Plans in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer. Included are pipe underdrains 4 inches in diameter or greater and all other pipe with an inside diameter of 12 inches or greater used in storm drains and culverts or drainage conduits not defined as bridges.

613.02 MATERIALS. Drainage conduit shall be of the kind specified on the Plans and shall meet the requirements of Section 726. The class of reinforced concrete pipe and the sheet thicknesses of the corrugated steel and corrugated aluminum pipe for various diameters and heights of fill above the top of pipes shall be as shown on the Plans. When the class of reinforced concrete culvert pipe is not specified it shall be Class III.

All reinforced concrete culvert pipe to be installed under paving shall be "O" ring joint pipe.

When not specified on the Plans, the kind of pipe will be optional with the Contractor, but the same kind of pipe shall be used throughout any one project, unless otherwise approved in writing by the Engineer.

Joint filler and cover materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Joint Filler	726.02 A.
Cover Material For Pipe Underdrains	703.04

The type, size, class and quantity of pipe to be installed by jacking shall be as specified on the Plans.

613.04 CONSTRUCTION METHODS.

A. General. The construction of all pipe conduit shall begin at the outlet or the low point in the line. When the construction involves the building of main or sub-main drainage conduit having one or more laterals or tributaries, the construction of tributary lines will not be started until the main or sub-main drainage conduit has been completed to the point where the tributary or laterals discharge into it.

The installation practices shall be adhered to as shown on the Plans. Any conduit cracked or deformed prior to final acceptance shall be replaced by the Contractor at his expense.

During the construction, adequate provisions for drainage of the system shall be made by the Contractor.

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The connection of storm drain appurtenances to other storm drain appurtenances shall be made in accordance with the Plans or in a manner approved by the Engineer. The work shall be done in a workmanlike manner in such a way as not to damage any of the structures involved. Storm drain conduit shall not project beyond the inside wall line of other sewers or of sewer appurtenances. The grade line shown on the Plans or established by the Engineer is the elevation of the invert or flow line of the drain. The center line and grade line shall be accurately established in the trench at intervals not more than 25 feet. If the Contractor elects to use a laser device to establish line and grade, the interval may be increased to 50 feet, except that the first interval shall be set at 25 feet when laying out of a manhole or appurtenance.

Dead ends of all conduits or drains, wyes, tees, etc., shall be closed with approved stoppers securely cemented in place. When work is stopped temporarily on storm drains 24 inches in diameter and smaller, the end of the pipe shall be closed to prevent trash or debris from entering the pipe. Such stoppers should not be watertight.

- B. *Excavation.*** Except by special permission from the Engineer, the amount of trench excavated at any time shall not exceed the amount in which pipe conduit can be set and the trench backfilled in 2 calendar days. Where conduits are to be placed in embankment fill, the trench excavation shall be made after the embankment has been completed to a height specified on the Plans above the design flowline grade for those conduits.

The width of trench excavation at the bottom of the trench shall be held to a minimum or as shown on the plans. Trench excavation shall be of constant width for at least 2 feet above the top of the conduit.

Bell holes or recesses for bells of the pipe shall be excavated at every joint and shall be of sufficient size and depth to relieve the bell of all load, permitting the barrel to be firmly bedded throughout its length and to provide ample space for forming the joint. Filling and ramming earth or other material beneath the pipe to raise it to grade will not be permitted. Where a concrete cradle or refill is shown on the Plans or required by the Engineer, it shall be placed in conformity with the Plans and Specifications and shall consist of Class A concrete meeting the requirements of Section 701.

The completed trench bottom shall be firm for its full length and width. Where required, in the case of cross drains, the trench shall have a longitudinal camber of the magnitude specified.

- C. *Bedding.*** When bedding is not specified on the Plans the bedding used shall be Class B except for pipe underdrains. Classes of bedding are as follows:

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1. *Class A.* Class A bedding shall consist of a continuous concrete cradle conforming to the Plan details.
2. *Class B.* Class B bedding shall consist of bedding the conduit to the depth shown on the Plans. The bedding material shall be shaped to fit the conduit for at least 15 percent of its total height with a cushion of bedding material a minimum of 4 inches deep below the conduit.

The bedding material shall be standard bedding material of sand, stone screenings or selected sandy soil, all of which passes the 3/8 inch sieve with not more than 15 percent passing the No. 200 sieve.

3. *Class C.* Class C bedding shall consist of bedding the conduit to a depth of not less than 10 percent of its total height. The bed shall be shaped to fit the conduit and shall have recesses shaped to receive the bell.
4. *Underdrain Bedding.* A bedding layer of granular backfill material meeting the requirement of Subsection 703.04 shall be compacted in the bottom of the trench for its full width and length as shown on standard drawings for pipe underdrain.

D. *Laying Pipe.* Pipe conduit shall not be laid unless the foundation is in a condition satisfactory to the Engineer. The laying of pipe in a wet trench shall be done only when and as approved by the Engineer. The spigot end of the pipe shall be laid in the direction of the flow. No buckling in or laying pipe downgrade will be permitted. Pipe shall not be dropped to the bottom of the trench, but shall be lowered and placed in its final position by hoisting equipment adequate to handle the pipe without damage to the pipe or trench. Damaged pipe shall be replaced by the Contractor at his expense. The inside of the barrel shall be cleaned when the pipes are lowered into the trench.

The conduit laying shall begin at the downstream end of the conduit line. The lower segment of the conduit shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid conduits and outside circumferential laps of flexible conduits shall be placed facing upstream.

Paved or partially lined conduit shall be laid so that the longitudinal center line of the paved segment coincides with the flow line. Elliptical and elliptically reinforced conduits shall be placed with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the conduit.

Underdrain pipe shall be embedded firmly in the bedding material. The pipe shall be laid reasonably true to the established line and grade. Perforated (round holes or elongated slots) pipe shall be laid with perforations down. Pipe underdrain with a top of pipe identification shall be laid with the marker up in all installations.

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Metal screens having 1/2 inch mesh size openings composed of either 0.062 or 0.041 inch diameter steel wire (after galvanization) meeting the requirements of ASTM A 740 shall be formed and securely fastened to the outlet end of the sub-drain pipe. End caps fabricated of the same base material as used in the pipe shall be shaped for a drive fit inside the dead end of the pipe or otherwise firmly attached thereto as approved by the Engineer.

After the pipe has been inspected and approved, it shall be carefully covered with cover material and/or backfill material as shown on current standard drawings, taking care in placing cover materials to prevent displacement or damage to the pipe. Regular backfill materials, excavated from the trench if suitable, may be used over non-perforated pipe underdrain unless the Engineer directs that granular cover material shall be used. When dumping from trucks or bucket machinery which causes deformation or misalignment in the installed pipeline, alternate methods such as small windrows on the trench edge and careful blading of small amounts of cover material into the trench may be utilized.

The Contractor shall furnish and set a marker post at the outlet of all pipe underdrains. (See details on current standard drawings.) Costs are to be included in the contract unit price per linear foot of pipe underdrain.

E. *Joining Pipe Conduit.* Rigid conduits may be of bell, spigot, or tongue and groove design unless one type is specified. The method of joining conduit sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Joints shall be made with mortar, cold applied mastic, rubber gaskets, or plastic joint material in accordance with the appropriate Specifications for the type of pipe being used. Joints shall be concentric, reasonably watertight and free from superfluous joint material on the inside of the pipe. Flexible conduit shall be joined by an approved external or internal coupling device (separate item), or by an approved twist-lock coupling system integrated into the wall of the conduit. Any coupling system shall firmly and solidly join the conduit to prevent separation during installation, handling, and backfilling operations. The performance under field conditions will determine the acceptability of the coupling system, and repeated releases of any system will be cause for rejection. The Engineer has the right of approval or rejection of any coupling system, regardless of its presence or absence on an approval list elsewhere.

F. *Shop Elongating.* When required on the Plans, the pipe shall be shop elongated in accordance with AASHTO M 36 to form an approximate ellipse with the vertical diameter approximately 5 percent greater than the nominal diameter of the corresponding round pipe.

G. *Backfilling.* Conduit shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and re-laid or replaced. Inside joints shall be smooth and barrels clean before

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backfilling. Standard bedding material shall be placed over all pipe except pipe underdrain to the depth shown on the Plans. Backfilling shall be placed and uniformly compacted in accordance with Subsection 615.04 F.

H. *Jacking, Boring Pipe Conduit.* Conduit of any nature shall not be placed by jacking, boring or pushing unless shown on the Plans or designated in the Contract. The Engineer will establish line and grade, and the limits, if any, of placement to be made by open trench methods of construction for each line of conduit where jacking or boring has been designated.

Unless otherwise specified, the methods and equipment used in jacking and boring conduit shall be optional with the Contractor, provided that the proposed method is approved by the Engineer. The Contractor shall investigate the area of placement and will be responsible not to interfere with existing underground utilities under the roadway or adjacent to the jacking operation. Care shall also be taken to keep the disturbed area of construction to a minimum.

Unless otherwise shown, conduits bored, pushed, or jacked shall be installed a minimum depth of 18 inches below the top of ground line or sub-grade, as applicable. Where conduit passes under a surfaced area, an "X" shall be cut in the curb or surfacing above the conduit crossings for future relocating purposes.

Where conduit is required to be installed under railroad embankments or under highways, streets, or other facilities construction, shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.

Conduit to be placed through boring shall proceed from a pit provided for the boring equipment and workmen. The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 2 inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

The use of water or other fluids in connection with jacking operation will be permitted only under unusual conditions as determined by the Engineer and only on his written approval. The water or other lubricant used as the circulation medium authorized under these conditions must be applied without the use of undue pressure and retained as jacking progresses.

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Conduit to be placed by jacking shall be of the size, type and class specified on the Plans, except that the strength of the conduit designated in the Contract is determined for not less than final loading, complete in place under the embankment. Additional reinforcement or strength of conduit required to withstand jacking pressure shall be the responsibility of the Contractor, and any such extra strength conduit required by the Contractor shall be at his expense.

Conduit larger than 2 inch inside diameter shall not be pushed or jacked under the highway, railroad or street without boring or otherwise removing the soil as the conduit is advanced. Conduit up to 36 inches inside diameter shall be constructed by a combined method of boring and jacking. The boring auger or bit shall have a smaller diameter than the specified diameter of the conduit to be jacked.

The conduit shall be jacked as the boring auger drills out the material. Excavation ahead of the conduit shall not exceed one foot.

Where conduit 60 inches inside diameter or greater is to be jacked for a distance greater than 32 feet, a pilot tunnel shall be constructed first to insure accuracy of grade and alignment. The dimensions and support of the pilot tunnel will be optional with the contractor, subject to the approval of the Engineer.

Supports for pilot tunnels shall be removed as jacking progresses. All costs involved in the performance of the work of constructing pilot tunnels shall be included in the contract unit price for jacking conduit.

If the grade of the conduit at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking to prevent earth caving. Dewatering, if necessary, shall be continuous until the backfill is made.

Heavy duty jacks suitable for forcing the conduit through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the conduit uniformly around the ring of the conduit. A suitable jacking frame or back stop shall be provided. The conduit to be jacked shall be set on guides, properly braced together, to support the section(s) of conduit and to direct it in the proper line and grade. When sections of conduit are less than 6 ft. in length, two sections shall be carefully placed in the guide frame with joints so treated as to minimize the possibility of breakage. The whole jacking assembly shall be placed so as to line with the direction and grade of the conduit. In general, earth material shall be excavated just ahead of the conduit and the material removed through the conduit, and the conduit forced

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through the embankment with jacks into the space thus provided.

The excavation for the underside of the conduit, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the conduit. Except as provided herein below, a clearance of not more than 2 inches may be provided for the upper half of the conduit. The clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the conduit.

The Contractor may at his option provide a steel cutting edge around the head and for not less than the upper 2/3 of the conduit and extending a short distance beyond the end of the conduit. The steel cutting edge shall be so constructed, mounted and used as to insure that clearance between the outside of the conduit and the undisturbed earth will be not more than 1/2 inch. Excavation inside the pipe shall not exceed the outside diameter of the conduit, nor extend more than one foot beyond the lead edge of the cutting head, thus providing for final trimming by the cutting edge and eliminating any void space except that clearance permitted herein by the described steel cutting edge.

When jacking of the conduit is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the conduit from becoming firmly set in the embankment.

Any evidence at any time of caving shall require that the operation be discontinued until provisions are made for eliminating such caving and the location of any cavity identified.

All cavities formed by caving or any voids resulting from excavation larger than the pipe diameter shall be filled with grout in a manner approved by the Engineer.

Any conduit damaged in jacking operations shall be removed and replaced by the Contractor at his expense.

- I. *Removing and Replacing Railway Track.*** The railway company shall remove trackage as required to permit the use of Contractor's excavation equipment. Before the start of trench excavation, the Contractor shall carefully set aside the ballast in a manner approved by the Engineer.

The Contractor shall immediately proceed with the trench excavation, Class B bedding and laying the pipe as shown on the Plans and in accordance with the Specifications.

Backfilling shall be in accordance with Subsection 613.04 G. except the standard bedding material and approved backfill material shall be placed in 4 inch layers (loose measurement) and compacted with approved mechanical

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tampers in accordance with Subsection 202.04 C. Flooding the trench will not be permitted.

Upon satisfactory completion of the backfill the railway company shall restore its ballast, ties and tracks.

The railway company will be reimbursed for removing and replacing the necessary trackage ballast and ties in accordance with a force account agreement with the Department.

613.05 METHOD OF MEASUREMENT. Drainage conduit will be measured by the linear foot along the center line of the conduit actually laid. Conduit with sloped or skewed ends will be measured along the invert or as shown on the Plans.

End sections will be measured by the number of units installed.

Deductions will not be made for wye branches. On conduits 12 inches or less in diameter, no deductions will be made for standard manholes. Deductions will be made for special structures, unless otherwise shown on the Plans. On conduits larger than 12 inches in diameter, deductions will be made for all manholes and for all structures. Conduits which extend only through the wall of the structure will be measured to the actual end of the pipe except as provided above for measuring conduits 12 inches or less in diameter through standard manholes.

Earth backfill, sheeting, and shoring will not be measured for payment.

Unless otherwise provided, concrete cradles, if specified, will not be a separate pay item.

Standard bedding material when specifically noted on the plans as a pay item will be measured by the cubic yard of standard bedding material calculated on a theoretical basis with the weight as shown on the Plans above and below the design flowline, the width inside the vertical neat lines of the trench as defined in Subsection 613.04 B., the length as that measured for the drainage conduit and deducting the volume displaced by the conduit calculated from the nominal designated outside diameter of the pipe, pipe arch or elliptical pipe, or precast box conduit.

Pipe underdrain cover material, when specified by the plans as a pay item, will be measured by the cubic yard of pipe underdrain cover material placed and accepted and based on Plan width and established depth of the trench with no deduction for the volume of the underdrain pipe.

Joint filler for pipe will not be measured for payment, but the cost will be included in other bid items.

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Trench excavation when specified as a pay item will be measured by the cubic yard calculated on a theoretical basis of the volume of material defined as follows:

The depth of the trench will be the average depth measured from the datum plane specified (below the conduit flowline as shown on the pipe or box installation standard drawings) to the finished sub-grade in cut areas. In fill areas the measurement will be from the datum plane to a distance 2 feet above the top of conduit. The Engineer shall establish an equitable measurement elevation in areas requiring both excavation and embankment in adjacent areas. Thickness of rigid conduit will be the actual measured thickness; thickness of flexible conduit will be the height of corrugation or wall thickness of the type of conduit used when calculating the dimension below the flow line for establishing the datum plane.

The length will be that measured for the drainage conduit.

The width will be measured inside the vertical neat lines of the trench defined in Subsection 613.04 B.

The conduit of the size and type as shown on the Plans and constructed by jacking as specified above will be measured by the linear foot along the center line of the conduit actually jacked in place and accepted.

613.06 BASIS OF PAYMENT. The accepted quantities of drainage conduit of the types and sizes specified, measured as provided above, will be paid for at the contract unit price for:

(A)	Non-Reinforced Concrete Pipe	Lin. Ft.
(B)	Reinforced Concrete Pipe, Round, Elliptical or Arch	Lin. Ft.
(CC)	Culvert End Treatment	Ea.
(D)	Corrugated Galvanized Steel Pipe, Round or Arch	Lin. Ft.
(G)	Galvanized Steel Culvert End Sections, Round or Arch	Lin. Ft.
(M)	Prefab. Culv. End Sec., Round or Arch	Ea.
(MM)	Sloped Concrete End Section	Ea.
(N)	Vitrified Clay Pipe	Lin. Ft.
(O)	PVC Pipe	Lin. Ft.
(P)	Perforated Pipe Underdrain	Lin. Ft.
(Q)	Non-Perforated Pipe Underdrain	Lin. Ft.
(R)	Pipe Underdrain Cover Material	Cu. Yd.
(S)	Trench Excavation	Cu. Yd.
(T)	Standard Bedding Material	Cu. Yd.
(U)	Jacked Conduit	Lin. Ft.
(V)	Cast Iron Pipe	Lin. Ft.
(W)	Corrugated Polyethylene Pipe	Lin. Ft.

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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

The Contractor shall inform the City of material or product that will be furnished to the project in accordance with Section 106.

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615.00 SANITARY SEWER

615.01 DESCRIPTION. This work shall consist of the construction of sanitary sewer pipe conduits of the type shown on the Plans in accordance with these and other applicable Specifications and in reasonable close conformity with the lines and grades shown on the Plans or established by the Engineer. No person shall uncover, make any connections with, alter, or disturb any public sewer without first obtaining a permit or work order from the City Engineer.

615.02 MATERIALS. Materials shall be of the types, classes, sizes and dimensions shown on the plans and/or required by the specifications. All materials delivered to the job site shall be marked with the appropriate specification number and designation, such as AASHTO, ASTM, ANSI, NSF, AWWA, etc. Prior to the starting of work or at the time of a pre-work conference, material certifications shall be furnished in accordance with the specifications.

615.02.1 Ductile Iron Pipe. Ductile iron pipe shall conform to and be tested in accordance with the American Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, AWWA Designation C 151, ANSI, A21.50, A21.51, Class 50, unless otherwise specified.

Ductile iron pipe fittings, shall comply with the specifications as listed:

Flanges:	ANSI A21.15, AWWA C115, Class 125
Bolts:	ASTM A307, Grade B, rounded ends projecting beyond face of nut.
Nuts:	ASTM A307, Grade B. hexagonal, ASA B18.2, heavy semi-finished pattern.
Flange Gaskets:	ASTM D1330, Grade I, red rubber ring type, 1/8" thick

Mechanical and push-on joints shall comply with ANSI/AWWA C111/A21.11, except they shall be made of Styrene Butadiene Rubber (SBR) for use in fresh water, salt water and sanitary sewage.

Flexible joint pipe shall comply with ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10 and shall be American Flex-Lok boltless ball joint pipe or approved equal.

All ductile iron pipe and fittings shall have interior surfaces cement lined, according to ANSI/AWWA C104/A21.4. All surfaces of pipe and fittings shall be shop coated with a bituminous coating according to Manufacturer's Standard.

615.02.2 Polyvinyl Chloride Pipe. Polyvinyl sewer pipe shall conform to the requirements of A.S.T.M. D-3034 for Type PSM, PVC sewer pipe and fittings. PVC sewer pipe shall have the elastomeric gasket type joint providing a watertight seal. A solvent cement type joint will not be allowed.

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Fittings shall correspond in all respect with the dimensions specified for pipe of the corresponding size. Wall thicknesses of molded and/or fabricated fittings shall be no less than the respective minimum thicknesses for the equivalent pipe size. No fittings shall have an ID dimension smaller than the base ID for the equivalent pipe size.

All PVC pipe shall have a minimum SDR of 35 unless otherwise noted on the plans or specifications.

The pipe shall be made and joined with an integral bell, bell and spigot rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F 477.

615.02.3 Vitrified Clay Pipe. Clay pipe and fittings shall conform to the specifications for extra strength in accordance with ASTM C700. All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, the location of the plant, and extra strength designation.

All clay pipe dimensions shall not vary from a true circle by more than 3 percent of nominal diameter. Pipe shall not deviate from straight by more than 1/16 inch per foot.

Clay pipe of sizes less than 18 inches in diameter shall have no blister exceeding 3 in., and no blister shall project more than 1/8 inch above the surface of the pipe. Pipe sizes over 18 inches shall have no blister exceeding 2 in. per foot of internal diameter, and no blister shall project more than 1/8 inch per foot of internal diameter above the surface of the pipe. All clay pipe shall have no broken blisters.

There shall be no fractures or cracks passing through the barrel or socket of the pipe. A single crack at the spigot end of the pipe not exceeding 75% of the depth of the socket may be permitted. Chips or fractures on the interior of the pipe shall not exceed 2 inches in length, 1 inch in width, and a depth of one fourth of the thickness of the barrel.

Clay pipe fittings shall correspond in all respect with the dimensions specified for pipe of the corresponding size. Dimensional tolerances of fittings shall be the same as for straight pipe. All fittings shall conform to the requirements for clay pipe described above and within these specifications.

615.02.4 Services. New or replacement services shall consist of an SDR 35 PVC wye, Bell X Spigot 45° bend, SDR 35X Schedule 40 adapter, Schedule 40 service line and Schedule 40 cap. All long services crossing under paving shall be sleeved in Schedule 40 PVC or other approved material.

615.02.5 Casting. The production of Gray Iron castings, materials, and production control processes shall conform to ASTM A48-84 or latest revision, Class

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20, Class 30, or Class 35, when required. Casting shall also conform to Federal Specification RRF-621-D latest revision.

Materials and workmanship shall be tested, and free from strength defects, shrinks, or other distortions. Test results are periodically verified by an independent laboratory and equipment is calibrated on a regularly scheduled basis.

Certified Reports of test results will be provided when requested with the casting order. Reports will accompany the castings at the time of shipment from the manufacturer.

Round manhole frames and lids designed for traffic applications will have machined seating surfaces and non-rocking fit. Traffic ratings on castings are verified according to Proof Load Testing procedures as written in RRF-621-D using a 9 x 9 footprint. Load rating will be stated by the designation recommended by AASHTO Specifications. H-20 is heavy roadway traffic (16,000 lb wheel load). H-15 is medium duty traffic rating (12,000 lb wheel load). Non-traffic loads are held to a minimum 1000 lb Transverse Proof Load Test without permanent deformation.

The manufacturing processes for the castings will occur in the United States.

615.03 CONSTRUCTION METHODS.

A. General. All equipment necessary and required for the proper construction of sanitary sewer shall be on the project in first class working condition and approved by the Engineer before construction is permitted to start.

The Contractor shall provide appropriate hoisting equipment to handle the pipe while unloading and placing it in its final position without damage to the pipe.

The pipe shall be handled with care to prevent damage and shall not be thrown, dropped or dragged. Pipe bundles shall be stored so that the barrels are evenly supported. When handling pipe in cold weather, consideration shall be given to variation in the pipe's impact strength, and to dimensional changes that may allow movement of pipe within bundles.

The connection of sanitary sewers or sewer appurtenances to other sanitary sewers shall be made in accordance with the Plans. The work shall be done in a workmanlike manner in such a way as not to damage any of the structures involved. Sewer pipe shall not remain projecting beyond the inside wall line of other sewers or of sewer appurtenances.

Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers, watermains, home service connections for both sewer and water and other obstructions encountered in the progress of the work shall be furnished by the Contractor at no additional cost to the Owner unless otherwise indicated by the Plans or Specifications. During

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construction adequate provisions for the continued sewerage of the system shall be made by the Contractor, at no additional cost to the City, unless otherwise shown on the Plans or by the Specifications.

Wherever existing utility structures or branch connections leading to main sewer or water mains or other conduits, duct, pipes or structures form obstructions to the grade and alignment of the sewer pipe to be laid, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impracticable, a deviation from the line and grade will be ordered by the Engineer, and the change shall be made in the manner directed by the Engineer. The grade line shown on the Plans or supplemental drawings or as established by the Engineer is the elevation of the invert or flow line of the sewer. The grade line and alignment shall be accurately established and maintained.

The Contractor shall establish and use throughout sewer construction a method for establishing grade and alignment. The use of batterboards, laser devices or other acceptable means in a manner approved by the Engineer will be required.

Horizontal and vertical separation of sanitary sewers and water mains must be maintained as specified in the OSHD regulations.

Dead ends of all sewers, wyes, tees, etc., shall be closed with approved stoppers securely cemented in place. Tight fitting stoppers or bulkheads shall be securely placed in or across the end of all sanitary sewer lines when construction is stopped at the end of each day's work or for any other cause. These stoppers or bulkheads shall be watertight.

B. *Excavation and Preparation of Trench.* The trench shall be dug to the alignment and depth required and only so far in advance of pipe laying that can be safely maintained by the Contractor. The trench shall be so braced and drained so that workmen may work there safely and efficiently. It is essential that the discharge from pumps be led to natural drainage channels, drains or storm sewer.

The trench width might vary depending upon the depth of the trench and the nature of the excavated material, but in any case shall be of minimum width to permit the pipe to be laid and joined properly and the bedding and backfill to be placed and compacted to the required density. The normal width of trench shall be thirty (30) inches and for pipe eighteen (18) inches or larger no more than twelve (12) inches greater than the outside diameter of the pipe barrel. If approved by the Engineer, the trench walls may be backsloped from a point two (2) feet above the top of the pipe.

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Whenever necessary, to prevent caving, excavations in sand, gravel, sandy soil, or other unstable material shall be adequately sheathed and braced. Where sheathing and bracing are used, the trench width shall be increased accordingly. Trench sheathing will be required on all ditches where necessary to prevent damage to utilities above or below ground. Trench sheathing shall remain in place until the pipe has been laid and the joint properly constructed and the backfill material thoroughly compacted to a depth over the pipe sufficient to protect any utility structures or adjacent paving, curb and gutter, sidewalks or trees which might be damaged by caving of the trench walls.

Excavation for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve boxes, curb stop boxes and other utility controls shall be left unobstructed and accessible during the construction period.

Adequate provisions shall be made for the flow of sewers, drains and water courses encountered during construction and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.

Trees, fences, poles and all other property shall be protected unless their removal is authorized by the Engineer and any property damages shall be satisfactorily restored by the Contractor.

All rock excavated from the trench having a diameter greater than eight (8) inches shall not be used as backfill but shall be disposed of as directed by the Engineer.

Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps or suitable means as approved by the Engineer. No attempt shall be made to make joints under water and the trench must be kept dry until the pipe has been installed and backfill has been placed to a height of two (2) feet above the top of pipe or to a sufficient height to prevent pipe movement.

The trench bottom shall be constructed to provide a firm, stable and uniform support for the bedding material for the full length of the pipe. Where the bottom of the trench uncovered is soft, spongy, unstable and in the opinion of the Engineer cannot support the pipe, the trench shall be excavated and refilled to the proper grade with foundation gravel or rock and thoroughly compacted. Unless otherwise indicated by the plans or specifications, the cost of additional excavation and subsequent placement of foundation gravel or rock shall be included in the prices bid for other items of work. Foundation gravel or rock shall meet the specifications of Section 703.01, Type A or B aggregate, 1-1/2" maximum size unless otherwise indicated by the plans or

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specifications. Recesses for the bells of pipe shall be provided at each joint to ensure proper joint assembly, alignment and pipe support. Any part of the trench bottom excavated below grade shall be backfilled to grade and shall be compacted in a manner approved by the Engineer.

When rock is encountered the rock shall be excavated to a depth of 6" below grade and the trench shall be backfilled to proper grade with pipe bedding material or an approved select soil. Where it becomes necessary to excavate beyond the limits of normal excavation in order to remove boulders or other interfering objects, the voids remaining shall be backfilled with an approved material.

The removal of boulders or other interfering objects or excavating an additional depth of rock removal and the backfilling and compaction caused by such removal shall be at the expense of the Contractor, and no payment for the cost of such work shall be made. The cost of such work shall be included in the prices bid for other items.

- C. Bedding.** Bedding shall be defined as that material supporting, surrounding and extending from the trench bottom to the springline of the pipe or as directed by the Plans and Specifications. Where it becomes necessary to remove boulders or other interfering objects for proper bedding placement, any void shall be filled with the bedding material designated.

Bedding material shall be placed upon a firm, stable and uniform trench bottom. Bedding material shall be placed so that the pipe is supported for the full length of the barrel with full bearing on the bottom segment of the pipe.

Except where otherwise specified, bedding material shall be gravel, crushed aggregate, native free-draining granular material, or other material approved by the Engineer. In cases where native free-draining granular material is suitable for use as bedding, the trench bottom may be excavated to a point above the invert grade and the trench bottom hand shaped so the bottom segment of the pipe is firmly supported on undisturbed material.

For all plastic pipe and fittings, the bedding material shall be composed of crushed rock conforming to Section 703.02, No. 1, Aggregate, 3/4" maximum size. The bedding shall have a minimum thickness of 4 inches and extend up to the springline of the pipe.

For all steel or cast iron pipe, special bedding will not be required. The trench bottom shall be shaped to provide firm and uniform bearing.

For all clay pipe and fittings, the bedding material shall be composed of crushed rock conforming to Section 703.02, No. 1, Aggregate, 3/4" maximum size. The bedding shall have a minimum thickness of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the

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pipe to a depth equal to 1/6 of the outside diameter of the pipe.

- D. *Laying Pipe.*** Proper implements, tools and equipment satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment.

After the trench has been excavated to the proper grade, the first pipe at the outlet end of the sewer shall be bedded to the proper line and grade with the bell end upstream. The pipe shall be held in place by backfilling, as specified. All joints shall be installed in accordance with the pipe manufacturer's instructions.

Adapters, where required to join pipe of different materials, shall be equal to those manufactured by Can-Tex Industries or by Fernco Joint Sealer Company. When using vitrified clay pipe flex joints shall be used at all manholes.

All sanitary sewers on slopes of 10% or greater shall be anchored with concrete collars cast immediately downhill from bells and shall be spaced at no greater than 75 feet. No additional compensation shall be made to the Contractor for this work; cost shall be included in other items of work.

- E. *Joining Pipe Conduit.*** Joints shall be constructed in accordance with the Manufacturer's recommendations.

Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Trenches shall be kept water free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.

- F. *Backfilling.*** Backfilling shall be considered as starting at the top of the bedding material. Backfilling shall be broken down into two (2) separate methods of operation; initial backfill and final backfill.

Initial backfill shall be that portion of backfill beginning at the top of bedding and extending to a distance of one (1) foot above the top of pipe. Initial backfill material may be material obtained from project excavations provided that all organic material, rubbish, debris and other objectionable material are first removed. Rocks greater than 2½ inches in any dimension shall not be permitted in the initial backfill. No special or mechanical compactive effort shall be required. Impact or free-fall compaction shall be considered sufficient for initial backfilling operations.

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Final backfill shall be that portion of backfill beginning at the top of the initial backfill and extending to final grade elevations. The final backfill shall be placed so that compaction requirements can be met. Final backfill shall be mechanically compacted, water densified or naturally compacted, as allowed by the Plans and Specifications.

Unless specified otherwise, the final backfill shall be placed using special compaction (mechanical or water densified) under improved surfaces or shoulders of streets, and under roads, aprons, curbs, sidewalks, lawns and areas designated for those potential uses.

Under open fields, unimproved right-of-way or neutral grounds which are free of traffic, final backfill may be placed using natural compaction. Areas allowing natural compaction shall be only those areas identified by the Plans and Specifications.

Mechanically Compacted Backfill shall be considered those methods which incorporate tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers or other mechanical tampers. Impact-type pavement breakers will not be permitted. All equipment shall be of a size and type approved by the Engineer.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under contract. The Contractor shall make his own determination in this regard.

Material for mechanically compacted backfill shall be placed in lifts which, prior to compaction, shall not exceed the thickness specified below for the various types of equipment:

- 1) Vibratory equipment, including vibratory plates, vibratory smooth-wheel rollers, and vibratory pneumatic tired rollers – maximum lift thickness of 2 feet.
- 2) Rolling equipment, including sheepsfoot (both vibratory and nonvibratory), grid, smooth-wheel (nonvibratory) and segmented wheels – maximum lift thickness of 1 foot.
- 3) Hand-directed mechanical tampers – maximum lift thickness of 6 inches.

Mechanically compacted backfill shall be placed in horizontal layers of thickness (not exceeding those specified above) compatible to the material being placed and the type of equipment being used. Each layer shall be evenly spread, moistened (or dried, if necessary), and then tamped or rolled until specified compaction has been attained.

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Water Densified Backfill shall be considered those methods which incorporate water in the compaction effort.

As used in these specifications, flooding shall mean the inundation of backfill with water, puddled with poles or bars to ensure saturation of the backfill material for its full depth. Jetting shall be accomplished by use of a jet pipe to which a hose is attached, carrying a continuous supply of water under pressure.

Unless flooding is specified or otherwise authorized by the Engineer, all backfill to be densified by water shall be jetted.

The backfill shall be jetted in accordance with the following requirements:

- 1) The jet pipe shall consist of a minimum 1-1/2 inch diameter pipe to which a minimum 2 inch diameter hose is attached at the upper end. The jet shall be of sufficient length to project to within 2 feet of the bottom of the lift being densified.
- 2) The Contractor shall jet to within 2 feet of the bottom of the lift and apply water in a manner, quantity and at a rate sufficient to thoroughly saturate the thickness of the lift being densified. The jet pipe shall not be moved until the backfill has collapsed and the water has been forced to the surface.
- 3) The lift of backfill shall not exceed that which can be readily densified by jetting, but in no case shall the undensified lift exceed 15 feet.
- 4) Where the nature of the material excavated from the trench is generally unsuitable for densification with water, the Contractor may, at no cost to the City, import suitable material for jetting or densify the excavated material by other methods. The backfill shall be allowed to thoroughly drain until the surface of the backfill is in a firm and unyielding condition prior to commencement of any subsequent improvements. The Engineer may require the Contractor, at the Contractor's expense, to provide a sump and pump to remove any accumulated water.
- 5) The Contractor shall make his own determination that jetting will not result in damage and any resulting damage shall be repaired at the Contractor's expense.

Natural Compaction shall be considered those methods requiring no additional compactive effort after initial placement of backfill. Natural compaction will be the loose placing of material (usually pushed or bladed) into the trench. The trench shall then be rolled with the placement equipment with native material mounded over the surface of the trench. Subsequent to final acceptance of

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the work and as required by the Plans and Specifications, the trench shall be filled and maintained as necessary.

G. *Compaction Requirements.* All embankments and backfill placed by mechanical or water densified means shall be compacted to a minimum of 90% of standard proctor density. Compaction within street right-of-way shall be a minimum of 95% of standard proctor density. The Contractor shall notify the Engineer prior to the density test, such that the Engineer may witness the test.

H. *Field Testing.* Leakage tests may include appropriate water or low pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 200 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of 2 feet.

Deflection tests shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5 percent. The deflection test shall be made with a rigid ball or mandrel. It shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without the use of mechanical pulling devices.

Lamping shall be performed by the Contractor in the presence of the Inspector. The Contractor shall provide a mechanical method of exchanging the air within the sewer line and use explosion proof devices as required by applicable OSHA regulations. If, in the opinion of the Engineer, any deviation in grade or alignment is excessive, then the Contractor shall correct the pipe alignment at his expense. In general, a full 3/4 of the barrel of the pipe shall be visible from manhole to manhole or appurtenance.

All of the before mentioned testing shall be conducted by the Contractor, all cost shall be included in the price bid for other items of work. The Contractor shall inform the Engineer, in writing, 24 hours in advance of any testing.

I. *Borings.* The boring shall proceed from a pit provided for the boring equipment and workmen. The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 2 inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

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615.04 METHOD OF MEASUREMENT. Pipe conduit will be measured by the linear foot along the centerline of the conduit actually laid. Conduit with sloped or skewed ends will be measured along the invert. That length of line within manholes and special structures will not be measured for payment. No additional payment shall be made for vertical pipe or fittings required for drop manhole connections.

Earth backfill, sheeting, shoring and bedding material will not be measured for unless otherwise provided. Concrete cradles, rock foundations or cradle, and other material required to properly construct the trench bottom, will not be a separate pay item unless otherwise provided.

Bedding material will not be measured for payment unless otherwise indicated by the Plans and Specifications.

Trench excavation will be measured by the linear foot for the depth of excavation specified.

615.05 BASIS OF PAYMENT. Accepted quantities of pipe conduit of the types and sizes specified, measured as provided above, will be paid for at the contract unit price for:

(A)	Ductile or Steel Pipe	Lin. Ft.
(B)	Vitrified Clay Pipe	Lin. Ft.
(C)	Polyvinyl Chloride (PVC) Pipe	Lin. Ft.
(F)	Trench Excavation *	Lin. Ft.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified, including all in-line wye and riser pipe to complete a service connection.

* Payment will be made for the depth of excavation specified on the plans with a pay item included for each range of trench depth.

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616.00 WATER PIPE AND FITTINGS

616.01 DESCRIPTION. This work shall consist of the construction of waterlines and service lines of the type shown on the Plans in accordance with these and other applicable Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

616.02 MATERIALS.

A. Pipe. Pipe shall be of the kind specified on the Plans and shall be identified with appropriate AASHTO, ASTM, ANSI or AWWA specifications numbers.

In no case shall pipe or fittings with a pressure rating of less than 200 pounds per square inch be used. Whenever plastic pipe is used, it shall bear the seal of the National Sanitation Foundation (NSF), have a Standard Dimension Ratio (SDR) not exceeding 14 and shall have an outside diameter (OD) equal to the OD of the equivalent size ductile iron pipe.

Ductile Iron Water Pipe. Ductile iron pipe shall conform to and be tested in accordance with the American Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, AWWA Designation C151, ANSI A21.50.

The minimum thickness class of cast or ductile iron pipe shall be Class 50 unless otherwise specified.

The interior surfaces of ductile iron pipe and fittings shall be provided with cement lining conforming to ANSI/AWWA C104/A21.4.

B. Joints. Cast iron pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Flange ends shall be used only where specifically noted on the drawings, except that the valve connection end of all tapping sleeves shall be flanged.

Mechanical and push-on joints shall conform to and be tested in accordance with the American Standard for Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings, AWWA C 111, ANSI A21.11 and shall be made for use in fresh water with Styrene Butadiene Rubber (SBR).

Flange joints shall conform to the American Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI A21.15, AWWA C115, Class 125. Flange gaskets shall be red rubber ring type 1/8" thick conforming to ASTM D1330.

C. Fittings. Standard water service line connections shall conform to and be tested in accordance with ASTM B62, ASTM B88 and AWWA C800. Corporations and curb ball valves shall be full port and all brass and shall be manufactured by Mueller, Ford, Jones or an approved equal. Meter setters

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shall be 7 inch with 1 inch CTS pack joint as manufactured by Ford, Mueller or an approved equal.

Water line fittings shall be SSB-Ductile Iron, Mechanical Joint, Class 350. 3" through 16" Mechanical Joint Ductile Iron Fittings shall be produced in strict accordance with all applicable terms and provisions of ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/A21.11. 18" through 24" diameters shall be manufacturer's standards with wall thickness equivalent to Class 56 ductile iron pipe. The working pressure rating shall be 350 PSI. Cement lining meets ANSI/AWWA C104/A21.4-85.

D. Valves.

1. *Gate Valves.* Gate valves shall conform to and be tested in accordance with the AWWA Standard for Gate Valves for Ordinary Water Works Service, AWWA C 509. Valves shall have resilient seat, non-rising stem, vertical mounting, "O" ring stem seal with stem extension and guides, counterclockwise opening, and ends to fit the pipe or fittings to which attached (mechanical or flanged). A valve position indicator on 12" valves or larger shall be supplied.

Gate valves shall be Darling, M & H, Mueller or approved equal.

2. *Ball Valves.* Ball valves shall be designated for 150 pounds per square inch working pressure; flanged end; O ring rotor bearing seals; constructed of high-tensile strength cast iron; equipped with totally enclosed manual operators, with open-closed indicator and hand wheel with standard size square wrench nut for one-man operation at 150 pounds per square inch unbalance across the valve. Valves shall be tested by, and shall withstand without leak, a hydrostatic pressure of: (1) 250 pounds per square inch on the valve body with the rotor in the open position; and (2) 150 pounds per square inch on each side of the valve with the opposite side open to atmosphere. Four copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve. They shall be Mueller, Ford or approved equal.
3. *Air Relief Valves.* Air relief valves shall be heavy-duty combination air release and vacuum type for 300 pounds per square inch water working pressure, tested to 300 pounds per square inch, 2 inch in size. Body, cover and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor. They shall be Apco No. 145C, Darling, Rensselaer or approved equal.
4. *Check Valves.* Check valves shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future

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installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, bell-and-spigot, or flanged).

They shall be Darling, M & H, Mueller or approved equal.

5. *Butterfly Valves.* Valves shall be designed, manufactured, and tested in accordance with AWWA C504, latest revision. Valves shall be rated and tested for absolute zero leakage shut-off.

Valve body shall be ductile iron per ASTM A536 Grade 65-45-12. Valve body to include a stainless steel seat ring that is mechanically retained without use of clamping devices, adjusting segments, or other hardware being in the waterway.

Valve disc shall be solid type ductile iron without any external vanes, ribs, etc., to obstruct flow. Resilient seat shall be located on edge of disc, offset from the shaft, and seal against mating stainless steel body seat with 360° uninterrupted contact. Valves shall be American Darling, Mueller or approved equal.

- E. Valve Boxes.** Unless otherwise specified on the Plans, valve boxes shall be of the screw type adjustable valve box, complete with dome lid or traffic ready model (where necessary).

- F. Fire Hydrants.** Fire hydrants shall conform to and be tested in accordance with the AWWA Standard for Fire Hydrants for Ordinary Water Works Service, AWWA C 502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which have a lower breaking point than the rest of the unit; 5-1/4 inch compression main valve; full 6" barrel; 4.5 feet bury length; two 2.5 inch hose nozzles with National Standard threads; one 4-1/2 inch pumper nozzle; "O" ring seal; drain valve, left (counterclockwise) opening; two coats silver finish paint above ground line; and National Standard pentagon operating nut.

Fire hydrant extensions shall be of the proper design to accommodate the make of fire hydrant installed.

Fire hydrants shall be Darling, Mueller Improved, M & H or approved equal.

- G. Lining.** When specified, cast iron pipe and fittings shall be lined in accordance with the American Standard for Cement Mortar Lining for Cast Iron Pipe and Fittings for water, AWWA C 104.

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H. Certification. Tests will not ordinarily be made by the laboratory on the above materials, but the materials furnished shall be recognized standard products and the manufacturer of such products shall furnish the Engineer a Certification.

I. Copper Water Service Pipe and Fittings.

1. *Material Covered.* This item covers copper water service pipe and fittings.
2. *Copper Service Pipe.* Copper service pipe shall be a seamless copper tubing cold drawn to size. It shall be Type K soft annealed and shall meet the requirements of ASTM B 88 and AASHTO M 258.

Sampling and testing shall be done as provided in ASTM B 88, with the exception that making the chemical analysis shall be optional with the Engineer.

3. *Fittings.* All fittings including corporation stops and curb stops shall be of cast brass or bronze and shall be finished in a thoroughly workmanlike manner. They shall be sound, clean, free from blow holes, porous places, cracks, or any other defects affecting their strength or appearance, which would indicate inferior quality of metal. All moving parts shall be accurately fitted up so as to work smoothly and freely without binding. They shall be of standard type commonly used and shall be the product of a recognized manufacturer of such fittings. Each casting shall bear the name or trademark of the manufacturer, permanently cast in metal.

Fittings shall withstand an hydrostatic pressure test of 200 pounds per square inch without leaking or showing any indications of metal fracture.

J. Polyethylene (PE) Plastic Tubing, Water Service Pipe and Fittings.

1. *Material Covered.* This item covers polyethylene (PE) water service pipe and fittings.
2. *Polyethylene Plastic Tubing.* Polyethylene (PE) plastic tubing shall be 1" CTS (copper tubing size) rated at 200 psi and shall meet all the requirements of PE 3408 SDR-9.0, wall thickness and tolerances shall have the National Sanitation Foundation stamp indicating its use for the transport of potable water NSF-PW, the PE plastic extrusion compound shall meet the requirements of grade A 23. Sampling and testing shall be done as provided in ASTM - D 2737.
3. *Fittings.* All fittings including corporation stops and curb stops shall meet the requirements of copper water service pipe and fittings Section 616.02 I.

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616.04 CONSTRUCTION METHODS.

- A. General.** In general, the depth of trench shall be such that it will provide a covering of at least 4 feet below the surface of the natural ground or established sub-grade.

During construction adequate provisions for drainage of the trench shall be made by the Contractor. Pipe laying operations should be suspended during rains or whenever the trench cannot be kept dewatered. A watertight plug shall be placed in the open end of the main when construction is stopped at the end of each day's work or for any other cause.

The Contractor shall locate or have located before excavation of the water line trench is begun all intersecting sewer lines, house sewer lines and sewers within 10 feet of the proposed water line location. These locations will be mapped and the Contractor shall take measures to prevent the discharge of waste into the trench. If any sewer is disturbed it must be carefully restored immediately to a tight operating condition at the Contractor's expense.

Horizontal and vertical separation of sanitary sewers and water mains must be maintained. Whenever possible, a water main shall be located at least 10 feet horizontally from any existing or proposed sanitary sewer line. Whenever possible, sewer pipe joints will be located at least 10 feet from any water line. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be constructed equal to water pipe and shall be tested to assure watertightness prior to backfilling.

All bends, tees, crosses, outlet assemblies, valves and plugs shall be blocked with concrete except where the fittings have flanged, welded or harnessed joints. Concrete blocking shall be placed so that joints are accessible for repair.

- B. Excavation.** Excavation shall be in accordance with Subsection 615.04 B.
- C. Bedding.** Bedding shall be in accordance with Subsection 615.04 C.
- D. Laying Pipe.** Laying pipe shall be in accordance with Subsection 615.04 D.
- E. Joining Pipe Conduit.** Joints shall be made in accordance with the Manufacturer's recommendations and requirements of the AWWA. Prior to making pipe joints all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Trenches shall be kept water free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.

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- F. *Connecting to Existing Lines.*** Where shown on the Plans or required by the Engineer, connections shall be made to existing lines. The Contractor shall furnish the materials required and make the connection. No additional compensation will be allowed for this, but the cost of same shall be included in the price bid for other items on the work.
- G. *Removal of Existing Lines.*** When necessary to remove existing line or lines to provide for new installation, no additional compensation will be paid for removal, but the cost of same shall be included in the price bid for the new line.
- H. *Setting Valves.*** Valves shall be located where shown on the Plans or as directed by the Engineer. They shall be set with the valve stem up unless otherwise specified, and the joints shall be as specified for other joints in the pipeline. Care should be taken to see that all parts are in first class working condition and that the valve is entirely free from foreign material before placing.
- I. *Setting Fire Hydrants.*** Fire hydrants shall be located where shown on the Plans or designated by the Engineer. The hydrant shall be harnessed, all thread from tee to valve with 3/4" cadmium coated all thread to prevent the hydrant and valves from blowing off the line. Each hydrant shall be placed on a slab of stone or concrete not less than 4 inches thick and 16 inches square. Around the drain of the hydrant shall be placed not less than 7 cubic feet of broken stone, gravel so the hydrant will properly drain. Backfill around the hydrant shall be firmly tamped to the surface of the ground and to a distance of 5 feet in front of the hydrant. Before placing any hydrant, care shall be used to see that all foreign matter is removed from within the body or barrel. The hydrant valve opened and closed to see that all parts are in a first class working condition. Hydrant leads shall be ductile iron pipe.
- J. *Dead Ends.*** Dead ends shall be closed with the required cap, valves or plug and blowoff. Caps, valves and plugs shall meet the same requirements as other cast iron fittings.
- K. *Backfilling.*** Backfilling shall be in accordance with Subsection 615.04 F.
- L. *Field Testing.*** The installed pipe shall be pressure tested and leakage tested in accordance with AWWA Standard C 600. Working pressure of the pipe should not exceed 2/3 of the rated pressure of the pipe. Leakage should not exceed 10 gallons per inch per mile of pipe per 24 hours at 150 pounds per square inch testing pressure.

All new, cleaned or repaired water mains shall be disinfected. Water with 100 parts per million of chlorine shall be allowed to stand 24 hours and develop a residual of at least 10 parts per million of chlorine. The spent solution shall be drained in an acceptable manner and replaced with potable water prior

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to use of the line. Safe bacteriological samples shall be obtained on two consecutive days before that portion of the line may be used.

All of the before mentioned testing shall be included in the price bid for other items of work. The Contractor shall inform the Engineer in writing 24 hours in advance of any testing.

M. Inspection. All negotiations, decisions, instructions, interpretations of applicable Specifications and other matters influencing the work shall be directed to the Engineer.

N. Borings. The boring shall proceed from a pit provided for the boring equipment and workmen. The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 2 inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

616.05 METHOD OF MEASUREMENT.

A. Water Pipe. Water pipe will be measured for payment by the linear foot, including such fittings as crosses, tees, sleeves, outlet assemblies, plugs and other specified fittings, complete in place and accepted. Each separate size of pipe shall constitute a separate item for payment. In measuring water pipe for payment it will be measured along the center line of the completed line and no deductions will be made for the space occupied by fittings, valves, etc.

B. Water Service Pipe. Water service pipe and fittings will be measured by the each, including corporation stops, meter setters and other specific fittings for a complete in place service.

C. Valves. Valves will be measured for payment by each valve installed. Valves of different sizes shall constitute separate pay items. The price bid for these items shall include all the costs of work required to install them such as tapping, tapping sleeves, valve boxes, meter boxes, etc.

D. Fire Hydrants. Fire hydrants will be measured for payment by each such fire hydrant set, complete in place and approved including placing drainage stone, blocking, fire hydrant extensions (if required), all threading, paint, and etc.

Excavations, bedding material, blocking, testing and fittings will not be measured for payment as a separate item, but the cost of same will be

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included in the contract unit price for water pipe. Corporation stop includes tapping, double banded service clamp for 1-1/2" or larger, and coupling for a complete installation.

Meter installation includes meter can as approved by Water Department, meter yoke with ground key angle stop, and fittings for a complete installation.

616.06 BASIS OF PAYMENT. Accepted quantities of water pipe and appurtenances of the types and sizes specified and supplied drawings, measured as provided above, will be paid for as the contract unit price for:

(A)	Ductile Iron Pipe (Lined)	Lin. Ft.
	Polyvinyl Chloride (PVC) Pipe	Lin. Ft.
(B)	Water Service Pipe and Fittings	Ea.
(C)	Valves	Ea.
(D)	Fire Hydrants	Ea.
(E)	Corporation Stop Installation	Ea.
(F)	Meter Installation	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Service lines 1-1/2" and larger shall be installed with a full port, teflon coated ball valve in lieu of the normal meter yoke.

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619.00 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

619.01 DESCRIPTION. This work shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, bridges, culverts, fences, structures, old pavements, abandoned pipe lines and any other obstructions which are designated or permitted to remain except for the obstructions to be removed and disposed of under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes and pits.

This work, when specified, shall also consist of removing designated traffic signal and highway lighting items such as: pole assemblies, luminaries, pull boxes, power supplies, signal heads, controllers and other related electrical equipment and delivering them to a location specified on the Plans and in a manner approved by the Engineer. This work shall also consist of removing abandoned items and restoring the site to match the surrounding conditions.

When the proposal does not include pay items for removal of structures and obstructions as set out in this Section such work shall be performed under Section 202 - Excavation and Embankment.

619.04 CONSTRUCTION METHODS.

A. General. The Contractor shall raze, remove and dispose of all buildings and foundations, structures, fences and other obstructions, any portions of which are on the right-of-way, except utilities and those for which other provisions have been made for removal. When one part of or portion of a system or configuration is removed the removal of that one part or portion shall be performed in such a manner that the remaining parts or portions shall continue to operate or function as previously intended. All designated salvable material shall be removed without unnecessary damage in sections or pieces which may be readily transported and shall be stored by the Contractor at specified places. Unusable perishable material shall be destroyed. Nonperishable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the Engineer. Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and if within the prism of construction shall be compacted in accordance with Subsection 202.04 C. and D. Floors of basements shall be broken in a manner acceptable to Engineer to provide adequate drainage from the basement.

When the work includes or involves traffic signals or highway lighting, the Contractor shall carefully disconnect the item to be removed from the existing footing, conduit and wiring system and carefully remove the item or assembly so that it may be stored for future use or reset. The Contractor shall be responsible for damage to the removed item as a result of his negligence and shall repair or replace the damaged item to the satisfaction of the Engineer.

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- B. Removal of Bridges, Culverts and other Existing Structures.** Bridges and culverts in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Removal of existing structures when shown on the Plans shall be in accordance with Subsection 104.06.

1. When structures are to remain the property of the City, the method of dismantling of steel superstructure and wood bridges shall insure the material against unnecessary damage. Steel members shall be dismantled at the original field splices and shall be supported on falsework during the operation of dismantling or shall be dismantled in a manner and method approved by the Bridge Engineer. Any steel damaged shall be replaced or satisfactorily repaired by the Contractor without compensation. Before dismantling, steel members shall be match marked by painting and by using steel stencils in a manner approved by the Bridge Engineer for re-erection purposes.

Piers, abutments and piling shall be cut off at the ground line or in case of channel change at the elevation of the channel excavation shown on the Plans.

Salvaged lumber, structural steel, etc., shall be stacked on the right-of-way outside of the ditch line in a neat and workmanlike manner.

Old concrete and other similar materials shall be broken up and placed in the fill as specified for placing solid rock in fills or otherwise disposed of as directed by the Engineer.

Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down one foot below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure. In no case shall material be left in the channel.

Blasting or other operations necessary for the removal of an existing structure or obstruction which may damage new construction shall be completed prior to placing the new work.

2. When structures or material in structures are to become the property of the Contractor, he shall remove and dispose of the material in accordance with Subsection 104.08. Piers, abutments, piling and substructures shall be removed as specified in 1. above.

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- C. *Removal of Culvert and Sewer Pipe.*** Unless otherwise provided all salvable culvert and sewer pipe shall be carefully removed and every precaution taken to avoid breaking and damaging the pipe. Pipes to be re-laid shall be removed and stored when necessary so that there will be no loss or damage before relaying. The Contractor will be required to replace sections lost from storage or damaged by negligence or by use of improper methods.
- D. *Removal of Pavement, Sidewalks, Curbs, Etc.*** All concrete pavement, base course, sidewalks, curbs, gutters, etc., designated for removal shall be broken into pieces weighing not more than 150 pounds and stockpiled at designated locations for use by the City or in a manner approved by the Engineer.

There will be no separate payment for excavating for removal of structures and obstructions or for backfilling and compacting the remaining cavity.

When the removal of asphalt concrete or portland cement concrete pavement is specified the joint shall be sawed in a manner approved by the Engineer. Sawing shall be reasonably true to line and the depth of sawing shall be such that when removing the material undue underbreakage or shattering of the adjacent area will not occur.

- E. *Structures Abandoned.*** Existing structures which are to be abandoned shall be broken off or removed to a depth of not less than 6 inches below the foundation grade of new structure.

Sewer lines, water lines, etc., to be abandoned shall be tightly plugged at each end with concrete in a manner approved by the Engineer.

Manholes and similar structures to be abandoned shall be removed to the depth specified, filled with suitable material and compacted in accordance with Subsection 202.04. If the structure abandoned and so backfilled is to be under paving or another structure, the backfill material shall be tamped in uniform layers not exceeding 6 inches in depth and compacted as specified in Subsection 202.04.

If the structure is not under paving or other structures, settlements may be obtained by thoroughly flushing with water during backfill operations.

- F. *Disposable Materials.*** Any abandoned concrete footing, concrete apron, conduit and other miscellaneous material shall become the property of the Contractor and shall be removed and disposed of in a manner approved by the Engineer. Materials such as drop inlet grates and frames, manhole covers and frames, concrete or clay pipe, water pipe, goosenecks, valves, stops, valve boxes or any material of value shall remain the property of the City, unless the Plans or Special Provisions provide otherwise for their disposal.

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619.05 METHOD OF MEASUREMENT. When the Contract stipulates that payment will be made for removal of obstruction on a lump sum basis, the pay item, removal of obstructions, will include all structures and obstructions encountered within the right-of-way in accordance with the provisions of this Section. Where the proposal stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the Contract

When such work is not separately classified for payment on the Plans or in the Proposal, it will be considered as incidental work and will not be paid for directly, but the cost will be included in the contract unit price for other items of work.

The length of pipe removed when stipulated as a pay item will be measured in linear feet computed by multiplying the number of commercial lengths removed by the nominal laying length or by measuring in place prior to removal if practicable.

When sawing of pavement is shown on the Plans as a pay item, it will be measured by the linear foot or lump sum.

619.06 BASIS OF PAYMENT. The accepted quantities of items, measured as provided above, will be paid at the contract unit price bid for:

(A)	Removal of Structures and Obstructions	Lump Sum
(B)	Removal of (Specific Item)	Ea., Lin. Ft., Sq. Yd., Cu. Yd., Lump Sum
(C)	Sawing Pavement	Lin. Ft., Lump Sum
(D)	Removal of Existing Bridge Structure	Lump Sum

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified. The price shall also include salvage of materials removed, their custody, preservation, storage and disposal as provided herein. There will be no separate payment for the excavation, removal, disposal, backfilling and compacting of the cavity created by the removal of these items.

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622.00 PIPE RAILING AND MISCELLANEOUS PIPE WORK

622.01 DESCRIPTION. This work shall consist of furnishing and erection of pipe railing with pipe posts, pipe railing with concrete posts, or miscellaneous work in accordance with these Specifications and in reasonably close conformity with the design, lines, grades and dimensions shown on the Plans or established by the Engineer.

622.02 MATERIALS. Materials shall meet the requirements of Subsection 732.04.

When standard black steel pipe is used, it shall be painted with 2 coats of aluminum paint (finish field coat) in accordance with Subsection 730.04 B. 3.

Concrete posts, when specified, shall be in accordance with Section 505. Reinforcement shall be in accordance with Subsection 723.01 or 723.02.

622.04 CONSTRUCTION METHODS.

A. Pipe Railing. All work shall be performed complete in every detail in accordance with the very best practice for the various items involved.

The rail pipe shall be joined to the post with fittings as shown on the Plans. Splices in pipe by couplings between connections will not be permitted, approved methods of welding will be permitted.

Each railing post shall be secured in position by means of such fittings as specified on the Plans.

B. Miscellaneous Pipe. Pipe used in miscellaneous work such as conduits or drains through concrete curb, sidewalks, or retaining walls shall be set as shown on the Plans or as directed by the Engineer. When pipe is embedded in concrete, care shall be taken to work the concrete in well around the pipe.

622.05 METHOD OF MEASUREMENT.

A. Pipe Railing. Pipe railing will be measured by the linear foot of pipe railing complete in place, measured center to center of the end posts. Posts of steel or concrete will not be measured for payment.

B. Miscellaneous Pipe Work. When classified for payment miscellaneous pipe work will be paid for by the linear foot of pipe. When this class of work is not specifically classified on the Plans or in the Proposal for payment, it will be considered as incidental work and will not be paid for as a separate item but the cost of same will be included in other contract prices.

622.06 BASIS OF PAYMENT. Accepted quantities of pipe railing and

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miscellaneous pipe work, measured as provided above, will be paid for at the contract unit price for:

- | | | |
|-----|-------------------------|----------|
| (A) | Pipe Railing | Lin. Ft. |
| (B) | Miscellaneous Pipe Work | Lin. Ft. |

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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623.00 GUARD RAIL AND GUIDE POSTS

623.01 DESCRIPTION. This work shall consist of the construction of guard rail and guide posts in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

623.02 MATERIALS. Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Guard Rail Posts	732.01
Guide Posts (Wood)	732.02
Spacer Blocks	732.01
Zinc Rich Paint	730.06
Beam Guard Rail Elements	732.01
Fittings (Steel) Hardware	732.01
Wire Cable and Fittings	732.05
Reflective Sheeting	733.05
Nonshrink Grout	733.07
Portland Cement Concrete, Class A	701.
Reinforcing Steel	723.

Epoxy resin adhesive (epoxy pourable grout) shall meet the requirements of AASHTO M-235, Type III and be pourable in consistency.

623.04 CONSTRUCTION METHODS.

A. *Setting Posts for Guard Rail, Guide Posts or Barrier Posts.*

Posts for guard rail shall be set in accordance with the Plans. When posts are set in the ground, the posts shall be set in holes dug in thoroughly compacted soil and the bottom of the holes shall be thoroughly rammed so that the post will have a stable foundation. The posts shall be spaced as shown on the Plans, set plumb and with the front faces in a straight line, or if on a curve, at a uniform distance from the edge of the pavement. The top of the post shall be set to the elevation shown on the Plans or as approved by the Engineer. After the posts are placed, the holes shall be backfilled with approved material, thoroughly rammed in layers not to exceed 6 inches in depth and in such manner as not to shift the posts from the correct alignment. Posts for guard rail may be machine driven in lieu of drilling holes and backfilling as specified above.

All other requirements shall be as shown on the current guard rail standard drawings.

B. *Rail Elements.* Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts, except adjustment bolts, shall be

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drawn tight. Bolts shall be of sufficient length to extend beyond the nuts.

Where painting of railing components is specified, any damage to the shop coat of paint shall be corrected by an application of an approved rust-inhibitive primer prior to other painting. Any surfaces inaccessible to painting after erection shall be field painted before erection. The railing components shall be given the specified number of coats of paint uniformly applied by thorough brushing or by approved pressure spray as specified.

Galvanized surfaces which have been abraded so that the base metal is exposed, threaded portions of all fittings and fasteners and cut ends of bolts shall be protected with 2 coats of an approved zinc rich paint.

Where double-faced guard rail is specified, it shall be installed in accordance with the Plans.

- C. *Placing Metal Plate Rails and Fittings.*** Where metal plate rails are specified or used, they shall be fastened to the posts in the manner shown on the Plans. The plate shall be at the elevation shown on the Plans. All laps in the rail shall conform to the direction of traffic on the roadway.

When the type of metal plate guard rail to be used is not specifically set out on the Plans, no more than one type will be permitted on any one Project.

- D. *Placing Reflective Sheeting on Guide Posts.*** After the posts are set, posts shall be provided with reflective sheeting, when specified, fixed to the post with four 8d box nails as shown on the Plans.

- E. *Guard Rail Anchor Units.*** Guard rail anchor units shall be constructed as shown on the Plans.

When rock harder than medium sandstone (outcropping on surface, massive boulders and ledge rock under overburden) is encountered during construction of the concrete anchor, the following steps should be followed.

For surface outcropping, drill four properly spaced and patterned 2 inch diameter holes to receive the full depth anchor bolts as shown on the Plans. Half fill the rock holes with pourable epoxy grout, insert the bolts and stabilize them to their final position, then fill the remainder of the hole. Air bubbles and voids shall be expelled from the holes to guarantee full bearing of the bolts.

For rock with a soil overburden up to 18 inches deep the following steps shall be followed. Drill the four properly spaced holes to receive the anchor bolts. Drill four additional 2-1/2 inch diameter holes spaced at 90° and 12 inches from center of concrete anchor. Half fill the outer holes with pourable epoxy grout, insert and stabilize plumb, one number 9 reinforcing steel bar per hole, cut to the proper length. Then fill the remaining hole and expel any bubbles.

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Length should enable insertion of full 12 inches into the rock and clear the top of the concrete anchor by 2 inches. Tie the 6x6-W1 .5xW1. 5 wire mesh to the bars after grout is dry. Pourable epoxy grout shall be spread on the mating surface between the rock and concrete for positive bond. Construct the upper portion with the same details as shown on the Plans.

For encountered rock at depths greater than 18 inches omit the holes for the four anchor bolts and construct the anchor as covered in the previous paragraph.

623.05 METHOD OF MEASUREMENT. Beam guard rail installations will be measured by the linear foot between end sections.

Guard rail anchor units and beam guard rail-transition sections will be measured separately as units shown on the standard drawings.

Fittings will not be measured separately but included as incidental to the type specified.

Guide posts will be measured by the number of posts, including reflective sheeting.

623.06 BASIS OF PAYMENT. The accepted quantities of the various items, measured as provided above, will be paid for at the contract unit price for:

(A)	Beam Guardrail	Lin. Ft.
(B)	Beam Guardrail-Transition Section	Ea.
(C)	Guardrail Anchor Unit	Ea.
(D)	Guide Posts	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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624.00 FENCES

624.01 DESCRIPTION. This work shall consist of the construction of fence and gates in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

The style, type and/or class of fence will be as shown on the Plans. The styles are designated as follows:

- (A) Fence, Style WWF (Woven Wire Fence)
- (B) Fence, Style SWF (Strand Wire Fence)
- (C) Fence, Style CLF (Chain Link Fence)
- (D) Fence, Style GDF (Glare Deflector Fence)

Fence gates shall be of the style, type and/or class, and size as shown on the Plans, and shall be installed at locations shown on the Plans or as directed by the Engineer. They shall be installed in accordance with the Plans.

624.02 MATERIALS. Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Fence, Style WWF	732.06
Fence, Style SWF	732.06
Fence, Style CLF	732.07
Fence, Style GDF	732.08
Zinc Rich Paint	730.06
Portland Cement Concrete, Class A	701

When not specified on the Plans or in the Proposal, the kind of post, hardware and fittings meeting the requirements of Section 732 shall be optional with the Contractor, but the kind selected shall be used throughout any one project unless otherwise approved in writing by the Engineer.

624.04 CONSTRUCTION METHODS.

A. General. The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment. Existing fencing on permanent right-of-way when the work order is issued will become the responsibility of the Contractor. At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made. Cross fencing connections shall include an end post approximately perpendicular to the right-of-way fence, or at an angle dictated by the route of the cross fence.

When the Plans require that posts, braces or anchors be embedded in concrete, the Contractor shall install temporary guys, or braces as may be required to hold the posts in proper position until such time as the concrete

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has set sufficiently to hold posts. Unless otherwise permitted, materials shall not be installed on posts or strain placed on guys and bracing set in concrete until 5 days after the placing of the concrete.

Line posts may be driven instead of set in concrete footings or tamped in earth holes at the option of the Contractor, and with the approval of the Engineer. For the driving option, wooden line posts shall be sharpened by the supplier prior to preservative treatment, and the top shall be protected. Splitting or damage to the post top as a result of the driving operation will be cause for rejection. Field sharpening or taper dressing will not be allowed. Metal posts shall also have a fitted impact head to minimize deformation or damage to the galvanized or painted finish.

Deformed and/or damaged tops of metal posts shall be cleaned and painted with a zinc-rich paint after driving.

Severely deformed or poorly painted tops will be cause for rejection.

Adequate plumb and offset (alignment) control shall be exercised to assure a smooth profile and alignment. In shallow depressions the use of extra length posts and barbed wire fans shall be utilized to maintain a smooth top of fence profile. Strengthened fence construction and the use of movable water gates may be necessary in installations over deep ravines. Under no circumstances shall swales or ravines subject to periodic water flow be filled to facilitate fence construction. Adequate provision for drainage must be maintained.

For installations in earth and soft rock (softer than medium sandstone) the following criteria shall be adhered to: Driven posts shall reach the minimum embedment as shown on the Plans unless refusal of the post is reached. Refusal is defined as one inch or less entry per minute of driving with a 60 pound hammer utilizing mechanical or pneumatic means, delivering a minimum of 60 blows per minute. If refusal is encountered at 24 inches or deeper, the post may remain and be top cut for profile control. If refusal is encountered at less than 24 inches depth, the post shall be pulled and a concrete footing of the dimensions as shown on the Plans for earth installations shall be installed.

For installations in medium to hard rock (medium sandstone or harder) when encountered at the surface, the following criteria shall be adhered to: a hole of the diameter and depth for footings in rock, as shown on the Plans for the type of post being used shall be drilled. The post shall then be inserted, plumbed, and braced, and the hole filled with lean grout.

The procedure for installations when medium to hard rock is encountered under a layer of earth is as follows. At any depth less than the minimum driven embedment (as shown on the Plans) at which rock is encountered, the earth shall be augured and treated like a regular concrete embedded earth

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footing. A hole of the diameter for footings in rock (as shown on the Plans for the type of post being used) shall be drilled to a depth which will yield the total minimum earth embedment, or the minimum rock embedment, whichever occurs first. The rock hole shall then be half filled with an approved type of lean grout, (thin hydraulic cement), the post inserted, plumbed braced, and the remainder of the rock hole filled with lean grout. Concrete for earth footing may be immediately placed above the grouted hole.

The intent is for all driven posts to be firmly in the earth a minimum of 24 inches where driving has been refused, or the minimum earth embedment as shown on the Plans, unless rock is encountered. The minimum rock embedment shall be required unless the total minimum earth embedment is reached prior to the rock embedment being reached. When these conditions have been fully satisfied, the post may be top cut for profile control.

The tops of all posts shall be set approximately to the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the Engineer or under the conditions specified herein or on the Plans.

Tops of wood posts shall be liberally painted with a preservative solution after cutting. Cut areas (no flame cuts allowed) on metal posts shall be cleaned and painted with a single coat of zinc-rich paint. Wire or fencing of the size and type required shall be firmly attached to the posts and braces in the manner indicated.

All wire shall be stretched taut and be installed to the required elevations.

At each location where an electric transmission, distribution or secondary line crosses any of the types of fences covered by the Specifications, grounding of the fencing shall be accomplished in accordance with the following: a galvanized or copper coated steel ground rod 8 feet long having a minimum diameter of 1/2 inch shall be installed directly below the point of crossing. The rod shall be driven vertically until the top is six inches below the ground surface. A No. 6 solid copper conductor or equivalent shall be used to connect each fence element to the grounding rod. The connections shall be either brazed or fastened with approved non-corrosive clamps.

When a powerline runs parallel or nearly parallel to and above the fence, the fence shall be grounded at each end and gate post and at intervals not to exceed 1,500 feet.

The Contractor shall provide the abutting property owners with the equivalent property protection given by the existing fences. The Contractor shall be responsible for the maintenance of all fences and gates that he constructs during his construction operations.

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B. Fence-Style WWF (Woven Wire Fence). This item shall consist of woven wire fabric with smooth, barbless, or barbed wire strands on a steel and/or wood post system.

1. *Alignment.* The Plan sheets show the general alignment, angles, corners and attachment types at culverts. In general, fence shall be constructed on the permanent right-of-way line and wire usually will be attached to the private property side of the fence posts. On curves, wire fabric shall be placed on that side of the post which will maintain the wire in a taut condition. The area where the right-of-way fence is to be constructed shall be cleared of obstructions and the ground leveled of minor irregularities so the fence can be free of an excessive number of anchor posts and fans.
2. *Setting Posts.* Line posts shall be of the size indicated on the Plans and shall be set on the permanent right-of-way line, or to a line shown on the Plans or approved by the Engineer, and in a reasonably true line on the property owner's side to which wire generally is to be attached. They shall be embedded in the ground to the depth shown on the Plans and shall be well tamped and firmly set. Spacing between line posts shall not exceed dimensions shown on the Plans. Additional posts shall be set at each abrupt change in grade, alignment, or at locations approved by the Engineer.

Extra length posts (fan posts) shall be required at small depressions where it is not practicable for the fence to follow closely to the contour of the ground. At such small ground depressions the Contractor shall close the space below the bottom of the fence fabric with wire, stretched taut between posts, either on horizontal lines or fanned at 6 inch maximum spacing, as shown on the Plans or as approved by the Engineer. The wires shall be stretched taut and securely fastened to the posts to prevent vertical movement of the wires.

Concrete for encasing posts as indicated on the Plans may be poured without forming if the excavation is of sufficient stability to receive the concrete without caving or sliding in. If specified by the Engineer, footings shall be formed.

3. *Placing Fencing.* Barbed wire, barbless wire, or smooth wire shall be fastened to all fan, end, corner, gate and/or stretcher posts, and to all line posts by substantial and approved means. Fastening shall be done by the use of tools designed for the purpose in accordance with the manufacturer's recommendations. The tension for stretching shall be applied by mechanical fence stretchers or with single-wire stretchers designed for the purpose. All strands shall be stretched taut to a tensile force of approximately 300 pounds as shown on the Plans or as recommended by the manufacturer.

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Splicing of strand wire, and wire fabric shall be made by a mechanical device of an approved type, or a wire splice may be made in the following manner: The ends of wires shall be carried 2 inches past the splicing tools and wrapped around both wires backward from the tool for at least five turns. An approved single strand of smooth steel wire or barbless wire may be substituted to the top strand of barbed wire, or for all the barbed wire with the approval of the Engineer, and the concurrence of the Contractor.

Woven wire fabric shall be stretched uniformly tight by means of an approved mechanical tensioning device and in conformity to the location on the posts designated on the Plans. Parallel stays shall be straight, and uniformly spaced as shown on the Plans. Each woven fabric wire and strand wire shall be stapled to wood posts or fastened with approved fittings to steel posts. Woven wire shall be cut or spliced at stretcher or wood posts as required to prevent buckling or undue stretching.

Attachment assemblies shall be built according to the Plans. When it is necessary to make attachments to culvert or bridge endwalls after the culvert is constructed, the hole shall be drilled with a drill of the same size as the expansion device and the holes shall be neat, without chipping or breaking the concrete.

C. Fence-Style SWF (Strand Wire Fence). This item shall consist of smooth, barbless, or barbed wire strands on a steel and/or wood post system constructed in the same manner as fence-style WWF, except the fencing fabric shall consist of strands of an approved smooth wire, barbless wire, or barbed wire. Fence-style SWF shall have the number of strands of wire as shown on the Plans or as approved by the Engineer. The fence shall be set on the permanent right-of-way line.

D. Fence-Style CLF (Chain Link Fence). This item shall consist of chain link type fabric fencing on galvanized steel or aluminum alloy post system, with or without barbed wire, smooth tension wire, or climb barrier systems.

1. *Alignment.* The provisions of Subsection 624.04 A. General and 624.04 B. 1. Fence-style WWF shall govern.
2. *Setting Posts and Placing Fencing.* See Subsection 624.04 A. General for alternate driving criteria for line posts. Post holes shall be dug to the minimum size and spacing as shown on the Plans. Posts shall be set plumb, centered in the hole and to the lines shown on the Plans. Posts shall be placed in the concrete before initial set, thoroughly puddled and supported plumb until concrete has set. Wire shall not be stretched until concrete in post holes is at least five days old. Wire shall be stretched slightly above the tension recommended by the manufacturer for the season of the year in which construction takes place and allowed to slack

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away slightly when pullers are released. Pullers shall attach to the wire full width and ties made in at least seven places on each post before releasing. If desired, pulls may be made from two ways and jointed by inserting one picket. All post braces shall be set before placing any wire. Tension and barb wire shall be placed after proper size of fabric is placed. Wire shall be placed on the outside of the posts, with respect to the road, except on curves where wire shall be placed on the outside of the post with respect to the center of the curve.

3. *Concrete Wall for Fence.* Across ravines where it would not be practical to set posts and follow the ground line with the fence, posts shall be set in a concrete wall as shown on the Plans and at locations directed by the Engineer. When a wall is constructed across any dry wash or periodically wet ravine, adequate provision for drainage must be made. A partial wall on each bank with a water gate or fan in the center, or culverts through any solid wall will satisfy the drainage requirements.

3.1 *Concrete.* All concrete shall be Class A and meet the requirements of Section 701.

3.2 *Reinforcing Steel.* Reinforcing steel shall meet the requirements of Section 511.

624.05 METHODS OF MEASUREMENT. Fence will be measured by the linear foot. Measurement will be along the ground line of the fence from outside to outside of end posts for each continuous run of fence. Connections to cross fences will not be measured separately, but costs shall be included in price bid for fence.

Gates will be measured as complete units of the size, type, and class specified. Concrete wall for fence, when specified, will be measured in accordance with the dimensions shown on the Plans and will be paid for under Section 509, Class A Concrete or Class A Concrete for Small Structures and Section 511, Reinforcing Steel.

624.06 BASIS OF PAYMENT. The accepted quantities of fence, measured as provided above, will be paid for at the contract unit price per linear foot of fence and per each for gates of the types and sizes for:

(A)	Fence-style WWF	Lin. Ft.
(B)	Gate-style WWF	Ea.
(C)	Fence-style SWF	Lin. Ft.
(D)	Fence-style CLF	Lin. Ft.
(E)	Gate-style CLF	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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625.00 REMOVAL AND STORAGE OR RECONSTRUCTION OF FENCING, GUARD RAIL AND GUIDE POSTS

625.01 DESCRIPTION. This work shall consist of the removal and storage or reconstruction of fencing, guard rail and guide posts in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the Engineer.

625.02 MATERIALS. When reconstruction is called for, materials salvaged from the existing installation may be used if in good condition. All other material shall be replaced with approved materials. Paint shall meet the requirements of Subsection 730.04 D. Unless otherwise specified, the paint for refurbishing shall be aluminum. Zinc rich paint shall meet the requirements of Subsection 730.06.

625.03 CONSTRUCTION METHODS.

A. Removal and Storage. The removed material, unless otherwise provided, shall be stored at a designated location, as may be directed by the Engineer. Care shall be taken in removal of material to prevent damage to posts, cable, fence, plates, or fittings. Cable or fence shall be coiled and tied tightly before storing. Fittings shall be tied together in bundles or boxed. Such items as metal plates and posts shall be neatly stacked on blocks to prevent contact with the ground.

B. Reconstruction.

1. *Guard Rail or Fence.* When reconstruction of guard rail or fence is provided in the Contract, the guard rail or fence in place shall be removed and stored as required above until such time as it is to be reset. All construction of guard rail or fence shall be done in the same manner as provided for new work. The Contractor will be required to replace at his own expense any material damaged or lost. All fresh or new cut holes, etc. will be coated with zinc rich paint. After erection of metal plate rail, all abrasions of the existing paint shall be thoroughly cleaned and given one coat of aluminum paint. After this paint coat is thoroughly dry, the plate rail and all fittings shall be given one coat of aluminum paint as required for new metal plate guard rail. Setting of guard rail furnished by the State, when such work manner as provided for new work.
2. *Guide Post.* Reconstructing guide posts shall consist of removing, storing and resetting guide posts. All reconstruction on of guide posts or setting guide posts shall be done in the manner as provided for new work. The Contractor will be required to replace at his own expense any guide posts damaged during removal or storage or any posts that may be lost.

625.04 METHOD OF MEASUREMENT. Guard rail or fence removed and stored and not to be replaced will be measured by the length in linear feet from center of

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end posts as measured before removal.

Guard rail or fence removed and stored to be reset will be measured by the length in linear feet from center to center of end posts as measured after reconstruction and approval.

Guide posts removed and stored, and not to be replaced, will be measured by the number of such guide posts actually removed and stored as directed.

Guide posts removed and stored to be reset will be measured by the number of such posts removed and reset as measured after reconstruction and approved.

625.06 BASIS OF PAYMENT. Accepted quantities of the various items, measured as provided above, will be paid for at the contract unit price for:

(A)	Remove and Store Fence	Lin. Ft.
(B)	Remove and Reconstruct Fence	Lin. Ft.
(C)	Remove and Store Guard Rail	Lin. Ft.
(D)	Remove and Reconstruct Guard Rail	Lin. Ft.
(E)	Remove and Store Guide Posts	Ea.
(F)	Remove and Reconstruct Guide Posts	Ea.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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642.00 CONTRACTOR CONSTRUCTION STAKING

642.01 DESCRIPTION. When specified in the Contract this work shall consist of the Contractor furnishing, placing and maintaining construction layout stakes necessary for the proper prosecution and inspection of the work under the contract in accordance with these Specifications.

642.02 CONSTRUCTION METHODS. The City will locate and reference the center line of construction and will establish bench marks.

The Contractor shall exercise care in the preservation of stakes and bench marks and shall have them reset at his expense when any are damaged, lost, displaced or removed. The Contractor shall use competent personnel and suitable equipment for the layout work required.

The Contractor shall provide field forces and shall set all additional stakes needed, such as offset stakes, reference point stakes, slope stakes, pavement and curb line and grade stakes, stakes for bridges, sewers, roadway drainage, pipe underdrains, paved gutter, fence, culverts or other structures, and any other horizontal or vertical controls necessary to secure a correct layout of the work. The Contractor shall also do all layout work and shall set stakes necessary for carrying out utility changes when such utility changes are required during the course of the Contract. Stakes for line and grade shall be adequate to maintain the specified tolerances for the operation being performed. The station number and the distance from the center line of construction shall be marked on all grade stakes.

The Contractor shall furnish the original of his survey records to the Engineer for computation of quantities and for the permanent file. These records shall be furnished as they are completed during the progress of the work. These records shall be in permanently bound field books and/or level books and formatted in a manner commonly accepted by the surveying profession. The Engineer may at any time check the correctness of the Contractors staking work by using spot check method. When significant errors occur, the Contractor shall resurvey to the satisfaction of the Engineer. The Contractor shall furnish, at his expense, platforms and equipment necessary for proper and safe access for checking his staking. Any inspection or checking of the Contractor's layout by the Engineer and the acceptance of all or any part of it shall not relieve the Contractor of his responsibility to secure the proper dimensions, grades, and elevation of the several parts of the work.

642.03 METHOD OF MEASUREMENT. Measurement for contractor construction staking will be made on a lump sum basis.

642.04 BASIS OF PAYMENT. Contractor construction staking, measured as provided above, will be paid for at the contract price for:

Staking

Lump Sum

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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Payment for this item of work shall be on the following schedule:

- 25 percent on first estimate
- 25 percent when 10 percent of the contract work is completed
- 25 percent when 50 percent of the contract work is completed
- 20 percent when 75 percent of the contract work is completed
- 5 percent when all field books and records have been furnished to the Engineer.