SECTION 02900
TURF ESTABLISHMENT

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Minimum requirements for acceptance of grass cover for erosion control.
- B. Requirements for preparing ground, providing and planting St. Augustine grass, providing and distributing Fertilizer and subsequent watering.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for Hydromulch seeding is on an acre basis.
  2. Payment for sodding is on a square yard basis.
  3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.
- C. Payment for all seeding either Hydromulch or Sodding shall be only to the extent of the limits in the Drawings. The Contractor shall replace all damaged ground cover outside of the limits shown on the Drawings at no cost to the City.

1.3 SUBMITTALS
- A. The following submittals shall be made prior to beginning of turf establishment.
  1. Vegetative Plan which shall include:
     a. Seed bed preparation.
     b. Method of seeding.
     c. Seed.
     d. Species.
     e. Rate of application.
     f. Optimum planting dates.
     g. Seed quality requirements.
     h. Fertilizer.
     i. Nutrient ration required.
     j. Schedule of application.
     k. Rate of application.
     l. Method of applications.
     m. Weed control methods.
  2. Extended maintenance plan.

1.4 REFERENCES
A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1. TOPSOIL
A. Topsoil that is either stripped and stockpiled or hauled in shall conform to Section 02905 – Topsoil.

2.2 SOD
A. Sodding shall conform to Section 02915 – Sodding.

2.3 Hydromulch Seed
A. Hydromulch seed shall conform to Section 02910 – Hydromulch Seeding. Hydromulch seeding shall be appropriate for the season in which it is being applied.

2.4 FERTILIZER
A. Fertilizer shall be of nutrient ratio specified in Vegetative Plan. Bagged or bulk fertilizer will be acceptable. If bulk fertilizer is used, Vendor shall sign Invoice to certify analysis. Only free-flowing uncontaminated fertilizer will be acceptable. Fertilizer shall conform to the specifications of Sections 02910 – Hydromulch Seeding and 02915 – Sodding.

PART III: EXECUTION

3.1 GENERAL
A. Turf establishment shall begin as soon as practically and economically feasible after approval by the Project Manager.
B. Proceed with seeding when environmental conditions are favorable.
C. Repair erosion occurring after topsoil placement but before beginning turf establishment.

3.2 TOPSOIL
A. Strip topsoil and stockpile in conformance with Section 02905 – Topsoil.
B. Place topsoil as shown in the Drawings to a depth of four inches (4 In) loose.
C. Do not under any circumstances, start fertilization and seeding before the topsoil has been approved by either a Landscape Architect or the Project Manager or both. Failure to get approval shall have all seeding and topsoil removed and replaced at no cost to the City.

3.2 PLANTING OPERATIONS
A. After topsoil placement and approval of the Project Manager, apply fertilizer at a rate of eighty (80) – eighty (80) per acre.
B. Disc fertilizer into seedbed.
C. Roll seedbed to compact soil.

D. Weed control shall be carried out during guarantee period as detailed in Vegetative Plan.
E. Rates, mixtures and techniques may be adjusted by Certified Professional Agronomist depending on season topsoil placement in completed with the approval of the Project Manager.
F. Plant San Augustine or Bermuda sod in residential areas and next to curb for erosion control in lieu of silt fencing.
G. Hydromulch all other areas not in residential areas with Bermuda seed mix.
H. Contractor shall guarantee at least ninety-five percent (95%) cover for grass in any ten square yard (10 Sy) area sampled at the end of one year (1 Yr) from date of acceptance of maintenance responsibility by the City. Any area that does not have grass cover at the end of guarantee period will be reestablished by Contractor at no additional cost to the Owner. The City shall not accept maintenance responsibilities until either the end of the one year (1 Yr) guarantee period or when grass covers at least ninety-five percent (95%) of the area; whichever is later.

END OF SECTION

SECTION 02905
TOPSOIL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Furnishing and placing topsoil for finish grading and for seeding, sodding and planting.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. No separate payment shall be made for topsoil under this Section. Include payment in Section 02910 – Hydromulch Seeding or Section 02915 – Sodding.
  2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENECES
- A. CFTS – City of Friendswood Technical Specifications.

PART II: PRODUCTS

2.1 TOPSOIL
- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having characteristics specified in TABLE 4.1 – TOPSOIL CHARACTERISTICS in this Section.
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials and other litter or contamination. Topsoil shall not contain roots, stumps and stones larger than two inches (2 In).
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at a minimum depth of four inches (4 In) and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of or reproductive parts of nut grass or other noxious weeds.

PART III: EXECUTION

3.1 EXAMINATION
- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by the Project Manager.
- B. Stockpile topsoil to depth not exceeding eight feet (8 Ft). Cover to protect

from erosion.

3.2 TOPSOIL EXCAVATION

A. Conform to excavation and stockpiling requirements of Section 02135 – Excavation for Roadway.

3.3 PLACEMENT

A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to a minimum depth of four inches (4 In) or as indicated on the Drawings. Remove vegetation and foreign inorganic material. Place four inches (4 In) of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.

B. Increase depth of topsoil to six inches (6 In) when placed over sand bedding and backfill materials specified in Section 02140 – Utility Backfill Materials.

C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on the Drawings.

D. Remove spilled topsoil from curbs, gutters and, paved areas and dispose of excess topsoil in accordance with requirements of Section 01580 – Waste Material Disposal.

E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for a minimum depth six inches (6 In), fill in and recompact areas of settlement.

3.4 PROTECTION

A. Protect topsoil from wind and water erosion until planting is completed.

PART IV: TABLES

4.1 TOPSOIL CHARACTERISTICS

TOPSOIL CHARSCTERISTICS	
CHARSCTERISTIC	**VALUE**
pH Value	Between 5.5 and 6.5
Liquid Limit	50 or Less
Plasticity Index	20 or Less
Gradation	Maximum of 10% passing No. 200 Sieve

END OF SECTION

SECTION 02910
HYDROMULCH SEEDING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Seeding, fertilizing, mulching and maintenance of areas indicated on the Drawings.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for Hydromulch seeding is on an acre basis.
  2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certification from supplier that each type of seed conforms to these Specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these Specifications and requirements of Texas Fertilizer Law.

1.4 REFERENCES
- A. CFTS – City of Friendswood Technical Specifications.
- B. Texas Seed Law.
- C. USDA – United States Department of Agriculture rules and regulations of Federal Seed Act.

PART II: PRODUCTS

2.1 MATERIALS
- A. Topsoil: Conform to material requirements of Section 02905 – Topsoil.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified ninety percent (90%) pure and furnish ninety percent (90%) germination and meet following requirements:
  1. Rye: Fresh, clean, Italian rye grass seed (lollium multi-florum), mixed in labeled proportions. As tested, the minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
  2. Bermuda: Extra-fancy, treated, lawn type common Bermuda

(Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vendor and germination test results.

3. Wet, moldy or otherwise damaged seed shall not be accepted.
4. Seed requirements, application rates and planting dates are as specified in TABLE 4.1 – SEEDING CONDITIONS in this Section.

C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged or otherwise unsuitable fertilizer shall not be accepted. Fertilizer shall contain the minimum percentages of elements as specified in TABLE 4.2 – MINIMAL FERTILIZER ELEMENTS in this Section.

D. Mulch:
1. Virgin wood cellulose fibers from whole wood chips having a minimum of twenty percent (20%) fibers forty-two hundredths inches (0.42 In) in length and one hundredth inch (0.01 In) in diameter.
2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
3. Dye mulch green for coverage verification purposes.

E. Soil Stabilizer: "Terra Tack 1" or approved equal.

F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART III: EXECUTION

3.1 PREPARATION

A. Place and compact topsoil in accordance with requirements of Section 02905 – Topsoil.

B. Dispose of Objectionable and Waste Materials in accordance with Section 01580 – Waste Material Disposal.

3.2 APPLICATION

A. Seed: Apply uniformly at rates given in TABLE 4.1 – SEEDING CONDITIONS in this Section, for type of seed and planting date.

B. Fertilizer: Apply uniformly at rate of five hundred pounds (500 Lbs) per acre.

C. Mulch: Apply uniformly at rate of fifty pounds (50 Lbs) per one thousand square feet (1000 Sf).

D. Soil Stabilizer: Apply uniformly at rate of forty pounds (40 Lbs) per acre.

E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.

F. Sod: Lay single row of sod along perimeter where top soil and pavement

intersect. Apply in conformance to Section 02915 – Sodding.

G. Suspend operations under conditions of drought, excessive moisture, high winds or extreme or prolonged cold. Obtain the Project Manager's approval before resuming operations.

3.3 MAINTENANCE

A. Maintain grassed areas for a minimum of ninety days (90 D) or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
B. Maintain grassed areas by watering, fertilizing, weeding and trimming.
C. Repair areas damaged by erosion by re-grading, rolling and replanting.
D. Reseed small, sparse grass areas. When sparse areas exceed ten percent (10%) of planted area, reseed by hydro mulch.
E. Mow grass when height reaches three and one-half inches (3-1/2 In) or greater on average before final acceptance. Mow to height of two and one-half inches (2-1/2 In).

PART IV: TABLES

4.1 SEEDING CONDITIONS

GRASS SEEDING CONDITIONS		
TYPE	APPLICATION RATE lbs/ac	PLANTING DATE
Hulled Common Bermuda 88/98	40	Jan 1 to Mar 31
Unhulled Common Bermuda 88/98	40	
Hulled Common Bermuda 88/98	40	Apr 1 to Sep 30
Hulled Common Bermuda 88/98	40	Oct 1 to Dec 31
Unhulled Common Bermuda 88/98	40	
Annual Rye Grass (Gulf)	30	

4.2 MINIMAL FERTILIZER ELEMENTS

MINIMAL FERTERLIZER ELEMENT PERCENTAGES	
ELEMENT	PERCENTAGE
Nitrogen	10%
Phosphoric Acid	20%
Potash	10%

END OF SECTION

SECTION 02915
SODDING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.
- B. Planting of sod within areas designated on the Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.
- C. Sod is defined as blocks, squares, strips of turfgrass and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.
- D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for sodding is on a square yard basis.
  2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.

1.4 REFERENCES
- A. CFTS – City of Friendswood Technical Specifications.
- B. Structural Pest Control Board of the State of Texas.

1.5 QUALITY ASSURANCE
- A. Sod only when weather and soil conditions are deemed by the Project Manager to be suitable for proper placement.
- B. Water and fertilize new sod.
- C. Guarantee sod to be growing thirty days (30 D) after substantial completion.
- D. Maintenance Period:
  1. Begin maintenance immediately after each section of grass sod is installed and continue for thirty day (30 D) period from date of substantial completion.
  2. Re-sod unacceptable areas.
  3. Water, fertilize, control disease and insect pests, mow, edge,

replace unacceptable materials and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

E. Notify the Project Manager ten days (10 D) before end of maintenance period for inspection.

PART II: PRODUCTS

2.1 SOD

A. Species: Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides) or St. Augustine (Stenotaphrum Secundatum) Gulf Coast variety to match existing sod.

B. Contents: ninety-five percent (95%) permanent grass suitable to climate in which it is to be placed; not more than five percent (5%) weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.

C. Size: twelve inch (12 In) wide strips, uniformly two inches (2 In) thick with clean-cut edges.

D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.2 FERTILIZER

A. Available nutrient percentage by weight: twelve percent (12%) nitrogen, four percent (4%) phosphoric acid and eight percent (8%) potash; or fifteen percent (15%) nitrogen, five percent (5%) phosphoric acid and ten percent (10%) potash.

2.3 WEED AND INSECT TREATMENT

A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to the Project Manager for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

2.4 WATER

A. Potable, available on-site through the Contractor's water trucks. The Contractor may use the City of Friendswood hydrants when water use is measured and verified. Do not use private resident's water.

2.5 BANK SAND

A. Free of clay lumps, roots, grass, salt or other foreign material.

PART III: EXECUTION

3.1 PREPARATION

A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.
B. Top soil shall be free of weeds and foreign material immediately before sodding.
C. Do not start the Work until conditions are satisfactory. Do not start the Work during inclement or impending inclement weather.
D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.
E. Two inches (2 In) of top soil shall be placed for sodding preparation in conformance of Section 02905 – Topsoil over areas to be sodded prior to planting of sod.
F. Apply fertilizer at rate of twenty-five pounds (25 Lbs) per 1000 square feet. Apply after raking soil surface and not more than forty-eight hours (48 Hrs) prior to laying sod. Mix thoroughly into upper two inches (2 In) of soil. Lightly water to aid in dissipation of fertilizer.

3.2 APPLICATION

A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within twenty-four hours (24 Hrs) of harvesting.
B. On slopes two to one (2:1) and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at a maximum of two feet (2 Ft) on center. Drive pegs flush with soil portion of sod.
C. Prior to placing sod, on slopes three to one (3:1) or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at a maximum of sixteen feet (16 Ft) on center along pitch of slope and equal to width of wire mesh horizontally across slopes.
D. After sod is laid, irrigate thoroughly to secure six inch (6 In) minimum penetration into soil below sod.
E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to the Project Manager for approval, prior to construction.

3.3 MAINTENANCE

A. Watering:
    1. Water lawn areas once a day with a minimum of one-half inch (1/2 In) of water for first three weeks (3 Wk) after area is sodded.
    2. After three week (3 Wk) period, water twice a week with three-quarters inch (3/4 In) of water each time unless comparable amount has been provided by rain.
    3. Make weekly inspections to determine moisture content of soil

unless soil is in frozen condition.

4. Water in afternoon or at night to enable soil to absorb a maximum amount of water with a minimum evaporation.

B. Mowing:
   1. Mow sod at intervals which shall keep grass height from exceeding three and one-half inches (3-1/2 In).
   2. Set mower blades at two and one-half inches (2-1/2 In).
   3. Do not remove more than one-half (1/2) of grass leaf surface.
   4. Mow sodded areas requiring mowing within one month (1 Mo) after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.
   5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:
   1. Evenly spread fertilizer composite at rate of forty pounds (40 Lbs) per five thousand square feet (5000 Sf) or as recommended by manufacturer. Do not place fertilizer until two weeks (2 Wks) after placement of sod.
   2. Restore bare or thin areas by topdressing with mix of fifty percent (50%) sharp sand and fifty percent (50%) sphagnum peat moss.
   3. Apply mixture one-quarter inch (1/4 In) to one-half inch (1/2 In) thick.
   4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

D. Restrict all traffic from sodded areas until sod is established or for a minimum of ten days (10 D) during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for a minimum of thirty days (30 D) during growing season.

3.4 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass and streets.

B. Remove barriers, signs and other the Contractor material and equipment from project site at termination of establishment period.

C. Dispose of unused materials and rubbish in accordance with Section 01580 – Waste Material Disposal.

END OF SECTION

SECTION 02920
TREE PLANTING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Tree planting and maintenance.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for tree planting is on unit price basis for each tree planted.
  2. When shown on the Drawings or directed by the Project Manager to remove and relocate tree affected by trench zone, work shall be paid for under one (1) of the following bid items:
     a. Bid item "Remove and Relocate Tree" includes moving tree with truck mounted tree spade and replanting same tree in new location. Payment is for each tree removed and relocated.
     b. Bid item "Remove, Temporary Store and Replant Tree" includes moving tree with truck mounted tree spade and replanting tree at temporary location, (determined by the Contractor) maintaining tree until construction is complete and replanting same tree back to its original location. Payment is for each tree removed, stored and replanted.
  3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. ANSI – American National Standards Institute.
  1. ANSI Z 60.1 – Nursery Stock.
- B. AOAC - Association of Official Agriculture Chemists.
- C. CFDCM – City of Friendswood Design Criteria Manual.
  1. Appendix D – Qualified Tree List.
- D. CFO – City of Friendswood Ordinance.
  1. Appendix C – Zoning.
- E. CFTS – City of Friendswood Technical Specifications.

1.4 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certification from supplier that each type of tree conforms to

these specification requirements.

C. For unpackaged materials, submit analysis by recognized laboratory made in accordance with methods established by Association of Official Agriculture Chemists, when applicable.

D. Submit name and experience of qualified Arborist to the Project Manager.

E. Submit temporary tree storage location. Location must be outside public right-of-way and within five miles (5 Mi) of project site, unless otherwise approved by the Project Manager.

1.5 QUALITY ASSURANCE

A. Landscaper shall be a firm specializing in landscape and planting the Work.

B. Do not make substitutions of approved trees unless approved in writing by the Project Manager. When specified planting material is not obtainable, submit proof of non-availability together with proposal for use of equivalent material. Substitutions of larger size or better grade than specified shall be allowed, but with no increase in unit price.

1.6 DELIVERY, STORAGE and HANDLING

A. Ship trees with Certificates of Inspection as required by governing authorities. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name. Do not remove container grown stock from containers before time of planting.

B. Deliver packaged materials in fully labeled original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at Site.

C. Materials shall not be pruned prior to installation unless approved by the Project Manager in writing. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Use protective covering during delivery.

1.7 WARRANTY

A. Warrant trees against defects including death, unsatisfactory growth or loss of shape due to improper pruning, maintenance or weather conditions, for one year (1 Yr) after completion of planting. Plumb leaning trees during warranty period.

B. Remove and replace trees found to be dead during warranty period. Remove and replace trees which are in doubtful condition at end of warranty period or when approved by the Project Manager, extend warranty period for trees for full growing season.

PART II: PRODUCTS

2.1 TREES

A. Provide container grown trees which are straight and symmetrical and have persistently preferred main leader. Crown shall be in good overall proportion to entire height of tree with branching configuration as recommended by ANSI Z60.1 for type and species specified. Where clump is specified, furnish plant having a minimum of three (3) stems originating from common base at ground line. Measure trees by average caliper of trunk as follows:

1. For trunks up to four inches (4 In) or less in diameter, measure caliper six inches (6 In) above top of root ball.
2. For trunks more than four inches (4 In), measure caliper twelve inches (12 In) above top of root ball.
3. Caliper measurements shall be by diameter tape measure. Indicated calipers on the Drawings are minimum. Averaging of plant calibers shall not be allowed.

B. Trees shall conform to following requirements:

1. Healthy, vigorous stock, grown in recognized nursery.
2. Free of disease, insects, eggs, larvae; and free of defects such as knots, sun-scald, injuries, abrasions, disfigurement or borers and infestations.

2.2 SOIL PRODUCTS

A. Topsoil: Conform to requirements of Section 02905 – Topsoil.

B. Peat moss, bark and fertilizer: Use material recommended by nursery for establishment of healthy stock after replanting.

2.3 STAKES AND GUYS

A. Provide a minimum eight foot (8 Ft) long steel T-stakes and one inch (1 In) wide plastic tree chains.

B. Where applicable for anchoring trees, use wood deadmen of at least two inch by four inch (2 In x 4 In) stock, thirty-six inches (36 In) long and buried three feet (3 Ft). Provide white surveyor's plastic tape for flagging tree guys.

2.4 TREE WRAP, TWINE and SEAL

A. Wrap: First (1st) quality, bituminous impregnated tape, corrugated or crepe paper, specifically manufactured for tree wrapping and having qualities to resist insect infestation.

B. Twine: Lightly tarred, medium-coarse sisal (lath) yarn. Do not use nails or staples to fasten wrapping.

C. Seal: Commercially available asphaltic-base black emulsion specifically produced for use in sealing tree cuts and wounds.

2.5 WATER

A. Water shall be potable from municipal water supplies.

2.6 SOURCE QUALITY CONTROL

A. Notify the Project Manager, prior to installation, of location where trees that have been selected for planting may be inspected. Plant material shall be inspected for compliance with following requirements.
   1. Genus, species, variety, size and quality.
   2. Size and condition of balls and root systems, insects, injuries and latent defects.

PART III: EXECUTION

3.1 PREPARATION

A. Schedule the Work so that planting can proceed rapidly as portions of site become available. Plant trees after final grades are established and prior to planting of lawns, unless otherwise approved by the Project Manager in writing. When planting of trees occurs after seeding the Work, protect lawn areas and promptly repair damage to lawns resulting from tree planting operations.

B. Layout individual trees at locations shown on the Drawings. In case of conflicts, notify the Project Manager before proceeding with the Work. Trees shall be staked and approved by the Project Manager prior to planting.

C. Trees shall not be planted in the City Rights-of-Way.

3.2 PREPARATION OF PLANTING SOIL

A. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.

B. Strip and utilize four inch (4 In) layer of top soil, placed on esplanades under Section 02910 – Hydromulch Seeding, for planting soil mixture.

C. Mix recommended soil amendments with topsoil at following rates:
   1. Top soil: Fifty percent (50%).
   2. Peat moss: Twenty-five percent (25%).
   3. Well rotted Bark: Twenty-five percent (25%).
   4. Fertilizer: Rate recommended by nursery.

D. Delay mixing of fertilizer when planting shall not follow placing of planting soil within forty-eight hours (48 Hr), unless otherwise directed.

E. Incorporate amendments into soil as part of soil preparation process prior to fine grading, fertilizing and planting. Broadcast or spread amendments evenly at specified rate over planting area. Thoroughly incorporate amendments into top two inches (2 In) or three inches (3 In) of soil until amendments are pulverized and have become homogeneous layer of topsoil ready for planting.

3.3 PLANTING

A. Excavate pits, beds or trenches with vertical sides and with bottom of excavation raised a minimum of six inches (6 In) at center for proper drainage. Provide following minimum widths:
   1. Fifteen gallon (15 Gal) containers or larger, two feet (2 Ft) wider than diameter of root ball.
   2. One gallon (1 Gal) and five gallon (5 Gal) containers, six inches (6 In) wider than diameter of root ball.

B. When conditions detrimental to plant growth are encountered, such as unsatisfactory soil, obstructions or adverse drainage conditions, notify the Project Manager before planting.

C. Deliver trees after preparations for planting have been completed and plant immediately. When planting is delayed more than six hours (6 Hr) after delivery, set trees and shrubs in shade, protect from weather and mechanical damage and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture and water as needed.

D. Set root ball on undisturbed soil in center of pit or trench and plumb plant. Place plants at level that, after settlement, natural relationship of plant crown with ground surface shall be established.

E. When set, place additional backfill around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two-thirds (2/3) full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

F. Dish top of backfill to allow for mulching. Mulch pits, trenches and planted areas. Provide not less than four inch (4 In) thickness of mulch, work into top of backfill and finish level with adjacent finish grades. Cover entire root ball.

G. Prune, thin out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed in writing, do not cut tree leaders and remove only injured and dead branches from flowering trees. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

H. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures.

I. Guy and stake trees immediately after planting.

J. Control dust caused by planting operations. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.

3.4 FIELD QUALITY CONTROL

A. The Project Manager may reject unsatisfactory or defective material at anytime during progress of the Work. Remove rejected trees immediately from site and replace with specified materials. Plant

material not installed in accordance with these Technical Specifications shall be rejected.

B. An inspection to determine final acceptance shall be conducted by the Project Manager at end of twelve month (12 Mo) maintenance period. Additional inspections shall be conducted for extended warranty periods provided for in paragraph 1.7.B.

3.5 MOVING EXISTING TREES

A. Perform tree moving and replanting by a professional Arborist during dormant growth season.

B. Provide tree spade of adequate size as directed by professional Arborist.

3.6 MAINTENANCE

A. Maintain trees during planting operations and for period of twelve months (12 Mos) after completion of planting.

B. Water trees to full depth a minimum of once each week or as required to maintain healthy vigorous growth.

C. Prune, cultivate and weed as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

3.7 CLEANUP AND PROTECTION

A. During planting work, keep pavements clean and work area in orderly condition.

B. Protect planting work and materials from damage due to planting operations. Maintain protection during installation and maintenance period. Treat, repair or replace damaged planting work as directed by the Project Manager.

C. Dispose of excess soil and waste in accordance with requirements of Section Waste 01580 – Waste Material Disposal. On-site burning of combustible cleared materials shall not be permitted.

END OF SECTION

SECTION 02925
LANDSCAPE IRRIGATION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Pipe and fittings, valves, sprinkler heads and accessories.
- B. Control system.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for landscape irrigation shall be made under this Section on lump sum basis.
  2. Payment for capped irrigation sleeve, for connection to future system expansion, is on linear foot basis.
  3. Refer to Section 01270 – Measurement and Payment.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. ASTM – American Society for Testing and Materials.
  1. ASTM D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
  2. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure – Rated Pipe (SDR Series).
- B. CFTS – City of Friendswood Technical Specifications.

1.4 SYSTEM DESCRIPTION
- A. Electric solenoid controlled underground irrigation system.
- B. Source Power: one hundred volt (120 V).

1.5 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.

1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in performing work of this Section with a minimum three years (3 Yr) documented experience.

1.7 REGULATORY REQUIREMENTS
- A. Conform to applicable code for piping and component requirements.

1.8 PRE-INSTALLATION CONFERENCE
- A. Convene one week (1 Wk) prior to commencing work of this Section.

1.9 COORDINATION
- A. Coordinate work with site landscape grading and delivery of plant life.

1.10 EXTRA MATERIALS
- A. Furnish extra components under provisions of Section 00300 – Unit Price Form.
  1. Two (2) sprinkler heads of each type and size.
  2. Two (2) valve box keys.
  3. Two (2) wrenches for each type head core and for removing and installing each type head.

PART II: PRODUCTS

2.1 PIPE MATERIALS
- A. Pipe shall be continuously and permanently imprinted with manufacturer's name, size, schedules, type and working pressure.
- B. PVC Pipe ASTM D2241; Two hundred pound per square inch (200 psi) pressure rated upstream from controls, one hundred sixty pounds per square inch (160 psi) downstream; solvent welded sockets rubber gasket joints.
- C. Fittings: Type and style of connection to match pipe.
- D. Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.
- E. Sleeve material: Four inch (4 In) schedule 40 PVC.

2.2 OUTLETS
- A. Manufacturer's or approved equal:
  1. Rainbird Model 1804.
  2. Rainbird Model 1812.
  3. Hunter Model PGP.
- B. Rotary type sprinkler head: Pop-up type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.
- C. Spray Type Sprinkler Head: Pop-up head with full circle, half circle, third circle, quarter circle and square pattern.

2.3 VALVES
- A. Manufacturer's or approved equal:
  1. Rainbird Model PEB Series.
- B. Gate Valves: Bronze construction, non-rising stem and sized to line.
- C. Backflow Preventers: FEBCO 765 Bronze body construction, reduced pressure zone or pressure vacuum breaker type.
- D. Valve Box and Cover: rectangular ten inches by four inches (10 In x 4 In) or nine inches (9 In) round.

2.4 CONTROLLER
- A. Manufacturer's or approved equal:
  1. Rainbird Model RC1260C.

B. Valves: Electric solenoid wiring including required fittings and accessories.
C. Wire conductors: Color coded.

PART III: EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01315 – Coordination and Meetings.
B. Verify location of existing utilities.
C. Verify that required utilities are available, in proper location and ready for use.

3.2 PREPARATION

A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover and structures.
B. Layout and stake locations of system components.
C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.3 TRENCHING

A. Trench and filling as required.
B. Trench size:
    1. Minimum cover over installed supply piping: Eighteen inches (18 In).
    2. Minimum cover over installed branch piping: Twelve inches (12 In).
    3. Minimum cover over installed outlet piping: Twelve inches (12 In).
C. Trench to accommodate grade changes.
D. Maintain trenches free of debris, material or obstructions that may damage pipe.
E. Do not leave trenches open overnight.

3.4 INSTALLATION

A. Install pipe, valves, controls and outlets in accordance with manufacturer's instructions.
B. Connect to utilities.
C. Set outlets and box covers at finish grade elevations.
D. Install control wiring as required. Provide ten inch (10 in) expansion coil at each valve to which controls are connected and at one hundred foot (100 Ft) intervals. Bury wire beside pipe. Mark valves with neoprene valve markers containing locking device. Set valve markers in one hundred pounds per square inch (160 psi) PVC pipe risers exiting from top of valve to finish grade.
E. After piping is installed, but before outlets are installed and filling commences, open valves and flush system with full head of water.

F. Coordinate pipe installation with conduit installation.

3.5 FIELD QUALITY CONTROL
A. Field inspection and testing shall be performed.
B. Prior to filling, test system for leakage for whole system to maintain one hundred pounds per square inch (100 psi) pressure for one hour (1 Hr).

3.6 FILLING
A. Cover with three inches (3 In) of sand over piping; fill trench and compact to subgrade elevation. Protect piping from displacement.

3.7 ADJUSTING
A. Adjust control system to achieve time cycles required.
B. Change and adjust head types for full water coverage as directed.

3.8 DEMONSTRATION
A. Demonstrate system under provisions of Section 01755 – Starting Systems.
B. Instruct City's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

END OF SECTION

SECTION 02930
CEDAR FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Furnishing and installation of cedar picket fencing, galvanized steel posts, and gates plus all accessories incidentals and specials necessary for the proper erection and installation of the fence and gates.
- B. The Contractor shall construct cedar picket fencing including posts, and gates as shown on the Drawings and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for Cedar Fence shall be on a per linear foot basis to include all necessary hardware, concrete, materials and labor.
  2. No separate payment shall be made for each gate. Gates shall be paid under Cedar Fence as part of the linear footage.
  3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. ASTM – American Society for Testing and Materials.
  1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. CTFS – City of Friendswood Specifications.

1.4 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed design mix and test data for each type and strength of concrete.
- C. Submit manufacturer's data and details of following items for approval:
  1. Cedar Fence Pickets.
  2. Galvanized Posts.
  3. Timber Rails.
  4. Materials to be used for installation.
  5. Latch and hinge hardware.
  6. Installation instructions for forms.

PART II: PRODUCTS

2.1 STYLE OF FENCE

A. The fence shall be eight feet (8 Ft) in overall height consisting of blunt cedar pickets attached to three (3) horizontal wooden rails on galvanized steel posts.

2.2 TERMINAL POSTS

A. End, corner and intermediate brace posts shall be hot dipped galvanized three inch (3 In) O.D. schedule 40 steel pipe set in concrete in a twelve inch (12 In) hole not less than thirty-nine inches (39 In) deep.

B. Intermediate posts shall be evenly spaced on centers between end and/or corner posts with a maximum spacing of seventy-five feet (75 Ft).

2.3 LINE POSTS

A. Line posts shall be hot dipped galvanized two and three-eighths inch (2-3/8 In) O.D. diameter schedule 40 steel pipe evenly spaced on centers not to exceed ten feet (10 Ft).

B. Posts shall be set in concrete in a twelve (12) inch diameter hole not less than thirty-three inches (33 In) deep.

2.4 GATE POSTS

A. Gate posts shall be hot dipped galvanized, schedule 40 steel pipe, set in concrete in a hole of a minimum diameter of twelve inches (12 In) or three (3) times the post diameter, and not less than fifty-one inches (51 In) deep.

B. Post sizes and rails shall be as specified in TABLE 4.1 – GATE MATERIALS in this Section.

2.5 RAILS

A. Rail material shall be two inch by four inch (2 In x 4 In) commercially available pine lumber, Number 1 grade, straight, free of knots and other defects, pressure treated, exterior grade, a minimum of twelve feet (12 Ft) in length.

B. Rail splices shall be made utilizing hot dipped galvanized rail splices, commercially available and shall overlap splices on adjacent rails a minimum of two feet (2 Ft).

C. Bottom rail shall be located at a sufficient distance above finished grade to allow attachment of a one inch by eight inch (1 In x 8 In) cedar rot board between the ground and the bottom of the fence pickets.

D. Bent or warped rails which would create an uneven mounting surface for the fence pickets shall not be accepted.

E. The middle and top rails shall be spaced evenly between the bottom rail and within six inches (6 In) below the top of the posts.

F. Rails shall be attached to line posts with five-sixteenths inch by four and three-quarter inch (5/16 In x 4-3/4) hot dipped galvanized carriage bolts with flat washers and nuts, two (2) per rail on each post.

G. Rails shall be attached to terminal posts with five-sixteenths inch by five

and one-half inch (5/16 In x 5-1/2 In) hot dipped galvanized carriage bolts with flat washers and nuts, two (2) per rail on each post.

H. Rails shall be attached to gate posts with hot dipped galvanized carriage bolts with flat washers and nuts, two (2) per rail on each post.

I. Rails shall be attached to gate posts with hot dipped galvanized carriage bolts with flat washers and nuts of the size shown in paragraph 2.4.B. of this Section.

J. Each rail member shall be supported by a minimum of two (2) posts between splices.

K. Splices shall not be made within four inches (4 In) of posts.

2.6 CEDAR PICKETS AND ROT BOARDS

A. Fencing pickets shall be one inch by six inch by eight feet long (1 In x 6 In x 8 Ft) commercially available cedar pickets number 1 graded, straight, free of knots and other defects and pointed on top.

B. Rot boards shall be one inch by eight inch by ten feet long (1 In x 8 In x 10 Ft) cedar number 1 graded, straight, free of knots and other defects.

C. Pickets and rot boards shall be of uniform coloration, size and grading to provide a neat and consistent appearance of the finished fence.

D. Bent or warped pickets or rot boards which would cause openings between adjacent pickets greater than one-quarter inch (1/4 In) in width shall not be accepted.

E. Pickets and rot boards shall be attached to rails with hot dipped galvanized 2-p nails, two (2) per rail on each picket.

F. Pickets shall be mounted against the rot board to provide approximately two inches (2 In) of clearance above finished grade.

2.7 GATES

A. Gate frames shall be fabricated of hot dipped galvanized two inch (2 In) O.D. schedule 40 steel pipe with galvanized pressed steel or malleable iron corner ells, securely riveted to the frame with four (4) rivets per corner.

B. Internal bracing shall be hot dipped galvanized one and one-quarter inch (1-1/4 In) schedule 40 steel pipe with three-eighths inch (3/8 In) adjustable truss rods.

C. Gates may be of the swing or slide type as approved or as shown on the Drawings.

D. Gates shall be provided with padlocking device.

E. Swing gates over six feet (6 Ft) in width shall have rollers near ends to make them easier to open and close.

F. Gates six feet (6 Ft) and greater in width shall have center rests and semiautomatic catch to secure gate in open position.

G. The bottom hinge shall be:

1. A ball and socket type; or
2. A type allowing pivot on vertical member of gate frame.
3. Gate removal shall not require disassembly of the hinge.

4. Made of malleable iron.

H. The upper hinge shall be:
   1. A one hundred degree (180°) wrap-around type,
   2. made of malleable iron, base galvanized; and
   3. allow gate to swing one hundred eighty degree (180°) in either direction.

I. Slide gates shall be track mounted or wheeled in such a manner as to provide a maximum opening clearances of gate.

J. Attach fencing pickets to gate frame with five-sixteenths inch by three and one-quarter inch (5/16 In x 3-1/4 In) hot dipped galvanized carriage bolts with flat washers and nuts, a minimum of two (2) per picket.

PART III: EXECUTION

3.1 INSTALLATION

A. The fence shall be installed by skilled and experienced fence erectors, and on lines and grades indicated on the Drawings.

3.2 CONSTRUCTION

A. All posts shall be capped and set plumb and in three thousand (3000 psi) compressive strength concrete footings of the size specified under corresponding post section of this specification and conforming to Section 03300 – Structural Concrete.

B. The concrete shall extend a minimum three inches (3 In) below the bottom of the post.

C. Concrete shall be crowned slightly above grade to provide drainage and troweled to provide a smooth, neat appearance.

D. Galvanizing shall be in accordance with ASTM A123.

E. No aluminum or pot metal fittings shall be acceptable.

PART IV: TABLES

TABLE 4.1 GATE MATERIALS

MAXIMUM WIDTH OF SINGLE GATE (FT)	DIAMETER OF POST (IN)	RAIL ATTACHEMENT BOLT SIZE
6	3	5/16” x 5 1/2"
12	4	5/16” x 6 1/2"
16	6	3/8” x 8 1/2"
20	8	3/8” x 10 1/2"

END OF SECTION

SECTION 02935
CHAIN LINK FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Furnishing and installation of chain link fencing, galvanized steel posts, and gates plus all accessories incidentals and specials necessary for the proper erection and installation of the fence and gates.
- B. The Contractor shall construct chain link fencing including posts, and gates as shown on the Drawings and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for Chain Link Fence shall be on a per linear foot basis to include all necessary hardware, concrete, materials and labor.
  2. No separate payment shall be made for each gate. Gates shall be paid under Chain Link Fence as part of the linear footage.
  3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. ASTM – American Society for Testing and Materials.
  1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  2. ASTM A90 – Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  3. ASTM A121 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
  4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  5. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
  6. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- B. CTFS – City of Friendswood Specifications.

1.4 SUBMITTALS
- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit proposed design mix and test data for each type and strength of concrete.

C. Submit manufacturer's data and details of following items for approval:
   1. Chain Link Fabric Mesh.
   2. Galvanized Posts.
   3. Materials to be used for installation.
   4. Latch and hinge hardware.
   5. Installation instructions for forms.

PART II: PRODUCTS

2.1 FABRIC

A. Wire Fabric for fencing shall be nine gauge (9 Ga) steel with a minimum tensile strength of eighty thousand pounds per square inch (80,000 psi). Mesh size shall be two inches (2 In) between parallel wires. Top salvages knuckled for sixty inch (60 In) or less in height. Top and bottom salvages twisted and barbed for fabric over sixty inches (60 In) in height. Fabric shall be furnished in one-piece.

B. Barbed Wire for mounting on security arms to be twelve and one-half gauge (12 1/2 Ga) with four-point (4 pt) barbs spaced at five inches (5 In) apart. Three (3) strands of barbed wire shall be required.

C. Fabric Ties shall be eleven gauge (11 Ga) steel to fasten fabric to top rail at eighteen inch (18 In) intervals. Ties shall be furnished to fasten the fabric to the bottom tension wire at eighteen inch (18 In) intervals. Ties shall be furnished to attach fabric to line posts at fifteen inch (15 In) intervals.

D. Bottom Tension Wire shall be seven gauge (7 Ga) coil wire.

2.2 RAILS AND POSTS

A. Top Rail shall be one and sixty-six hundredths inch (1.66 In) outside diameter (OD) steel pipe weighing two and twenty-seven hundredths pounds per foot (2.27 lb/ft). Top rail shall be furnished in random lengths not less than eighteen feet (18 Ft) per section and shall be joined with outside sleeve, steel couplings not less than six inches (6 In) long and having a wall thickness not less than seven hundredths of an inch (0.7 In) Couplings shall be designed to allow for expansion and movement of the top rail.

B. Posts shall be furnished in sufficient quantity to provide a maximum spacing of ten feet (10 Ft). Minimum size and weights are as specified in TABLE 4.1 – LINER POST REQUIREMENTS, TABLE 4.2 – CORNER, PULL AND END POST REQUIREMENTS, and TABLE 4.3 – GATE POSTS in this Section.

C. Post Brace Assembly shall be manufacturers standard adjustable brace at end and gate posts, at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Brace to be same material as top rail and trussed to line posts with three-eighths inch (3/8 In) diameter rod with adjustable turnbuckles.

D. Post Caps for pipe shall be designed to exclude moisture. Where barbed

wire is specified, extension arms shall be integral with post caps. Where top rail is specified, post caps shall have an opening for the top rail. All post caps shall have a two inch (2 In) skirt for rigidity.

E. Tension bars shall be not less than three-sixteenths of an inch (3/16 In) by three-quarters of an inch (3/4 In) flat steel and not more than two inches (2 In) shorter than the fabric height. One (1) tension bar shall be provided for each gate and end post. Two (2) tension bars shall be provided for each corner and pull post. Tension bars shall be attached to terminal posts with one inch (1 In) twelve gauge (12 Ga) flat steel bands, with carriage bolts at intervals not exceeding fifteen inches (15 In).

F. Barbed Wire Support Arms shall be metal and finish to match fence framework, with provision for anchoring to posts and attaching three (3) rows of barbed wire with each arm. Supporting arms may either be attached to posts or integral with post top weather cap and shall be capable of withstanding two hundred fifty pounds (250 Lb) downward pull at outermost end. Arms shall be at a forty-five degree (45°) angle from vertical.

2.3 GATES

A. Fabricate perimeter frames of gates from metal and finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members a maximum of eight feet (8 Ft) apart unless otherwise indicated. Provide same fabric as for fence, unless otherwise indicated. Install fabric with tension bars at vertical edges and at top and bottom edges. Attach tension bars to gate frame not more than fifteen inches (15 In) on center (OC).

1. Install one (1) diagonal cross-bracing consisting of a minimum three-eighths inch (3/8 In) adjustable length truss rods with turn-buckles on gates to ensure frame rigidity without sag or twist.
2. Where barbed wire is indicated above gates extend end members of gate frames one foot (1 Ft) above top member and prepare to receive three (3) strands of wire. Provide necessary clips for securing wire to extensions.

B. Swing gates shall be fabricated with frames a minimum of one and seven-eights inch (1 7/8 In) outside diameter (OD) pipe weighing two and seventy-two hundredths pounds per foot (2.72 Lb/Ft). The top of all gate frames shall align with the fencing top rail. Vehicular gates shall be four inches (4 In) greater in overall height than the adjacent fencing so as to extend to within two inches (2 In) of pavement between curb, if curbs are designated are designated on the Drawings.

1. Corner and tee fittings of malleable iron or pressed steel having means of attaching diagonal members. Hinges of malleable iron

providing for full one hundred eighty degree (180°) swing with bottom hinges to be ball and socket type.

2. Diagonal braces consisting of a minimum one-half inch (1/2 In) truss rods with turn-buckles, two (2) for each gate frame. Vertical gates shall have vertical one and seven-eighths inch (1 7/8 In) outside diameter (OD) pipe brace at the center of each gate leaf.

C. Provide gate hardware and accessories for each gate galvanized in accordance with ASTM A153 and as specified below:
   1. Hinges: Size and material to suit gate size, non-liftoff type, offset to permit one hundred eighty degree (180°) gate opening. Provide three (3) hinges for each leaf over six foot (6 Ft) nominal height.
   2. Latch: Forked type or plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.
   3. Provide keeper for vehicle gates which automatically engages gate leaf and holds it in open position until manually released. Keeper to be anchored at least twelve inches (12 In) into a twelve inch by twenty-four inch (12 In x 24 In) concrete footing.
   4. Double gates shall be provided with gate stops consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch permitting both gate leaves to be locked with single padlock.

D. Roller Gates shall be the responsibility of the Contractor to design using same fabric as for fence. Drawings shall indicate the size of opening for single or double gate application. Design to provide for free flowing opening and closing. Additional rollers or support bearing wheel should be incorporated to minimize binding where necessary.

2.4 GALVANIZING

A. All material used in chain link fencing shall be hot-dip zinc coated as specified by the following:
   1. All posts and pipe shall be one and eight-tenth ounces per square foot (1.8 Oz/SF) in accordance with ASTM A53.
   2. All H-Beam Sections shall be two ounces per square foot (2.0 Oz/SF) in accordance with ASTM A123.
   3. Fence Fabric shall be one and two-tenths ounces per square foot (1.2 Oz/SF) in accordance with ASTM A392, Class I.
   4. Tension and Barbed wire shall be eight-tenths ounce per square foot (0.8 Oz/SF) in accordance with ASTM A121, Class III.
   5. Post Caps, Tension Bars and Miscellaneous fittings shall be in accordance with ASTM A153.
   6. The weight of zinc coating for all items shall be determined in accordance with ASTM A90.

PART III: EXECUTION

3.1 INSTALLATION

A. The fence shall be installed by skilled and experienced fence erectors, and on lines and grades indicated on the Drawings.

3.2 CONSTRUCTION

A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of the fencing.

B. The fencing panels between corner and terminal posts shall generally follow the finished ground elevations. The Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under bottom edge of fence fabric to a distance of not more than six inches (6 In) and not less than two inches (2 In) from the ground at any point along the fencing.

C. Post Spacing:
   1. Line Posts shall have a maximum spacing of no more than ten feet (10 Ft).
   2. Pull Posts shall not be located more than five hundred feet (500 Ft) and shall be installed at each change in direction exceeding twenty degrees (20°), both vertically and horizontally.
   3. Runs of fencing over five hundred feet (500 Ft) but less than one thousand feet (1,000 Ft) shall have a pull post in the center of the run.

D. Holes
   1. Holes for concrete footings for all posts shall be drilled to the dimension as specified in TABLE 4.4 – HOLES FOR LINE, TABLE 4.5 – HOLES FOR END POSTS, and TABLE 4.6 – HOLES FOR GATE POSTS.
   2. Concrete footings shall be Class A Concrete, NO EXCEPTIONS. Concrete shall be in accordance with Section 03300 – Structural Concrete. All concrete footings shall be cast up to finished grade and crowned one inch (1 In) to shed water. Excess concrete and other material shall be removed and disposed of in accordance with Section 01580 – Waste Material Disposal.

E. The fence fabric shall be erected by securing one (1) end and applying sufficient tension to the other to remove all slack before making attachments. The fabric shall be cut and each span shall be attached independently at all corner posts and pull posts.

F. Fastening to end, pull, corner and gate posts shall accomplished with tension bars which shall be secured to the post with tension bar bands at intervals not to exceed fifteen inches (15 In).

G. Fence fabric shall generally follow the finished contour of the site with the bottom edge of the fabric located two inches (2 In) above the grade.

H. Erect fencing to generally follow ground surface and adjust irregularities in grade. Where depressions or swales are crossed by the fencing,

provide galvanized pipe and ire fabric laced to main fabric to prevent entrance of small animals but permit natural drainage flow.

I. Join top rails with suitable sleeve-type couplings, making rigid connections with provisions for expansion and contraction. Pass rail through base line post barbed wire extension arm and fasten securely to terminal post.

J. Brace all terminal posts with brace member securely fastened to terminal and first line post. Tie terminal post near ground line to line post at brace member with steel tension rod complete with turn-buckle.

PART IV: TABLES

TABLE 4.1 LINE POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	H-BEAM SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	1.90	2.27	2.70	24
4 to 8	2.375	3.65	4.10	24
8 to 12	2.875	5.79	5.79	24

TABLE 4.2 CORNER POST, PULL POST AND END POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	2.75	3.65	30
4 to 8	2.875	5.79	36
8 to 12	3.50	9.10	36

TABLE 4.3 GATE POST REQUIREMENTS

FABRIC HEIGHT (FT)	POST OUTSIDE DIA. (IN)	PIPE SECTION (LB/FT)	EMBEDMENT LENGTH (IN)
0 to 4	2.875	5.79	36
4 to 8	4.00	9.11	36
8 to 12	6.625	18.79	42

TABLE 4.4 HOLES FOR LINE POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	9	30	24
4 to 8	9	30	24
8 to 12	9	30	24

TABLE 4.5 HOLES FOR END POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	12	36	30
4 to 8	12	42	36
8 to 12	12	42	36

TABLE 4.6 HOLES FOR GATE POSTS

FABRIC HEIGHT (FT)	MINIMUM HOLE DIA. (IN)	MINIMUM HOLE DEPTH (IN)	POST EMBEDMENT (IN)
0 to 4	12	42	36
4 to 8	18	42	36
8 to 12	18	48	42

END OF SECTION

SECTION 02940
FIXED KNOT FABRIC FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Furnishing and installation of Fixed Knot Fabric fence, galvanized steel posts, and gates plus all accessories incidentals and specials necessary for the proper erection and installation of the fence and gates.

B. The Contractor shall construct Fixed Knot Fabric fencing including posts, and gates as shown on the Drawings and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for Fixed Knot Fabric Fence shall be on a per linear foot basis to include all necessary hardware, concrete, materials and labor.
2. No separate payment shall be made for each gate. Gates shall be paid under Fixed Knot Fabric Fence as part of the linear footage.
3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. AASHTO – American Association of State Highway and Transportation Officials.

1. AASHTO M279 – Standard Specification for Metallic-Coated, Steel Woven Fence Fabric.

B. ASTM – American Society for Testing and Materials.

1. ASTM A116 – Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric.
2. ASTM A121 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
3. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
5. ASTM A500 – Standard Specifications for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
6. ASTM A572 – Standard Specification for High-Strength Low-

Alloy Columbium-Vanadium Structural Steel.

7. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
8. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
9. ASTM A824 – Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence.
10. ASTM A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
11. ASTM F1043 – Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.
12. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

B. CTFS – City of Friendswood Specifications.

C. FS – Federal Specifications.

1. FS RR-F-191K/Gen – Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories).
2. FS RR-W-410E – Wire Rope and Strand

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.

B. Submit proposed design mix and test data for each type and strength of concrete.

C. Submit manufacturer's data and details of following items for approval:

1. Fixed Knot Fabric Mesh.
2. Galvanized Posts.
3. Materials to be used for installation.
4. Latch and hinge hardware.
5. Installation instructions for forms.
6. Gates.

PART II: PRODUCTS

2.1 MANUFACTURERS

A. Stay-Tuff Fence Manufacturing, Inc.

B. Ranger Gate Company

2.2 FIXED KNOT FENCE WIRE FABRIC

A. Fixed Knot Fabric Fence shall be High Tensile Fixed Knot Fence and shall be forty-nine inches (49 In) in vertical height. The horizontal openings starting from the bottom shall be:

1. Two each (2 Ea) openings of five inches (5 In).
2. Three each (3 Ea) openings of six inches (6 In).

3. Three each (3 Ea) openings of seven inches (7 In).

The horizontal spacing of the Fixed Knot Fabric Fence shall be six inches (6 In) between vertical stay wires. The wire shall be heavily galvanized Class 3 coating eighty-five hundredths ounce (.85 Oz) to one and one tenth ounces (1.1 Oz) per square foot (Sf) and shall meet or exceed ASTM A116 and the requirements of Table 4.1 – Fixed Knot Fence Wire Fabric, in this Section. The fence knot shall be a minimum of thirteen gauge (13 Ga) "fixed-knot" that will reinforce the wire so that it stands up to impacts without sagging or breaking. No hinged joint knot shall be used.

B. Barbed Wire for mounting on security arms shall be Zinc-coated, two (2) strand twisted fourteen gauge (14 Ga) galvanized steel wire with four point (4 Pt) barbs of fourteen gauge (14 Ga) steel wire spaced at five inches (5 In) apart. Three (3) strands of barbed wire shall be required. All wire shall conform to ASTM A121, Type Z.

2.3 WATER GAP MATERIALS

A. Materials for the water gap fence shall be made of high quality, commercially available materials. The fence fabric for the water fence gap shall be a minimum six gauge (6 Ga) Class 3 galvanized steel wire in a four inch (4 In) mesh and shall meet the requirements of ASTM A116. Posts shall conform to the requirements of paragraph 2.4 of this Section. The steel tubing shall be a two inch by two inch (2 In x 2 In) fourteen gauge (14 Ga) hot dipped galvanized steel meeting the requirements of ASTM A500 Grade B. Wire rope shall be five-sixteenths inch (5/16 In) diameter galvanized cable meeting the requirements of Federal Specification RR-W-410E. Eye bolts and "D" shall be galvanized steel as recommended by the wire rope manufacturer for use with the wire rope specified.

2.4 BRACE POSTS, LINE POSTS, T-POSTS AND ACCESSORIES

A. These items, when specified, shall conform to the requirements of Federal Specification RR-F-191 or ASTM F1043 as amended by ASTM F1083 as follows:
   1. Galvanized tubular steel pipe shall conform to the requirements of Group 1A, (Schedule 40) coatings conforming to Type A or Group IC (High Tensile Strength Pipe), External coating Type B, and internal coating Type B or D.
   2. Posts and braces, with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:
      a. External: One thousand hours (1,000 Hr) with a maximum of five percent (5%) red Rust.
      b. Internal: Six hundred fifty hours (650 Hr) with a maximum of five percent (5%) red Rust.

3. The dimensions of the posts and braces in accordance with Table I through VI of Federal Specification RR-F-191/3D, as amended.
4. All posts and braces used for the fence shall be zinc-coated or galvanized. T-posts for the fence shall be a minimum of seventy-eight inches (78 In) in length with a weight of one and five-tenths pounds per linear foot (1.5 Lb/Lf). T-Post clips shall be made of 0.115 galvanized wire, or thicker, or as recommended by the manufacturer, whichever is sturdier.

2.5 GATES

A. Gates shall be manufactured by Ranger Gates or City approved equal. Gate frames shall consist of galvanized tubular steel pipe or square tubing meeting the dimensions stated in this paragraph and on the plans and shall conform to the same materials as list in paragraph 2.4 of this Section.

B. Pasture Tube Gates shall be five (5) - one and five-eighths inch (1 5/8 In) diameter horizontal bars and two (2) one and five-eighths inch (1 5/8 In) diameter horizontal bars. Bars shall be saddled and fitted before welding and made of nineteen gauge (19 Ga) galvanized tubing. Gate shall be forty-eight inches (48 In) in height overall. Gate shall have two (2) – five-eighths inch by six inch (5/8 In x 6 In) screw hooks and adjustable hinges.

C. Wire Mesh Gates shall be three (3) - one and five-eighths inch (1 5/8 In) diameter horizontal bars and two (2) one and five-eighths inch (1 5/8 In) diameter horizontal bars. Bars shall be flattened before welding and made of nineteen gauge (19 Ga) galvanized tubing. Gate shall be forty-eight inches (48 In) in height overall. Wire Mesh Panel shall be thirty-six inches (36 In) tall, mesh opening shall be four inch by four inch (4 In x 4 In) openings. Gate shall have two (2) – five-eighths inch by six inch (5/8 In x 6 In) screw hooks and adjustable hinges.

2.6 WIRE TIES AND TENSION WIRES

A. Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type with a minimum seven gauge (7 Ga) thickness or as recommended by the manufacturer. Tension wires are to be a minimum seven gauge (7 Ga) marcelled steel tension wire conforming to ASTM A824. All material shall conform to Federal Specification RR-4-191/4D, as amended.

2.7 MISCELLANEOUS HARDWARE AND FITTINGS

A. Miscellaneous steel hardware and fittings for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide balanced design when used in conjunction with fabric posts and wires of the quality specified herein. All steel hardware and fittings shall be protected with a zinc coating applied in conformance with ASTM A153.

2.8 CONCRETE

A. All concrete shall conform to Technical Specification 03300 – Structural Concrete and have a minimum twenty-eight day (28 Dy) strength of three thousand pounds per square inch (3,000 PSI).

2.9 MARKING

A. Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), type of coating, the gauge of wire, the length of fencing on the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and type of coating.

2.10 PAINT

A. Paint for repair of damaged hot dipped galvanized coating shall be zinc rich paint with organic binders meeting the requirements of ASTM A780. Paint to be Galv Match Plus as manufactured by NuWave Solutions or City approved equal.

PART III: EXECUTION

3.1 INSTALLATION

A. The fence shall be installed by skilled and experienced fence erectors, and on lines and grades indicated on the Drawings. The finished fence shall be plumb, taut, true to line and ground contour and complete in every detail.

3.2 CONSTRUCTION

A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of the fencing.

B. The fencing panels between corner, brace and line posts shall generally follow the finished ground elevations. The Contractor shall grade off minor irregularities in the path of the fencing as necessary to limit the variation of grade under bottom edge of fence fabric to a distance of not more than three inches (3 In) and not less than two inches (2 In) from the ground at any point along the fencing. Care shall be taken not to stretch the wire fabric so tight that is will break in cold weather or pull up the brace posts.

C. Post Spacing:

1. T-Posts shall have a maximum spacing of no more than twenty-five feet (25 Ft).
2. Line Posts shall have a maximum spacing of no more than one hundred twenty-five feet (125 Ft).

3. Bracing of fencing shall be a maximum of one thousand three hundred twenty feet (1,320 Ft).
4. Line Fence Post, Line Brace Posts, and End Brace Posts shall be set in concrete as specified in Paragraph 3.2.D of this Section.

D. Holes
1. Holes for concrete footings for all posts shall be drilled to the dimension as specified in TABLE 4.2 – HOLES FOR LINE, LINE BRACE AND BRACE POSTS.
2. Concrete footings shall be Class A Concrete, NO EXCEPTIONS. Concrete shall be in accordance with Section 03300 – Structural Concrete. All concrete footings shall be cast up to finished grade and crowned one inch (1 In) to shed water. Excess concrete and other material shall be removed and disposed of in accordance with Section 01580 – Waste Material Disposal. Embedded posts shall have a minimum of three inches (3 In) of clearance from the sides and bottom of the post.
3. No material shall be set on posts line and brace posts for a minimum of seven days (7 Dy) after individual concrete footing has been placed.

E. Fence fabric shall generally follow the finished contour of the site with the bottom edge of the fabric located two inches (2 In) above the grade.

F. Erect fencing to generally follow ground surface and adjust irregularities in grade. Where depressions or swales are crossed by the fencing, provide galvanized pipe and ire fabric laced to main fabric to prevent entrance of small animals but permit natural drainage flow.

G. Splicing
1. The splice shall be made with approved wire splice with a rated holding capacity higher that the breaking strength of the wire as recommended by the wire manufacturer and using an approved crimping tools as recommended by the wire manufacturer. The splice shall be made in accordance with industry standards and wire manufacturers recommendations. Any splices that fail to meet these requirements shall not be accepted and shall be redone at the Contractor's expense.

H. Gates
1. Install gates at the proper dimensions and alignments as shown on the drawings. Contractor shall grade the area in the vicinity of the gate to provide a level area for gate opening.

I. Existing Connections
1. Wherever the new fixed knot wire fabric fence or water gap joins an existing fence, either at the corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced as shown in the detail drawings. If the connection is made at other than an intersection or junction, then the last span of the existing fence shall contain a brace span.

J. Electrical Grounds

1. Electrical grounding shall be installed where a power line passes over the fence and shall be installed directly below the point of crossing. The grounding shall be accomplished with an eight foot (8 Ft) copper clad rod a minimum of five-eighths inch (5/8 In) in diameter driven vertically until the top is six inches (6" In) below natural grade. A number six (#6) solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element in the fence is grounded and per current NEC requirements and inspected by City's Electrical Inspector. All work described in this paragraph is incidental to the work.

PART IV: TABLES

TABLE 4.1 FIXED KNOT FABRIC FENCE REQUIREMENTS

WIRE	GAUGE	TENSILE STRENGTH	BREAKING LOAD
Top & Bottom	12	Hi-Tensile: 185K – 215K	1,512 Lbs. – 1,689 Lbs.
Line Wires	12 ½	Hi-Tensile: 185K – 215K	1,339 Lbs. – 1,492 Lbs.
Stay Wires	12 ½	Med-Tensile: 130K – 150K	940 Lbs. – 1,041 Lbs.
Knot Wires	13	Low-Tensile: 60K – 85K	356 Lbs. – 482 Lbs.

TABLE 4.2 LINE, LINE BRACE, AND BRACE POST REQUIREMENTS

POST	HEIGHT	WIDTH	EMBED	HOLE DEPTH	HOLE WIDTH
Brace Post	8' - 0"	2.875"	3' – 6"	3' – 9"	9"
Fence Pull	8' - 0"	2.875"	3' – 6"	3' – 9"	9"
Angle Brace	4' – 6"	2.875"	3' – 6"	3' – 9"	9"
Line Post	7' – 0"	2.375"	2' – 6"	2' – 9"	9"
T-Post	6' – 6"	N/A	2' – 6"	N/A	N/A

END OF SECTION

SECTION 02945
WIRE ROPE BOUNDARY FENCE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Furnishing and installation of Wire Rope Boundary fence, and timber posts plus all accessories incidentals and specials necessary for the proper erection and installation of the fence and gates.

B. The Contractor shall construct Wire Rope Boundary fencing including posts, and gates as shown on the Drawings and in accordance with this Specification.

1.2 MEASUREMENT AND PAYMENT

A. Unit Prices:

1. Payment for Wire Rope Boundary Fence shall be on a per linear foot basis to include all necessary hardware, concrete, materials and labor.
2. Payment will be on a center of pull post to center of pull post.
3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. ANSI – American National Standards Institute.

1. ANSI 05.1 – Wood Poles – Specifications and Dimensions.

B. ASTM – American Society for Testing and Materials.

1. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
2. ASTM A475 – Standard Specification for Zinc-Coated Steel Wire Strand.
3. ASTM D245 – Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber.
4. ASTM D1165 – Standard Nomenclature of Commercial Hardwoods and Softwoods.
5. ASTM D2555 – Standard Practice for Establishing Clear Wood Strength Values.

C. AWPA – American Wood Preserver's Association.

1. C5 – Fence Posts – Preservative Treatment by Pressure Processes.
2. M2 – Standard For Inspection Of Wood Products Treated With Preservatives.
3. P1/P13 – Standard For Creosote Preservative.

4. P2 – Standard for Creosote Solution.
5. P5 – Standards For Waterborne Preservatives.
6. P8 – Standard For Oil-Borne Preservatives.
7. P9 – Standards For Solvents and Formulations For Organic Preservative Systems.

D. CTFS – City of Friendswood Specifications.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.
B. Submit proposed design mix and test data for each type and strength of concrete.
C. Submit manufacturer's data and details of following items for approval:
   1. Treated Wood Post.
   2. Wire Cable.

PART II: PRODUCTS

2.1 TREATED WOOD POSTS

A. Wood Posts shall be made of Southern Pine, including minor species as specified in ASTM D1165.
B. Do not use any post where a straight line drawn from the center of the butt to the center of the top varies more than one-half inch (1/2 In) at any point.
C. Do not use posts with splits or ring shakes in the top. Do not use posts with splits in the butt. If a single is in the butt, then the post shall be permitted to be used provided the shake is not wider than one-half (1/2) the butts diameter for round posts or one-half (1/2) the narrowest width for a rectangular post.
D. Round Posts shall adhere to the following:
   1. Round posts shall conform to ANSI Standard 05.1, except as modified herein.
   2. Round posts shall have a seven inch (7 In) minimum diameter at any point, as determined by a circumference-diameter tape.
   3. Round posts shall not exceed eight inches (8 In) in diameter below the dome.
   4. Do not use posts that vary more than one inch (1 In) from the specified length as listed in TABLE 4.1 – Post Lengths.
   5. Round posts shall have a dome that is one-half inch (1/2 In) diameter of the post at the base of the domed portion. Dome shall have a smooth finish with the distance from the top of the dome to the base of the dome having a variance no greater than one inch (1 In).
   6. Smooth shave round posts by machine. No ringing shall be permitted. The definition of the ground line, for applying the restrictions of ANSI 05.1 shall be one-half (1/2) the length.
   7. No knot shall be longer than three inches (3 In) in any direction.
   8. Do not use any post that has more than eight inches (8 In) for the

total sum of all knots greater than one-half inch (1/2 In) in any one foot (1 Ft) section of post.

9. Do not allow scars, as defined in ANSI 05.1, if the depth of the trimmed scar is deeper than one-quarter inch (1/4 In).

E. Rectangular Posts shall adhere to the following:
   1. Use Grade Number 1 rectangular posts, as designated by the Southern Pine Inspection Bureau, with a minimum F_b of 3.0 ksi (Load and Resistance Factor Design) or better. The strength value and grading shall be in accordance with ASTM D245 and ASTM D2555.
   2. Rectangular post shall be six inches by eight inches (6 In x 8 In), less any routing, notching, or finishing.
   3. Rectangular posts shall not vary dimensions of E.2 above by more than one-quarter inch (1/4 In) maximum.
   4. Do not use posts that vary more than one inch (1 In) from the specified length as listed in TABLE 4.1 – Post Lengths.
   5. Do not exceed two and three-quarter inches (2¾ In) in any direction for a single knot or equivalent displacement on the centerline of the eight inch (8 In) face.
   6. Do not exceed two inches (2 In) in any direction for a single knot or equivalent displacement on the edge of the eight inch (8 In) face.
   7. Do not exceed two and one-quarter inches (2¼ In) in any direction for a single knot or equivalent displacement on the centerline of the six inch (6 In) face.
   8. Do not exceed one and one-half inches (1½ In) in any direction for a single knot or equivalent displacement on the edge of the six inch (6 In) face.

F. Treat posts with preservative in accordance to industry standard and TABLE 4.2 – Minimum Retention of Preservative Treated round post shall have a minimum of one inch (1 In) sapwood depth as determined by examining the top and bottom of the posts. Before treatment, posts shall be inspected for moisture content in accordance with AWPA Standard M2. Conduct tests on representative pieces.

G. The lot shall be deemed acceptable when the average moisture content does not exceed twenty-five percent (25%). Any piece that exceeds twenty-nine percent (29%) moisture content shall be removed from the lot.

2.3 WIRE CABLE

A. Furnish wire cable meeting ASTM A475 and shall adhere to the following:
   1. Three-Eighths inch (3/8 In.) nominal diameter.
   2. Seven (7) wire strand, common grade.
   3. Minimum four thousand pound (4,000 LB) breaking strength.
   4. Minimum zinc coating of three-tenths ounce per square foot (0.30 OZ/SF).
   5. Do not exceed two and three-quarter inches (2¾ In) in any direction

for a single knot or equivalent displacement on the centerline of the eight inch (8 In) face.

2.4 MISCELLANEOUS HARDWARE AND FITTINGS

A. Miscellaneous steel hardware and fittings for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide balanced design when used in conjunction with wood posts and wires of the quality specified herein. All steel hardware and fittings shall be protected with a zinc coating applied in conformance with ASTM A153.

2.5 CONCRETE

A. All concrete shall conform to Technical Specification 03300 – Structural Concrete and have a minimum twenty-eight day (28 Dy) strength of three thousand pounds per square inch (3,000 PSI).

PART III: EXECUTION

3.1 INSTALLATION

A. The fence shall be installed by skilled and experienced fence erectors, and on lines and grades indicated on the Drawings. The finished fence shall be plumb, true to line and ground contour and complete in every detail.

3.2 CONSTRUCTION

A. The Contractor shall perform all clearing of brush and debris, which may be necessary for the installation of the fencing.
B. Thoroughly compact backfill in four inch (4 In) lifts.
C. Post Spacing:
   1. Shall have a maximum spacing of no more than twenty-five feet (25 Ft).
   2. End Brace Posts shall be set in concrete as specified in Paragraph 3.2.D of this Section.
D. Holes
   1. Concrete footings shall be Class A Concrete, NO EXCEPTIONS. Concrete shall be in accordance with Section 03300 – Structural Concrete. All concrete footings shall be cast up to finished grade and crowned one inch (1 In) to shed water. Excess concrete and other material shall be removed and disposed of in accordance with Section 01580 – Waste Material Disposal. Embedded posts shall have a minimum of three inches (3 In) of clearance from the sides and bottom of the post.
   2. No material shall be set on posts line and brace posts for a minimum of seven days (7 Dy) after individual concrete footing has been placed.

E. WIRE CABLE
   1. Drill holes in wood post a minimum of five-eighths inch (5/8 In) in diameter.

F. Splicing
   1. The splice shall be made with approved wire splice with a rated holding capacity higher that the breaking strength of the wire as recommended by the wire manufacturer and using an approved crimping tools as recommended by the wire manufacturer. The splice shall be made in accordance with industry standards and wire manufacturers recommendations. There shall be no more than two (2) splices per one hundred foot (100 Ft) of wire cable. Any splices that fail to meet these requirements shall not be accepted and shall be redone at the Contractor's expense.
   2. There shall be no more than three inches (3 In) of droop between wooden posts for all wire cables.
   3. Multiple cable wire fences shall have a maximum space of thirteen inches (13 in) and a minimum eleven inches (11 in) of droop between posts and each wire cable.

PART IV: TABLES

TABLE 4.1 POST LENGTHS

Number of Wires	Length	Bury	Hole Location
1	6'	3'	7" from the top
2	7'	3' 6"	7" and 13" from the top
3	8'	4'	7", 13", and 19" from the top

TABLE 4.2 MINIMUM RETENTION OF PRESERVATIVES

Product	Creosote (LB/CF)	Creosote-Coal Tar Solution (LB/CF)	Penta-Chloro-Phenol (LB/CF)	ACA[1] OR CCA[2] (LB/CF)	AWPA Standard For Treatment
AWPA Preservative Standard	**P1/P13**	**P2**	**(P8/P9)**	**P5**	
Rectangular Fence Posts[3]	12	N/A	0.6	0.5	C14
Round Fence Posts[3]	8	N/A	0.4	0.4	C5

1. Ammoniacal Copper Arsenate.
2. Chromated Copper Arsenate.
3. Retention determined by assay (0 to 1.0-inches zone).

END OF SECTION