

City of Hercules
Department of Public Works

2002

STANDARD PLANS

DESIGN STANDARDS

STANDARD SPECIFICATIONS



STANDARD PLANS INDEX

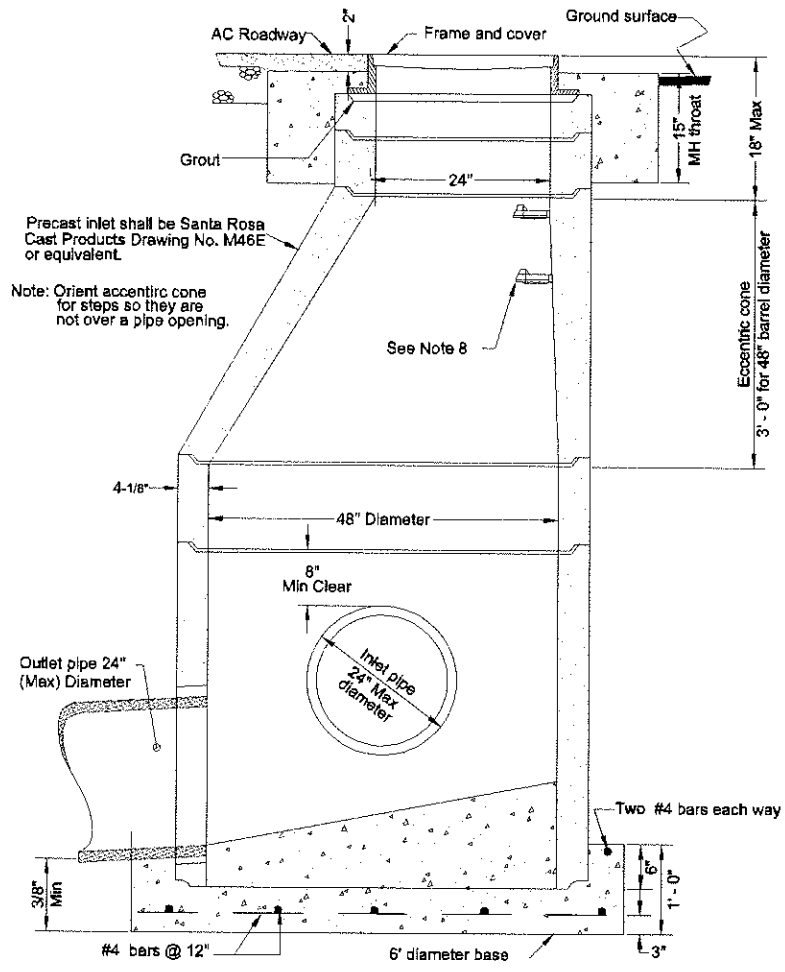
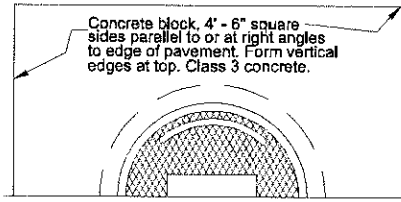
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D-3	Manhole Cover & Frame
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RW-19.1	Removable Bollard
RW-20.1	Bus Turnout
RW-21.1	Pavement Widening Connections
RW-22.1	Fire Hydrant Marker

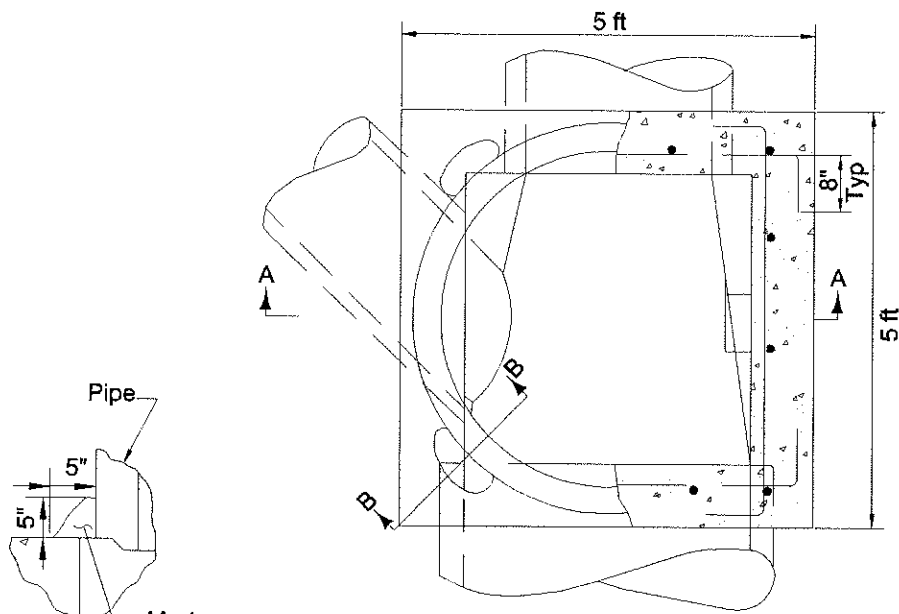


PRECAST MANHOLE WITH TYPE 1 BASE

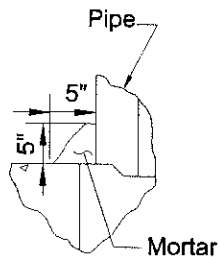
NOTES:

1. All reinforced concrete shall be Class 2.
2. All concrete joints shall be cleaned, wetted, and mortared prior to placing the next section. Joints shall be patched, troweled end smooth.
3. Type 1 manhole bases are for use with pipes to 24 inches in diameter and where there is sufficient cover to use the minimum lengths for barrels, eccentric cones, and frames.
4. The frame and extension rings shall be secured by pavement or concrete block.
5. The cover frame shall conform to grade and cross slope of the pavement.
6. The frame and cover shall be Phoenix Iron (Oakland) Model P-1090 or South Bay Foundary (Lodi) Model A-640, or an approved equal.
7. The use of extension rings is limited by the 18 inch maximum throat length. Extension rings are allowed for conforms to pavement overlays only.
8. Steps shall be steel reinforced polypropylene plastic and in accordance with CAL OSHA.

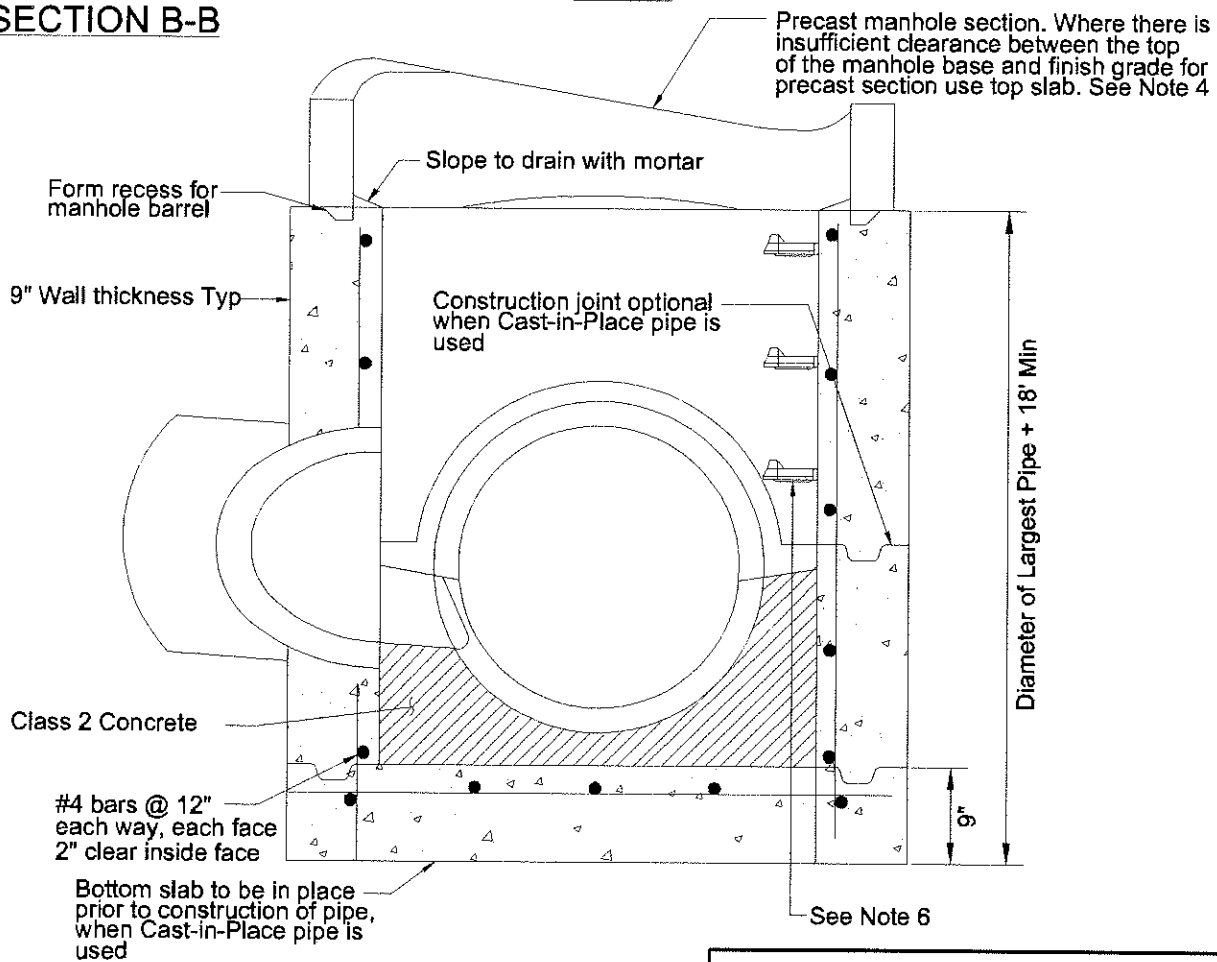
CITY OF HERCULES		
Precast Manhole Type 1 Base		
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PLAN

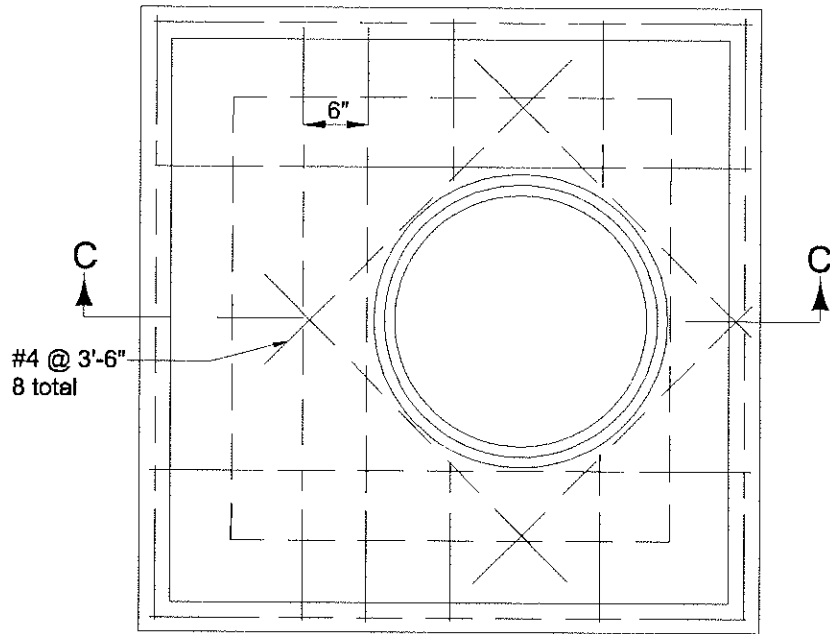


SECTION B-B

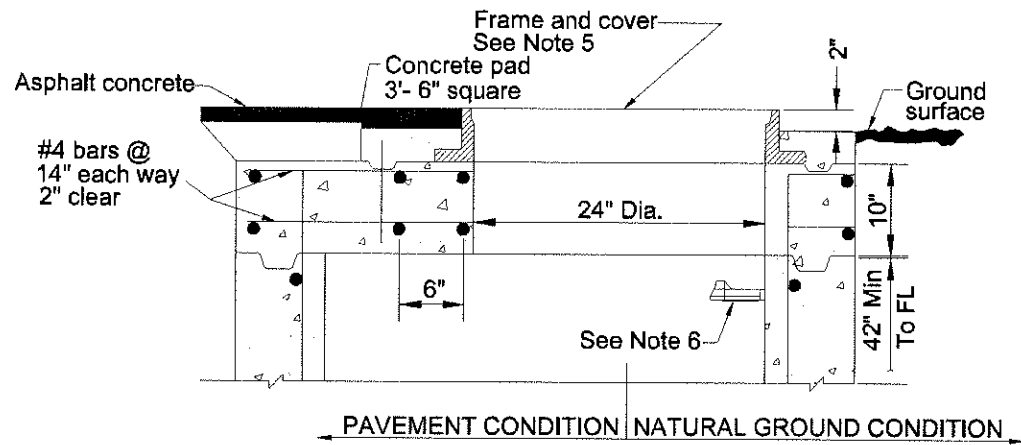


SECTION A-A

CITY OF HERCULES		
Type II Manhole Base Plan, Sections A-A and B-B		
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PLAN



**SECTION C-C
TOP SLAB**

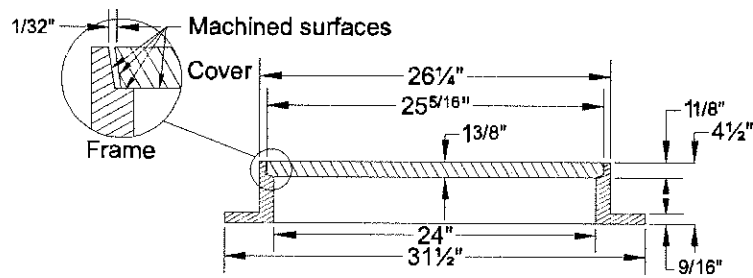
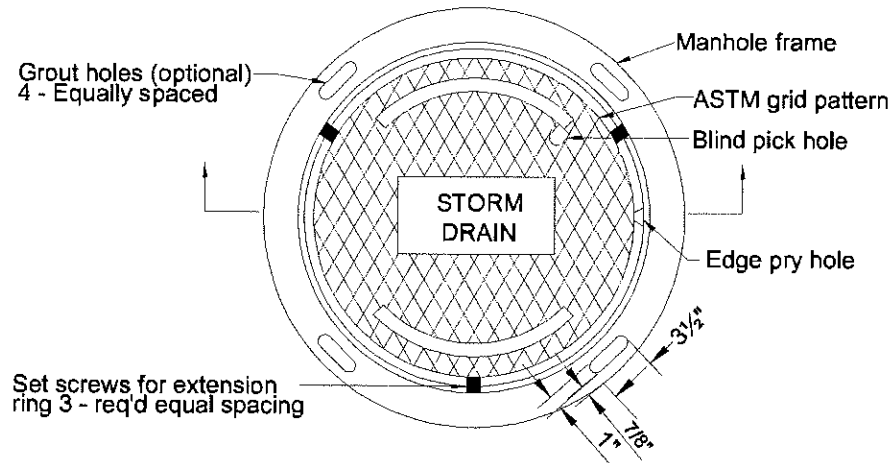
USE TOP SLAB:

1. Where there is insufficient clearance between the top of the manhole base and finish grade for a precast section and cover frame.
2. When placing a Type A or Type C Inlet on a Type II manhole base. The opening in the slab shall conform to the inside dimensions of the inlet to be used.

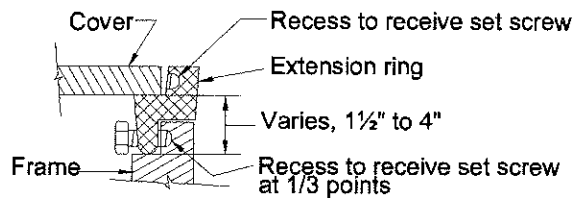
NOTES:

1. A reinforced concrete shall be Class 2.
2. Construction joints are optional where shown. Key dimensions are 1 1/2 inches x 3 inches.
3. Inlet and outlet pipes shall not intercept a manhole base through a corner. If the skew angle is too great to permit the opening to be made in a single wall use a CCCo Type III manhole base.
4. Type II manhole bases are for pipes to 42 inches in diameter.
5. Manhole frame and cover details are shown on Standard Plan D-3.
6. Steps shall be reinforced polypropylene plastic in accordance with CAL OSHA.

CITY OF HERCULES		
Type II Manhole Base Plan, Section C-C and Notes		
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TYPICAL FRAME AND COVER DETAIL



TYPICAL CAST IRON EXTENSION RING

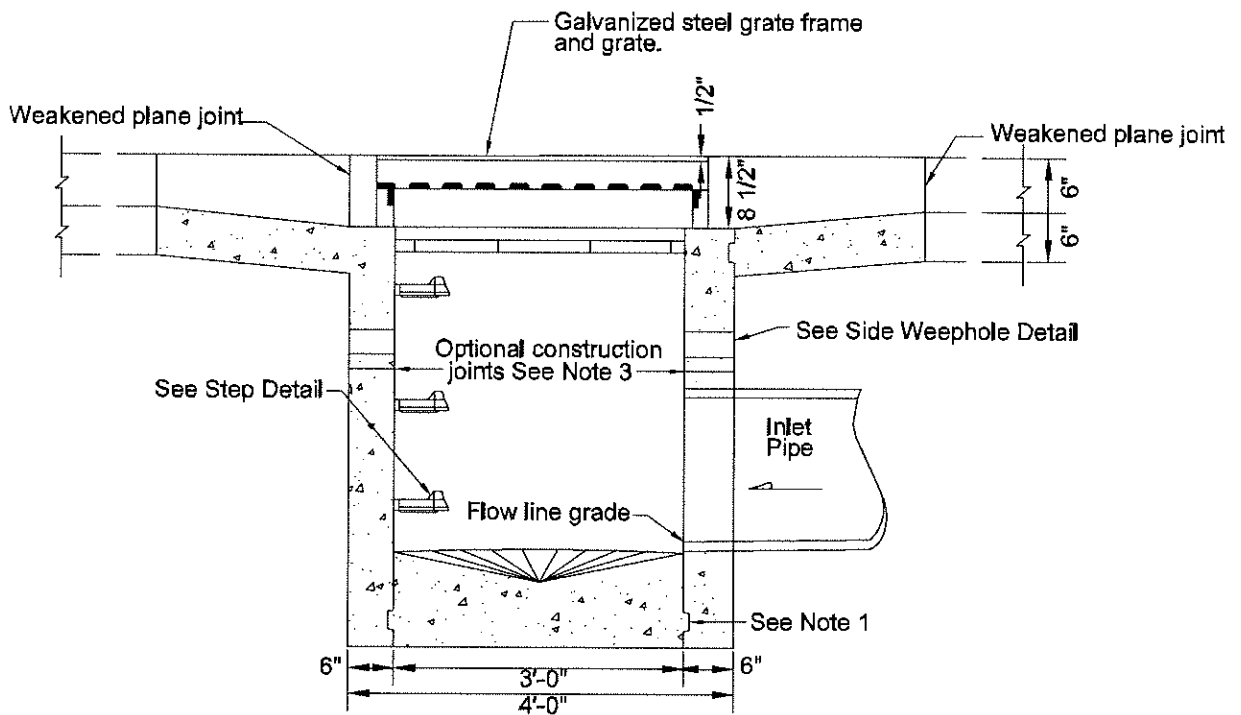
CITY OF HERCULES

Manhole Cover and Frame

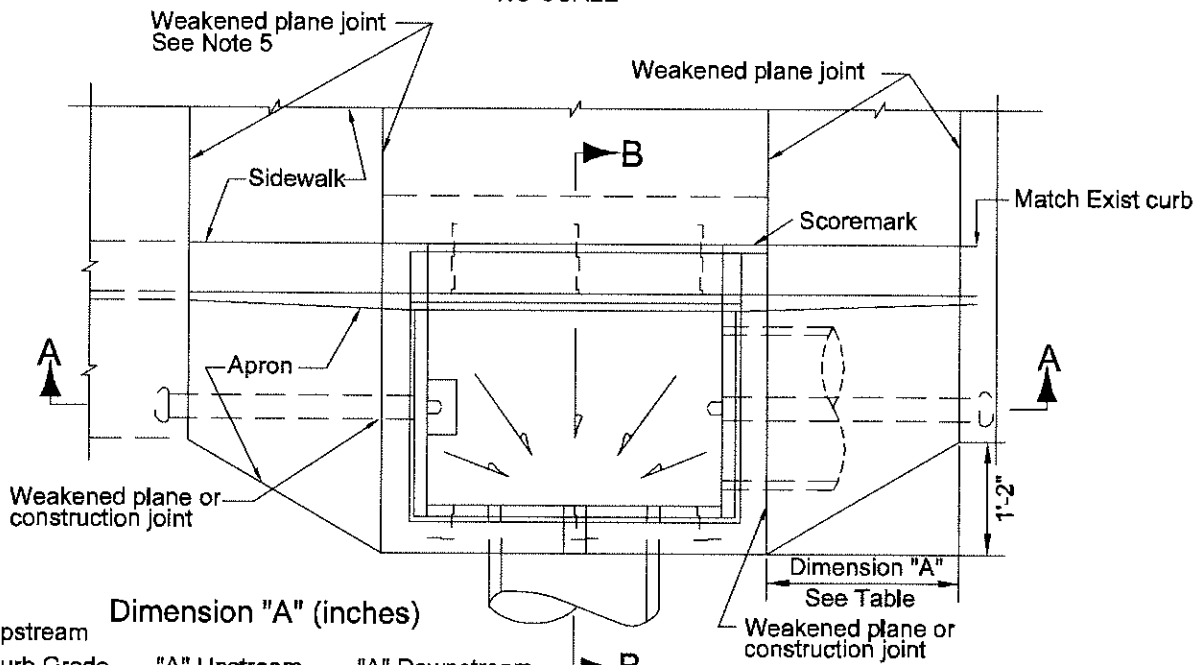
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D-3



SECTION A-A
NO SCALE



Upstream Curb Grade	Dimension "A" (inches)	
	"A" Upstream	"A" Downstream
2% and less	24	24
3%	36	24
4%	48	24
5%	60	24
6%	72	24
7%	84	12
8%	96	12
9%	108	12
10% and greater	120	24

See "Detail for Steep Curb Slope" Std. Plan D-4.3

PLAN
NO SCALE
GRATE NOT SHOWN

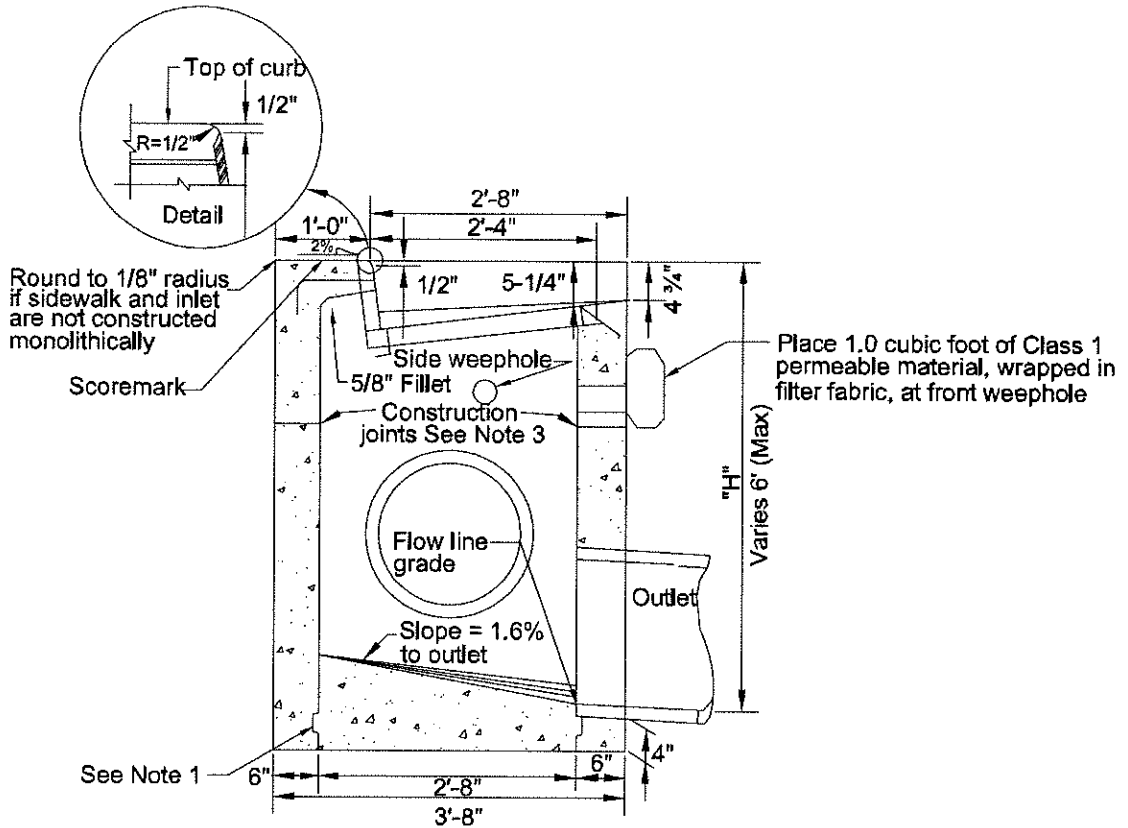
CITY OF HERCULES

Type A Inlet
Plan, Section A-A

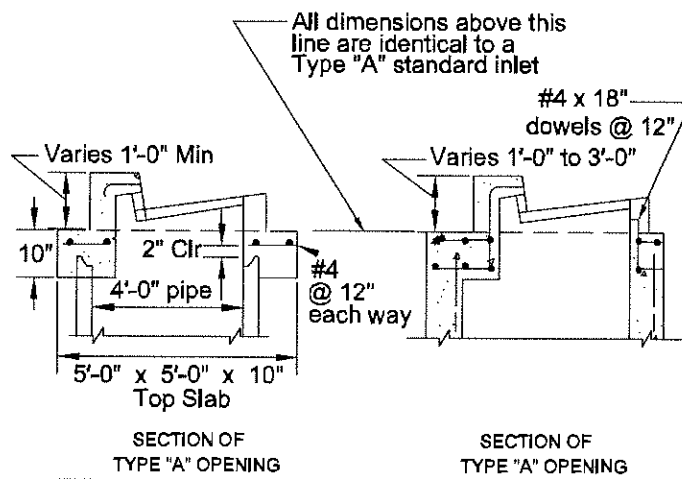
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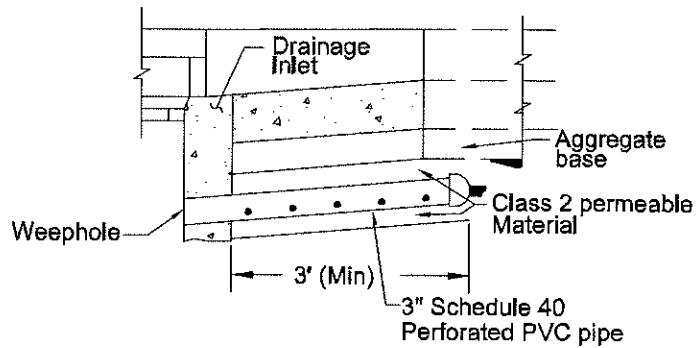
D-4.1



SECTION B-B
NO SCALE
GRATE NOT SHOWN

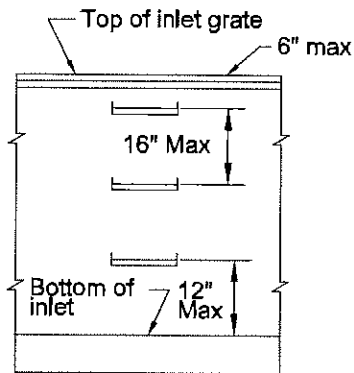


CITY OF HERCULES		
Type A Inlet Section A-A, Type A Openings		
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SIDE WEEPHOLE DETAIL

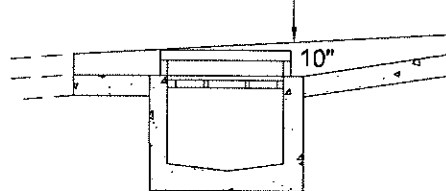
See Note 4



STEP DETAIL

See Note 5

When curbgrade upstream is 5% or greater, depress upstream edge of grate to 10"



DETAIL FOR STEEP CURB SLOPE

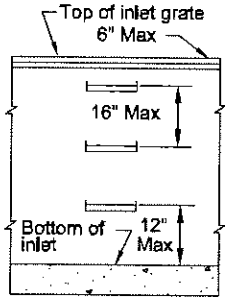
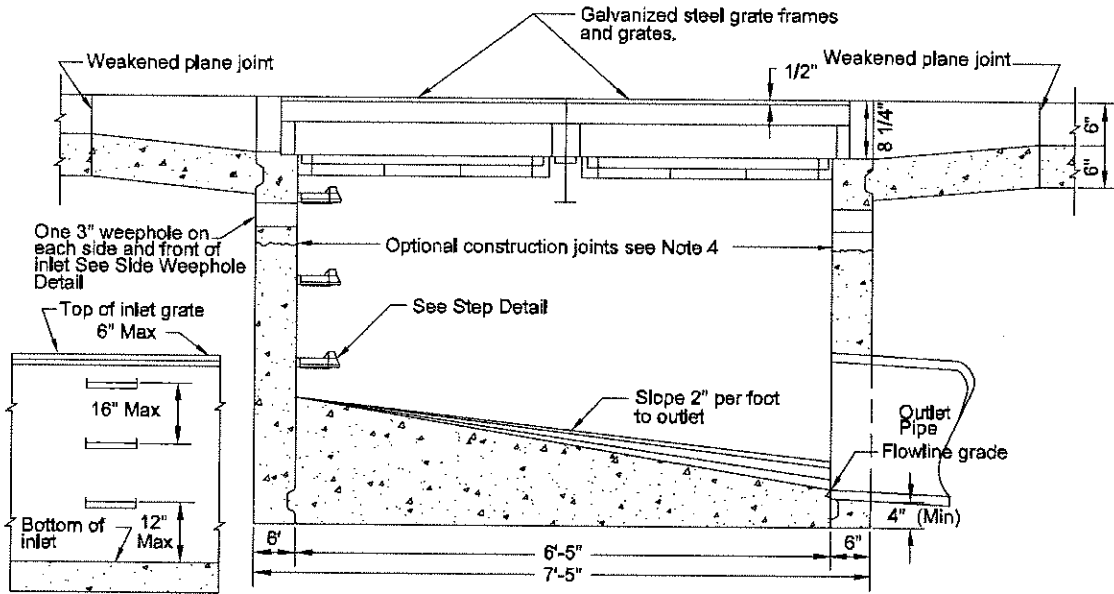
NOTES:

1. Construction joints are optional where shown. Key dimensions are 3/4 inch x 1 1/2 inches.
2. When dimension 'H' exceeds 6 feet, use a manhole base with a Type A inlet top.
3. Construction joints are allowed where the top portion of the inlet is to be constructed monolithically with curb and sidewalk. The following shall apply:
 - A. Concrete above the construction joint shall be Class 3.
 - B. Concrete below the construction joint shall be Class 2.
 - C. The concrete joint shall be located at pavement subgrade.

Where the inlet is constructed as a single unit concrete shell be Class 2.

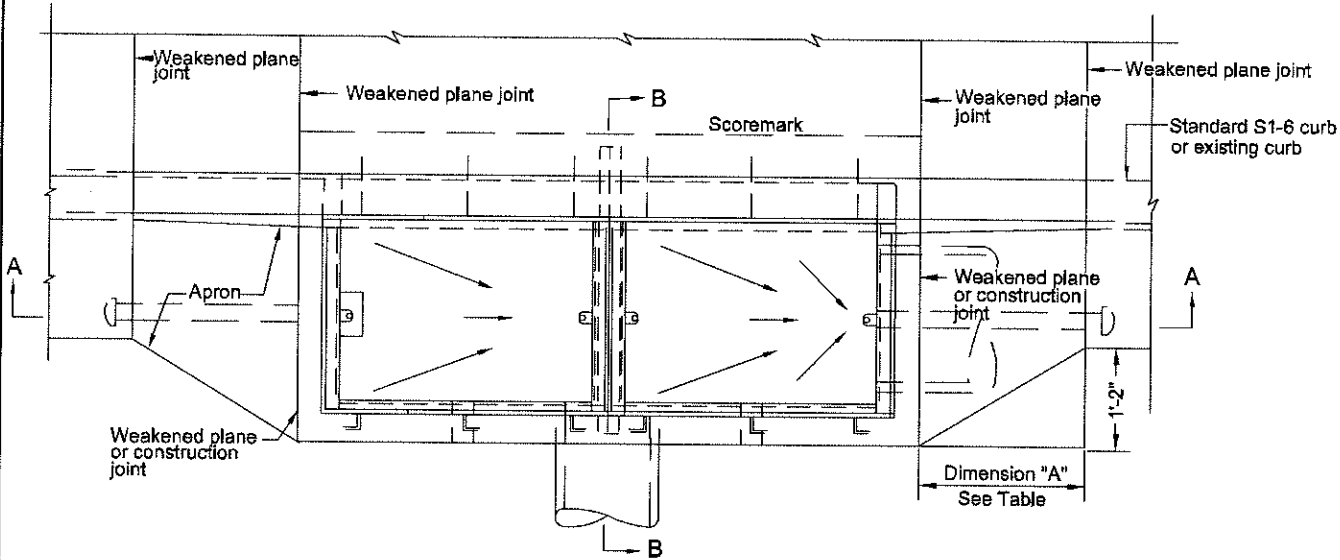
4. Weephole depth is a minimum of 1'-2" below the grate and may vary with road section.
5. Steps shall be steel reinforced polypropylene plastic in accordance with CAL OSHA.
6. All inlets shall have an "anti-pollution" thermoplastic decal applied as directed by the Engineer.

CITY OF HERCULES		
Type A Inlet Details, Notes		
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STEP DETAIL

SECTION A-A



PLAN

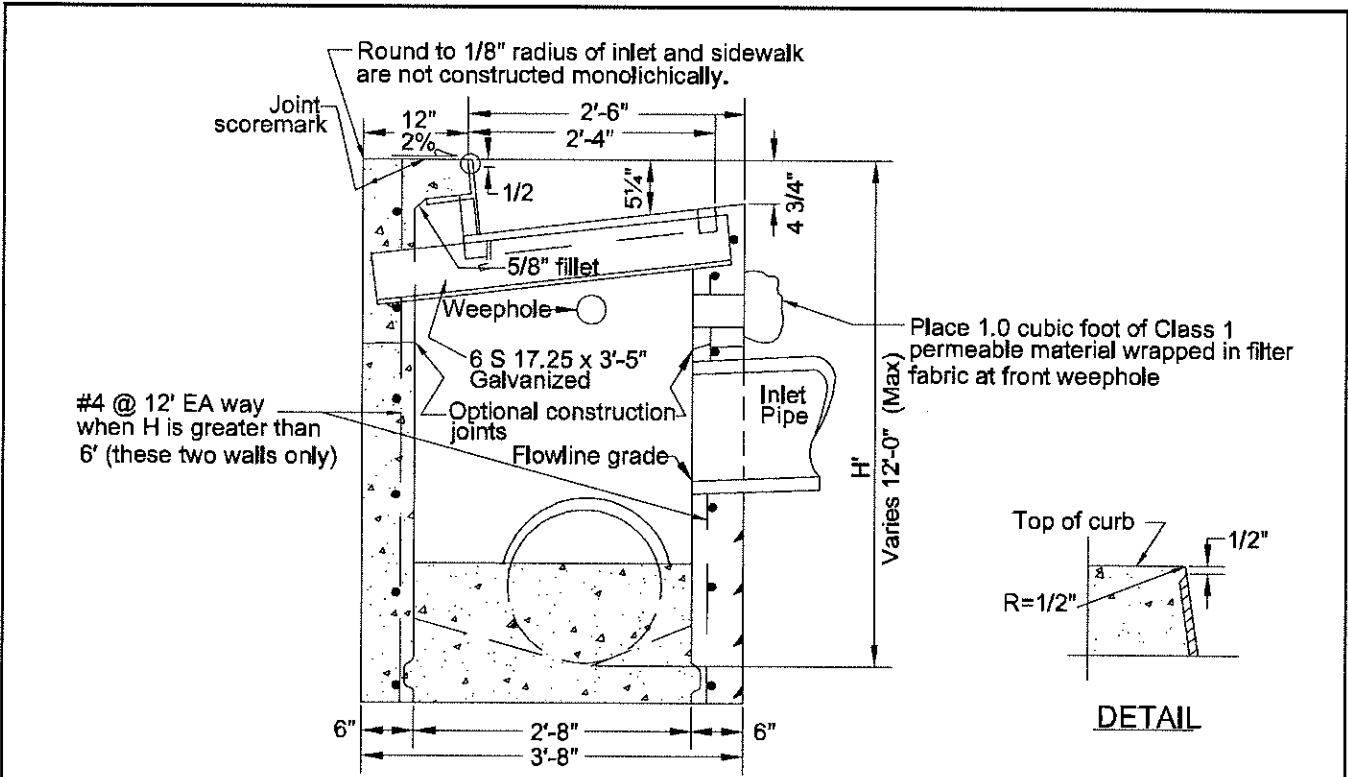
GRATE NOT SHOWN

Dimension "A" (inches)

Upstream Curb Grade	"A" Upstream	"A" Downstream
2% and less	24	24
3%	36	24
4%	48	24
5%	60	24
6%	72	24
7%	84	12
8%	96	12
9%	108	12
10% and greater	120	24

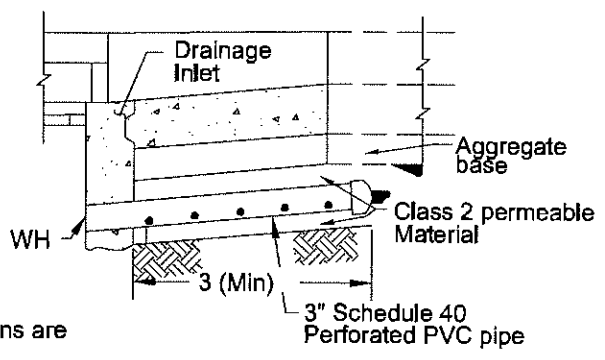
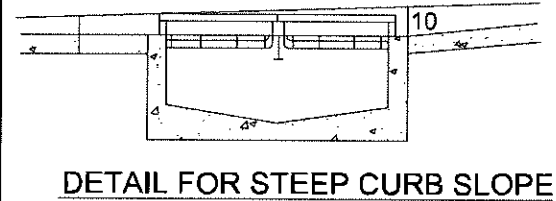
See "Detail for Steep Curb Slope" Std. Plan D-5.2

CITY OF HERCULES		
Type B Inlet		
Plan, Section A-A		
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When curb grade upstream is 5/ or greater
Depress upstream edge of grate frames to 10 inches

SECTION B-B
GRATE NOT SHOWN



NOTES:

1. Construction joints are optional where shown. Key dimensions are 3/4 inch x 2 3/8 inches.
2. Clearance shall be 1-1/2 inches for reinforcing steel.
3. The two grate frames shall be clamped to the "S" beam during concrete placement.
4. Construction joints are allowed where the top portion of the inlet is to be constructed monolithically with curb and sidewalk. The following shall apply:
 - A. Concrete above the construction joint shall be Class 3.
 - B. Concrete below the construction joint shall be Class 2.
 - C. The construction joint shall be located at pavement subgrade.
 - D. Vertical reinforcement shall extend 6 inches above the joint.

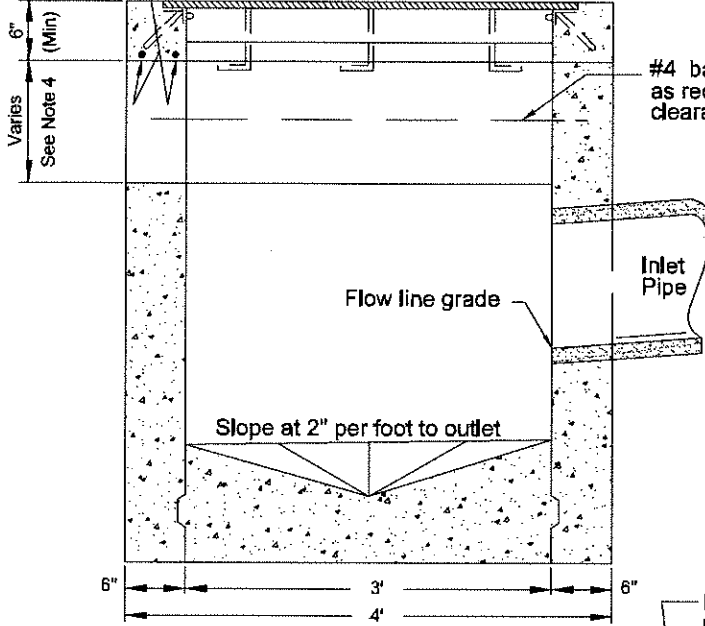
Where the inlet is constructed as a single unit concrete shall be Class 2.

5. Weep hole depth shall be 1'-2" below the grate and may vary with road section.
6. Steps shall be steel reinforced polypropylene plastic and shall be in accordance with CAL OSHA.
7. All inlets shall have an "anti-pollution" thermoplastic decal applied as directed by the Engineer.

CITY OF HERCULES		
Type B Inlet		
Section B-B, Notes		
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Galvanized steel grate and frame.
See Note 5

Two #4 X 2' - 6"
across side openings



#4 bars across openings
as required for 6" vertical
clearance (Max)

Flow line grade

Inlet
Pipe

Slope at 2" per foot to outlet

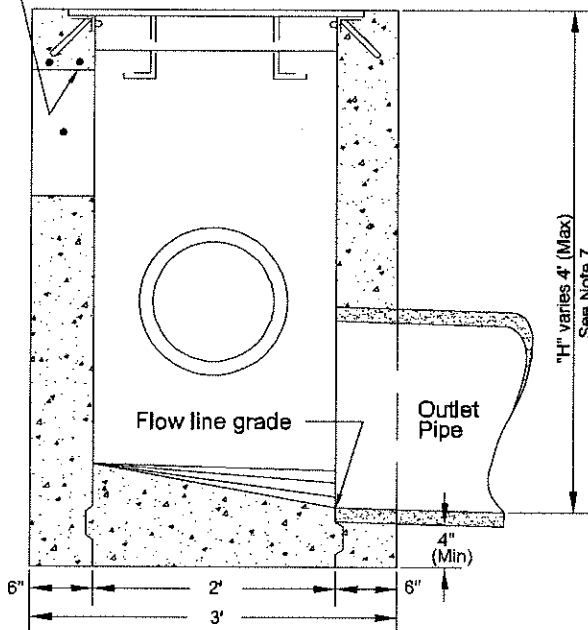
SECTION A-A

Front opening

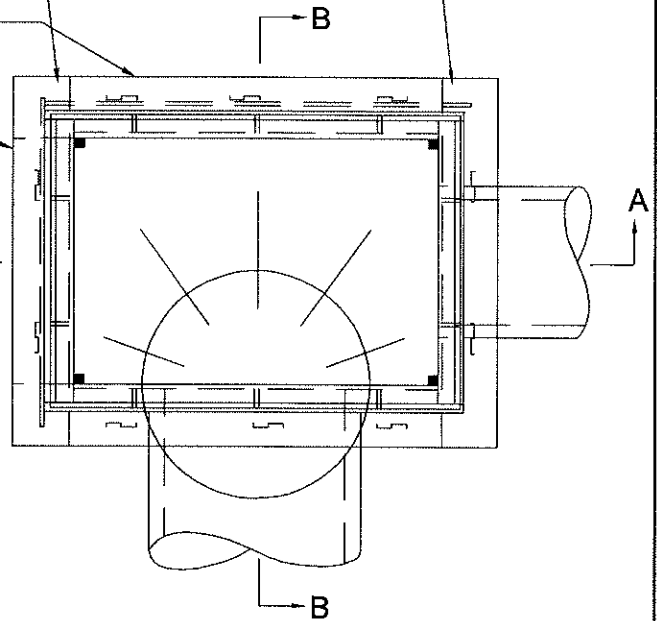
Round to 4 inch radius when
used as curb opening

Side opening

Two #4 x 3' - 8"
across front openings



SECTION B-B



PLAN
GRATE NOT SHOWN

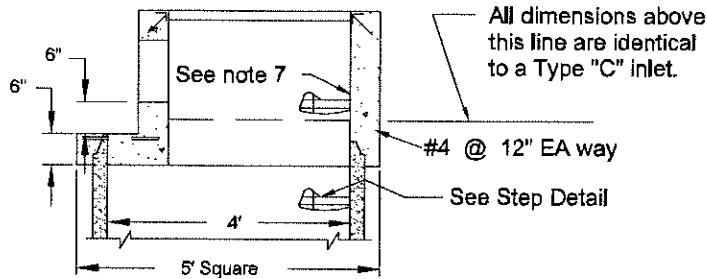
CITY OF HERCULES

Type C Inlet
Plan, Sections A-A and B-B

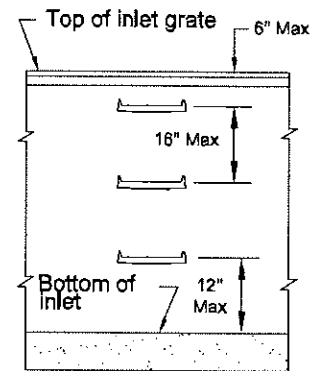
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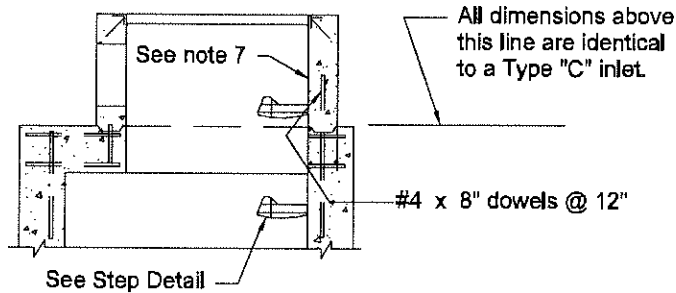
D-6.1



SECTION OF TYPE "C" OPENING



STEP DETAIL

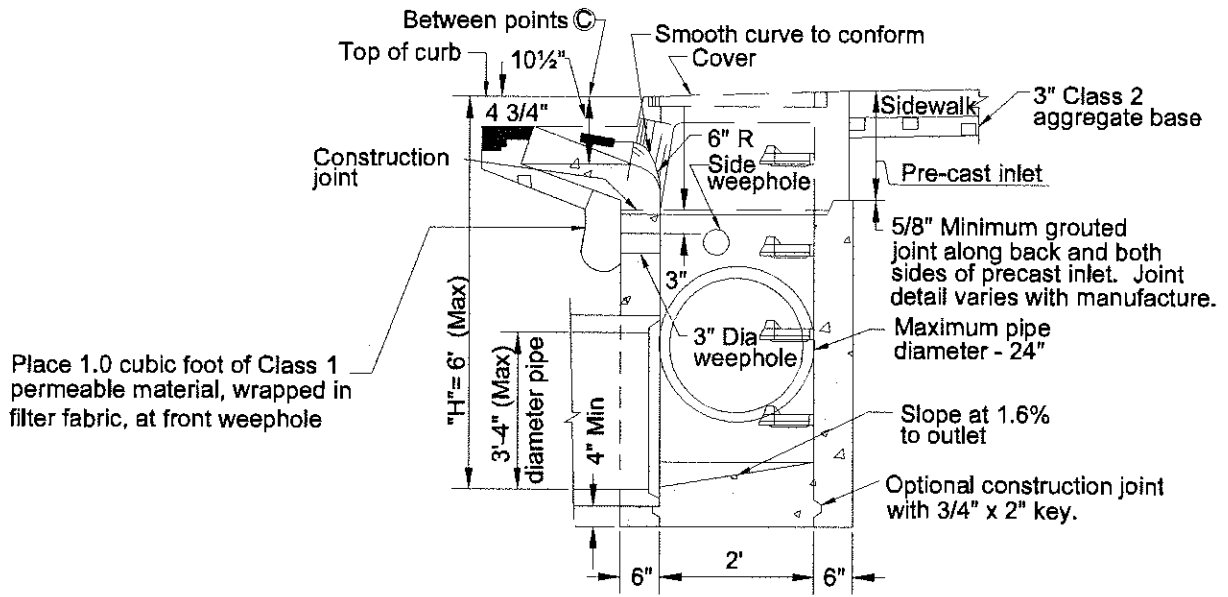


SECTION OF TYPE "C" OPENING

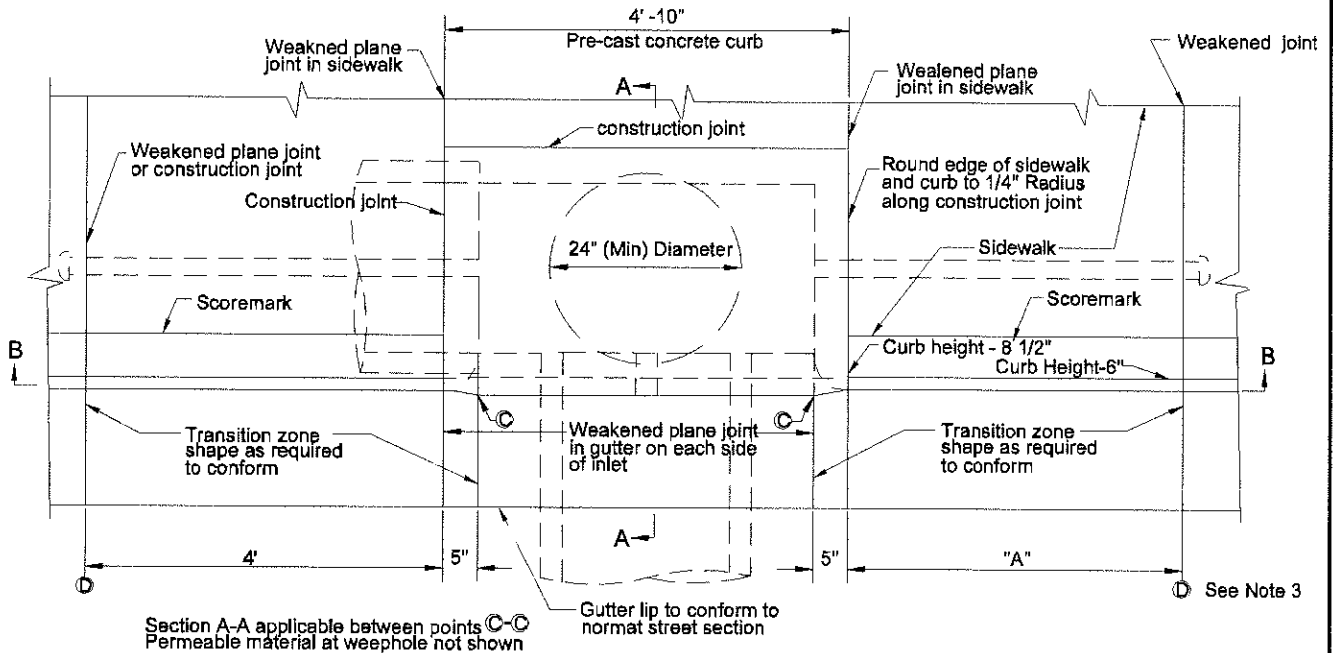
NOTES:

1. Construction joints are optional where shown. Key dimensions are 3/4 inch x 2-1/2 inches.
2. Clearance shall be 2 inches for all reinforcing steel.
3. Inlet and outlet pipes shall not intercept a box through a corner. Where the pipe is too large or the skew angle is too great to permit the opening to be made in a single wall use a manhole base with a Type C inlet opening on top.
4. The location and size of the opening shall be as shown on the plans, unless otherwise directed by the Engineer.
5. All inlets shall be constructed with grates. Inlets installed in a pedestrian area shall be by a Type D.
6. The maximum depth for a Type C inlet shall be 4 feet. For depths greater than 4 feet use a manhole base.
7. Steps shall be steel reinforced polypropylene plastic and shall be in accordance with CAL OSHA.
8. All inlets shall have an "anti-pollution" thermoplastic decal applied as directed by the Engineer.

CITY OF HERCULES		
Type C Inlet Details, Notes		
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SECTION A-A



PLAN

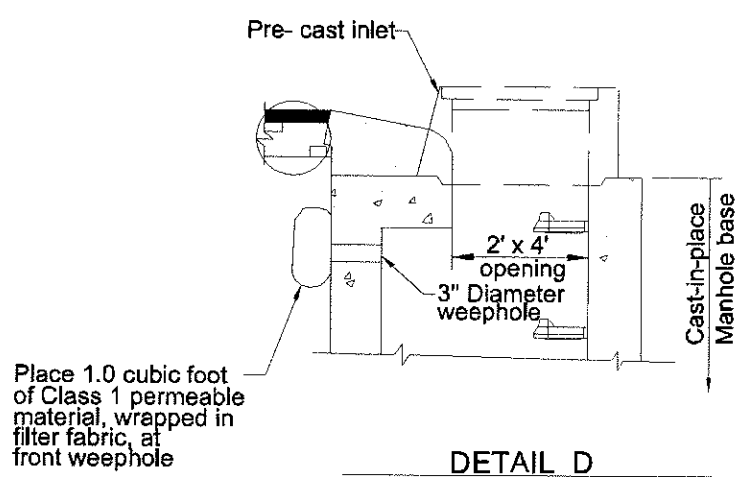
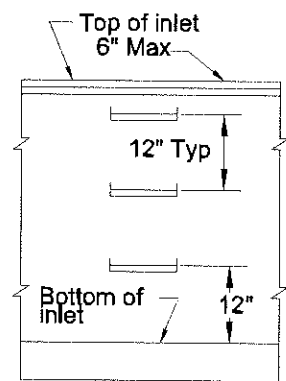
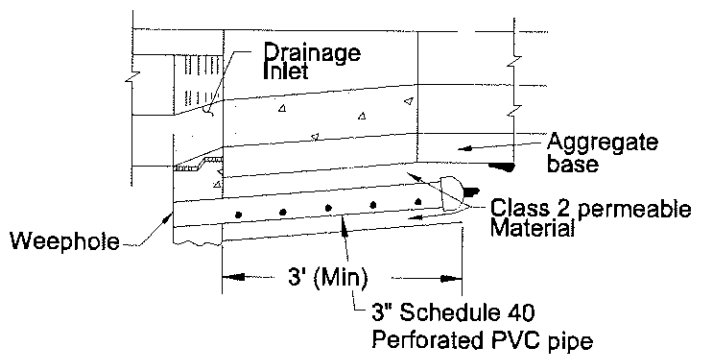
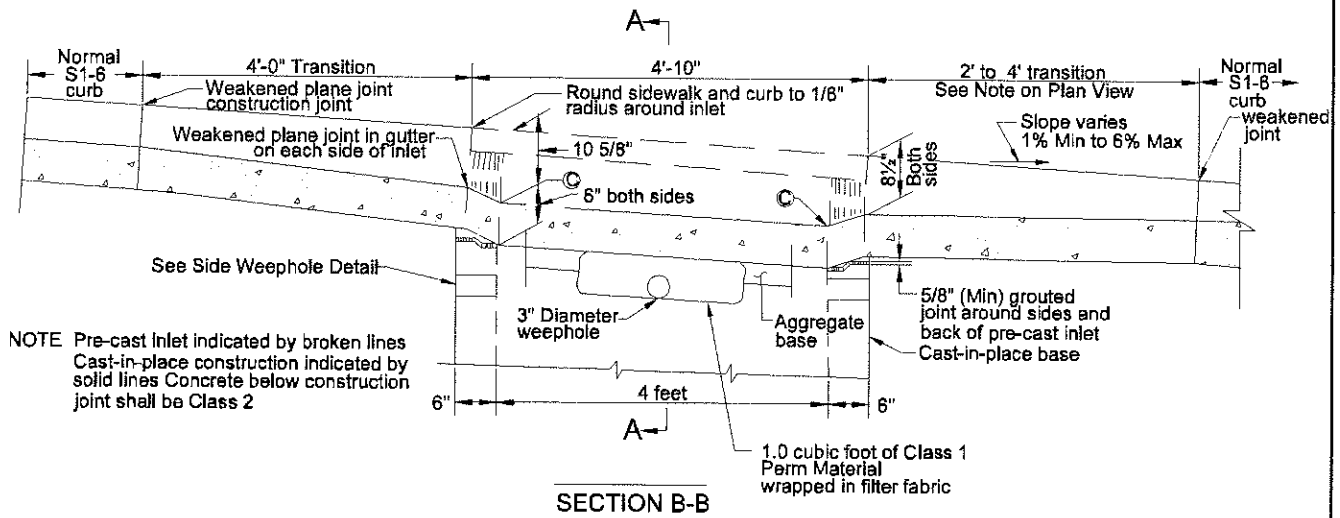
CITY OF HERCULES

Type D Inlet
Plan, Section A-A

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D-7.1



PRE-CAST INLET ON TYPE II OR TYPE III MANHOLE BASE

CITY OF HERCULES		
Type D Inlet Section B-B, Details		
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NOTES:

1. A Type D inlet is not allowed where the street grade exceeds 6 percent. Use a CCCo Type E inlet.
2. The precast concrete curb shall be Santa Rosa Cast Products Co. Model 4A , or Christy Concrete products Model U-37, or an approved equal.
3. Where curb and sidewalk are extruded, construction joints shall be provided at the "C" locations as shown on the plan view, Standard Plan D-7.1.
4. Curb and sidewalk shall be constructed monolithically.
5. If "H" exceeds 6 feet, a precast inlet on a Type II manhole base or on a CCCo Type III manhole base shall be constructed.
6. Pipe shall not enter the inlet through a corner. Where the pipe exceeds the maximum diameter allowed, or where the skew angle prevents the pipe from being made in a single wall, construct a Type II or Type III manhole base to accommodate the precast inlet.
7. Weephole depth shall be 1'-2" minimum below the curb opening and may vary with road section.
8. Steps shall be steel reinforced polypropylene plastic and in accordance with CAL OSHA.
9. All inlets shall have an "anti-pollution" thermoplastic decal applied to the inlets as determined by the Engineer.

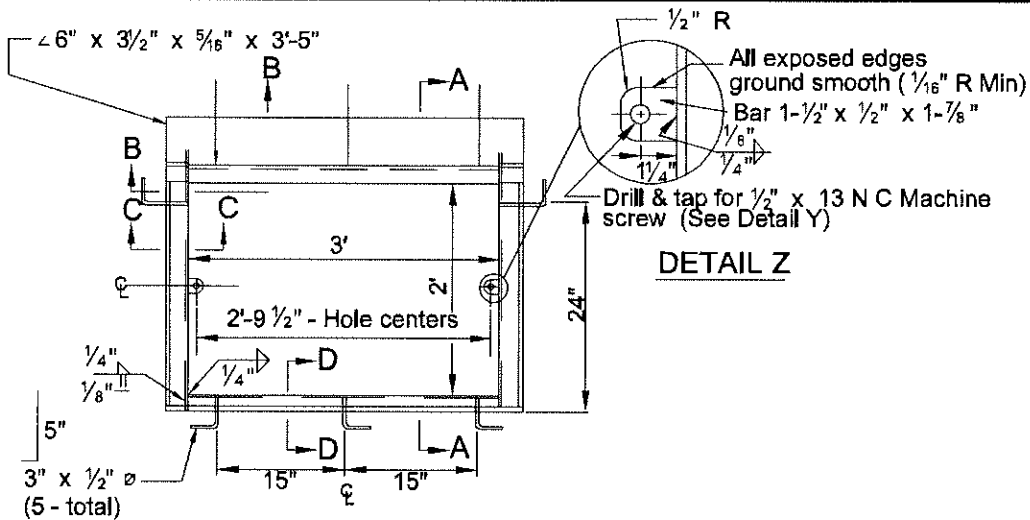
CITY OF HERCULES

**Type D Inlet
Notes**

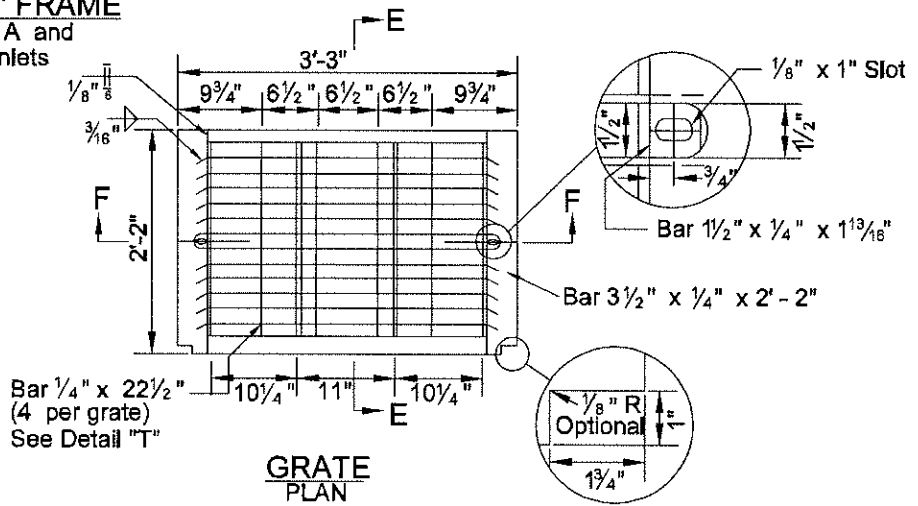
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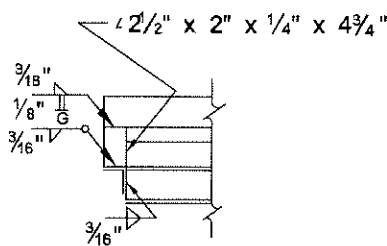
D-7.3



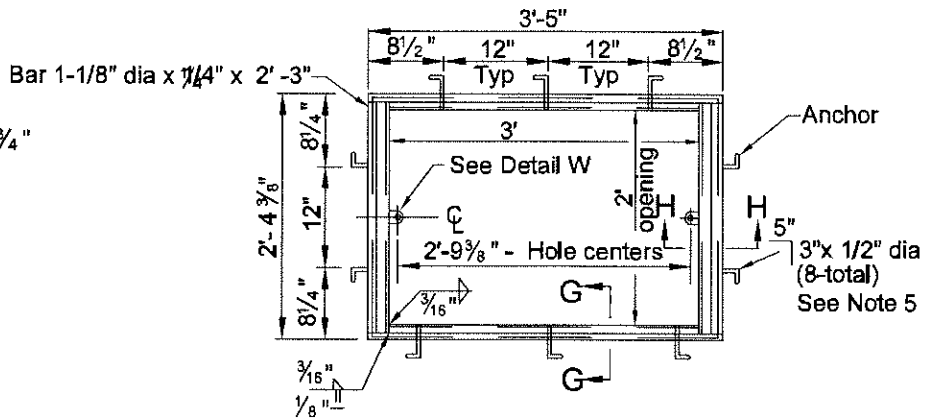
TYPE "A" FRAME
for Type A and Type B Inlets



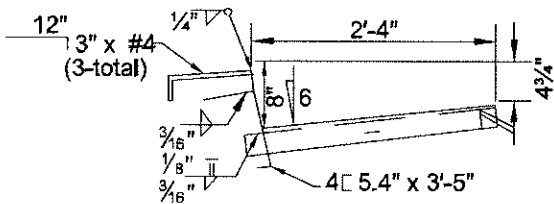
GRATE PLAN



SECTION B-B



TYPE "C" FRAME
for TYPE "C" INLET



SECTION A-A

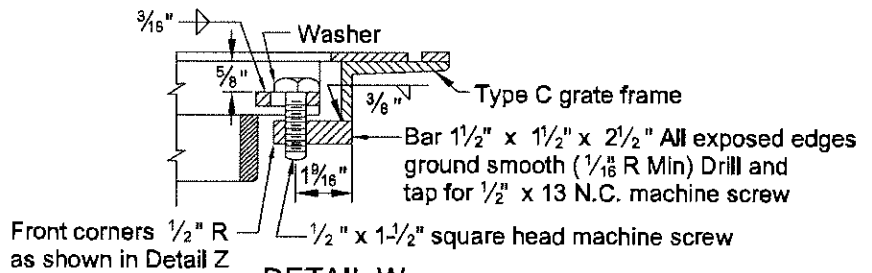
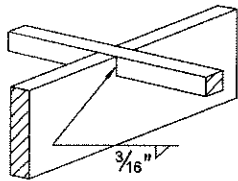
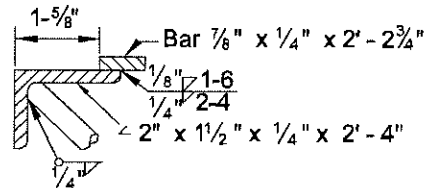
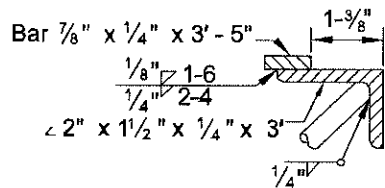
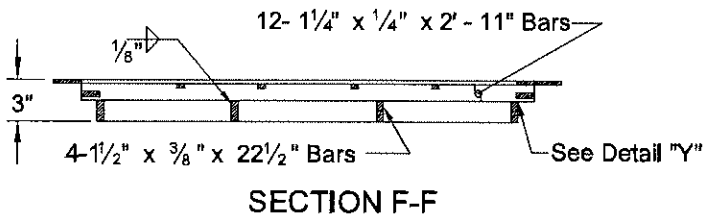
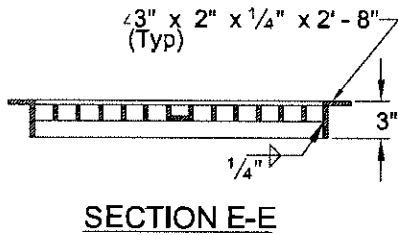
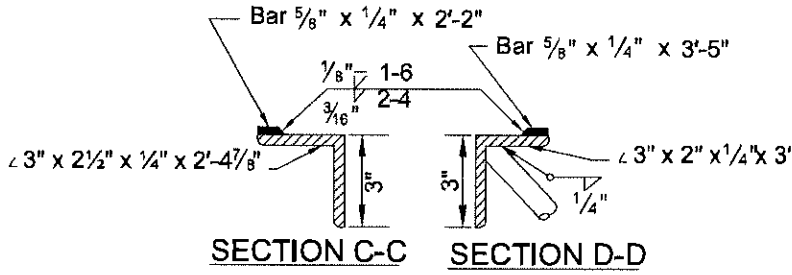
CITY OF HERCULES

Inlet Frame and Grate
Type A and Type C Frames

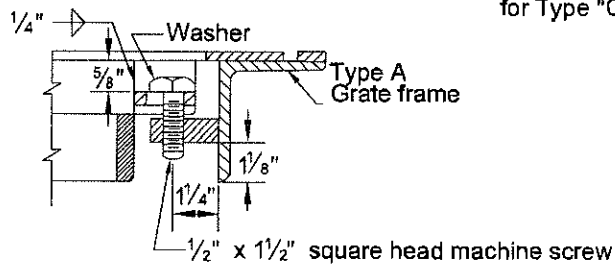
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D-8.1



Grate Fastening Lug for Type "C" Inlet Frame



Grate Fastening Lug for Inlet Frame

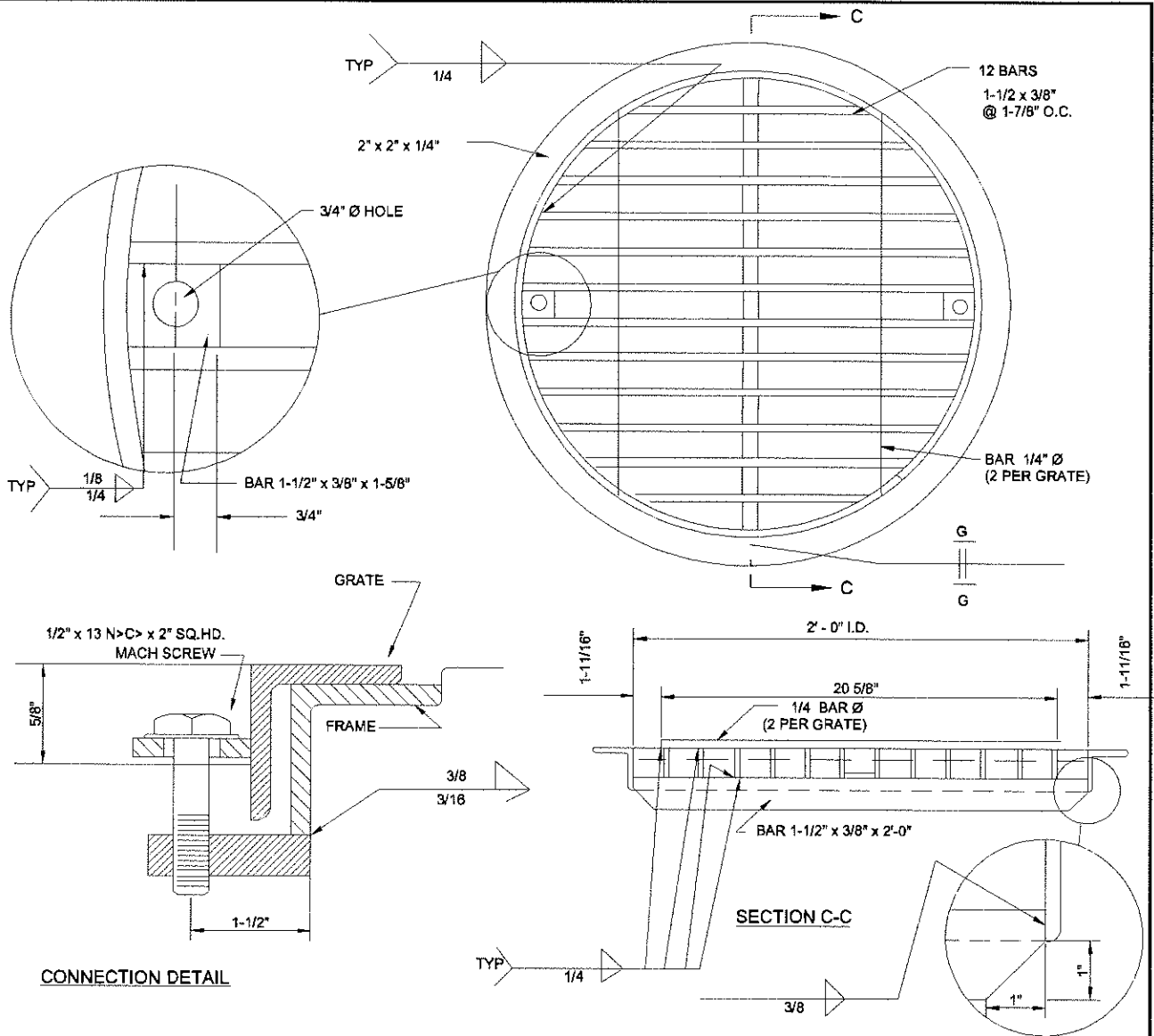
CITY OF HERCULES

Inlet Frame and Grate Details

JULY 2002

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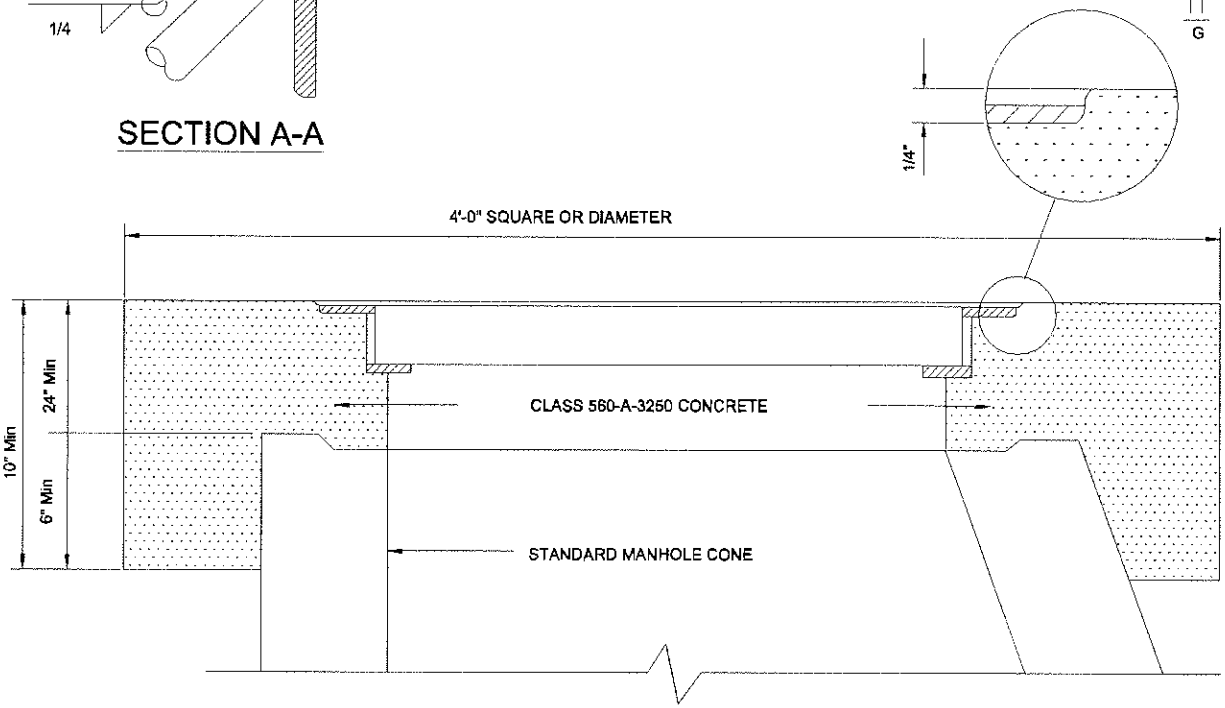
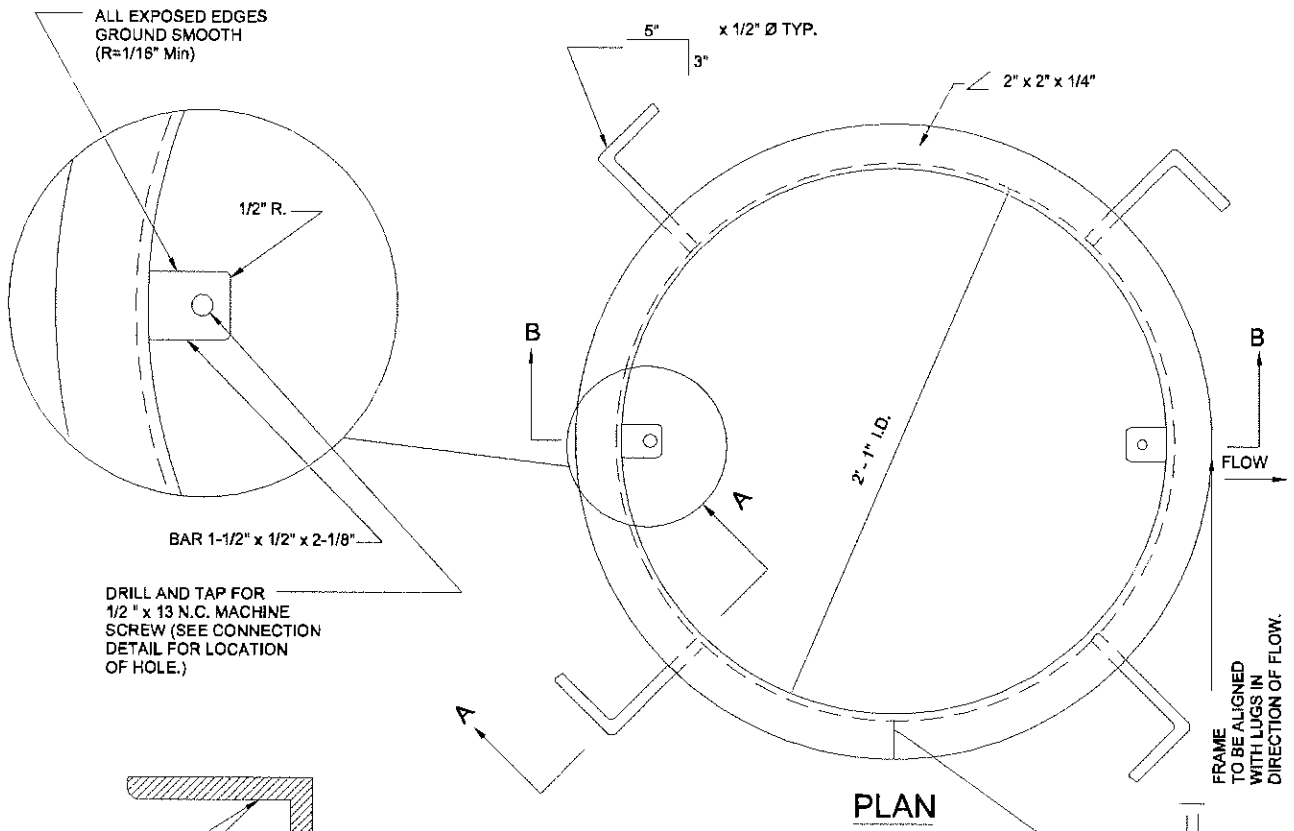
D-8.2



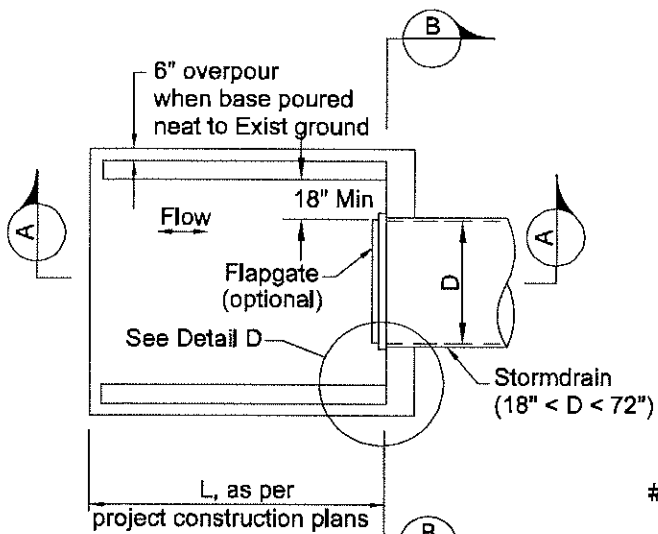
NOTES:

1. All materials, fabrication, and galvanizing shall be completed in accordance with the Standard Specifications.
2. Frames and grates shall fit together without rocking.
3. The fabricator shall supply fasteners with the frames.
4. The grate should weigh approximately 71 pounds and the frame should weigh approximately 24 pounds.
5. The grate shall not be used in public streets.
6. Where possible, a rectangular grate should be used in lieu of the circular grate.
7. Four 5-1/4 inch x 1/2 inch shear studs may be used in lieu of the four bent rod studs shown on the grate frame.

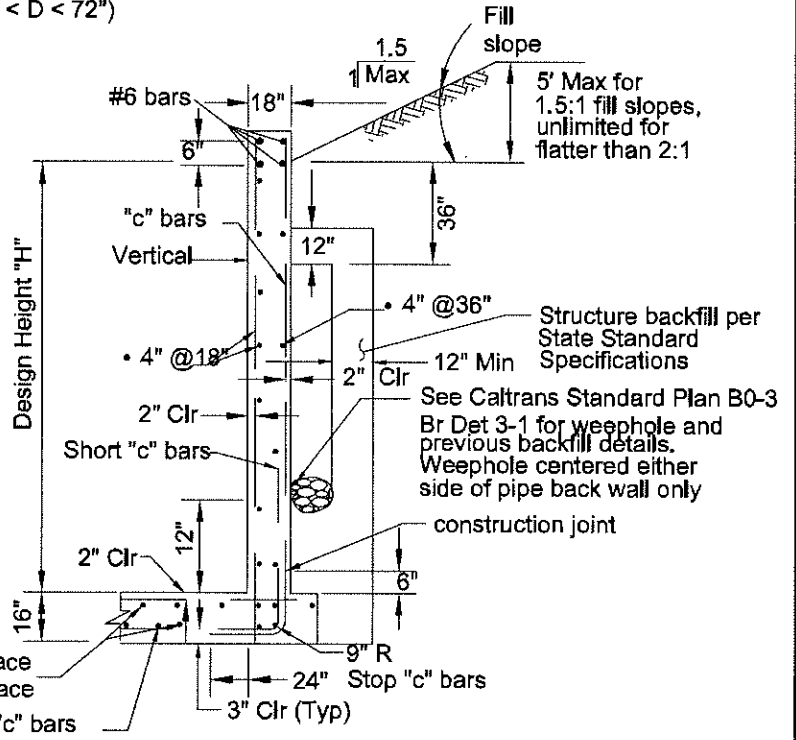
CITY OF HERCULES		
Circular Frame and Grate Grate Details		
JULY 2002	Page 1 of 2	D-9.1



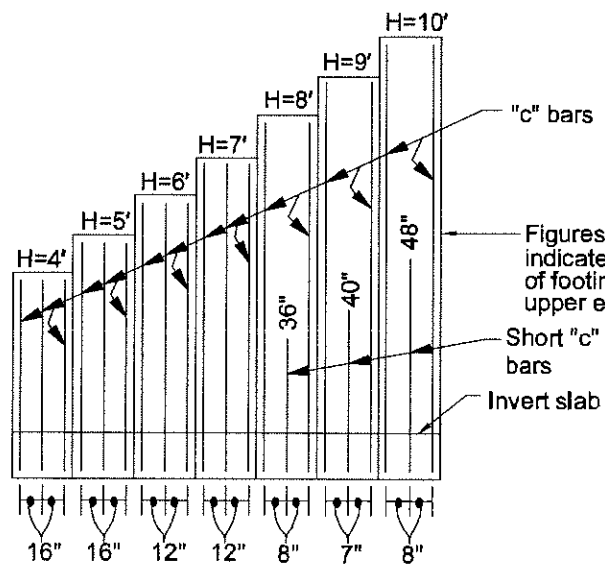
CITY OF HERCULES		
Circular Frame and Grate Frame Details		
JULY 2002	Page 2 of 2	D-9.2



PLAN



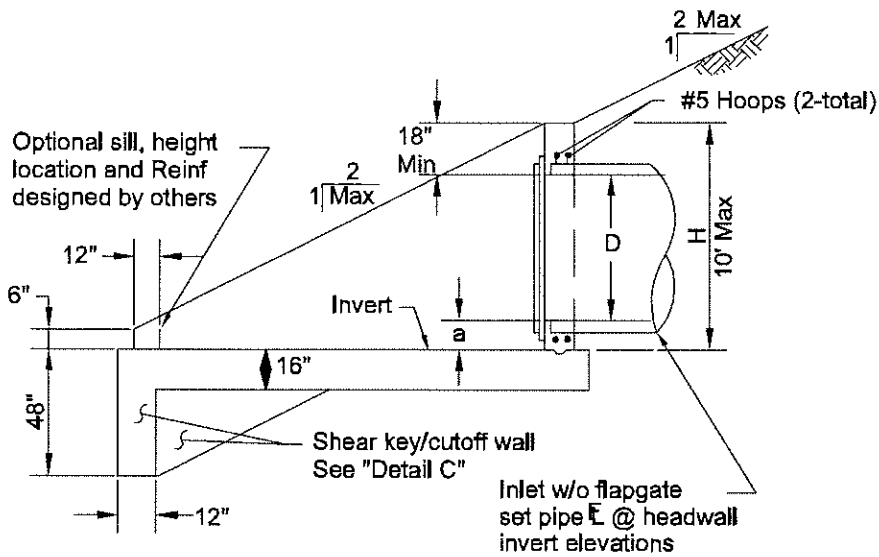
TYPICAL SECTION



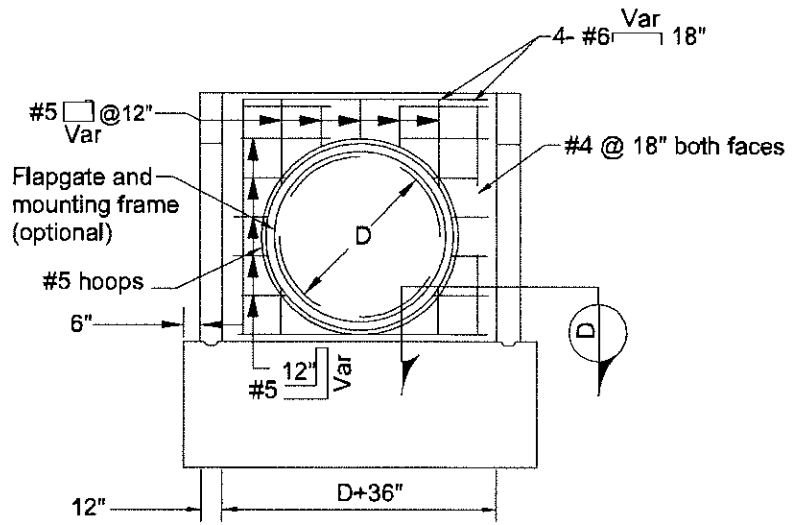
H Max.	4 ft	5 ft	6 ft	7 ft
"c" bars	#5 @ 16"	#5 @ 16"	#5 @ 12"	#5 @ 12"
H Max.	8 ft	9 ft	10 ft	
"c" bars	#5 @ 8"	#5 @ 7"	#6 @ 8"	

REINFORCED CONCRETE WALLS

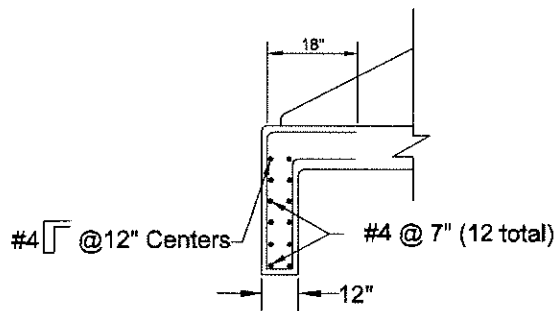
CITY OF HERCULES		
Type M Headwall		
Plan, Typical Section, Schedule		
JULY 2002	Page 1 of 3	D-10.1



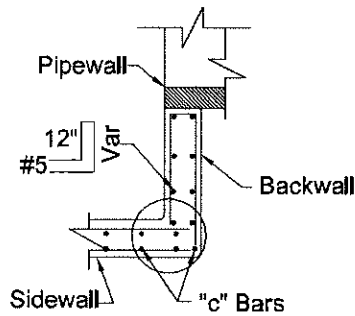
SECTION A-A



SECTION B-B



DETAIL "C"



SECTION D-D

CITY OF HERCULES		
Type M Headwall		
Sections A-A and B-B, Details		
JULY 2002	Page 2 of 3	D-10.2

GENERAL NOTES:

USE:

The Type M headwall may be used in various locations: channel outlet, basin outlet, and side channel outlet. The standard plan does not address site conditions that may be unique to the planned use.

Items that should be considered include:

1. Safety pipe railing for basin inlets and outlets or chainlink fencing for channels, outlets, and inlets.
2. Flapgate details.
3. Rock slope protection.
4. Pipe orientation, size, configuration, type.
5. Wall elevations.
6. Grading.
7. Trash rack details.

PLAN NOTES

1. Unit stress: $F_s = 60,000$ psi, $f_c = 3000$ psi.
2. Walls design for 2 feet live load surcharge, 1.5:1 sloping surcharge not to exceed 5 feet in elevation plus a 2 feet live load surcharge, or unlimited 2:1 surcharge.
3. Dimension "H" is shown on the project plans.
4. Wall height may be exceeded by 6 inches before selecting the next greater "H".
5. D maximum = 6 feet. D minimum = 18 inches.
6. a = 9 inch minimum for basin or creek inlet structures. Pipe flowline shall be depressed to structure invert. #5 bar hoops shall be placed in invert in such instances.
7. Riprap type shall be determined by the project engineer and approved by the Engineer.

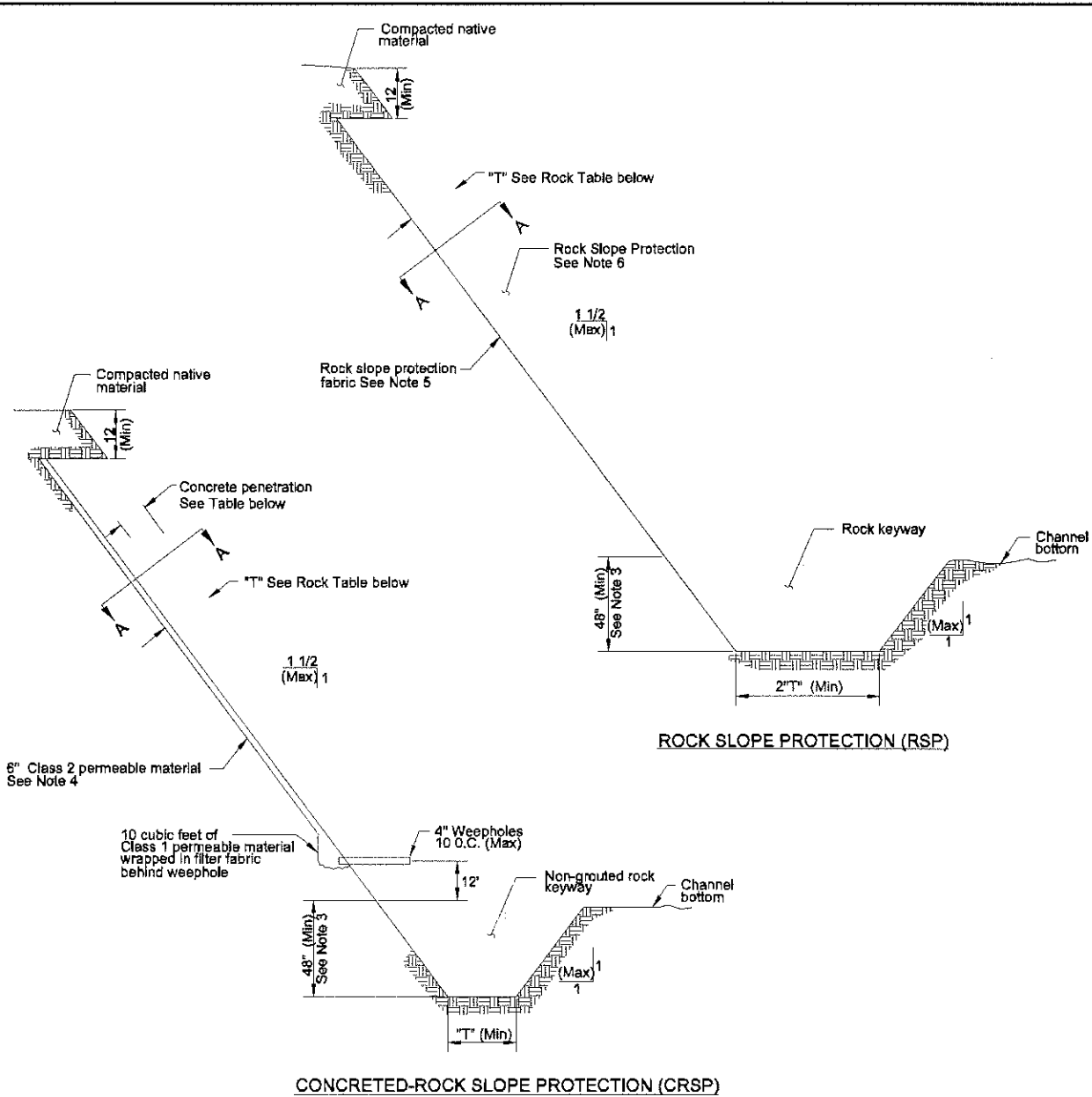
CITY OF HERCULES

**Type M Headwall
Notes**

JULY 2002

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D-10.3



ROCK SLOPE PROTECTION (RSP)

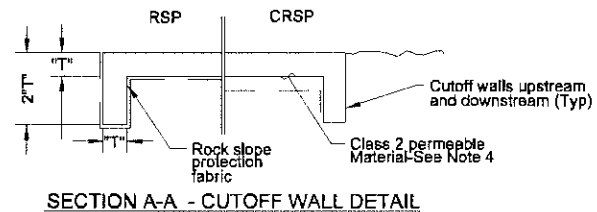
CONCRETED-ROCK SLOPE PROTECTION (CRSP)

NOTES:

1. Sideslopes and toe depth are dependent on soil and hydraulic conditions and may vary with site location.
2. Thickness "T" shall conform to the Table as shown.
3. Depth of keyway may vary. The 48 inch minimum may decrease where bed rock is less than 48 inches below the ground surface.
4. Class 2 permeable material shall be required unless otherwise directed by the Engineer.
5. Rock slope protection fabric shall be placed in accordance with Section 72-2 of the State Standard Specifications.

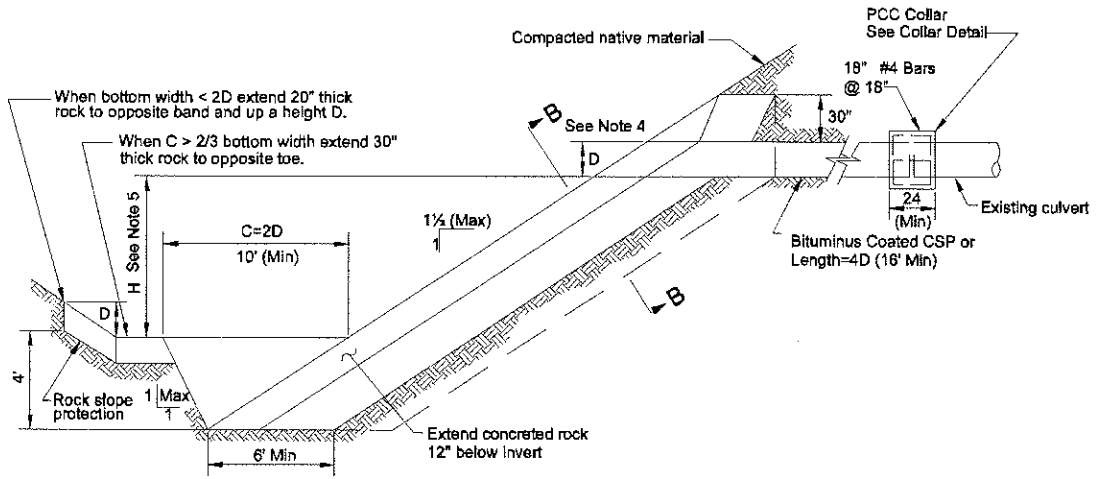
ROCK TABLE

Rock Grading	Concrete penetration depth in in. (Min)	"T" (In)
1/2 Ton	18	48
1/4 Ton	14	36
Light Facing	8	18

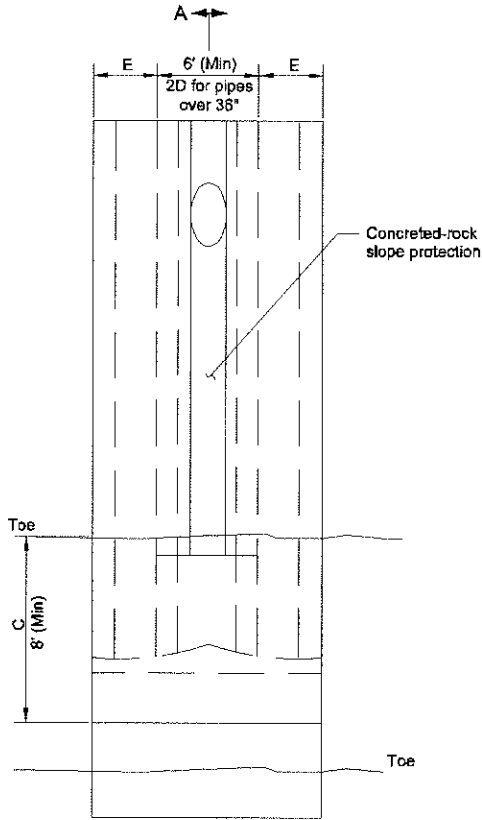


CITY OF HERCULES

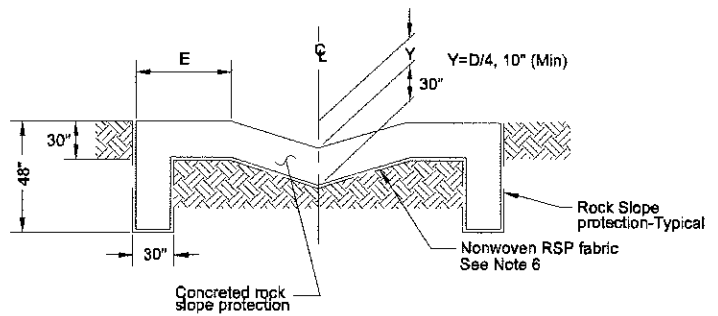
Rock Slope Protection



SECTION A-A



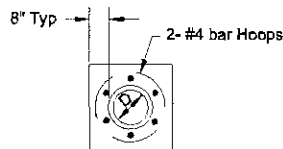
PLAN



SECTION B-B

NOTES:

1. Concreted-rock slope protection and rock slope protection shall conform to the State Standard Specifications. Unless otherwise specified the rock class shall be Light. Where channel conditions warrant the use of any rock class other than Light proper documentation shall be submitted to the Engineer.
2. Lap rock slope protection fabric in accordance with the manufacturer's requirements.
3. Concrete shall be placed in accordance with the Standard Specifications.
4. The minimum pipe diameter "D" shall be 18 inches.
5. The dimension "H" shall be a minimum of 24 inches.
6. Fabric shall comply to the State Standard Specification 72-2 "Rock Slope Protection".



COLLAR DETAIL

H (ft)	E (ft)
2 to 7	2
7 to 14	4
Over 14	8

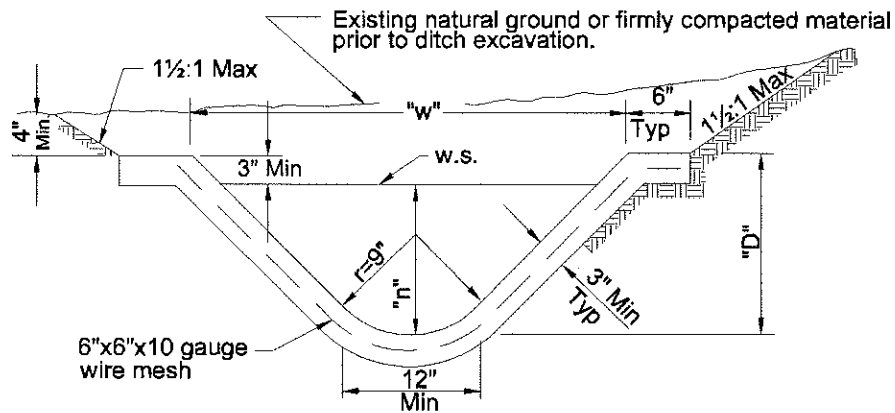
CITY OF HERCULES

Rock Pipe Outfall

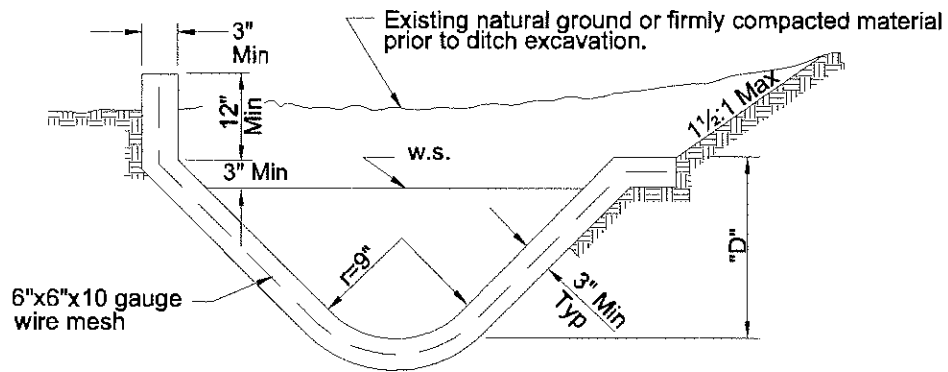
JULY 2002

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D-12



NORMAL SECTION



SUPERELEVATED SECTION
Use on Curves

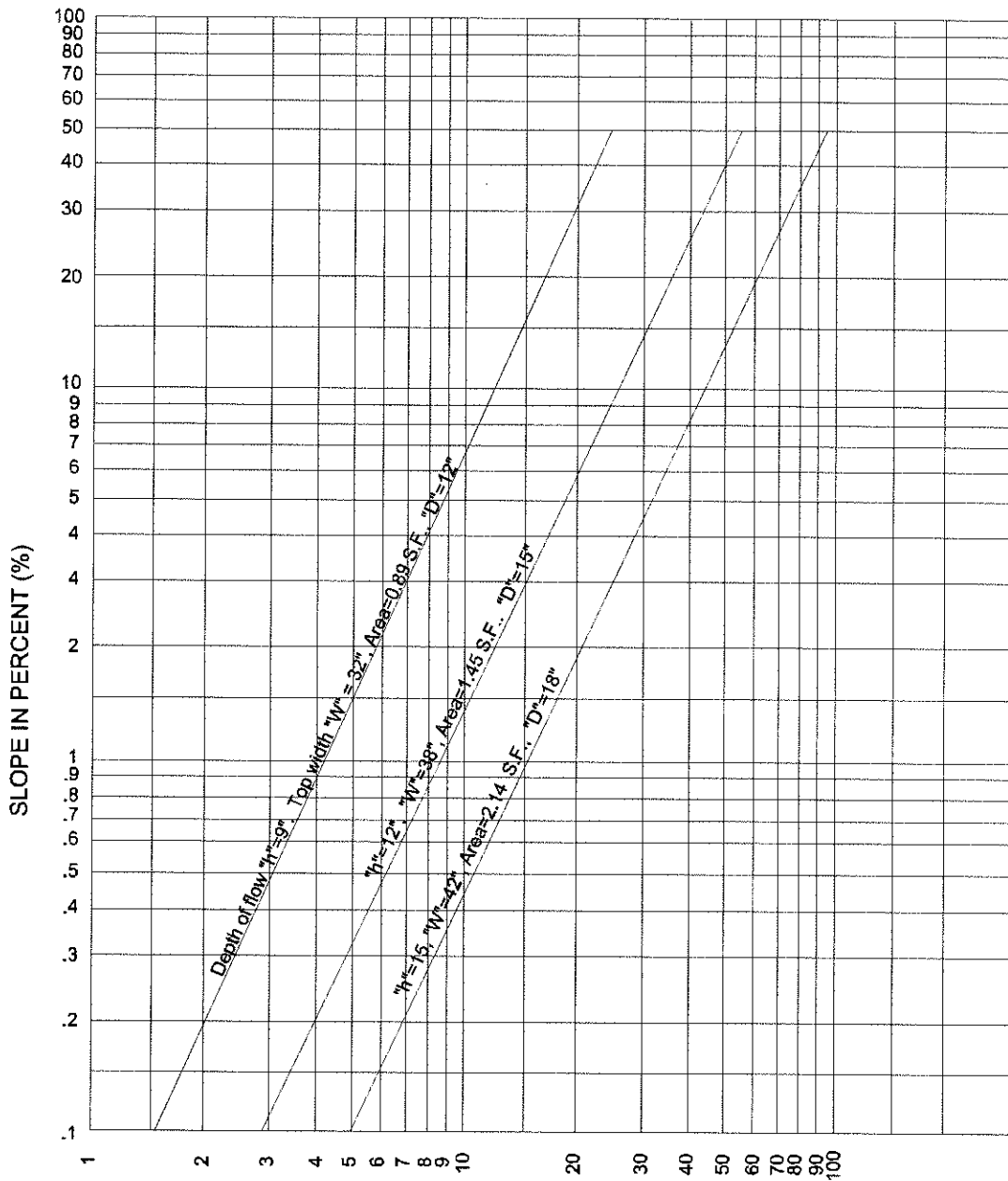
CITY OF HERCULES

Concrete V Ditch
Typical Sections

JULY 2002

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D-13.1



$D = h + 3$

QUANTITY IN C.F.S. (Q)

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Concrete V Ditch
Capacity Chart

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D-13.2

EXISTING

PROPOSED

DESCRIPTION

		PROPERTY LINE
		SIDEWALK, CURB @ GUTTER
		CENTERLINE
		EDGE OF PAVEMENT
		SANITARY SEWER & MAINTENANCE HOLE
		SANITARY SEWER & RISER
		STORM SEWER & MAINTENANCE HOLE
		STORM SEWER & INLET
		WATER MAIN
		MONUMENT LINE & MONUMENT
		UTILITY POLE
		TRAFFIC SIGN
		FIRE HYDRANT - commercial - residential
		WATER MAIN & VALVE
		WATER MAIN & BLOW-OFF
		WATER MAIN & TEE
		WATER MAIN & CROSS
		WATER MAIN & REDUCER
		GAS MAIN
		TELEPHONE CONDUIT
		ELECTROLIER & CONDUIT

X" = indicates diameter in inches

CITY OF HERCULES

STANDARD SYMBOLS

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G-1

ABBREVIATIONS

AB	= aggregate base	O.D.	= outside diameter
ABS	= Acrylonitrile-Butadiene-Styrene pipe	PCC	= portland cement concrete
AC	= asphalt concrete	PE	= polyethylene plastic pipe
AWWA	= American Water Works Association	℞	= property line
Caltrans	= State of California, Department of Transportation	pt.	= point
CF	= cubic foot (feet)	PUE	= public utilities easement
cl.	= clear	PVC	= polyvinyl chloride pipe
CLSM	= Controlled low strength materials	PVCpp	= PVC pressure pipe
conc.	= concrete	PVCsdnpp	= PVC storm drain nonpressure pipe
const.	= construction	R	= radius
C-I-P	= cast-in-place	RCE	= registered civil engineer
CIPCP	= cast-in-place concrete pipe	RCP	= reinforced concrete pipe
CVC	= California Vehicle Code	RCPP	= reinforced concrete pressure pipe
C&G	= curb & gutter	RCP(PVCL)	= reinforced concrete pipe (PVC lined)
℄	= centerline	req'd	= required
Detail x	= Caltrans striping designation	(rt)	= right
DF	= douglas fir	r/w	= right of way
dia.	= diameter	"s"	= slope
DIP	= ductile iron pipe	SD	= storm drain
dist.	= distance	Sch.	= schedule
DWY	= driveway	sq.	= square
elev.	= elevation	SS	= sanitary sewer
E.P.	= edge of pavement	std.	= standard
exist.	= existing	SW	= sidewalk
FC	= face of curb	SWE	= sidewalk easement
℞	= flow line	T	= telephone
galv.	= galvanized	TC	= top of curb
HDPE	= corrugated polyethylene nonpressure pipe	T.V.	= television
HPS	= high pressure sodium	typ.	= typical
I.D.	= inside diameter	T&B	= top and bottom
l.p.	= iron pipe	VCP	= vitrified clay pipe
LS	= registered land surveyor	w	= water
LSE	= landscape easement	WRD	= Water Resources Division
max.	= maximum	w\	= with
mech	= mechanical	∅	= diameter
MH	= maintenance hole		
min.	= minimum		
MLCSP	= mortar-lined and mortar-coated steel pipe		
mph	= miles per hour		
O.C.	= on center		

CITY OF HERCULES

ABBREVIATIONS

JULY 2002

Page 1 of 1

G-2

ABREVIATURA

AB	= base agregada	O.D.	= diametro exterior
ABS	= Acrylonitrile-Butadiene-Styrene pipe	PCC	= concreto del cemento de portland
AC	= concreto del asfalto	PE	= pipa del plastico del polietileno
AWWA	= Asoc. Americanan De los Trabajos De Agua	ℓ	= linea de la caracteristica
Caltrans	= Estado del Departamento de California del Transporte	pt.	= punto
CF	= pie cubico (pies)	PUE	= servidumbre de las utilidades publicas
cl.	= claro	PVC	= pipa del loruro de polivinilo
CLSM	= Materiales bajos controlados de la fuerza	PVCpp	= pipa de la presion del PVC
conc.	= concreto	PVCsdnpp	= pipa del nonpressure del dren de la tormenta del PV
const.	= construccion	R	= radio
C-I-P	= cast-in-place	RCE	= ingeniero civil registrado
CIPCP	= pipa concreta cast-in-place	RCP	= pipa concreta reforzada
CVC	=Codigo Del Vehiculo de California	RCPP	= pipa concreta reforzada de la presion
C&G	= encintado y canal	RCP(PVCL)	= pipa concreta reforzada (PVC alineado)
℄	= linea central	req'd	= requerido
Detail x	= Designacion de las rayas de Caltrans	(rt)	= la derecha
DF	= abeto de douglas	r/w	= derecho de paso
dia.	= diametro	"s"	= cuesta
DIP	= pipa ductil del hierro	SD	= dren de la tormenta
dist.	= distancia	Sch.	= horario
DWY	= calzada	sq.	= cuadrado
elev.	= elevacion	SS	= alcantarilla sanitaria
E.P.	= borde del pavimento	std.	= estandar
exist.	= el existir	SW	= acera
FC	= cara del encintado	SWE	= servidumbre de la acera
ℓ	= linea del flujo	T	= telefono
galv.	= galvanizado	TC	= tapa del encintado
HDPE	= pipa acanalada del nonpressure del polietileno	T.V.	= television
HPS	= sodio del alta presion	typ.	= tipico
I.D.	= diametro interior	T&B	= tapa y fondo
l.p.	= pipa del hierro	VCP	= pipa de arcilla vitrified
LS	= topografo registrado de la tierra	w	= agua
LSE	= servidumbre del paisaje	WRD	= Division de los Recursos de Agua
max.	= maximo	w\	= con
mech	= mecanico	∅	= diametro
MH	= agujero del mantenimiento		
min.	= minimo		
MLCSP	= pipa de acero mortero-alineada y mortero-revestida		
mph	= millas por hora		
O.C.	= en centro		

CIUDAD DE CONCORD

ABREVIATURA

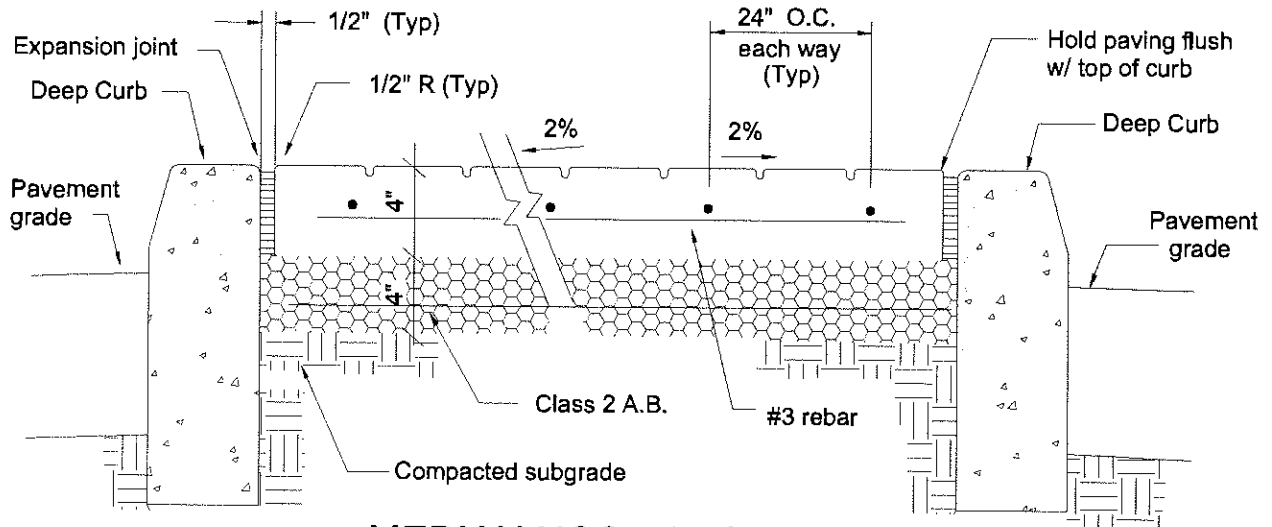
JULY 2002

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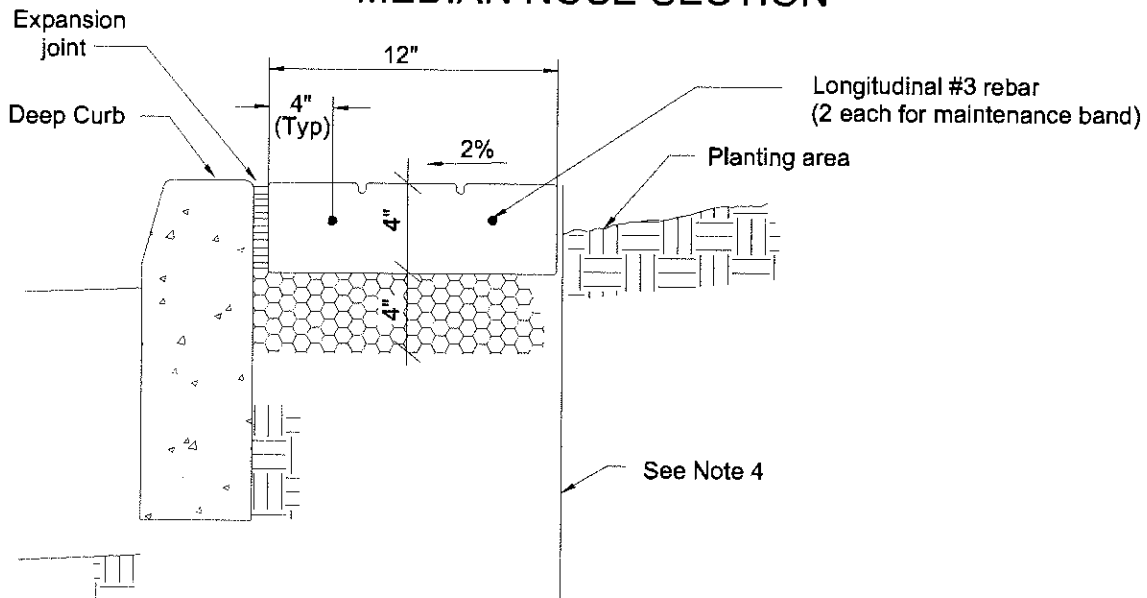
G-2

NOTES:

1. Install 1 inch deep transverse joints at a spacing equal to 1.5 times the width of each median section, unless otherwise approved by the City Engineer.
2. Textured concrete paving color and pattern may be used where approved by the City Engineer.
3. Aggregate base to be treated with a pre-emergent herbicide as approved by the City Engineer.
4. Where roadway structural section is greater than 14 inches, install a water barrier extending from the top of pavers to 6 inches below the street subgrade. See Standard Plan L 2.3.



MEDIAN NOSE SECTION

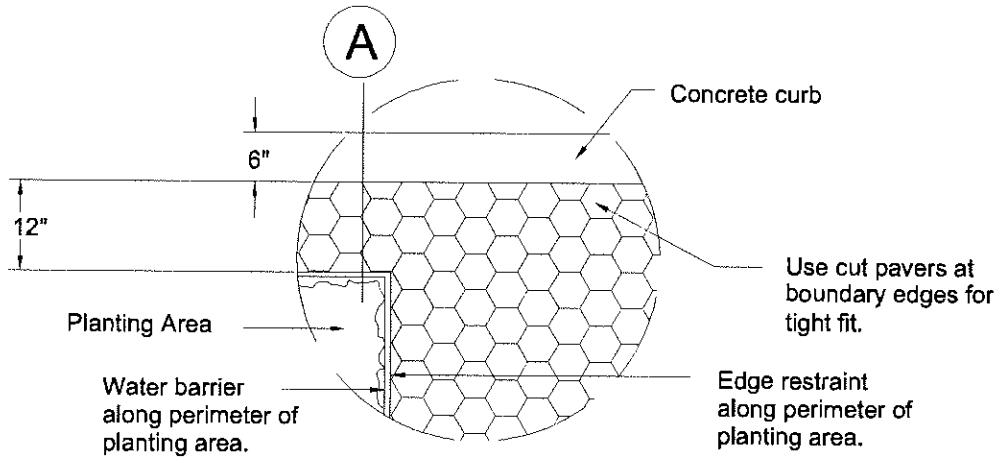


MAINTENANCE BAND SECTION

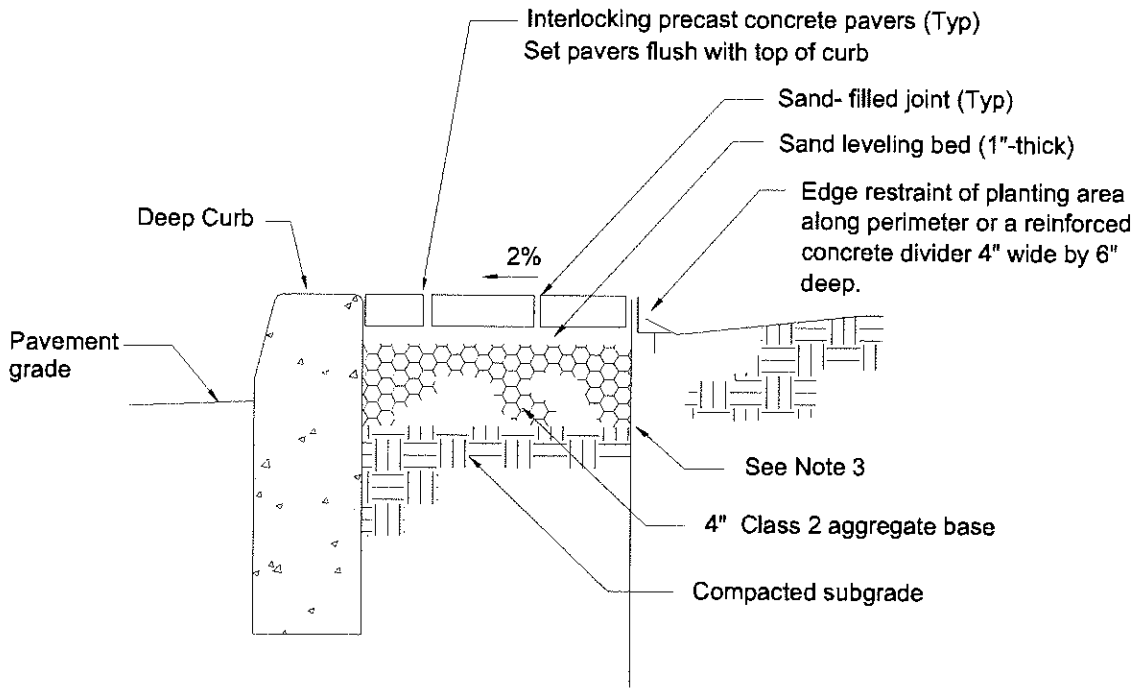
CITY OF HERCULES		
MEDIAN PAVING TEXTURED CONCRETE		
JULY 2002	Page 1 of 3	L 1.1

NOTES:

1. Interlocking precast concrete paver color and pattern may be used where approved by the City Engineer.
2. Aggregate base shall be treated with a pre-emergent herbicide.
3. Where the roadway structural section is greater than 14 inches, install a water barrier extending from the top of pavers to 6 inches below the street subgrade. See Standard Plan L 2.3



PLAN

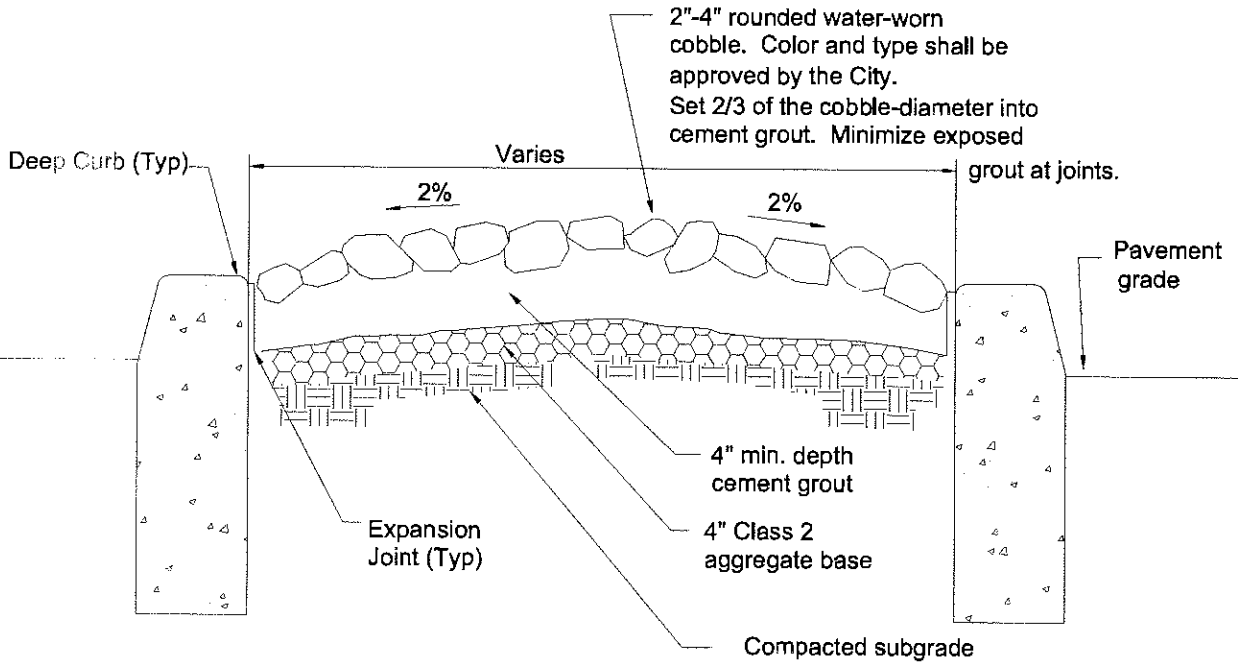


A MAINTENANCE BAND SECTION

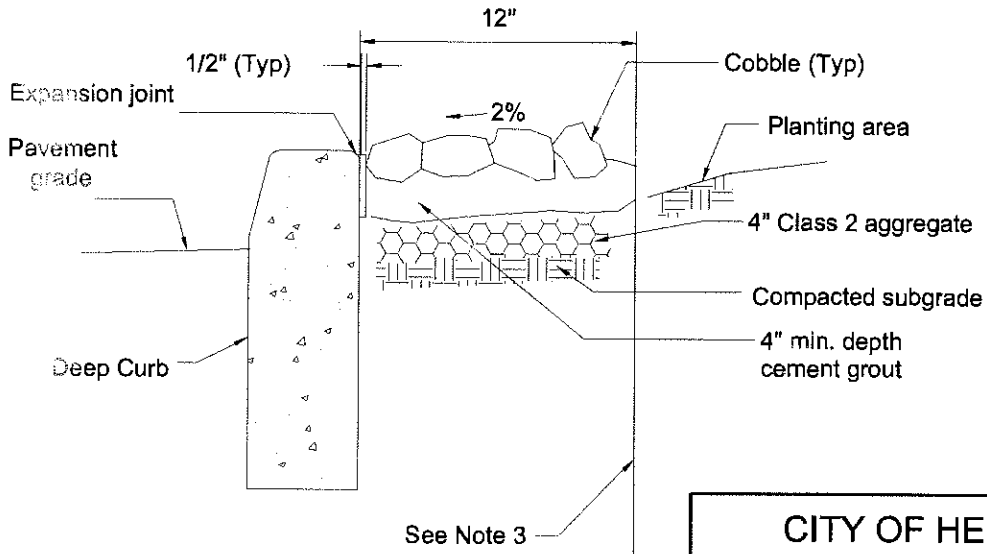
CITY OF HERCULES		
MEDIAN PAVING INTERLOCKING PAVERS		
JULY 2002	Page 2 of 3	L 1.2

NOTES:

1. Cobblestone shall be approved by the City Engineer.
2. Aggregate base shall be treated with a pre-emergent herbicide as approved by the City.
3. Where roadway structural section is greater than 14 inches, install water barrier extending from top of pavers to 6 inches below street subgrade. See Standard Plan L2.3.



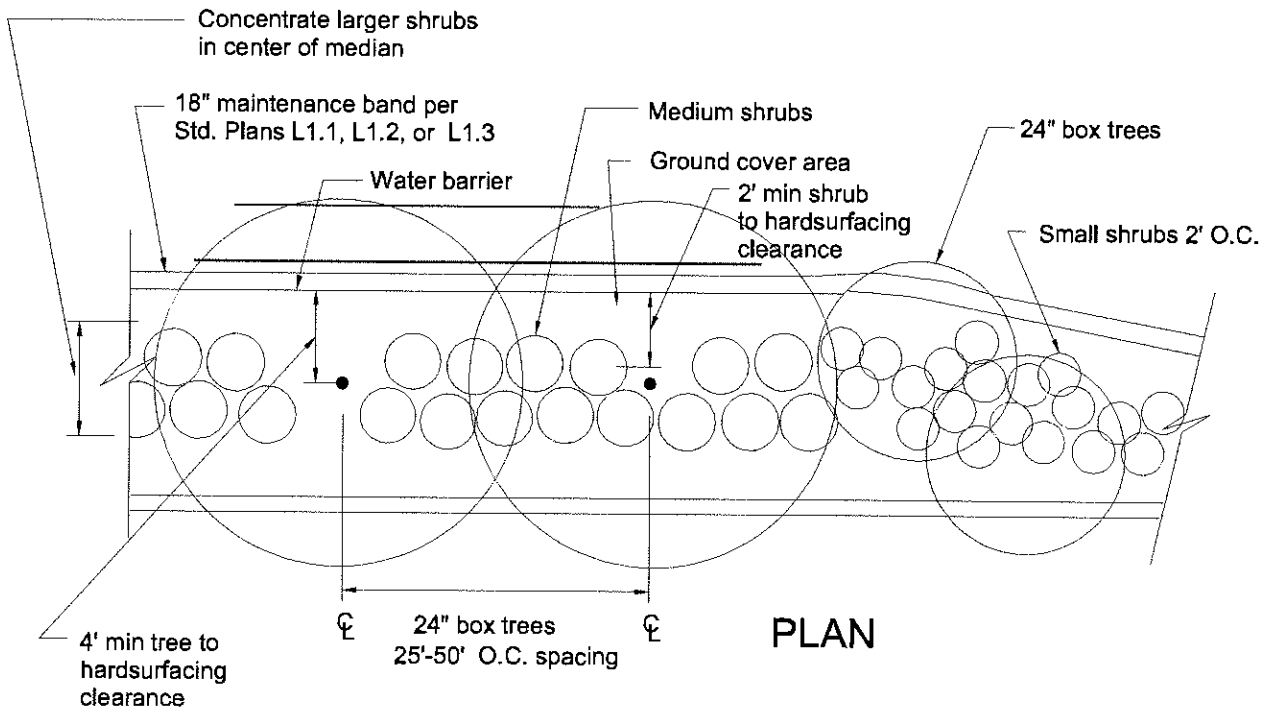
MEDIAN NOSE SECTION



MAINTENANCE BAND SECTION

CITY OF HERCULES		
MEDIAN PAVING COBBLESTONE		
JULY 2002	Page 3 of 3	L 1.3

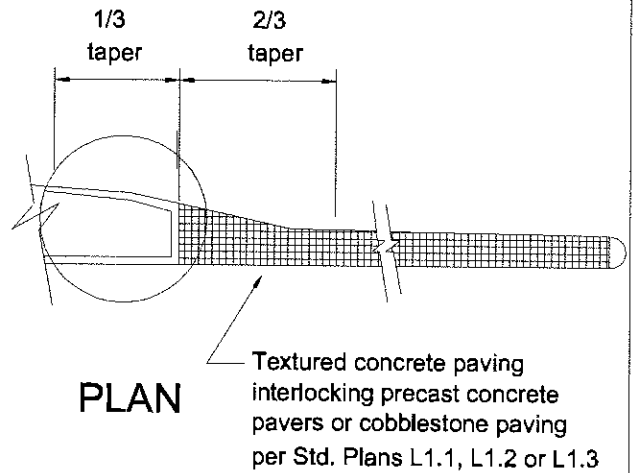
NOTE: This detail is only a guideline. Plant variety/size and hardsurfacing materials shall be approved by the City. Minimum quantities of plant materials are shown.



PLAN

Minimum quantity of plant material per 100 foot long section of standard 16 foot wide median. Quantities will vary proportionally for other median widths.

- TREES: (7 trees minimum per 100 feet)
 24 inch box: 2-4 trees per 100 feet large canopy trees
 24 inch box: 3-5 trees per 100 feet accent trees
- SHRUBS: (Mature Height)
 Large: 5'-10' high, 30 shrubs per 100 feet
 Medium: 3'-5' high, 40 shrubs per 100 feet
 Small: 1'-3' high, 50 shrubs per 100 feet
- GROUND COVER:
 Fast growing: 12 inches O.C.
 Moderate growing: 9 inches O.C.
 Slow growing: 6 inches O.C.

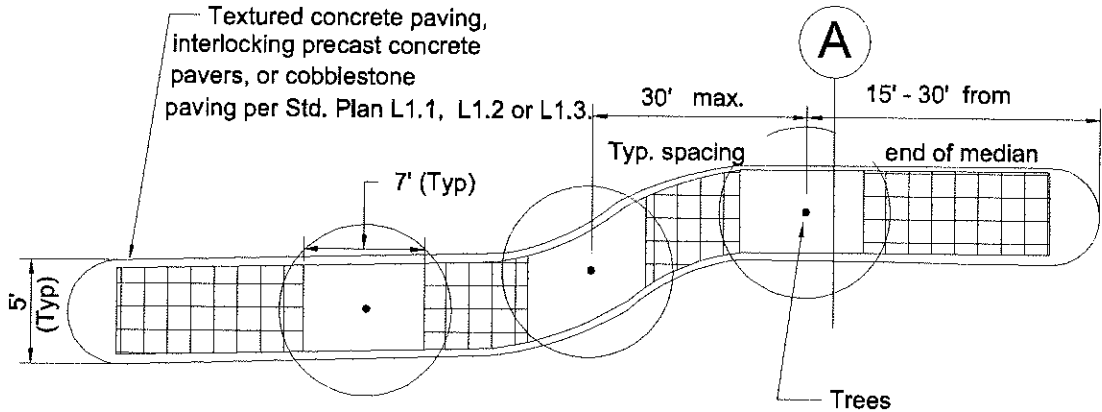


PLAN

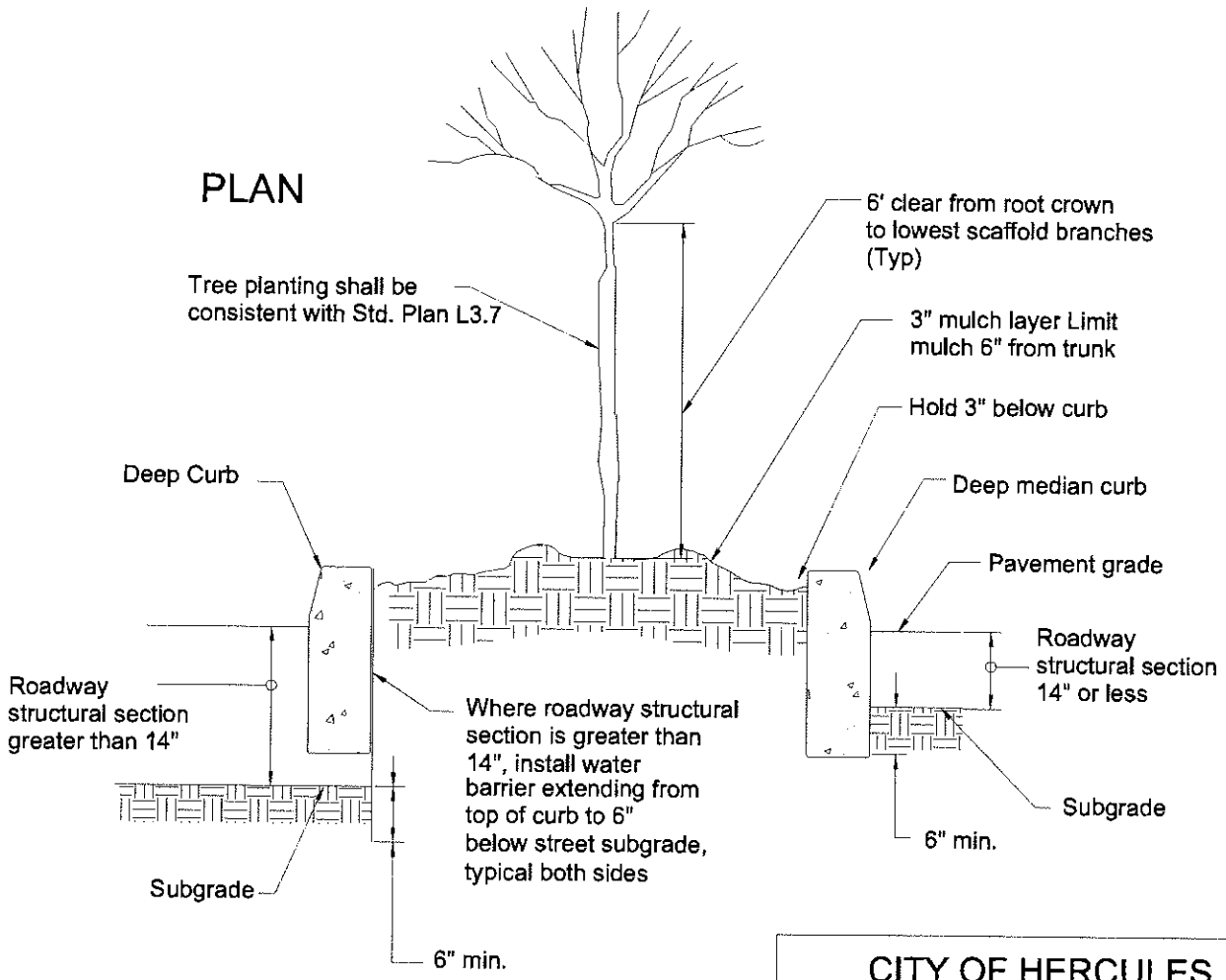
NOTES:

1. Areas between plants shall receive a 3 inch layer of mulch.
2. Trees within 300 feet of intersections, as measured from the centerline of the cross-street, shall have canopies trimmed to provide 8 feet clear from top of curb to lowest scaffold branch. Groundcover within 300 feet of intersections and driveways shall be specified as a low-growing variety, with native growth height of no more than 30 inches above top of curb including mounding.

CITY OF HERCULES		
MEDIAN PLANTING GENERAL		
JULY 2002	Page 1 of 3	L 2.1

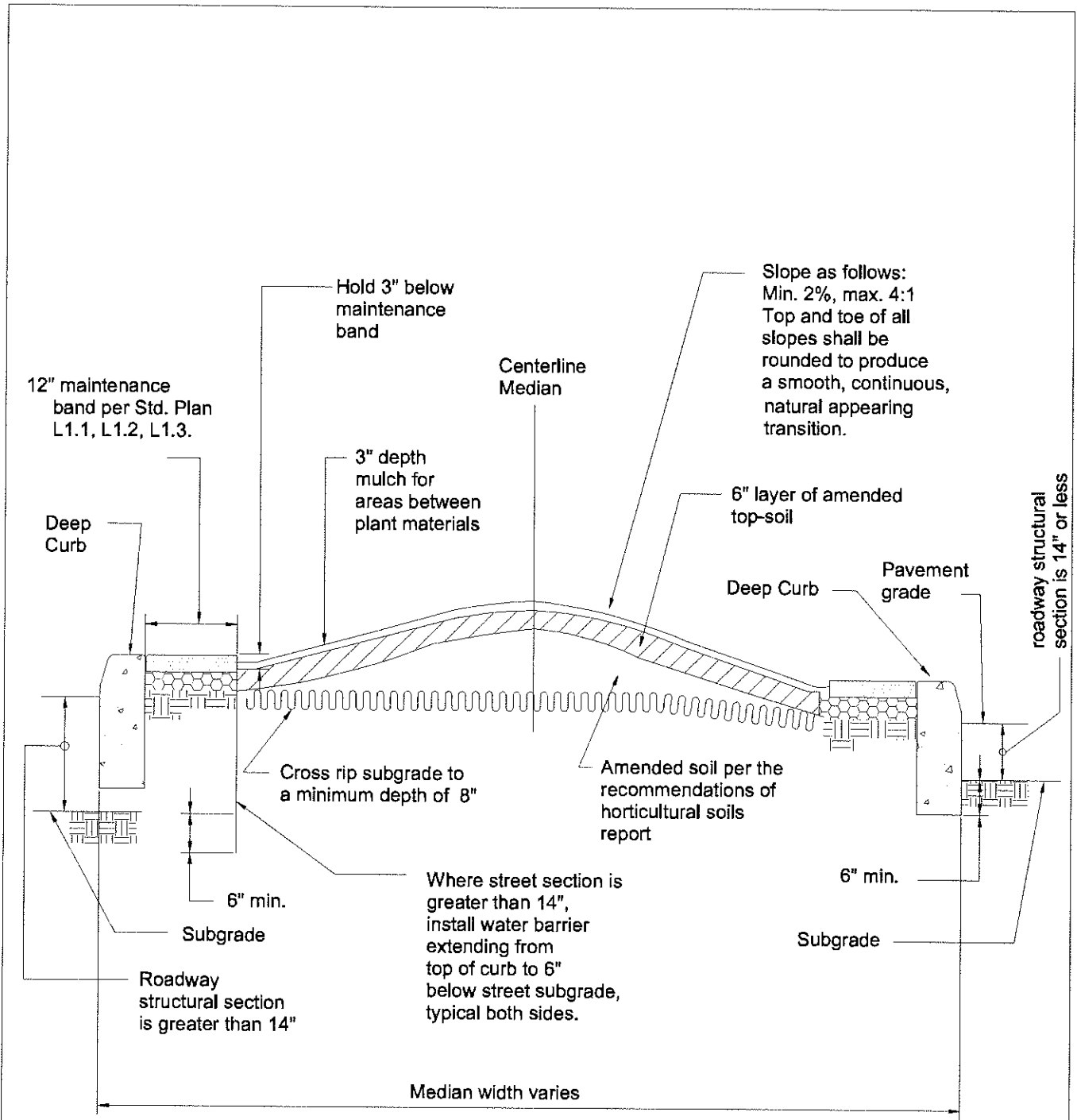


PLAN



A SECTION

CITY OF HERCULES		
MEDIAN PLANTING NARROW MEDIANS		
JULY 2002	Page 2 of 3	L 2.2



SECTION

CITY OF HERCULES		
MEDIAN PLANTING WIDE MEDIANS		
JULY 2002	Page 3 of 3	L 2.3

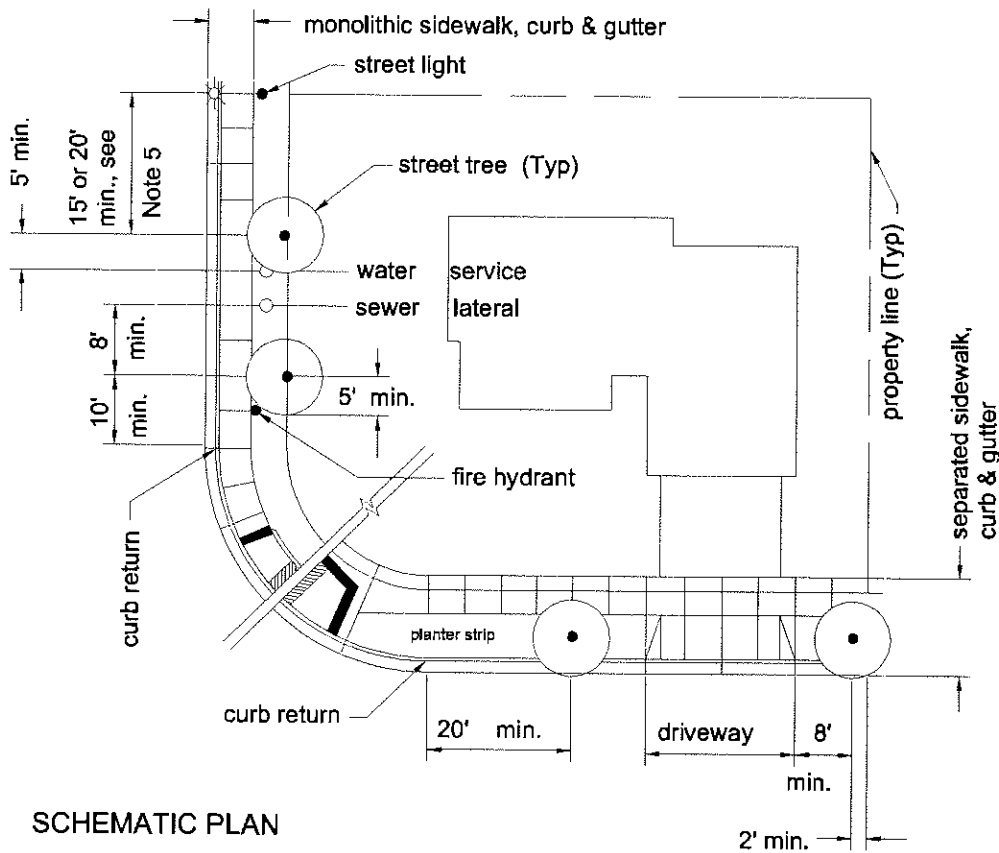
Minimum street tree quantities for new development:

1. Single frontage residential lot: 1 tree.
2. Dual frontage (corner) lot: 2 trees.
3. Industrial/commercial frontage: 1 tree per 50 feet of frontage.

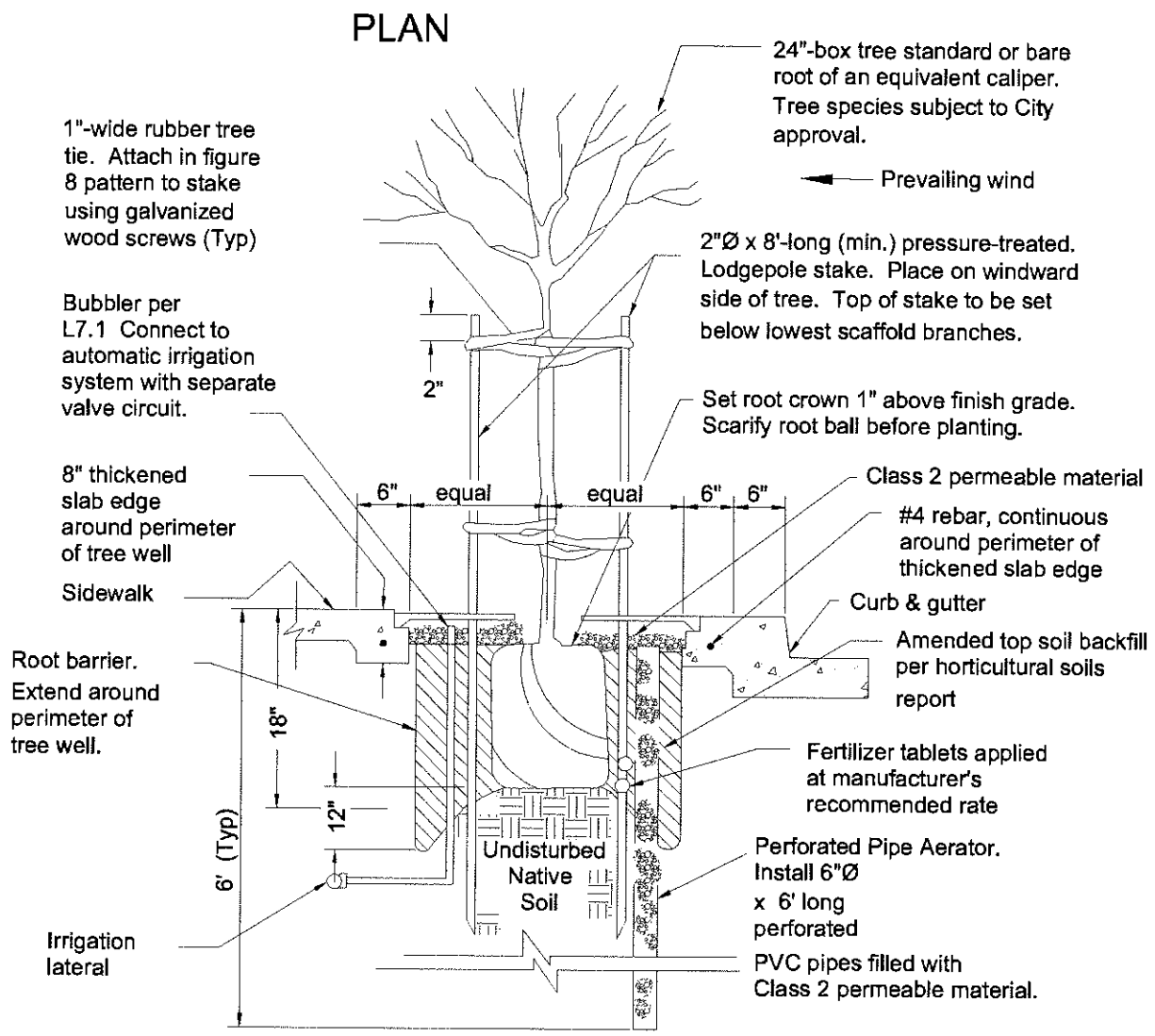
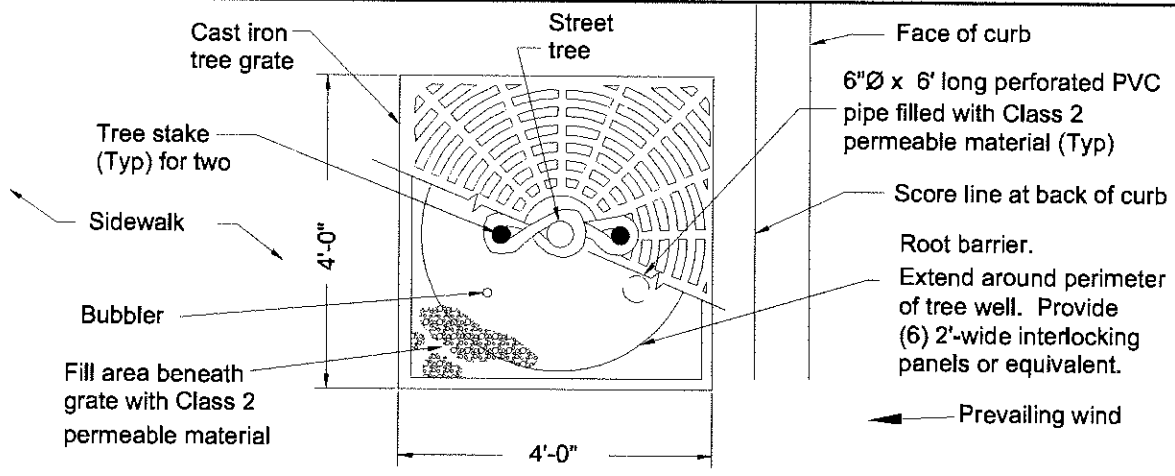
All tree varieties and quantities shall be approved by the City.

Minimum street tree clearances (see schematic plan below for illustration):

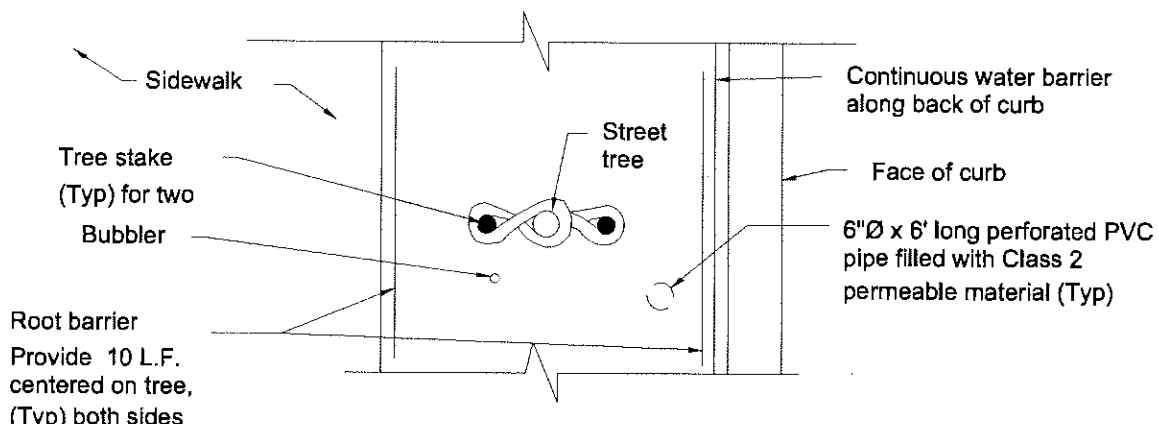
1. Street trees shall be located 8 feet (minimum) from sanitary sewer mains and laterals.
2. Street trees shall be located 5 feet (minimum) from water mains and services.
3. Street trees shall be located 5 feet (minimum) from fire hydrants.
4. Street trees shall be located 8 feet from driveways.
5. Street trees shall be located 20 feet (minimum) from standard street lights.
Street trees shall be located 15 feet (minimum) from decorative street lights.
6. Street trees shall be located 20 feet (minimum) from curb returns with separated sidewalk, or 10 feet (minimum) from curb returns with monolithic sidewalk.
7. Street trees shall be located 2 feet (minimum) from the common property line separating lots.



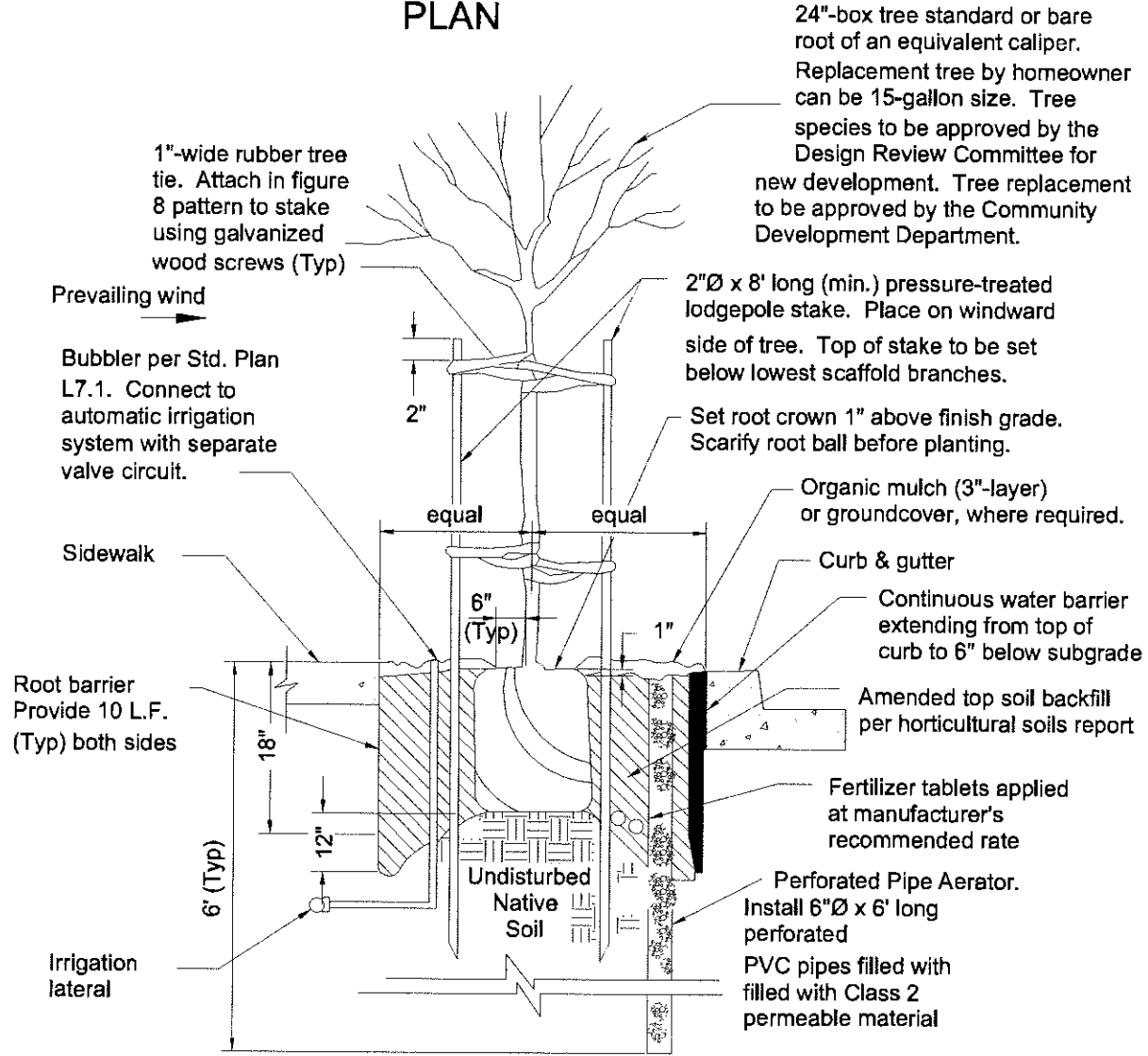
SCHEMATIC PLAN
(for illustration only)



CITY OF HERCULES		
STREET TREE PLANTING TREE WELLS WITH GRATES		
JULY 2002	Page 2 of 7	L 3.2



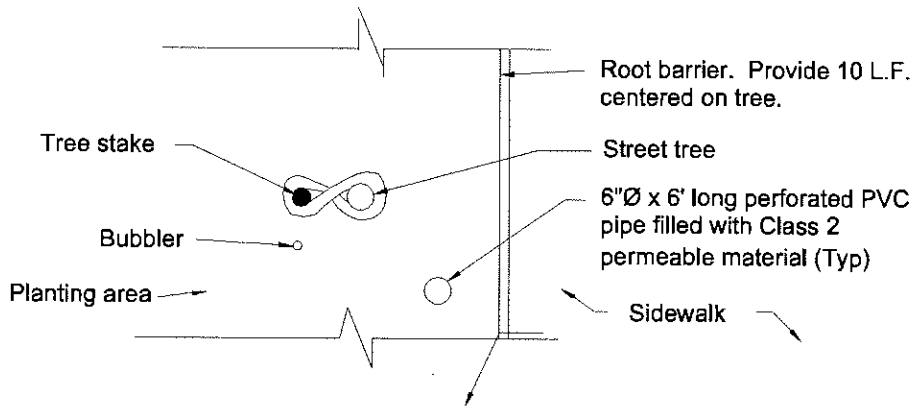
PLAN



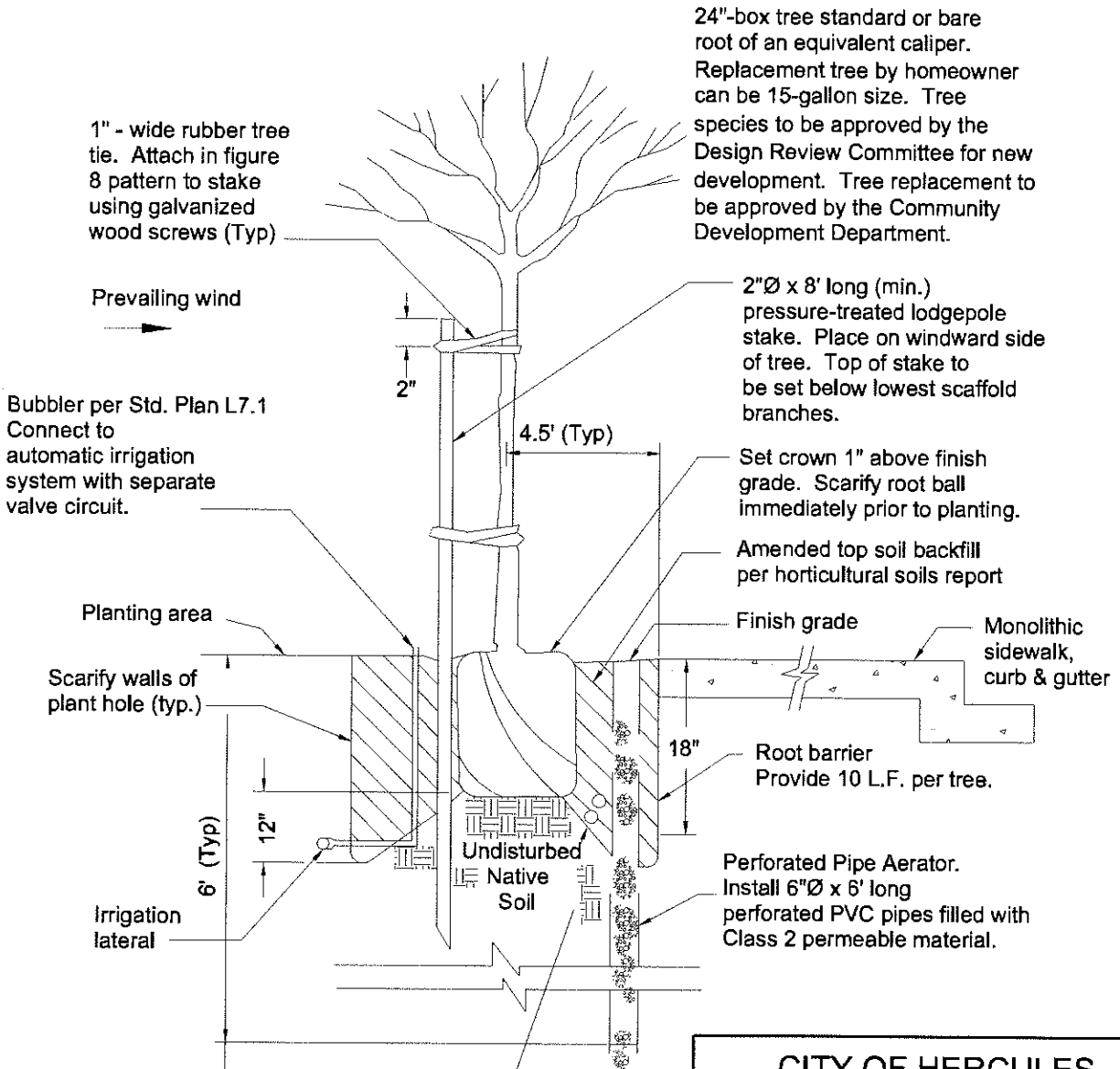
SECTION

24"-box tree standard or bare root of an equivalent caliper. Replacement tree by homeowner can be 15-gallon size. Tree species to be approved by the Design Review Committee for new development. Tree replacement to be approved by the Community Development Department.

CITY OF HERCULES		
STREET TREE PLANTING FOR SEPARATED SIDEWALK		
JULY 2002	Page 3 of 7	L 3.3



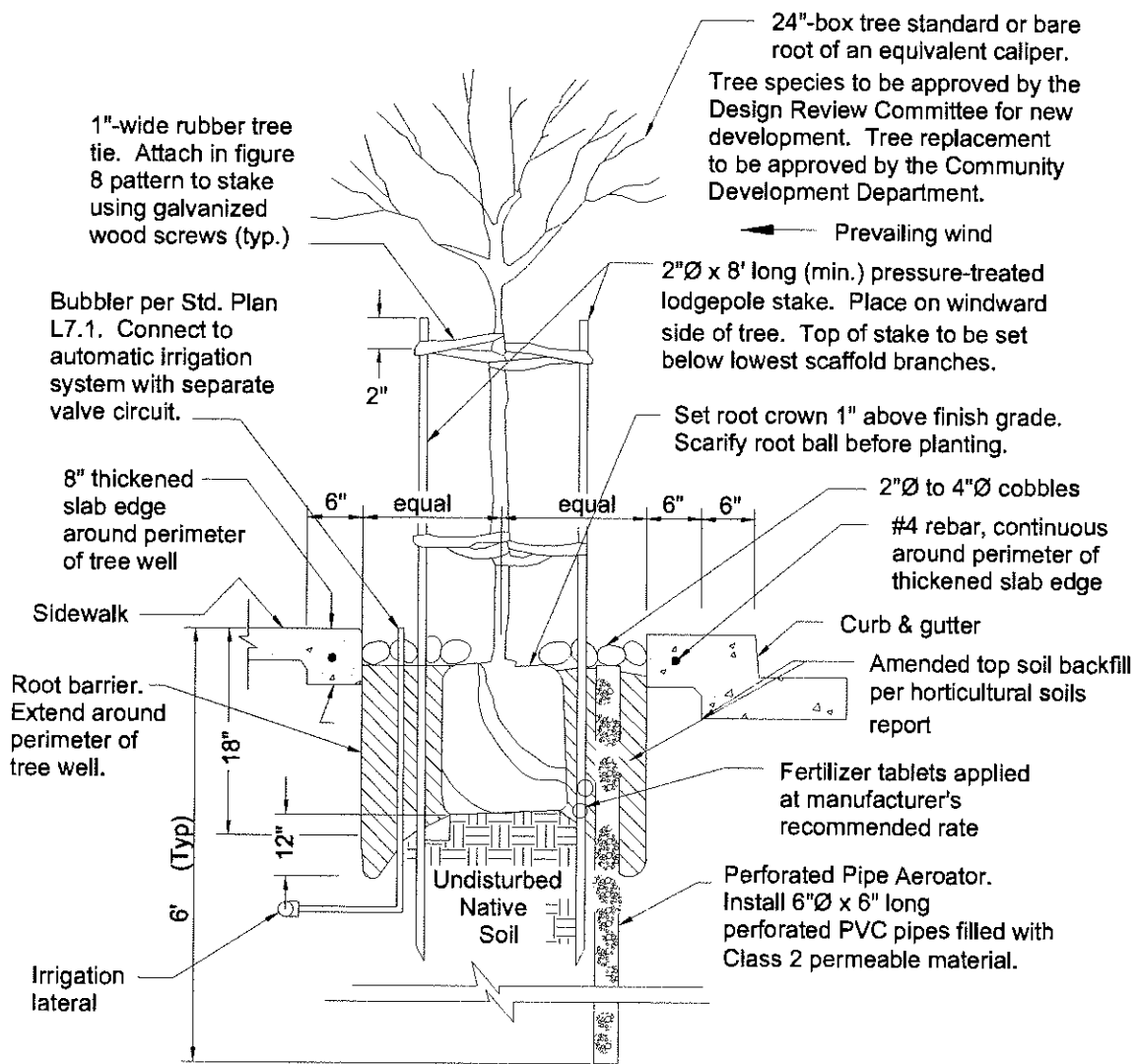
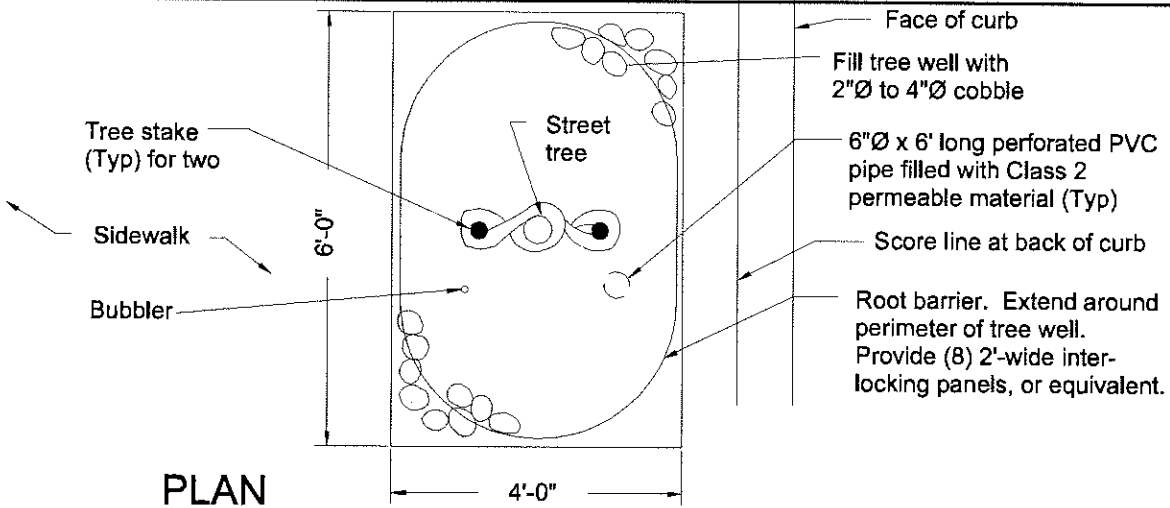
PLAN



SECTION

24"-box tree standard or bare root of an equivalent caliper. Replacement tree by homeowner can be 15-gallon size. Tree species to be approved by the Design Review Committee for new development. Tree replacement to be approved by the Community Development Department.

CITY OF HERCULES		
STREET TREE PLANTING MONOLITHIC SIDEWALK		
JULY 2002	Page 4 of 7	L 3.4



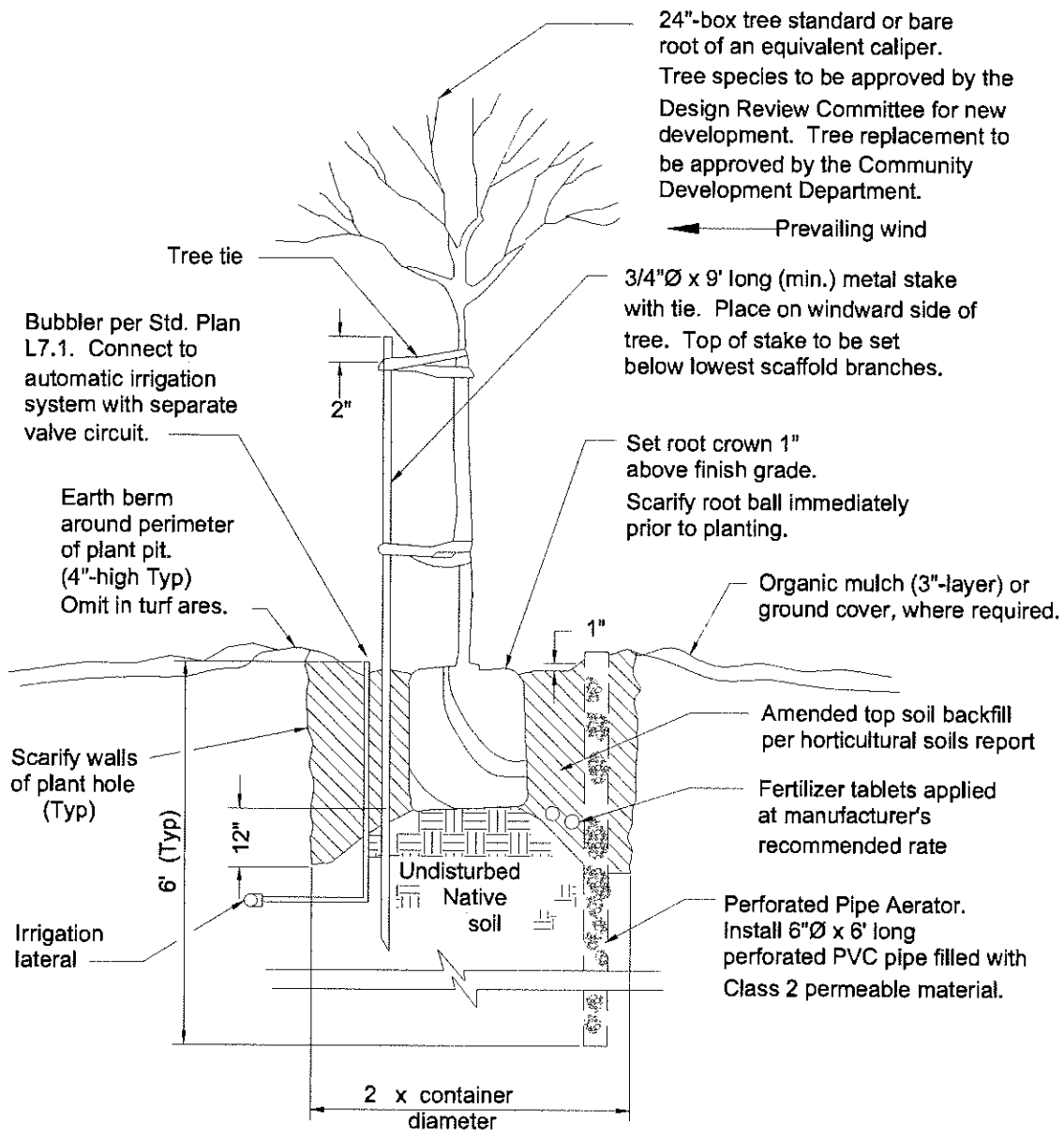
CITY OF HERCULES

**STREET TREE PLANTING
FOR TREE WELLS**

JULY 2002

Page 5 of 7

L 3.5

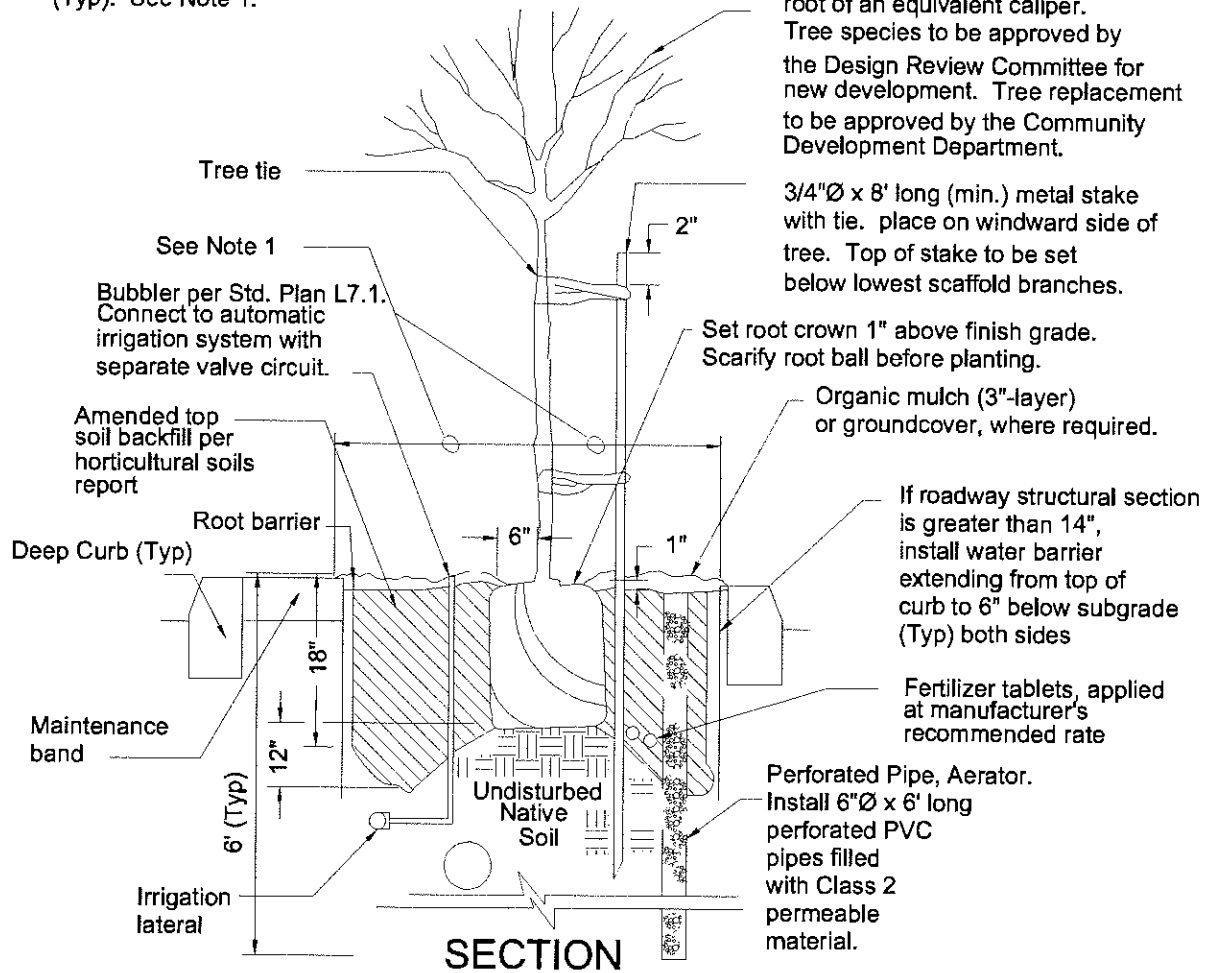
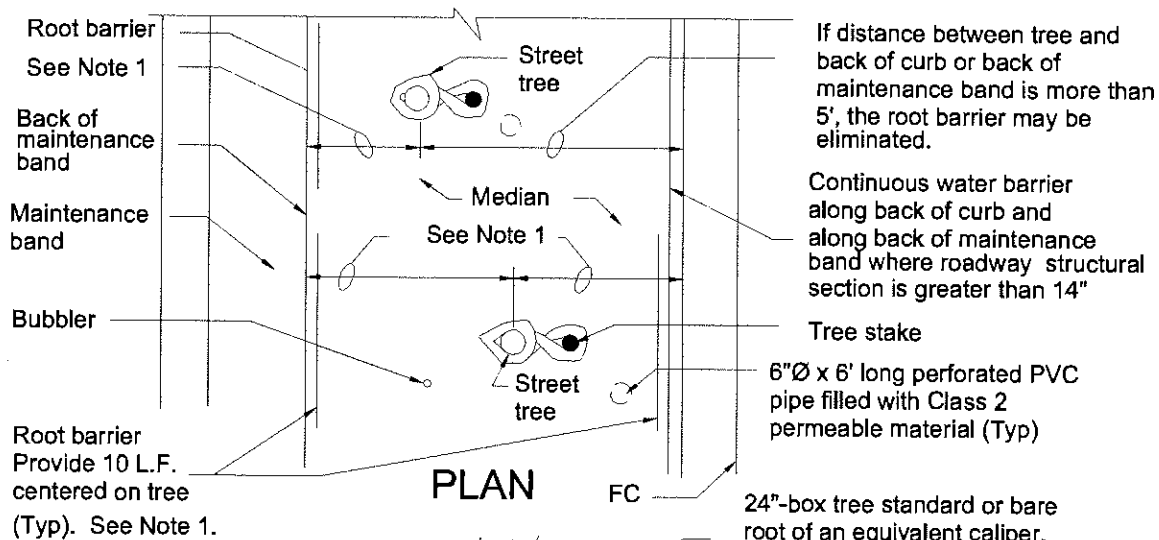


SECTION

NOTES:

1. When tree is located within 6 feet of sidewalk, curb, or other hard surfacing, plant tree per Std. Plan L3.4.
2. The mulch, if required, shall not be placed in contact with the parent trunk of the tree.

CITY OF HERCULES		
STREET TREE PLANTING FOR OPEN AREAS		
JULY 2002	Page 6 of 7	L 3.6



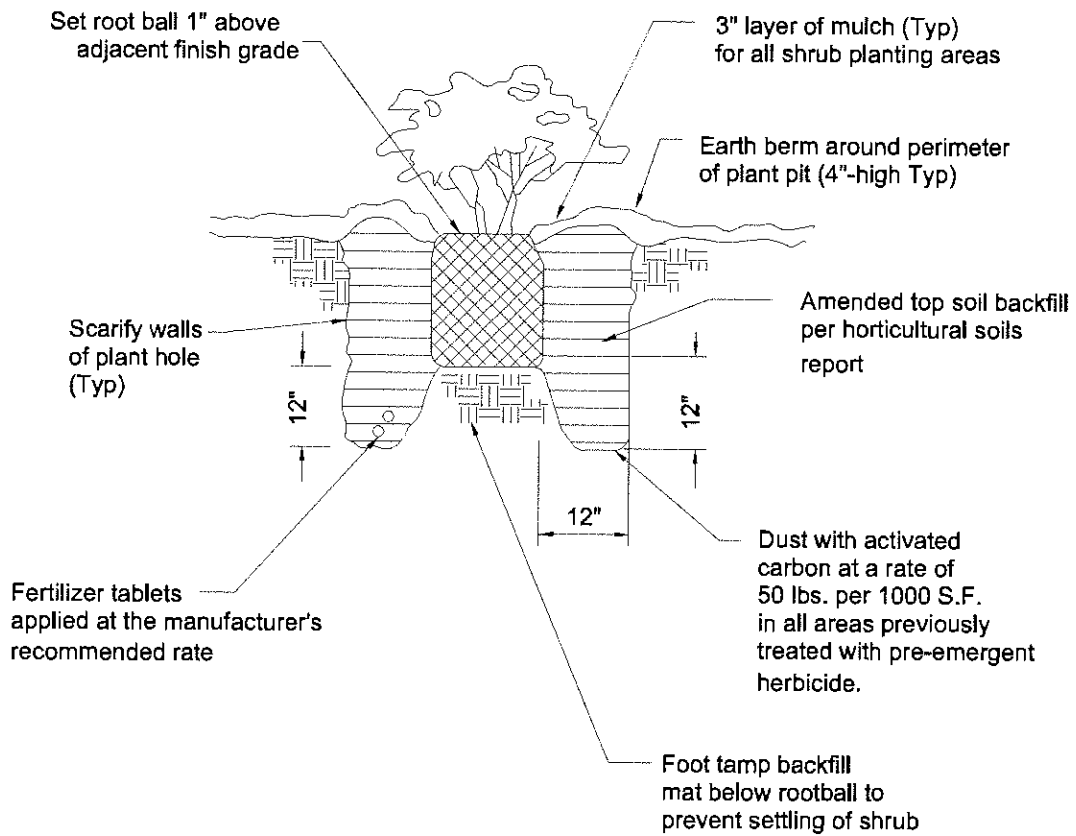
NOTES:

1. Provide 10 L.F. root barrier if distance is 5 feet or less.
2. The mulch, if required, shall not be placed within 6 inches of the trunk of the tree.

CITY OF HERCULES		
STREET TREE PLANTING FOR MEDIANS		
JULY 2002	Page 7 of 7	L 3.7

NOTES:

1. Shrub varieties, quantities, sizes, and spacing are subject to Design Review Committee approval.
2. The mulch, if required, shall not be placed within 6 inches of parent trunk of the shrub.
3. The shrub hole shall be 12 inches (minimum) deeper than the root ball. The shrub hole radius shall be 12 inches (minimum) greater than the radius of the root ball.

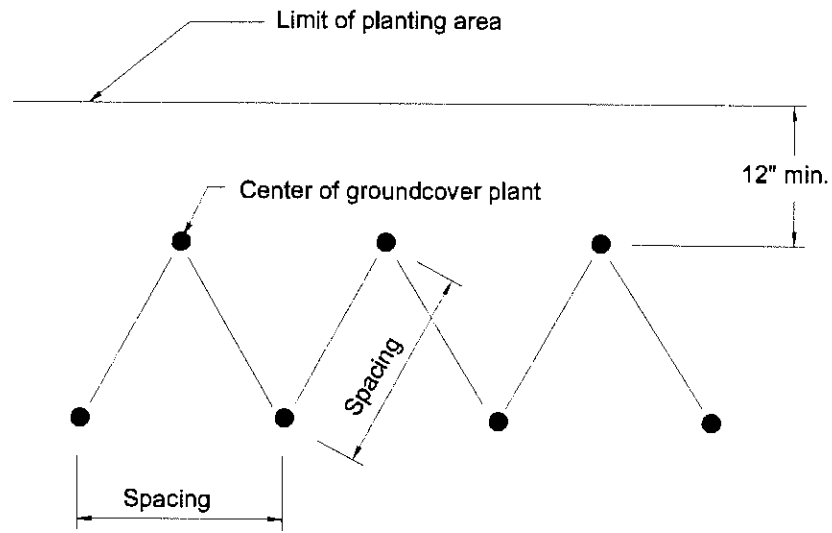


SECTION

CITY OF HERCULES		
SHRUB PLANTING		
JULY 2002	Page 1 of 1	L 4.1

NOTES:

1. Groundcover varieties, quantities, sizes and spacing are subject to Design Review Committee approval.
2. Dust the plant pits with activated carbon at a rate of 50 pounds per 1000 S.F. in all areas previously treated with pre-emergent herbicide.



PLAN

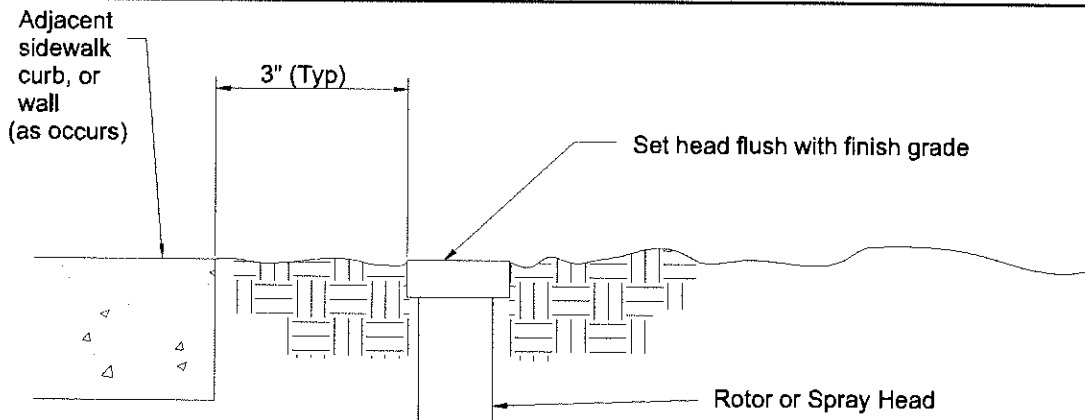
CITY OF HERCULES

GROUNDCOVER SPACING

JULY 2002

Page 1 of 1

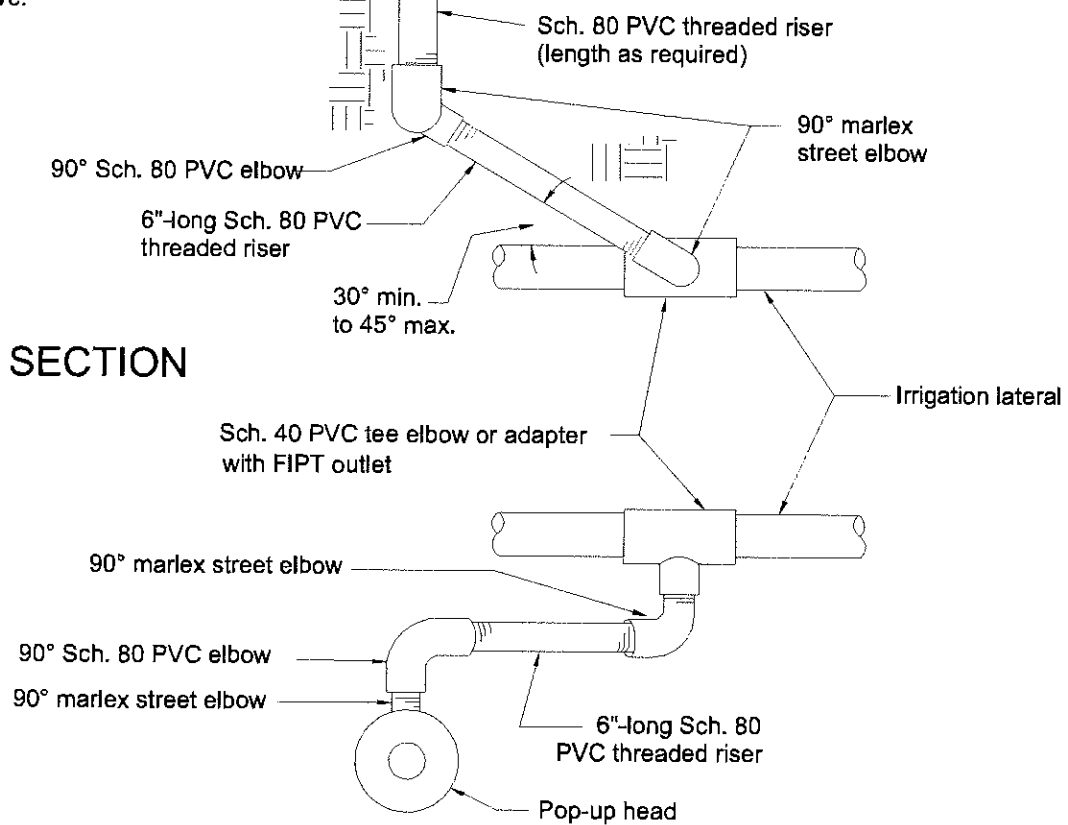
L 5.1



NOTE:

Provide in-line check valves at base of head as required to prevent unwanted discharge from low elevation heads. Omit if spray head equipped with integral check valve.

SECTION

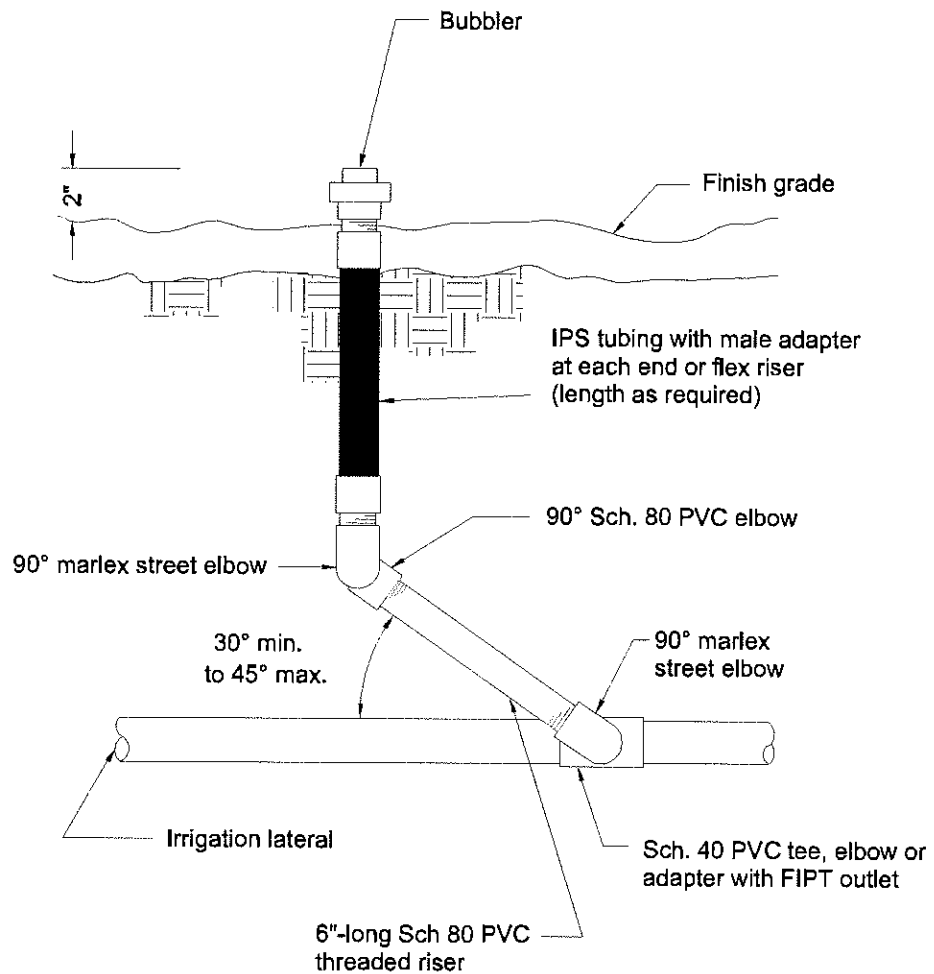


PLAN

LEGEND:

MIPT = Male Iron Pipe Thread
 FIPT = Female Iron pipe Thread

CITY OF HERCULES		
ROTOR OR SPRAY HEAD		
JULY 2002	Page 1 of 1	L 6.1

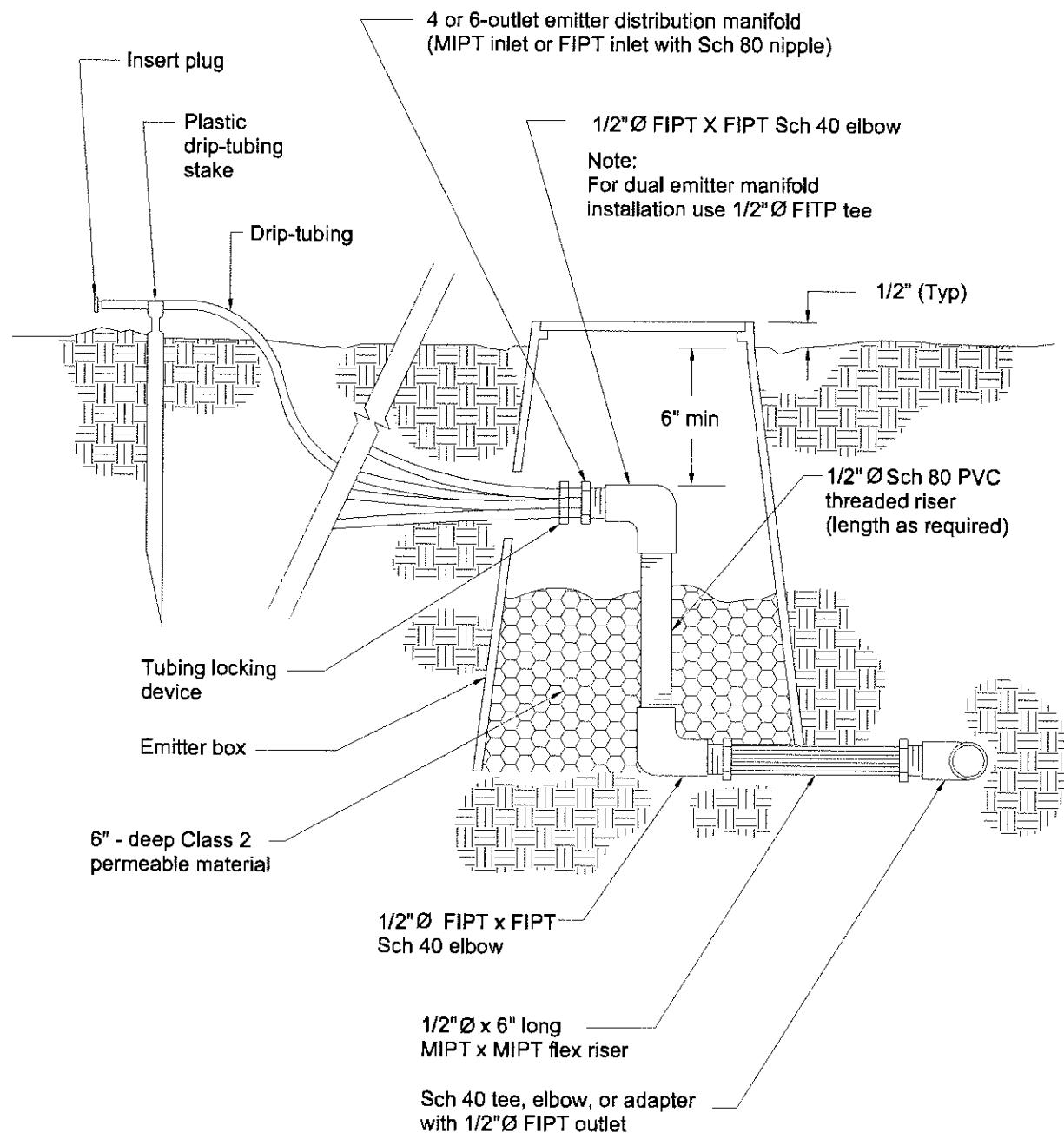


SECTION

LEGEND:

FIPT = Female Iron Pipe Thread

CITY OF HERCULES		
TREE BUBBLER		
JULY 2002	Page 1 of 1	L 7.1



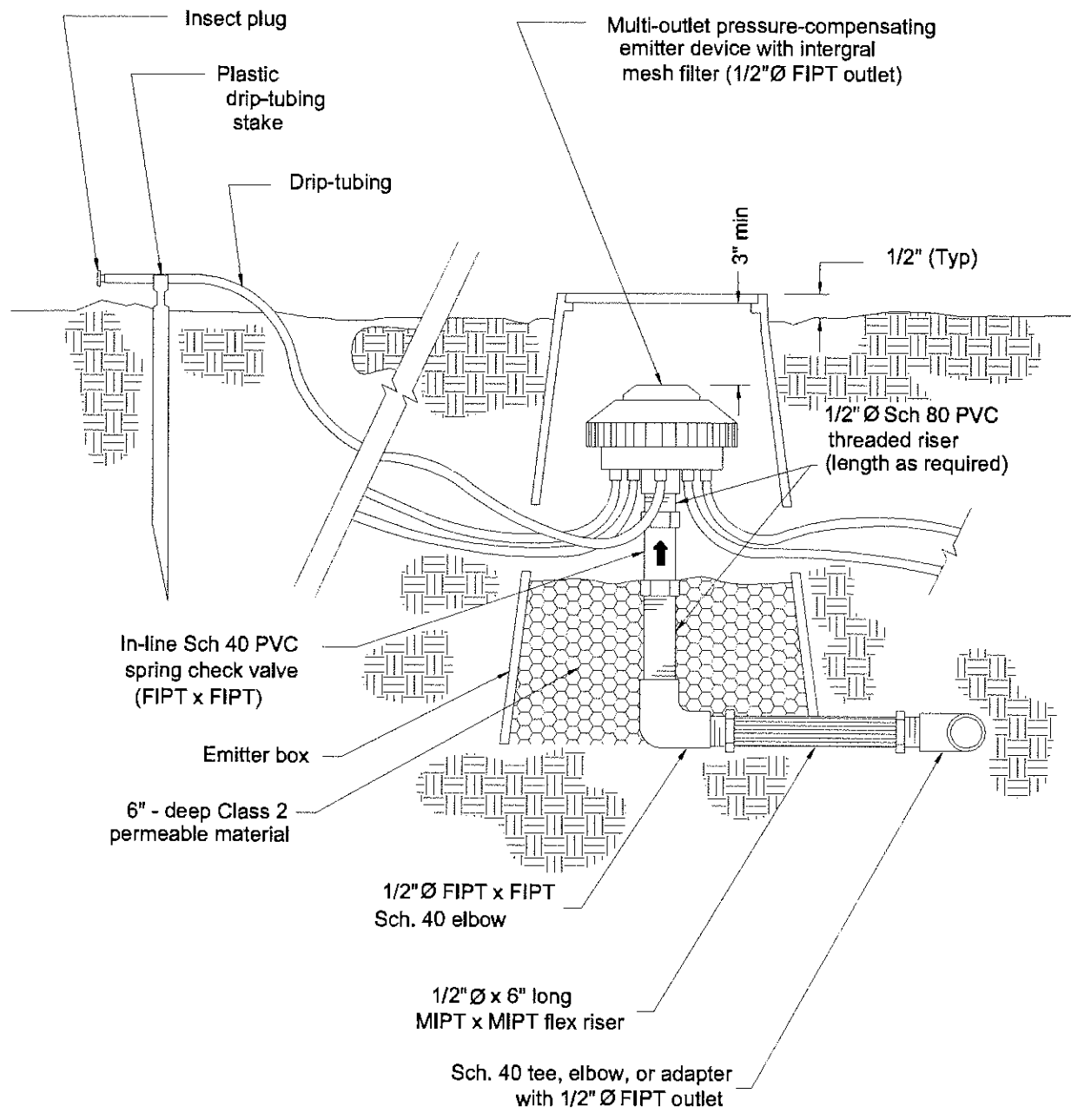
LEGEND:

MIPT = Male Iron Pipe Thread

FIPT = Female Iron Pipe Thread

SECTION

CITY OF HERCULES		
DRIP EMITTER FOUR OR SIX OUTLET		
JULY 2002	Page 1 of 2	L 8.1



SECTION

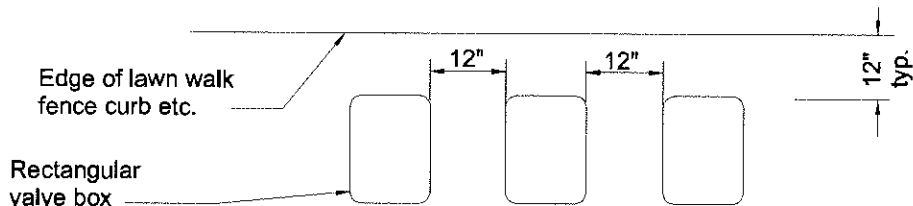
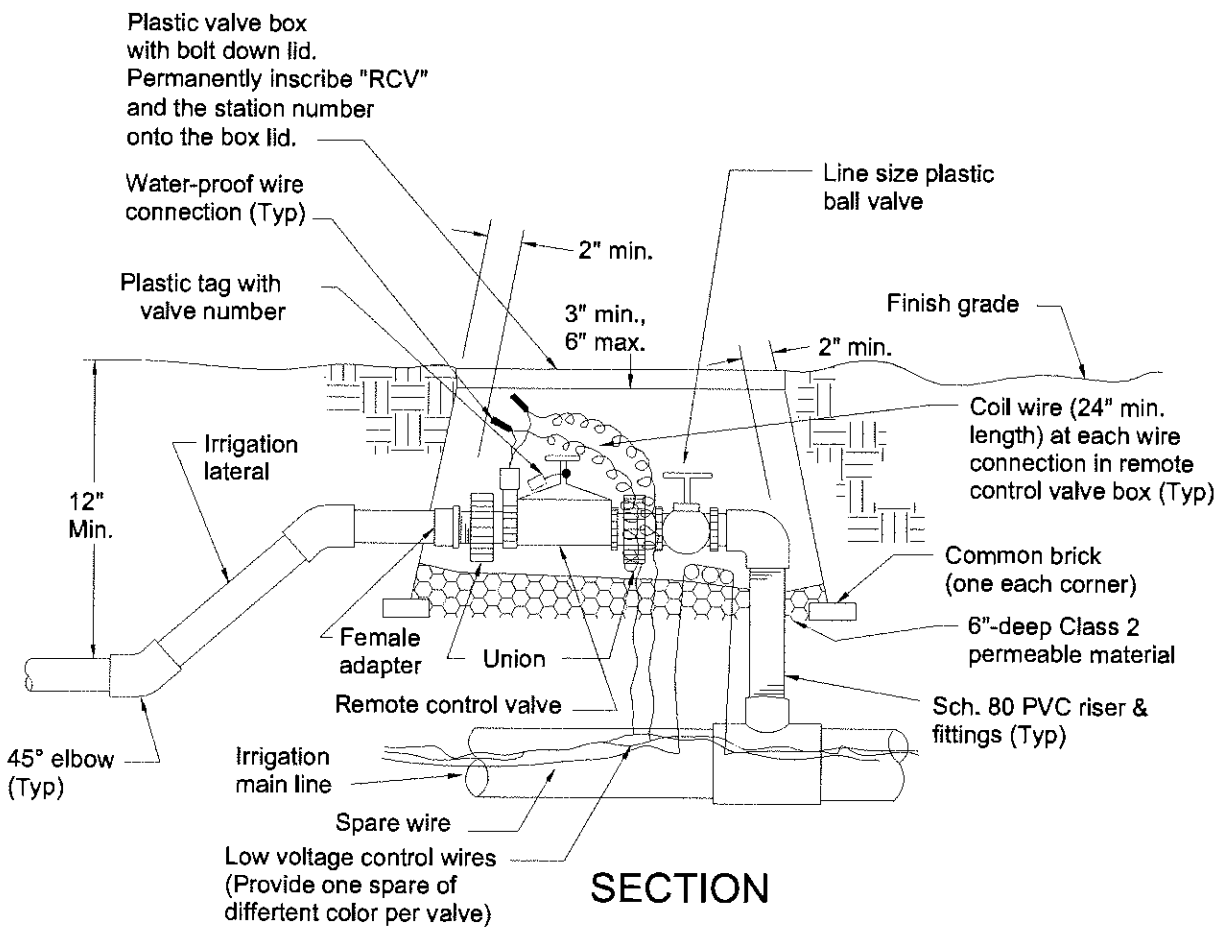
LEGEND:

MIPT = Male Iron Pipe Thread
 FIPT = Female Iron Pipe Thread

CITY OF HERCULES		
DRIP EMITTER MULTI-OUTLET		
JULY 2002	Page 2 of 2	L 8.2

NOTES:

1. Center valve box over remote control valve.
2. Set boxes 1 inch above finish grade or mulch cover in planting areas and flush with finish grade in turf.
3. Set boxes in ground cover/shrub areas where possible. Use concrete boxes in hardsurfaced areas.
4. Set boxes parallel to each other and perpendicular to edge of sidewalk, curb, wall or hardsurfacing.
5. Avoid heavy compacting of soil around boxes to prevent collapse of box sides.
6. All fittings shown shall be the same as the valve size specified.



CITY OF HERCULES
REMOTE CONTROL VALVE
STANDARD

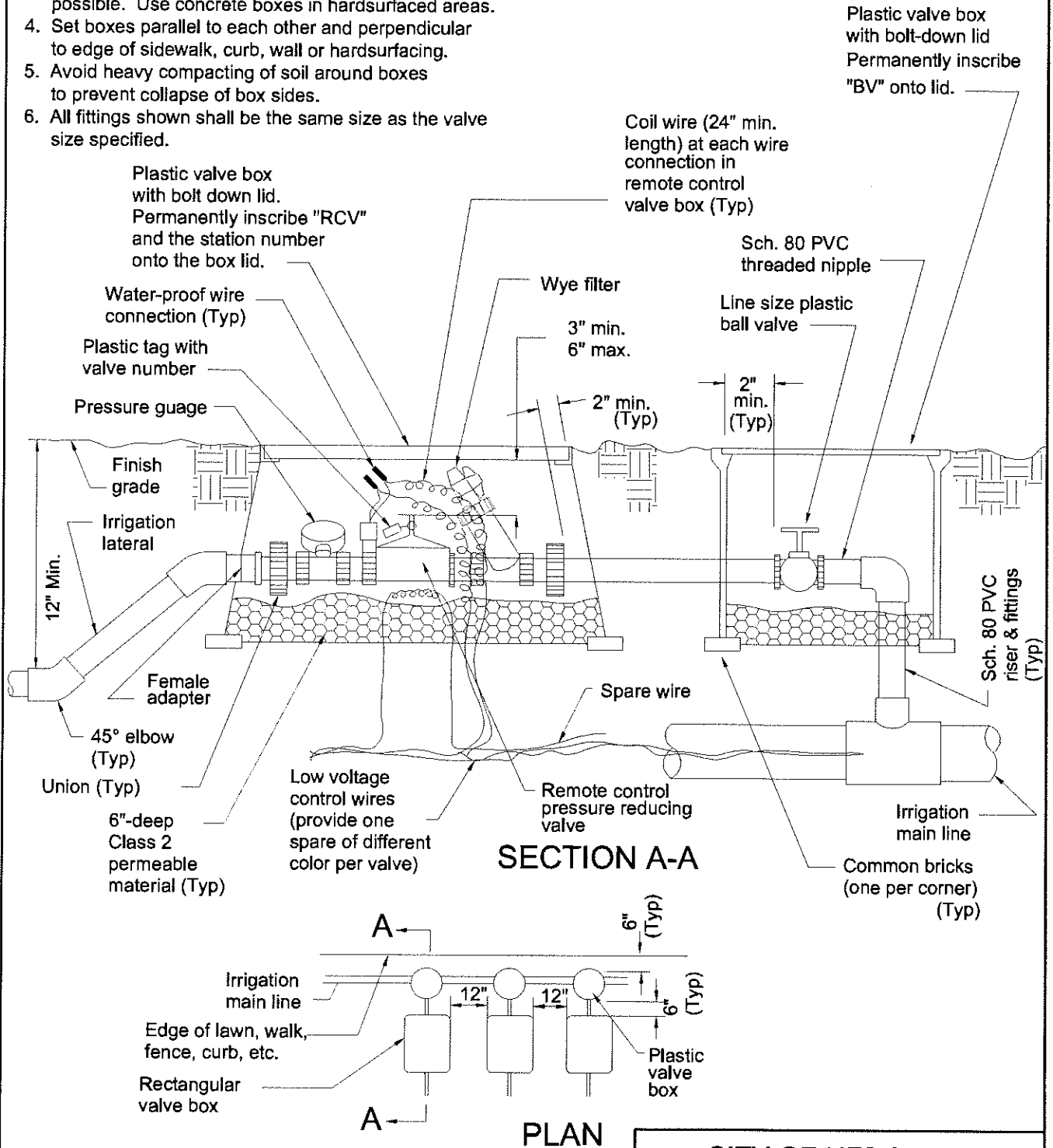
JULY 2002

Page 1 of 3

L 9.1

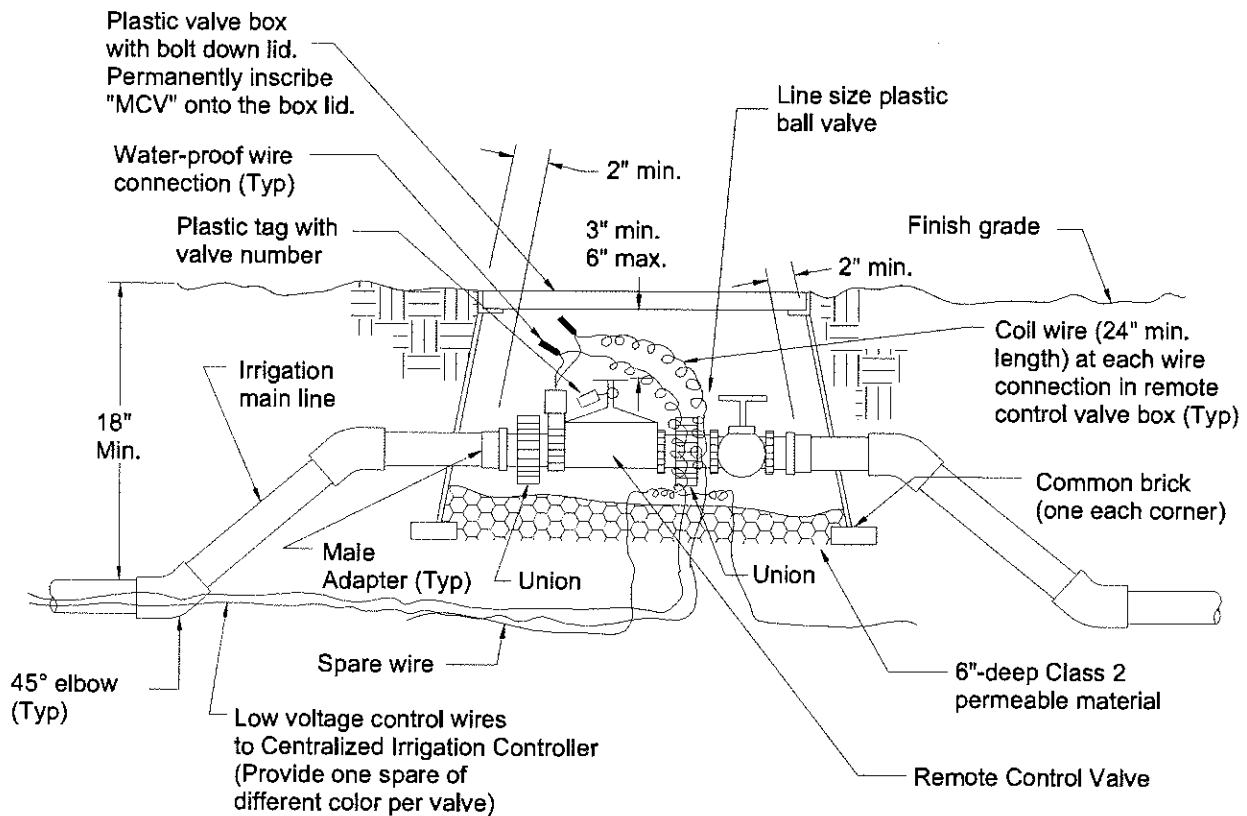
NOTES:

1. Center valve box over remote control valve.
2. Set boxes 1 inch above finish grade or mulch cover in planting areas and flush with finish grade in turf.
3. Set boxes in groundcover/shrub areas where possible. Use concrete boxes in hardsurfaced areas.
4. Set boxes parallel to each other and perpendicular to edge of sidewalk, curb, wall or hardsurfacing.
5. Avoid heavy compacting of soil around boxes to prevent collapse of box sides.
6. All fittings shown shall be the same size as the valve size specified.

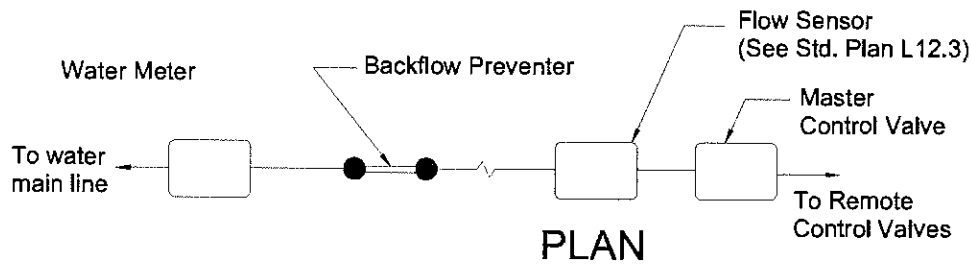


NOTES:

1. Center valve box over remote control valve.
2. Set boxes 1 inch above finish grade or mulch cover in planting areas and flush with finish grade in turf.
3. Set boxes in groundcover/shrub areas where possible. Use concrete boxes in hardsurfaced areas.
4. Set box perpendicular to edge of sidewalk, curb, wall or hardsurfacing.
5. Avoid heavy compacting of soil around box to prevent collapse of box sides.
6. All fittings shown shall be the same size as the valve size specified.

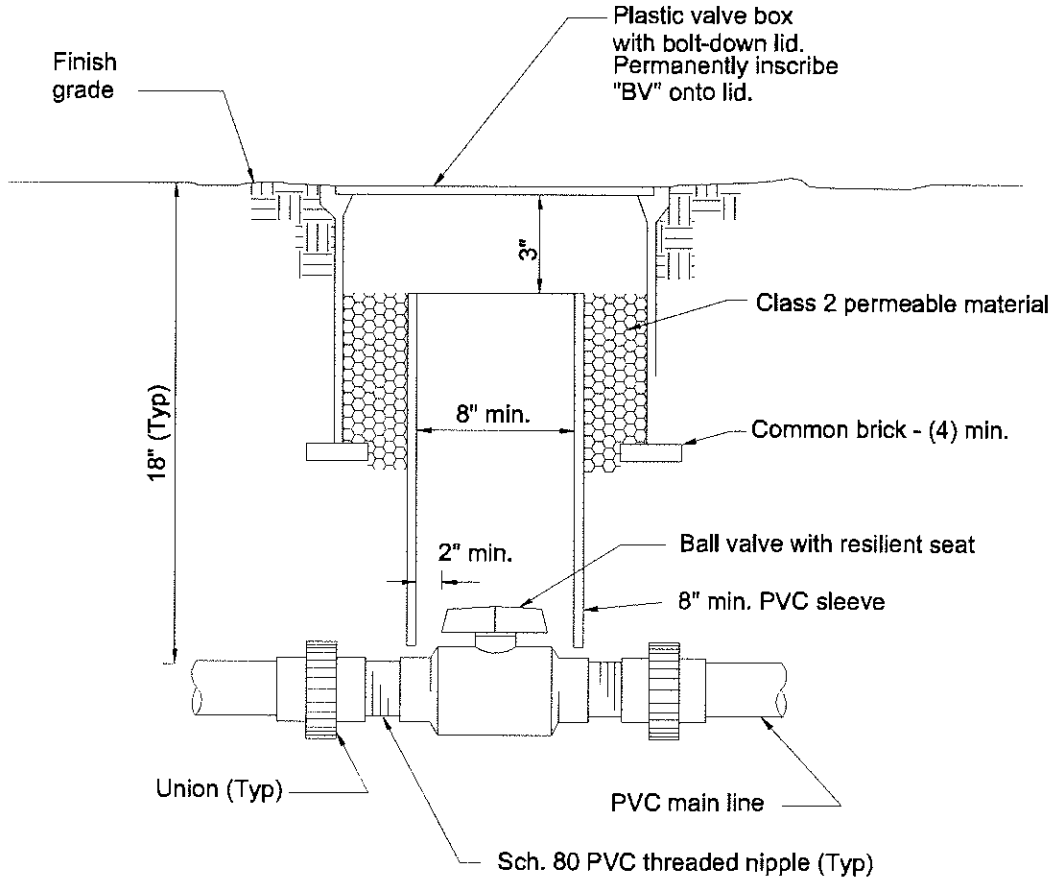


SECTION



PLAN

CITY OF HERCULES		
MASTER CONTROL VALVE CENTRAL IRRIGATION SYSTEMS		
JULY 2002	Page 3 of 3	L 9.3

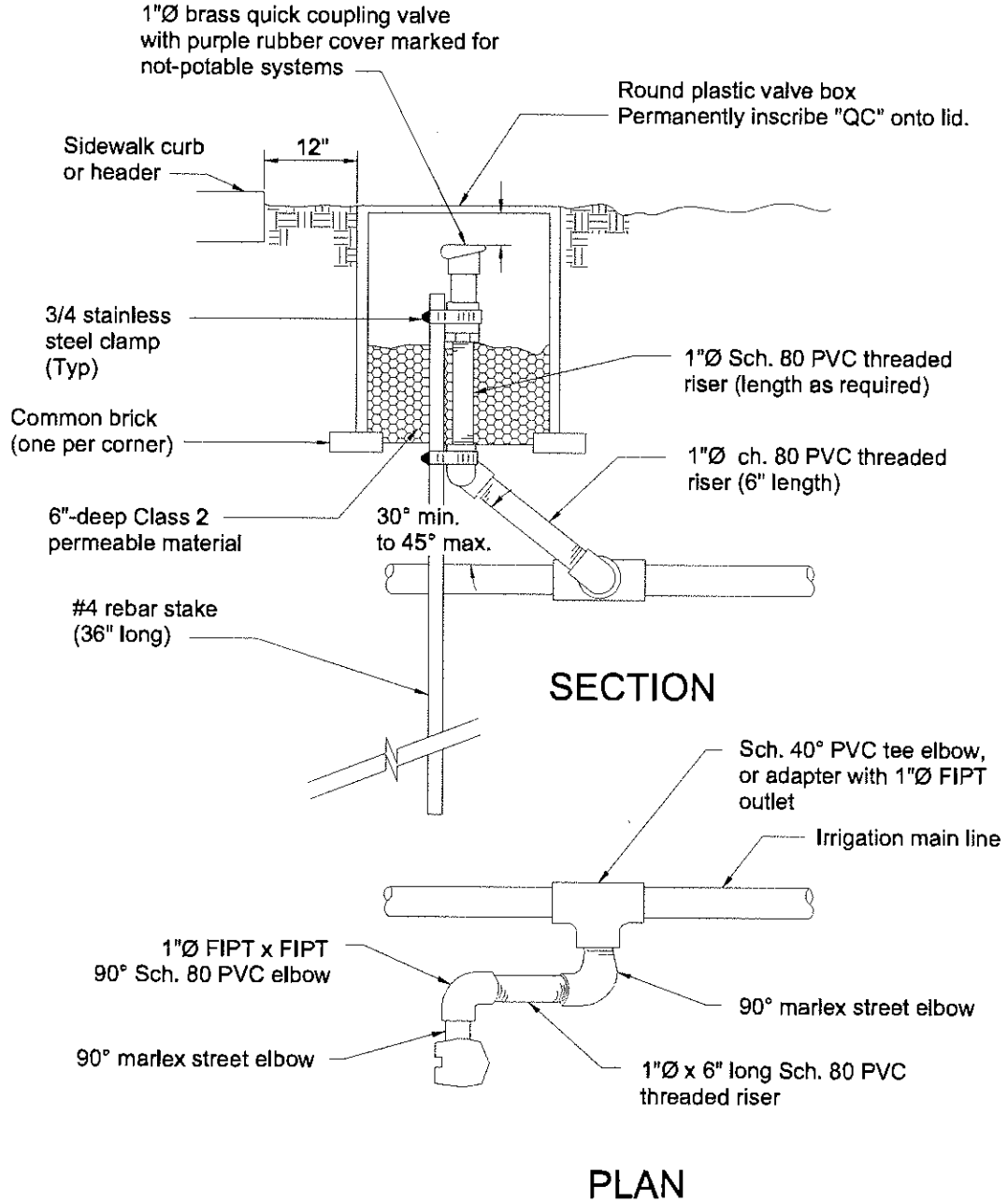


SECTION

CITY OF HERCULES		
BALL VALVE		
JULY 2002	Page 1 of 1	L 10.1

NOTE:

Set boxes 1 inch above finish grade or mulch cover in planting areas and flush with finish grade in turf areas.



LEGEND:

MIPT = Male Iron Pipe Thread

FIPT = Female Iron Pipe Thread

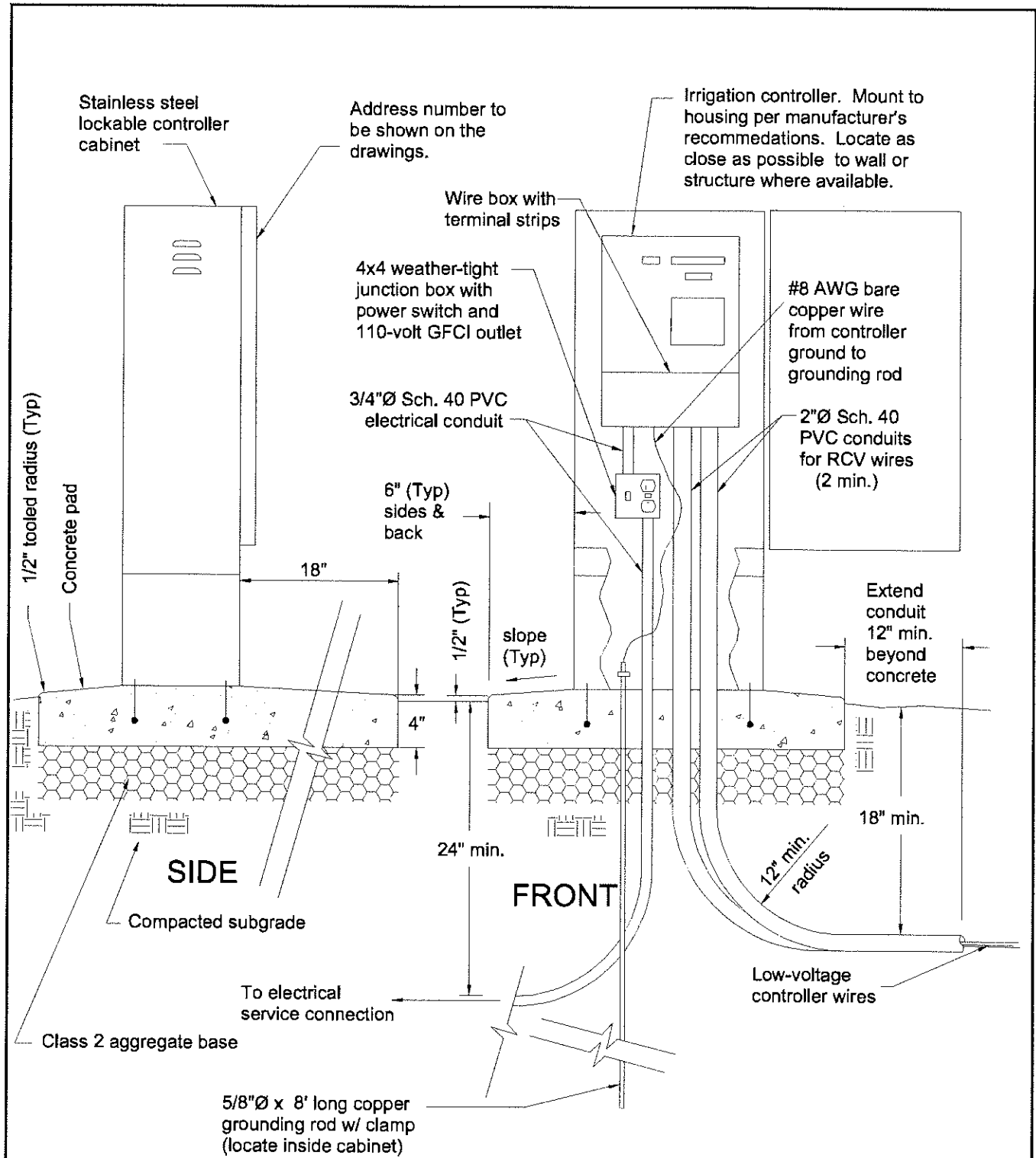
CITY OF HERCULES

QUICK COUPLING VALVE

JULY 2002

Page 1 of 1

L 11.1



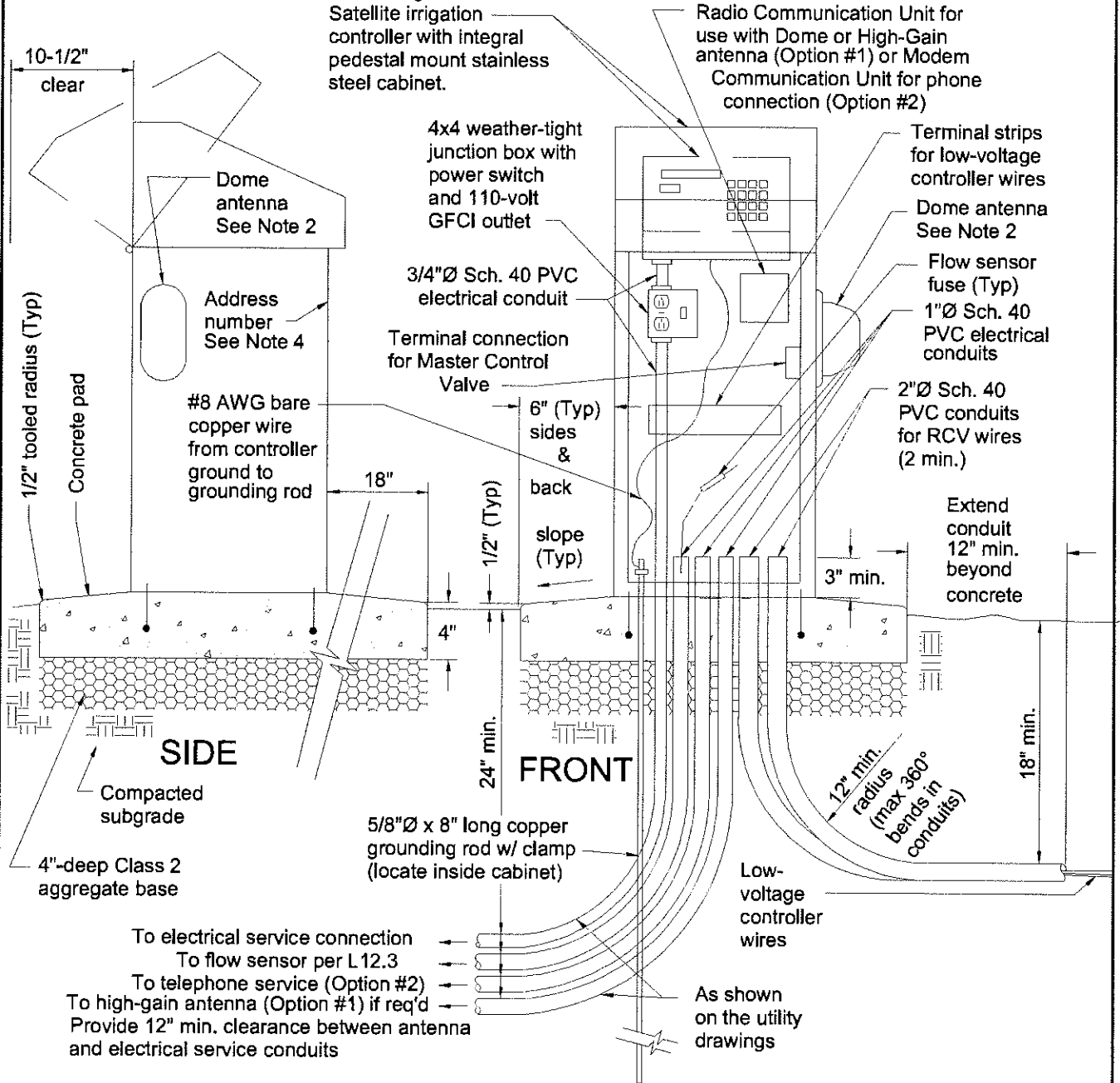
ELEVATIONS

NOTE:
All electrical service components shall be U.L. listed and installed per National Electric Code requirements.

CITY OF HERCULES		
CONTROLLER STANDARD		
JULY 2002	Page 1 of 4	L 12.1

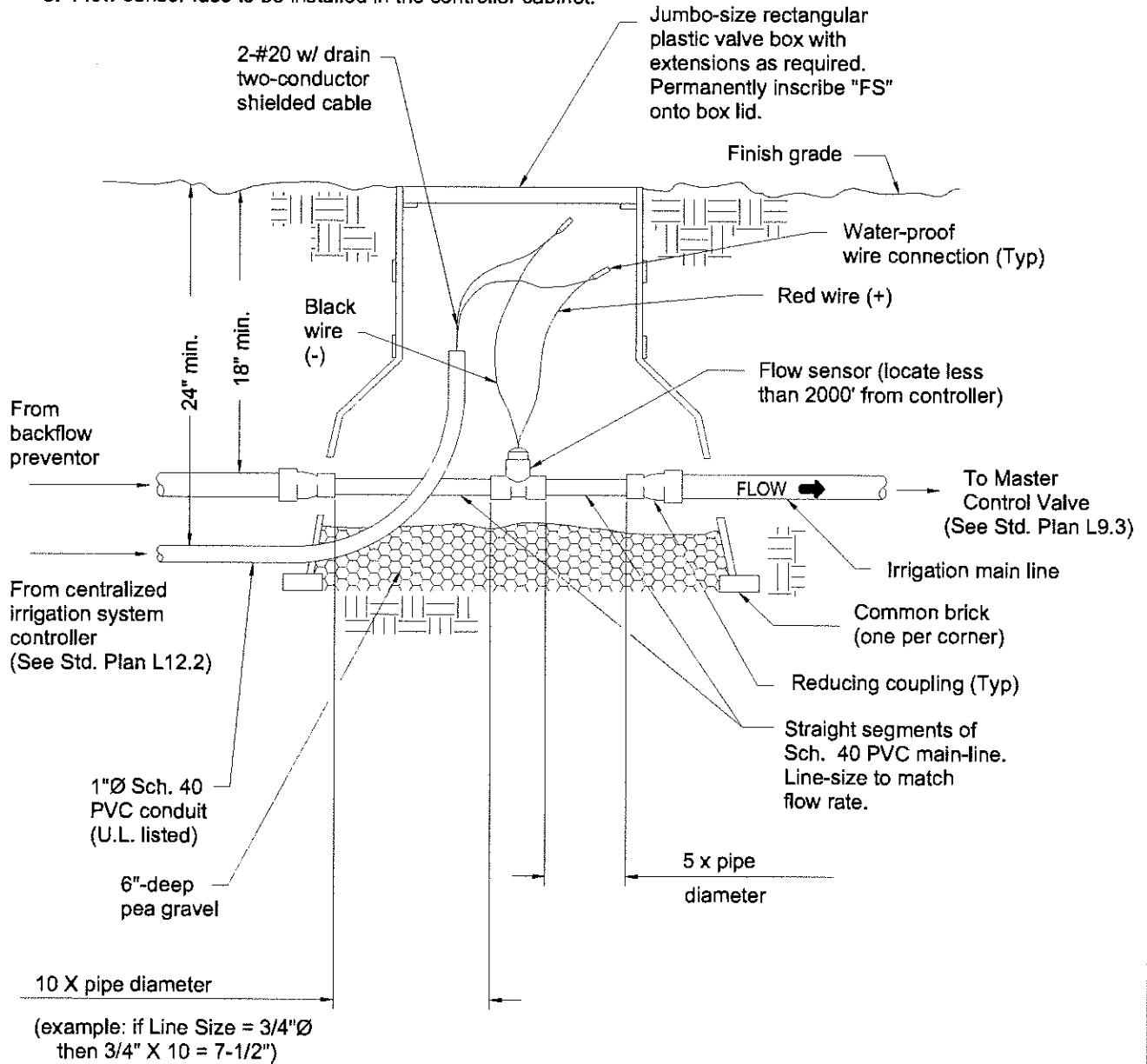
NOTES:

1. All electrical service components shall be U. L. listed and installed per National Electric Code requirements.
2. (Option #1) Provide dome antenna only if clear reception can be established between the controller and the City Maintenance Service Center. Otherwise, provide a high-gain antenna per Std. Plan L12.4.
3. (Option #2) provide a Modem Communication Unit connected to a two-pair telephone service (if clear reception cannot be established).
4. Address numbers as shown on the drawings.



NOTES:

1. The flow sensor cable shall be continuous between the controller and the flow sensor box (no intermediate splices).
2. Set box 1 inch above finish grade or mulch cover in planting areas or flush with finish grade in turf areas.
3. Set box in ground cover or shrub areas where possible. Use equivalent-sized concrete box in sidewalk area.
4. Avoid heavy compacting of soil around box to prevent collapse of box sides.
5. Flow sensor fuse to be installed in the controller cabinet.



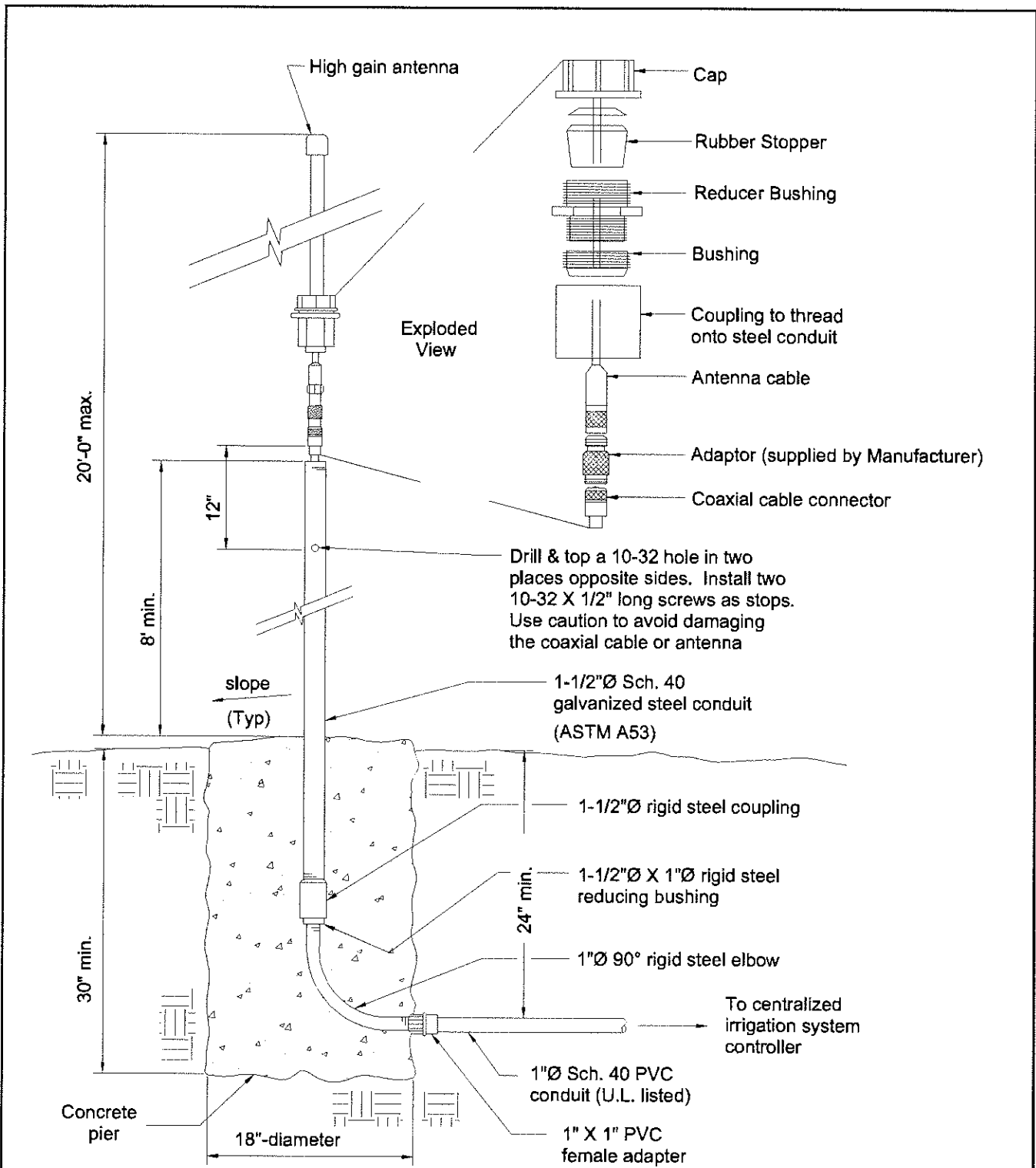
CITY OF HERCULES

FLOW SENSOR
CENTRAL IRRIGATION SYSTEMS

JULY 2002

Page 3 of 4

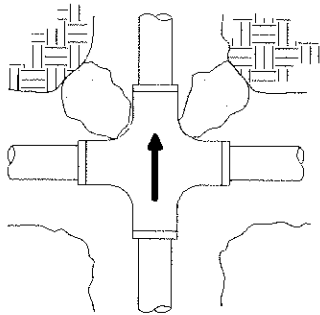
L 12.3



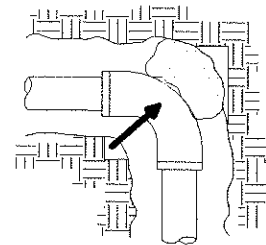
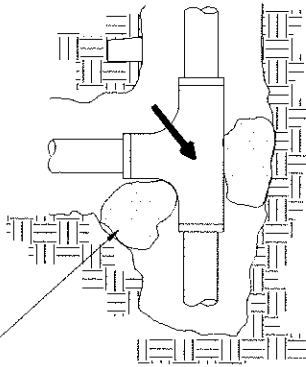
NOTE: Coordinate final location and height with the City Engineer prior to installation.

SECTION

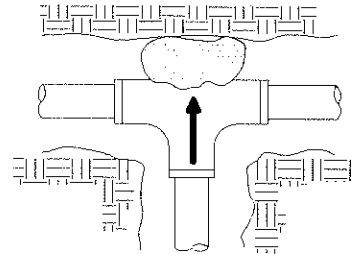
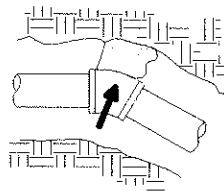
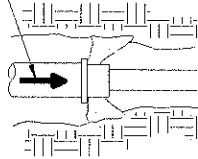
CITY OF HERCULES		
HIGH-GAIN ANTENNA		
CENTRAL IRRIGATION SYSTEMS		
JULY 2002	Page 4 of 4	L 12.4



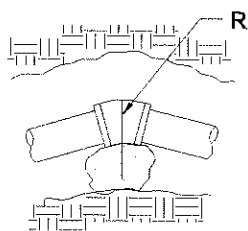
Concrete thrust block typical



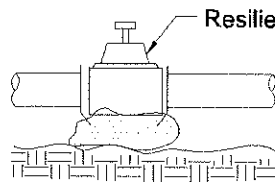
Arrow indicates direction of flow or force



PLAN



Rebar tie, typical



Resilient seat ball valve

SECTION

NOTE:

Install main line as per manufacturer's installation guide.
Size of concrete thrust blocks shall be as per pipe manufacturer's installation guide.

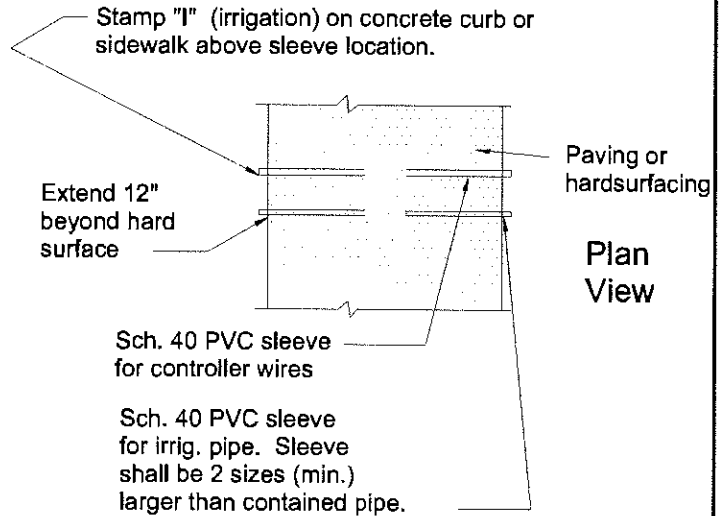
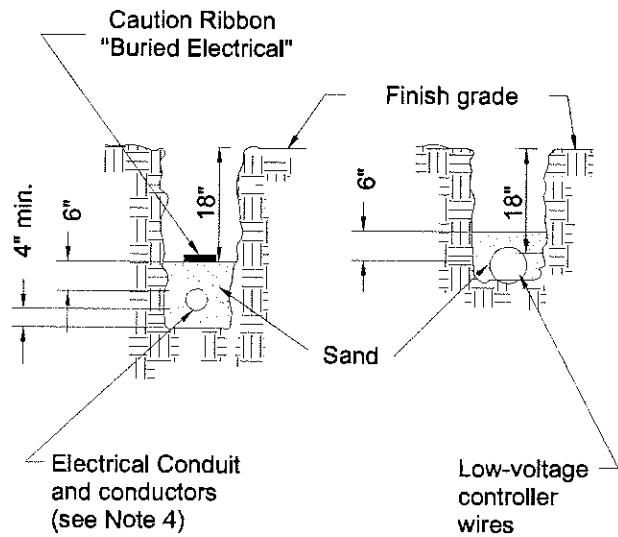
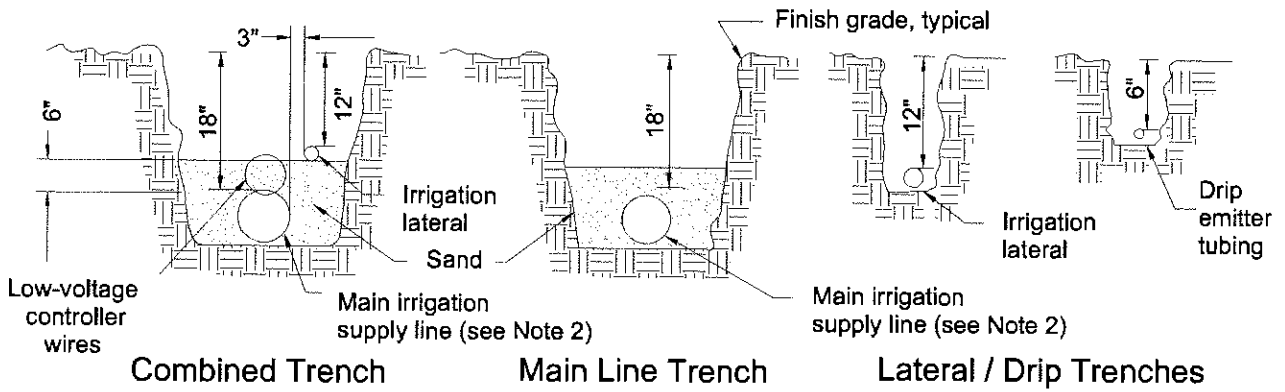
CITY OF HERCULES

IRRIGATION MAIN
THRUST BLOCK

JULY 2002

Page 1 of 1

L 13.1



**120-Volt
or Flow Sensor
Conduit Trench**

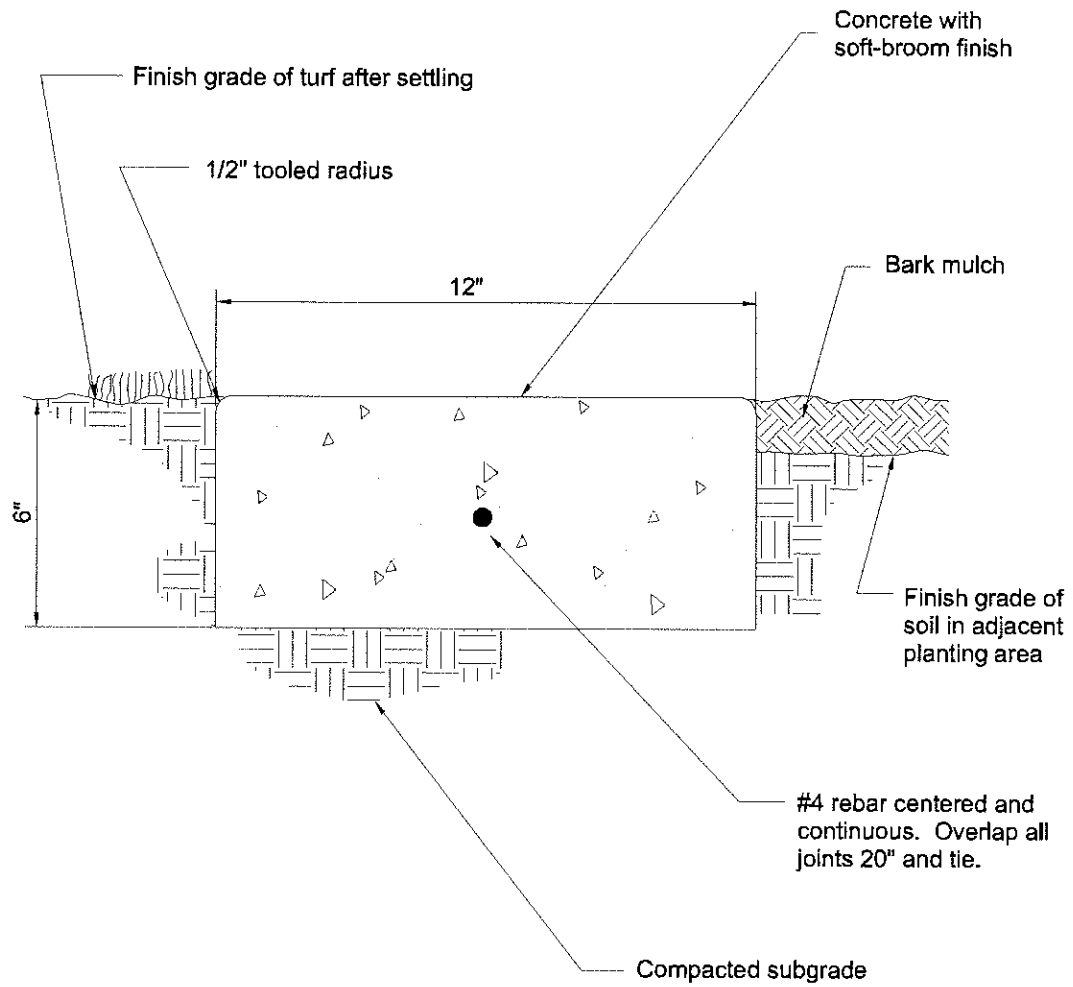
**Controller
Wire Trench**

**Typical Irrigation
Crossing at Paving
or Hardsurfacing**

NOTES:

1. All irrigation piping shall be installed in the trench in a serpentine manner as per the manufacturer's recommendations.
2. All main supply lines shall be installed as per the manufacturer's recommendations.
3. All electric service components shall be U.L. listed and installed as per the requirements of the National Electric Code (N.E.C.).
4. All main and lateral lines and control wiring shall be placed in sleeves under paved or hardsurfaced areas.
5. All sleeves to be installed at depths indicated on plan but no less than 6 inches below street or sidewalk subgrade.

CITY OF HERCULES		
IRRIGATION TRENCHING		
JULY 2002	Page 1 of 1	L 14.1

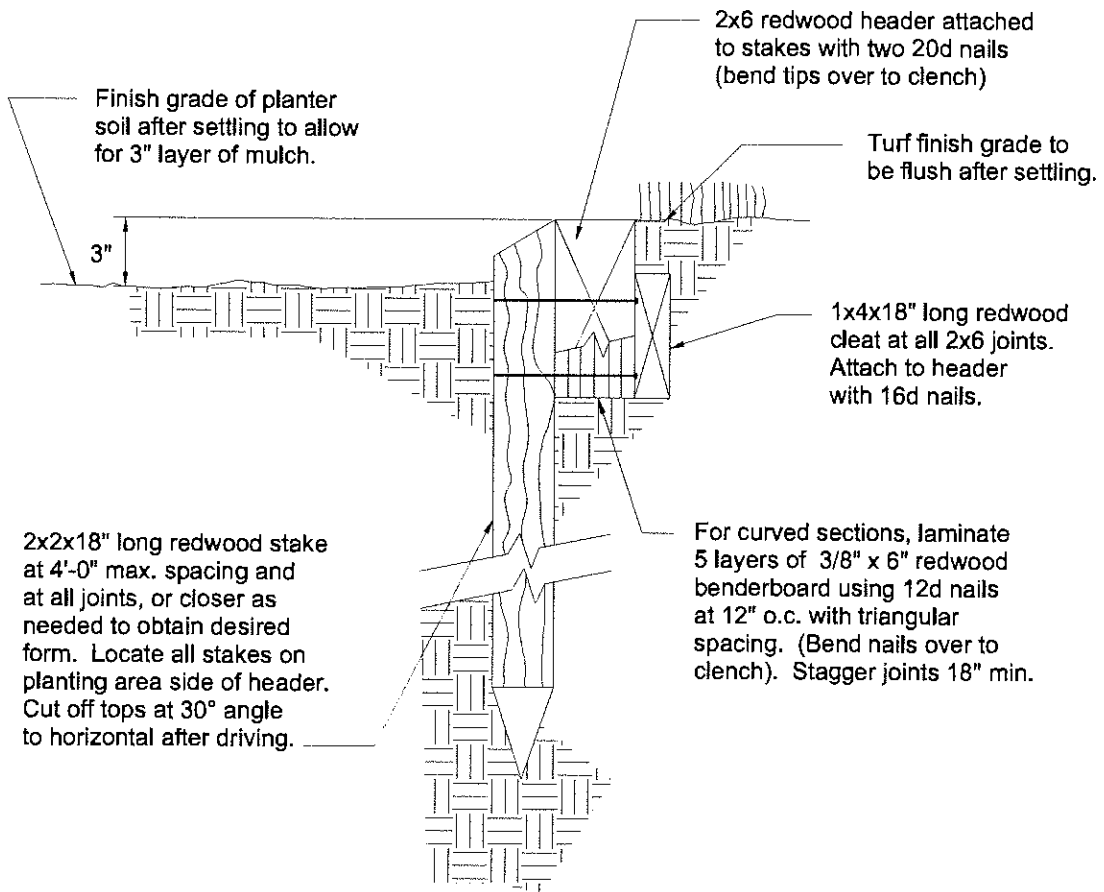


SECTION

NOTE:

Provide 1/4 inch wide by 1/2 inch deep score lines at 8 feet on center and provide expansion joints at 32 feet on center.

CITY OF HERCULES		
CONCRETE DIVIDER		
JULY 2002	Page 1 of 1	M 1.1



TYPICAL SECTION

NOTES:

1. All redwood shall be rough construction heart grade.
2. All nails shall be hot dipped galvanized.

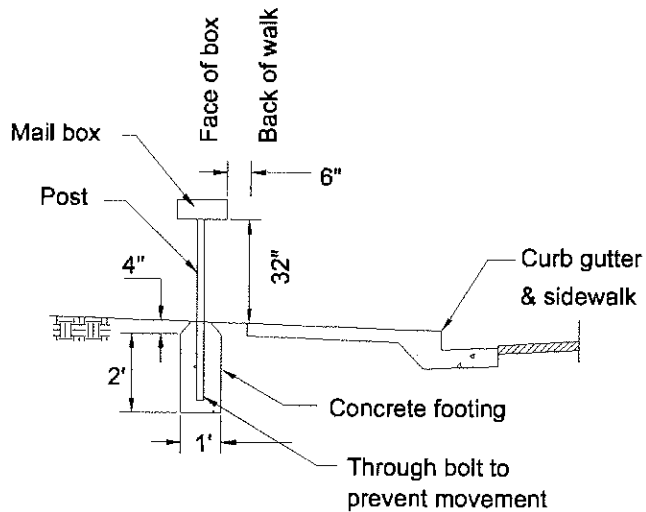
CITY OF HERCULES

WOOD HEADER

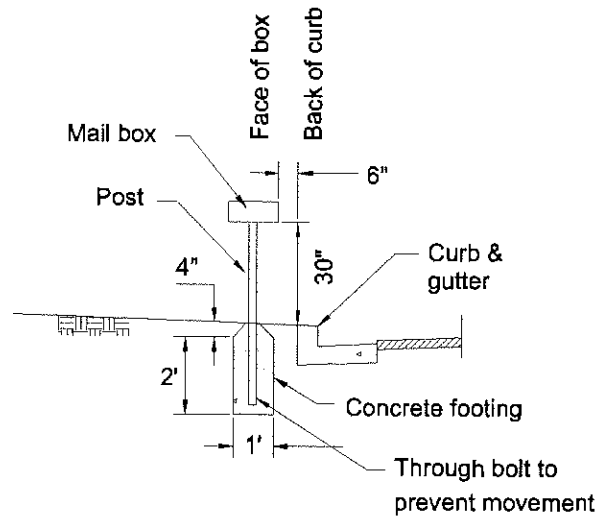
JULY 2002

Page 1 of 1

M 2.1



WITH MONOLITHIC SIDEWALK



ALL OTHER CASES

NOTES:

1. Residential mailboxes may be installed on 4 inch by 4 inch construction heart S4S Grade wood posts set in PCC concrete footings (1500 psi minimum).
2. Residential installation shall be dual or cluster installation. Single box installation allowed only where approved by the Postmaster.
3. Install industrial boxes on 2 inch diameter steel pipes.
4. Industrial boxes shall be installed on the side of the street without sidewalk, and may be single box installation.
5. The edge of the mailbox shall be a minimum distances from:
 - 5 feet from utility of street sign poles
 - 3 feet from driveways
 - 10 feet from curb returns
 - 5 feet from fire hydrants
6. The locations of all mailboxes are subject to the approval of the Postmaster.

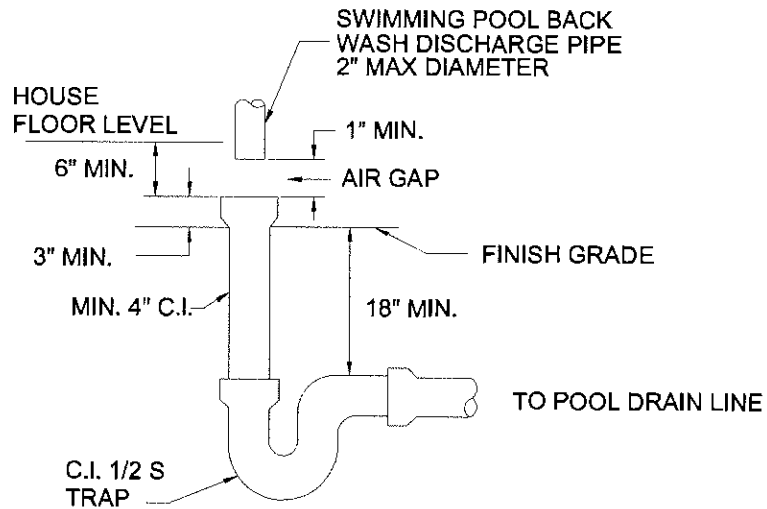
CITY OF HERCULES

MAIL BOX
INSTALLATION

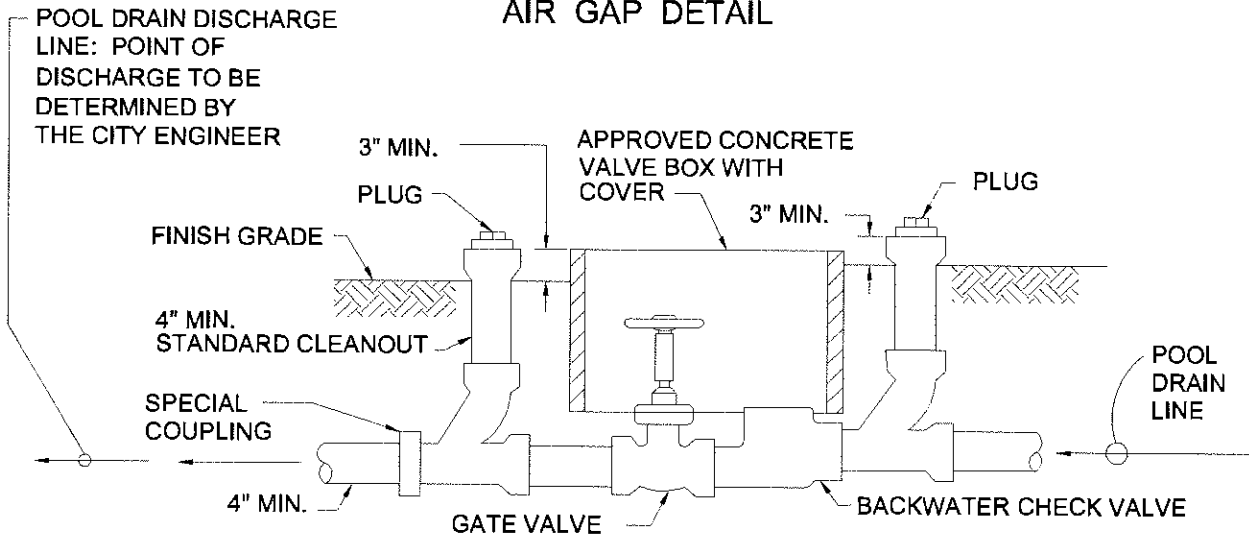
JULY 2002

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M 3.1



AIR GAP DETAIL

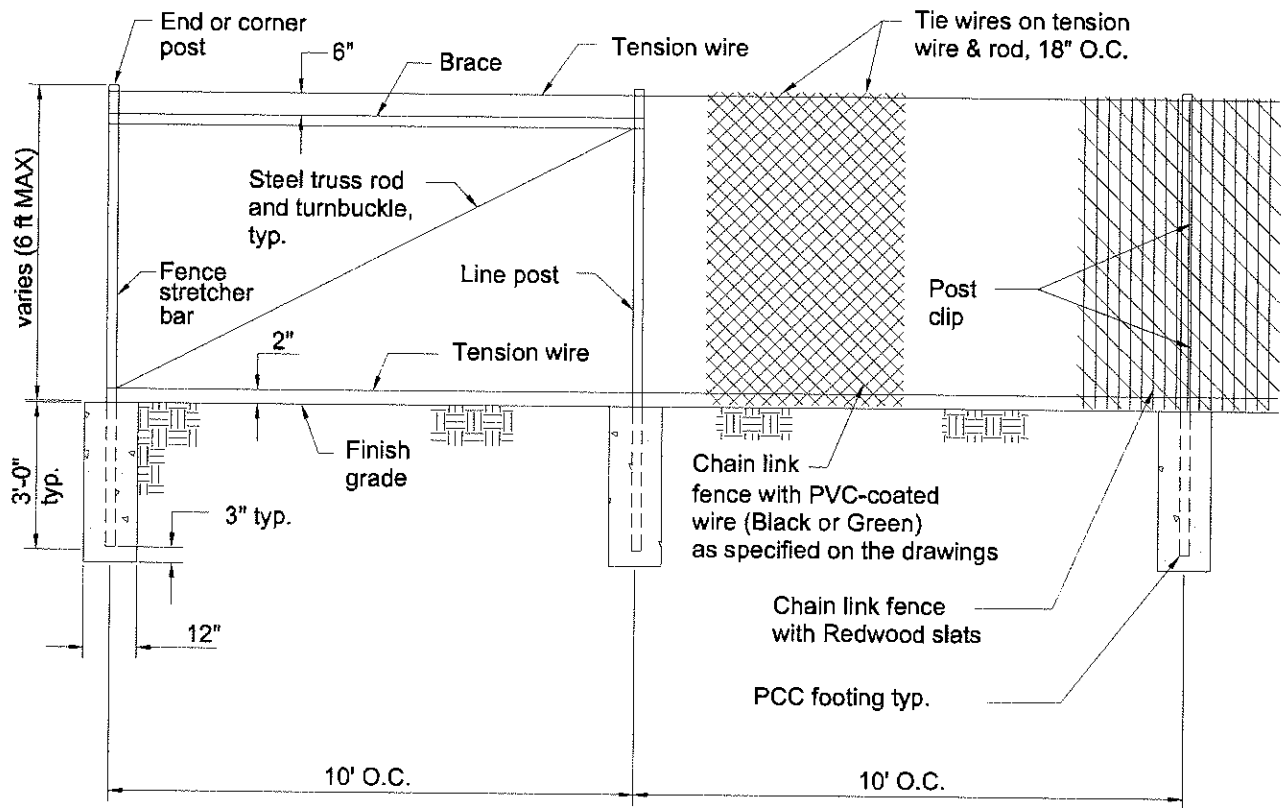


**SWIMMING POOL DRAIN LINE
BACKWATER CHECK VALVE & SHUTOFF SYSTEM**

NOTES:

1. Swimming pool drain lines shall not be connected to or discharged into any storm drain or sanitary sewer pipe or facility.
2. No person shall discharge the contents of a swimming pool into City-owned facilities without a permit.

CITY OF HERCULES		
SWIMMING POOL DRAIN LINES		
JULY 2002	Page 1 of 1	M 4.1



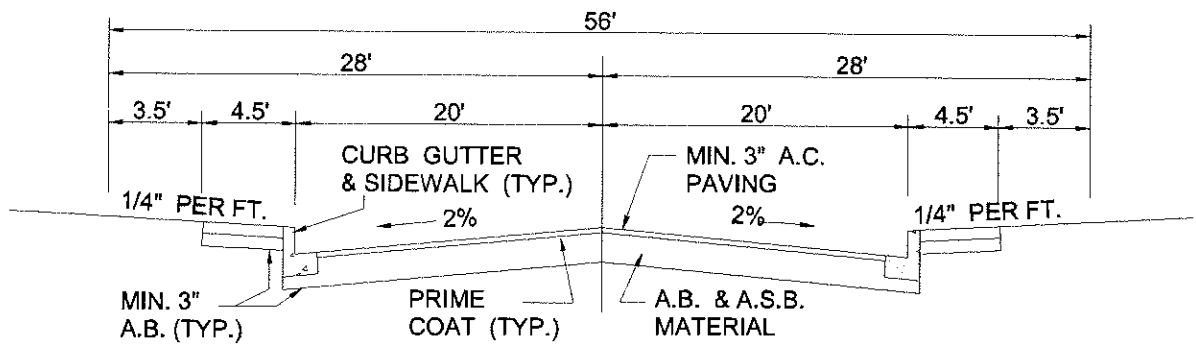
CITY OF HERCULES

CHAIN LINK FENCE

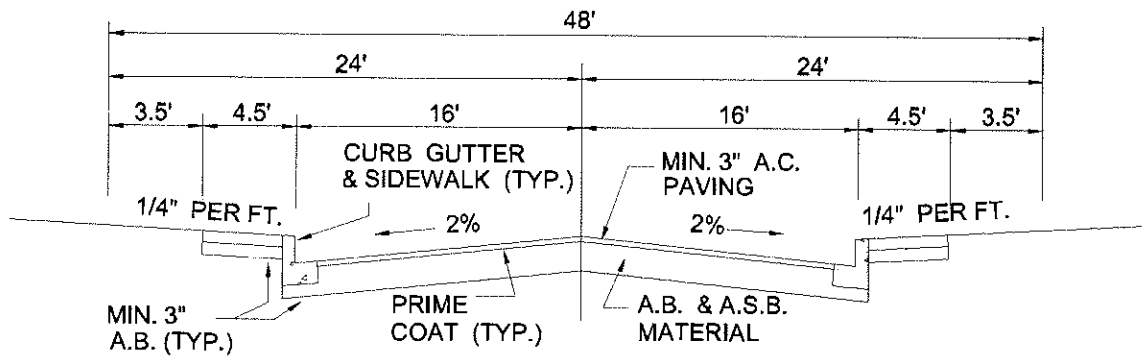
JULY 2002

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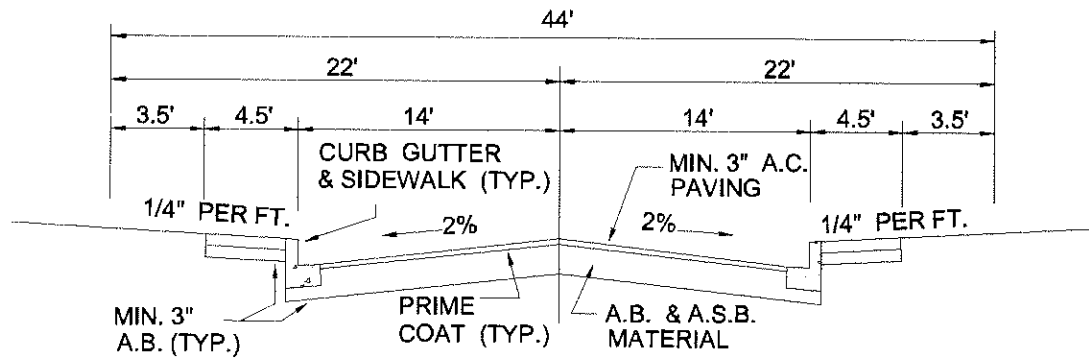
M 5.1



COLLECTOR STREET



MINOR STREET



CUL - DE - SAC STREET

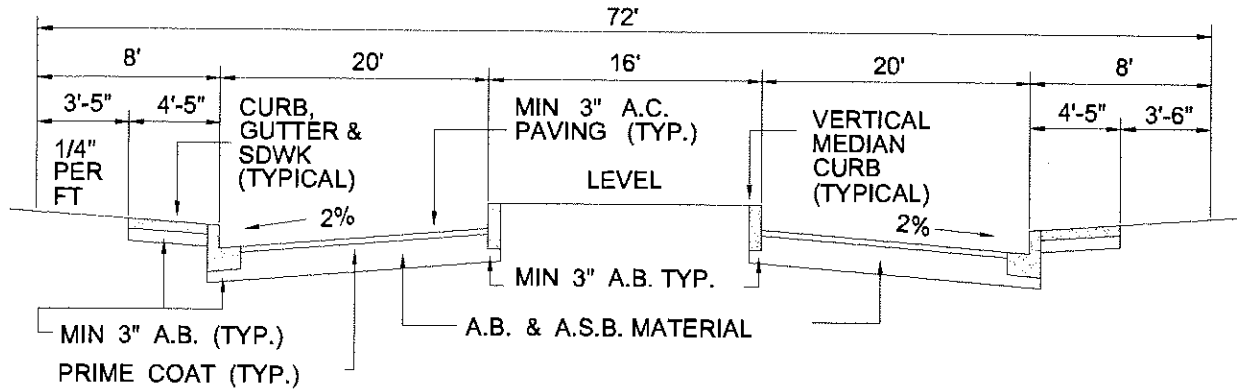
CITY OF HERCULES

STREET SECTIONS

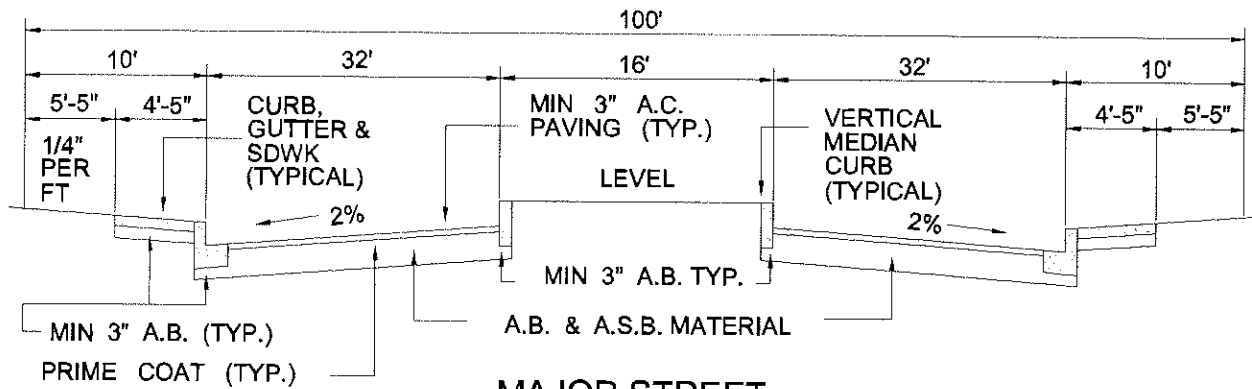
JULY 2002

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RW-1.1

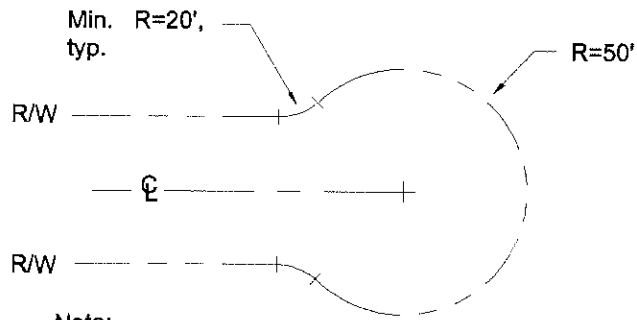


DIVIDED COLLECTOR STREET



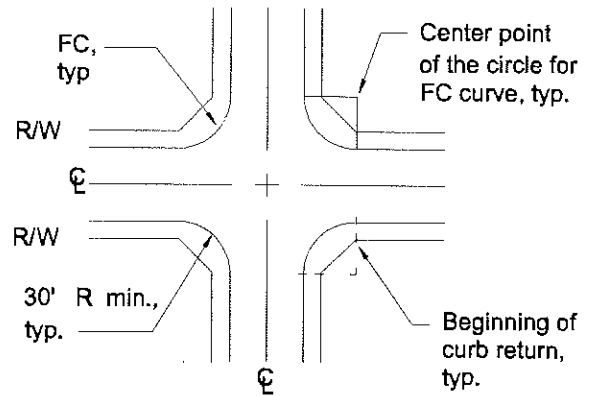
MAJOR STREET

CITY OF HERCULES		
STREET SECTIONS		
JULY 2002	Page 2 of 2	RW-1.2

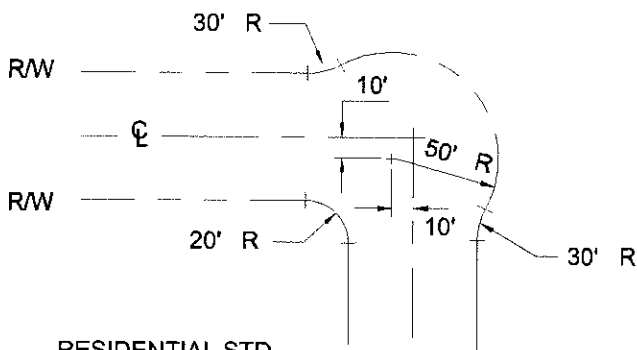


Note:
Cul-de-sac radius point
may be offset from centerline.

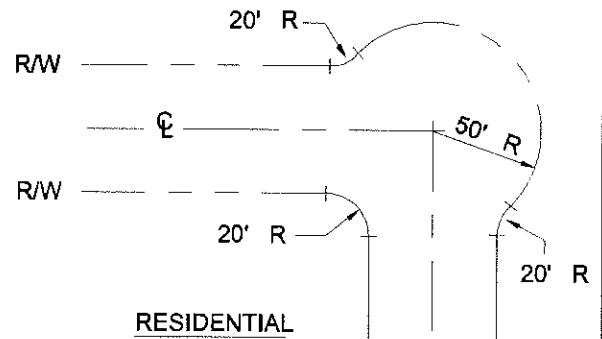
CUL-DE-SAC



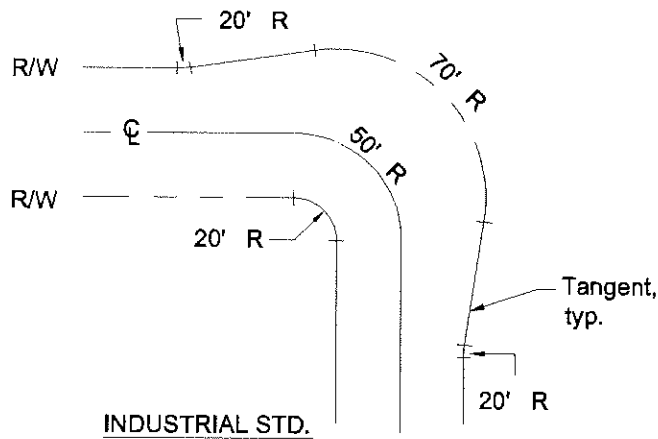
CURB RETURN



RESIDENTIAL STD.



RESIDENTIAL
Alternate



INDUSTRIAL STD.

ELBOWS

NOTES:

1. Radii shown are minimums.
2. See Standard Plans RW-1.2 and RW-1.2 for standard street widths.

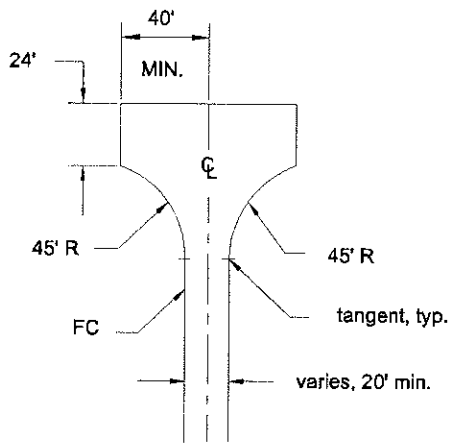
CITY OF HERCULES

Cul-de-Sac, Curb Return
and Elbows

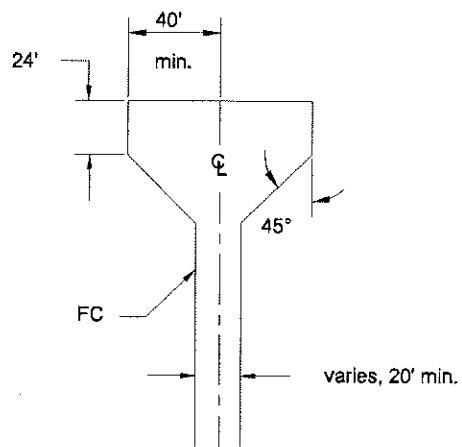
JULY 2002

Page 1 of 2

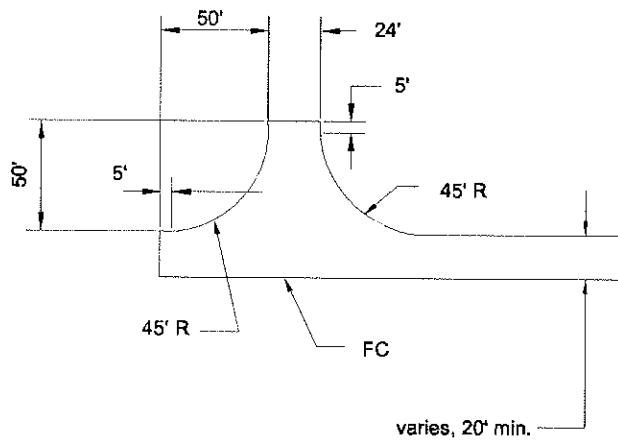
RW-2.1



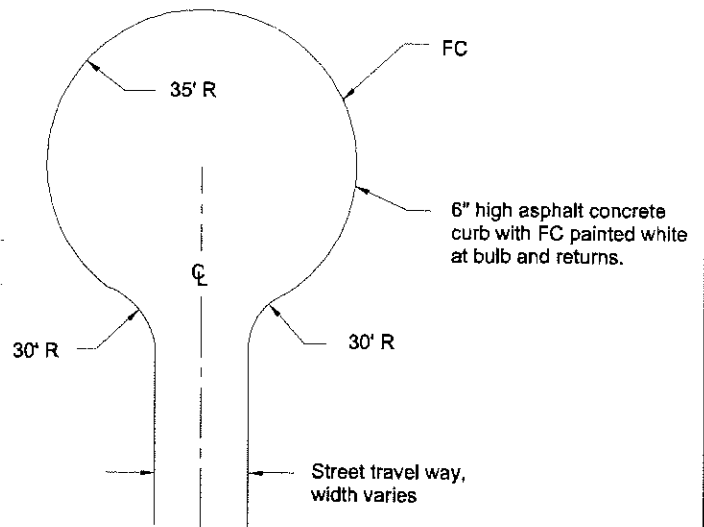
"T" HAMMERHEAD



"T" HAMMERHEAD
Chamfer Alternative



DOG LEG HAMMERHEAD



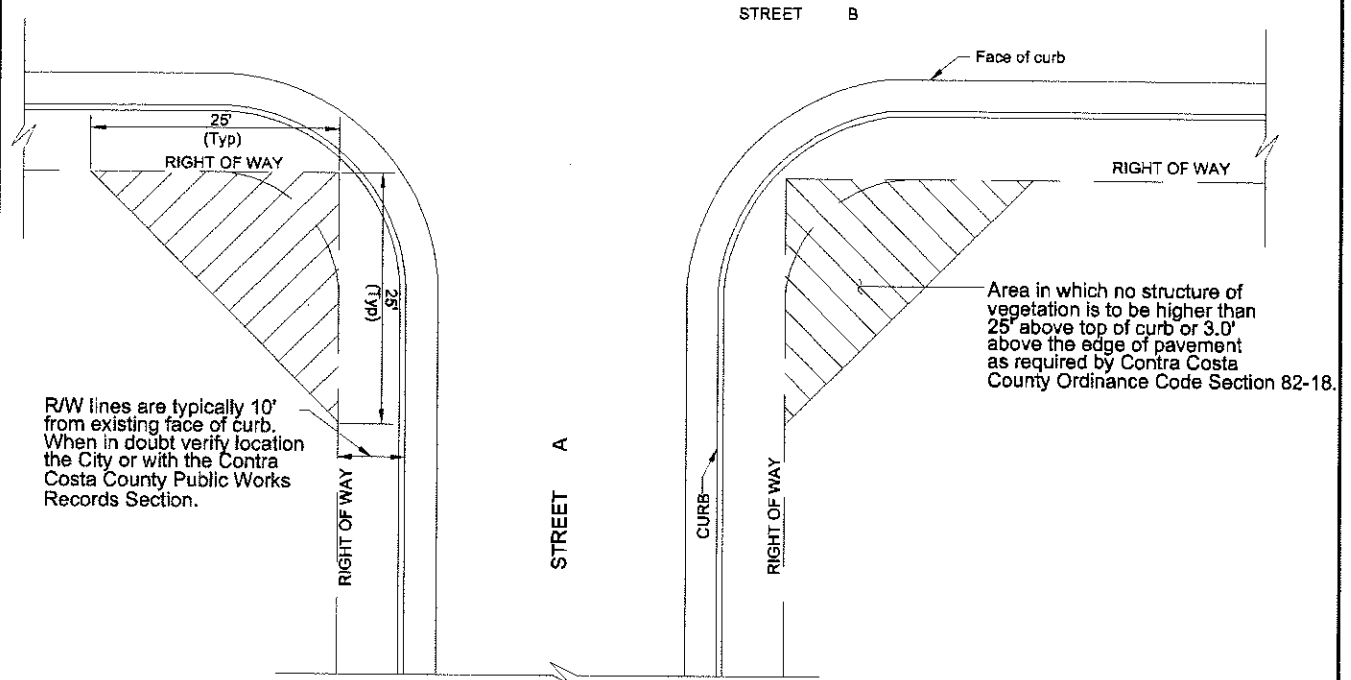
TEMPORARY TURNAROUND

NOTES:

1. Radii shown are minimums.
2. See Standard Plans RW-1.2 and RW-1.2 for standard street widths.
3. The hammerheads shall not be used in lieu of cul-de-sacs. Hammerheads are only used where approved by the Engineer.

CITY OF HERCULES		
Hammerheads and Temporary Turnaround		
JULY 2002	Page 2 of 2	RW-2.2

TYPICAL STREET INTERSECTION

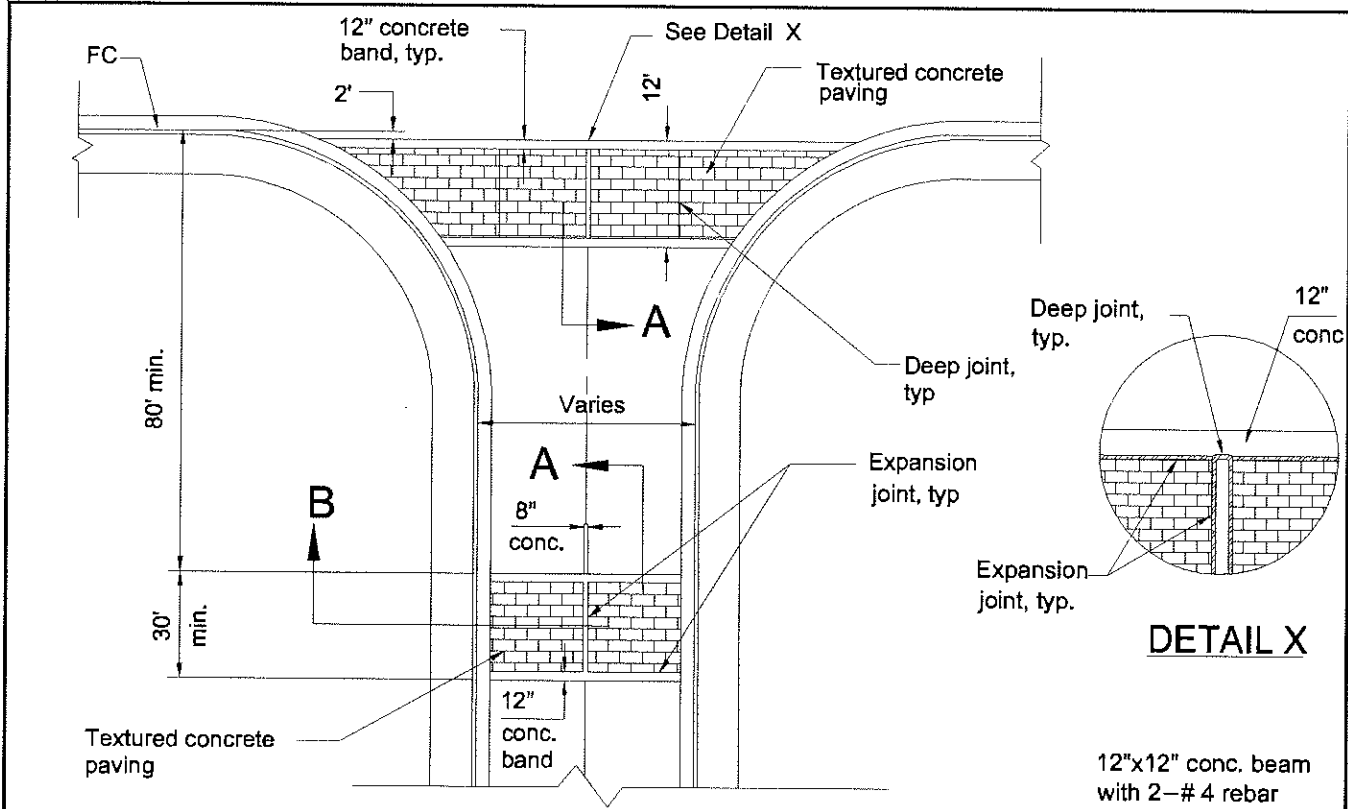


REQUIRED CLEARANCE AT INTERSECTIONS

NOTE:

This plan is intended for use in low volume subdivision streets. For commercial or high volume streets refer to the Caltrans Highway Design Manual, Chapter 400, Section 405 - Intersection Design Standards, Sight Distance.

CITY OF HERCULES		
REQUIRED CLEARANCE AT INTERSECTIONS		
JULY 2002	Page 1 of 1	RW-3.1

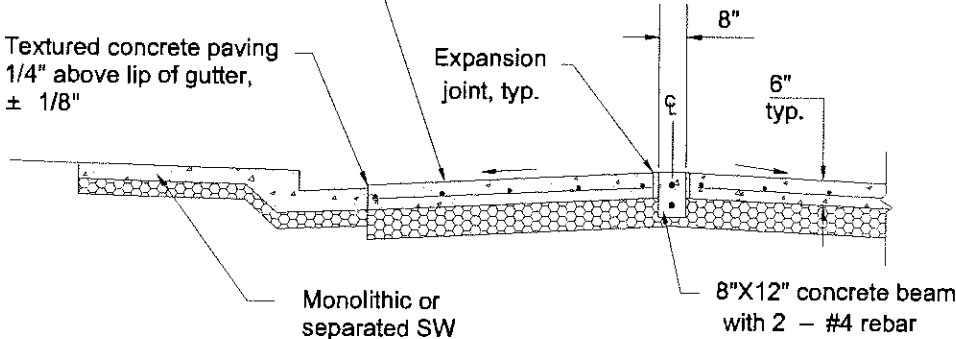


PLAN

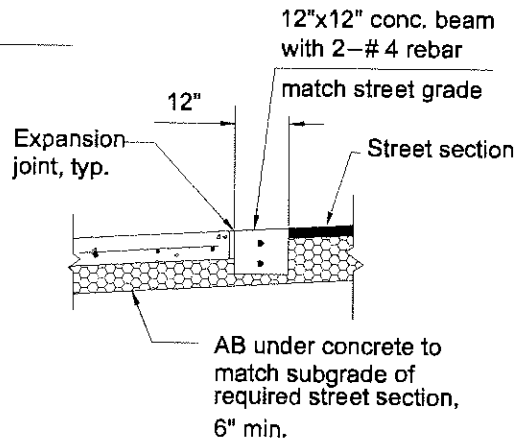
DETAIL X

Textured concrete paving
W/ #3 rebar @ 18" O.C.
each way, 3" clearance
from top of concrete,
see drawing for texture
and color

Textured concrete paving
1/4" above lip of gutter,
± 1/8"

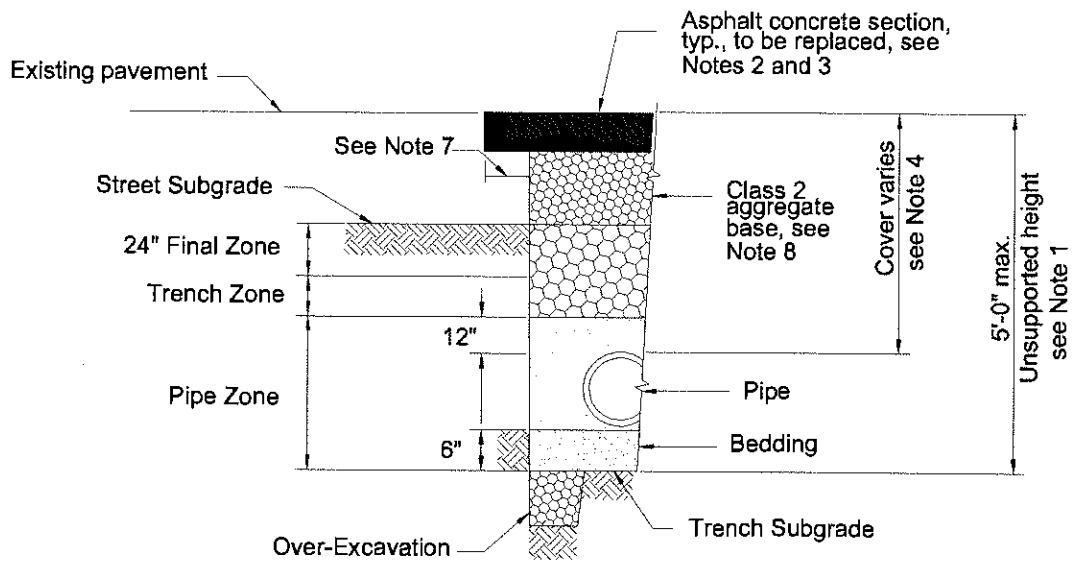


SECTION "B"

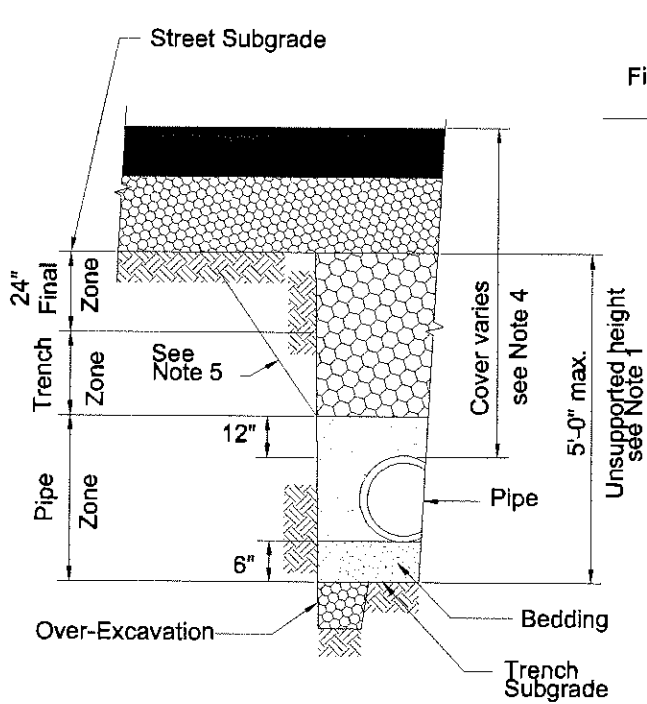


SECTION "A"

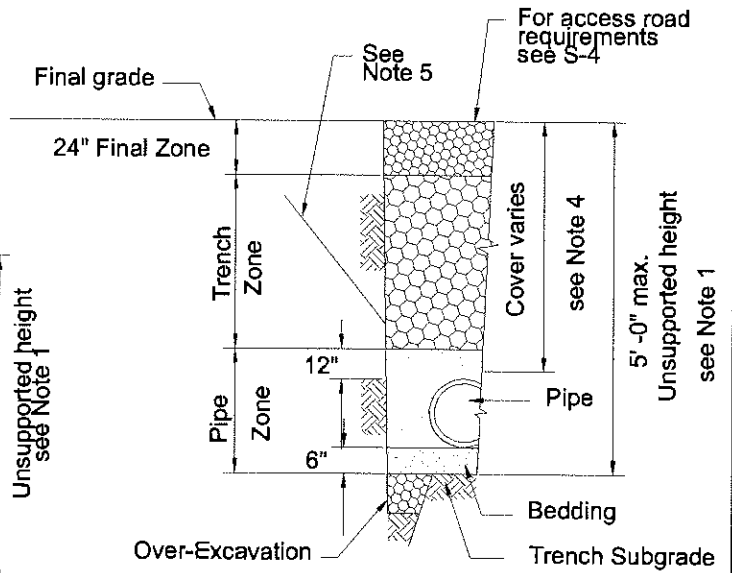
CITY OF HERCULES		
TEXTURED CONCRETE PAVING		
JULY 2002	Page 1 of 1	RW-4.1



EXISTING STREET

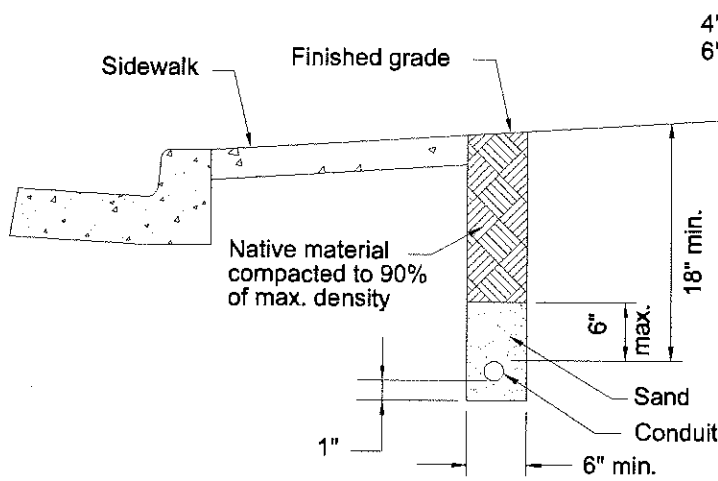


NEW STREET

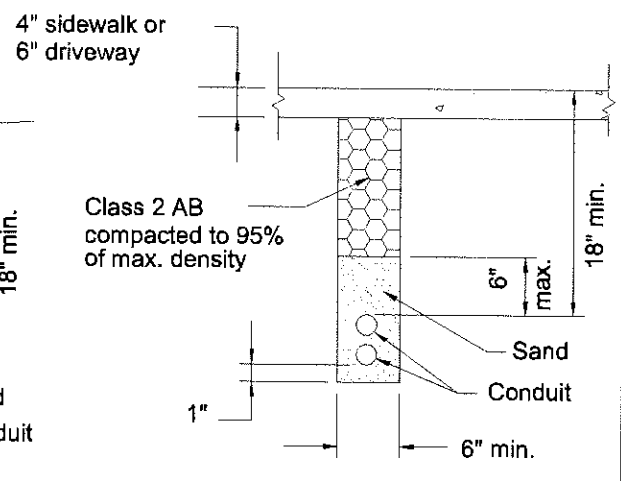


UNIMPROVED AREAS

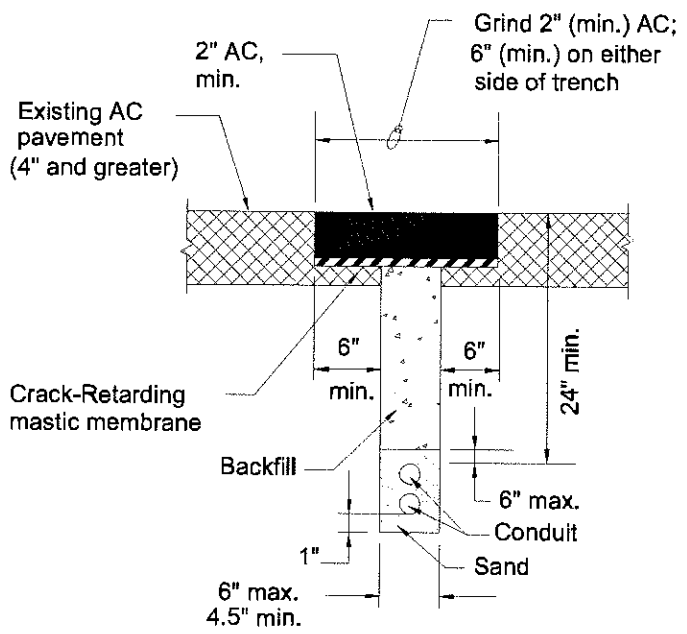
CITY OF HERCULES		
TRENCH SECTION		
JULY 2002	Page 1 of 3	RW-5.1



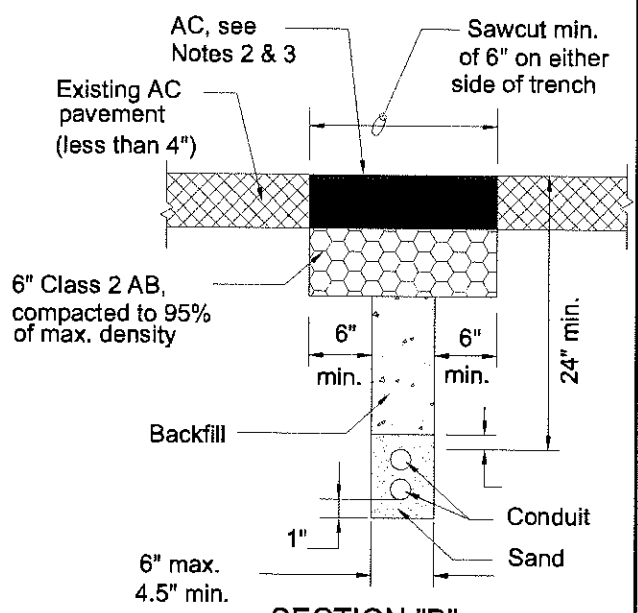
**STREET LIGHT CONDUIT
TRENCH SECTIONS
(WHEN NOT IN JOINT TRENCH)**



**TRAFFIC SIGNAL CONDUIT
TRENCH SECTIONS UNDER
SIDEWALKS/DRIVEWAYS**



**SECTIONS "A"
FOR EXISTING ASPHALT CONCRETE
SECTIONS 4" AND GREATER**



**SECTION "B"
FOR EXISTING ASPHALT CONCRETE
SECTIONS LESS THAN 4"**

TELECOMMUNICATIONS CONDUIT TRENCH SECTIONS

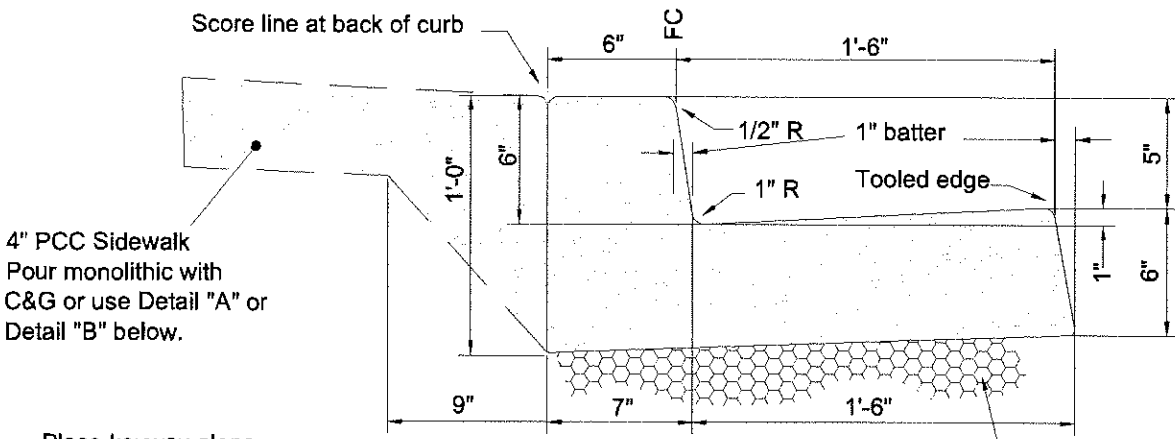
(ELECTRICAL, TRAFFIC SIGNAL CONDUITS, STREET LIGHT CONDUIT CROSSINGS, TELEPHONE, CABLE TV / COMMUNICATIONS CONDUITS)

CITY OF HERCULES		
TRENCH SECTION		
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NOTES:

1. Trenching shall conform to the "Construction Safety Orders of the State of California" and Section 6705 of the California Labor Code.
2. In existing streets, the total asphalt concrete thickness replaced shall not be less than 6 inches (4 inches in residential streets), or match the existing asphalt concrete section, whichever is greater.
3. In existing streets the asphalt concrete bottom lift(s) shall not be less than 4 inches (2 inches in residential streets), and the asphalt concrete top lift shall not be less than 2 inches.
4. Where adequate compaction cannot be achieved due to obstruction or other conditions, replace pipe zone and/or trench zone fill with select imported material as directed by the Engineer.
5. Sloping trench sections, above pipe zone, can only be used where stable compact soil conditions exist, where approved by the Engineer or where shown on the drawing or specifications. Sloping trench sections will not be allowed in existing streets.
6. Prior to trenching, contact USA 1-800-227-2600
7. Before pavement section is replaced, the existing pavement shall be sawcut at least 12 inches back from trench excavation along neat, straight, parallel lines. Where the existing asphalt concrete is 6 inches or more in thickness or where the repaving is less than 15 square feet in area, sawcut may be the edge of the trench excavation. Where wall of trench excavation is within 18 inches of the lip of gutter replace AC from trench wall to lip of gutter.
8. In existing streets the total aggregate base shall be the greater of the existing street aggregate base section or the following minimum aggregate base:
 - a) Local, loops, cul-de-sac, and private residential street: 12 inches AB (min.)
 - b) Collector, frontage, major, and industrial/commercial streets: 18 inches AB (min.)
9. See the "Utility Earthwork" section of the City Standard Specifications for additional information.

CITY OF HERCULES		
TRENCH SECTION NOTES		
JULY 2002	Page 3 of 3	RW-5.3

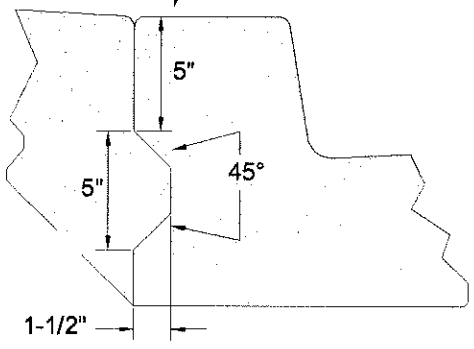


4" PCC Sidewalk
Pour monolithic with
C&G or use Detail "A" or
Detail "B" below.

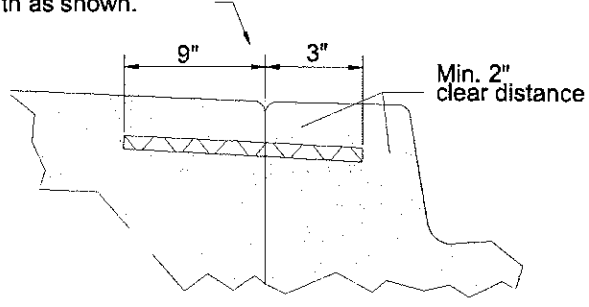
Place keyway along
entire length of C&G
as shown.

CURB & GUTTER

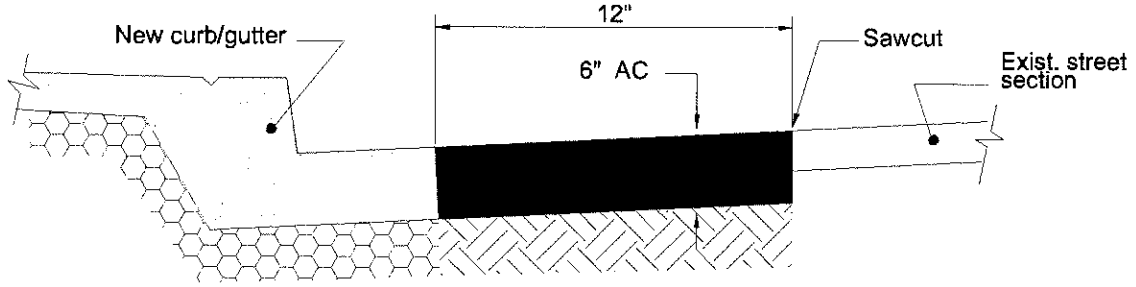
#4 rebar, 12" long. Install rebar into 3" deep hole
drilled into existing curb at 3' O.C.
for entire length as shown.



**DETAIL "A"
KEYWAY**



**DETAIL "B"
DOWELS**

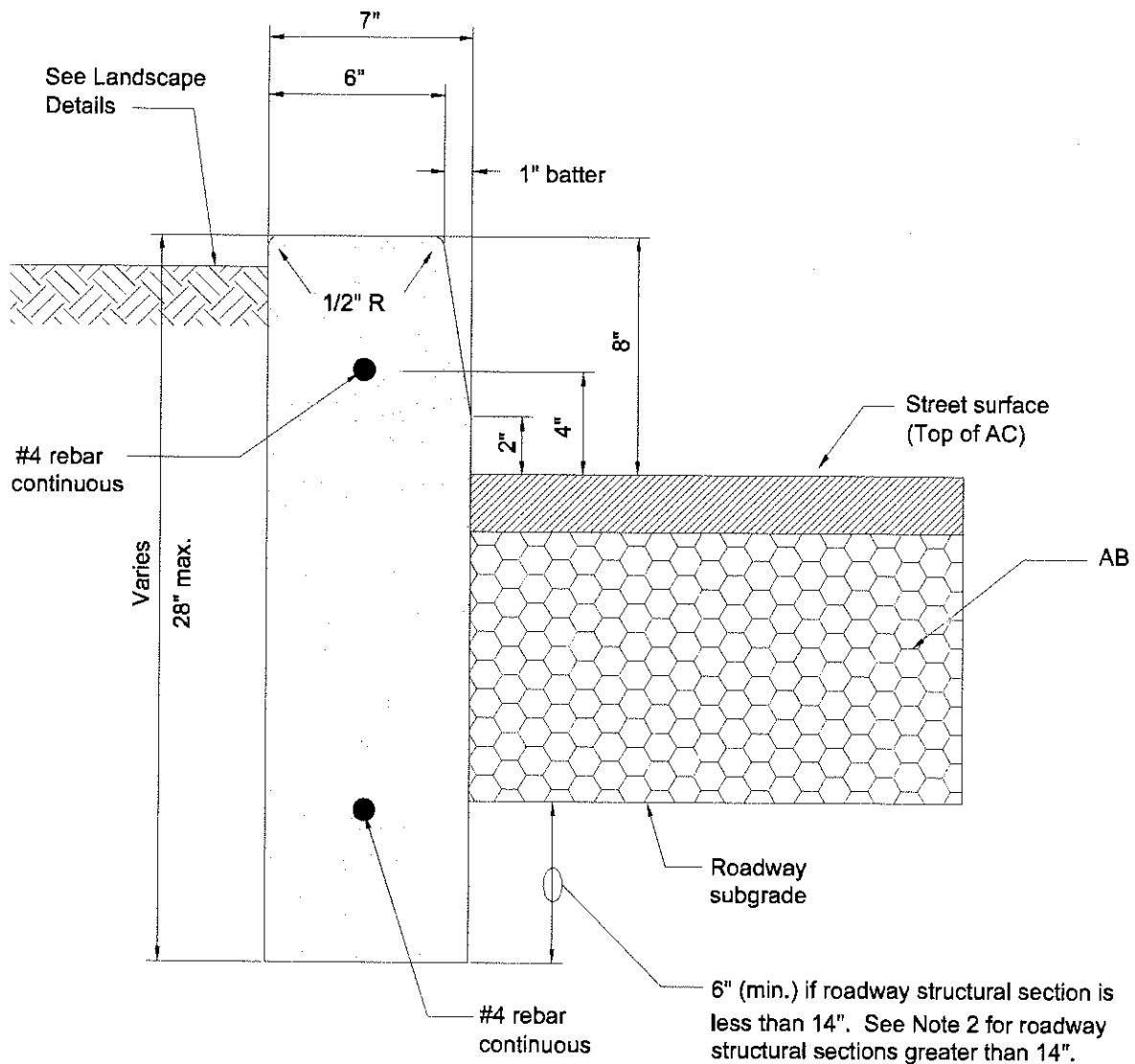


**NEW OR REPLACEMENT CURB & GUTTER
AT EXISTING STREET**

NOTE:

Curb, gutter and sidewalk to be placed monolithically where possible. Where non-monolithic, place dowels and/or keyway as shown.

CITY OF HERCULES		
CURB AND GUTTER		
JULY 2002	Page 1 of 1	RW-6.1



NOTES:

1. Place deep joints at 10 feet spacing along median curb.
2. Where roadway structural section is greater than 14 inches install a water barrier extending from the top of curb to 6 inches below the roadway subgrade.
3. See Standard Plans L-5.1 and L-6.1 for water barrier installation.

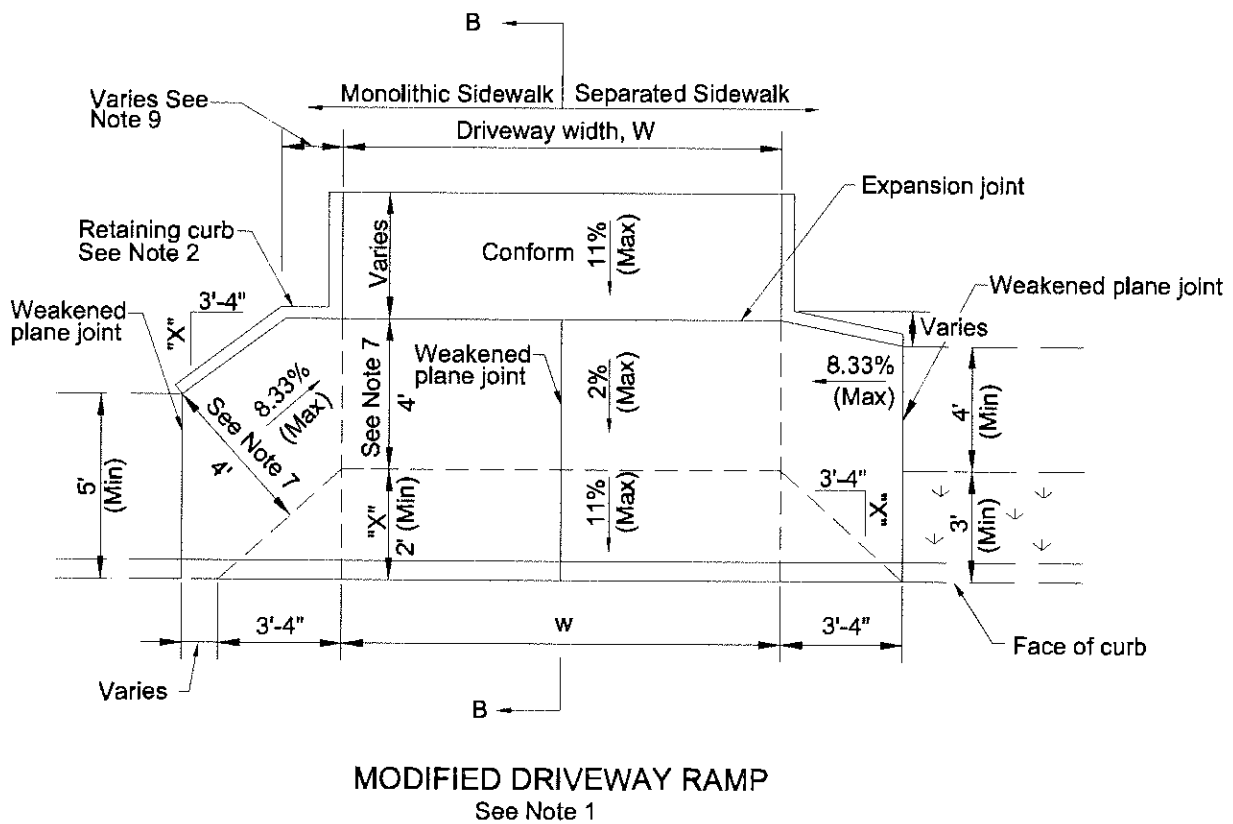
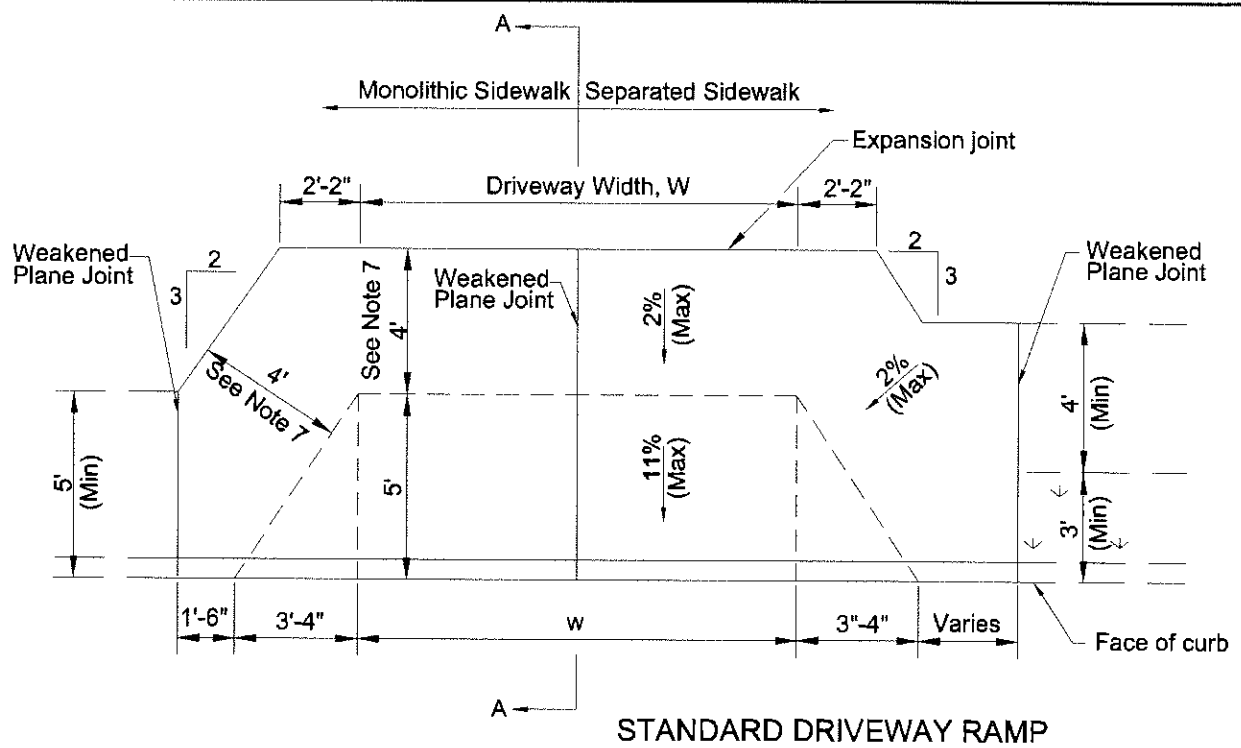
CITY OF HERCULES

**MEDIAN CURB
(DEEP CURB)**

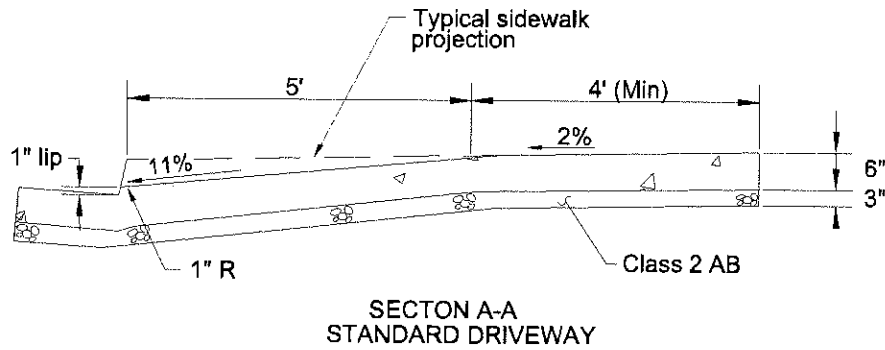
JULY 2002

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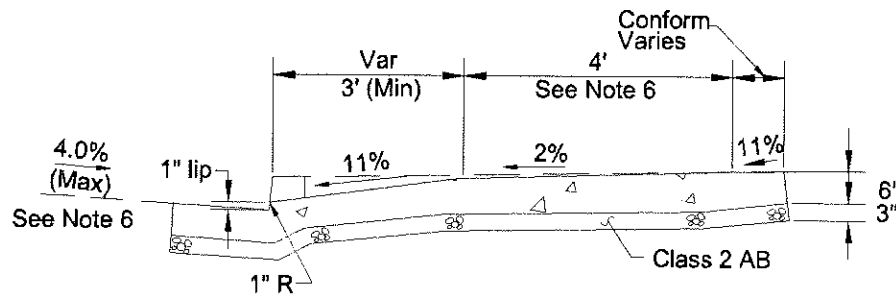
RW-7.1



CITY OF HERCULES		
DRIVEWAY RAMP DETAILS		
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SECTION A-A
STANDARD DRIVEWAY



SECTION B-B
MODIFIED DRIVEWAY

NOTES:

1. New depressed curb and driveway ramps shall be constructed monolithically.
2. The modified driveway may be used where approved by the Engineer. "X" shall be as large as possible.
3. Retaining curbs and driveway conforms shall be constructed as required by the Engineer.
4. For depressed driveways (Section B-B) the sidewalk shall be a minimum of 3-5/8 inches ("X" = 2 feet) above the gutter flowline. The depth of the gutter flow shall be calculated and compared to sidewalk elevations.
5. Provide expansion joints and scoremarks as required by the Engineer.
6. If the pavement cross slope exceeds 4% the modified driveway shall be used with the slope of the driveway ramp reduced such that the difference in slope of the driveway ramp and the slope of a line between the gutter and a point on the roadway 5 feet from the gutter flowline shall not exceed 15%. Other dimensions shall be modified as approved by the Engineer.
7. The minimum width of clear passage shall be 4 feet. Where right of way restrictions, natural barriers, or other restrictions create an unreasonable hardship, the clear width may be reduced to 3 feet with approval by the Engineer.
8. An acquisition of a construction easement may be necessary where the right of way is limited.
9. The variable width dimension shown on the Modified Driveway Ramp is 18 inches for a sidewalk width of 4 feet, 23 inches for a sidewalk width of 5 feet, and 14 inches for a sidewalk width of 3 feet.

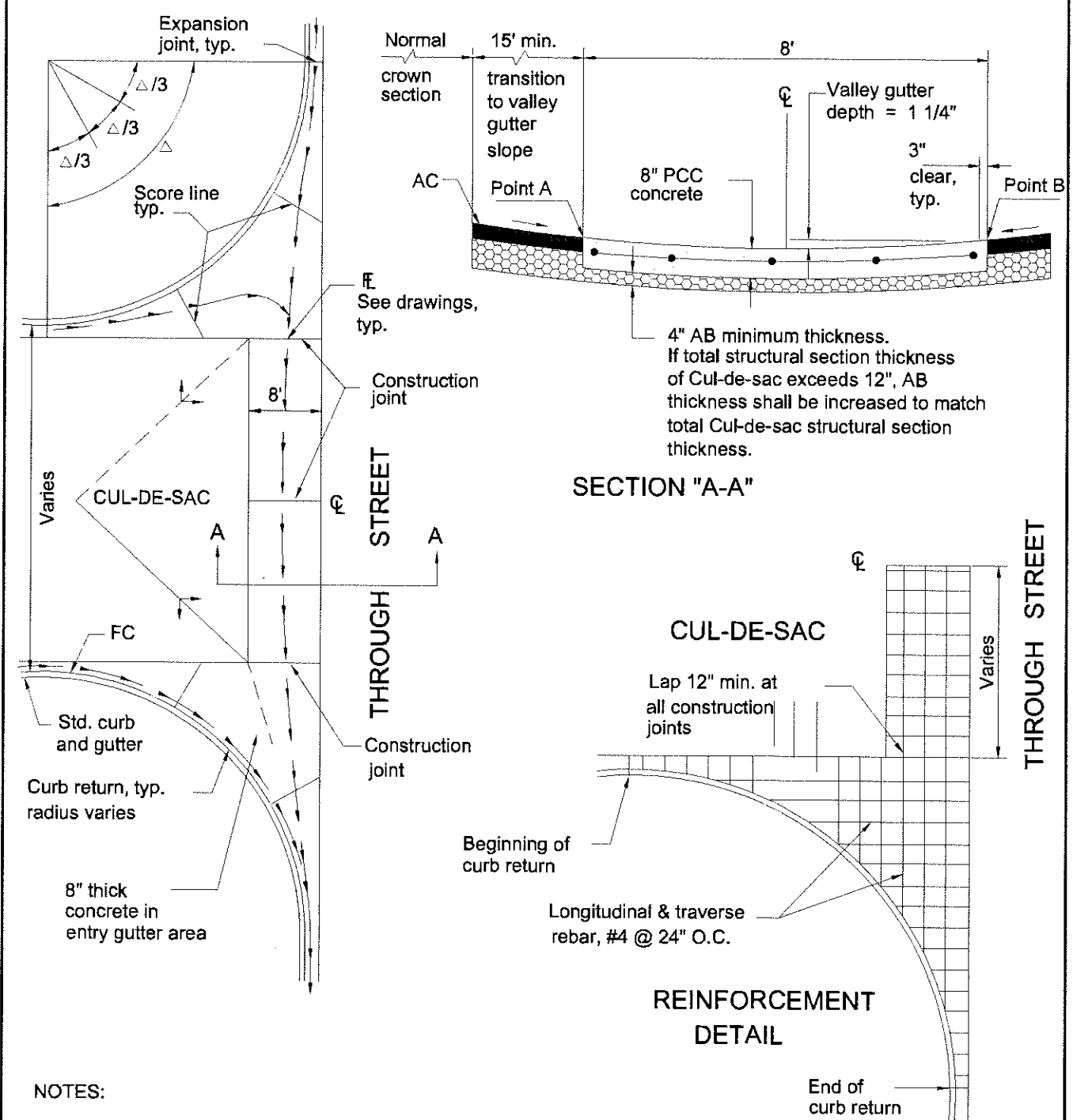
CITY OF HERCULES

DRIVEWAY RAMP DETAILS

JULY 2002

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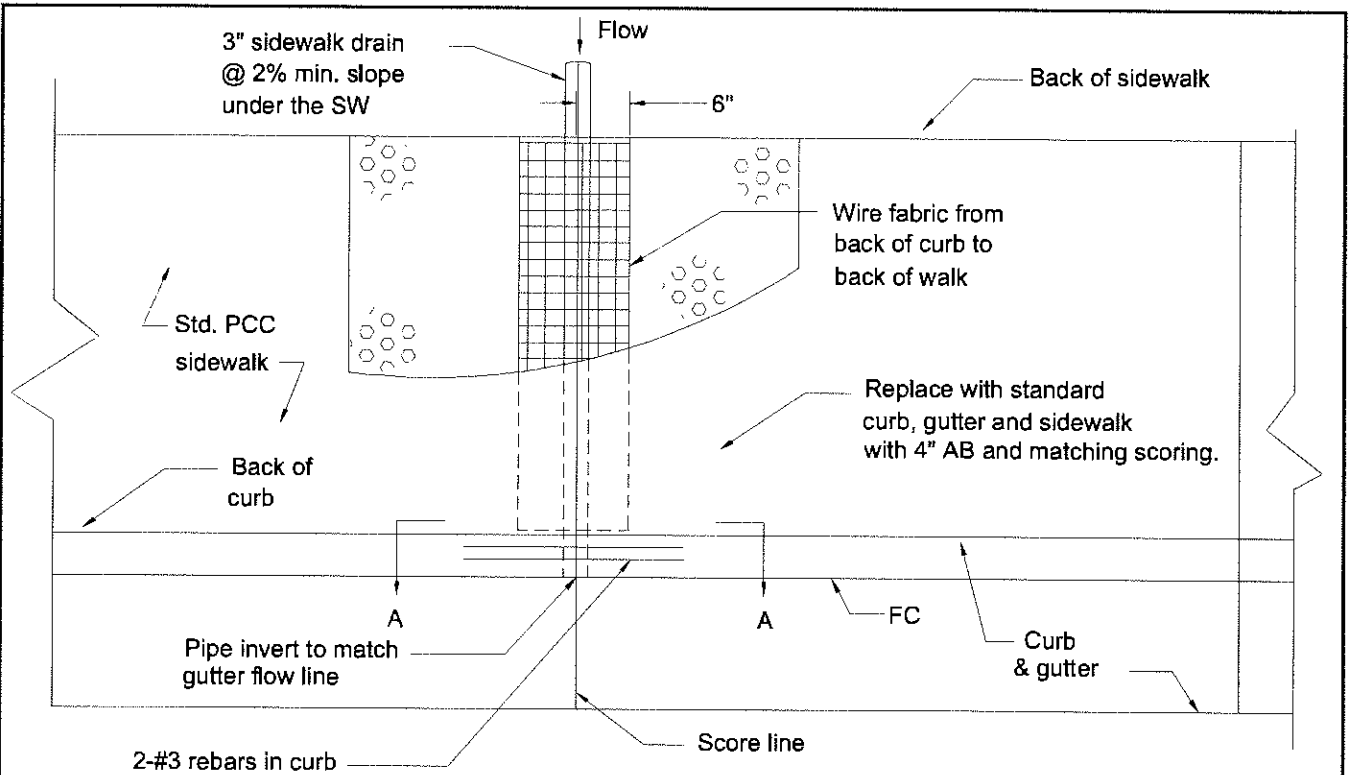
RW-8.2



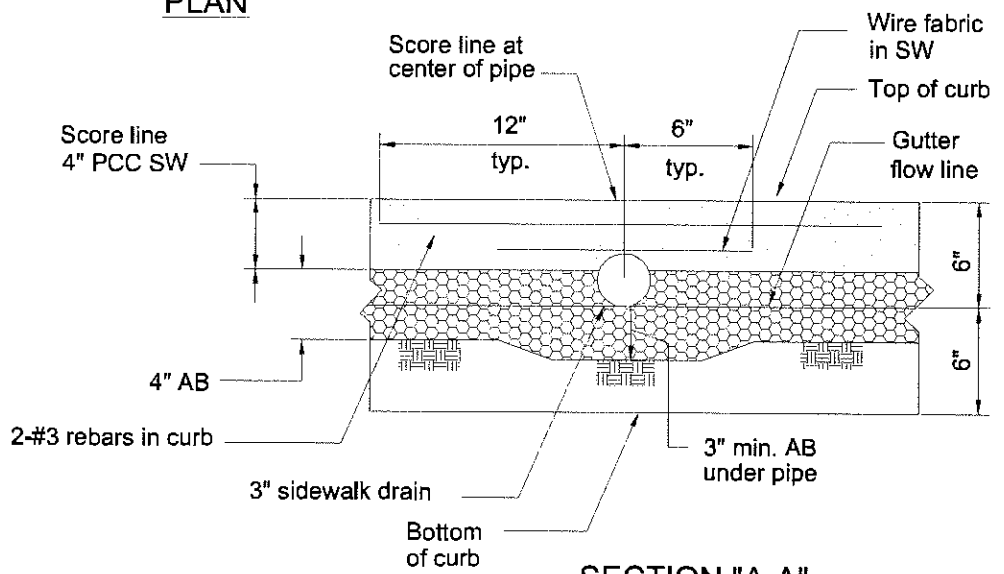
NOTES:

1. See Standard Plan RW-6.1 for curb and gutter.
2. Point A and Point B shall be at the same elevation.
3. Pavement replacement for existing street shall be approved on a case by case basis by the Engineer.

CITY OF HERCULES		
VALLEY GUTTER		
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PLAN



SECTION "A-A"

NOTES:

1. There shall be a minimum of 4 inches between pipes in multiple installations.
2. Sidewalk drains shall not be installed within driveway approach (top of flare).
3. The longitudinal axis of the sidewalk drain shall be perpendicular to the face of curb.

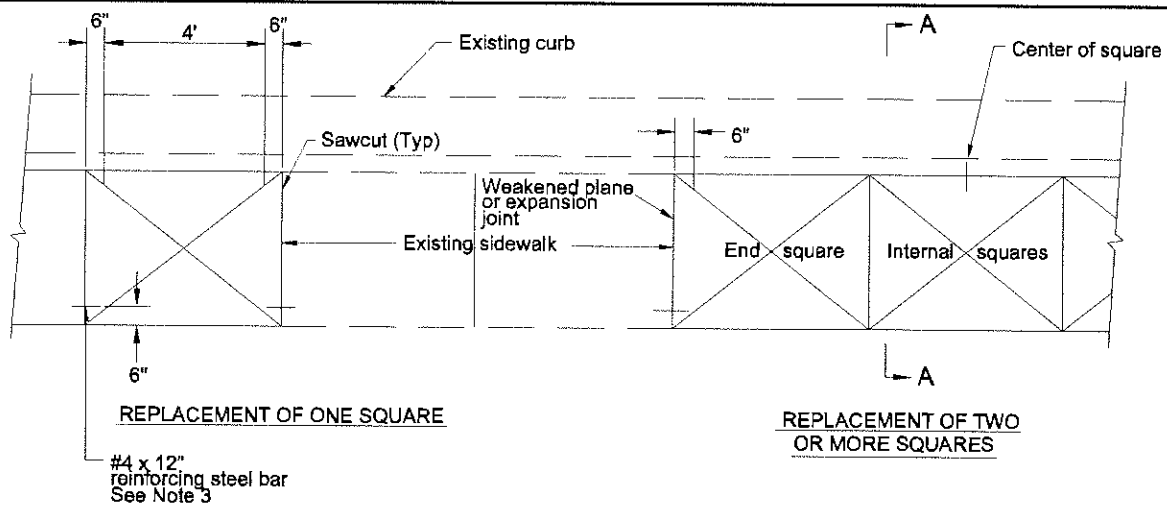
CITY OF HERCULES

SIDEWALK DRAIN

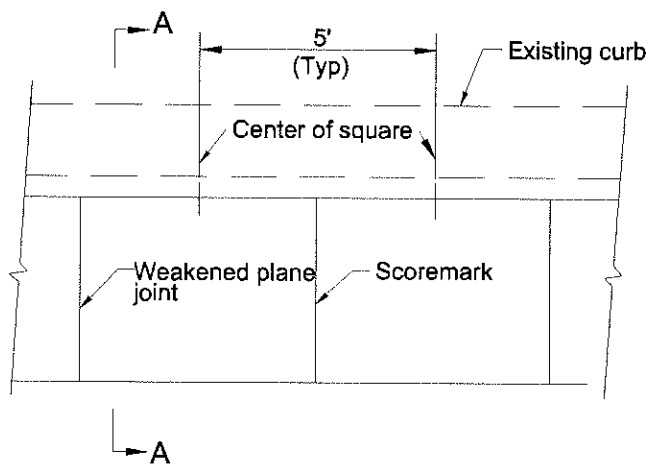
JULY 2002

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RW-10.1



LOCATIONS FOR REPLACEMENT SIDEWALK

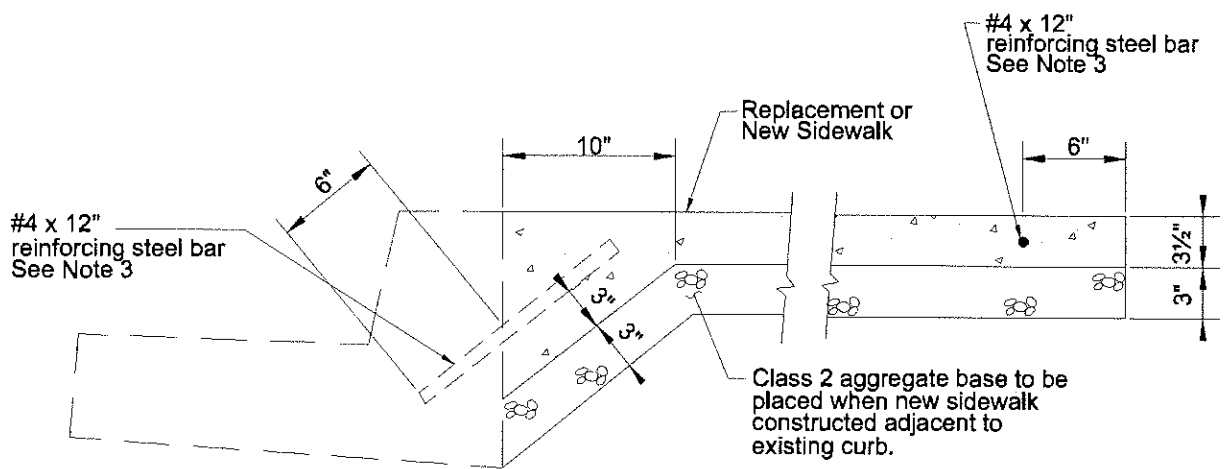


DOWEL LOCATIONS FOR NEW SIDEWALK
ADJACENT TO EXISTING CURB

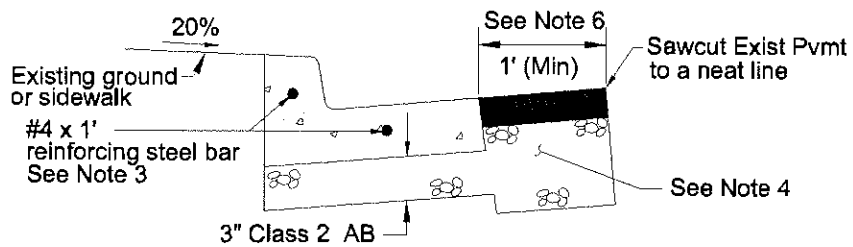
NOTES:

1. All curb, gutter, and sidewalk shall conform to Standard Plan RW-7.1.
2. Concrete removed for replacement construction shall be sawcut to a neat line at the weakened plane joint or scoremark nearest to the full width of replacement.
3. Dowels shall be placed in a 3/4 inch diameter drilled hole filled with a 1:1 sand and cement grout.
4. Asphalt concrete and aggregate base shall be placed to the thickness required by the Engineer. The minimum section for curb replacement shall be 0.5 feet AC.
5. Where the street slopes away from the curb, the paving shall match the gutter lip.
6. The asphalt concrete conform for new or replacement curb shall be a minimum width of 1 foot measured from the new gutter lip or 1 foot inside existing edge of pavement, whichever is greater.

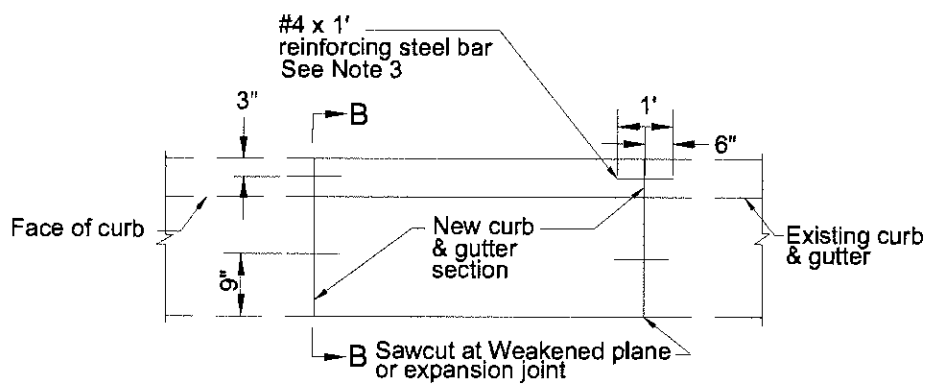
CITY OF HERCULES		
DOWELING DETAILS FOR CURB AND SIDEWALK		
JULY 2002	Page 1 of 2	RW-11.1



SECTION A-A

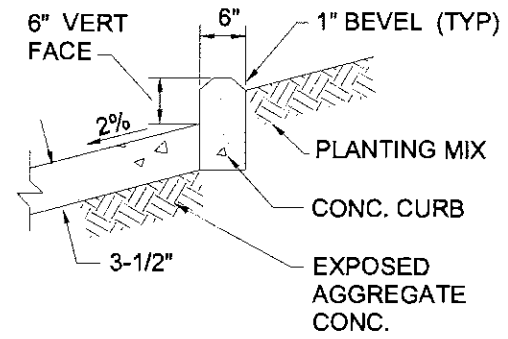
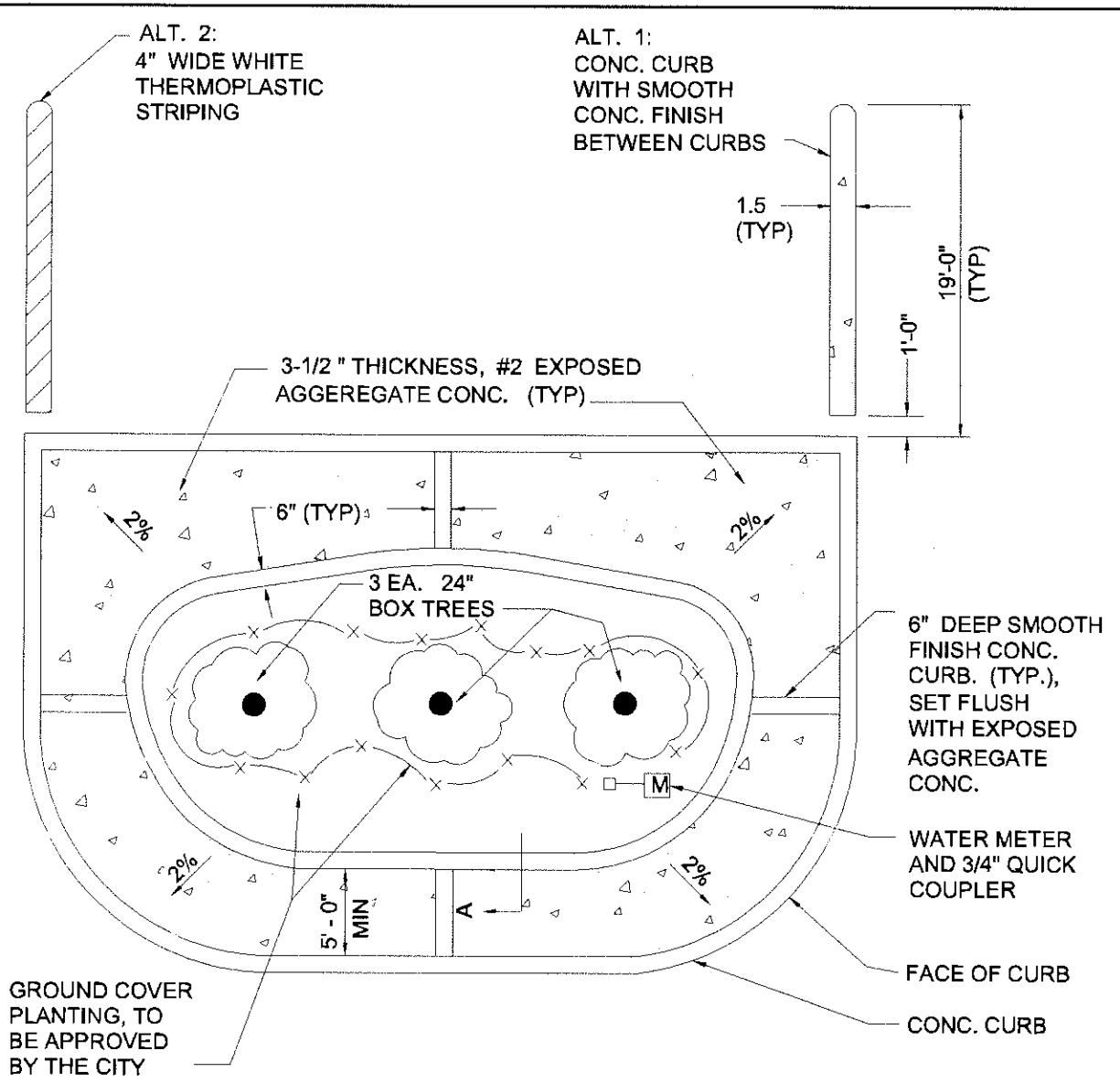


SECTION B-B



DOWELING LOCATION FOR NEW CURB ADJACENT TO EXISTING CURB

CITY OF HERCULES		
DOWELING DETAILS FOR CURB AND SIDEWALK		
JULY 2002	Page 2 of 2	RW-11.2

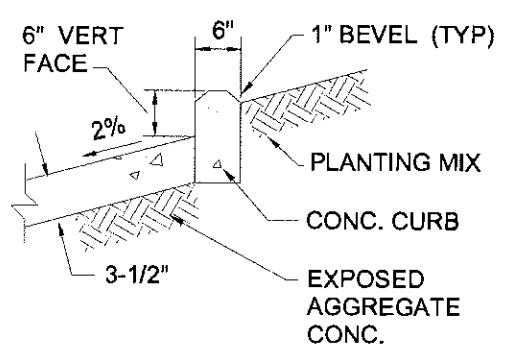
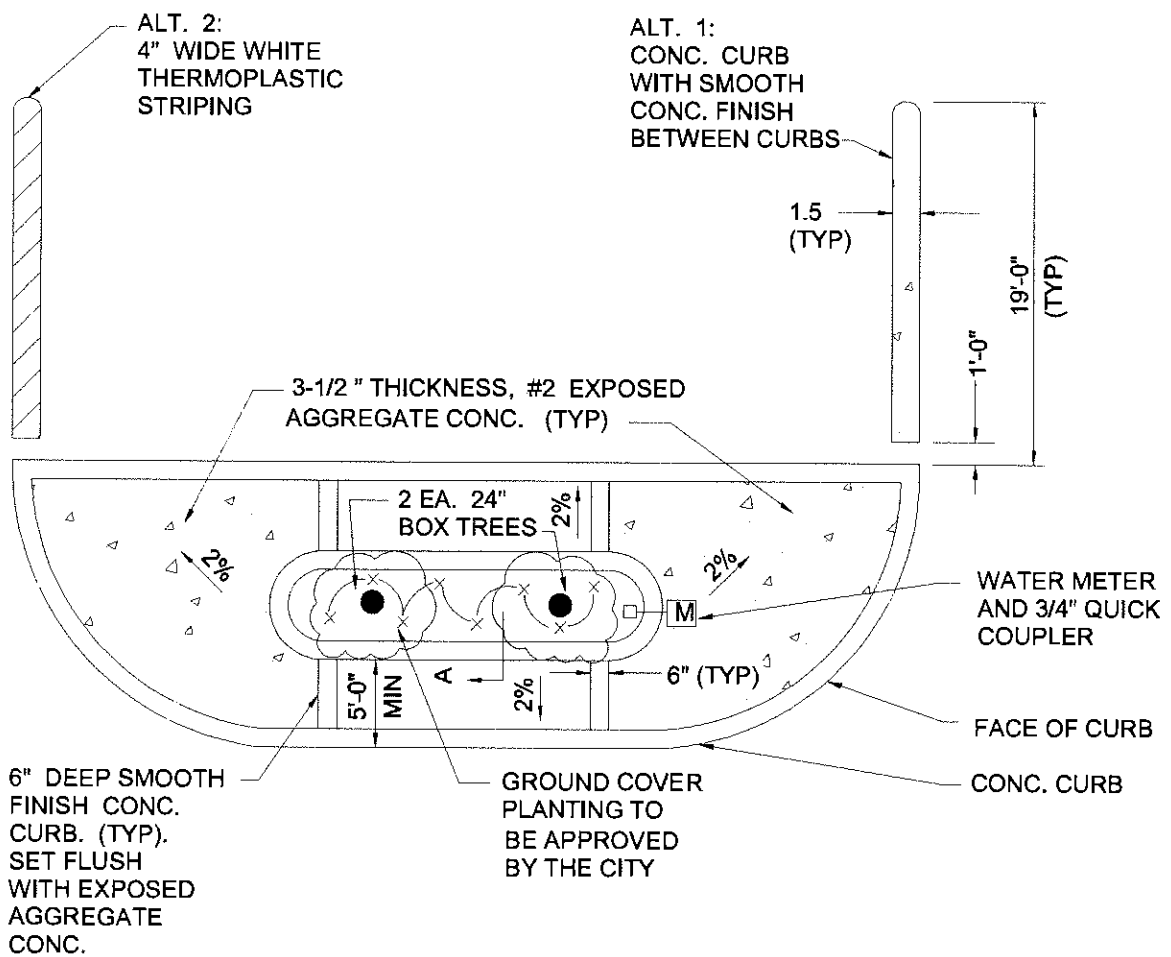


SECTION A-A

NOTES:

Below grade irrigation piping and sprinkler heads, hand operated gate valve box and backflow prevention device per E.B.M.U.D. standards are required.

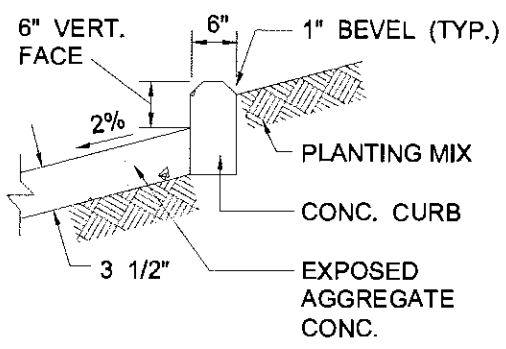
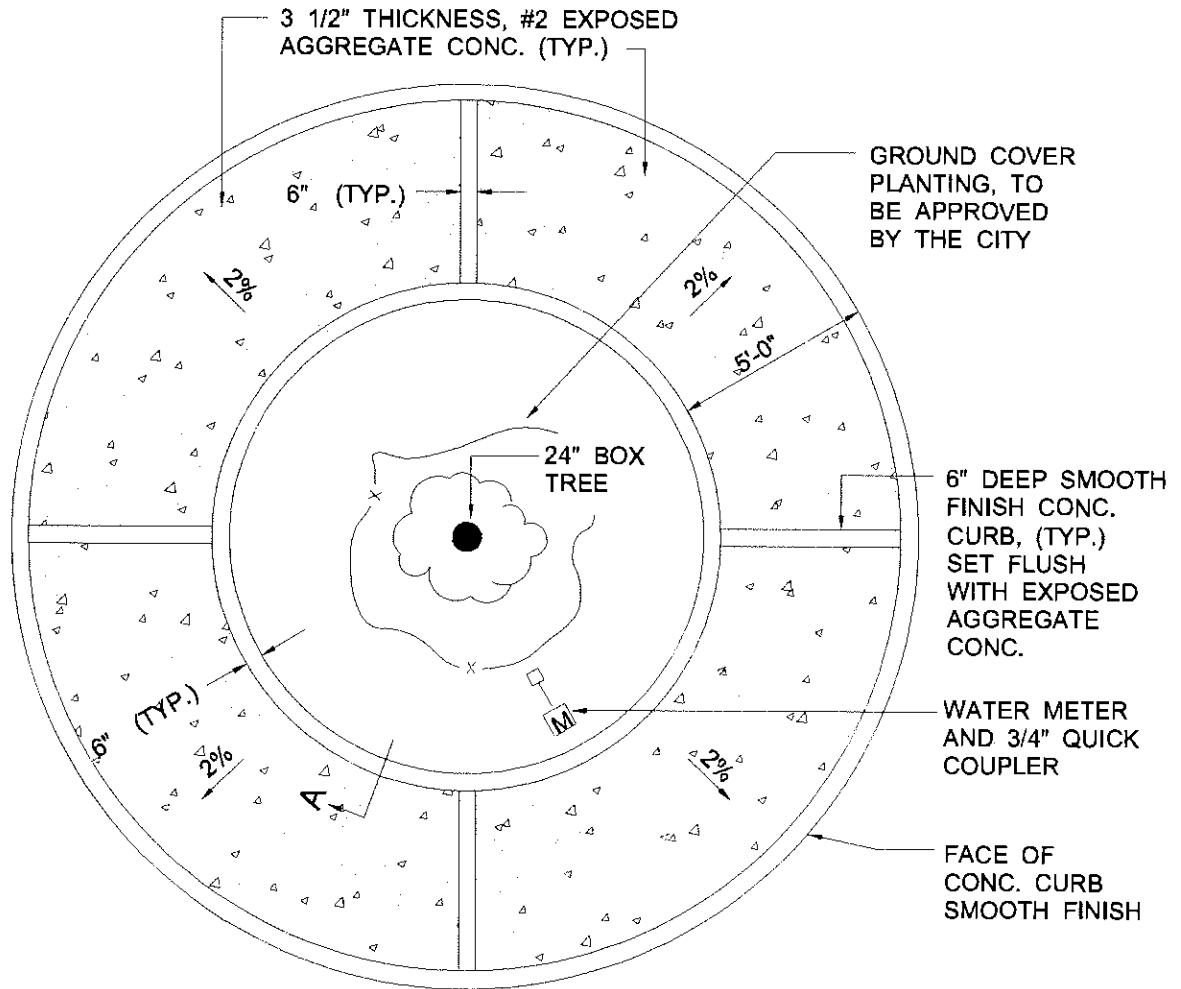
CITY OF HERCULES		
TYPE A CUL-DE-SAC PLANTER		
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SECTION A-A

NOTE:
Below grade irrigation piping and sprinkler heads, hand operated gate valve box and backflow prevention device per E.B.M.U.D. standards are required.

CITY OF HERCULES		
TYPE B CUL-DE-SAC PLANTER		
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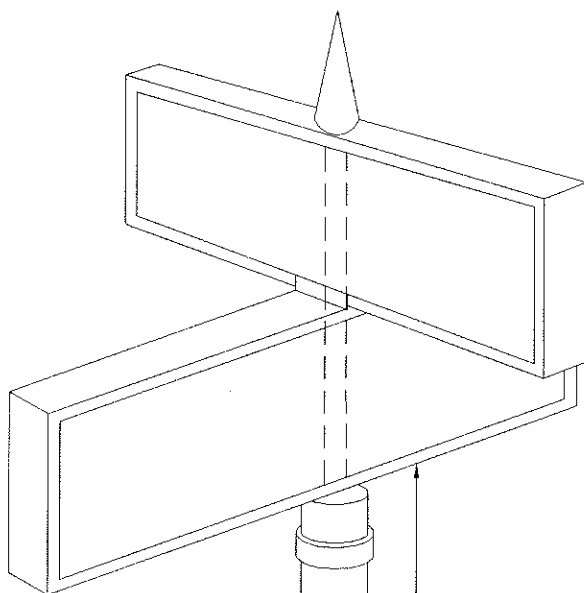


SECTION A-A

NOTE:

Below grade irrigation piping and sprinkler heads, hand operated gate valve box and backflow prevention device per E.B.M.U.D. standards are required.

CITY OF HERCULES		
TYPE C CUL-DE-SAC PLANTER		
JULY 2002	Page 3 of 3	RW-12.3



2" STD.
GALVANIZED
IRON PIPE

9' - 0"

FINISH GRADE

PCC CONCRETE

1' - 0"
MIN.

5"

2' - 7"

3"

1' - 0"

GENERAL NOTES:

1. STREET NAME SIGNS SHALL BE CONSTRUCTED IN THE LOCATIONS SHOWN ON THE PLANS

MATERIALS:

1. STREET NAME SIGNS AND MOUNTING HARDWARE SHALL BE AS MANUFACTURED BY HAWKINS-HAWKINS INC., "ASTROSIGN" 2 NAME ASSEMBLY V14(HA) 2C4P.
2. PLATES SHALL BE TYPE F.B. 102 DOUBLE FACED 0.050" THICK ALUMINUM, 6" HIGH BY VARIED LENGTH. LETTERS SHALL BE SILVER REFLECTIVE L.A. "MISSION STYLE" 4" COPY ON NON-REFLECTIVE L.A. BROWN, FINISH: PLATES SHALL BE SURFACED WITH "SAFE-FACE" MATERIAL, NO SUFFIX OR ARROWS. PLATES SHALL BE SET IN THE CROSSPIECE AT 90 DEGREES TO EACH OTHER UNLESS OTHERWISE AUTHORIZED BY CITY.

MOUNTINGS:

1. FREE STANDING MOUNTINGS SHALL CONFORM WITH THE DETAILS SHOWN HEREON.
2. POLE MOUNTED STREET NAME SIGNS MOUNTED ON POWER POLES, ELECTROLIERS ETC. SHALL BE MOUNTED WITH WING BRACKET AND STRAPPED TO POLES BY MEANS OF TWO STAINLESS STEEL STRAPS AND CLAMPS USING EITHER V14F-PHA-WB2P (SINGLE NAME) OR V14F-HA-WB4P (TWO NAME) MOUNTING ASSEMBLIES. FOR MOUNTING ON WOOD POLES USE WING BRACKETS V14F-PHA-WB 316 ATTACHED WITH TWO LAG BOLTS.

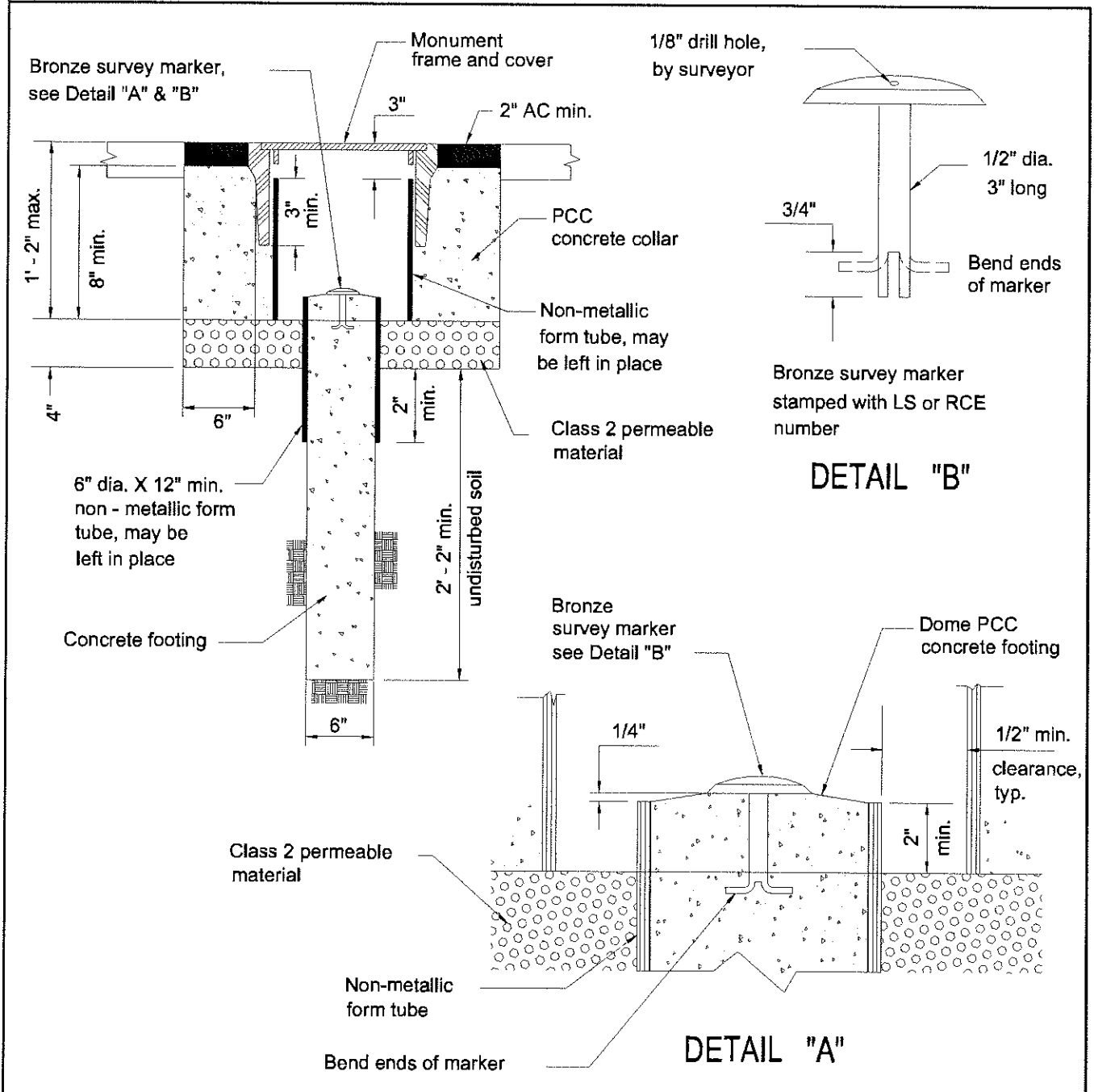
CITY OF HERCULES

STREET NAME SIGN FOR
RESIDENTIAL AND COMMERCIAL

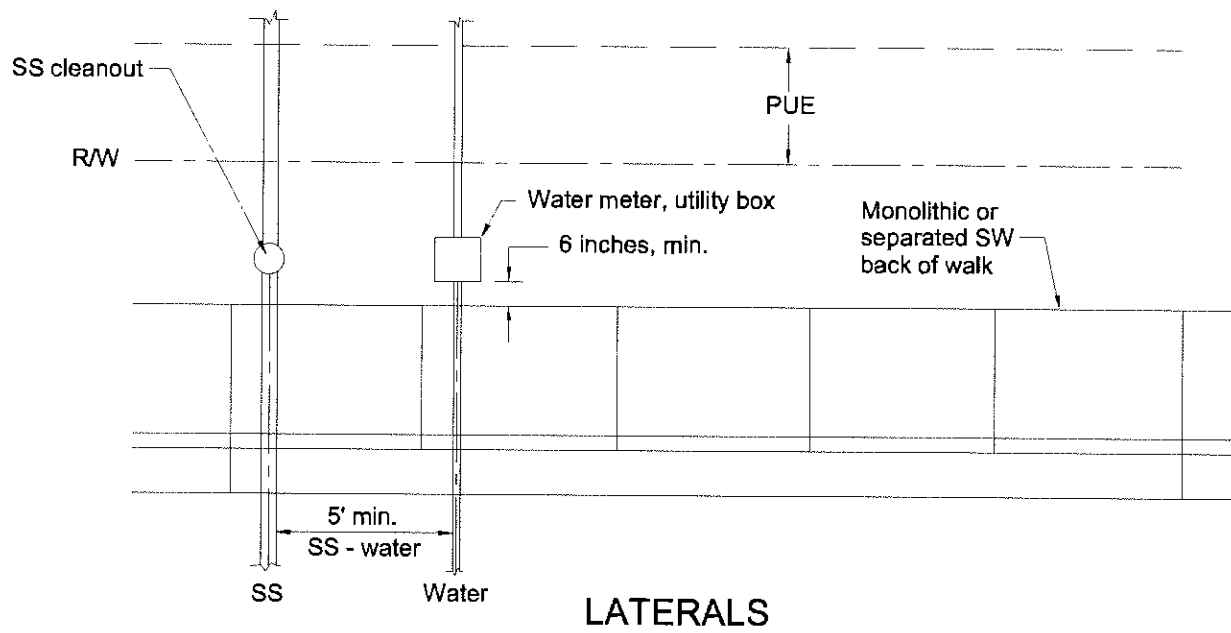
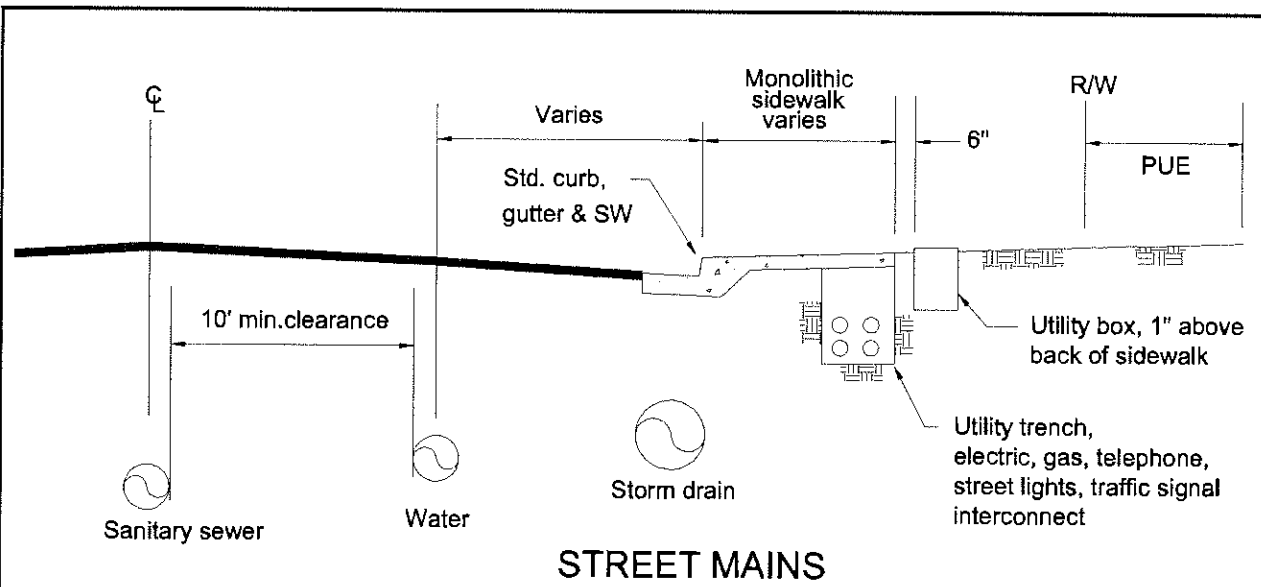
JULY 2002

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RW-13.1



CITY OF HERCULES		
MONUMENT		
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NOTES:

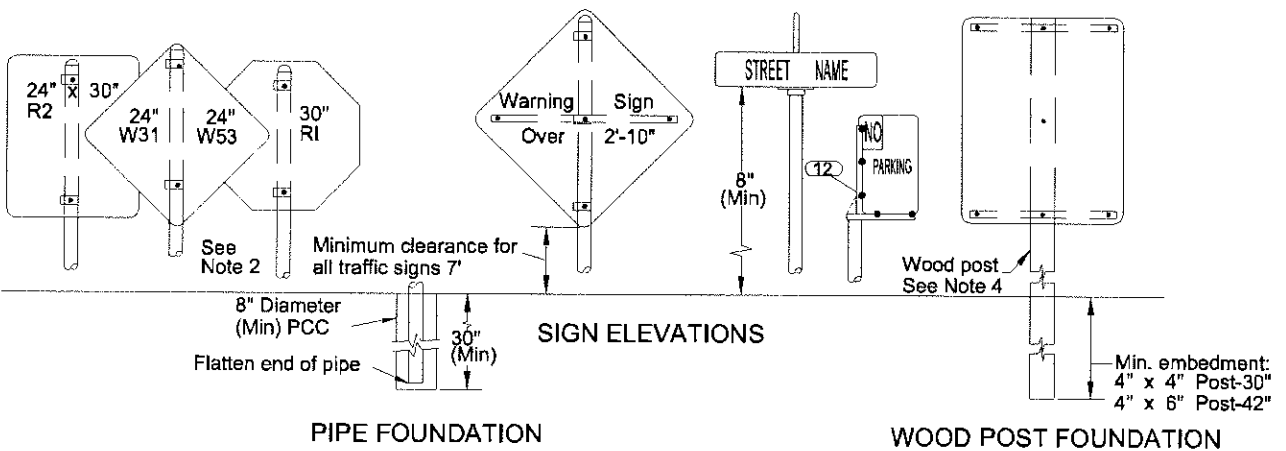
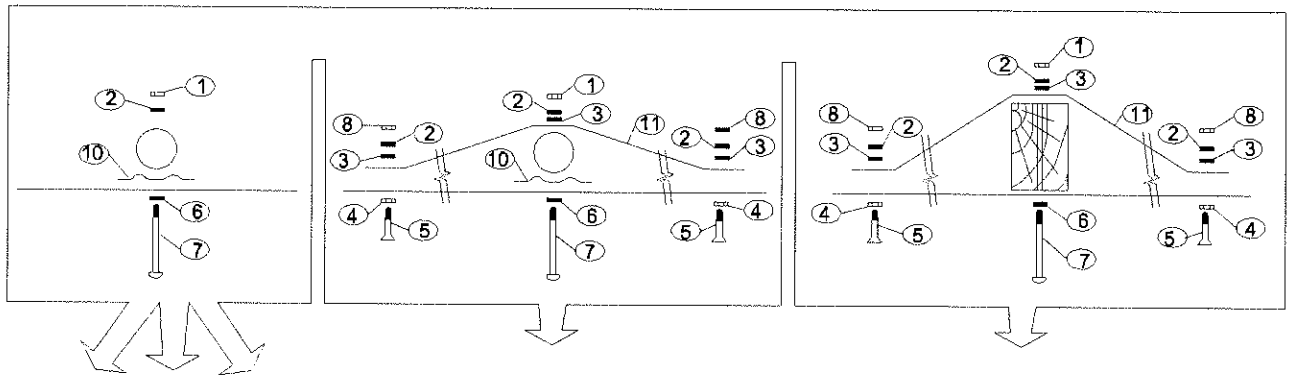
1. Water lines shall be placed on the north or west side of the street centerline.
2. Utility services shall be located a minimum of 2 feet away from any driveway. No utility services shall be placed beneath a driveway unless approved by the Engineer.
3. All utility boxes in driveway areas shall have traffic lids.

CITY OF HERCULES		
UTILITY LOCATIONS		
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HARDWARE SCHEDULE

- ① 5/16 inch nut, galvanized
- ② Lock washer, galvanized
- ③ Flat washer galvanized
- ④ Finishing washer, nickle plated
- ⑤ 1/2 inch x 1 inch brass flathead bolt
- ⑥ Fiber washer
- ⑦ 5/16 inch x 3 1/2 inch buttonhead bolt, galvanized
- ⑧ 1/4 inch brass nut
- ⑨ 5/16 inch x 6-1/2 inch buttonhead bolt, galvanized
- ⑩ Standard sign saddle, galvanized
- ⑪ Standard sign back brace, galvanized
- ⑫ Standard cast aluminum "L" bracket

TRAFFIC SIGN AND HARDWARE ASSEMBLY DETAILS



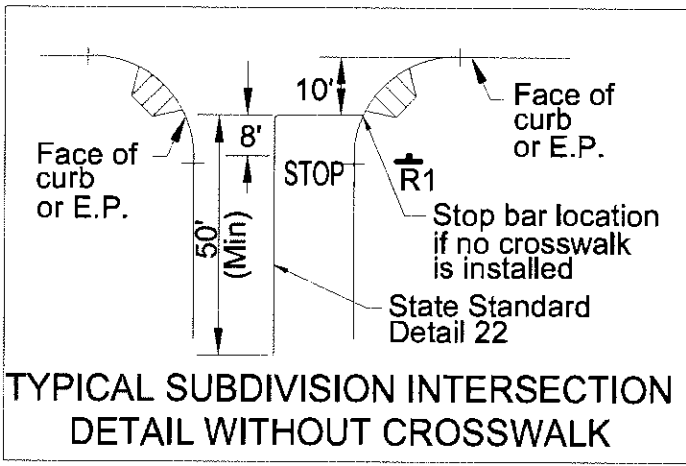
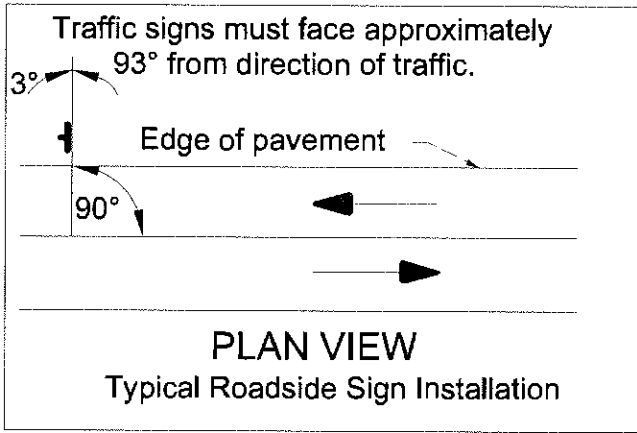
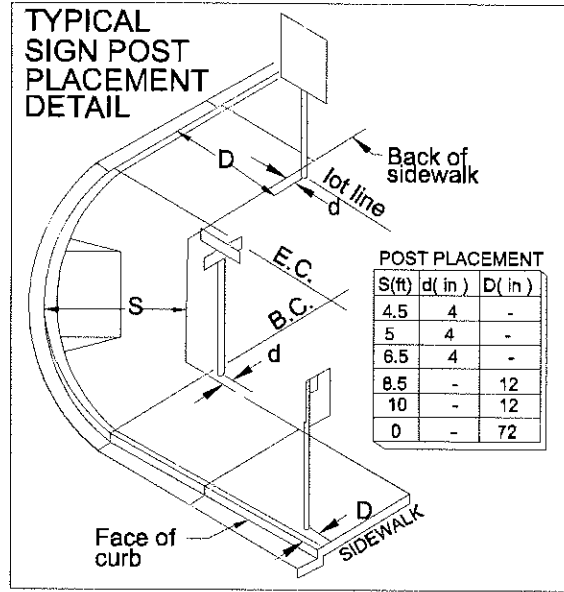
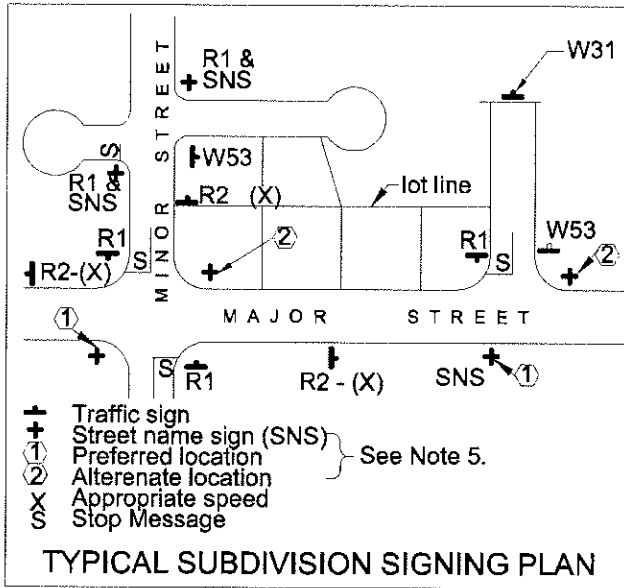
CITY OF HERCULES

**SIGNING AND STRIPING
STANDARDS**

JULY 2002

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RW-16.1



NOTE: Crosswalk shall be centered on the curb ramps, or as directed by the Engineer.

NOTES:

1. Street name and traffic signs shall conform to the current City Ordinance Specifications.
2. All sign posts shall be 2-3/8 inch O.D. galvanized iron pipe as shown on this standard plan. Two inch (12 gauge) "Unistrut" or "Ulti-mate" square sign post systems approved for highway sign use by the FHWA are an acceptable substitution.
3. Posts supporting street name signs and traffic signs shall not be painted.
4. Wood posts shall be used in rural locations only and shall conform to Section 56 of the State Standard Specifications for grade, species, and preservative treatment.
 - a. Use 4 inch x 4 inch posts with any size R7 sign.
 - b. Use 4 inch x 6 inch wood posts with any 36 inch x 42 inch R2 sign. A hole must be drilled at the base in accordance with State Standard Plan RS2 "Breakaway Feature".
5. Street name signs shall be installed on the corner with the greatest sight distance to the sign and which favors the major street.
6. One street name sign assembly shall be installed at the intersection of City or County maintained roads with two or more lanes in each direction.
7. Where sign posts are to be installed within an existing sidewalk, the sidewalk shall be sawcut to a neat appearance when finished to surrounding grade.
8. Where conditions permit, street name signs (SNS) may be installed on the same sign post with a STOP (R1) sign.
9. Pavement markings shall be thermoplastic and shall conform to the State Standard Specifications.
10. For G7 signs, use 6 inch U.C. and 4-1/2 inch L.C. lettering.
11. The first 3 inches of all island noses shall be painted with reflective white paint.
12. Striping details and markings shall conform to the State Standard Plans.
13. Carriage bolts shall be peened after assembly.

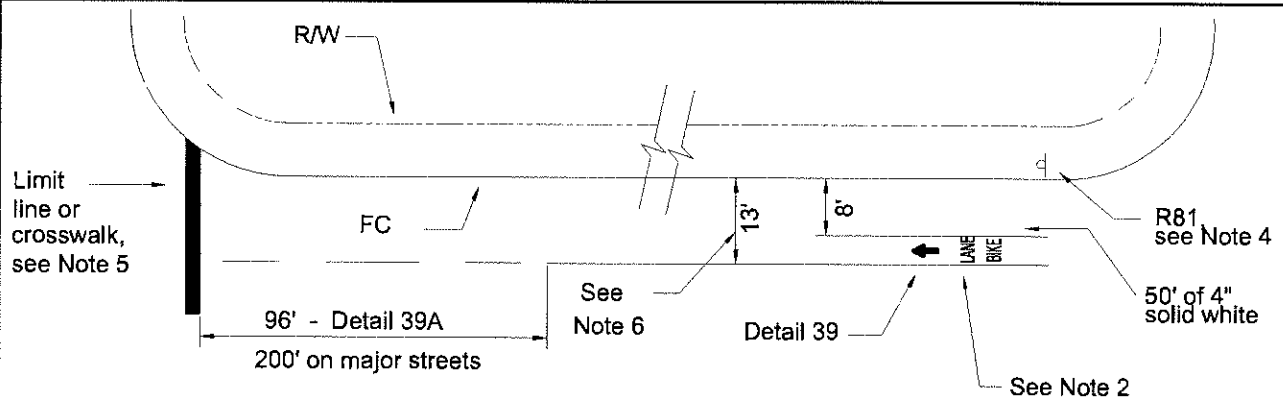
CITY OF HERCULES

SIGNING AND STRIPING
STANDARDS

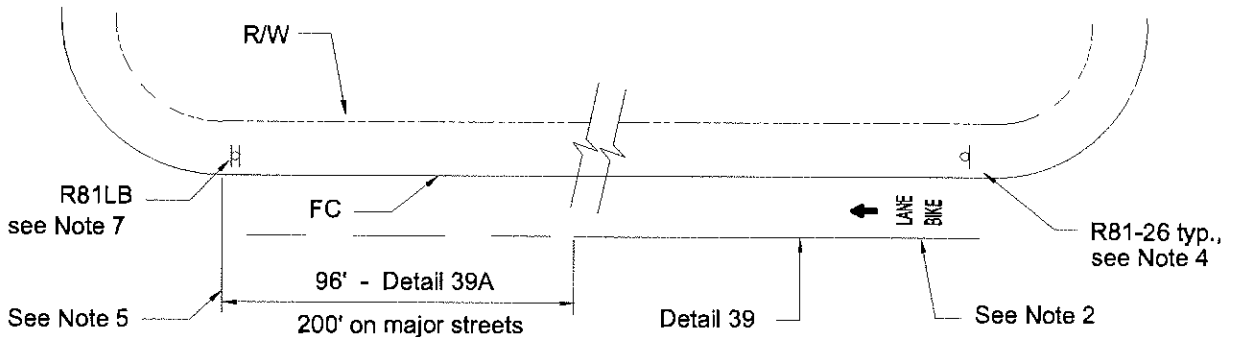
JULY 2002

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RW-16.3



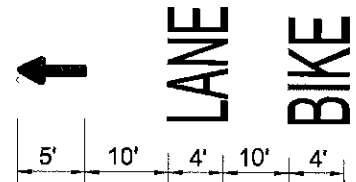
WITH PARKING



WITHOUT PARKING

NOTES:

1. See Standard Plan RW-16 for sign pole locations.
2. Bike Lane legend shall be per Caltrans Standard Plan A24A "Pavement Marking Arrows" and A24D "Pavement Marking Words".
3. All striping to be thermoplastic except bike lane legends which shall be installed using white paint.
4. Install 12 inch x 18 inch R81 signs at the beginning of the bike lane at all major street intersections and at a 1/2 mile minimum spacing. Install legends at the beginning of the bike lane at all intersections and at a 1/2 mile minimum spacing.
5. At crosswalks or limit lines, extend Detail 39A to the line; otherwise end the line at the curb return.
6. Parking plus Bike Lane may be reduced to 12 feet in special cases as approved by the Engineer.
7. On major streets install R81LB back to back with the last R81-26 on each block.

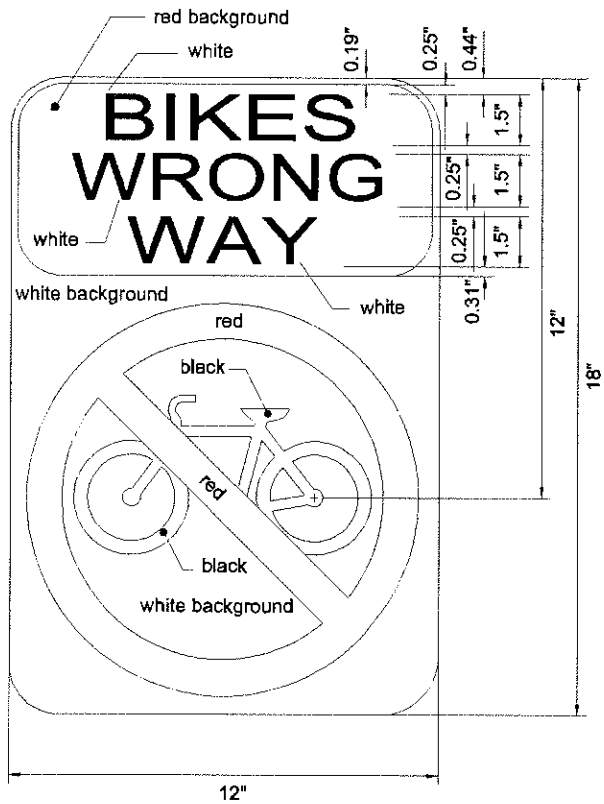


BIKE LEGEND DETAIL

Legend type	Legend area
←	7 SF
LANE	6 SF
BIKE	5 SF
total:	18 SF

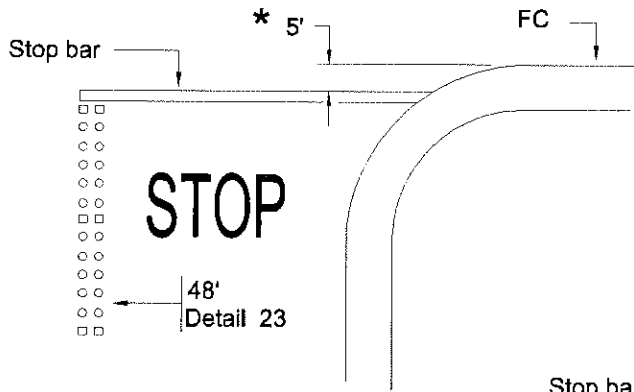


R81 - 26

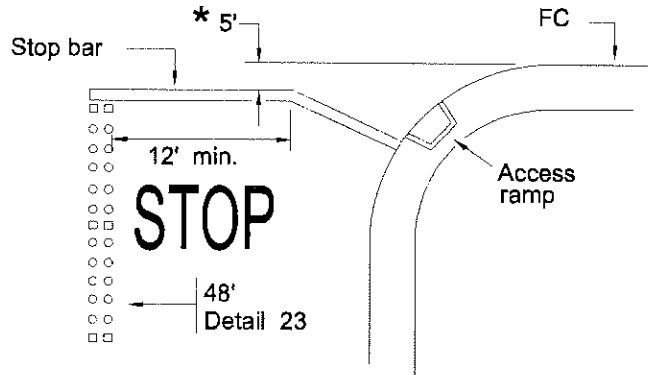


R81LB

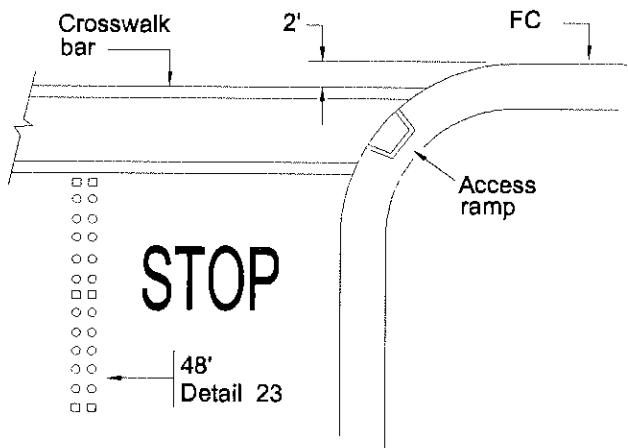
CITY OF HERCULES		
BIKE LANES SIGNS		
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STOP BAR AT INTERSECTION
NO ACCESS RAMP



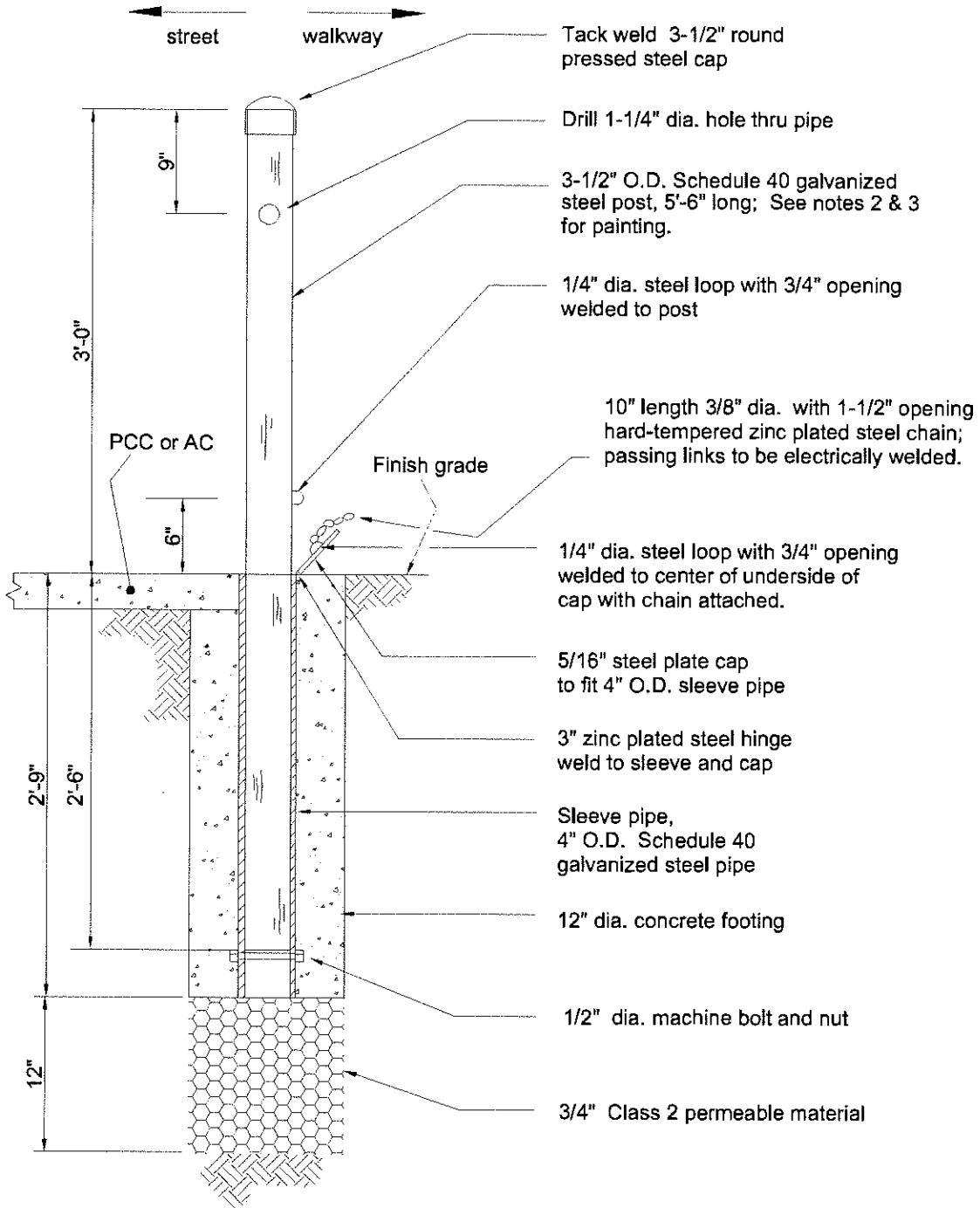
STOP BAR AT INTERSECTION
WITH ACCESS RAMP



CROSSWALK

* 10' when sidewalk is 10' wide

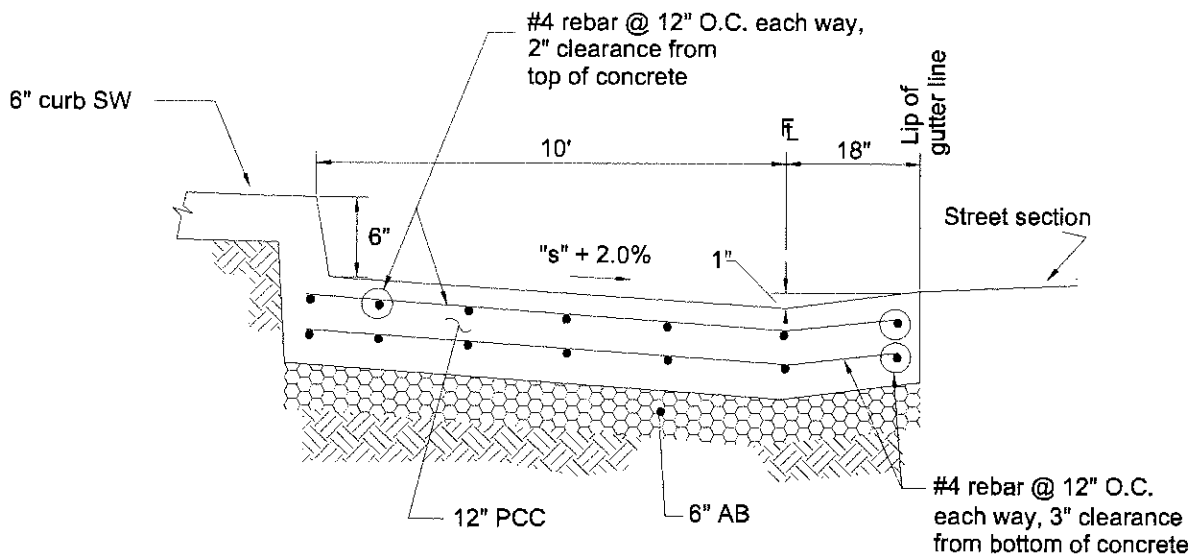
CITY OF HERCULES		
CROSSWALK / STOP BAR INSTALLATION		
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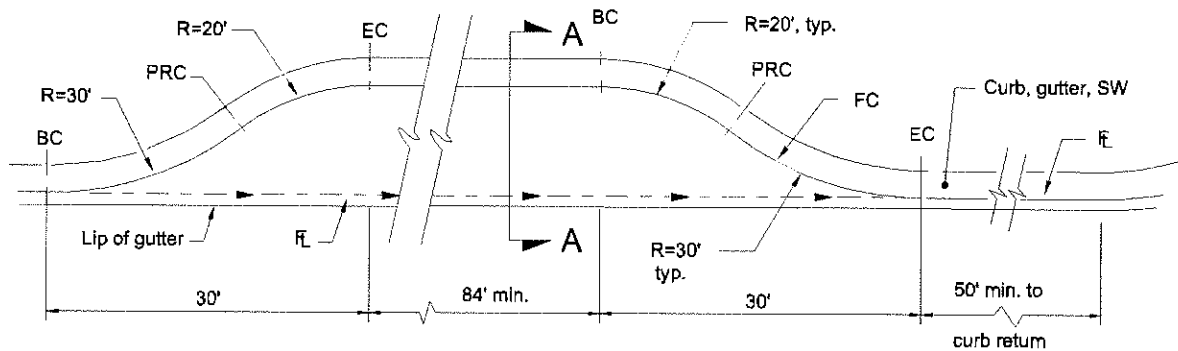
NOTES:

1. Locate all underground utilities prior to excavating post footing.
2. Prime all metal with one coat of galvanize-compatible primer and two coats of white industrial enamel.
3. Paint the top 6 inches of the post with two coats of reflective yellow enamel or attach two 3 inch wide strips of reflectorized yellow tape.

CITY OF HERCULES		
REMOVABLE BOLLARD		
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SECTION A-A



BC = begin curve
PRC = point of reverse curve
EC = end curve

NOTES:

1. The flowline elevation shall control the top of curb elevation.
2. The bus turnout shall be installed beyond the street intersection and not immediately before the intersection.

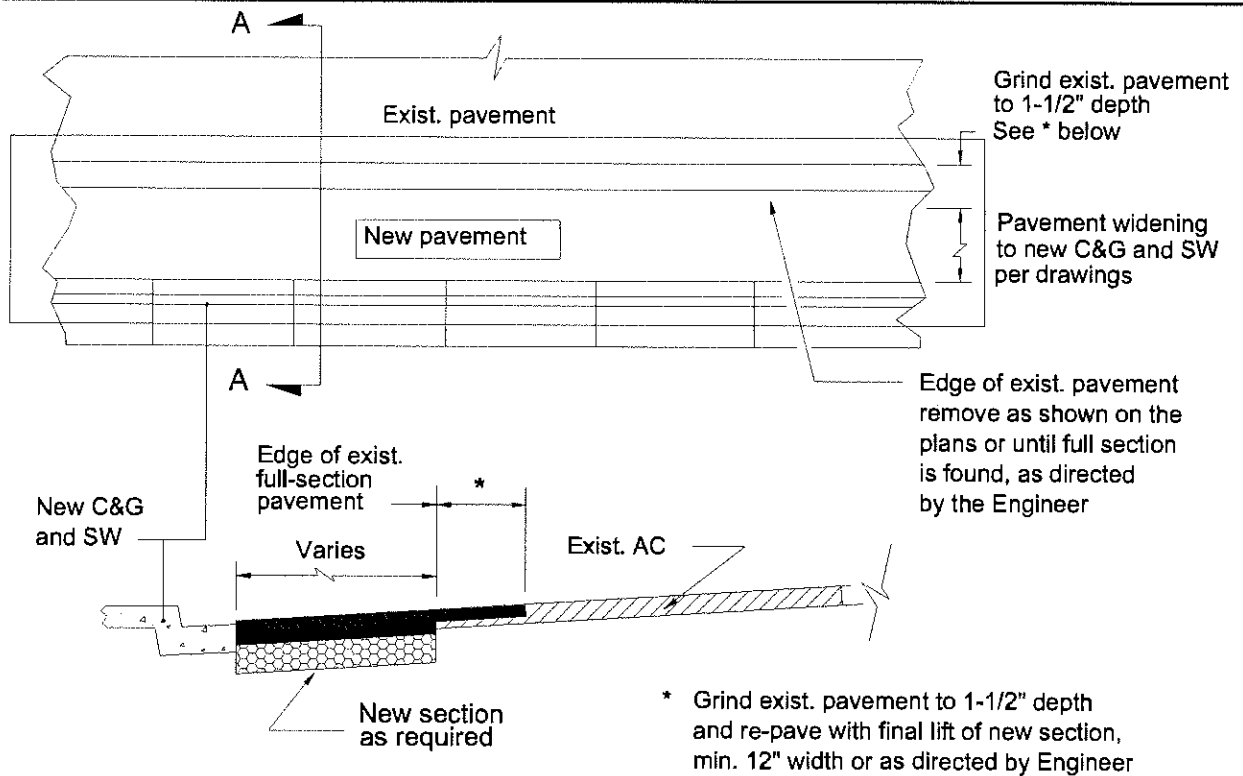
CITY OF HERCULES

BUS TURNOUT

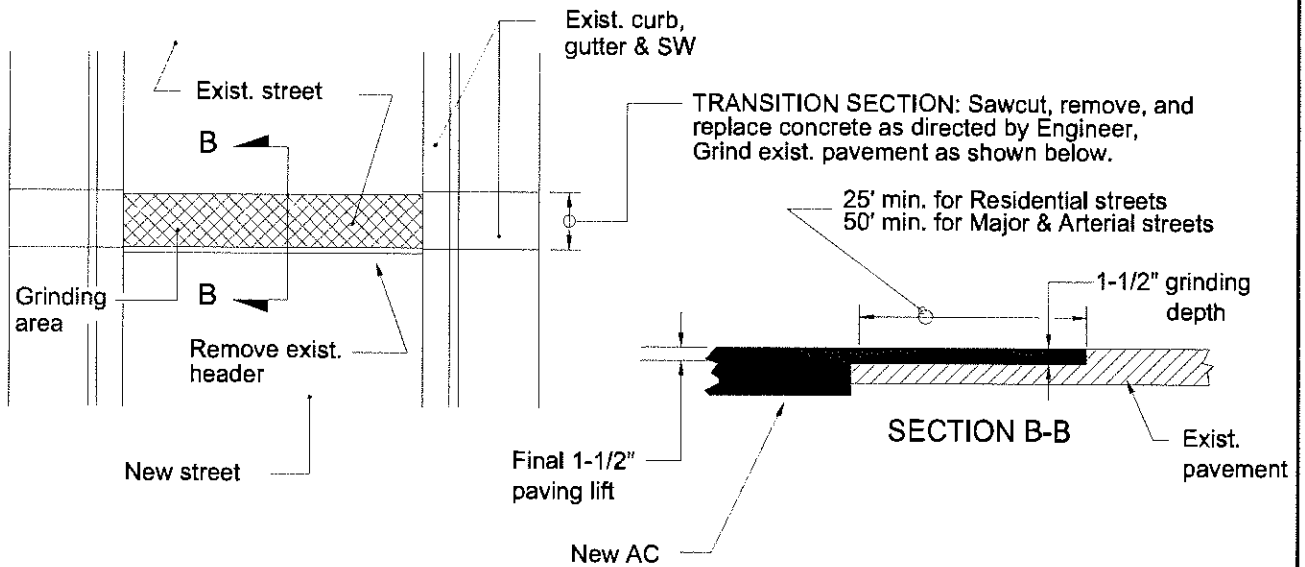
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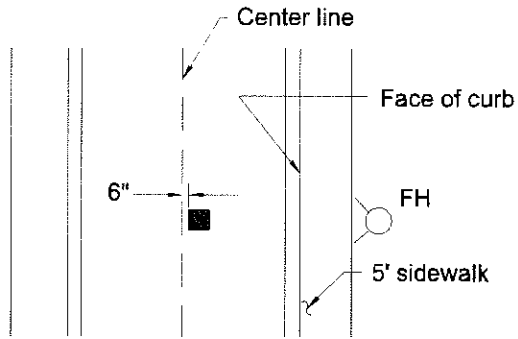


SECTION A-A PAVEMENT WIDENING

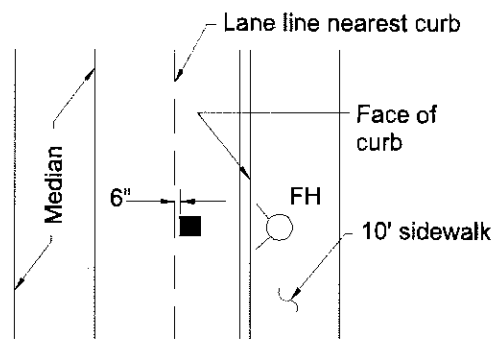


SECTION B-B STREET EXTENSION

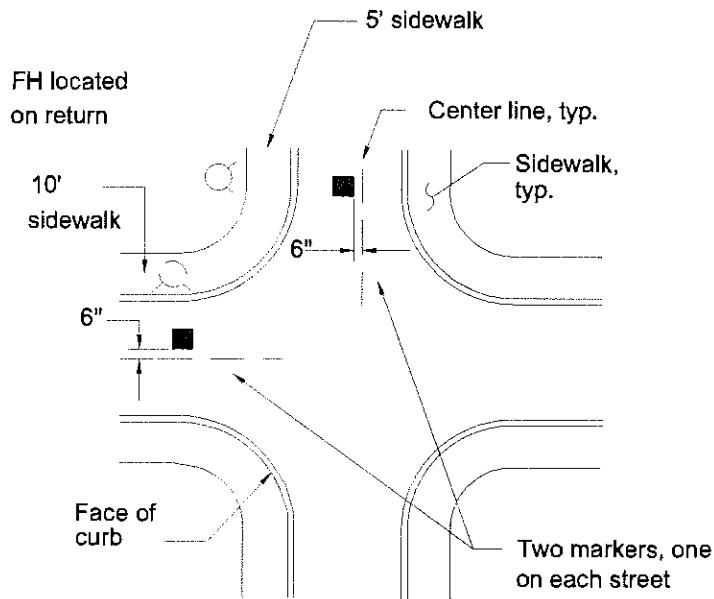
CITY OF HERCULES		
PAVEMENT WIDENING AND CONNECTIONS		
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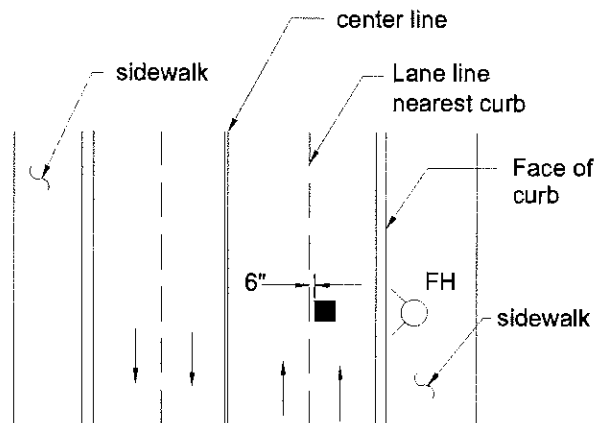
FH MARKER LOCATION



FH MARKER LOCATION WITH MEDIAN



FH MARKER LOCATION at intersection



FH MARKER LOCATION WITHOUT MEDIAN

■ Two-way blue reflective pavement marker, typ.

CITY OF HERCULES

FIRE HYDRANT MARKER

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Excerpt from “Electric Gas and Service requirements, 2001” by Pacific Gas and Electric Company, specifically Section 1, General, pages 1-1 through 1-7, page 1-2 intentionally left blank by PG&E and not included.

SECTION 1

TERMS, DEFINITIONS, AND ABBREVIATIONS

1.01 GENERAL

Unless otherwise stated, the words “directed”, “required”, “permitted”, “ordered”, “instructed”, “designated”, “applicable”, “appropriate”, “sufficient”, “proper”, “desirable”, “necessary”, “prescribed”, “approved”, “acceptable”, “satisfactory” or words of like import, refer to actions, expressions and prerogatives of the Engineer.

Masculine gender words include the feminine. References to gender, such as “workman” and “flagman” and the pronoun “he” or “his” referring to such titles, are abstract in the specifications used for the sake of brevity and are intended to refer to persons of either sex. Singular words include the plural and “person” includes firms, companies and corporations.

1.02 DEFINITIONS

Acceptance: The formal written acceptance by the City Council of an entire Contract that has been completed in all respects in accordance with the Contract Documents and any approved modifications.

Acts of God: Earthquakes in excess of magnitude 6.0 on the Richter Scale, and tidal waves.

Addenda: Written or graphic instruments issued prior to the Bid which modify or interpret the Contract documents, plans and specifications, by additions, deletions, clarifications or corrections.

Agreement: The written improvements agreement between the City and the Developer covering the Work to be performed; other Contract Documents may be attached to and made a part of the Agreement.

Bidder: Any properly licensed and qualified individual, firm, partnership, corporation, joint venture or combination thereof, submitting a proposal for the work contemplated, acting directly or through an authorized representative.

Calendar Days: All days except legal City designated holidays. The City’s designated holidays are New Year’s Day, Martin Luther King, Jr. Day, President’s Day, Memorial Day, Independence Day, Labor Day, Veteran’s Day, Thanksgiving Day, Day after Thanksgiving Day, December 24, December 25, and December 31. When a holiday listed above falls on a Saturday, the preceding Friday shall be considered the holiday, and when a holiday listed above falls on a Sunday, the following Monday shall be considered the holiday.

City: The governing body of the City of Hercules, County of Contra Costa, State of California.
City Council: The City Council of the City of Hercules, California.

Claim: A separate demand by the Contractor for a time extension, payment of money or damages arising from work done by, or on behalf of, the Contractor pursuant to the Contract and payment of which is not otherwise expressly provided for, or the claimant is not otherwise entitled to, or an amount the payment of which is disputed by the City.

Completion: Completion of the Work shall be the date of acceptance of the Work by the City Council.

Consulting Engineers: The engineering firm, architectural firm or other specialty firm and their designated representatives acting on behalf of the City of Hercules as their authorized representative within the scope of authority defined in their contract with the City.

Contract Documents: The Contract Documents shall include the Improvement Agreement, all Insurance Certificates and Endorsements, Performance Bond, Payment Bond, Maintenance Bond, General Conditions and Requirements for Development, Technical Specifications, Standard Plans, Approved Construction Drawings, Approved Revisions to the Approved Construction Drawings, and all appurtenant reports and documents used in the design and construction of the Work.

Contract Item: A specific unit of work for which a price is provided for in the Contract. Also Bid Item or Pay Item.

Contract Time: The number of calendar days or working days stated in the Contract Documents for the completion of the Work.

Contractor: The person or persons, firm, partnership, corporation, or combination thereof, which have entered into a contract with the City, as a party or parties of the second part or his or their legal representatives. Also Developer.

Contractor's Plant and Equipment: Everything, except labor, used by the Contractor in order to carry out the work, but not to be incorporated in the work.

Contractor's Project Representative: Contractor's superintendent for the project through whom all matters addressed to the Contractor regarding the project shall be directed. The Contractor may designate in writing to the Engineer an authorized representative other than the Superintendent. The Superintendent and the Authorized Representative shall be the only two individuals who shall have the authority to provide direction and receive authorization on matters pertaining to the project.

Days: Days shall mean consecutive calendar days unless otherwise specified. A day is 24 hours, measured from midnight to the next midnight.

Defective Work: Work that is, in the opinion of the Engineer or his representative, unsatisfactory, faulty, or deficient, or that does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; or work that has been damaged prior to the City's final acceptance.

Design: Shall mean street alignment, grade, geometric section, structural section; sanitary sewer alignment, grade, size; water system alignment, size, valve installation, fire hydrant location; storm drain alignment, grade, size and miscellaneous improvements as required by the Engineer.

Designated Authority: The term Designated Authority, if used in the Contract Documents, shall be taken as a general reference to designate the party or parties authorized or employed by the City to observe and test materials or completed work and to observe their general compliance with the Contract Documents. The Designated Authority may include the following, among others, insofar as they perform designated functions within the scope of their authority: Engineer and his duly authorized representative, consulting engineers, soils engineers.

Developer: Shall mean any person, firm, corporation, partnership or association engaged in the development of property in part or in whole by the placing of any improvements thereon, whether the property was previously developed in whole, in part, or at all.

Developer's Engineer: The Engineer whose signature and stamp is on the Developer's Approved Construction Drawings.

Drawings / Approved Construction Drawings: The City approved improvement construction drawings and plans, signed and stamped by the Developer's Engineer; and all referenced standard plans and standard specifications.

Effective Date of Agreement: The date indicated in the Agreement on which the Agreement was executed by the City.

End of Agreement: The End of the Agreement shall be the day the maintenance bond expires.

Engineer: The Engineer designated by the City to have administrative control over the work acting either directly or through duly authorized personnel.

Engineer's Estimate: The list of estimated quantities of work to be performed as contained in the "Bidder's Proposal".

Easement: An easement dedicated to the City or Public Utility that shall be continuing and irrevocable unless formally abandoned.

Extra Work: An item of work not provided for in the Contract or not included in bid items and not appurtenant or incidental to the items included, but found by the Engineer to be essential to the satisfactory completion of the Contract within its intended scope.

Field Memo: A written order issued by the Engineer to provide directions or corrections to ensure compliance with the Contract Documents.

Geotechnical (Soils) Report: A report prepared by any person, firm, partnership, or corporation legally licensed to prepare "Geotechnical Reports" in the State of California.

Green Book: Standard Specifications for Public Works Construction, Building News, Inc., latest edition.

Hazardous Waste: The term Hazardous Waste shall have the meaning provided in Section 25117 et. Seq. of the California Health and Safety Code. RCRA Hazardous Waste shall have the meaning provided in Section 25120.2 of the California Health and Safety Code.

Inspection: An authorized representative of the Engineer assigned to make all necessary inspections of the work performed or being performed, or of the materials furnished by the Contractor.

Invitation to Bid: The notice published and included in the proposal package. Also called the Notice to Contractors.

Improvements: Refers to street work, sidewalk, curb, gutter, driveways, water mains, sanitary sewer, storm drainage, public utilities, landscaping, and fences to be installed by the developer on land to be used for public right of way.

Laboratory: The designated materials testing laboratory authorized by the Engineer to test materials and work involved in the Contract.

Liquidated Damages: The amount prescribed in the specifications, pursuant to the authority of §10226 of the California Public Contract Code, to be paid to the City or to be deducted from any payments due or to become due the Contractor for each day's delay in completing the whole work, or any specified portion of the work, beyond the time allowed in the specifications.

Manual of Warning Signs: The "Manual of Warning Signs, Lights, and Devices for Use in Performance of Work Upon Highways" of the State of California, Department of Transportation, latest edition.

Notice of Award of Contract: The formal notice of the contract for the work, issued by the City to the lowest responsible bidder that was awarded the Contract.

Notice to Proceed: The formal notice to proceed, issued by the Engineer, after all Contract, insurance and bond forms have been approved and the Agreement has been executed by the Contractor.

Plans: The official project plans and standard plans, profiles, cross sections, working drawings and supplemental drawings, approved by the Engineer, that show the location, character, dimensions and details of the work to be performed.

Proposal: The offer of the bidder for the work, when made out and submitted in the prescribed proposal form, properly signed and guaranteed. Also referred to as Proposal Form.

Proposal Guarantee: The cashier's check, certified check, or bidder's bond accompanying the proposal submitted by the bidder, as a guaranty that the bidder will enter into a Contract with the City for the performance of the work if the Contract is awarded to him.

Reference Specifications: Those bulletins, standards, rules, methods of analysis or tests, codes, and specifications of other agencies, engineering societies, or industrial associations referred to in the Contract documents. These refer to the latest edition, including amendments in effect and published at the time of advertising the project or issuing the permit, unless specified otherwise.

Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that will establish the standards by which the portions of the Work will be judged.

Shall, Will or May: "Shall" or "will" is used to stipulate anything that is mandatory and means shall or will be done, or be performed, and means that the Contractor or the City has entered into a covenant with the other party to do or perform the same. "May" is permissive.

Shop Drawings: All drawings, diagrams, illustrations, brochures, schedules and other data that are prepared by the Contractor, a subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

Special Provisions: Specific clauses setting forth conditions or requirements that are peculiar to the work and that are supplements to the Standard Specifications.

Specific Plan: Any and all specific plan documents that have been adopted for a given design area by the Planning Commission and the City Council.

Specifications: The written directions, provisions and requirements pertaining to the method and manner of performing the work, or to the quantities of the materials to be furnished under the contract, together with all other directions, provisions and requirements, plus such amendments, deletions from, or additions to, that may be provided by supplemental agreements.

Standard Plans: The Standard Plans of the City of Hercules. Whenever the words "Standard Plans" are used without further identification or title, they shall mean the latest edition of the "Standard Plans" of the City of Hercules.

Standard Specifications: The Standard Specifications of the City of Hercules. Whenever the words "Standard Specifications" are used without further identification or title, they shall mean the latest edition of the "Standard Specifications" of the City of Hercules.

State Highway Design Manual: The State of California, Department of Transportation, Highway Design Manual, latest edition.

State Materials Manual: The Materials Manual of Testing and Control Procedures of the State of California, Department of Transportation, Public Transportation Laboratory, Manual of Tests, latest edition.

State Planning Manual: The Planning Manual of Instructions of the State of California, Department of Public Works, Department of Transportation, Part 1 through Part 8, latest edition.

State Standard Specifications: The Standard Specifications of the State of California, Department of Transportation, latest edition.

State Standard Plans: The Standard Plans of the State of California, Department of Transportation, latest edition.

State: The State of California.

Subcontractor: The individual, partnership, corporation or other legal entity entering into a contract with the Contractor to perform a portion of the work, sometimes referred to as an employee of the Contractor.

Submittal: Any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, survey data, record drawings, or similar items.

Substantial Completion: That date, as certified by the Engineer, when the construction of the work, or a specified portion is sufficiently completed, in accordance with the Contract Documents, so that the work can be used.

Supplier: A manufacturer, fabricator, retailer, wholesaler, distributor, material-man, or vendor having a direct contract with the Developer to furnish materials or equipment to be incorporated in the Work by the Developer.

Surety: Any individual, firm, or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Underground Facilities: All pipelines, conduit, ducts, cables, wires, manholes, vaults, tanks, tunnels, drains, or other facilities or attachments, and any encasements containing the facilities that have been installed underground to furnish any of the following services or materials:

electricity, water, sewage or drainage, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic or other control systems.

Utility: Railroad tracks, overhead or underground wires, pipe lines, conduits, ducts, or structures, sewers or storm drains, operated, maintained, or existing in, or across, a public right of way or private easement.

Work: The term "work" shall be taken to mean all the work specified, indicated, shown or contemplated in the Contract to construct the improvements including all alterations, amendments or extensions made by a Contract Change Order or other written orders of the Engineer. The term includes all labor and materials and equipment necessary to produce the construction required by the Contract Documents, and all materials, equipment and incidentals incorporated in the construction. Anything and everything to be done for the execution, completion and fulfillment of the Contract to the satisfaction of the City.

Work Day: Any day, as determined by the Engineer, other than a legal holiday, Saturday or Sunday, on which the Contractor may proceed with regular work on the current controlling operation toward the completion of the Contract, unless the controlling operation of work is delayed by inclement weather.

1.03 ABBREVIATIONS

Whenever in these Design Standards, or in the Standard Specifications, references are made to the standards, specifications, or other published data of the various national, regional, and local organizations, the organizations may be referred to by their acronym or abbreviation. As a guide to the user of these specifications, the following acronyms or abbreviations shall have the meanings indicated.

AAMA	Architectural Aluminum Manufacturers Association
AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturer's Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute

AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLA	American Society of Landscape Architects
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CALOSHA	California Occupational Safety and Health Administration
CALTRANS	State of California, Department of Transportation
CBM	Certified Ballast Manufacturers
CEMA	Conveyors Equipment Manufacturers Association
CGA	Compressed Gas Association
CLPCA	California Lathing & Plastering Contractors Association
CLFMI	Chain Link Fence Manufacturers Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
EI	Electrical Engineers Institute
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society

IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturers Association
MPTA	Mechanical Power Transmission of Association
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electric Safety Code
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration (Federal)
PCA	Portland Cement Association
PUC	Public Utilities Commission
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Maker Association
SIS	Swedish Standards Association
SMA	Screen Manufacturer's Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry

TFI	The Fertilizer Institute
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriter's Laboratories, Inc.
UPC	Uniform Plumbing Code
USA	Underground Service Alert
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

SECTION 2

LEGAL RELATIONS AND RESPONSIBILITIES

2.01 LAWS TO BE OBSERVED

The Contractor shall keep fully informed of all existing and pending County, State and Federal laws and regulations and all municipal ordinances and regulations of the City of Hercules that may affect those engaged or employed in the work, or the materials used in the work, or that may affect the conduct of the work, and all orders and decrees of bodies or tribunals having any jurisdiction or authority over the work.

The Contractor shall protect and indemnify the City of Hercules and all of its officers, employees, and agents against any claim or liability arising from, or based on the violation of, any such laws, ordinances, regulations, orders, or decrees whether by himself, his employees, or his subcontractors. If any discrepancy or inconsistency is discovered in the Contract Documents for the work in relation to any law, ordinance, regulations, order or decree, the Contractor shall immediately report the discrepancy or the inconsistency to the Engineer in writing.

2.02 CONTRACTOR EQUIPMENT AND FACILITIES

The Contractor shall furnish and maintain in good condition all equipment, plant, and other facilities as required for the proper execution and inspection of the work. The facilities shall meet all requirements of applicable ordinances and laws.

Unless approved otherwise by the Engineer, the Contractor shall provide temporary toilet facilities at or near the site, at a location and in a form acceptable to the City. The temporary facilities shall be maintained in a sanitary condition at all times. When directed by the Engineer, the Contractor shall provide additional facilities and/or move the facilities to more convenient locations or to locations less disruptive to the general public. See ♣ 2.23.7 “Sanitation”.

2.03 LABOR

2.03.1 General

Only competent workmen shall be employed. Any person employed who is found to be incompetent, intemperate, troublesome, disorderly or otherwise objectionable, or who fails or refuses to perform his work properly, shall be immediately removed from the work by the Contractor and shall not be reemployed on the work.

2.03.2 Laws

The Contractor, his agents and employees shall be bound by, and shall comply with, all applicable provisions of the California Labor Code and with Federal, State and local laws related to labor.

The Contractor shall strictly adhere to the provisions of the Labor Code regarding minimum wages, the 8-hour day and 40-hour week, overtime, Saturday, Sunday, and holiday work, and non-discrimination because of race, color, national origin, ancestry, religion, sexual orientation, and other characteristics specified in the Labor Code. The Contractor shall forfeit to the City the penalties prescribed in the Labor Code for violations.

2.03.3 Prevailing Wages

The Contractor shall comply with § 1774 and § 1775 of the State Labor Code. In accordance with the Labor Code, the Engineer has on file a schedule of prevailing wage rates for the types of work to be done. The Contractor shall pay not less than the prevailing rates as required in the Labor Code.

The City will not recognize any claim for additional compensation because of payment by the Contractor of any wage in excess of the prevailing wage set forth in the Contract. The possibility of wage increases is one of the elements to be considered by the Contractor in determining the bid, and wage increases will not be considered as the basis of a claim against the City on the Contract.

2.03.4 Payroll Records

The Contractor's attention is directed to the provisions of § 1776 of the State Labor Code. Regulations implementing Labor Code §1776 are located in §16016 through §16019 and §16207.10 through §16207.19 of Title 8, California Code of Regulations. The Contractor shall be responsible for compliance with these regulations and for his subcontractor's compliance with these regulations.

For the duration of the project, the Contractor shall submit copies of certified payroll reports on a weekly basis. Failure to submit reports within two weeks after the last work day of each week may result in damages being assessed at the rate of fifty dollars (\$50) per day per employee on the job for the duration of non-compliance.

2.04 CONTRACTOR'S LICENSING LAWS

The Contractor's attention is directed to the provisions of Chapter 9 of Division 3 of the California Business and Professions Code concerning the licensing of contractors. All bidders and contractors shall be licensed in accordance with the laws of the State of California and any bidder or contractor not so licensed is subject to the penalties imposed by such laws. The Contractor's attention is also directed to the provisions of § 10164 of the Public Contract Code.

2.05 WEIGHT LIMITATION

Unless expressly permitted in the special provisions, construction equipment shall not exceed the maximum weight and size limitations set forth in the California Vehicle Code unless approved by the Engineer in writing. The Contractor shall repair all facilities damaged by overloaded equipment or vehicles.

2.06 PAYMENT OF TAXES

Contract prices bid for the work shall include full compensation for all taxes which the Contractor is required to pay, whether imposed by Federal, State or local government, including, without being limited to, Federal excise tax. No tax exemption certificate nor any document designed to exempt the Contractor from payment of any tax will be furnished to the Contractor by the City of Hercules, as to any tax on labor, services, materials, transportation, or any other items furnished pursuant to the Contract.

2.07 PERMITS AND LICENSES

The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of the work. On contracts awarded by the City, fees and charges for City issued permits will be waived.

Permits shall be obtained whenever the work comes under the jurisdiction of other agencies. The Contractor shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including the furnishing of insurance and bonds, if required. The Contractor shall pay for all charges and inspection fees necessary for the prosecution of the work. The appropriate jurisdictional agencies shall be notified by the Contractor prior to beginning any work covered by the permit.

All contractors and subcontractors must have or obtain a City Business License and such business license fees will be required for all work undertaken within the limits of the City of Hercules.

2.08 PATENTS

The Contractor shall hold and save the City, its officers, agents, and employees harmless from and against all and every demand or demands, of any nature or kind, for, or on account of, the use of any patented invention, process, equipment article, or appliance employed in the execution of the work or included in the material or supplies furnished under the Contract.

Should the Contractor, his agents, subcontractors, or employees, be enjoined from furnishing or using any invention, process, equipment article, materials, supplies or appliance supplied, or required to be supplied, or used under the Contract, the Contractor shall promptly substitute other inventions, processes, equipment, articles, materials, supplies, or appliances in lieu thereof. Substitutions shall be of equal efficiency, quality, finish, suitability, and market value, and shall be satisfactory to the Engineer.

Should the Contractor neglect or refuse to make any required substitution promptly, or to pay royalties and secure the licenses that may be necessary and requisite, the Engineer shall have the right to make the substitutions. Alternatively, the City may pay the royalties and secure the licenses and charge the cost against any money due the Contractor, or recover the amount from him and his surety, notwithstanding final payment under the Contract that may have been made.

2.09 STATE AND FEDERAL REGULATIONS

The Contractor shall conform to all requirements of Title 88, Chapter 4 of the California Administrative Code and the rules and regulations pertaining to safety established by the California Division of Industrial Safety, California Occupational Safety and Health Act, the California and Federal Office of Safety and Health Administration and other applicable regulations.

2.10 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall conduct his operations to offer the least possible obstruction and inconvenience to the public. He shall have under construction no greater length or amount of work than he can prosecute properly with due regard to the safety, rights, and convenience of the public.

At least two (2) weeks prior to the start of construction, the Contractor shall notify all businesses and residents, and all emergency, public transportation, garbage collection, and school bus services, by letter, of the pending work, unless otherwise directed by the Engineer.

At least five (5) working days in advance of road closures, all emergency, public transportation, garbage collection, and school bus services shall be notified by the Contractor, in writing, of the locations, times and date of lane closures. In case of schedule changes, these services shall be notified by telephone at least two (2) working days before the road closure.

A copy of all written notices and their dates of distribution shall be given to the Engineer. The Contractor shall furnish and install project information signs informing through traffic of the construction start and ending dates and the name and contact information of the Contractor.

Project information sign fabrication and installation, and printing and distribution of the letters shall be by the Contractor and shall be paid for as specified under "Mobilization".

Two days before road work where parking restrictions are necessary the Contractor shall furnish and erect "No Parking" signs. These signs shall be attached to portable barricades. These signs and barricades shall be removed when the street is reopened.

It shall be the Contractor's responsibility to arrange for towing and removal of vehicles that have not been removed by the owners and that interfere with roadway operations.

The Contractor shall ensure that all gutters, sewers, drainage ditches, culverts, and natural watercourses function properly.

No road or street shall be closed to the public without the approval of the Engineer.

Construction equipment shall not interfere with the free passage of traffic. The Contractor shall provide, at his own expense, the necessary signs, lights and flagmen to safely direct public traffic past the work.

No material or other obstruction shall be placed within 25 feet of active fire hydrants. The fire hydrants shall be kept accessible to the Fire District at all times.

The Contractor shall take due precaution against starting fires, and shall be responsible for any damage caused by fire started by his forces.

2.11 GENERAL SAFETY

2.11.1 General

In accordance with generally accepted construction practices, the Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Construction review of the Contractor's performance by the Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site.

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work.

The Contractor shall maintain adequate emergency first aid treatment for his employees. "Adequate" means sufficient to comply with the Federal Occupational Safety and Health Act of 1970 (P.L. 91-596).

Equipment and materials shall not block sight distance, turning movements, and pedestrian movements. Barricades, flashers, and tape shall be placed around all equipment and materials and shall provide adequate protection for vehicle and pedestrian traffic.

Any lane closures, restricted turning movements, and pedestrians shall be protected by suitable signs, markings, striping, and barricades.

The Contractor shall erect and maintain all reasonable safeguards for safety and protection of persons, including: posting danger signs, warning lights, reflectors, fences, barriers, warnings against hazards, promulgating safety regulations, and any other necessary safety devices and measures in sufficient quantity to effectively warn of hazards to vehicles or persons at, or adjacent to, the project site.

In areas concerning the safety of the public and/or employees, whenever two or more laws, regulations, or standards apply, the more restrictive of those laws, regulations, or standards shall govern.

2.11.2 Trenching

All trenches shall be adequately protected by barricades, flashers, and tape. Trench sides shall be stable, firm, and supported by jacks as needed, or as directed by, the Engineer.

All trenches in areas subject to vehicle travel shall be covered by steel plates. Plates shall be level, square, without gaps, and adequately supported by firm material beyond the edge of the trench. Cold-mix asphalt shall be placed around all plate edges to a minimum distance of twelve (12) inches from the plate. Steel plates shall be welded and or bolted in high traffic roads or as directed by the Engineer.

All unpaved trenches subject to vehicle traffic shall be protected by temporary asphalt prior to being reopened to traffic.

2.11.3 Excavation Safety

2.11.3.1 Plans

The Contractor's attention is directed to the provisions of §6705 of the Labor Code. Excavation for any trench 5 feet or more in depth shall not begin until the Contractor has received approval from the Engineer of the Contractor's detailed plan for worker protection from the hazards of caving ground during the excavation of the trench. The plan, including a Cal/OSHA excavation permit, shall be submitted at least 10 days before the Contractor intends to begin excavation for the trench and shall show the details of the design of shoring, bracing, sloping or other provisions to be made for worker protection during the excavation. No plan shall allow the use of shoring, sloping or protection systems less effective than that required by the Construction Safety Orders for the Division of Industrial Safety. Where the plan varies from the shoring system standards established by the Construction Safety Orders the plan shall be prepared and signed by a qualified engineer who is registered as a civil engineer in the State of California.

2.11.3.2 Confined Spaces

Tests for the presence of combustible gases or dangerous gases shall be made with an approved device immediately prior to a workman entering a confined space and at intervals frequent enough to ensure a safe atmosphere during the time a workman is in the structure. A record of the tests shall be kept at the job site. Sources of ignition, including smoking, shall be prohibited in any confined space until after the atmosphere within the confined space has been tested and found safe.

Confined spaces, for the purpose of this section, shall mean the interior of storm drains, sewers, vaults, utility pipelines, manholes, reservoirs, and any other structure that is similarly surrounded by confining surfaces so as to permit the accumulation of gases or vapors.

Unless a worker is wearing suitable and approved respiratory equipment, no worker shall be permitted to enter or remain within a confined space until the confined space is free of harmful gases, including lack of oxygen,

Confined spaces that contain or that have last been used as containers of toxic gases, light oils, hydrogen sulfide, corrosives, or poisonous substances, shall, in every case, be tested by approved devices or chemical analysis before being entered without using approved respiratory equipment.

Reservoirs, vessels, or other confined spaces having openings or manholes in the side, as well as in the top, shall be entered from the side openings or side manholes when practicable.

2.11.4 Potential Hazardous Waste

The Contractor's attention is directed to §7104 of the Public Contract Code and the **Construction Contingency Plan for Contaminated Soils** procedural chart presented in this section. The Contractor shall promptly, and before such conditions are disturbed, notify the Engineer in writing of:

1. Material that the Contractor believes may be hazardous waste, as defined in §25117 of the Health and Safety Code, that is required by law to be removed to a Class I, Class II, or Class III disposal site.
2. Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract.
3. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

The Engineer will investigate the conditions. Samples may be collected and analyzed in a state certified laboratory to confirm non-hazardous conditions. Samples shall only be collected by qualified consultants who have completed the OSHA Health and Safety training and subsequent 8-hour refresher courses. The Contractor shall not be allowed to work in the vicinity of the suspect area while sample results are pending. The Contractor may continue to work at other locations on the job site which are unaffected by the suspect material. If the Contractor is unable to work at a different location on the job-site than all work will be suspended in accordance with §10.03 "Temporary Suspension of Work" until non-hazardous results are received.

The Contractor shall not be allowed extra compensation for delays or inconveniences. The Contractor may request an adjustment in the contract work days provided any suspended operations are controlling items of work.

2.11.5 Material Safety Data Sheets (MSDS)

The Contractor's attention is directed to the provisions of the General Industry Safety Orders, §5194, Title 8, California Administrative Code. The Contractor shall submit to the Engineer a Material Safety Data Sheet or a letter from the manufacturer or supplier stating that an MSDS is not required for each potential hazardous substance proposed to be used, ten days prior to the delivery of the material to the job site, or prior to the use of the material at a manufacturing plant where the Engineer is to perform an inspection.

CONSTRUCTION CONTINGENCY PLAN FOR CONTAMINATED SOILS

PROCEDURES

1. STANDARD PRACTICE

Be aware of gases, odors, soil discolorations, liquids, unusual debris, etc., encountered during construction activities. **THEY MAY BE HAZARDOUS!**

2. STOP WORK

Stop work on all construction affected by the suspected contaminated soil. Stop all work, if deemed necessary, or if ordered by the City.

3. CONTACT

- A. Project Inspector
- B. Project Manager
- C. City Engineer
- D. Contra Costa County Environmental Health Department (646-2286)
- E. Emergency Response Hot Line (646-1112)

4. The City will have an Environmental Consultant investigate the site for possible hazardous contamination of the soil.
 5. Findings will be reviewed with appropriate City personnel to determine if the work will be suspended in whole or in part.
 6. Soils samples will be taken by an Environmental Consultant as deemed necessary by the Environmental Consultant and Engineer for lab analysis.
 7. Based on lab results the Environmental Consultant will recommend measures necessary for employees and for the safety and the clean up of the site. Should clean up be required it shall be performed only by a qualified environmental contractor.
 8. Measures will include defining the limits of contamination, disposal requirements, necessary permits, and measures required for the safety of construction personnel and the general public.
 9. Portions of the work previously suspended will resume upon finding the site to be safe. If the site is not safe, the work may be modified as recommended by the Environmental Consultant and as approved by the City and permitting agencies.
-

Hazardous substance is defined as any substance included in the list (Director's List) of hazardous substances prepared by the Director, California Department of Industrial Relations, pursuant to Labor Code §6382. Failure to comply with the submittal of an MSDS for any hazardous material will result in the suspension of construction work.

2.11.6 Payment

All costs incurred in providing and conforming to safety requirements shall be included in the various Contract bid prices and no separate payment shall be made.

2.12 TRAFFIC CONTROL

2.12.1 General

Unless otherwise provided in the special provisions, one lane in each direction for public traffic shall be permitted to pass through the work. Unless approved otherwise by the Engineer, traffic delays shall not exceed ten (10) minutes. The Contractor shall provide the necessary traffic control including: barricades, signs, flagmen, lights and other warning and safety devices as required by the latest manual approved by the California Department of Transportation for traffic control through construction areas.

Unless otherwise allowed by the Contract special provisions, existing traffic signal and street lighting systems shall be kept in operation for the benefit of the public during the work.

The Contractor may be required to temporarily cover certain signs that are in conflict with the construction area signs. The Engineer shall approve which signs shall be covered and the period of covering.

Construction operations shall cause as little inconvenience as possible to adjacent property owners.

At locations where traffic is being routed through construction under one-way controls and where ordered by the Engineer, the movement of the Contractor's equipment from one portion of the work to another shall be governed in accordance with the one-way controls.

Should the Contractor appear to be neglectful or negligent in furnishing warning and protective measures, the Engineer may direct the Contractor's attention to a potential hazard, and the necessary warning and protective measures shall be furnished and installed by the Contractor at no cost to the City. Should the Engineer point out an inadequacy of warning and protective measures such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety nor abrogate his obligation to furnish and pay for implementing these measures.

2.12.2 Public Parking

The Contractor shall submit a proposed "Parking Restriction Plan" to the City with the required "Work Schedule".

On residential streets the Contractor's operation shall allow parking on one side of the street at all times, unless specified otherwise by the Contract special provisions or in writing by the City. Parking restrictions required by the Contractor's operations must be posted at least forty-eight (48) hours prior to their being used. Posting shall be by temporary signs attached to portable barricades or any other method, except attachment to utility poles or private property. The parking restriction signs must provide effective dates and a notice that vehicles in violation of the restriction will be towed at the owners' expense. It shall be the responsibility of the Contractor to arrange for towing and removal of any vehicles that have not been removed by the owners and that interfere with the work. No vehicle shall be towed unless the required notices have been properly posted.

All temporary signs shall be removed immediately upon the termination of the parking restriction.

2.12.3 Paving Transitions

Roadway excavation and the construction of embankments shall provide a reasonably smooth

and even surface suitable for use by public traffic. Sufficient fill at culverts and bridges to permit traffic to cross shall be placed in advance of other grading operations; roadway cuts shall be excavated in lifts and embankments shall be constructed part width at a time, construction being alternated from one side to the other and traffic routed over the side opposite the one under construction.

Where sub-grade and paving operations are underway, public traffic may be allowed to use the shoulders and, if half-width paving methods are used, may use the side of the roadbed opposite the one under construction. When sufficient width is available, a passage way wide enough to accommodate at least 2 lanes of traffic shall be kept open at all times where sub-grade and paving operations are active.

2.12.4 Temporary Street Closures

Unless specified otherwise by the Contract Special Provisions, closures shall not exceed ten (10) minutes in duration for a given vehicle.

Temporary road closures in excess of ten (10) minutes, if approved by the Engineer, will be limited to the hours between 7:00 AM and 5:00 PM, Monday through Friday (except Holidays). Where closures in excess of ten (10) minutes are approved by the City, the Contractor shall post advisory signs notifying the public of the proposed temporary closure and shall deliver, by direct handout, flyers notifying property owners of the planned closure. Signs shall be posted and flyers delivered not less than 48 hours (excluding weekends and City holidays) prior to the approved closure.

The Contractor shall give written notification to all emergency services, public transportation, garbage collection and the City's school bus Coordinator at least forty-eight (48) hours (excluding weekends and City holidays) prior to the closure.

The form and content of all notification signs and flyers shall be approved by the Engineer. The notification shall provide the dates and times of the planned closure. All detour routes and signs required for street closures must be approved by the Engineer at least five (5) working days prior to any approved street closure.

2.12.5 Maintaining Traffic in Public Streets

The Contractor's attention is directed to Section 7-1.08, Section 7-1.09 and Section 12 of the Caltrans Standard Specifications. Nothing in these Contract Documents shall be construed as relieving the Contractor from his responsibility to comply with Section 7-1.08, Section 7-1.09 and Section 12 of the Caltrans Standard Specifications.

The Contractor shall be responsible for providing all flagmen and traffic control in conformance with the current edition of the Caltrans Traffic Manual, and the "Uniform Sign Chart". The Contractor shall furnish, erect, maintain, and remove all necessary signs and devices during

construction. Modifications to the approved traffic control plan, dictated by field conditions, shall be completed by the Contractor as required by the Engineer.

Personal vehicles of the Contractor's employees shall not be parked on the travel way or shoulders within any section closed to public traffic.

A minimum of one paved traffic lane, not less than 12 feet wide, shall be open for use by public traffic in each direction of travel, except that a single, paved, 12 feet wide traffic lane may be used with flagmen for short lengths and short periods where approved by the Engineer.

The full width of the travel way shall be open for use by public traffic as follows, unless otherwise approved by the Engineer:

1. On all designated major streets before 9:00 AM and after 3:30 PM, Monday through Friday.
2. On all other streets before 7:00 AM and after 5:00 PM, Monday through Friday.
3. On all streets regardless of designation all day on Saturday, Sunday, and designated legal holidays and after 3:30 PM on the day preceding a City designated legal holiday.

2.12.6 Opening Completed Work to Public Traffic

Whenever a portion of the project has been completed, the Contractor shall open it for public use, as required by the Engineer. The Contractor will not be allowed any compensation due to any delay, damage, or inconvenience to his operations caused by the public use. The Contractor will not be relieved of any other responsibility under the Contract nor will he be relieved of cleanup and finishing operations.

2.12.7 Temporary Traffic Striping and Pavement Marking

Immediately after paving or removal of existing traffic striping and markings, temporary striping and markings shall be applied and maintained until the permanent striping and markings are installed. Temporary striping and markings shall be approved by the Engineer.

2.12.8 Supervision

The traffic control system shall be placed, maintained, and removed under the direct supervision of someone who is certified as having successfully completed training in the design and operation of work zone traffic control by one of the following:

Institute of Transportation Engineers (ITE)

American Traffic Safety Services Association (ATSSA)

International Municipal Signal Association (IMSA)

State of California Department of Transportation (Caltrans)

Two (2) working days prior to starting work requiring traffic control, the Contractor shall designate, in writing, the person who shall have supervision responsibility and shall submit proof of the required certification to the Engineer. The supervisor shall have the authority to stop work when necessary to correct improper traffic control. Failure of the designated person to be present at the job site at all times when traffic control is in place shall be considered as failure by the Contractor to perform a provision of the Contract and the Engineer may suspend all work.

2.12.9 Measurement and Payment

Full compensation for conformance to the requirements of ♣ 2.12 shall be considered as included in the Contract lump sum price paid for "Traffic Control" of the Bid Schedule and no additional compensation shall be made. If the "Bid Schedule" does not contain a bid item for "Traffic Control" then full compensation for conformance to the requirements of this section shall be considered as included in the other Contract bid items of work and no additional compensation shall be made.

2.13 TEMPORARY TRAFFIC CONTROL

2.13.1 General

The Contractor shall provide all materials, equipment, and labor necessary to furnish, place, and maintain all temporary traffic control systems, including construction and maintenance area traffic control devices and flagmen as required to perform the work in accordance with the Contract, and all other appurtenant work, complete in place, as shown on the drawings and as specified in this section.

The Contractor shall provide all appropriate traffic control measures in accordance with this section prior to start of construction in the public right-of-way or in any area adjacent to the right-of-way where public safety may be affected.

The Contractor shall take all necessary precautions for the protection of the work and the safety of its employees and the public. Traffic shall be maintained through the construction or maintenance zone in accordance with ♣7-1.08, ♣7-1.09 and ♣12 of the State Standard Specifications.

Proposed traffic control plans shall be approved by the Engineer, and any other public agency with jurisdiction over the roadway, prior to installation of the controls.

All construction area signs, lights, barricades, and traffic control devices shall be furnished, installed, maintained, and removed in conformance with the specifications of the Caltrans Traffic

Manual, latest edition. Additional or alternate signs may only be used where specifically authorized by the Engineer.

The Contractor shall station guards or flagmen and shall conform to special safety regulations relating to traffic control as may be required by these Design Standards, the Engineer, or other public authorities acting within their jurisdictions. Section 12-2.02 of the State Standard Specifications is revised to provide that all flagmen and guards shall be furnished by the Contractor at the Contractor's expense.

The Contractor shall monitor traffic and safety conditions and maintain adequate traffic control measures during both work and non-work hours in order to be in compliance with the requirements of this section.

The Contractor shall conform to all requirements of the current "Safety Orders of the Division of Industrial Safety, Department of Industrial Relations of the State of California". Where a hazardous condition is observed and the City notifies the Contractor, either directly or by telephone, the Contractor shall correct the condition immediately. If the Contractor fails to correct the hazardous condition immediately the City reserves the right to perform the work and the cost shall be billed to the Contractor.

All construction area signs, lights, barricades, and temporary traffic control devices shall be removed from the roadway when not in use. Locations and methods of storing traffic control equipment adjacent to the roadway between interrupted use shall require the approval of the Engineer.

The Contractor shall completely remove all temporary signs, striping and/or delineators and restore the pavement, as necessary, upon removal or relocation of any temporary traffic controls or detours constructed as part of the work.

When traffic is detoured to the bicycle/parking lane and where street tree branches are interfering with vehicular traffic, the Contractor shall trim the trees in accordance with the Standard Specifications.

Where proposed construction will cause any detector loop at a traffic signal to become inoperative for a period of seventy-two (72) hours or more, the Contractor shall provide video detection, or any other similar device that is not installed in the pavement, prior to the start of work at his own expense. The Contractor shall provide a temporary video detection device attached to the traffic signal pole or arm that is wired to the traffic signal controller. The proposed video detection device shall be approved by the Engineer.

2.13.2 Submittals

The Contractor shall provide the following to the Engineer:

1. A “Letter of Responsibility” on company letterhead, indicating the names and telephone numbers of at least three people who shall be available in case of emergency at any time during the life of the Contract. Each persons shall have decision-making authority within the company.
2. “Traffic Control and Construction Staging Plans” indicating proposed traffic control measures during all stages of the work. These plans shall be submitted to the Engineer for review and approval in order to determine the Contractor’s compliance with the requirements of this section.

The Contractor shall be responsible for submitting separate applications for encroachment permits to the appropriate agencies for work or traffic control within areas outside of the jurisdiction of the City. The Contractor shall be responsible for compliance with all traffic control required by other permitting agencies or other public authorities acting within their jurisdictions.

2.13.3 Products

All construction area stationary and portable sign panels, lights, barricades, and traffic control devices shall be the product of a commercial sign or safety device manufacturer conforming to the requirements of Section 12, “Construction Area Traffic Control Devices” of the Caltrans Standard Specifications, unless otherwise shown on the drawings, and/or as directed by the Engineer.

2.14 PROTECTION OF EXISTING FACILITIES

2.14.1 General

The Contractor shall protect all existing utilities, trees, shrubbery, landscaping, irrigation facilities, buildings, fences, roadside signs, poles, mailboxes, and all other improvements not designated for removal. The Contractor shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with the requirements of the Contract Documents.

The Contractor shall verify the exact locations and depths of all utilities shown on the drawings and the Contractor shall make exploratory excavations of all utilities that may interfere with the work. When the exploratory excavations show the utility locations shown to be in error, the Contractor shall notify the Developer’s Engineer and the Engineer.

Private hose bibs and hoses shall not be used for construction unless the Contractor secures the owner's written permission prior to use.

All reference markings made by the Contractor shall be done with spray chalk and shall be removed by the Contractor.

2.14.2 Protection of Roadway Markers

The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers unless specifically shown on the Contract plans. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. All survey markers or points disturbed by the Contractor shall be accurately restored to the satisfaction of the Engineer by the Contractor at the Contractor's expense.

2.14.3 Existing Utilities and Improvements

The Contractor shall protect all underground utilities and other improvements that may be impaired during construction. It shall be the Contractor's responsibility to determine the location of all existing utilities and other improvements that will be encountered during construction, and to ensure that the utilities or other improvements are protected from damage. The Contractor shall take all possible precautions for the protection of unforeseen utility lines.

Prior to relocating or moving the property of any public utility or franchise holder, the Contractor shall secure the written permission to do so from the appropriate utility or franchise holder.

Where the proper completion of the work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement that is shown, the Contractor shall remove and replace or relocate the utility or the facility at the direction of the affected utility. In all cases of temporary removal or relocation restoration to the former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former location and to as good or better condition than found prior to removal.

The Contractor shall notify the appropriate utility or agency of any existing utility lines that are damaged or exposed during construction.

The Contractor shall keep existing streets free from dust and debris during all phases of construction.

2.14.4 Trees Within Street Right-of-Ways

The Contractor shall not damage or destroy any trees or shrubs, including those lying within street right-of-ways, and shall not trim or remove any trees unless the trees have been approved for trimming or removal by the City. Trees and shrubs that are not scheduled for removal shall be protected with temporary fencing placed below the outer extent of their drip lines. All trees and shrubs that are damaged during construction shall be trimmed or replaced by the Contractor to the satisfaction of the City and/or other jurisdictional agency. Tree trimming and replacement shall be accomplished in accordance with the requirements of the City.

2.14.5 Notification by the Contractor

The Contractor shall notify Underground Service Alert (USA) and all utilities forty-eight (48) hours prior to any excavation so that their lines can be marked.

Prior to any excavation in the vicinity of any underground facilities, including all water, sewer, storm drain, irrigation, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and on all roadway and state highway right-of-ways, the Contractor shall notify Underground Service Alert and the respective authorities representing the owners or agencies responsible for the underground facilities forty-eight (48) hours prior to the work so that the owners or agencies can be present during the work.

2.15 ACCESS TO ADJACENT PROPERTY

Convenient access to driveways, houses, and buildings that may be affected by the work shall be provided and maintained and temporary approaches to crossings or intersecting streets shall be provided and maintained in good condition. When the adjacent property owner's access across the right-of-way line is to be eliminated, or to be replaced under the Contract by other access facilities, the existing access shall not be closed until the replacement access is are usable. At least forty-eight (48) hours in advance of any work affecting access, such as a driveway closure, all owners that may be affected shall be notified in writing by the Contractor of the time, date and reason for the closure. The notice shall be approved by the Engineer and shall be hand delivered or securely attached to the door of the affected property in a non-destructive manner if the owner is not present.

2.16 STORAGE OF MATERIALS AND EQUIPMENT

No material or equipment shall be stored where it will interfere with the free and safe passage of the public. At the end of each day's work and at other times when construction is suspended, the Contractor shall remove all equipment and other obstructions from that portion of the roadway open for public use.

The Contractor shall be responsible for safety and protection until acceptance of the work. The City may require warehousing, watch service or other types of protection.

2.17 USE OF EXPLOSIVES

All persons engaged in receiving, storing, using, handling or transporting explosives must obtain a permit from the Fire District; and all work shall be governed by the Health & Safety Code and any amendments or existing articles of the State of California, Construction Safety Orders. Any

use of explosives must be approved in writing by the Engineer. In general, the use of explosives will not be allowed unless it can be demonstrated to the Engineer's satisfaction that other methods cannot accomplish the work.

2.18 DISPOSAL OUTSIDE PROJECT LIMITS

The Contractor shall make his own arrangements for disposing of materials outside the right-of-way and he shall pay all costs involved. Such costs shall be included in the various Contract bid items and no additional compensation shall be allowed.

The Contractor is encouraged to dispose of materials at locations where materials will be recycled or reused (diverted from a landfill). The Contractor shall provide the Engineer with receipts or itemized listing showing quantities (preferably in weight) disposed at each location (including landfills) before retention will be released to Contractor.

When any material is to be disposed of outside of the right-of-way the Contractor shall first obtain written permission from the property owner on whose property the disposal is to be made. The Contractor shall file a copy of said permission with the Engineer together with a written release from the property owner absolving the City from any and all responsibility, including costs, in connection with the disposal or removal of material on the property. Except for certain hazardous materials written permission is not required for disposal at public landfills or transfer stations. The Contractor is also responsible for obtaining any necessary permits from other Federal, State, County or local agencies.

When material is disposed of as provided above the Contractor shall conform to all requirements of the City Municipal Code and other applicable regulations pertaining to grading, hauling, and filling of earth. Full compensation for all costs involved in disposing of materials as specified in this subsection, including all costs of obtaining a disposal site, required permits, loading, hauling and disposal, shall be included in the price paid for the Contract item of work and no additional compensation will be allowed. No additional payment will be granted to the Contractor for inconvenience or delays encountered in complying with the requirements of this section.

2.19 RESPONSIBILITY FOR THE WORK AND MATERIALS

Until the acceptance of the work, the Contractor is responsible for material used for the work, including materials for which he has received partial payment for or materials that have been furnished by the City. The Contractor shall bear the risk of injury, loss or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or non-execution of the work, except as provided for in §2.33 "Relief from Maintenance and Responsibility". The Contractor, at the contractor's expense, shall rebuild, repair, restore, and make good all injuries, losses, or damages by any cause to any portion of the work or the materials before its completion and acceptance.

The Contractor shall, at his expense, provide suitable drainage of the project and erect such temporary structures as are necessary to protect the work or materials from damage.

The suspension of the work for any cause shall not relieve the Contractor of his responsibility for the work. If ordered by the Engineer, the Contractor shall, at the Contractor's expense, properly store materials which have been partially paid for by the City or that have been furnished by the City. The storage by the Contractor shall be on behalf of the City and the City shall at all times be entitled to the possession of the materials, and the Contractor shall promptly return the materials to the site of the work when requested. The Contractor shall not dispose of any materials except as authorized by the Engineer.

2.20 SUBCONTRACTING

The Contractor shall fulfill the Contract and shall keep the work under his control. No subcontractor shall be recognized as such, and all persons engaged in the work will be considered as employees of the Contractor. The Contractor will be responsible for their work.

The Contractor shall provide appropriate provisions in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the contract documents. All subcontracts shall give the Contractor the same power regarding the termination of any subcontract as the City may exercise over the Contractor.

Nothing contained in any subcontract shall create any contractual relation between any subcontractor and the City.

Before work is started on a subcontract, the Contractor shall file a written statement with the Engineer showing the work to be subcontracted, the names of the subcontractors and the description of each portion of the work to be subcontracted.

2.21 MUTUAL RESPONSIBILITY OF CONTRACTORS

If, through acts of neglect on the part of the Contractor, other contractors or subcontractors suffer loss or damage, the Contractor agrees to settle with the other contractors or subcontractors by agreement or arbitration if the other contractor or subcontractor will so settle. If the other contractors or subcontractors assert any claim against the City on account of any damage alleged to have been sustained, the City shall notify the Contractor, who shall indemnify and hold harmless the City, its agents, employees, officials, and the Engineer against any such claim in accordance with § 2.38 "Indemnity Provision".

2.22 COORDINATION WITH OTHER CONTRACTORS

Where two or more contractors are employed by the City on related or adjacent work, or obtain materials from the same material source, each shall conduct his operations to not cause any unnecessary delay or hindrance to the other. Each contractor shall be responsible to the other for all damage to work, to persons or property caused to the other by his operations, and for loss caused to the other due to his unnecessary delays or his failure to finish the work within the time specified for completion.

The Contractor, including his subcontractors, shall keep informed of the progress and the detail work of other contractors and shall notify the Engineer immediately of lack of progress or defective workmanship on the part of other contractors. Failure of a Contractor to keep informed of the work, and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by the Contractor of the work being satisfactory for proper coordination with his own work.

2.23 ENVIRONMENTAL RESPONSIBILITIES

2.23.1 General

The Contractor shall comply with all air, water and other pollution and environmental control rules, regulations, ordinances and statutes that apply to any work performed pursuant to the Contract.

2.23.2 Noise Control

The Contractor shall comply with all local ordinances setting forth noise level rules and regulations.

Work shall not commence prior to 7:30 AM weekdays, 9:00 AM on weekends (when the Contractor is allowed by the Engineer to work weekends) and shall not extend beyond 6:00 PM without the approval of the Engineer.

All internal combustion engines shall be equipped with mufflers of a type recommended by the manufacturer. Mufflers shall be maintained in good working order at all times. Noise generated by the Contractor's equipment shall not exceed the levels as set forth by the California Occupational Safety and Health Administration.

The Contractor shall be advised that the operation of any noise creating blower, power fan, or internal combustion engine which causes noise due to the explosion of operating gases or fluids is prohibited between the hours of 6:00 PM to 7:30 AM. The operation of any pile driver, steam shovel, pneumatic hammer, derrick, steam, electric hoist sandblaster or other equipment used in construction, demolition or other repair work is prohibited between the hours of 6:00 PM and 7:30 AM.

2.23.3 Water Pollution Control

The Contractor shall exercise every reasonable precaution to protect streams, creeks, reservoirs, and San Francisco Bay from pollution with fuels, oils, bitumens, calcium chloride and other harmful materials. The Contractor shall conduct and schedule operations to avoid or minimize the muddying and silting of existing storm drains, streams, creeks, reservoirs, and the Bay.

Debris produced by saw cutting pavement shall be collected, as they are created, by vacuuming or other means approved by the Engineer. Saw cutting debris shall not be allowed to enter storm drain facilities at any time.

Water pollution control work is intended to provide prevention, control and abatement of water pollution. Where the measures being taken by the Contractor, in the opinion of the Engineer, are inadequate to control water pollution effectively, the Engineer may direct the Contractor to submit a water pollution control program, including an implementation schedule. The plan shall be submitted within five (5) working days after the written request by the Engineer. The Engineer will accept, accept subject to conditions, or reject the Contractor's plan within five (5) calendar days after its receipt.

The Engineer may suspend all or portions of the work until adequate water pollution control measures have been implemented.

Nothing in the terms of the Contract nor in these Design Standards or the Contract special provisions shall relieve the Contractor of his responsibility to comply with §5650 and §12015 of the Fish and Game Code and other applicable statutes relating to the prevention or abatement of water pollution.

2.23.4 Air Pollution Control

The Contractor shall comply with all air pollution control rules, regulations, ordinances and statutes that apply to the work including any air pollution control, rules, regulations, ordinances and statutes, specified in § 11017 of the Government Code. Burning of materials shall not be allowed.

2.23.5 Dust Control

The Contractor shall furnish all labor, equipment, and means required, at all times during construction, to prevent an airborne dust nuisance and dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. All work shall be completed in conformance with ♣ 10 "Dust Control" and ♣ 18 "Dust Palliative" of the State Standard Specifications. The Contractor shall be responsible for damage resulting from dust originating from his operations.

Upon failure of the Contractor to remove the dust nuisance as specified above within two (2) hours after notification by the Engineer, the City may order that the work be done by others, at the Contractor's expense.

2.23.6 Rubbish Control

During the work, the Contractor shall prevent rubbish and debris leaving the construction site in an uncontrolled manner. The Contractor shall keep all public streets and roads free from mud, dirt, rubbish, and unnecessary obstructions resulting from his operations. Disposal of all rubbish and surplus materials shall be off-site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable laws and regulations.

2.23.7 Sanitation

The Contractor shall ensure that existing sanitation facilities are available or the Contractor shall provide and maintain adequate sanitation facilities. All waste and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of in accordance with all laws and regulations. Sanitation facilities will not be allowed in public street right-of-ways or on public lands. If more than four sanitation facilities are being used the Contractor shall locate these facilities no closer than one hundred (100) feet from existing homes.

2.23.8 Chemicals

All chemicals used, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of chemicals and disposal of residues shall be in strict accordance with the manufacturer's instructions.

2.23.9 Cultural Resources

The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470 and 36 CFR 800) which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

The Contractor shall perform remediation in conformance with the requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

Where potential cultural resources are discovered during subsurface excavations in the public street right-of-way or on public lands, the Contractor shall immediately cease all operations and shall notify the Engineer.

The Contractor shall be responsible for hiring a qualified archaeologist to assess the value of potential cultural resources and who shall contact the State Water Resources Control Board, Cultural Resources Officer.

If the archaeologist determines that the find is a bona fide cultural resource (at the direction of the State Water Resources Control Board, Cultural Resources Officer) the Contractor shall suspend work at the location of the find.

2.24 TEMPORARY EROSION CONTROL

2.24.1 General

Temporary erosion control shall include the prevention, control, and abatement of water, mud, construction materials, hazardous materials and erosion damage to public and private property associated with the Contractor's operations.

Conformance with the requirements of this section shall not relieve the Contractor from the Contractor's responsibilities, as provided in ♣ 7-1.01G "Water Pollution" and ♣ 7-1.11 "Preservation of Property" of the State Standard Specifications.

Construction vehicles and equipment entering existing paved areas shall be free of mud, silt and other debris during all phases of work. No mud, silt and other debris shall be tracked on paved surfaces. If such materials are tracked on the streets or other paved areas (both public and private) the Contractor shall immediately remove these materials and shall prevent the materials from entering the storm drain system.

Stockpiling of materials on the street will not be allowed unless otherwise approved by the Engineer. The Contractor shall cover any construction or excavated materials between October 15th and April 15th that may erode and enter the storm drain system of paved streets or other paved areas (both public and private). Stockpiling of dirt on paved areas will not be allowed.

The Contractor shall sweep the work area and clean up the work site daily.

Where a Storm Water Pollution Prevention Plan (SWPPP) is required for the project, the Contractor shall be responsible for installing, constructing, inspecting and maintaining the control measures included in the SWPPP and any amendments and for removing and disposing of temporary control measures.

By October 15th of each year the temporary erosion control measures shall be constructed and functioning. If the earthwork in any area has not progressed to a point where any part of the facilities on the temporary erosion control plans for that area can be constructed, the Contractor shall construct temporary erosion control facilities that are necessary to protect adjacent property.

Temporary erosion control measures shall include the following:

1. The Contractor shall contain storm runoff within the site or cause the runoff to be channeled into the storm drain system which serves the runoff area. Storm runoff from one area shall not be diverted to another runoff area.
2. Storm drain systems, slope drains, and outlet structures shall be incorporated into embankments. Temporary downdrains, drainage structures, and other devices shall be provided to channel storm runoff water into the permanent storm drain systems during construction. Mud and silt shall be settled out of the storm runoff before the runoff enters the storm drain system.
3. Embankment areas shall be protected to eliminate erosion and the siltation of downstream facilities and adjacent areas. These measures may include: temporary downdrains, either in the form of pipes or paved ditches with protected outfall areas, graded berms around areas to eliminate erosion of embankment slopes by surface runoff, confined ponding areas to desilt runoff, and temporary check dams in slope ditches to desilt runoff.
4. Excavation areas, while being brought to grade, shall be protected from erosion. Erosion control measures may include: check dams, confined ponding areas to desilt the runoff, and protection, such as sandbags around inlets which have not been brought up to grade.
5. Graded areas shall be protected against erosion. Various measures may include: the use of graded berms to control sheet flow, supplemental grading of large areas around temporary or unfinished inlet structures to provide desilting basins, and temporary ditch paving.
6. From October 15th to April 15th:
 - A. During embankment construction, drainage shall be directed away from the edge of the top of the embankment.
 - B. Area that have been cleared and grubbed prior to excavation or embankment operations, and which are subject to runoff, shall be protected . Temporary measures may include: desilting basins, graded ditches, paved and unpaved ditches, and filter fabric fences.
 - C. After each storm, desilting basins shall be checked against their design capacity and silt and sediment shall be removed to restore capacity as warranted.

2.24.2 Inspection and Maintenance

To ensure the proper implementation and functioning of temporary erosion control measures, the Contractor shall regularly inspect and maintain the construction site for the control measures identified in the Storm Water Pollution Prevention Plan (SWPPP). The Contractor shall identify

corrective actions and time periods to address any damaged measures or reinitiate any measures that have been discontinued.

During the winter season (defined as the period between October 15th and April 15th) inspections of the construction site shall be conducted by the Contractor to identify deficient measures as follows:

1. Prior to a predicted storm.
2. After all precipitation which causes runoff capable of carrying sediment from the construction site.
3. At twenty-four (24) hour intervals during extended precipitation events, or as needed.
4. Routinely and at least once every two weeks.

If the Contractor identifies a deficiency in an erosion control measure, the deficiency shall be corrected in a timely manner and prior to the next forecasted storm. If the Engineer identifies a deficiency in an erosion control measure the Contractor will be notified in writing and the deficiencies shall be corrected by the Contractor in a timely manner and prior to the next forecasted significant storm.

2.25 CONTRACTOR NOT AN AGENT OF THE CITY

The right of general supervision by the City shall not make the Contractor an agent of the City, and the liability of the Contractor for all damages to persons or to public or private property, arising from the Contractor's work, shall not be lessened because of such general supervision.

2.26 PROPERTY RIGHTS IN MATERIALS

Nothing in the Contract shall be construed as vesting the Contractor with any right of property in the materials used after they have been attached or affixed to the work or soil; or after partial payment has been made as provided by these Design Standards for material delivered or stored and unused. All the material shall become the property of the City upon payment for the materials.

2.27 RIGHTS IN LAND AND IMPROVEMENTS

Nothing in the Contract shall be construed as allowing the Contractor to make arrangements with any person to permit occupancy or use of any land, structure, or building within the limits of the Contract for any purpose whatsoever, either with or without compensation, in conflict with any

agreement between the City and any owner, former owner, or tenant of such land, structure, or building.

The Contractor shall not occupy City-owned property outside the work as shown on the plans unless he enters into a rental agreement with the City.

2.28 PERSONAL LIABILITY

Neither the Engineer, nor any other officer or authorized employee or agent of the City, nor any authorized officer or employee of the State, County, or any District shall be personally responsible for any liability arising from or by virtue of the Contract.

2.29 REPAIR OF EQUIPMENT

The work of installing, assembling, repairing or reconditioning, or other work of any nature on machinery, equipment, or tools used in or upon the work shall be considered a part of the work to be performed under the Contract.

2.30 MATERIAL PLANTS

The construction, erection, and operation of material production, proportioning, or mixing plants from which material is used wholly on the Contract or on contracts under supervision of the City shall be considered a part of the work to be performed under the Contract and any laborers, workmen, or mechanics working on such plants shall be subject to all of the requirements relating to labor set forth in the Contract.

2.31 NON-ENFORCEMENT - NO WAIVER BY CITY

The failure of the City or Engineer in any one or more instances to insist upon strict performance of any of the terms of this Contract or to exercise any option therein conferred, shall not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon any such terms or option on any future occasion or at any future time.

2.32 GUARANTEE AND WARRANTY

In addition to guarantees required in other provisions of the Contract the Contractor shall, and hereby does, guarantee and warrant all work for a minimum period of one year after date of acceptance of work by the City. The Contractor shall repair or replace any or all such work, together with any other work that may be displaced in so doing, and that may prove defective in

workmanship and/or materials within a one year period from the date of acceptance without expense whatsoever to the City. Ordinary wear and tear, unusual abuse or neglect is excepted.

The Contractor shall request, in writing, a warranty inspection by the City not less than fifteen (15) calendar days nor more than thirty (30) calendar days prior to the expiration of the warranty period. The Engineer shall perform a warranty inspection and notify the Contractor, in writing, of any defects.

Where the Contractor fails to repair any defects within one week after being notified in writing by the Engineer, the City may have the defects repaired at the expense of the Contractor. The Contractor agrees to pay all costs and charges immediately on demand including engineering costs and a twenty (20) percent markup for administration.

If, in the opinion of the Engineer, defective work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the City or to prevent interruption of operations of the City, the City will attempt to give the notice required by this article. If the Contractor cannot be contacted, or does not comply with the Engineer's request for correction within a reasonable time as determined by the Engineer, the City may proceed to make the corrections without further notice. The cost of any corrections performed by the City, plus a twenty (20) percent markup for administration, will be charged to Contractor.

Should the Contractor fail to pay the City for the costs within sixty (60) days from the date of the invoice for the costs, the City will take appropriate legal action to collect the payment including interest and attorney fees. Any such action by the City will not relieve the Contractor of the guarantees provided in this article or elsewhere in this Contract.

This section does not in any way limit the guarantee on any items for which a longer guarantee is specified or on any items for which a manufacturer gives a guarantee for a longer period, nor does it limit other remedies of the City in respect to latent defect, fraud or implied warranties.

2.33 RELIEF FROM MAINTENANCE AND RESPONSIBILITY

Upon the request of the Contractor, the City may relieve him of the duty of maintaining and protecting certain portions of the work that have been opened for City use and that have been completed in all respects in accordance with the requirements of the Contract and to the satisfaction of the Engineer. In addition, such action by the City will relieve the Contractor of responsibility for injury or damage to the completed portions of the work resulting from use by public traffic or from the action of the elements or from any other cause, but not from injury or damage resulting from the Contractor's own operations or from his negligence.

Nothing in this section shall be construed as relieving the Contractor of full responsibility for making good on defective work or materials found at any time before the formal written acceptance of the entire Contract by the City. The start of the guarantee period is the date of final acceptance of the entire project by the City Council.

2.34 DAMAGE TO WORK BY AN ACT OF GOD

The Contractor will not be responsible for the cost of repairing or restoring damage to work, when such damage is determined by the Engineer to have been caused by an Act of God. This provision shall apply only to costs in excess of five (5) percent of the total Contract amount, per occurrence. The provisions of this section shall not apply to projects financed by revenue bonds.

2.35 RESPONSIBILITY FOR CLAIMS AND DAMAGES

The Contractor agrees to indemnify and save the City, its officers, agents and employees harmless from any loss or damage resulting from any claim or damage asserted under its care, custody or control. The City and all such officers and employees connected with the work shall not be answerable or accountable in any manner for any loss or damage to any of the materials or other things used or employed in performing the work; for injury to or death of any person (either workmen or the public) or for damage to the property of others from any cause that might have been prevented by the Contractor, or his workmen, subcontractors, or anyone employed by him.

The Contractor shall be responsible for any liability imposed by law and for injuries to, or death of, any person or damage to property resulting from defects or obstructions or from any cause whatsoever during the progress of the work or anytime before its completion and final acceptance.

The Contractor shall indemnify and save harmless the City of Hercules and all of its officers and employees connected with the work, from all claims, suits or actions of every name, kind and description, brought for, or on account of, injuries to, or death of, any person or damage to property resulting from the construction of the work or by, or in consequence of, any negligence in guarding the work, use of improper materials in construction of the work, or by, or on account, of any act or omission by the Contractor or his agents during the progress of the work or at any time before its completion and final acceptance.

In addition to any remedy authorized by law, the amount of money due to the Contractor, as shall be considered necessary by the City, may be retained by the City until disposition has been made of any suits or claims for damages.

Notwithstanding assertions that the City, its City Council, or its officers, agents, or employees may have been solely negligent, the Contractor shall assume the defense of the City, its City Council, and its officers, agents, and employees from all claims of any kind arising directly or indirectly out of the performance of the work.

2.36 INSURANCE

2.36.1 General

The Contractor and his Subcontractor's Public Liability and Property Damage Insurance shall provide adequate protection against Public Liability, Property Damage, and Vehicular Liability.

The Contractor shall either (a) require each of his subcontractors to procure and to maintain, during the life of his subcontract, Subcontractor's Public Liability and Property Damage and Vehicular Liability of the type and in the same amounts specified for the Contractor, or (b) insure the activities of his subcontractors in his own policy.

All insurance policies shall bear an endorsement or shall have a rider whereby it is provided that in the event of expiration or proposed cancellation of such policies for any reason whatsoever, the City shall be notified by registered mail not less than thirty (30) days before the expiration or cancellation is effective.

The Contractor shall not commence work under this Contract until all required insurance is obtained and approved. The following requirements apply to the Contractor and his subcontractors.

At the time of the execution of the agreement, the Contractor shall, at his own expense, procure and maintain in full force and effect (at all times during the work and until final completion of the work) Workmen's Compensation Insurance and Public Liability Insurance, including motor vehicles and equipment, perils of explosion, collapse, underground and personal injury as follows:

A policy of public liability insurance naming the City, its officers, agents and employees as additional insured against all loss from liability, contingent or otherwise, for injury to, or death of, any person or persons, or damage to real or personal property, arising in or by reason of, or in connection with, the performance of the work contemplated, and agreeing to defend against all claims, demands, actions or legal proceedings made or brought by any person by reason of any such injury, death or damage and to pay all judgments, interests, costs, legal and other expenses arising out of, or in connection with, the work.

The insurance required shall provide adequate protection for the Contractor and his subcontractors against damage claims that may arise from operations under the Contract, whether such operations be by the insured or by anyone directly or indirectly employed by him and also against any of the special hazards that may be encountered in the performance of the Contract.

The policies shall be issued by an insurance carrier satisfactory to the City and shall be delivered to the City at the time of delivery of the Contract. In lieu of actual delivery of such policies, a certificate issued by the insurance carrier showing such policies to be in force for the period covered by the Contract, covering without exclusions the requirements as specified and covering the City, its officers, its agents and employees as additional insured, may be delivered to the City. Such policies and such certificates shall be of a form approved by the City Attorney.

The Contractor shall save, keep and hold harmless the City, its officers, agents and employees from all damages, costs or expenses in law or equity that may at any time arise or be set up because of damages to property, or of personal injury received by reason of, or in the course of, performing work, which may be occasioned by any act or omission of the Contractor, any of the Contractor's employees, or any subcontractor. The City will not be liable for any accident, loss or damage to the work prior to its completion and acceptance.

In case an extension of time is granted to the Contractor by the City the Contractor shall submit evidence of the required insurance coverage for the additional length of time required to complete the work.

The City may require a copy of the actual policy represented by any certificate. The Contractor shall promptly comply.

The cost of providing all required insurance coverage shall be considered as included in the various Contract bid prices and no additional compensation shall be made.

2.36.2 Worker's Compensation Insurance

Pursuant to the requirements of § 1860 of the State Labor Code, the Contractor will be required to secure the payment of workers' compensation to the Contractor's employees in accordance with the provisions of §3700 of the Labor Code.

Prior to the commencement of work the Contractor shall sign and file with the Engineer a certification in the following form:

"I am aware of the provisions of §3700 of the Labor Code which requires every employer to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing with the performance of the work of this Contract."

This certification is included in the Contract and signature and return of the Contract as provided in §9.03, "Execution of Contract Agreement" shall constitute signing and filing of the certificate.

2.36.3 Contractor's Comprehensive General Insurance

The Contractor shall procure, and shall maintain during the life of the Contract, Contractor's Public Liability Insurance, Contractor's Property Damage Insurance and Vehicle Liability Insurance. The Contractor shall either require each of his subcontractors to procure and to maintain, during the life of his subcontract, the Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance or insure the activities of his subcontractors in his policy.

The policies shall provide coverage at least as broad as that provided in the Standard Form approved by the National Bureau of Casualty Underwriters together with such endorsements as are required to cover the risks involved. The City reserves the right to approve the form,

sufficiency and manner or execution of the insurance contract. The Contractor shall arrange for the policies to be so conditioned as to cover the performance of any extra work during the Contract.

These policies shall each provide at least the following limits:

Public Liability \$1,000,000.00 each person, \$2,000,000.00 each occurrence
Property Damage \$ 500,000.00 each occurrence.

2.36.4 "All Risk" Builders Coverage

When required by the Contract Special Provisions, the Contractor shall furnish to the City and maintain during the life of the Contract "All Risk" Builder's coverage. The policy shall insure the work against all risks of fire, lightning, vandalism, water and other risks of loss provided in the "all risk" type policy. The City reserves the right to approve the form, sufficiency and manner of execution of the contract of insurance. This insurance shall be written on a Builder's Risk Form for 100% of the value of the work completed and materials delivered at the site, at all times. The Contractor shall deliver to the City a duly certified copy of the insurance policy at the time the Contract is signed; the policy shall be written in the name of both the City and the Contractor. All losses shall be paid to the insured as their interests appear.

The term "public streets and highways" shall be deemed to include, without limiting the generality thereof, all roads, roadways and thoroughfares used for access to the site of the work.

No payment will be made to the Contractor unless all provisions of this section have been complied with.

2.36.5 Failure to Provide Insurance

A material breach of contract occurs where the Contractor, for any reason, fails to maintain the insurance coverage that is required pursuant to the Contract. The City, at its sole option, may terminate the Contract and obtain damages from the Contractor resulting from the breach. Alternatively the City may procure the insurance and the cost of the insurance shall be deducted from any payment due to the Contractor.

2.37 NON-DISCRIMINATION AND EQUAL OPPORTUNITY

The Contractor's attention is directed to Chapter 5 of Division 4 of Title 2, California Code of Regulations. The Contractor shall not discriminate against any employee or applicant for employment because of race, religious creed, color, national origin, ancestry, physical handicap, medical condition, marital status, gender, except as provided for in § 12940 of the Government Code.

2.38 INDEMNITY PROVISION

Notwithstanding the existence of insurance coverage required of the Contractor pursuant to the Contract, the Contractor shall save, keep, indemnify, hold harmless, and defend the City from every claim or demand made and every liability, loss, damage or expense of any nature whatsoever. The Contractor shall protect the City from any and all costs or expenses incurred in connection therewith, which arise at any time by reason of damage to the property of, or personal injury to, any person, occurring or arising out of the performance of the Contractor and its subcontractors (hereinafter collectively referred to as "Contractor"), of the work required pursuant to this Contract, occasioned by any alleged or actual negligent or wrongful act or omission by the Contractor. Indemnification is limited to the amount stated in the additional insured endorsement.

The Contractor will defend any action or actions filed in connection with any claims, damages, penalties, obligations or liabilities and will pay all costs and expenses, including attorney's fees incurred in connection herewith.

The Contractor will promptly pay any judgment rendered against the City, its officers, agents or employees for any claims, damages, penalties, obligations or liabilities.

In the event the City, its officers, agents or employees are made a party to any action or proceeding filed or prosecuted against the Contractor for damages or other claims arising out of, or in connection with, the sole negligence or wrongful acts of the Contractor, the Contractor agrees to pay the City, its officers, agents, or employees, any and all costs and expenses incurred by the City, its officers, agents or employees in the action or proceeding, including attorney fees.

2.39 PAYMENT

Unless otherwise provide for in this section, or by the Contract Bid Proposal and/or special provisions, full compensation for conforming to all the provisions of §2 "Legal Relations and Responsibilities" shall be considered as included in the various Contract items of work and no additional compensation will be allowed.

SECTION 3

PLANS AND SPECIFICATIONS

3.01 INTENT OF PLANS AND SPECIFICATIONS

The Contract plans and specifications describe the details for the construction and completion of the work that the Contractor performs in accordance with the terms of the Contract. Where the plans or specifications describe portions of the work in general terms but not in complete detail, it is understood that only the best general practices are to prevail and that only materials and workmanship of the best quality are to be used. Unless otherwise specified, the Contractor shall furnish all tools, equipment, and incidentals, and do all the work involved in executing the Contract in a satisfactory and workmanlike manner.

Complete plans and specifications for all proposed improvements, including any necessary dedications and easements, shall be submitted to the Engineer for approval. The approval must be received before the beginning of construction. This shall apply where any portion of any improvement will be transferred to the City of Hercules. The plans shall be prepared under the direction of a qualified and registered civil engineer in accordance with the provisions of the "Civil Engineer's Act" Chapter 7 - Division 3 of the Business and Professions Code.

Where materials or equipment are to be furnished by the City, as designated in the Contract special provisions, or as agreed on, the exchange shall not relieve the Contractor of the requirements to furnish all other labor, materials and equipment to complete the work.

3.02 ACCURACY OF PLANS & SPECIFICATIONS

Should errors appear in the plans, details, standard drawings or appendices or the specific provisions within the Contract documents, or in the work done by others affecting this work, the Contractor shall immediately notify the Engineer prior to installation, who will issue instructions on how to proceed. If the Contractor proceeds with the work without instructions from the Engineer the Contractor shall remove the incorrect work or make the necessary corrections to comply with the Engineer's instructions at no cost to the City. This includes typographical errors and notational errors where interpretation is ambiguous.

Omissions from the plans, details, drawings or appendices or Contract special provisions shall not relieve the Contractor from the responsibility of furnishing, making, or installing all items required by law or usually furnished, made or installed in a project of the scope and general character indicated by the plans and specifications.

3.03 AS BUILT DRAWINGS

The Contractor shall keep and maintain a set of project plans at the job site for the sole purpose of noting changes, details, corrections, and any other information reflecting or clarifying actual conditions. Both the Contractor and the Engineer shall have access to the plans and all entries on the plans shall be initialed and dated. All entries shall be clear and sufficiently detailed to be transferred to the "As Built Drawings". The plans at the job site shall be the City's property under custody of the Contractor and shall be returned to the City upon completion of the project.

3.04 PLAN PREPARATION

Construction plans and specifications shall be prepared in accordance with the following requirements:

3.04.1 Dimensions

Construction plans shall be clearly and legibly drawn in ink on engineering mylar 24 by 36 inches with a 1-½ inch clear margin on the left edge and one inch margins on all other edges. Lettering heights shall be 1/8 inch tall or greater.

3.04.2 Scale

The horizontal scale shall be one inch = forty (40) feet. The vertical scale shall be one inch = four (4) feet or as approved.

3.04.3 Form

1. Title Sheet

- a. Name of subdivision or project.
- b. Vicinity Map with north arrow.
- c. Index of sheets.
- d. City Engineer's signature block.
- e. Water authority signature block.
- f. Sewer district signature block.
- g. Plan view showing the entire street right-of-way layout. (Scale: one inch = 100 feet). Proposed water and sewer mains, storm drainage system, lot numbers, street lights, sheet index flow arrows, and other miscellaneous improvements to be installed.
- h. Complete legend.
- i. Typical street section for each width street. Plans shall indicate the design "R" value for the roadway. If acceptable tests have not been taken an "R" value of 5 shall be used.
- j. Title block - located along lower edge or right edge of the plan sheets.
- k. Temporary and permanent bench marks including their descriptions.

- l. General and special notes relating to construction methods.
- m. Geotechnical engineer's, developer's name, developer's engineer's name and land surveyor's name, including addresses and telephone numbers.

2. Street Plan and Profile

a. A plan view of each street shall be shown on separate sheets (extremely short streets may be shown on a single page) indicating existing improvements and contours and elevations within 100 feet of the project boundary and proposed improvements. Proposed improvements shall include sidewalk, curb, gutter, driveways, sewer mains, water mains, water service and sewer lateral locations, storm drains, manholes, valves, fire hydrants, barricades, monuments, survey stationing, curves information and other data as required by the Engineer. Landscaping irrigation, and fencing shall be shown on a separate sheet. The survey stationing shall normally read from left to right with the north arrow pointing either to the top or left edge of the sheet. All stationing shall begin at, and be a continuation of, existing improvements where possible.

b. A profile view of each street shall be shown below its plan view. The profile shall include existing grade lines, sewer mains, storm drains, water mains, public utility mains (where existing or design information is available), all utility crossings, and top of curb. Both the top outside edge and invert of all pipes shall be shown. Top of curb elevations shall be shown at grade break points, manhole and catch basin inverts, and water main crossings with other utilities, and at each lot line, or at every 50 feet, whichever is less.

3. Site Development (Grading) Plan

The site development plan shall include all drainage facilities, building pad elevations and drainage characteristics, finished floor elevations, individual lot drainage patterns, adjacent land drainage, driveway size and locations, fencing, existing and proposed contours, and existing trees, wells, ditches and other landmarks. Adjacent lot grades shall be shown for a minimum of fifty (50) feet from the project boundary. The site development plan shall conform to FHA standards.

4. Street Light Layout and Traffic Controls

A separate street light/traffic control and striping plan shall be included with the improvement plans. The street light plan shall show the location, spacing and wattage of the proposed lights and the manufacturer and model number of the luminaire and pole, photometric calculations, service pedestal details, locations of service points, and locations of pull boxes. Conduit and wire sizes, and lengths shall be shown in tabular form on the plans. Traffic control devices, including all striping, shall be shown on the plans and all quantities shall be tabularized.

3.05 SUBMISSION

Six (6) sets of construction plans and six (6) copies of the subdivision final map shall be submitted to the Engineer. Submitted plans shall include specifications, test data, materials list, drainage calculations, sewer calculations, soils report and design, lot closures, area of each lot in square feet, easements and right of way descriptions, ties to the City of Hercules Bench Mark and Monument System, and other material as requested by the Engineer.

A current title report, thirty (30) days old or less from the submittal date, shall be submitted with the final map. The title report shall include the legal boundary of the property.

Closure calculations shall be provided at the time of the initial map check submittal. All calculated points within the map shall be based upon one common set of coordinates. All information on the map shall be directly verifiable by information shown on the closure calculation print-out. The point(s) of beginning shall be defined and all lot areas shall be shown and shall be verifiable from information shown on the closure calculation print-out.

Geotechnical Reports shall be submitted in 8-1/2 inch x 11 inch bound folders. The analysis shall, at a minimum, include a map of the subject area showing existing streets, contours and location and type/characteristics of soil samples obtained. Where possible, the proposed street pattern shall be shown. The results of all field data and laboratory tests shall be included. Design for the proposed street sections shall be based on the minimum criteria contained in the Design Standards and the Standard Specifications. Street structural section design shall include recommendations for: natural subgrade, subbase, base and pavement compaction and thickness to achieve design strength. In no instance shall structural sections be less than those outlined in the Design Standards or Standard Specifications.

One blackline mylar photocopy (polyester film, 3 mil, matte surface down) and three paper photocopies of the recorded final/map shall be submitted to the Engineer prior to acceptance of any improvements. In addition, one computerized copy of the final map in .dwg or .dxf format shall be provided to the Engineer.

A minimum of fifteen (15) working days shall be allowed for review of Construction Plans and Final Subdivision Maps. The fifteen day period begins when all required and completed items have been submitted to the City. Where alterations or revisions to the plans are required, one copy shall be returned by the City to the developer's engineer with the required corrections indicated. When all revisions are complete and the plans are approved for signature, the developer shall be notified of the submission date to the City Council. However, plans shall not be considered approved and no construction shall begin until the Engineer has signed in the approval block on the plans. There shall be no changes permitted to an approved set of plans unless such changes, corrections, or additions are resubmitted to the Engineer for approval as previously described for original plans. Excepted from approval are any features of the plans that

are contrary to, in conflict with, or do not conform to any California State Law, City of Hercules ordinances or resolutions or Design Standards, Standard Plans, and Standard Specifications or generally accepted good engineering practice; even though such errors, omissions or conflicts may have been overlooked by the Engineer. In such instances, changes shall be shown on as-built drawings.

After signature of the plans by the Engineer, three blackline paper photocopies plus one mylar photocopy (polyester film, 3 mil, matte side down) shall be filed with the Engineer. In addition, one mylar photocopy (polyester film, 3 mil, matte side down) of the the as-built drawings shall be filed with the Engineer's office prior to acceptance of the proposed improvements by the City.

SECTION 4

EXISTING UTILITIES

4.01 GENERAL

The Contractor's attention is directed to the possible existence of underground main or trunk line facilities not indicated on the plans or in the Contract special provisions and to the possibility that underground main or trunk lines may be in a location different from that which is indicated on the plans or in the Contract special provisions. The Contractor shall determine the exact location of underground main or trunk lines as indicated on the plans or in the special provisions, the location of their service laterals or other appurtenances of any other underground facilities which can be inferred from the presence of visible facilities such as buildings, meters and junction boxes. The locations shall be confirmed prior to doing work that may damage the facilities or interfere with their service.

Where the Contractor discovers underground main or trunk lines that are not indicated on the plans or in the Contract special provisions he shall immediately give the Engineer and the utility company written notification of the existence of the facilities. The main or trunk lines shall be located and protected from damage as directed by the Engineer.

The Contractor's attention is directed to § 1540 (a) (1) of the Construction Safety Orders (Title 8 California Administration Code § 1540), issued by the Occupational Safety and Health Standards Board pursuant to the California Occupational Safety and Health Act of 1973, which states in part:

"Prior to opening an excavation, effort shall be made to determine whether underground installations; i.e., sewer, water fuel, electric lines, etc., will be encountered and, if so, where such underground installations are located. When the excavation approaches the approximate location of such an installation, the exact location shall be determined by careful probing or hand digging; and, when it is uncovered, adequate protection shall be provided for the existing installation. Underground Service Alert (USA) shall be advised of the proposed work at least 48 hours prior to the start of actual excavation."

Utility notification and verification of the location of existing underground utilities is the Contractor's responsibility. All costs to the Contractor related to this section shall be considered as included in the various contract bid prices and no additional compensation shall be made.

4.02 UTILITY RELOCATION AND REARRANGEMENT

The right is reserved by the City and the owners of utilities to enter the work area for the purpose of making changes necessary for the rearrangement, repair and/or connections of their facilities. The Contractor shall cooperate with the forces engaged in the work and shall conduct his

operations to avoid any unnecessary delay or hindrance to the work. The Contractor shall allow the respective utilities time to relocate and/or repair their facilities.

The Contractor is responsible for verifying that all existing utilities are shown on the plans. The Contractor is responsible for the removal, relocation, or protection of existing facilities where the facilities are identified by the plans or Contract special provisions. The Contractor shall coordinate with the owners of the utilities for the rearrangement of the facilities.

Where underground utilities are found to exist that are not known to the City or that are in a different location than shown on the plans the Contractor shall:

1. Notify the Engineer of the existence of the facilities.
2. Locate all underground facilities prior to doing work that may damage the facilities or interfere with their service.
3. Notify the owner(s) of the utility.

Where the Engineer determines that the rearrangement of an underground utility that is not shown on the plans or in the special provisions, is essential in order to accommodate the proposed improvement; the Engineer will provide for the rearrangement of the facility. At the Engineer's direction the Contractor may complete the rearrangement and the Contractor will be paid for the rearrangements as extra work.

When the Contract special provisions or plans indicate that a utility is to be relocated, altered or constructed by others, the City will conduct all negotiations with the owners and the work will be done at no cost to the Contractor.

The Contractor shall not be assessed damages for delays where the delay is caused by the failure of the public agency or the owner of the utility to remove or relocate the existing facilities as it affects a controlling item of work.

Except where noted on the plans to be removed or relocated by others, it shall be the Contractor's responsibility to arrange and coordinate the temporary or permanent relocation, alteration or lowering of utilities and other improvements, for the convenience of the Contractor's work. This includes the temporary lowering of manholes and utility frames and covers. Such arrangements and coordination shall be in the contract unit prices for the various items of work and no additional compensation shall be made.

4.03 NOTIFICATION AND LOCATION

At least two (2) working days before performing any excavation work the Contractor shall request that the utility owners mark or otherwise indicate the location of any utilities owned by

East Bay Municipal Utility District, Central Contra Costa Sanitary District, Pacific Gas & Electric Company, SBC, AT&T Broadband, City of Hercules and any other utility owners as may be necessary.

There is an "Underground Service Alert Plan" in the Hercules area. Prior to doing any underground work or excavation, the Contractor shall give Underground Service Alert (USA) forty-eight (48) hour notice.

It shall be the Contractor's responsibility to determine the exact location and depth of all utilities, including service connections, that have been marked by the respective owners and that he believes may affect, or be affected by, his operations.

4.04 PAYMENT

Full compensation for conforming to all the provisions of this section shall be considered as included in the price bid for the various Contract bid items of work and no additional compensation will be allowed.

SECTION 5

SUMMARY OF WORK

5.01 ORDER OF THE WORK

It shall be the responsibility of the Contractor to schedule the major items of construction in the following order:

1. Street excavation and rough grading.
2. Storm and sanitary sewers.
3. Water facilities, and their services.
4. Underground gas, electric, telephone, cable TV.
5. Curb, gutter, sidewalk, driveways, and access ramps.
6. Street sub-base (if required).
7. Base rock.
8. Paving.

5.02 NOTIFICATIONS

The Contractor shall notify the owners of adjacent properties and affected utilities when prosecution of the work may affect them. The notification shall consist of a sign at the site's main construction entrance and written notices to the adjacent property owners. The sign and notices shall include the name, address, and local phone number of the Contractor.

When work is required in any existing street, the Contractor shall notify all residents 48 hours in advance of all operations. When parked vehicles interfere with the Contractor's operations, the Contractor shall adhere to the requirements of ♣ 2.12 "Traffic Control" and ♣ 2.13 "Temporary Traffic Control".

If the work has not commenced during the scheduled period, the work shall be rescheduled within five (5) working days advance notice. If the work is not completed by the end of the period covered in the initial notification the Contractor shall re-notify all residents of the construction schedule extension. The Contractor will re-post of all signs and re-notification notices.

5.03 PRE-CONSTRUCTION MEETING

Except for work covered by an encroachment permit, a pre-construction meeting is required prior to commencement of any work. The purpose of the pre-construction meeting is to designate responsible personnel and establish working relationships. Matters requiring coordination will be discussed and procedures for handling such matters established.

The meeting will be held at a mutually agreed time and place which shall be attended by the City, the developer / developer's engineer or representative, contractor's construction superintendent, subcontractors (as appropriate), and other governmental or agency representatives, as appropriate. The developer shall be responsible for ensuring that all interested parties are notified and present, as warranted.

The Contractor shall bring to the pre-construction meeting sufficient copies of each of the following:

1. Tentative construction schedules.
2. Shop drawings/sample/substitute or "or equal" submittal schedule.

See ♣ 6.01.1 "Submittals Required at the Pre-Construction Meeting".

SECTION 6

SUBMITTALS

6.01 GENERAL

Where submittals are required, all submittals shall be submitted to the Engineer for review.

All submittals shall be accompanied by a transmittal form or cover letter acceptable to the Engineer. Information shall include: the developer's name and address, project identification, sender's name and phone number, and a summary of the transmittal.

6.01.1 Submittals Required at the Pre-construction Meeting

At the pre-construction meeting the Contractor shall submit the following items:

- 1 . A schedule of work, that is based on the following order of work:
 - a. Rough grading
 - b. Sanitary sewer
 - c. Storm drainage
 - d. Water mains
 - e. Joint trench
 - f. Subgrade
 - g. Aggregate sub-base
 - h. Concrete surface improvements
 - i. Aggregate base
 - j. Asphalt concrete pavement
 - k. Striping and markings
 - l. Signs
 - m. Monuments
 - n. Fire hydrants
 - o. Street lights
 - p. Landscaping
2. A preliminary schedule of shop drawings, samples, and proposed substitutes or "or equal" submittals.
3. A list of all permits the developer, developer's engineer or contractor is required to obtain.

6.01.2 Submittals Required After the Pre-construction Meeting

The Contractor shall submit to the Engineer all proposed substitutes or "or equal" products thirty (30) days prior to use on the work. All submittals shall be in conformance with the requirements of this section.

The Contractor shall submit copies of all required permits prior to starting any work covered by the various permits.

The Contractor agrees that failure to submit his requests for alternative products within the time period stipulated in the Contract shall serve as a waiver for any future rights to offer such substitutes, and the Contractor agrees to provide one of the specified products called for on the plans.

The Contractor shall submit a copy of the valid trench shoring permit issued by CAL OSHA, if applicable, prior to starting any trenching.

6.02 CERTIFICATES OF COMPLIANCE

The Contractor shall provide Certificates of Compliance for all proposed products and materials to be used. The Certificates of Compliance shall include identification of the material, material source, name of the supplier, project name, and the portion of the work where the material represented by the sample will be used.

6.03 SHOP DRAWINGS

Where called for in the plans, or where required by the Engineer, the Contractor shall furnish to the Engineer six (6) copies of each shop drawing. "Shop Drawings" includes detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, and similar items. Unless otherwise required, the Shop Drawings shall be submitted to the Engineer early enough for the Engineer to review the Shop Drawings to accommodate the proposed construction schedule.

All Shop Drawings shall be accompanied by a standard transmittal form or cover letter. Any submittal not accompanied by the form, or where all applicable items on the form are not completed, will not be considered. Incomplete submittals will be returned for re-submittal only if the sender is identified on the form or cover letter.

A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturers "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.

Except as may otherwise be provided in this section, the Engineer will return prints of each submittal to the Contractor with his comments noted thereon, within twenty-one (21) calendar days following their receipt by the Engineer. The Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. Any required review after the first re-submittal is defined as Excessive Review and all costs for Excessive Review shall be charged to the Developer. Final acceptance will be withheld until all costs for Excessive Review are reimbursed to the City.

If a submittal is returned to the Contractor marked "No Exceptions Taken" formal revision and resubmission of the submittal will not be required.

If a submittal is returned to the Contractor marked "Make Corrections Noted" a formal revision and resubmission of the submittal will not be required.

If a submittal is returned to the Contractor marked "Amend – Re-submit" the Contractor shall revise the submittal and shall resubmit six (6) copies of the revised submittal to the Engineer.

If a submittal is returned to the Contractor marked "Rejected – Re-submit" the Contractor shall revise the submittal and shall resubmit six (6) copies of the revised submittal to the Engineer.

Fabrication of an item may begin only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "No Exceptions Taken" or "Make Corrections Noted". Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract documents.

All Contractor submittals shall be reviewed by the developer's engineer prior to submittal to the Engineer. Each submittal shall be dated, signed, and certified by the developer's engineer and Contractor as being correct and in conformance with the Contract documents. For shop drawings each sheet shall be dated, signed, and certified. No consideration for review by the Engineer of any Contractor submittals will be made for any items that have not been certified by the developer's engineer and Contractor. All non-certified submittals will be returned to the developer's engineer and Contractor without action by the Engineer and any delays caused shall be the responsibility of the Contractor.

The Engineer's review of Contractor submittals shall not relieve the Contractor of the responsibility for the correctness of the details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in the Contractor's submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

6.04 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

Any material, product or equipment to be incorporated may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product or equipment that is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:

1. The burden of proof as to the quality and utility of any substitute material, product, or equipment shall be upon the Contractor.
2. The Engineer will be the sole judge as to the quality and utility of any substitute material, product, or equipment and his decision shall be final.

Where the name or the name and address of a manufacturer or supplier is given for a material, product or equipment, or if any other source of a material, product, or equipment is indicated such information is given for the convenience of the Contractor only and no limit, restriction, or direction is indicated or intended nor is the accuracy or reliability of the information guaranteed. It shall be the responsibility of the Contractor to determine the accurate identity and location of any such manufacturer, supplier, or other source of any material, product, or equipment.

The Contractor may offer any material, product, or equipment that the Contractor considers equal to those specified. The Contractor, at his expense, shall furnish data concerning items he has offered as a substitute or as an "or equal". The Contractor shall provide data required for the Engineer to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability and that the substitute or "or-equal" item will fulfill its intended function.

Approval by the Engineer of a substitute item proposed by the Contractor shall not relieve the Contractor of the responsibility for full compliance with the Contract documents and for the adequacy of the substituted item. The Contractor shall be responsible for changes and all costs that the substitution requires in his work, the work of his subcontractors and of other contractors and shall complete the changes without cost to City.

6.05 SAMPLES

Where samples are required, the Contractor shall submit three (3) units of each sample item or material to the Engineer at no cost to the City.

Samples shall be submitted for approval a minimum of fourteen (14) calendar days prior to ordering the material for delivery to the job-site and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled.

All samples shall be individually and indelibly labeled or tagged, indicating all specified physical characteristics and manufacturer's names for identification, and submitted to the Engineer. Two (2) sets of the samples will be stamped and dated by the Engineer and returned to the Contractor; one set will be retained by the Engineer.

Unless otherwise specified, all colors and textures of specified items will be selected from the manufacturer's standard colors and standard materials, products, or equipment lines.

6.06 ACCEPTANCE FOR MAINTENANCE

Improvements will not be accepted by the City for permanent maintenance until the Contractor-prepared as-built drawings have been delivered to and accepted by the Engineer.

6.07 USE OF PRIVATE PROPERTY

If the Contractor uses private property for access or construction, the Contractor shall obtain all necessary permits / approvals from the Planning Department. The Contractor shall also obtain signed agreements from the property owners. The Contractor shall submit to the Engineer a copy of each executed agreement with the private property owner(s) for access or use of the private property before using the private property.

6.08 PIPELINE CUT SHEETS

The Contractor shall submit to the Engineer cut sheets for any sanitary sewer line installation, storm drain line installation, and curb and gutter construction twenty-four (24) hours prior to start of the construction work. See ♣ 18 “Storm Drainage and Water Quality”.

6.09 STREET LIGHT WIRING PLAN

The Contractor shall submit to the Engineer an acceptable street light wiring plan, showing the wiring layout and the location of the power source. The plan shall be approved by the Engineer before any street lights are installed. See ♣ 16 “Street Lighting”.

6.10 STREET TREE REMOVAL

The Contractor shall give the Engineer ten (10) calendar days notice prior to removal of any street tree designated for removal on the approved construction drawings.

6.11 GRADING

The Developer shall notify the Engineer two (2) working days prior to starting any grading.

SECTION 7

CONTROL OF WORK AND MATERIALS

7.01 AUTHORITY OF ENGINEER

The Engineer shall evaluate the quality or acceptability of materials furnished and work performed and the rate of progress of the work. The Engineer's decision shall be final and he shall have the authority to enforce and make effective the decisions and orders which the Contractor fails to carry out promptly. The Engineer will interpret the Contract plans and specifications, where required, determine when the contract is fulfilled, and resolve all issues pertaining to compensation.

7.02 ASSIGNMENT

The performance of the Contract may not be assigned, except upon the written consent of the Engineer.

Consent will not be given to any proposed assignment, which would relieve the original Contractor or his surety of their responsibilities under the Contract nor will the Engineer consent to any assignment of a part of the work under the Contract.

7.03 PRECEDENCE OF CONTRACT DOCUMENTS

Where conflict may exist in the work the terms of the following documents shall control, each over the other, in the following order:

1. Permits from other agencies as required.
2. Contract change orders.
3. Approved revisions to the plans.
4. Addenda.
5. Special provisions.
6. Bid proposal.
7. Standard Specifications.
8. Reference specifications.
9. Project drawings.
10. Standard Plans.
11. Design Standards.

The plans, specifications and other Contract documents will govern the work. Anything in the specifications and not on the plans, or on the plans and not in the specifications, shall be as

though shown or mentioned in both. The Standard Specifications and Standard Plans are a part of the Contract documents.

Where there is any discrepancy between any drawing and the numeric values written thereon, the numeric values shall be taken as correct.

7.04 INTERPRETATION AND FAMILIARITY WITH CONTRACT PLANS AND SPECIFICATIONS

The Contract plans consist of general drawings and show details necessary to give a comprehensive idea of the construction. All authorized alterations affecting the requirements and information given on the Contract plans shall be in writing.

Shop drawings or plans for any work not included in the Contract plans shall be approved by the Engineer before any work involving these plans is begun.

The Contractor shall keep a copy of the plans and specifications, including addenda and change orders, at the work site. The Engineer shall have access to the documents upon request.

Existing improvements at the job site, for which no specific disposition is made on the plans, but that could reasonably be assumed to interfere with the satisfactory completion of the work, shall be removed and disposed of by the Contractor as part of the work at no additional cost to City, or left in place and protected by the Contractor, at the direction of the Engineer.

It is the responsibility of the Contractor to be thoroughly familiar with all aspects of the project, including the work of his own forces and all subcontractors. The following matters shall be called to the prompt attention of the Engineer before an error is made on the job:

1. Errors and omissions in the drawings, Contract plans or special provisions.
2. Work on the drawings, Contract plans or special provisions that, if constructed, would result in confusion or interference with other work or the work of other trades, including the location of fixtures and equipment.
3. The Contractor shall coordinate the work to assure the orderly sequencing of the construction elements.
4. The Contractor shall take field measurements, verify field conditions and compare these with other information known to the Contractor and to the Contract Documents before beginning activities. The Contractor shall, upon discovering any error, inconsistency, omission or conflict in the plans or specifications, immediately notify the Engineer.

7.05 SHOP DRAWINGS

When shop drawings or other details are necessary to control the work or are required by the Contract documents, or as requested by the Engineer; they shall be prepared in accordance with current engineering and architectural practice and at the Contractor's expense. Drawings shall be of a size and scale to show all details and shall be transmitted by letter to the Engineer for review or correction at least ten (10) working days before the drawings will be required for the work.

Materials shall not be furnished or fabricated nor any work done for which drawings are required, before the City has reviewed and approved the drawings. Any work or fabrication prior to City approval shall be at the Contractor's risk.

Review and approval of drawings by the Engineer shall not relieve the Contractor from the responsibility of deviations from the Contract Documents unless such deviations were specifically called to the attention of the Engineer in the letter of transmittal submitted with the drawings. The Contractor shall be responsible for the correctness of the drawings, for shop fits and field connections, and for the results obtained by use of the drawings.

The Engineer's review and approval is a general review for compliance with the Contract documents only, and does not constitute a detailed check of dimensions, quantities, materials, or fabrication processes. The review shall not relieve the Contractor, subcontractor, or vendor from conforming to all aspects of the Contract documents, and neither the Engineer nor the City shall be responsible for any errors or omissions by reason of the review.

7.06 CONSTRUCTION STAKING

Stakes or marks will be set by the Contractor to establish basic control lines and grades required for the completion of the work.

Unless otherwise specified in the special provisions, initial horizontal and vertical control points will be established by the Engineer at no cost to the Contractor. These points shall be used as datum for the work. Additional survey, layout, and measurement work shall be the Contractor's responsibility.

The Contractor shall deliver written notice at least two (2) working days prior to the time when he will require the Engineer to set initial control points.

The Contractor shall preserve all initial control points, permanent survey monuments, benchmarks or boundary markers, in their proper places until authorized to remove and reset them by the Engineer. All expenses incurred in resetting the survey controls shall be paid by the Contractor.

All construction surveys and measurements, stakes and marks and all the related work necessary to do the work, except the basic control survey furnished by the Engineer, shall be the

Contractor's responsibility and the costs included in the various Contract items of work. The construction surveys shall be performed under the supervision of experienced and licensed persons and be sufficient to assure compliance with the plans and specifications.

7.07 SUPERINTENDENCE

At all times during the work, the Contractor shall have an authorized representative or agent present at the construction site who shall have complete authority to represent and to act for the Contractor. The Contractor's representative may not be a subcontractor or an employee of the subcontractor.

Before initial work is begun on the Contract, the Contractor shall file with the Engineer addresses and telephone numbers where the superintendent can be reached during all hours, including nights and weekends, when the work is not in progress. The Contractor's authorized representative shall supervise the work crews and subcontractors and coordinate all construction activities and operations including traffic control, work by others (including utility companies) and public notifications. Lack of supervision shall be cause to suspend the work as provided for in § 10.03 "Temporary Suspension of Work".

When the supervision is not provided as required, the City may assess the Contractor for the lack of such superintendence. The assessment shall be based on prevailing wage(s) plus benefits and a twenty (20) percent markup for administration cost times the number of hours the supervision has not been provided. The assessment will be deducted from any amounts due to the Contractor.

Where the Contractor or his authorized representative is not present on any particular part of the work where it may be desired to give direction, orders may be given by the Engineer, that shall be completed by whomever may have charge of the particular work in reference to which the orders are given.

Full compensation for conforming to superintendence shall be included in the Contract prices paid for the various items of work and no additional compensation shall be allowed.

7.08 COORDINATION

7.08.1 General

The Contractor shall be responsible for the coordination of all work and the coordination of the work of all subcontractors. The Contractor shall not delegate coordination to any subcontractor. Coordination shall include the establishment of on-site lines of authority and communication. The Contractor's on-site supervisory person shall be present at all times when any work is in progress.

7.08.2 Scheduling

The Contractor shall prepare construction schedules as specified in ♣ 6 "Submittals". All schedule submittals shall conform to the requirements specified in ♣ 6.

7.08.3 Requests for Substitutions

The Contractor shall review subcontractors requests for changes and for substitutions. All requests for substitutions shall conform to the requirements of ♣ 6 "Submittals".

7.08.4 Submittals

All submittals to the City shall be made by the Contractor.

7.08.5 Coordination of Subcontractor Responsibilities

The Contractor shall coordinate the work of each of its subcontractors and suppliers. Special attention is directed to the following obligations of the Contractor:

1. Verify that subcontractors have obtained permits for inspections.
2. Review all subcontractor shop drawings, product data, and sample submittals for compliance prior to submittal to the City.
3. Maintain onsite documentation and keep a current record drawing set at the construction site.

7.09 DEFECTIVE AND UNAUTHORIZED WORK

All materials, parts and equipment furnished by the Contractor in the work shall be new and free from defects. Used or secondhand materials, parts and equipment may be used only if permitted by the Special Provisions. Recycled materials may be used if they are high grade and free of defects and conform to the project specifications. Workmanship shall be in accordance with generally accepted standards. Material and workmanship shall be subject to the Engineer's approval.

Materials and workmanship not conforming to the requirements of the Contract documents shall be considered defective and will be subject to rejection. When directed by the Engineer defective work or material, whether in place or not, shall be removed immediately from the site by the Contractor, at the Contractor's expense.

Any work done beyond the limits of work, lines and grades shown on any approved plans or established by the Engineer, or any extra work done without written authority, will be considered as unauthorized and shall not be paid for.

Where the Contractor fails to comply with any order of the Engineer made under the provisions of this article, the Engineer shall cause the defective or unauthorized work to be remedied, or removed and replaced, and to deduct the costs from any payment due, or to become due, to the Contractor. Costs to be deducted shall include engineering costs plus a twenty (20) percent markup for administration costs.

7.10 CHARACTER OF WORKMEN

Any subcontractor, or person employed by the Contractor, that appears to the Engineer to be incompetent or to act in a disorderly or improper manner shall be discharged from the site immediately by the Contractor upon written direction of the Engineer. That person or subcontractor shall not be re-employed on the work. See ♣ 2.03.1 “Labor, General”.

7.11 CITY FURNISHED MATERIALS

Materials, if furnished by the City, will be available as designated in the special provisions. The cost of loading, unloading, hauling and handling and placing City-furnished materials shall be included in the price bid for the Contract item involving the City-furnished material.

The Contractor shall inspect and assure himself of the amount and soundness of the materials and provide a written receipt for them.

The Contractor is responsible for all materials furnished to him, and for all shipping, delivery and storage charges. City-furnished materials lost or damaged from any cause whatsoever shall be replaced by the Contractor. The Contractor will be liable to the City for the cost of replacing City-furnished materials and the costs may be deducted from any payment due, or to become due, to the Contractor.

7.12 STORAGE OF MATERIALS

Materials shall be stored to ensure the preservation of their quality and fitness. The materials shall be placed on platforms or other hard, clean surfaces and covered as warranted. Materials shall be stored to facilitate inspection. If necessary to protect the public the material shall be guarded by fences.

Unless otherwise designated in the special provisions, locations and arrangements for storage sites for materials and equipment outside the right-of-way, or limits of work, shall be selected and maintained by the Contractor at his expense. Full compensation for furnishing storage shall be included in the various Contract bid items and no additional compensation will be allowed.

7.13 TRADE NAMES AND ALTERNATIVES

The Contractor shall supply any of the materials specified or he may propose an equivalent. The use of recycled materials is encouraged. The Engineer shall determine whether the proposed material offered is equivalent to that specified. Adequate time shall be allowed for the Engineer to make this determination.

Where any material, process, or equipment is indicated by patent, proprietary or brand name, or by name of manufacturer, such wording is used for the purpose of facilitating its description and shall be deemed to be followed by the words "or approved equal". See ♣ 6.04 "Proposed Substitutes or 'Or Equal' Items".

A listing of materials is not intended to be comprehensive, nor is it listed in order of preference. The Contractor may offer any material, process, or equipment, that he considers to be equivalent to that indicated. Requests for substitutions of equivalent materials and data substantiating the request shall be made in ample time to permit approval without delaying the work.

The Contractor shall, at his expense, furnish data for proposed items. He shall have the material tested, at no expense to the City, as required by the Engineer. Tests shall determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, uniformity, and suitability are such that the item will fulfill its function.

Test methods shall be subject to the approval of the Engineer. Test results shall be reported promptly to the Engineer who will evaluate the results and determine if the substitute item is equivalent. The Engineer's findings shall be final. Installation and use of a substitute item shall not be made until approved by the Engineer.

If a substitute offered by the Contractor is not equal to the specified material the Contractor shall furnish and install the specified material.

Where an item is specified for the purposes of matching, aesthetics, maintenance, interfacing or other reason based on similarity or compatibility with existing or planned facilities, there shall be no substitute.

The specified Contract completion time shall not be affected by any circumstance developing from the provisions of this section.

Any redesign required by a substitution shall be at the Contractor's expense.

7.14 SAMPLES AND TESTS

Sampling and testing shall be at the sole discretion of the Engineer. The City is not obligated to perform sampling and testing. A decision not to sample or test by the City shall not relieve the Contractor from his responsibility for the quality and workmanship of the work and to comply with the Contract.

Before incorporating materials in the work, the Contractor shall submit samples, as the Engineer may require, at no cost to the City. The Contractor, at his own expense, shall deliver materials for testing to the place and at the time designated by the Engineer. The Contractor shall bear all costs for materials or services proposed for substitution. Re-testing of any kind shall be at the Contractor's expense. When required by the Engineer, the Contractor shall furnish, at no cost to the City, the manufacturer's Certificate of Compliance and other documents that state that tests of quality have been passed.

The Contractor shall notify the City in writing at least fifteen (15) calendar days in advance of his intention to use materials for which tests are required to allow sufficient time to perform the tests. The notice shall name the proposed supplier and the source of material.

7.15 INSPECTION

All work and materials are subject to inspection and approval by the Engineer. The Contractor shall notify the Engineer at least two (2) days in advance that inspection is required. Any work done without proper inspection will be subject to rejection. The Engineer shall have access to the work during its construction at shops and yards as well as at the project site. The Contractor shall ensure that the materials and workmanship are in accordance with the Contract documents. Inspection of the work shall not relieve the Contractor of his obligation to fulfill all conditions of the Contract.

No portion of any work or installed materials shall be covered or concealed in any manner before all required inspections are complete. The cost of uncovering and replacing work and materials not inspected shall be borne by the Contractor.

Overtime construction work performed at the option of, or for the convenience of, the Contractor will be inspected by the City at the Contractor's expense and will be deducted from any payments due. For any such overtime beyond the regular 8 hour day and for any time worked on Saturday, Sunday, or holidays, the charges will be as specified in ♣ 7.16 "Overtime Inspections".

There will be no charge for the inspection of overtime work ordered by the Engineer. Projects financed in whole or in part with County, State or Federal funds shall be subject to inspection by the agency involved.

Upon completion of the work the Contractor shall request that the Engineer perform a "Final Inspection". The Engineer will schedule the inspection at the earliest possible date and invite the Contractor to attend. During the Final Inspection the Engineer will note all defects, unacceptable work, incomplete work and other outstanding items. Following the final inspection the Engineer will provide the Contractor with a written list (Punch List) of all defects, unacceptable work, incomplete work and other outstanding items noted during the Final Inspection. Providing the Contractor with a "Punch List" does not preclude the City from adding additional items which may be discovered prior to final payment.

Provided the Engineer finds the "Punch List" to be minor in nature, the Engineer may suspend the counting of working days for the purpose of computing Contract Liquidated Damages. The Engineer may continue to suspend, at the Engineer's option, charges for liquidated damages provided the Contractor diligently works to complete and/or correct all deficiencies identified in the "Punch List".

Suspension of the count of working days for the purpose of computing Liquidated Damages is solely at the discretion of the Engineer. Suspension of the count of working days is not a decision subject to a protest or claim by the Contractor, and does not waive the City's right to charge the Contractor for additional costs to the City for inspection and administration of work beyond the required completion date.

7.16 OVERTIME INSPECTIONS

Inspection of the Contractor's work by the Engineer is limited to eight (8) hours during any one calendar day, and forty (40) hours during any one calendar week except as described in this section. Inspections provided in excess of 8 hours per day, and 40 hours during any one week will be billed to the Contractor at not less than 1 ½ times the basic rate of pay plus applicable benefits, vehicle and equipment charges, and overhead. Overtime inspection charges shall also include work on weekends and any City holidays.

7.17 SUGGESTIONS TO THE CONTRACTOR

Any plan or method of work suggested but not specified by the Engineer to the Contractor, whether followed or ignored by the Contractor, in whole or in part, shall be at the risk and responsibility of the Contractor. The City and the Engineer shall not be responsible.

7.18 FOREIGN MATERIALS

Section 6-1.08 "Foreign Materials" of the State Standard Specifications shall apply to any item processed, manufactured or assembled outside the United States.

7.19 SALVAGE OF EXISTING FACILITIES

Any existing public or City facilities to be removed as directed by the Engineer shall be salvaged by the Contractor and delivered to the City facility as directed by the Engineer.

The Contractor shall prevent damage to any and all materials and equipment specifically designated by the Engineer to be removed and salvaged.

Any items damaged during removal, storage, or handling, as a result of carelessness, negligence, or improper procedures, shall be replaced by the Contractor with corresponding items of equal or greater value.

The Contractor may, at his option, and as approved by the City, furnish and install new items in lieu of those indicated to be salvaged or reused, in which case the original items shall become the property of the Contractor and shall be removed from the site. The cost of substituting new items in lieu of salvaged or revised items, at the Contractor's option, shall be the responsibility of the Contractor.

Existing materials and equipment removed by the Contractor shall not be reused in the work, except where otherwise called for in the Contract documents.

7.20 PROJECT CLOSEOUT

All construction shall meet the Public Works Occupancy Requirements prior to any building occupancy. Public Works Occupancy Requirements include the following:

1. All underground facilities.
2. Asphalt concrete pavement.
3. Portland cement concrete improvements which may include, but not be limited to: curb, gutter, sidewalk, driveways, and access ramps.
4. Finish grading within the street right-of-way.
5. Street name signs.
6. Traffic regulatory signs, striping, and markings.
7. Street lights installed and energized.
8. Fire hydrants installed and accepted.
9. All potential hazards removed within the street right-of-way.
10. Street and sidewalks and driveways cleaned.
11. Water meters and boxes installed.
12. Sanitary sewers cleaned out.
13. Street trees installed.
14. All conditions of approval complied with.

7.21 FINAL CLEAN UP

Before final inspection of the work, the Contractor shall remove all rubbish, debris, unused materials, concrete forms, construction equipment and temporary structures and facilities used during construction. Final acceptance of the work by the City will be withheld until the Contractor has satisfactorily complied with the requirements for final cleanup of the project site.

SECTION 8

BID PROPOSAL REQUIREMENTS

8.01 BID PROPOSAL FORMS

The City will furnish to each Bidder a Proposal Form which, when filled out and executed, may be submitted as a bid. Bids not presented on the furnished forms will be disregarded. The Proposal Form, bound together with the Contract Proposal Packet, must remain intact.

If applicable, the proposal shall set forth for each Contract item of work, in clearly legible figures, an item price and a total for the item in the respective spaces provided, and shall be signed by the bidder. The bidder shall fill out all blanks in the proposal form as required. No mention shall be made of Sales Tax or Use Tax as all prices submitted will be considered as including such tax.

All forms contained in the proposal packet shall be completed and the proposal submitted in accordance with the instructions included with the requirements of this section.

A financial statement of the lowest bidder, when required by the Contract special provisions shall be submitted to the City within three (3) calendar days following the bid opening.

The Proposal Packet shall be submitted as directed in the Notice to Contractors under sealed cover plainly marked as a "Proposal" and identifying the project to which the proposal relates and the date of the bid opening. Proposals that are not properly marked may be disregarded.

In submitting the Bid Proposal the Contractor warrants that there has been no collusion and that he has not been influenced by any oral statement or promise of the Engineer, but only by the Contract Documents.

The Bid Proposal shall be signed by the Contractor's legal representative as indicated on the Bid Proposal Form. If the proposal is made by an individual it shall be signed and his full name and his address shall be given; if it is made by a partnership, it shall be signed with the partnership name by a member of the firm, who shall sign his own name and provide the name and address of each member; and if it is by a corporation, the proposal shall show the name of the corporation and the State under the laws of which the corporation was chartered. When the proposal is signed by the authorized officer or officers of the corporation it shall be attested by the corporate seal, and the names and titles of the principal officers of the corporation shall be given. When proposals are signed by an agent, other than the officer or officers of a corporation authorized to sign contracts on its behalf or a member of a partnership a "Power of Attorney" must be filed with the City prior to opening bids or shall be submitted with the proposal; otherwise, the proposal may be rejected as irregular and unauthorized. Bids submitted as joint ventures must so state and must be signed by each joint venture partner.

The Contractor's address given on the Bid Proposal is where all notices, letters and other communications to the Contractor shall be mailed or delivered. The mailing, or delivery of the notice, letter or other communication to the Contractor shall be deemed sufficient service upon the Contractor. The date of the service shall be the date of the mailing or delivery. The address may be changed at any time by a written notice signed by the Contractor and delivered to the Engineer. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter or other communication upon the Contractor personally.

8.02 EXAMINATION OF DOCUMENTS AND SITE

The Bidder shall examine the site of the work and the Contract Documents. The submission of a bid proposal shall be prima facie evidence that the bidder has investigated, and is satisfied as to, the conditions to be encountered, including surface and subsurface soils conditions, as to the character, quality, and scope of work, the quantities and quality of materials to be furnished, the order of work to be performed, the order of installation of materials, and the requirements of the Contract and the Contract Documents, specifications and plans. The bidder shall not, at any time after submission of the bid, dispute, complain, or assert that there was any misunderstanding in regard to the nature, amount, or type of work to be done.

Where the City has made investigations of subsurface conditions in areas where work is to be performed under the Contract or in other areas, some of which may constitute possible local material sources, such investigations are made only for the purpose of study and design. Where such investigations have been made, bidders may, upon written request, inspect the records of the City subject to the conditions set forth in this section.

The records of such investigations are not a part of the Contract and are shown solely for the convenience of the bidder or Contractor. The Contractor understands and agrees that the City assumes no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations, the records, or of the interpretations set forth or made by the Engineer in its use. There is no warranty or guaranty, either expressed or implied, that the conditions indicated by such investigations will be encountered or that unlooked-for developments may not occur, or that materials other than, or in proportions different from those indicated, may not be encountered.

When logs of test borings showing a record of the data obtained by the City's investigation of subsurface conditions are included with the Contract plans the Contractor understands and agrees that the logs of test borings do not constitute a part of the Contract. The logs only represent the opinion of the City as to the character of the materials encountered by the City in its test borings, is included in the plans only for the convenience of bidders and its use is subject to all of the conditions and limitations set forth in this section.

No information derived from the Contractor's inspection of records of investigations or compilation made by the City or from the Engineer, or his assistants, will in any way relieve the bidder or the Contractor from any risk or from fulfilling the terms of the Contract.

8.03 WITHDRAWAL OF BID PROPOSALS

The Contractor may withdraw any bid, at any time, prior to the time fixed in the public notice for the opening of bids, by filing a request with the City Clerk. The request shall be executed by the Bidder or his duly authorized representative. The withdrawal of a bid does not prejudice the right of the Bidder to file a new bid. Whether or not bids are opened exactly at the time fixed in the public notice for opening bids, a bid will not be received after that time, nor may any bid be withdrawn after the time fixed in the public notice for the opening of bids, or such time set by Addendum.

8.04 PUBLIC OPENING OF BID PROPOSALS

Proposals will be opened and read publicly at the time and place indicated in the "Notice to Contractors". Bidders or their authorized agents are invited to be present. After opening of bids the Engineer will review all bids for accuracy. The Engineer reserves the right to make corrections of obvious errors. Upon completion of the Engineer's review an apparent low bidder will be notified.

8.05 DISQUALIFICATION OF BIDDERS

More than one proposal from an individual, firm, partnership, corporation, or combination thereof under the same or different names will not be considered. Reasonable grounds for believing that any individual firm, partnership, corporation or combination is interested in more than one proposal for the work may cause the rejection of all proposals that the individual, firm, partnership, corporation or combination is interested in. If there is reason for believing that collusion exists among the bidders, any or all proposals may be rejected and none of the participants involved in the collusion will be considered in future proposals. Proposals in which the prices are obviously unbalanced, those that are incomplete, those that show any alteration of form or contain any additions or conditions, and alternate bids that are not called for or otherwise permitted, may be rejected.

Pursuant to §10162 of the Public Contract Code the bidder shall complete, under penalty of perjury, the questionnaire in the Proposal relating to previous disqualification, removal or other prevention of bidding of the bidder, or officers or employees of the bidder because of violation of law or a safety regulation.

A bid may be rejected on the basis of a bidder, any officer of the bidder, or any employee of the bidder who has a proprietary interest in the bidder, having been disqualified, removed or otherwise prevented from bidding on, or completing a federal, state, or local project because of a violation of law or a safety regulation.

8.06 RELIEF OF BIDDERS

The Bidder's attention is directed to the provisions of §5100 to §5107, inclusive of the Public Contract Code, concerning relief of bidders.

Written Notice by Bidder

Should a Bidder claim a mistake was made in his bid, the Bidder shall give the City written notice within five (5) working days after the opening of the bids of the alleged mistake. The notice shall certify:

1. How the mistake occurred.
2. The nature of the mistake.
3. How the mistake made the bid materially different than was intended.
4. That the mistake was made in filling out the bid and not due to an error in judgment or to carelessness in inspecting the site of the work, or in reading the plans or specifications.

The written notice shall be certified by the Bidder as being true and correct. The written notice shall be accompanied by sufficient documentation to fully explain the nature and magnitude of the error.

City Review of Notice and Disposition of Bidders Request for Relief from the Bid

The Engineer shall consider the notice from the bidder and review all supporting documents submitted with the notice. The Engineer may request additional information or documentation.

Where the Engineer finds sufficient evidence to substantiate the Bidders request to be relieved from the bid, the Engineer shall prepare and submit a report to the City Council for its consideration. The Engineer's report shall document the findings, pursuant to §5101 "Relief of Bid (b)" of the Public Contract Code required to be made by the City Council in consenting to the relief of the Bidder.

The mistake was made in filling out the bid and not due to an error in judgment, or to carelessness in inspecting the site of the work, or in reading the plans or specifications.

The report will be considered at the earliest possible regular meeting of the City Council. The Bidder will be given notification of the date and time the report will be considered by the City Council. The City Council action on the Engineer's report shall be final and binding upon the Bidder.

Should the Engineer find the evidence submitted by the Bidder to be inconclusive, or not to support the Bidders request to withdraw the bid, the Bidder shall be notified by the Engineer. The Engineer's denial of the Bidder's request to be relieved from the bid shall be final and binding upon the Bidder.

Should the Engineer and/or City Council not find sufficient evidence to support the relief of the bid the Bidder shall be bound by the provisions of the Contract documents to enter into an agreement to perform the work. Should the Bidder fail to enter into a contract agreement with the City within the time set forth by the Contract documents the bid security shall be forfeited to the City.

8.07 REJECTION OF BID PROPOSALS

Bid Proposals may be rejected if they show any alteration of form, additions not called for, conditional bids, incomplete bids, erasures, or irregularities of any kind. Alternative proposals will not be considered unless called for. No oral, telegraphic, or telephonic proposals or modifications will be considered.

The City reserves the right to reject any bid for: improper form, Contractor irresponsibility or incompetence, collusion, unbalanced bid price, or for any other reason found to be detrimental to the City's interest or welfare. The City reserves the right to reject any or all proposals or portions thereof, and to waive any irregularities if to do so is deemed to best serve the interests of the City.

8.08 BID PROPOSAL GUARANTY

All bids shall be presented under sealed cover and accompanied by one of the following forms of bidder's security:

1. A cashier's check.
2. A certified check.
3. A bidder's bond consisting of the City's Standard Bond Form and executed by an admitted surety insurer, made payable to the City of Hercules.

The security shall be in an amount equal to at least 10 percent of the amount of the bid. A bid will not be considered unless one of the forms of the bidder's security is enclosed with it.

A bidder's bond will not be accepted unless it conforms to the bond form included in the Contract Documents.

8.09 ADDENDA

The Engineer may, before the bid opening, issue addenda to the Contract Documents to amend, clarify or correct matters contained in the bid package. The addenda shall constitute a part of the Contract Documents and shall be binding. Addenda will be forwarded to all prospective bidders, insofar as they are known to the Engineer.

8.10 APPROXIMATE ESTIMATE

The quantities given in the proposal and Contract forms are approximate only, being given as a basis for the comparison of bids and the City does not, expressly or by implication, agree that the actual amount of work will correspond therewith, but reserves the right to increase or decrease the amount of any class or portion of the work, or to omit portions of the work, as determined by the Engineer.

8.11 SUBSTITUTION OF EQUALS

Where in the Contract documents, any material, equipment or process is indicated or specified by patent or proprietary name or by name of manufacturer, and the Bidder offers substitute material, equipment or process on the basis that a substitute is the equal in every respect to that specified, then the Bidder shall first submit to the Engineer a request in writing for his approval along with such detailed plans and specifications and other data as the Engineer may deem necessary to determine if the substitute is the equal of that called for. A request by a prospective bidder for approval shall be submitted to the Engineer at least ten (10) days in advance of the time and date set for opening of bids in order that all interested bidders may be notified of the approval or approved alternative. The Engineer shall judge as to whether the substitute offered is the equal in all respects of the material, equipment or process specified. See ♣ 6.04 "Proposed Substitutes or 'Or Equal' Items" and ♣ 6.05 "Samples".

If the material, equipment or process offered by the Bidder is of, in the opinion of the Engineer, not equal to that specified, then the Bidder must furnish the material, equipment or process specified, or one that, in the opinion of the Engineer, is the equal to that specified.

The bidder is encouraged to use recycled materials where the materials are an equal substitute.

8.12 INTERPRETATION OF DOCUMENTS

If any person submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the Contract Documents, or finds discrepancies in, or omissions from the plans or specifications, he may submit a written request to the Engineer for an interpretation or a correction. The person submitting the request will be responsible for its prompt delivery at least seven (7) days prior to the bid opening. Answers to requests that do not give any single bidder an

unfair advantage will be given orally. Otherwise, interpretation or correction of the proposed documents will be made by addendum duly issued, and a copy of the addendum will be mailed or delivered to each person receiving a set of the documents. Any addenda issued during the period of bidding shall be executed by the bidder. The addenda must be attached to and submitted with the Bid Proposal. Absence of the attachment of addenda may be cause for rejection of a proposal. The City will not be responsible for any other explanations or interpretations of the Contract Documents.

The bidder is responsible for inquiring, prior to submitting the bid, whether the City has issued any addenda.

Neither the City nor the Engineer shall be deemed responsible for any oral clarification.

8.13 LISTING OF PROPOSED SUBCONTRACTORS

Each proposal shall list the name and address of each subcontractor to whom the bidder proposes to subcontract portions of the work in an amount in excess of one-half of one percent of the total bid, or \$10,000, whichever is greater. Subcontracting shall be in accordance with the Subletting and Subcontracting Fair Practices Act, commencing with § 4100 of the Public Contract Code. The bidder's attention is directed to other provisions of the Act related to the imposition of penalties for a failure to observe its provisions by using unauthorized subcontractors or by making unauthorized substitutions.

The Contractor shall perform, with his own organization, contract work amounting to not less than 50 percent of the original total contract price, except that any designated "Specialty Items" may be performed by the subcontractor and the amount of any "Specialty Items" so performed may be deducted from the original total contract price before computing the amount of work required to be performed by the Contractor with his own organization.

SECTION 9

AWARD AND EXECUTION OF CONTRACT

9.01 AWARD OF CONTRACT

The right is reserved by the City to reject any or all proposals and to waive irregularities in the bid procedure and proposal.

The award of the Contract will be to the lowest responsible bidder whose proposal complies with all the requirements prescribed. The award will be made within ninety (90) calendar days after the opening of the proposals.

If the lowest responsible bidder refuses or fails to execute the Contract, his bid security is forfeited to the City, and the City may award the Contract to the second lowest responsible bidder. Such award, if made, will be made within one hundred and five (105) calendar days after the opening of proposals.

If the second lowest responsible bidder refuses or fails to execute the Contract, his bid security is forfeited to the City, and the City may award the Contract to the third lowest responsible bidder. Such award, if made, will be made within one hundred and twenty (120) calendar days after the opening of the proposals.

The periods of time specified above within which the award of Contract may be made shall be subject to extension for such further periods as may be agreed upon in writing between the City and the bidder concerned.

All bids will be compared on the basis of the Engineer's Estimate of the quantities of work to be done, whenever applicable.

9.02 CONTRACT BONDS

The successful bidder shall furnish two bonds. The first bond, a "Material and Labor Payment Bond" to secure the payment of laborers, mechanics, and other workers employed on the job and the payment to suppliers for materials to be delivered and placed under the Contract. The second bond, a "Faithful Performance Bond" shall guarantee the faithful performance on the Contract. The bond forms will be furnished by the City to the successful bidder.

When the total contract amount is less than \$5,000,000 (5 million) the "Material and Labor Payment Bond" and the "Faithful Performance Bond" shall both be in an amount equal to 100% of the contract amount.

When the total contract amount is \$5,000,000 or more the "Material and Labor Bond" shall be in an amount equal to at least 50% of the total contract amount and the "Performance Bond" shall be in an amount equal to 100% of the total contract amount.

All alterations, extensions of time, extra and additional work, and other changes authorized by the Standard Specifications, the Contract Special Provisions, of any part of the Contract may be made without securing the consent of the surety or sureties on the Contract Bonds.

9.03 EXECUTION OF CONTRACT AGREEMENT

The contract agreement, which is contained in the Special Provisions, shall be signed by the successful bidder and returned, together with the Contract bonds and insurance certificates, within five (5) working days after receipt of the Notice of Award and Contract from the City. No proposal shall be binding on the City until the execution of the Contract by the City.

9.04 FAILURE TO EXECUTE CONTRACT

Failure of the lowest responsible bidder, the second lowest responsible bidder, or the third lowest responsible bidder to execute the Contract and file acceptable bonds as provided within ten (10) calendar days after such Bidder has received notice that the Contract has been awarded to him shall be cause for the annulment of the award and the forfeiture of the bid proposal guaranty.

The successful bidder may file with the City a written notice, signed by the Bidder or his authorized representative, specifying that the Bidder will refuse to execute the Contract if presented to him. The filing of such notice shall have the same force and effect as the failure of the Bidder to execute the Contract and furnish acceptable bonds within the time prescribed. The work may then be re-advertised or may be constructed by day labor as the City may decide.

9.05 CONTRACT DOCUMENTS

The documents covering the performance of the work, and the furnishing of labor, materials, and Contractor's plant and equipment in the construction of the work, is also referred to herein as the Contract. The Contract documents include:

1. Accepted bid proposal
2. Notice to bidders
3. Contract Agreement
4. Bond for faithful performance

5. Bond for labor and materials
6. Addenda
7. List of subcontractors
8. Standard Specifications
9. Special Provisions
10. Reference specifications and drawings
11. Contract plans
12. Contract change orders
13. Permits from agencies as required
14. Insurance certificates.

The Contract Documents do not, however, include the logs of geologic test borings and other geologic records, reports and interpretations.

9.06 BOND RENEWAL AND EXTENSION

Should any bond become insufficient, the Contractor shall renew the bond within ten (10) calendar days after receiving notice from the City.

Should any surety, at any time, be unsatisfactory to the City, notice will be given to the Contractor to that effect. No further payments shall be deemed due or will be made under the Contract until the City accepts a new qualified surety.

Changes in the work, or extensions of time, made pursuant to the Contract, shall in no way release the Contractor or surety from their obligations. Notice of such changes or extensions shall be waived by the surety.

9.07 RETURN OF BID PROPOSAL GUARANTEES

Within ten (10) days after the award of the contract, the City Clerk will, upon request, return the proposal guarantees accompanying the proposals that are not considered in making the award. Proposal guarantees will be held until the Contract has been fully executed and returned to the Contractor who receives the project award.

SECTION 10

PROGRESS OF WORK

10.01 BEGINNING OF WORK

The Contractor shall begin work within ten (10) calendar days after the notice to proceed and shall diligently prosecute the work to completion within the time limit provided for in the Contract Agreement, or Contract Special Provisions.

Should the Contractor begin work in advance of the notice to proceed, any work performed by him in advance of the date of approval shall be considered as having been done by him at his own risk and as a volunteer unless the Contract is approved.

10.02 PROGRESS SCHEDULE

Unless otherwise specified in the Contract Special Provisions, the Contractor shall, within five (5) calendar days after receiving the notice to proceed, submit to the Engineer a schedule showing the order in which the Contractor proposes to carry out the work, the dates on which he will start the salient features of the work (including procurement of materials, plant and equipment), and the proposed dates for completing the features. The Contractor shall update the schedule as required by the Engineer. The schedule shall be in the form of a bar chart or a Critical Path Method (CPM) schedule.

Where the work is not, in the opinion of the Engineer, proceeding in accordance with the schedule a revised schedule may be required. When requested the revised schedule shall be submitted to the Engineer within five (5) calendar days. No progress payment will be made for any work until a revised schedule, satisfactory to the Engineer, has been submitted.

10.03 TEMPORARY SUSPENSION OF WORK

Where the Engineer determines that the work, or any portion of the work, is not proceeding in accordance with the Contract Documents or any applicable laws, rules, or regulations, the Engineer may order the cessation of further work, either in part or in whole, until the work proceeds in compliance with such requirements. All delays in the work due to the stoppage shall not relieve the Contractor of his duty to perform the work nor will the stoppage justify an extension of time for its completion. Any and all necessary corrective work done in order to comply with the plans and specifications shall be done at no cost to the City.

The Engineer shall also have the authority to suspend the work, wholly or in part, due to unsuitable weather, or to other conditions that are considered unfavorable for the completion of

the work. The temporary suspension will be considered as justification for time extensions to the contract in an amount equal to the delay.

The Engineer may also temporarily suspend the work upon the written request of the Contractor and showing that the request is reasonable and necessary due to delays beyond the Contractor's control. All costs associated with the delay, including City costs, shall be the responsibility of the Contractor.

Where a suspension of work is ordered, the Contractor, at his expense, shall do all the work necessary to provide a safe, smooth and unobstructed passageway through the construction area for use by public, pedestrian and vehicular traffic, during the period of the suspension. Should the Contractor fail to perform the work as specified, the City may perform the work and the cost will be charged against the Contractor and will be deducted from payments due, or to become due to, the Contractor.

Where a suspension of work is ordered by the Engineer, due to the failure on the part of the Contractor to carry out orders given or to perform any provision of the Contract, the days on which the suspension order is in effect shall be considered working days if those days are working days within the meaning set forth by §10.09 "Time of Completion".

The Contractor shall not be entitled to any claim for additional time or compensation for any delays due to any suspension lawfully ordered by a duly authorized City, State, Federal or other officer having jurisdiction of safety, health, labor or environmental statute violation.

10.04 TERMINATION OF CONTROL

The failure of the Contractor to commence with the work in accordance with the City's "Notice to Proceed" or to perform any covenant or condition contained in the Contract documents within the time period specified shall constitute a material breach of the Contract and shall entitle the City to terminate the Contractor's control unless the Contractor applies for, and receives, an extension of time in accordance with §10.09 "Time of Completion".

Failure to supply an adequate working force, or material of proper quality, or failure to comply with § 10262 of the State Contract Act or failure, in any respect, to prosecute the work with the diligence and force specified by the Contract, is grounds for termination of the Contractor's control over the work and for taking over the work by the City as provided for in the State Contract Code.

Upon receiving notice from the Engineer of the termination of the Contractor's control, the Contractor shall discontinue the work, or portions of it as the Engineer may designate. With such termination, the Contractor's control is terminated and the City may take possession of all or any part of the Contractor's materials, tools, equipment, and appliances, and plant. The City may buy additional materials and supplies or may employ other parties or workmen to complete the

Contract. The City may substitute other machinery or materials and purchase the materials contracted for.

Where the Contractor services are terminated all money due to the Contractor or retained under the terms of his Contract shall be forfeited to the City. The Contractor and his sureties will be credited with the surplus remaining, if any, after subtracting all costs incurred by the City to complete the work. Any cost in excess of the amount retained by the City will be charged against the Contractor and his sureties, who will be held liable. The forfeiture will not release the Contractor or the Contractor's sureties from liability for failing to fulfill the Contractor's obligations under the Contract.

Should the Contractor's control of the work be terminated, or if the Contractor abandons the work, and the Contract work is completed in conformance with the provisions of § 10255 of the State Contract Act, any dispute concerning the amount to be paid to the Contractor or the Contractor's surety, or to be paid to the City by the Contractor or the Contractor's surety, under the provisions of § 10258 of the State Contract Act shall be subject to arbitration in accordance with the provisions of §12 "Protests and Claims by the Contractor" of these Design Standards.

10.05 RIGHT-OF-WAY DELAYS

If, through the failure of the City to acquire or clear right-of-ways, except for utility delays, the Contractor sustains loss which could have been avoided by the judicious handling of forces, equipment, supplies and plant; the Contractor shall, upon written request, be entitled to an amount the Engineer may find to be fair and reasonable compensation for the Contractor's actual loss where, in the opinion of the Engineer, the loss was unavoidable. Any such compensation will be made as provided for in §8-1.09 "Right of Way Delays" of the State Standard Specifications and §11.03 "Extra Work" of these Design Standards, and as modified in this section.

Actual loss shall be understood to include no items of expense other than idle time of rental equipment and the cost of the extra moving of equipment, with no markup in any case for overhead or profit.

If the performance of the Contractor's work on the current controlling operation is delayed as the result of the failure of the City to acquire or clear right-of-ways, except for utility delays, an extension of time may be granted upon written request. The Engineer shall make the determination on the number of additional working days to be granted.

The current controlling operation or operations as used in the above paragraph is to be construed to include any feature of the work, considered at the time by the Engineer, which, if delayed, would delay the time of completion of the Contract.

10.06 CONTRACT CHANGES, CHANGE ORDERS

10.06.1 General

A Contract Change Order is a written order from the Engineer to the Contractor covering changes in the plans or specifications, or quantities, within the scope of the project, and establishing the basis of payment and time adjustments for the work affected by the changes.

The City reserves the right to delete any bid item in its entirety from the Contract at no cost to the City. The City also reserves the right to make such alterations, deviations, additions to or deletions from the drawings and specifications, including the right to increase or decrease the quantity of any item or portion of work, or to omit any item or portion of the work, and to require such changes in the work determined by the Engineer to be necessary or advisable for proper completion or construction of the work.

The City may change the Contract plans, specifications, character of the work, or quantity of work without adjustment of the Contract Unit Bid Prices provided that the total dollar value of all such changes, both additive and deductive, does not exceed twenty-five (25) percent of the total Contract Price. Should it become necessary to exceed this limitation, the Contractor and the City shall have the right to negotiate a change in the Contract Unit Prices of those Bid Items for which the increase or decrease in the value of the Bid Item exceeds twenty-five (25) percent of the total contract price.

10.06.2 Change Orders

Changes will be set forth by Contract Change Orders. If the specified work or the proposed change causes an increase or decrease in the Contractor's cost of performance of the Contract an equitable adjustment, as determined by the Engineer, may be made. The Contract change order will specify the payment to be made or credit to be taken and adjustment of the Contract time, if any. Payment in accordance with the terms and conditions set forth in a Contract change order shall constitute full compensation for all work included or required.

Contractor shall proceed with the ordered work, unless another starting date is specified. If the Contractor agrees with the terms and conditions of the Contract change order he shall indicate his acceptance by signing the original copy and returning it the Engineer within five (5) working days. The five (5) working days shall commence from the date of issuance of the change order by the Engineer. If the Contractor disagrees with the terms and conditions of the Contract change order, he shall proceed with the ordered work and shall submit a written protest in accordance with §10.06.3 "Protest Procedure". Should the Contractor fail to file a timely protest pursuant to §10.06.3. The Contract change order shall be deemed as approved by the Contractor and shall take full effect.

Prior to issuing a Contract change order the Engineer may request that the Contractor submit a proposal covering the proposed changes. The request will include a description of the work or

revised drawings or specifications reflecting the changes proposed to be ordered. Within ten (10) calendar days after receiving the request, the Contractor shall submit his proposal to the Engineer, including any claim for extension of time and any and all compensation that may be necessary as a result of the changes. If the Engineer decides not to issue a Contract change order after requesting a proposal from the Contractor, the Contractor will be notified of the decision in writing.

The Engineer may, in writing, order the Contractor to proceed with the work prior to the Contractor's receipt of a Contract change order. The Engineer will issue a Contract change order for the work as soon as practicable and the provisions of § 12 "Protest and Claims by Contractor" shall be applicable to the Contract change order.

The Contractor shall keep full and complete records of the cost of the ordered work until the method of compensation is determined and the Contract Change Order is received, and shall permit the Engineer to have access to the records. A Contract Change Order shall supersede any previously issued written order covering the same work.

10.06.3 Protest Procedure

Should the Contractor disagree with any of the terms or conditions set forth in a Contract Change Order he shall submit a written protest to the Engineer within five (5) calendar days after the receipt of the Contract Change Order. The date of receipt for the Contract Change Order shall be the date the change order was delivered to the Contractor's on-site representative or the date the change order was faxed to the Contractor's primary office, whichever is earlier.

The protest shall state the points of disagreement, contract references, quantities, and costs involved. The Engineer shall consider and investigate the protest. The Engineer shall notify the Contractor, in writing, within thirty (30) calendar days following the date of receipt of the Contractor's written protest. The Engineer's decision shall be conclusive and binding against both parties to the Contract, except in the case of gross error. If a written protest is not submitted, adjustment of the Contract time and payment will be made as set forth in the change order and shall constitute full compensation for all work included or required. A change order not protested within the time limits specified shall be deemed a fully executed Contract change order. Not signing a change order does not constitute a valid protest by the Contractor.

Where the protest concerning a Contract change order relates to compensation the Contractor shall keep full and complete records of the cost of the work and shall permit the Engineer to have access to the records.

When the protest concerning a Contract change order relates to the adjustment of contract time for the completion of the work, the time to be allowed will be determined in the Contract change order.

10.06.4 Changes Requested by the Contractor

Changes requested in the plans and specifications shall be made in writing. Approved changes requested by the Contractor shall be made by change orders at a reduction in cost or at no additional cost to the City. Nothing in this section shall be construed as granting a right to the Contractor to demand acceptance of the changes.

10.06.5 Value Engineering Change Proposals (VECP)

10.06.5.1 General

This section applies to Contractor-developed value engineering change proposals (VECPs) that:

1. Require a change to the existing Contract to implement,
2. Reduce the Contract price without impairing essential functions or characteristics,
3. Will not have an adverse financial impact on the City for operating and maintenance costs through the life cycle of the item, and
4. Are not based solely on changes in deliverable quantities.

The Contractor will share in the net Contract savings realized from accepted VECPs.

10.06.5.2 Definitions

Gross Savings: The difference between the Contractor's estimated cost of performing the work in accordance with the existing requirements and the Contractor's estimated cost of performing the work in accordance with the proposed change. The cost of performing the work may include overhead but not profit.

Contractor Development and Implementation Costs: Reasonable costs incurred by the Contractor in developing, testing, preparing, and submitting the VECP and costs incurred by the Contractor to make contractual changes required for the City's acceptance of the VECP.

Net Savings: Gross Savings less Contractor Development and Implementation Costs.

City Costs: Reasonable costs incurred by the City for evaluating and implementing the VECP; such as analyzing, testing, and redesign. City costs do not include normal administrative costs for processing the VECP.

10.06.5.3 Contractor Request

After receiving a Notice to Proceed the Contractor may request a preliminary determination from the City that the proposed VECP does not impair an essential function or characteristic of the

work and that a formal VECP may be accepted. Prior to issuing a Notice to Proceed the City will not comment on any VECP.

A preliminary request should be submitted prior to any significant expenditure of time or effort to develop a VECP. The preliminary request must be in writing and must be sufficiently detailed to enable the City to evaluate the viability of the VECP. The Contractor shall have the right to withdraw, in whole or in part, any VECP at any time prior to acceptance by the City.

10.06.5.4 Documentation

The Contractor shall submit the following information with each VECP:

1. Description of the existing Contract requirements.
2. Description of the proposed change.
3. Discussion of the differences between existing requirements and the proposed change. Give advantages and disadvantages of each, justify any changes to function or characteristics, and explain or state the effect of the change on the performance of the item.
4. Identify and describe each part of the existing requirements that must be changed to implement the VECP and recommend how to make the change.
5. State the estimated effect of the proposed change on the costs of operating and maintenance throughout the life of the item.
6. State the latest time for acceptance of the VECP by the City to obtain the maximum cost reduction during the remainder of the Contract.
7. State the effect on the Contract completion time if the VECP is accepted.
8. Detailed estimate of the cost of performing the work in accordance with the Contract requirements.
9. Detailed estimate of the cost of performing the work in accordance with the proposed Contract change.
10. Gross savings to the Contractor.
11. Implementation costs.
12. Estimated City costs.
13. Estimated net savings.

10.06.5.5 City Review

Until a VECP is accepted by the City and an implementing change order is issued by the Engineer and executed by the Contractor, the Contractor shall perform the work in accordance with the existing Contract.

The Engineer will evaluate the VECP and make a determination of the effect of the proposed change on the functions and characteristics of the item, the effect of the proposed change on the performance of the item, and the life cycle costs and City implementation costs.

The Engineer will notify the Contractor of the status of the VECP within fifteen (15) working days after receipt a completed proposal. If additional time is required, or additional information or data is needed, the Engineer will notify the Contractor within the fifteen (15) day period.

If the VECP is not accepted, the Engineer will notify the Contractor in writing. The City will not be liable for any delay in acting upon any VECP proposal submitted.

10.06.5.6 Acceptance by City

The City may accept or reject, in whole or in part, any VECP. Acceptance will be by Contract Change Order.

The decision of the Engineer to accept or reject, in whole or in part, any VECP under this Contract shall be final and shall not be subject to protest.

If a VECP submitted by the Contractor is not accepted, the Contractor will not be entitled to an extension of time or to any other compensation for the effort expended in developing and submitting the VECP.

10.06.5.7 Adjustment in Contract Price

If a VECP submitted by the Contractor is accepted the Contract price will be reduced by an amount equal to 50% of Net Savings plus 50% of City Costs, expressed by the formula:

$$\text{Reduction} = 0.5 (\text{Net Savings}) + 0.5 (\text{City Costs})$$

10.06.5.8 Use of VECP Documents

The City reserves the right to duplicate, use, and disclose any part of a VECP or any part of the supporting data submitted by the Contractor.

10.07 EMERGENCY WORK

10.07.1 During Working Hours

In case of an emergency during working hours that threatens loss of, or damage to, property and/or threatens the general safety and welfare of the public, the Contractor shall act, without previous instructions from the City, as the situation may warrant. He shall notify the Engineer of the emergency and the action taken. Any compensation claimed by the Contractor, together with documents in regard to expense, shall be submitted to the Engineer within (five) 5 calendar days after the emergency. Compensation, if allowed, will be paid for as extra work.

10.07.2 Outside of Working Hours

Where, outside of the regular working hours, an emergency involving a danger or potential danger to the public, the City's forces may handle such emergency work if the Contractor fails to immediately respond to an emergency call out from the City. If such emergency arises out of, or is the result of, operations by the Contractor, the cost of the corrective measures will be billed to the Contractor and deducted from progress payments. The charge to the Contractor per the City response shall be \$500.00 or the actual costs of labor, equipment and materials plus a twenty (20) percent administrative charge, whichever is greater.

10.07.3 By City Forces

Emergency work by City forces will not relieve the Contractor of any of his responsibilities, obligations, or liabilities under the Contract. This provision shall not relieve the Contractor from monitoring and maintaining public safety at all times.

10.08 WORKING HOURS

Without prior approval of the Engineer, and except for emergency work and traffic safety work, work or activity of any kind shall be limited to the hours between 7:30 AM and 6:00 PM. Monday through Friday. Work on weekends, when approved by the Engineer, shall not commence prior to 9:00 AM and shall not continue beyond 5:00 PM, subject to the ♣ 2 "Legal Relations and Responsibilities".

Work in excess of eight hours per day, on Saturdays, on Sundays, or on City holidays (♣ 1.02 Definitions), requires the prior consent of the Engineer and is subject to Cost of Overtime Construction Inspection plus a twenty (20) percent administrative charge.

10.09 TIME OF COMPLETION

The Contractor shall complete all work called for under the Contract within the number of days set forth in the contract, notwithstanding any additional working days added by virtue of any contract change orders.

Failure of the City to insist upon the performance of any covenant or condition within the time period specified in the Contract documents shall not constitute a waiver of the Contractor's duty to complete the work within the designated periods unless the waiver is in writing.

The City's agreement to waive a specific time provision or to extend the time for performance shall not constitute a waiver of any other time provisions contained in the Contract documents.

Failure of the Contractor to complete the work within the additional time authorized in the waiver or extension of time agreement shall constitute a material breach of the Contract entitling the City to terminate the Contract.

A working day is defined as any day, except as follows:

1. Saturday, Sunday, or City holidays, or
2. Days on which the Contractor, by inclement weather or conditions resulting immediately therefrom and adverse to the current controlling operation or operations, as determined by the Engineer, is prevented from proceeding with at least 75 percent of the normal labor and equipment force engaged on that operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations.

Determination that a day is a non-working day by reason of inclement weather or conditions resulting immediately therefrom shall be made by the Engineer. The Contractor shall be allowed five (5) Calendar days from the issuance of the weekly statement of working days in which to file a written protest setting forth in what respects the Contractor's opinion differs from that of the Engineer; otherwise the decision of the Engineer shall be deemed to have been accepted by the Contractor as correct and binding.

Except during temporary suspensions of work, the Engineer will furnish the Contractor a weekly statement showing the number of City or Engineer:

1. Working days of time extensions approved,
2. Working days originally specified for the completion on the Contract, and
3. The anticipated date of completion.

Failure of the Engineer to provide the Contractor with a statement of working days shall not in and of itself be considered cause for an extension nor extend the required completion date of the work under the Contract.

10.10 LIQUIDATED DAMAGES

In accordance with §53069.85 of the Government Code, the parties to the Contract agree that time is of the essence in the completion of the work. Further, the parties to the Contract agree that in the case where all the work called for under the Contract is not completed before or upon the expiration of the time limit as set forth in the Contract, damage will be sustained by the City. The parties to the Contract agree that it is impracticable to determine the actual damage that the City will sustain in the event of and by reason of such delay; and it is therefore agreed that the Contractor will pay to the City the sum set forth in this section, per day for each and every calendar day's delay beyond the time required to complete the work. The Contractor agrees that the City may deduct the amount thereof from any payments due or that may become due to the Contractor under the Contract.

The parties to the Contract further agree that where the work called for under the Contract is not finished and completed within the number of Contract days specified, the Engineer shall have the right to increase the number of Contract days, or not, as may be deemed to serve the best interests of the City. Should the Engineer elect to extend the number of working days required to complete the work, he shall further have the right to charge to the work all, or any part of, the actual cost of engineering, inspection, superintendence and overhead which the City incurred during the period of the extension. All elections shall be at the sole discretion of the Engineer.

Unless such liquidated damages are specified differently in the Contract Special Provisions the amount per calendar day shall be as follows:

Amount of Contract	Liquidated Damages Per Day
Less than \$50,000.00	\$ 250.00
\$ 50,000.00 to \$ 99,999.99	\$ 500.00
\$ 100,000.00 to \$ 499,999.99	\$ 750.00
\$ 500,000.00 to \$ 999,999.99	\$1,000.00
\$1,000,000.00 and Over	\$1,500.00

The Contractor will be granted an extension of time and will not be assessed a penalty for the cost of engineering and inspection for any portion of the delay in completion of the work beyond the time named in the Contract for the completion of the work when delays are caused by: Acts of God, a public enemy, labor strikes, shortage of materials, freight embargoes, or for fire or flood not caused or preventable by the Contractor provided the Contractor notifies the Engineer in writing of the causes of the delay within five (5) calendar days from the beginning of the delay. The Engineer shall determine the facts and the extent of the delay and his findings and action shall be final and conclusive.

No extension of time will be granted for a delay caused by a shortage of materials unless the Contractor furnishes documentary proof to the Engineer that he has diligently made every effort to obtain the materials from all known sources within reason and provides further proof in the form of supplementary progress schedules and that the inability to obtain the materials when originally planned did in fact cause a delay in final completion of the entire work that could not be compensated for by revising the sequence of the Contractor's operations. Only the physical shortage of material will be considered under these provisions as a cause for an extension of time. No consideration will be given to any claim that material could not be obtained at a reasonable, practical, or economical cost or price.

Where the Contractor is delayed in completion of the work by reason of changes made by any act of the Engineer not contemplated for by the Contract, an extension of time commensurate with the delay in completion of the work thus caused will be granted and the Contractor shall be relieved from any claim for liquidated damages, or engineering and inspection charges or other penalties for the period covered by the extension of time; provided that the Contractor shall notify the Engineer in writing of the causes of delay within five (5) calendar days from the beginning of any the delay. The Engineer shall determine the facts and the extent of the delay and his findings and actions shall be final and conclusive.

The intent of the above provisions is that the Contractor shall not be relieved of liability for liquidated damages or engineering and inspection charges for a period of delay in completion of the work in excess of that provided for herein. Excusable delays shall not entitle the Contractor to additional compensation. The sole remedy of the Contractor shall be to seek an extension of time.

10.11 COMPLETION OF WORK / CITY COUNCIL ACCEPTANCE

When the Engineer has made the final inspection and determines that the Contract has been completed in all respects in accordance with the plans and specifications, and other Contract Documents, the Engineer will recommend that the City Council formally accept the work as complete. Immediately upon and after such acceptance by the Council, the Contractor will be relieved of the duty of maintaining and protecting the work as a whole. The Contractor will not be required to perform any further work, except as required under the warrantee provisions of the Contract or for work specifically required by the Contract provisions, such as landscape maintenance.

Except as provided for in this section, the Contractor shall be relieved of his responsibility for injury to persons or damage to property which occurs after acceptance by the City Council. The Contractor's responsibility for injury to persons or damage to property shall fully apply to the Contractor's correction of defects, or faulty work, or other work, such as landscape maintenance, performed after acceptance by the City Council.

SECTION 11

MEASUREMENT AND PAYMENT

11.01 MEASUREMENT OF QUANTITIES

11.01.1 General

Measurements of the work shall be in accordance with, and by, instruments and devices calibrated to the United States Standard Measures. The units of measurement for payment shall be as shown on the plans or the special provisions and in accordance with this section.

In determining quantities, all measurements shall be made in horizontal or vertical planes.

11.01.2 Methods of Measurement

Materials and items of work that are to be paid for on the basis of measurement shall be measured in accordance with the methods stipulated in the particular sections involved.

11.01.3 Certified Weigh

Where payment is made on the basis of weight, the weighing shall be done on certified platform scales or, when approved by the Engineer, on an automated weighing and recording system. The Contractor shall furnish the Engineer with certificates from a licensed weigh-master showing the actual net weights. The City may accept the certificates as evidence of the weights delivered.

11.01.4 Units of Measurement

Measurements, conversions, multiples and fractions thereof shall be in accordance with United States Standard Measures. A pound is an avoirdupois weight. A ton is 2,000 pounds. The unit of liquid measure is the U.S. gallon. The unit of length is linear feet. The units of area are square feet and square yards. The unit of volume is cubic yards.

When materials are to be measured and paid for on a volume basis and it would be impractical to determine the volume, or when requested by the Contractor, in writing, and approved by the Engineer, in writing, the material will be weighed and converted to volume measurement for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer before this method of measurement of pay quantities will be adopted.

Unless otherwise specified, units of measurement are as determined in place based on neat lines as indicated on Contract plans or drawings without regard to expansion, consolidation or compaction.

11.01.5 Quantities to be Deducted from Payment

Quantities of materials will not be paid for and the quantities will not be included in the final total quantities, where:

1. The materials are wasted or disposed of in a manner not called for under the Contract.
2. The materials are rejected, including materials rejected after placement.
3. The materials are not unloaded from the transporting vehicle.
4. The materials are placed outside the lines indicated on the plans or the limits set by the Engineer.
5. The materials remain on hand after completion of the Contract

Where Contract Plans, drawings, reference drawings or other contract specifications indicate a minimum dimension (e.g., 2 inch minimum depth of asphalt concrete overlays), no payment for exceeding the minimum dimension shall be allowed, except where payment is based on weight or volume. The Engineer may approve up to a five (5) percent increase based either on the Contract bid amount or the theoretical weight or volume based on the Contract drawings and specifications, whichever is less.

11.01.6 Payment

No compensation will be allowed for hauling and disposing of rejected materials. Full compensation for all expenses involved in conforming to the requirements for measuring and weighing materials shall be considered as included in the unit prices bid for the materials being measured or weighed and no additional allowance will be made.

11.02 SCOPE OF PAYMENT

The Contractor shall accept the compensation for all work to be performed under the Contract as provided in the Contract Bid Proposal as full compensation for all costs, overhead, profit and expenses including: furnishing all labor, materials, tools, equipment bonds, licenses, permits, fees, insurance, supervision, testing, corrections, repairs, restoration of existing improvements, construction surveys, and incidentals, and for completing each item as shown and specified.

The Contract bid prices shall also include full compensation for:

1. Any loss or damage arising from the nature of the work or from the action of the elements.

2. Unforeseen difficulties that may be encountered during the work.
3. All risks associated with the construction of the work.
4. All expenses incurred as a result of the suspension, or discontinuance, of the work as provided for in the Contract.
5. Completion of the work in accordance with the Contract Documents.

Neither the payment of any estimate nor any retained percentage shall relieve the Contractor of his obligation to make good any defective or damaged work or material.

Principal features of the work to be included under the various payment items are noted in the bid proposal. Work not specifically listed in the "Bid Proposal" shall be included in the prices bid under the items to which the work is applicable. Quantities of work to be paid shall be based on the number or amount of the item acceptably installed and complete in place, as measured by the Engineer.

When payment limits are designated on the plans the limits shall control and no separate measurement or payment will be made for any items that are placed beyond the limits.

No compensation will be made for loss of anticipated profits. Changes in the amount of work involving Contract change orders or supplemental agreements will be paid for as provided in the Contract change orders and agreements.

Payments for materials and supplies stored or not installed in their final positions will not be allowed.

Unless otherwise provided for "Contractor's cost", "borne by the Contractor", "paid by the Contractor" and phrases of like import shall be deemed to be accompanied with the phrase "at no additional cost to the City".

The parties of the Contract agree that no certificate given or payments made under this Contract, except the final certificate of payment, shall be conclusive evidence of the performance of the Contract either wholly or in part.

Progress payments or other payments shall not be construed as an acceptance of any defective work or improper materials. The Contractor agrees that the payment of the final amount due under the Contract shall release the City, Engineer, and their authorized representatives from any and all claims or liability or compensation on account of work performed under the Contract.

All work necessary to complete the project as shown on the plans but not specifically set forth as a pay item in the Bid Proposal Form shall be considered a subsidiary obligation of the Contractor

and all costs shall be included in the various contract bid items of work and no additional compensation shall be allowed.

All estimated quantities stipulated in the Bidder's Proposal or other Contract documents are approximate and are to be used only as a basis for estimating the probable cost of the work and for the purpose of comparing the bids submitted for the work. The actual amount of work done and materials furnished under unit price items may differ from the estimated quantities. The Contractor agrees that he will make no claim for damages, anticipated profits, or issues on account of any difference between the amount of work performed and the materials furnished and the estimated amounts provided.

11.03 EXTRA WORK

11.03.1 General

New or unforeseen work will be classified as "extra work" when the Engineer determines that it is not covered by Contract unit prices or stipulated unit prices.

11.03.2 Payment

Where the Contractor and the Engineer cannot agree on the cost of the extra work the City will pay for the extra work by force account.

11.03.3 Daily Reports by Contractor

The Contractor shall submit a daily report to the Engineer at the beginning of the following day, on forms approved by the City, together with applicable delivery tickets. The reports should be reconciled daily and all reports shall be signed by the Engineer and the Contractor. In the event of disagreement pertinent notes shall be entered by each party to explain controversial items. Each party shall retain a signed copy of the report. Reports by subcontractors or others shall be submitted through the Contractor.

The Daily Reports shall show the following:

1. The report shall show names of workers, labor classification and hours worked.
2. The material portion of the report shall describe and list quantities of materials used.
3. The report shall show types of equipment, size, identification number and hours of operation, including loading and transportation, if applicable.
4. Other services and expenditures shall be described in detail.

11.03.4 Basis for Establishing Costs

11.03.4.1 Labor

The costs of labor will be the actual cost for wages, not to exceed the local prevailing wages for each craft or type of workman at the time the extra work is done, plus costs. The use of labor classification that would increase the extra work cost will not be permitted unless the Contractor establishes the necessity for such additional costs. Labor costs for equipment operators and helpers shall be reported only when the costs are not included in the invoice for the equipment rental.

11.03.4.2 Labor Surcharge

The labor surcharge compensates the Contractor for statutory payroll items stipulated by various governmental agencies. The four items included are Workers' Compensation, Social Security (including Medicare), State Unemployment and Federal Unemployment taxes. The general rate is an average of the job classifications common to public projects.

The labor surcharge percentage to be applied to the base wages paid will be twenty (20) percent for all work.

11.03.4.3 Materials

The cost of materials reported shall be at invoice or the lowest current price that the materials are locally available and delivered to the job site in the quantities required, plus sales tax, freight and delivery.

The City reserves the right to approve materials and sources of supply, or to supply materials to the Contractor if necessary for the progress of the work. No charge or markup shall be applied to any material provided by the City.

11.03.4.4 Tool and Equipment Rental

No payment will be made for the use of tools that are not listed on the current Caltrans Equipment Rental Rate List.

The rates used in determining equipment rental costs shall not exceed those determined using the latest Caltrans Manual of Equipment Rental Rates.

The rental rates paid shall be considered complete compensation shall and include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance and all incidentals. Necessary loading and transportation costs for equipment used on extra work shall also be included.

If equipment is used intermittently and, when not in use, could be returned to its rental source with less expense to the City than holding it at the work site, it shall be returned unless the Contractor elects to keep it at the work site at no expense to the City.

All equipment shall be acceptable to the Engineer, in good working condition, and suitable for the purpose for which it is to be used. Manufacturer's ratings and manufacturer's approved modifications shall be used to classify equipment and the equipment shall be powered by at least the minimum ratings recommended by the manufacturer.

The reported rental time for equipment already at the job site shall be for the duration of its use on the extra work, commencing at the time it was first put into actual operation on the extra work, plus the time required to move it from its previous location and back, or to a closer location, or to move it from its normal storage location and back, whichever is the least total distance.

11.03.4.5 Other Items

The City may authorize other items that may be required on the extra work. Such items include labor, services, and material and equipment that are different in their nature from those required for the work specified in the Contract and that are of a type not ordinarily available from the Contractor or any of his subcontractors. Detailed invoices covering all such items shall be submitted with the request for payment.

11.03.4.6 Invoices

Vendor's invoices for material, equipment rental, and other expenditures shall be submitted with the request for payment. If the request for payment is not substantiated by invoices or other documentation the City may establish the cost of the item involved at the lowest price that was current at the time of the work.

11.03.4.7 Markups

The following percentage shall be added to the Contractor's costs and shall constitute the markup for all overhead, superintendence and profits.

Item	Markup
Labor	20% ⁽¹⁾
Materials	15%
Equipment & Equipment Rental	15%
All Other Items & Expenditures	15%

(1) 20% is in addition to the 20% surcharge on the base wage. See ♣ 11.03.4.2 "Labor Surcharge".

A five (5) percent markup shall be allowed to the Contractor for the performance of extra work by a subcontractor.

11.04 PROGRESS PAYMENTS

11.04.1 General

Submittal, review and payment of monthly progress payments to the Contract shall conform to §7107, §20104.4 and §22300 of the Public Contract Code and as specified in this section.

The Contractor shall, once each month, prepare an estimate of the total amount of work done. The form used for the progress payment shall be approved by the Engineer.

11.04.2 Engineer's Review and Approval

The Engineer will review each pay request. Where the pay request is determined to be improper it shall be returned to the Contract within seven (7) days after receipt. The returned pay request shall be accompanied with the reasons why the payment request is not proper. This process may be repeated until a proper pay request has been submitted to the Engineer.

If no action is taken by the Engineer on an initial monthly pay request or a revised monthly pay request within the seven (7) day time period the pay request shall be considered proper. A proper pay request shall be paid by the City within thirty (30) days following its receipt.

11.04.3 Retention

The City shall retain ten (10) percent of the estimated value of the work done from progress payments.

11.04.4 Payment Amount

The amount of each progress payment to the Contractor shall be the total estimated value of work completed less:

1. All previous payments.
2. An amount equal to all outstanding claims.
3. The required 10% retention (unless approved securities for the retention have been posted with the City).
4. All other sums to be kept or retained under the provisions of the Contract.

The City may withhold or, on account of later discovered evidence, nullify all, or part of, any certification made to the Contractor by the City as to the amount due the Contractor, to the extent and period of time only as may be necessary to protect the City from loss on account of:

1. Defective work not remedied.
2. Claims filed or reasonable evidence indicating probable filing.
3. Failure to properly pay subcontractors for material or labor,
4. "Stop Notices" filed pursuant to §3179 et. Seq. of the Civil Code.
5. Reasonable doubt that the work can be completed for the balance then unpaid.
6. Damage to the City (including liquidated damages), another contractor, or third parties.

No monthly estimate or progress payment shall be made when, in the judgment of the Engineer, the work is not proceeding in accordance with the provisions of the Contract; or when the total value of the work done since the last estimate is less than one thousand dollars (\$ 1,000.00).

11.04.5 Substitute Securities

At the request and expense of the Contractor, pursuant to § 10263 of the Public Contract Code, the City will make payment of funds for the required ten (10) percent retention, provided the Contractor deposits in escrow with a bank acceptable to the City, securities eligible for the investment of State funds as provided for in § 16430 of the Government Code or bank certificates of deposit, subject to the following:

1. The Contractor shall enter into an escrow agreement that is satisfactory to the City. The escrow agreement shall be substantially similar to the "Escrow Agreement for Security Deposits In Lieu of Retention" in § 10263 of the Public Contract Code, incorporated herein by reference.
2. The Contractor shall obtain the written consent of the surety to the agreement.
3. The Contractor shall bear all expenses associated with the escrow deposit.
4. Securities or certificates of deposit to be placed in escrow shall be subject to approval of the City unless otherwise permitted by the escrow agreement and shall be valued at ten (10) percent of the amounts of retention to be paid to the Contractor pursuant to this section.

11.05 DELIVERED MATERIAL

Where provided for in the Contract special provisions, subject to the limitations and conditions therein, the cost of materials and equipment delivered but not incorporated in the work, may be included in the progress estimate, upon approval by the Engineer.

11.06 FINAL PAY QUANTITIES

When the estimated quantity for a specific portion of the work is designated on the plans as a "final pay" quantity, the estimated quantity shall be the final quantity for which payment will be made. Adjustments to final pay quantities will be made only in the event that the dimensions of the work covered by the pay item in the bid proposal is changed.

11.07 ACCEPTANCE, FINAL ESTIMATE AND FINAL PAYMENT

11.07.1 General

Where the Contractor, in the opinion of the Engineer, has completed his Contract the Engineer shall so certify in writing to the City Council and shall make a final estimate of the amount of the work done by the Contractor and also the total value of the Contractor's work according to the Contract.

The Contractor shall indicate his approval of the final estimate by signing the final pay estimate or by filing a statement of claims no later than the close of business day of the thirtieth day after receiving the Engineer's proposed final pay estimate. Where the thirtieth day falls on a Saturday, Sunday or City Holiday the receipt of the written approval or statement of claims by the Engineer shall not be submitted later than the close of business on the next business day.

11.07.2 Claims

No claim will be considered that was not included in the written statement of claims, nor will any claim be allowed when a notice of parties is required under the provisions of §10.05 "Right-of-Way Delays", §10.06.3 "Protest Procedure", §10.09 "Time of Completion", §10.10 "Liquidated Damages" and §12 "Protests and Claims by Contractor" unless the Contractor has complied with the notice or protest requirements in those sections.

11.07.3 No Outstanding Contractor's Claims

Within thirty (30) calendar days following the Engineer's approval of the final estimate the City Council will accept the work as complete and authorize the filing of the "Notice of Completion". If the Contractor files no claims, within the specified thirty (30) day period, the estimate shall be deemed accepted by the Contractor and the Engineer will issue a final pay estimate.

On the Contractor's approval, or if the Contractor files no claim within the specified thirty (30) day period, the final payment, less a ten (10) percent retention, will be made to the Contractor. The payment due to the Contractor for work performed and materials furnished shall be determined from the final measurements made by the Engineer and the unit prices bid by the Contractor, including extra work that may have been authorized. All prior partial quantities and payments shall be adjusted for correction in the final payment. No payment shall be construed to be an acceptance of any defective work or improper materials.

The final estimate and payment shall be conclusive and binding against both parties to the Contract on all questions relating to the amount of work done and the compensation payable, except in the event of a clerical error verified by the Engineer.

A deduction of a ten (10) percent retention will be made from the total amount of the work. From the remainder will be deducted all amounts due to the City from the Contractor in accordance with the terms of the Contract. The remaining balance due the Contractor will be paid no sooner than thirty (30) calendar days and or later than sixty (60) calendar days following City Council acceptance.

11.07.4 Contractor Claims Outstanding

If the Contractor files claims within the specified period of thirty (30) days, the Engineer will issue a semifinal estimate of undisputed amounts to the Contractor and within thirty (30) days thereafter the City will pay the sum due. The semi-final estimate and payment shall be conclusive and binding against both parties to the Contract on all questions relating to the amount of work done and the compensation payable, except insofar as affected by the claims filed within the time and in the manner required in this section, and except in the event of a clerical error verified by the Engineer.

Upon final determination of the claims, the Engineer will issue the final pay estimate in writing. The City Council shall accept the work as complete within thirty (30) calendar days thereafter and authorize the filing of the "Notice of Completion". The final estimate shall be conclusive and binding against both parties to the Contract on all questions relating to the amount of the work done and compensation payable, except in the event of a clerical error verified by the Engineer.

SECTION 12

PROTESTS AND CLAIMS BY CONTRACTOR

12.01 GENERAL

The processing of protests and claims by the Contractor shall be in accordance with Article 1.05 "Resolution of Construction Claims" §§20104 through §§20104.6 of the Public Contract Code and as specified in this section.

Where the final day of any time limit specified for responding to a protest, request for information or data, or to file a claim, falls on a Saturday, Sunday or City holiday, then the final date of receipt shall not be later than the close of business of the next business day.

12.02 PRE-CLAIM WRITTEN PROTEST

If work demanded by the Engineer is considered by the Contractor to be outside the requirements of the Contract, or if he considers any decision of the Engineer to be unfair Contract the Contractor shall, upon such work being demanded or such decision being made, proceed without delay to perform the work or conform to the decision and shall give written notice of protest to the Engineer. The protest shall be filed with the City within three (3) business days after the work demand or the Engineer's decision.

The written notice shall include the date and circumstances of the order or decision and the Contractor's reasons for his objections.

The Engineer will consider and investigate the protest and his decision shall be final and conclusive, except in the case of gross error. In the event of gross error the Engineer may reconsider his findings and thereafter his findings shall be final and conclusive.

Except for such protests that are made of record in the manner specified, the Contractor waives all grounds for protest to such orders or decisions of the Engineer.

12.03 WRITTEN CLAIM

12.03.1 General

For a claim by the Contractor to be considered by the Engineer it must be submitted in writing within thirty (30) calendar days after receipt of the Engineer's written decision upon a written protest in accordance with § 12.02 above, or thirty (30) calendar days after completing the protested work, if that is later. The claim shall be accompanied the following information:

1. Detailed reasons for the claim for each item of additional compensation or time adjustment.
2. References to applicable provisions of the specifications.
3. The nature and amount of cost or time involved, or both.
4. The computations used in determining the cost or time and all other pertinent factual data.
5. Certified payroll records for the labor charges being claimed.
6. A notarized certificate certifying that all statements, information, data and computations, etc. submitted with the claim are true, accurate, and supported by the Contractor's records.
7. Support documents such as material tags, invoices, superintendent's notes and diaries.

Claims filed by the Contractor shall be in sufficient detail to enable the Engineer to ascertain the validity and amount of the claims.

12.03.2 Contractor's Records

The Contractor shall keep full and complete records of the costs and additional time incurred for any work for which a claim for additional time or compensation is made. The Engineer or any designated claim investigator or auditor shall have access to those records and any other records as may be required by the Engineer to determine the facts or contentions involved in the claims. Failure by the Contractor to permit access to those records shall be cause for denying the claim. Anecdotal recollection of events prepared after-the-fact shall not be admissible as records to document the claim.

12.03.3 Contractor's Certificate

Claims submitted by the Contractor shall be accompanied by a notarized certificate conforming to and containing the following language:

Under the penalty of law for perjury or falsification and with specific reference to the California False Claims Act, Government Code § 12650 et. Seq., the undersigned,

(Name)

(Title)

(Company)

hereby certifies that the claim for the additional compensation and time, if any, made herein for the work on the Contract for (Project Title) is a true statement of the actual costs incurred and time sought, and is fully documented and supported under the Contract with the City of Hercules.

Dated _____

/s/ _____

Subscribed and sworn before me this _____ day

Of _____

Notary Public

My Commission Expires _____

Failure to submit the notarized certificate with a claim will be sufficient cause for denying the claim.

Any costs or expenses incurred by the City in reviewing or auditing any claims that are not supported by the Contractor's cost accounting or other records shall be deemed to be damages incurred by the City within the meaning of the California False Claims Act. The damage may be withheld from any payment due, or to become due, to the Contractor.

12.03.4 Engineers Review of Claim and Action

12.03.4.1 Claims less than \$50,000

Within thirty (30) days following the receipt of the claim the Engineer shall approve or deny the claim or may request in writing additional information and data as may be necessary to evaluate the claim.

If additional information or details are required by the Engineer to determine the validity and amount of the claims, the Contractor shall furnish the additional information or details no later than the fifteenth day after the receipt of the written request by the Engineer. Failure to submit the additional information and details shall be sufficient cause for denying the claim.

Within fifteen (15) calendar days after the receipt of additional information or data the Engineer shall respond to the Contractor's claim in writing.

12.03.4.2 Claims in excess of \$50,000 but less than \$375,000

Within sixty (60) days following the receipt of the claim the Engineer shall approve or deny the claim or may request additional information and data as may necessary to evaluate the claim.

If additional information or details are required by the Engineer to determine the validity and amount of the claims, the Contractor shall furnish the additional information or details no later than the fifteenth day after the receipt of the written request by the Engineer. Failure by the Contractor to submit the additional information and details shall be sufficient cause for denying the claim.

Within fifteen (15) calendar days after the receipt of additional information or data the Engineer shall respond to the Contractor's claim in writing.

12.04 MEET AND CONFER

If the claimant disputes the Engineer's written response to a claim, or the Engineer fails to respond within the time prescribed, the claimant may so notify the City in writing. The written notification must be within fifteen (15) calendar days of receipt of the City's response or within fifteen (15) calendar days of the City's failure to respond within the time prescribed. Upon receipt of the notification, the City will schedule an informal conference to for settlement of the issues in dispute. The City shall schedule the conference within thirty (30) calendar days of the receipt of the notification from the Contractor, or as otherwise agreed to.

Within thirty (30) days following the meet and confer conference, the Engineer will submit to the Contractor a statement of any claims that remain and that are in dispute with the Contractor.

If following this determination the claim or any portion thereof remains in dispute, the Contractor may file a claim pursuant to Chapter 1 (commencing with §900) and Chapter 2 (commencing with §920) of Part 3, Division 3.06 of Title 1 of the Government Code. For purposes of those provisions, the running of the time period within which a claim must be filed shall begin when

the claimant submits the written claim pursuant to § 12.03.1 "General" until the time the claim is denied, including any period of time utilized by the meet and confer conference.

12.05 CIVIL ACTION PROCEDURES - MEDIATION AND ARBITRATION

Civil actions filed to resolve claims subject to Article 1.05 "Resolution of Construction Claims" of the Public Contract Code shall follow the procedures set forth by § 20104.4 of the Public Contract Code.

Any orders or decisions of the Engineer rendered on a protest by the Contractor shall be final and binding on the Contractor if he fails to submit or document a claim in the manner prescribed and within the times stated above. The failure to submit a document or claim shall constitute a waiver of all claims in connection therewith, whether direct, indirect, or consequential in nature.

SECTION 13

SUBDIVISIONS

13.01 GENERAL

All subdivisions shall be designed in accordance with the provisions of Ordinance 78-5 (Title 9, the Subdivision Ordinance of the County of Contra Costa), Title 10, Public Works and Flood Control, and Ordinance 69-59 ♣ 1 (part), 1969, Division 716 – the Grading Ordinance of Contra Costa County. In addition, subdivisions shall be designed in accordance with the City of Hercules General Plan, specific plans, tentative maps, Standard Plans, Standard Specifications, and the requirements of all agencies having jurisdiction or interest in the project.

Complete sets of plans and specifications for all proposed improvements shall be submitted to the Engineer for review and approval prior to beginning work. The plans shall be prepared under the direction of a qualified civil engineer who is registered in California in accordance with the provisions of the Business and Professions Code.

SECTION 14

GRADING

14.01 GENERAL

All grading projects within the City of Hercules shall be designed and built in accordance with the provisions of Ordinance 69-59 ♣ 1 (part), 1969, Division 716 – the Grading Ordinance of Contra Costa County. In addition, grading shall be designed in accordance with the City of Hercules General Plan, specific plans, tentative maps, Standard Plans, Standard Specifications, and the requirements of all agencies having jurisdiction or interest in the project.

Complete sets of grading plans and specifications for all proposed improvements shall be submitted to the Engineer for review and approval prior to beginning work. The plans shall be prepared under the direction of a qualified civil engineer who is registered in California in accordance with the provisions of the Business and Professions Code.

SECTION 15

STREET DESIGN

15.01 GENERAL

For the purposes of geometric and structural design, streets shall be classified according to Table 15.1. The following standards for street cross sections and geometrics may be superseded by an approved Specific Plan, approved Tentative Map, or other discretionary approval granted by the Planning Commission or City Council. Any other deviation from these or the following standards shall require the approval of the Engineer.

TABLE 15.1 – MINIMUM STANDARDS FOR STREET DESIGN

Class	Right-of-Way Width (feet)	Width Between Curbs (feet)	Intersection Radius(feet)		Minimum Traffic Index ⁽¹⁾	Standard Street Section (inches)	Minimum Centerline Radius for Horizontal Curve ⁽²⁾ (feet)
			Property Line	Curb Line			
Arterial	84	64	40	50	9	5.5 AC 22.5 AB	800
Collector	60	40	30	40	7	4.0 AC 18.0 AB	600
Residential and Cul-de-sac	50	36	20	27	5	3.0 AC 15.0 AB	250
Heavy Industrial	60	52	30	40	9	5.5 AC 22.5 AB	250
Frontage	50	34	20	27	9	5.5 AC 22.5 AB	600

⁽¹⁾ Traffic Index value may be raised at the discretion of the Engineer.

⁽²⁾ Actual design of horizontal curves shall be based on the design speed of the street as determined by the Engineer. Deviations may be approved by the Engineer. All streets shall be signed and posted for the actual design speed.

The minimum standards in Table 15.1 provide prudent requirements, that, because of exceptional circumstance, may not be achievable. Where the Developer is unable to achieve the standards, or where the Developer believes alternative standards are appropriate, the Developer may submit a Traffic Impact Study to the Engineer. The study shall review existing traffic volumes, projected

increases caused by the proposed development, cumulative traffic increases caused by projects using the roadway, and alternate roadway designs. The Developer must show, to the satisfaction of the Engineer and City Council, that the probable future traffic conditions justify the proposed road widths. Increased widths may be required where probable traffic conditions warrant. The Developer shall show that proposed deviations from the standards will not harm or otherwise adversely impact the public.

15.02 PAVEMENT STRUCTURAL SECTION

The structural design of the roadbed includes the determination of the thickness and type of sub-base, base, and surfacing to be placed over the basement soil according to an accepted method approved by the Engineer. The Engineer shall approve the structural design before the start of construction.

Street sections shall be calculated based on "R" values obtained from material gathered from the level of the proposed subgrade using the State of California Division of Highways Design Method. Where that actual subgrade level "R" value tests have not been taken, the street section shall match the one shown in Table 15.1.

Regardless of traffic index and/or "R" value, no street section shall be built with less than 3 inches of asphalt concrete and 15 inches of aggregate base. The aggregate base section may be comprised of an equivalent section of aggregate base and aggregate sub-base, as approved by the Engineer.

The Contractor, at his expense, shall make tests of the soils over which the surfacing and base is to be constructed and shall furnish the test reports to the Engineer for use in determining a preliminary structural design for the road bed. After rough grading has been completed, the Contractor, at his expense, shall provide the Engineer with test reports to determine the final structural design of the road bed.

15.03 GEOMETRICS

1. All street centerlines shall intersect each other at 90 degrees, plus or minus 5 degrees.
2. There shall be a minimum length of 200 feet (street centerline to street centerline) between intersections.
3. Curb line radii shall be tabulated and shall be shown on the improvement plans.
4. Gutter flow line grades shall have a minimum slope of 0.007 feet per foot and a maximum as determined by the Engineer.

5. Cross slopes on all streets shall be 2.5 percent (minimum) as shown on the Standard Plans unless a deviation has been approved by the Engineer.
6. The minimum vertical curve length at the junction of two grades shall be 100 feet. The actual design of the vertical curve shall be based on the design speed of the street and stopping sight distance as determined by the Engineer. Vertical curves may be omitted where the algebraic difference in grades does not exceed one (1.0) percent and the design speed is forty-five (45) miles per hour or less.
7. The minimum stopping sight distance over any segment of the roadway on residential, collector or arterial streets shall conform to the Caltrans Highway Design Manual unless specific approval is received from the Engineer.

15.04 APPURTENANCES

15.04.1 Driveways

1. No driveway shall be permitted within 2 feet of a property line on multi-family property and commercial property. Driveway locations for single family property shall not be permitted within 2 feet of a property line. Special consideration may be given to major and minor street driveway configurations of an unusual nature such as a shared driveway.
2. The maximum width for a driveway shall be 44 feet for commercial driveways. Residential driveways shall be 24 feet for 2-car and 32 feet for 3-car as measured at the face of curb. These widths include sidewalk transitions at each side of the driveway.
3. The minimum distance between driveways serving the same parcel shall not be less than 20 feet as measured at the face of curb, including sidewalk transitions.
4. Not more than 40 percent of the frontage of any parcel shall be devoted to driveways. Lots fronting on a cul-de-sac or elbow and commercial lots with one driveway are exempt from this requirement.

15.04.2 Parking

For all single family properties, one on-street parking space, 18 feet long, measured along the curb, shall be provided within reasonable proximity of each single family lot.

15.04.3 Valley Gutters

Valley gutters will not be allowed within the public right-of-way or public easement without written approval from the Engineer.

15.04.4 Sidewalks, Curbs and Gutters

1. Sidewalks, including curbs, shall be a minimum of 5.5 feet wide on residential streets and 6.5 feet wide on collector and arterial streets. Wider and/or separated sidewalks may be required, and, in these case, increased sections and reinforcements shall be determined by the Engineer.
2. Sidewalk, curb and gutter shall be as shown on the Standard Plans unless otherwise required by the Engineer.
3. Concrete curbs shall be provided on both sides of all streets unless otherwise approved by the City Council. Curbs on all streets shall be a 6 inch standard vertical curb and gutter made of Class B concrete. The width, location, and grades of the curbs shall be reviewed and approved by the Engineer in accordance with the tentative map.
4. Handicap ramps shall be installed at all street crossings and curb returns and shall comply with all applicable state and federal laws and regulations.

15.04.5 Medians

1. Medians built in a public street shall not be underlain by asphalt, base rock or other rubble or waste material. All medians shall contain at least 18 inches of topsoil and shall be provided with a public and automatic sprinkler system.
2. Watering systems shall be provided to all medians and shall be supplied by a meter that is separate from any privately maintained landscaping water system.
3. Median curbs shall be an 8 inch vertical curb without gutter, unless otherwise required by the Engineer.
4. Planting of medians shall be according to plans and specifications prepared by a qualified landscape architect and approved by the Engineer.

15.04.6 Survey Monuments

Survey monuments shall be installed as follows:

1. On the street centerline at intersections and at all other locations as required by the Engineer.
2. A minimum of two (2) monuments shall be installed in all subdivisions and tied to the California Coordinate System.

3. Lot line extensions shall be clearly marked with a "+" at the back of sidewalk in the concrete.

All monuments set shall be as shown on the Standard Plans and shall show the registration number of the registered civil engineer or licensed land surveyor who prepared the final or parcel map.

15.04.7 Signing and Barricades

1. Street names shall require approval by the Planning Director. Street signs and poles shall meet the approval of the Engineer and the Planning Director.
2. Street name signs, stop signs, and all striping shall be paid for and installed by the Developer.
3. All regulatory and warning signs shown on the plans, or required by the Engineer, to control traffic shall be furnished and installed by the Developer.
4. Permanent barricades shall be installed where improvements cover only a portion of the ultimate development or as directed by the Engineer. The barricade shall be constructed, erected, painted and signed in accordance with the Standard Plans.

15.04.8 Easements

Public service, drainage, tree planting, and fence easements shall be a minimum of ten (10) feet in width or as required to meet specific City and utility company needs. These easements shall be situated along the boundaries of all public right-of ways unless specifically exempted by the Engineer.

15.05 STREET TREES

The Developer is required to plant street trees every thirty (30) feet on centers along all public streets within and bordering the proposed developments or at other spacing as specified by the City. The minimum size of the trees shall be 15 gallons the trees shall be of the species approved by the Engineer.

The exact location, species, and size of the trees shall be shown on the improvement plans. Landscape plan sheets showing street tree installations may be submitted as part of the improvement plan set. Tree species selected should not drop seed pods, fruit, sap, oils, or other deleterious material onto roadways or sidewalks. Selected species should also have root systems that deeply penetrate the ground and that do not spread along the surface in a manner that may lift sidewalks and pavements.

15.06 PEDESTRIAN FACILITIES

15.06.1 Paths

Pedestrian paths shall be paved with concrete and shall be no less than 6 feet wide. Pedestrian paths of concrete shall be at least 4 inches thick on 3 inches of compacted aggregate base rock. Asphalt path structural sections shall be 2 inches thick, applied in one layer, on 6 inches of compacted aggregate base.

15.06.2 Pedestrian Ways

Pedestrian ways 10 feet or more in width may be required through the middle of blocks that are more than 1,200 feet in length. The pedestrian ways may be used to connect cul-de-sacs or to provide access to playgrounds, parks, schools, shopping centers, or other community facilities. The Developer shall install paving, landscaping, and fences as required by the Engineer.

15.06.3 Trails

Trails shall be built and graded as required by the Engineer. Related improvements (fences, signs, security features) shall be provided as necessary for the safety and general welfare.

15.07 BIKEWAYS

Paved bikeways in the public right-of-way are required on arterial and collector routes and in all locations designated by the City Council. Bikeways outside the City right-of-way shall be approved by the Engineer.

The design and placement of bikeways shall conform to Chapter 1000 “Bikeway Planning and Design” of the Caltrans Highway Design Manual or as revised pursuant to Sections 890 (Bikeways Act) of the Streets and Highways Code.

The structural thickness of public bikeways outside of street right-of-ways shall be the same as that specified in ♣15.01.1 “Paths”.

The Developer shall furnish and install appropriate signs as may be required by the Engineer.

SECTION 16

STREET LIGHTING

16.01 GENERAL

The design and installation of street lighting shall conform to these Design Standards, the Standard Specifications, the Standard Plans, Section 86 of the State Standard Specifications, and the Caltrans Traffic Manual. All completed street light systems shall be dedicated to the City of Hercules.

Standard street lighting shall be defined as General Electric "Cobra Head" style luminaires (or equivalent) with tapered galvanized steel shafts.

Theme street lighting shall be defined as special architectural street lighting of various styles.

Traffic Control Devices shall include: lane/parking delineation, traffic control signage, traffic signals, and channelization.

The street lighting and traffic control plans shall be submitted to the Engineer for review.

The cost for all PG&E services including design and construction, shall be paid for by the developer or contractor. This shall include the PG&E connection charge for energizing streetlights.

16.02 DESIGN

16.02.1 General

All street lighting systems shall be designed in accordance with the Guide for the Design of Street Lighting Installations published by Pacific Gas and Electric (PG&E), latest revision. Street lights shall be of the spacing, intensity, and mounting heights so that the following minimum average horizontal illumination levels are maintained:

Residential: 0.25 foot-candles

Collector: 0.40 foot-candles

Arterial: 0.60 foot-candles

In no case shall the minimum lumen be less than 0.10 foot-candles, 0.15 foot-candles, and 0.25 foot-candles for residential, collector, and arterial respectively.

Illumination levels for other street classifications or uses shall be determined by the Engineer. For purposes of the PG&E calculations the following shall apply:

1. Lateral distribution: Type III Medium Asymmetric
2. Luminaire dirt depreciation factor: 0.60
3. Lamp type: High Pressure Sodium

Other variables necessary to complete the PG&E calculations shall be determined as the design condition dictates. Variation from the aforementioned requirements may be approved on an individual basis by the Engineer.

16.02.2 Location of Street Lights

Whenever possible, street lights shall be located on a property line.

On streets with separated sidewalks, street lights shall be located at the front of sidewalk within the parking strip. The edge of the pole foundation shall meet the front of sidewalk.

On streets with monolithic curb, gutter, and sidewalk, streetlights shall be located at the back of sidewalk. The edge of the pole foundation shall meet the back of sidewalk.

Where there is only curb and gutter, the center of the streetlight foundation shall be located six (6) feet from the back of curb.

Tee intersections: A street light shall be located at the nearest lot line on the through street along the projected centerline of the intersecting street.

Four way intersection / major streets: Street lights shall be located at all curb returns.

Four way intersection / major and minor streets: Street lights shall be located at the far right curb returns of the major street in the direction of travel.

Four way intersection / minor streets: A street light shall be located at one of the curb returns.

Electroliers will normally be staggered on opposite sides of the street. Electroliers shall be placed on the outer edge of curves.

Street lights shall be placed at all street intersections and, as necessary, at curves. Additional streetlights may be added at the discretion of the Engineer if, in his opinion, they are necessary for adequate illumination.

16.02.3 Pull Boxes

Pull boxes shall be spaced at a maximum distance of 200 feet.

One pull box shall be located next to each electrolier on all streets.

One pull box shall be located at each side of all street crossings, at or near the curb return.

Pull boxes shall generally be placed six (6) inches behind the sidewalk. In monolithic sidewalk areas they should be located on the street side of the sidewalk. In locations with no sidewalk, they should be placed five (5) feet behind the face of curb.

Each electrolier shall be installed with a water-proof fuse in the splice box.

16.02.4 Conduit

Conduit installed outside of the street pavement shall be placed not less than 18 inches below the surface of the ground or sidewalk. The minimum conduit diameter shall be 2 inches. The conduit shall be laid over 2 inches of uniformly spread sand and shall be covered by a minimum of 6 inches of sand. The trench may then be backfilled with compacted native material up to grade.

16.02.5 Conductors and Wiring

Conductors shall be sized to meet the load demands with a minimum of #8 THW copper. The contractor shall tag all street light conductors and wiring in accordance with PG&E standards and details.

16.03 STANDARD STREET LIGHTING

Standard streetlights ("Cobra Heads") shall have the following minimum wattage, and mounting heights as shown in Table 16.1:

TABLE 16.1 STREETLIGHT WATTAGE, AND MOUNTING HEIGHTS

	Luminaire Wattage	Mounting Height (feet)
Residential	70	27.5
Collector	100	28.0
Frontage	70	32.5
Arterial	200	35.0
Industrial	70	27.5

Where the event that the developer is unable to provide lumen calculations, the following maximum spacing shall be used:

Residential:	150 feet
Collector:	160 feet
Frontage:	180 feet
Arterial:	170 feet
Industrial:	160 feet

The above spacing are minimums; accordingly, unusual conditions such as curves, corners, or other geometrics may dictate additional streetlights and/or different light distribution patterns.

All streetlights shall have a single arm except in median islands where double armed poles shall be used. Streetlight height, luminaire model, and arm length shall be as shown in the standard details.

16.04 THEME STREET LIGHTING

Theme street lighting is specialized in nature, reflecting community design, the surrounding environment, and other architectural factors. Where theme lighting is contemplated, it will be the developer's engineer's responsibility to show that the proposed street lighting system meets the requirements of this section. The following criteria shall be adhered to when designing theme street lighting:

1. Components such as ballasts, refractors, photocells, etc. shall be compatible with theme streetlights already in use elsewhere in the City. Replacement parts shall be readily available to improve maintenance efficiencies.
2. Street lights shall have bolted bases with separate foundations. Direct burial poles will not be allowed. A four inch thick concrete mow pad shall be placed under the light pole base or skirt. The mow pad dimensions shall exceed the skirt/base diameter by a minimum of 6 inches.
3. Luminaires shall be mounted a minimum of 18 feet above the highest adjacent grade.

16.05 TRAFFIC CONTROL DEVICES

The developer will be responsible for the design and construction of all temporary and permanent traffic control devices, including: signs, pavement striping, traffic signals, channelizers, and raised pavement markers. All permanent street markings shall be thermoplastic or raised markers (paint shall not be permitted).

Traffic control devices shall be designed in accordance with the Caltrans Traffic Manual and as directed by the Engineer.

SECTION 17

GENERAL DRAINAGE GUIDELINES

17.01 PROTECTION OF LIFE AND PROPERTY

The provision of adequate drainage is necessary to preserve and promote the general health, welfare and economic well being of the public. Drainage is a regional feature that affects all parcels of property. The responsibility for storm water management is shared by governmental jurisdictions and all property owners.

When planning and designing new drainage facilities or improvements to existing drainage facilities, measures should be considered that would lessen the exposure of the public, property and infrastructure to losses due to flooding, improve the long-range land management and use of flood-prone areas, and promote compatible development.

All habitable structures and other improvements subject to potential loss of life or property when inundated by flood waters should be protected from damage. Drainage facilities shall be planned and designed to protect life and property.

17.02 DISPOSAL OF STORM RUNOFF

The planning and design of drainage systems within the City of Hercules shall consider potential downstream impacts including those to property, flow regimes, water quality or riparian and wetlands areas. Mitigation of potential impacts shall be included as a part of the drainage analysis for the proposed project.

Planning and design of drainage facilities shall not be based on the premise that drainage problems can be transferred from one location to another, except when the transfer is part of a regional solution to flood problems. A proposed development shall not create increased runoff to a downstream property through diversion of flows that had previously drained to another area without the implementation of adequate mitigation measures.

Diversion into non-tributary watercourses is discouraged. Diversion of natural runoff or blocking of existing drainage conveyances shall not be permitted without adequate provisions and mitigation. Modification of runoff from unconcentrated flow to concentrated flow associated with proposed downstream disposal shall be evaluated and appropriate mitigation implemented, such as providing sheet flow for drainage or the implementation of erosion control provisions.

17.03 INCREASED RUNOFF

Increases in storm runoff from upstream properties resulting from improvements is discouraged. Improvements that may increase storm water runoff from an upstream property shall be evaluated to determine if downstream conveyance facilities can accept and convey the runoff increases. The downstream facilities shall be evaluated to a point or location determined by the Engineer. Downstream facilities shall have the reserve capacity to accept the runoff increases.

A detailed analysis of downstream facilities shall be made and shall include impacts and mitigation to all downstream facilities to show that the facilities can adequately accept the increased flows. This analysis shall include conveyances to the confluence of the nearest master planned, regional or previously designed system as determined by the Engineer. The detailed analysis must show that land of downstream properties is not lost due to increased flood plain limits, there is no increase in erosion, there is no net loss of storage available to attenuate peak flows, and the capacity of the downstream facilities are such that they can accommodate the increased flow from the maximum development possible for the entire upstream catchment.

When downstream facilities are unable to adequately accommodate increases in storm water runoff, appropriate mitigation measures shall be implemented into the analysis and design. Implementation of detention or retention facilities on-site to attenuate peak runoff to a level that does not impact downstream facilities shall be submitted to the Engineer for his review.

17.04 FLOOD PLAINS

Flood plain requirements must include the definition of the boundaries necessary for runoff waters. Land development shall be evaluated for impacts to onsite and offsite flood plains. Measures shall be implemented that will lessen the exposure of property and facilities to flood losses. Flood plain boundaries shall be determined along all significant watercourses within the proposed development. Flood plain boundaries shall be shown on preliminary maps and final maps. The area within the boundaries should be indicated as a flow easement.

Boundaries shall be established from applicable Federal Emergency Management Agency studies, U.S. Army Corps of Engineers Flood Plain Information Studies, U.S. Geological Survey Flood Plain Maps, regional flood studies prepared by consulting engineers or other available studies.

Proposed development within a flood plain shall meet all requirements from jurisdictional agencies independent of the City of Hercules. If no requirements, exist documentation shall be provided by the developer's engineer stating that an investigation was made and requirements do not exist.

17.05 EROSION AND POLLUTION CONTROL

Storm runoff can transport pollutants that can degrade the quality of surface waters. The water quality parameters of concern include total suspended solids, oxygen demand, nutrients, trace metals, oil and grease, bacteria, elevated temperatures, pesticides and herbicides. Hydrologic changes can occur when natural lands are developed. Pollutants can occur in higher concentrations in post-development conditions resulting from surface runoff volume increases and evapotranspiration and infiltration decreases. Additionally, erosion resulting from development can cause an increase in sediment.

Storm Water Management Programs (SWMPs) are used to implement provisions designed to reduce the discharge of pollutants and protect receiving waters. SWMPs incorporate the use of Best Management Practices that are comprised of source and treatment controls. Best Management Practices are used as an aid in preventing pollution from entering storm water and to treat polluted runoff.

17.06 DRAINAGE REQUIREMENTS

17.06.1 General Design Criteria

The information contained in this section is intended to provide consistent, specific criteria and guidelines regarding the design of storm drainage facilities and the management of storm water in the City of Hercules. Additional drainage criteria and design requirements are available from the Contra Costa County Department of Public Works.

17.06.2 Design Criteria -Land Divisions

Subdivisions shall be designed to receive surface water, stream water, and flood water emanating from outside its boundaries and from within. Water shall be designed to pass through the subdivision without injury to improvements, buildings or building sites and without adversely impacting or exceeding the capacity of existing downstream drainage facilities. Surface waters shall be discharged into the natural watercourse to which they would normally drain. Design of drainage facilities shall accommodate the ultimate development within the drainage area with minimum modification to building setback areas around wetlands, springs, creeks and streams.

Design of Drainage Facilities - Hydrologic Design

Flood estimation used for the design of drainage facilities can be based upon either historical flood data or from data obtained through statistical analysis. Determination of critical events must be made and the probability of recurrence must be analyzed. Acceptable levels of risk must then be established and then the design of storm water facilities can be based upon the risk of the flow exceeding a selected design.

The "100 year runoff event" is the event that has probability of occurrence of 0.01 in any given year. It is often taken to mean that the event will occur only once in one hundred years, which although true on the average, may not be true for a particular 100 year period.

The density of precipitation gauges in Contra Costa County is sufficient to permit using a statistical model for precipitation depths, from which storms of the selected return period can be predicted. Discharge can be estimated with a rainfall-runoff routing model. If the median or average values of all model parameters are used, the return period of the discharge computed from precipitation should equal approximately the return period of the precipitation (Pilgrim and Cordery, 1975).

Drainage facilities for areas greater than 100 acres shall be designed to safely convey the storm runoff from an event with an average recurrence interval of 100 years. All available headwater depth of the culvert may be utilized for these facilities. Flooding effects from backwater shall be analyzed when available headwater depth is incorporated into the design.

Drainage facilities for areas less than 100 acres shall be designed to safely convey the storm runoff from an event with an average recurrence interval of 10 years without the headwater depth exceeding the culvert barrel height. Exceptions will be considered when upstream ponding is required for the attenuation of flood peaks.

The use of natural channels for the collection and conveyance of storm water runoff is preferred in the City of Hercules. The advantages of natural channels include the following:

- Preservation of riparian habitat.
- Water quality enhancement.
- Preservation of floodplain storage areas.
- Energy dissipation due to vegetation, irregular alignments and sections.
- Passive recreation uses.
- Aesthetic qualities consistent with the character of the City of Hercules.

Natural channels may be used for the conveyance of storm runoff when the following conditions are satisfied:

The natural drainage ways and other courses shall contain sufficient capacity to safely convey the storm runoff from an event with an average recurrence interval of 100 years.

The natural waterways shall have historically existed in a reasonably stable condition.

It can be shown that increased rates of erosion are not likely to occur as a result of the land improvements.

Considerations are given to the natural floodway and open space requirements of the conveyance facility. Channels and adjacent land areas shall be reserved to provide an unobstructed area for the passage of the 100 year runoff event while providing for the appropriate use of adjacent lands based on the awareness of flood hazards. Where appropriate, floodplain and open space criteria shall comply with FEMA standards and the 100 year flood plain shall be designated.

Natural channels shall be capable of conveying runoff without increased erosion or widening and meandering of the channel alignment due to increased runoff from development. Improvements to natural channels providing additional capacity and/or stability erosion may be necessary when this criteria cannot be satisfied.

Design of Drainage Facilities - Hydraulic Design

1. The depth of flow or ponding shall not inundate building sites. One foot of freeboard shall be maintained between the building finished floor elevation and the water surface elevation resulting from a storm runoff event with an average recurrence interval of 100 years.
2. The depth of flow or ponding shall not exceed a level that would cause inundation of areas required for on-site sewage disposal systems. Inundation of sanitary sewage manholes by storm water from storm water conveyance facilities shall be avoided. In cases when inundation of sanitary sewage manholes is unavoidable, approval from the Central Contra Costa Sanitary District will be required.
3. The use of roadside ditches is discouraged and the use of any roadside ditch shall be approved by the Engineer. All ditches shall be designed to carry runoff from the road surface and adjacent tributary lands without damage to the roadway or adjacent property. Roadside ditches required to transport storm runoff that has been gathered and conveyed to the roadside in channels or conduits is discouraged; however, the design will be reviewed where it can be demonstrated that the activity will not create inundation of traffic lanes or additional maintenance requirements. The depth and velocity of flow in roadside ditches shall be analyzed to determine the requirements for scour prevention and other erosion measures, maintenance, prevention of ponding, frequency of cross culverts and right-of-way requirements. Further guidance can be found in Hydraulic Design Series No. 4, Design of Roadside Drainage Channels, published by the U.S. Department of Commerce, Bureau of Public Roads.
4. In general, the placement of roadways in locations previously occupied by drainage ways is discouraged. For major land divisions where large drainage ways may be located within the street right-of-way the water shall be carried underground in a closed conduit.
5. Drainage ways shall not block reasonable access to lots. Reasonable access is defined as permitting a driveway to be constructed utilizing an eighteen inch diameter pipe or smaller.
6. Storm runoff ponded on road surfaces resulting from depressed areas caused by grade changes or the crown slope of intersecting roads may have an adverse effect on traffic safety. Problems include depths of ponding higher than the adjacent curb, ponding that remains on the roadway for long periods of time and vehicles entering ponded areas at high rates of speed. Depressed areas that create ponding which encroach into a travel lane will not be allowed in the City of Hercules.
7. Depressed areas that create ponding due to site grading will generally not be allowed. Exceptions will be considered when retention is required for the attenuation of flood peaks.

8. The minimum culvert size for street crossings shall be 18 inches in diameter including street cross culverts. No storm drain conduit shall have a diameter less than that of the upstream conduit. Where the slope of the culvert is not sufficient to produce self-cleaning velocities, larger culvert sizes should be considered for maintenance requirements. Exceptions will be considered when upstream ponding is required for the attenuation of flood peaks.

9. Roadway cross culverts placed in drainage ways shall have flared end sections, beveled end sections, or reinforced, portland cement concrete headwalls on the inlet side. The outlet side shall have such end sections or slope protection that will return water to the normal flow without causing erosion.

Structural Design

1. Drainage channels shall have side slopes of 2 horizontal to 1 vertical or flatter unless mechanical stabilization is used. Bank stabilization and stream bed stabilization along constructed or natural channels is required if the channel velocities are sufficient to cause bank or bed erosion.

2. If closed conduit is used for storm drainage, manholes shall be provided at all angle points, intersections and at intervals not to exceed 400 feet. Small diameter conduits with short runs may utilize drop inlet structures at angle points.

3. Drainage facilities located at areas subject to vehicular loading shall be able to withstand anticipated vehicle loads and contain materials that will have a service life of 50 years pursuant to the testing methods for the selected material identified in the State Standard Specifications.

Easements for Drainage Purposes

Drainage easements shall be shown on the parcel or final map and shall be identified as a "Drainage Easement". Combined easements will be considered for approval pursuant to the requirements of shared use.

Drainage easements for closed conduits and appurtenances shall be no less than 10 feet in width and sufficient to provide 2 feet of clearance outside the conduits and appurtenances. Drainage easements for closed conduits shall not traverse under a building footprint and shall, insofar as possible, be placed away from the building footprint along, or adjacent to, lot boundary lines in a straight alignment.

Drainage easements for minor conveyance swales shall be sufficient to contain the swale and provide two (2) feet of clearance on both sides of the top of the swale (4 feet total clearance). Drainage easements to accommodate the swales shall be shown on the parcel map or final map and designated by the following statement:

A perpetual right of way over, upon, and across those strips of land between the rear and/or sidelines of lots and the lines shown hereon and designated "secondary flowage

easement" for the purpose of preserving and forever leaving open an easement for the passage of surface drainage.

Drainage easements for natural waterways are subject to the following criteria:

1. Drainage ways originating within the subdivision and not receiving water from culverts or roadside ditches do not require easements. All other drainage ways and all watercourses require drainage easements reserved for drainage purposes.
2. Drainage easements for natural waterways shall be surveyed and shown within the lot or parcel.
3. Drainage easements shall be no less than ten (10) feet wide and sufficient to contain the channel plus additional space for a maintenance path or roadway, as determined by the Engineer.
4. Requirements for all watercourses within the jurisdiction of the State of California, Department of Fish and Game shall be provided for by the drainage easement.

Drainage Easement Maintenance

Subdivisions shall form a community services district to provide maintenance for drainage easements.

For all other land divisions, drainage easements located outside the City of Hercules right-of-ways shall have adequate provisions to ensure maintenance.

17.07 SUBMITTAL REQUIREMENTS

Submittal of a hydrologic and hydraulic analysis is required for all proposed drainage facilities. In cases where the applicant determines that drainage improvements are minor and would not require a detailed analysis, the applicant can request, in writing, an exemption from this submittal.

A grading and drainage plan is required where surface drainage is discharged onto any adjoining property. An analysis of the effect of the discharge is required.

The drainage analysis submittals for minor land divisions shall include adequate supporting hydrologic and hydraulic information for the proposed improvements and supporting documentation including computations and any relevant information that will assist in the review process.

Drainage analysis to be provided with the improvement plans shall include a hydrologic and hydraulic analysis report.

17.08 HYDOLOGIC AND HYDRAULIC ANALYSIS REPORT

The hydrologic and hydraulic analysis report shall include a complete analysis of proposed improvements and supporting documentation including computations and any relevant information that will assist in the review process. The report shall be prepared by a qualified civil engineer who is registered in the State of California. The report shall bear the State of California Registered Professional registration seal with signature, license number and expiration date of the Engineer responsible for the preparation of the report. The following information shall be included in the report.

Introduction and Background

The introduction and background shall consist of a discussion of the proposed project including existing conditions. A discussion on the purpose and scope of the drainage study and a discussion of the proposed methodology for the analysis shall also be included. The report shall contain a description of the project site and a location map. A discussion of the level of detail for the study and general assumptions including those associated with parameter estimations considered for the analysis shall be incorporated. Existing drainage problems or proposed alterations to existing drainage features or flows shall be identified and thoroughly discussed. Discussion of constraints that influence selection of available alternatives shall also be included.

Location Map Description

A map identifying the location of the proposed project shall be included in the study.

Catchment Description and Delineation

The catchment for project improvements and for downstream facilities shall be shown on a map with the parameters utilized in the analysis. The map scale and the level of detail shall be sufficient for the level of analysis. A base map created from information on a United States Geological Survey 7.5 minute quadrangle map is the minimum required for the submittal.

Hydrologic Analysis

The hydrologic analysis shall include a presentation and discussion of the results obtained by the hydrologic analysis and calculations.

Hydraulic and Structural Analysis of Existing and Proposed Drainage Improvements

The hydraulic and structural analysis shall include a discussion of the condition of existing drainage facilities including hydraulic capacities, flow characteristics and structural integrity. A similar discussion of the proposed drainage facilities shall also be included. Mapping shall be included which is sufficient in detail to identify the drainage system and analytical parameters.

Risk Assessment Impacts Discussion

At a minimum, an evaluation of the significance of computed discharges with respect to flood protection, flood damage and redistribution of losses incurred by flooding shall be included in the report. Vulnerability of exposure shall be determined and proposed improvement levels of protection shall be justified. Cost/benefit review of increased levels of protection and analysis/estimate of potential damage to property at risk shall be investigated and discussed in the report.

Impacts to downstream facilities and other proposed mitigation measures included in the design shall be discussed. Potential impacts resulting from backwater effects, hydraulic scour and deposition, off-site discharges and other environmental issues shall be analyzed and discussed in the report.

Unusual or Special Conditions

Any unusual or special conditions shall be discussed in the report. These might include those conditions related to existing facilities, physical or hydrological characteristics of the catchment and unusual or special requirements of the existing or proposed drainage system related to operation or maintenance. Description of any special permits or special conditions required from regulatory agencies other than the City of Hercules for the construction of proposed drainage improvements shall be thoroughly discussed in the report.

Conclusions

A conclusions section shall be included in the report. Outcomes resulting from the proposed improvement analysis shall be summarized and proposals, recommendations and requirements shall be identified and adequately discussed.

Technical Appendix of Supporting Documentation for Calculations

A technical appendix shall be included in the report. The technical appendix should include documentation of the analysis including reference materials, documentation estimations, historical data, worksheets, computer files, water surface profiles, cross section information and flood plain mapping. The appendix will be reviewed as the complete technical support data package.

17.09 ADDITIONAL REGULATORY REQUIREMENTS

Any given development project is subject to requirements or conditions based on broad authorities granted to various jurisdictions to provide protection from or mitigation of effects of the development. The purpose of § 17.09 is to identify and describe the basic authorities and their requirements in general terms.

17.09.1 Basic Drainage Law Requirements

Drainage law is primarily case, or common law. Drainage law is complex, however, and the courts have established some general principles that apply to development projects:

1. The upstream property owner is entitled to discharge surface waters from the upstream property as such waters would naturally flow from the property. The downstream property owner is obligated to accept and make provision for those waters that are the natural flow from the land above.
2. The upstream property owner shall not concentrate water where it has not concentrated before without making proper provision for its disposal without damage to the downstream property owner.
3. The upstream property owner may reasonably alter the volume or velocity of surface waters following a particular natural watercourse if such alterations do not result in damage to downstream properties. Reasonableness is often based on prevailing standards of practice in the community or region.
4. No property owner shall block, or permit to be blocked, any drainage channel, ditch, or pipe. No property owner shall divert drainage water without properly providing for its disposal.

17.09.2 Subdivision Map Act

Specific drainage improvements or drainage fees and assessments may be imposed by the local jurisdiction based on powers granted in the Subdivision Map Act. The Subdivision Map Act is contained in Government Code ♣ 66410. The sections of this Act providing authority for the imposition of conditions related to drainage requirements include Government Code Sections: 66411, 66418, 66419, 66421, 66457, and 66483.

The Subdivision Map Act gives local agencies the authority to:

1. Provide drainage facilities necessary for the general use of lot owners, the subdivision and the local neighborhood.
2. Provide for proper grading and erosion control.
3. Require dedication or irrevocable offers of dedication of real property within the subdivision for drainage easements.
4. Provide for the imposition and collection of fees needed to defer actual or estimated costs of constructing drainage facilities used for the removal of surface and storm waters from local or neighborhood drainage areas.

The exact nature of these improvements may be specified in local ordinances that identify specific improvements such as storm sewers, subdrain systems, detention basins, pumps, and catch basins, or in ordinances which require improvements for facilities to carry storm runoff.

Although local governments have broad authority to require drainage easements, their authority is limited by § 66411 and § 66421 of the Subdivision Map Act.

17.09.3 California Environmental Quality Act (CEQA)

CEQA requires that local agencies disclose and consider the environmental implications of their actions and requires avoidance of environmental impacts where feasible. Mitigation requirements may be identified in a regional plan and fees or assessments imposed on specific developments within the plan area.

17.09.4 Porter-Cologne Water Quality Control Act

California Water Code § 13000, et seq., also known as the Porter-Cologne Water Quality Control Act, gives the State of California, through the State Water Resources Control Board and the various Regional Water Quality Control Boards, the primary responsibility for control of state water quality. The primary enforcement mechanisms are Water Code § 13260, § 13266, § 13301, and § 13304.

Section 13260 mandates that any person proposing to or discharging waste within any region that could affect state water quality, other than into a community sewer system, must file a report with the Board that contains such information as required by the Board. Proposed changes or changes in the character of any previously approved discharge requires an additional report be filed. Criminal penalties can be attached to violations of the Act.

Section 13266 mandates that each citizen or county must notify the Board if a subdivision map is filed, or if a building permit is filed that may involve the discharge of waste other than from dwellings involving five families or less, or discharge other than to a community sewer system.

Section 13301 gives Boards the authority to issue Cease and Desist Orders for violations of the Act.

Section 13304 provides the State Attorney General with the power to petition the Superior Court for prohibitory or mandatory injunctions to stop violations of the Act.

The Subdivision Map Act, Government Code Section 66747.6, provides that the governing body of a local agency shall determine whether discharge of waste from a proposed subdivision into an existing community sewer system would cause a violation of existing Board requirements. If the proposed waste discharge would cause, or add to, such violations, the proposed subdivision can be denied.

17.09.5 California Fish and Game Code

The California Fish and Game Code (♣1603) states that it is unlawful to substantially divert or obstruct the material flow, or substantially change the bed, channel, or bank of any river, stream, or lake, or use material from the streambeds without first notifying the Department of Fish and Game. Title XIV, California Administrative Code 720, was adopted by the Department of Fish and Game for the purpose of implementing ♣1603, and designates all rivers, lakes, streams, and streambeds for such purposes (including those with intermittent flows of water).

Department of Fish and Game guidelines define a river or stream as "a natural watercourse as designated by a solid line or a dash and three dots symbol shown in blue on the largest scale United States Geological Survey Topographic Map most recently published" (Department of Fish and Game, Departmental Guidelines Memo No. FG 1061). However, the Department of Fish and Game has taken the position that their authority and responsibility extends to all watercourses that could directly or indirectly affect resource values. An agreement from Department of Fish and Game is required for all activities that alter the streambed or flow.

17.09.6 Section 404 of the National Clean Water Act

Section 404 of the National Clean Water Act prohibits the placement or discharge of fill or dredged material into "waters of the United States" without a permit from the Corps of Engineers. "Waters of the United States" includes streams that "...are periodically or permanently inundated by surface or ground water and support vegetation adapted for life in saturated soil."

The U.S. Army Corps of Engineers coordinates the concerns of various reviewing agencies and the public. Permits are circulated among these parties and any conditions to the permit are based on their legitimate concerns. Procedures and requirements are further explained in Permit Program, A Guide for Applicants, U.S. Army Corps of Engineers, Pamphlet No. EP 1145-2-1, November 1, 1977.

17.09.7 National Flood Insurance Program

The National Flood Insurance Program was developed in 1968 to provide federally subsidized insurance policies to the owners of flood plain properties and to provide incentives to local government to plan and regulate land use and building design in flood hazard areas. This program is set forth in the National Flood Insurance Act (42 USC Sections 4401-4128).

The Federal Emergency Management Agency (FEMA) has responsibility for administering the National Flood Insurance Program, but local communities participating in this program review specific development proposals to assure that structures that may be in a 100 year floodplain are protected from flood damages and that any changes in the floodplain do not cause unacceptable increases in the elevation of the 100 year water surface. Property developers may be held liable for designing and/or constructing drainage projects which aggravate existing insurance risks.

17.10 DEFINITIONS

The definitions set forth in this section are to provide for a consistent understanding of the terms related to drainage engineering. Certain specialized definitions are defined in each individual part where they apply.

Acre-Foot: The amount of water that will cover one acre to a depth of one foot (equals 43,560 cubic feet).

Appurtenances to Storm Drains: Structures, devices, and appliances, other than pipe or conduit, that are an integral part of a drainage system, such as manholes, storm water inlets, detention storage facilities, etc.

Apron: A floor or lining of concrete, timber, or other suitable material at the toe of a dam, discharge side of a spillway, a chute, or other discharge structure, to protect the waterway from erosion from falling water or turbulent flow.

Backfill: 1. The operation of filling an excavation after it has been made, usually after some structure has been placed in the excavation. 2. The material placed in an excavation in the process of backfilling.

Backwater: The water retarded above a dam or backed up into a tributary by a channel obstruction, confinement of flow or abrupt change in channel section, slope, roughness or alignment.

Backwater Effect: Increase in upstream depth above normal depth due to channel obstruction, confinement of flow or abrupt change in channel section, slope, roughness or alignment.

Backwater Curve: The term applied to the longitudinal profile of the water surface in an open channel when flow is steady, but non-uniform.

Baffles: Deflector vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water to:

1. check or effect a more uniform distribution of velocities
2. absorb energy
3. divert, guide, or agitate the liquids
4. check eddy currents.

Bank: The lateral boundary of a stream or channel confining water flow.

Base Flood: The flood having a one percent chance of being exceeded in any given year. The "base flood" is commonly used as the "standard flood" in federal flood insurance studies.

Base Flood Plain: The area subject to flooding by the base flood.

Bedding: The foundation supporting a drainage structure.

Bed Load: Sediment that moves by rolling, sliding or skipping along the bed and that is essentially in contact with the stream bed.

Berm: A horizontal strip or shelf built into an embankment or cut, to break the continuity of an otherwise long slope, usually for the purpose of reducing erosion, improving stability, or to increase the thickness or width of the cross section of an embankment.

Bridge: A structure for carrying traffic over a watercourse, depression, or other obstacle.

Capacity: The effective carrying ability of a drainage structure or facility. May also refer to storage capacity.

Carry Over: The quantity of water not conveyed by an inlet that continues past the inlet.

Catch Basin: A basin, combined with a storm drain inlet, that traps solids.

Catchment Area: 1. The contributing area to a single drainage basin, expressed in acres, square miles, or other unit of area (also called Drainage Area or Watershed). 2. The area served by a drainage system receiving storm and surface water; or by a water-course.

Channel: 1. A natural or artificial watercourse of perceptible extent that periodically or continuously contains moving water, or that forms a connecting link between two bodies of water. It has a definite bed and banks that serve to confine the water. 2. The deep portion of a river or waterway that is used by watercraft. Also see Watercourse.

Channel Storage: The volume of water stored in a channel. Generally considered in the attenuation of the peak of a flood hydrograph moving downstream.

Check: A barrier placed in a ditch, canal or channel to decrease the velocity of the flow of water so as to minimize erosion of the bottom and banks or to raise the level of the water. Also used for diverting water from one channel to another, as in irrigation.

Chute: An inclined conduit or structure used for conveying water at a high velocity to lower levels. For vertical structures, see Drop.

Concentrated Flow: Flow that is altered from its natural surface runoff and that has been directed into a ditch, channel or pipe.

Conduit: Any pipe, arch or box through which water is conveyed.

Confluence: A junction of streams or channels.

Control: A section or reach of an open conduit or channel that maintains a stable relationship between stage or discharge.

Conveyance: A measure of the water-carrying capacity of a stream or channel.

Cost/Benefit Ratio: A comparison of the cost of a project with the anticipated benefits.

Course: A natural or artificial channel for passage of water.

Cross-Street Flow: Flow across the traffic lanes of a street from external sources, as distinguished from the sheet flow of rain on the pavement surface.

Culvert: A closed conduit for the passage of surface drainage water under or over a roadway, railroad, canal, or other structure.

Culvert Box: Generally a rectangular or square concrete structure for carrying large amounts of water under a roadway. This term is sometimes applied to long underground conduits.

Dam: A barrier constructed across a watercourse for the purpose of: 1. creating a reservoir, or 2. diverting water therefrom into a conduit or channel.

Datum: A plane, level, or line from which heights and depths are calculated or measured.

Debris Basin: A basin formed behind a low dam, or an excavation in a stream channel to trap debris or bed load carried by a stream.

Detention: Temporary ponding of storm water to attenuate peak runoff rates.

Detention, Upstream: Normally used for the detention of water close to the point of rainfall occurrence, usually applied to rooftop ponding, parking lot ponding, and small storage basins.

Development: Any man-made change to improved or unimproved real estate, including but not limited to: buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations.

Discharge: A volume of water flowing past a given point per unit time. In its simplest concept, discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal or of a river. A canal or stream may discharge into a lake, stream, or ocean.

Diversion: The change in character, location, direction, or quantity of flow of a natural drainage course.

Drainage: 1. A general term applied to the removal of surface or sub-surface water from a given area either by gravity or by pumping. The term is commonly applied to surface water. 2. The area from which water occurring at a given point or location on a stream originates. In such case the term is synonymous with Drainage Area and Watershed. 3. The term is also used in a general sense to apply to the gravity-induced flow of liquids.

Drainage Area: See Catchment Area.

Drainage Way: Natural depressions in the earth's surface, such as swales, ravines, draws and hollows, in which surface water tends to collect, but that does not constitute a watercourse.

Drains: A pipe, ditch, or channel for collecting and conveying water, Sometimes used as "Storm Drains" when describing an urban storm drainage system to carry the initial runoff.

Drawdown: The vertical distance the free water elevation is lowered, or the reduction of the pressure head, due to the removal of free water.

Drop: A vertical structure in a conduit or canal that drops water to a lower level.

Drop Inlet Culvert: A culvert installed with a drop inlet on one end and day-lighted at the other end.

Encroachment: The advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development that may impede or alter the flow capacity of a floodplain.

Energy Dissipator: A structure used to reduce the flow rate and reduce the erosive forces present in any watercourse.

Erosion: Wearing away of the lands by running water and waves, abrasion, and transportation.

FEMA: Federal Emergency Management Agency.

Flood: A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters; the unusual and rapid accumulation or runoff of surface waters from any source.

Flood Control: The elimination or reduction of flood losses by the construction of flood storage reservoirs, channel improvements, dikes, and levees, by-pass channels, or other engineering works.

Flood Plain: Any land area susceptible to being inundated by water from natural or improved channels.

Flood Plain Management: Control of the use of land subject to flooding.

Flood Proofing: A combination of structural changes and adjustments to land subject to flooding; primarily for the reduction of flood damages.

Flood Storage: Storage of water during floods to reduce downstream peak flows.

Flood Plain Fringe: That portion of the flood plain that lies outside the regulatory area. Its hazard should be recognized although it is not great enough to make public regulations desirable.

Flood Waters: Waters that escape from a watercourse in great volume and flows over adjoining lands. Although the flood water may create a temporary channel or follow some natural channel, gully or depression that does not affect their character as flood waters, or give the course which they follow the character of a natural watercourse.

Floodway: Floodway is that portion of the regulatory area required for the reasonable passage or conveyance of the design flood. This is the area of significant depths and velocities, and due consideration should be given to effects of fill, loss of cross sectional flow area, and elevated water surfaces.

Flood Storage Area: Flood storage area is that portion of the regulatory area that may serve as a temporary storage area for flood water from the 100-year flood and that lies landward of the floodway.

Flow: The movement of water, silt, sand, etc.; discharge; total quantity carried by a stream.

Flow Line: 1. The position of the water surface in a flowing stream or conduit for a normal or specified rate of discharge. 2. The hydraulic grade line in an open channel.

Freeboard: The vertical distance between the normal maximum level of the surface of the liquid in a conduit, reservoir, tank, basin, canal, etc., and the top of the confining structure.

Frequency Curve: A curve that expresses the relation between the frequency of occurrence and the magnitude of the variables. The theoretical frequency curve is a derivative of the probability curve.

Gabion: A wire basket containing earth or stones to protect against erosion.

Grade: 1. The inclination or slope of a channel, canal, conduit, etc., or natural ground surface, usually expressed in terms of the percentage of number of units of vertical rise (or fall) per unit of horizontal distance. 2. The elevation of the invert of the bottom of a conduit, canal, culvert, sewer, etc. 3. The finished surface of a canal bed, road bed, top of an embankment, or bottom of an excavation.

Gutter: See Street Nomenclature

Gutter Flow: Flow in a gutter.

Habitable Structure: Any building or structure that would be damaged as a result of inundation by flood water.

Headwater:

1. The upper reaches of a stream.
2. The region where ground water forms a stream.
3. The water upstream from a structure.

Hydraulics: A branch of engineering that deals with practical applications of the mechanics of water movements.

Hydraulic Gradient: A hydraulic profile of the piezometric level of the water, representing the sum of the depth of flow and the pressure. In open channel flow it is the water surface.

Hydraulic Jump: An abrupt rise in the water surface which occurs in an open channel when water flowing at supercritical velocity is retarded by water flowing at subcritical velocity. The transition through the jump results in a marked loss of energy, evidenced by turbulence of the flow within the area of the jump. The hydraulic jump is often used to dissipate energy.

Hydrograph: A graph showing stage, flow, velocity, or other properties of water with respect to time.

Hydrology: The science that deals with the processes governing the occurrence and movement of water upon and beneath the land.

Impervious: A term applied to a material through which water cannot pass, or through which water passes at an extremely slow rate.

Infiltration: 1. The entering of water through the interstices or pores of a soil or other porous medium. 2. The quantity of ground-water that leaks into a sanitary sewer or combined sewer or drain through defective joints. 3. The entrance of water from the ground into a sewer or drain through breaks, defective joints, or porous walls. 4. The absorption of liquid water by the soil, either as rain, or from a stream flowing over the surface. See Surface Infiltration.

Inlet: 1. An opening into a storm sewer system for the entrance of surface storm runoff, more completely described as a storm sewer inlet. 2. A structure at the diversion end of a conduit. 3. The upstream connection between the surface of the ground and a drain or sewer, for the admission of surface or storm water.

Inlet Gratings:

A. **Longitudinal Bar Grate:** A grate in which the bars are oriented parallel to the direction of flow.

B. Transverse Bar Grate: A grate in which the bars are located at some angle, usually perpendicular, to the direction of flow.

Inlet Types:

A. Combination Inlet: An inlet composed of a curb opening and a grated gutter opening inlet. Usually the gutter opening is placed directly in front of the curb opening. This arrangement is called a contiguous combination inlet, or more simply a combination inlet. When the curb and gutter opening are placed in an overlapping, or end-to-end position, the arrangement is called an overlapping, offset, or special combination inlet.

B. Curb Opening Inlet: A vertical opening in a curb through which the gutter flow passes. The gutter may be undepressed or depressed in the area of the curb opening.

C. Grated Inlet: An opening in the gutter covered by one or more grates through which the water falls. As with all inlets, grated inlets may be either depressed or undepressed and may be located either on a continuous grade or in a sump.

D. Multiple Inlet: Two or more closely spaced inlets acting as a unit. The two inlets may be of any of the types mentioned above.

Intensity: A rainfall rate, usually expressed in inches per hour.

Interception: The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs and buildings, never reaching the surface of the ground, and is lost by evaporation.

Invert: The bottom of a drainage facility.

Isohyetal Line: A line drawn on a map or chart joining points that receive the same amount of precipitation.

Isohyetal Map: A map containing isohyetal lines and showing rainfall intensities.

Left Bank: The left-hand bank of a stream or dam when the observer is facing downstream.

Lining: Material such as concrete, rock, cobbles, grass, geotextiles, etc., placed on the sides and bottom of a ditch, channel, and reservoir to prevent or reduce seepage and to prevent erosion.

Lip: A small wall on the downstream end of an apron to break the flow from the apron.

Manhole: A structure through which a person may gain access to an underground or enclosed facility.

Nappe: The sheet or curtain of water overflowing a weir or dam.

NOAA: National Oceanic and Atmospheric Administration.

NWS: National Weather Service.

Orifice: 1. An opening with a closed perimeter, and of regular form in a plate, wall, or partition, through which water may flow. 2. The end of a small tube, such as a pitot tube, piezometer, etc.

Peak Rate of Runoff: The maximum rate of runoff during a given runoff event.

Permeability: The quality of a soil horizon permitting movement of water through it when saturated and actuated by hydrostatic pressure.

Pervious: Applied to a material through which water passes relatively freely.

Point of Concentration: That point at which water, flowing from a given drainage area, concentrates.

Pollution: Physical impurity or uncleanness, usually brought about by the addition of sanitary sewage, harmful industrial waste, or other harmful materials to water which make it unfit for its intended use.

Precipitation: Any water that falls from the atmosphere, including snow, sleet, rain, and hail.

Reach: Any length of river or channel. Usually used to refer to sections that are uniform with respect to discharge, depth, area or slope, or sections between gauging stations.

Regime: The system of order characteristic of a stream; its behavior with respect to velocity and volume, form, capacity to transport sediment, amount of material supplied for transportation, etc.

Retention: Containment of runoff by ponding. Usually discharged by infiltration and evaporation or by controlled release.

Riprap: Broken stone or boulders placed compactly or irregularly on dams, levees, ditches, dikes, etc., for protection of the earth against erosion.

Right Bank: The right-hand bank of a stream or dam when the observer is facing downstream.

Riparian: Pertaining to the banks and other adjacent, terrestrial environs of freshwater bodies, watercourses, and surface emergent aquifers.

Risk: The potential adverse consequences measured in terms of inconvenience, damage, safety or professional liability or political retribution.

Risk Analysis: The quantification of exposure, vulnerability and probability.

Routing, Hydraulic: 1. The derivation of an outflow hydrograph of a channel or stream from known values of upstream inflow. 2. The process of determining the timing and shape of a flood wave at successive points along a stream or channel.

Runoff: That part of the precipitation that reaches a stream, drain, sewer, etc., directly or indirectly.

A. **Direct Runoff:** The total amount of surface runoff and subsurface storm runoff that reaches stream channels.

B. **Overland Runoff:** Water flowing over the land surface before it reaches a definite stream channel or body of water.

Sanitary Sewer: A closed conduit carrying sewage and other waste liquids, does not include intentionally added surface and storm water.

Scour: The erosive action of water in streams or channels in excavating and carrying away material from the bed and banks.

SCS: Soil Conservation Service.

Sediment: Native earth material transported, carried, or deposited by water.

Sheet Flow: Any flow spread out and not confined.

Silt Basin: A basin or reservoir installed in a storm drainage system to retard velocity, causing sedimentation and providing storage for deposited solids.

Slope: See Grade.

Spillway: A waterway in or about a dam or other hydraulic structure, for the conveyance of excess water. Also referred to as By-Channel, By-Wash, and Diversion Cut.

Stage: The elevation of a water surface above its minimum; also above or below an established "low water" plane; hence above or below any datum of reference; gauge height.

Storm: A disturbance of the ordinary and average conditions of the atmosphere that may include all meteorological disturbances such as wind, rain, snow, hail, lightning or thunder.

Storm Sewer: A closed conduit for conducting storm water that has been collected by inlets or collected by other means. The various parts of a drainage system are defined as follows:

A. Lateral (Collection) Storm Sewer: A sewer that has inlets connected to it but has no other storm sewer connected.

B. Branch (Submain) Storm Sewer: A sewer receiving runoff from a relatively small area and discharging into a trunk or main sewer and that may or may not have inlet connections.

C. Trunk (Main) Storm Sewer: A sewer receiving the discharge from several branches (submains) and generally serving a relatively large area, and that may or may not have inlet connections.

D. Outfall Storm Sewer: A sewer receiving the runoff from a collecting system, such system being lateral (collection) storm drains, branch (submain) storm sewers, and trunk (main) storm sewers, as are required, and carrying such runoff to a point.

E. Relief Storm Sewer: A storm sewer that is provided to relieve a storm drainage system not having the capacity to convey the Design Storm.

Storm Drainage System: All facilities used for conducting the storm water through and from a drainage area to the point of final outlet, consisting of: conduits and appurtenant features, canals, channels, ditches, streams, gulches, gullies, flumes, culverts, streets, and pumping stations.

Storm Runoff: The water from precipitation running off the surface of a drainage area during and immediately following a storm.

Stream: A body of water flowing in a natural surface channel.

A. Continuous: A stream that habitually flows or contains water throughout its entire course, or between any two points on its course.

B. Effluent: A stream or stretch of stream that receives water from ground water in the zone of saturation. The water surface of such a stream stands at a lower level than the water table or piezometric surface of the ground water body from which it receives water.

C. Ephemeral: 1. One that flows only in direct response to precipitation. Such a stream receives no water from springs and no long-continued supply from melting snow or other surface sources. Its channel bottom is at all times above the water table. 2. The term may be arbitrarily restricted to streams or stretches of streams that do not flow continuously.

D. Influent: A stream or stretch of stream that contributes water to the zone of saturation. The water surface of such a stream stands at a higher level than the water table or piezometric surface of the ground water body to which it contributes water.

E. Intermittent: A stream that, when it receives water from springs or surface runoff, flows during protracted periods, but not continually.

F. Perennial: A stream that flows continuously. Such streams are usually fed by ground water, and their water surface generally stands at a lower level than that of the local water table.

Stream Flow: Water that is flowing in a stream channel, canal, ditch, etc.

Stream Response: Changes in the dynamic equilibrium of a stream.

Street Flow: The total flow of storm runoff in a street, usually being the sum of the gutter flows on each side of the street. Also the total flow where there are no curbs and gutters.

Street Nomenclature

1. **Crown:** The highest point in the paving cross-section.
2. **Grade:** The longitudinal slope measured along the crown.
3. **Crown Slope:** The slope of the pavement perpendicular to the crown.
4. **Curb:** The lateral side of the pavement terminated by either a vertical or a sloped section.
5. **Curb and Gutter Section:** A curb section constructed integrally with the gutter.
6. **Cross Fall:** In a lateral pavement cross-section, the difference in elevation between the gutter flow lines.
7. **Cross Pan:** A concave paved surface crossing a street, usually at pavement intersections, for the purpose of carrying surface water across the street to continue the surface flow.
8. **Gutter:** A paved section designed to carry surface flow. Often the gutter is terminated with a curb when located at the edge of a street section.

Subdrain: An underground conduit designed to permit infiltration for the purpose of collecting ground water.

Subgrade: 1. The bottom of a trench, or other excavation, that is somewhat below the predetermined elevation of the bottom of the final excavation or structure which is to be placed therein, the intervening space being backfilled with some special material such as sand, gravel, broken stone, or tamped earth, or impervious lining, or occupied by the structure for which the excavation was made. The term is also applied to the elevation of the excavation. 2. The natural soil area beneath a street or road.

Subsoil: That portion of a normal soil profile underlying the surface, or A-horizon. Its depth and physical properties may control the movement of soil moisture.

Sump: Low point in natural or improved surface topography where surface flows will pond if a drain is not provided.

Sump Condition: Water restricted to an inlet area because the inlet is located at a low point.

Surface Detention: The storm runoff detained on the surface of the ground at or near where the rain fell.

Surface Flow or Sheet Flow: The surface flow from rainfall on pavements, ground surfaces, and other exposed surfaces until such flow reaches a gutter, ditch, water course, inlet, or other point of concentration.

Surface Infiltration: That rainfall that percolates into the ground surface and that does not contribute to the surface runoff flow.

Surface Runoff: The movement of water on the earth's surface.

Suspended Load: Sediment that is supported by the upward components of turbulent currents in a stream and that stays in suspension for an appreciable amount of time.

Swale: A shallow, gentle depression in the earth's surface. The swale collects water to some extent as a drainage course, although water in a swale is not a stream.

Trash Rack: A grid, screen, or other barrier constructed to catch debris and to prevent the debris from entering downstream facilities.

Trench: An excavation made for installing pipes, masonry walls, and other purposes. A trench is distinguished from a ditch in that the trench opening is temporary and is eventually backfilled.

Tributary Basin: An area tributary to a specific point under study.

Water, Various Forms

A. **Diffused Surface:** 1. Flood water that has escaped from a stream channel. 2. Water that has not reached a defined channel and is derived from rainfall, melting snow, seepage, or springs.

B. **Drainage:** 1. Water that has been collected by a drainage system and discharges into a watercourse. 2. Water flowing in a drain derived from ground, surface, or storm water.

C. **Foreign:** Water occurring in a stream or other body of water that originated in another drainage basin.

D. **Ground:** Water in the ground beneath the surface. In a strict sense, the term applies to water below the water table.

E. **Storm:** The water from precipitation running off the surface of a drainage area during and immediately following a period of rain.

F. **Stream:** Former surface waters that are conveyed in a well-defined watercourse.

G. **Surface:** The waters falling upon, arising from, and naturally spreading over lands and produced by rainfall, melting snow, or springs. They continue to be surface water until they percolate through the ground or flow over the surface of the land into well-defined watercourse or stream.

Watercourse: A running stream of water, a natural stream, or storm water channel, including rivers, creeks, runs, and rivulets. Also known as Drainage Way and Waterway.

A. **Artificial:** A surface watercourse constructed by human agencies, usually referred to as channel, canal, or ditch.

B. **Natural:** A surface watercourse created by natural agencies and conditions.

Watershed: See Drainage Area.

Wetland: A zone periodically or continuously submerged or having high soil moisture, that has an aquatic or riparian component or both, and is maintained by imported water supplies in excess of those available through local precipitation.

SECTION 18

STORM DRAINAGE AND WATER QUALITY

18.01 GENERAL

These standards are intended to ensure that watercourse and surface water laws are complied with and that runoff from storms up to the 100 year return frequency are conveyed through storm facilities and disposed of in a manner which protects public and private improvements from flood hazards.

All subdivision and improvements shall be designed in accordance with the provisions and requirements of this section, § 17, Title 10 – Public Works and Flood Control (Contra of Contra Costa County) and the requirements of all agencies having jurisdiction or interest in the project.

The diversion of natural drainage will be allowed only within the limits of a proposed improvement. All natural drainage must leave the improved area at its original horizontal and vertical alignment unless a special agreement, approved by the Engineer, has been executed with adjoining property owners.

All proposed storm drainage facilities shall include provisions for the ultimate upstream development and no development shall discharge at a rate that exceeds the capacity of the existing downstream system. Where the downstream storm drain system is insufficient to carry the design flow, the Contractor shall prepare a storm water routing analysis for review by the Engineer. Where storm water cannot be contained within public right-of-ways the Contractor shall either replace downstream constrictions or attenuate the developed discharge through the construction of detention facilities. Calculations for storm drainage design within a development, as well as calculations for runoff generated by upstream areas within the contributing watershed, shall be submitted to the Engineer. These calculations shall be based upon the ultimate watershed development and shall include:

1. A topographic map sufficiently detailed to show the relationship between the proposed development and the remainder of the watershed, including the acreages of all sub-areas.
2. A map of the proposed development indicating all applicable existing and proposed improvements and runoff coefficients for all areas where runoff was calculated, time of concentration and intensity of rainfall at each hydraulic structure, the magnitude and direction (indicated by arrows) of flow in each pipe and flow to each structure contributed by its tributary area. All flow rates shall be in cubic feet per second (cfs) and the design shall show the elevation of pipe inverts, top of structure elevations, and the material types, configuration and slopes of all storm water conveyance structures and conduits.
3. A summary of the design.

All proposed pipes and channels shall be designed such that there is a minimum freeboard of twelve (12) inches as measured from the top of curb for the design storm.

Containment of flood waters within the public right-of-ways is required at all times. Flood waters shall be confined to streets or other approved right-of-ways by grading or alternative means acceptable to the Engineer. In no instance shall an improvement be designed such that flood waters can reach a depth of 0.50 feet, as measured from the top of curb, before overland release occurs.

The design of all bridges, box culverts, levees, detention basins, spillways, and other applicable structures shall comply with the latest regulations and requirements of FEMA and of the Department of Water Resources, Division of Safety of Dams.

At intersections of pipes, the downstream pipe shall have a crown elevation that is less than, or equal to, the crowns of all upstream connecting pipes. Pipe diameters shall not decrease in the downstream direction.

18.02 COLLECTION SYSTEM DESIGN

18.02.1 Design Storm

The following table shall be used to determine the required design storm for drainage calculations. These shall be considered minimum requirements only and shall be increased by the developer's engineer when circumstances warrant.

TABLE 18.1 - DESIGN METHODS AND ACREAGE

Design Area or Item	Design Method	Design Return
Less than 640 Acres	Rational Method	15 year
Between 640 and 3200 Acres	Unit Hydrograph	25 year
Greater than 3200 Acres ¹	Unit Hydrograph	100 year, 24 hour
Detention Basin ²	Unit Hydrograph	100 year, 24 hour

(1) Rainfall depths shall be taken from NOAA Atlas 2, Volume XI

(2) Peak discharge from a detention basin shall not exceed 95% of the undeveloped peak flow from the 24 hour, 100 year event or the capacity of the downstream system.

18.02.2 Capacity

All storm water conveyance structures, unless otherwise directed by the Engineer, shall be designed to function without surcharging for the purposes of determining hydraulic capacity.

18.02.3 Storm Runoff

Storm runoff for areas smaller than 640 acres may be computed using the Rational Method according to the formula: $Q = ciA$

Where Q = design runoff, in cubic feet per second

c = coefficient of runoff based on ultimate development of the drainage area according to the values shown in Table 18-2

A = area of drainage basin in acres

i = rainfall intensity as derived from the following Contra Costa County, Public Works, Flood Control District figures:

Figure	Title
B-166	Mean Seasonal Isohyets Compiled from Precipitation Records, 1879-1973
B-158	5 year Precipitation Duration-Frequency-Depth Curves
B-159	10 year Precipitation Duration-Frequency-Depth Curves
B-160	25 year Precipitation Duration-Frequency-Depth Curves
B-161	50 year Precipitation Duration-Frequency-Depth Curves
B-162	100 year Precipitation Duration-Frequency-Depth Curves

TABLE 18.2 - RUNOFF COEFFICIENTS FOR RATIONAL METHOD

SURFACE OR AREA TYPE	RUNOFF COEFFICIENT (c)
Paved areas (asphalt and concrete)	0.95
Industrial areas	0.90
Commercial areas	0.85
Residential areas	
Single family, average slope less than 2%	0.50
Single family, average slope between 2% and 7%	0.55
Single family, average slope greater than 7%	0.65
Multi-family, detached	0.65
Multi-family, attached	0.75
Schools	0.45
Agricultural land	0.50
Undeveloped open spaces, including pasture	
Average slope less than 2%	0.45
Average slope between 2% and 7%	0.52
Average slope greater than 7%	0.60
Oak timber and heavy brush	
Average slope less than 2%	0.40
Average slope between 2% and 7%	0.47
Average slope greater than 7%	0.55

18.02.4 Pipe Materials

The minimum allowable inside diameter of any storm drain pipe shall be twelve (12) inches and shall be designed to flow with a minimum velocity of 2.5 feet per second when flowing full. All pipes shall be bedded as per the manufacturer's recommendations.

18.02.5 Cover Requirements

All storm drain pipe alignments shall be designed such that the top of pipe lies at least six (6) inches below the street subgrade. If, for sound engineering reasons, the above requirements cannot be met, the developer's engineer shall submit an alternative to the Engineer for review and approval.

Table 18.3 lists the minimum allowable classes of reinforced concrete pipe (RCP). For use in this chart, cover is defined as the distance from the inside top of pipe to either the top of curb or finished grade, whichever is applicable.

TABLE 18.3 – PIPE COVER AND RCP MINIMUM CLASS

Cover (feet)	Minimum Class of RCP
Less than 2.5	Class IV
2.5 – 7.9	Class III
8.0 – 11.9	Class IV
12.0 – 17.0	Class V

Any storm drain pipe that lies wholly or in part within the street structural section, including subgrade, shall be Class V. The developer's engineer shall determine the appropriate D-load based on anticipated vehicular traffic and submit the design assumptions to the Engineer for review.

Cast-in-place concrete pipe (CIPP) shall have a minimum cover in conformance with the following:

1. Cast-in-place concrete pipe shall not be used if the paving surface is less than 18 inches above the top of pipe or a distance less than 1/2 of the outside pipe diameter, whichever is greater.
2. Backfill shall be placed in accordance with the City of Hercules backfill requirements for utility trenches.
3. The Engineer may seasonally or permanently deny the use of cast-in-place concrete pipe if, in his judgment, local conditions make the use of the pipe undesirable.

18.02.6 Horizontal Alignments

Storm drainage lines shall be parallel with the centerline of the street, with the outside face of pipe directly under the face of curb or as per the Standard Plans. Although deflection into and out of catch basins may be necessary, unnecessary meandering and angular changes shall be avoided. Pipe curvature shall not exceed the manufacturer's recommendations.

18.02.7 Open Channels

Drainage shall not be conveyed through a development in open channels without the written approval of the Engineer. Open channels shall be designed in accordance with the following:

1. Velocity range shall be between 2.0 feet per second and 5.0 feet per second in unlined open channels and between 3.0 feet per second and 12.0 feet per second in lined open channels.
2. Channel lining shall be either finished concrete or rock riprap. The minimum weight of rock shall be determined using methods and procedures developed by the U.S. Army Corp of Engineers. In no case shall the design or actual rock weigh less than 75 pounds.
3. All open channels shall be designed to carry the 100 year frequency flood. The hydraulic grade line shall be calculated and plotted on all channel profiles. All computations, including a narrative of the design, shall be clearly documented and submitted to the Engineer for approval.
4. Freeboard shall be a minimum of 1.0 feet for the 100 year event and shall comply with the latest FEMA regulations.
5. Side slopes shall be 2 feet horizontal to 1 foot vertical or flatter and the minimum bottom width of the channel shall be twice the channel depth.
6. The profile of the existing channel for a minimum of 1000 feet at each end of the development, and outside of the boundaries of the development, shall be shown on the construction plans to establish an average profile grade.
7. Maintenance roads on one or both sides of the channel shall be required as directed by the Engineer.

18.02.8 Drainage Structures

1. Manholes and function boxes shall conform to the Standard Plans and Standard Specifications. They shall be located at changes in grade or conduit size, at junction points, on curved pipe at the end of curve or the beginning of curve, and at 300 feet (maximum) intervals along the curve.

2. Catch basins shall conform to the Standard Plans and Standard Specifications. Catch basins shall be designed and spaced such that they intercept and fully contain the 10 year storm. Multiple catch basins may be required at isolated low points (double draining catch basins). Under no circumstance shall the spacing of catch basins exceed 750 feet.
3. Box culverts shall be required when specified by the Engineer and shall be designed on an individual basis.
4. Headwalls, wingwalls and endwalls shall be considered on an individual basis, and in general, designed in accordance with Section 51 of the State Standard Specifications.
5. Drainage pump stations may be permitted on an individual basis with the written approval of the Engineer. In the event that pump stations are used, they shall be supplied with acceptable back-up power, backup pumps, and shall be designed to convey the 100 year event.
6. Temporary inlets and outlets shall conform to good engineering practice and shall be specifically designed and detailed on the plans.
7. Storm water runoff in gutters shall be conveyed in underground structures when any one of the following criteria is met:
 - A. The gutter runoff exceeds 3.0 cubic feet per second.
 - B. The length of gutter flow exceeds 750 feet.
 - C. The water depth in the gutter reaches the top of curb.

18.02.9 Easements

Publicly owned drainage conduits and channels will not be allowed on private property unless they lie within a dedicated public easement. Where minor improvement of a drainage channel encroache upon adjacent property written permission from the adjacent property owner(s) for the construction and future maintenance of the drainage facilities shall be required. A copy of the document which grants the permission shall be submitted to the Engineer prior to review and approval of the improvement plans.

Easements for underground closed conduits shall meet both of the following width criteria:

1. Minimum width of any easement for a closed conduit shall be fifteen (15) feet.
2. All easements for closed conduits shall have a minimum width in feet equal to the required trench width according to the standard detail for trench backfill plus two (2) additional feet of width for every foot of depth of the pipe as measured from the bottom of the pipe to finished grade. All conduits shall be centered within their easements.

Drainage easements for open channels shall have sufficient width to contain the open channel and a seventeen (17) feet wide service road. The toe of a bank shall not be within five (5) feet of an easement boundary. Easement boundary lines shall, at changes of alignment, have a radius sufficient enough to provide turning room for maintenance vehicles operating on the service road.

18.02.10 Miscellaneous Items

Fencing

All open channels shall be enclosed by a minimum six (6) feet high chain link fence complying with the State Standard Specifications and State Standard Plans or other decorative fencing as may be approved by the Engineer. Gates and the location of access points shall be determined by the Engineer. The fence shall be located a minimum of six (6) inches within the required easement boundary.

Service Road

A service road shall be provided within the boundary of all open channels. It shall be a minimum of seventeen (17) feet wide, graded for vehicular traffic and clear of trees, shrubbery, and other obstructions for its full width. Fourteen (14) feet of the road's width shall be paved or graveled (surface type to be determined by the Engineer for each case) with a minimum unpaved shoulder width of one foot on each side of the roadway. Service roads may be required on both sides of the channel as determined by the Engineer.

18.03 WATER QUALITY

Storm water quality shall be addressed, and adverse impacts caused by a project shall be mitigated to the extent practicable. In order to guarantee a minimum of impacts to receiving waters, all projects, regardless of size, shall prepare a storm water pollution prevention plan (SWPPP) for approval. The SWPPP shall include a construction and a post construction component. The construction component shall specify erosion and sedimentation control measures that shall be adhered to during construction. The post construction component shall outline maintenance and management practices that will mitigate the impacts of the project on storm water quality.

All projects which affect more than five (5) acres of land shall provide evidence of coverage under the State Construction General Permit from the State Regional Water Quality Control Board.

18.03.1 Storm Water Pollution Prevention Plan

All proposed projects shall submit a storm water pollution prevention plan (SWPPP) for approval which includes the following:

1. Site plan showing existing vegetation, existing water resources, proposed areas of land disturbance, and proposed best management practices (BMP's) for construction and post-construction activity. Appropriate best management practices shall be implemented that promote:
 - A. Prevention and control of erosion.
 - B. Preservation of natural drainage systems.
 - C. Source control of construction site materials, wastes, and chemicals.
 - D. Control and treatment of runoff.
 - E. Limited construction site accesses.
2. Estimates of pre- and post-construction runoff, erosion, sediment, and other pollutants.
3. Descriptions of proposed operations and maintenance plans including responsibility and cost.

18.03.2 Minimum Construction Best Management Practices

The following minimum construction BMP's shall be included in the SWPPP:

1. Disturbed areas shall be stabilized between October 1 and May 1 using suitable construction practices such as seeding, mulching, sod stabilization and vegetative buffer strips.
2. Downstream areas shall be protected using vegetative buffer strips, sediment barriers and dikes.
3. Fencing shall be required around all sensitive areas that are not to be disturbed such as tree drip lines and wetlands areas.
4. Sediment controls and filtration shall be used to remove silt from water generated by runoff and dewatering operations.
5. Materials shall be properly stored and vehicle cleaning, fueling and maintenance waste shall be properly treated and disposed of at appropriate facilities
6. Specific BMPs, as required by the Engineer, shall be implemented as may be required for a particular project.

18.03.3 Inlet Marking

All curb inlets shall be labeled to discourage illegal dumping and water pollution. The configuration of the labeling, the materials, colors, and methods used shall be as specified by the Engineer. All inlets shall be labeled prior to acceptance of the improvements.

SECTION 19

SANITARY SEWERS

19.01 GENERAL

All sanitary sewer systems shall be designed in accordance with the requirements of the Central Contra Costa Sanitary District (CCCSD), Standard Specifications, latest edition. The specifications are available at the CCCSD District Office, 5019 Imhoff Place, Martinez, California 94553.

The CCCSD Standard Specifications for sewerage shall govern requirements, design, and all work in connection with sewer construction within the jurisdiction of the CCCSD.

The jurisdiction of the CCCSD includes the entire sewerage systems and its appurtenances from the point of connection with building plumbing to the discharge terminus of the treatment plant outfall. The Code and all ordinances of the CCCSD shall be considered a part of the CCCSD Standard Specifications and all plans, profiles, cut sheets, right-of-way documents, and specifications shall conform to the standards and requirements established in the CCCSD Standard Specifications.

19.02 DEVELOPER'S ENGINEER'S RESPONSIBILITY

The CCCSD Standard Specifications establish uniform policies and procedures for the planning, design, and construction of the District's sewer system. They are not intended to be a substitute for engineering knowledge, judgment, and experience. The procedures contained within the CCCSD Standard Specifications shall be reviewed by the developer's engineer and shall be applied as necessary to the project.

Plans that have been stamped "Approved" or "Approved for Construction" by the CCCSD do not relieve the developer's engineer of the responsibility to meet all requirements of the Central Contra Costa Sanitary District, the City of Hercules, and all applicable state and federal agencies and jurisdictions having an interest in the work.

19.03 PLANS

The proposed sanitary sewer system shall be presented on the developer's improvement plans and shall be submitted to the Engineer for review. The plans shall demonstrate that conflicts do not exist between the proposed sanitary sewer system and all other existing and proposed utilities, water distribution systems, and storm drainage facilities.

All plans, specifications, reports and documents shall be prepared by a registered civil engineer, or under his direction, and shall be signed and stamped to indicate his authority.

SECTION 20

WATER DISTRIBUTION SYSTEMS

20.01 GENERAL

All water distribution systems shall be designed in accordance with the requirements of the East Bay Municipal Utility District (EBMUD), Standard Specifications, latest edition and their accompanying Standard Drawings, latest edition. The specifications are available at the EBMUD District Office, 375 11th Street, 5th Floor, Oakland, California.

The EBMUD Standard Specifications and Standard Drawings for water distribution systems shall govern the requirements, design, and all work in connection with water supply construction within the jurisdiction of the District.

The jurisdiction of the EBMUD includes the entire water distribution systems and its appurtenances beginning at the building's water meter. All plans, profiles, cut sheets, right-of-way documents, and specifications shall conform to the standards and requirements established in the EBMUD Standard Specifications and Standard Drawings.

20.02 DEVELOPER'S ENGINEER'S RESPONSIBILITY

The EBMUD Standard Specifications and Standard Drawings establish uniform policies and procedures for the planning, design, and construction of the District's water distribution system. They are not intended to be a substitute for engineering knowledge, judgment, and experience. The procedures contained within the EBMUD Standard Specifications shall be reviewed by the developer's engineer and shall be applied as necessary to the project.

Plans that have been stamped "Approved" or "Approved for Construction" by the EBMUD do not relieve the developer's engineer of his responsibility to meet all requirements of the East Bay Municipal Utility District, the City of Hercules, and all applicable state and federal agencies and jurisdictions having an interest in the work.

20.03 PLANS

The proposed water distribution system shall be presented on the developer's improvement plans and shall be submitted to the Engineer for review. The plans shall demonstrate that conflicts do not exist between the proposed water distribution system and all other existing and proposed utilities, sanitary sewer systems, and storm drain facilities.

All plans, specifications, reports and documents shall be prepared by a registered civil engineer, or under his direction, and shall be signed and stamped to indicate his authority.

SECTION 21

LANDSCAPE AND IRRIGATION

21.01 GENERAL

Complete sets of plans and specifications for all proposed improvements shall be submitted to the Engineer for review and approval prior to beginning work. The plans shall be prepared under the direction of a Landscape Architect or Irrigation Designer who is registered in California according to the provisions of the Business and Professions Code. These requirements apply for all proposed work within the public right-of-way and any other area in which the proposed improvements will be maintained by the City of Hercules.

21.02 IRRIGATION

All irrigation systems shall be designed to operate efficiently and effectively to support long-term viability for landscaping. Irrigation calculations shall be supplied to the Engineer for review. Assumptions used for wind, soil permeability, evapotranspiration, system efficiency, and other design parameters shall be shown in tabular form. The ability of the irrigation system to efficiently provide water to the landscape shall be clearly demonstrated by the designer. The required calculations shall include:

1. Precipitation rate of each system type (e.g.; large area rotors, small area pop-up sprays, grid emitterline system, etc.)
2. System zone calculations listing friction losses for the longest line and heaviest line on the system. All pipes, heads, valves, and appurtenances to the water meter or point of connection shall be included. On systems larger than 1-1/2 inches calculations shall be taken to the City water main tap.

The system shall be designed with the following minimum safety factors. The system designed shall show the ability of the system to adequately irrigate the landscape both with, and without, these additional factors of safety.

1. The water service to the site, up to and excluding the meter and backflow device, shall be sized to deliver a minimum of 25% more water than required by all anticipated landscaping.
2. An additional head loss of 5% above that calculated shall be taken across the meter and backflow device.
3. All other losses (e.g.; line, fitting, equipment) shall be increased by 10%.

4. The irrigation controller shall have a minimum of 10% of its stations (and no fewer than two) unused and available for future use by the City.

21.03 LANDSCAPING

The landscape design shall utilize only the highest quality plants and materials that are suitable for the local area. The design shall take into account site-specific sun, rain, and wind exposures. The landscaping plans and specifications are expected to produce a beautiful, thriving landscape that requires a minimum of maintenance effort and expense.

It may be necessary to remove upper portions of the native soils and replace them with a suitable imported topsoil. It may also be necessary to install in-planter subdrainage. The landscape architect shall pay particular attention to the soil quality, character, drainage, runoff, and erosion characteristics, water table, and other factors pertinent to the proposed planting area. A complete soil analysis is required prior to planting and finish grading. The Engineer may also require a fertility analysis of the base site prior to approval of the plans and specifications.

SECTION 22

PG&E

The following is excepted from the “Electric & Gas Service Requirements, 2001” by Pacific Gas and Electric Company, Section 1, General. The section is included in the Design Standards for the convenience of the Contactor only. The information contained in this section shall be verified with PG&E and shall not be used as the sole basis of design. The Contractor shall design all gas and electric systems in accordance with the PG&E requirements and standards.

Begin PG&E Section 1: Contents

- 1.1 Purpose
- 1.2 Permits and Inspection
- 1.3 Application for Service
- 1.4 Additional Commercial and Industrial Service Information
- 1.5 Design
- 1.6 Service Connections and Sealing
- 1.7 Changes in Requirements
- 1.8 Access to Premises
- 1.9 Change of Customer's Load or Equipment
- Safety Alert
- 1.10 Overhead Electric Lines
- 1.11 Underground Electric Lines and Gas Pipelines
- 1.12 Notice of Installation of Excess Flow Valves on Residential Services
- 1.13 PG&E Online (Website)
 - 1.13.1. Tariffs and Rates
 - 1.13.2. Electric and Gas Service Requirements Manual

1.1 Purpose

This manual is a guide for Pacific Gas and Electric Company (PG&E) customers on establishing gas and electric service to new or remodeled buildings.

This information is presented by PG&E in an effort to deliver safe, uniform service to customers.

1.2 Permits and Inspection

It is necessary that the construction of new or remodeled buildings conform to the provisions of city and county ordinances, rules on file with, or issued by, the California Public Utilities Commission (CPUC) and applicable rules and laws of the state of California.

PG&E will establish gas or electric service only after the gas piping or electric service facilities are satisfactorily installed. Local and state ordinances require that permits and final inspection be obtained before PG&E can establish service.

In areas where there are no ordinances governing gas or electrical installations, piping and wiring should meet the requirements of the state of California Plumbing Code, Mechanical Code, Electric Code, and all applicable state of California Rules, Laws and Regulations, including, but not limited to, those promulgated by the CPUC.

In addition to local or state inspection, PG&E will inspect service equipment installed by the customer. PG&E's inspection generally involves service requirements that are not governed by local or state codes. Certain parts of the customer's installation may require approval by state, local and PG&E inspectors.

1.3 Application for Service

Requests for service require considerable advance planning by PG&E in order to serve the connected load. Large capacity gas meters, electric transformers, or other special equipment often require several months lead time for delivery from the manufacturer. It is important that the local PG&E office be provided as early as possible with accurate load information and the predicted date the customer will require service so that all necessary arrangements for the service may be completed.

For commercial, industrial, subdivision and apartment complex applications, customers must include certain plans and maps as part of their request for service. Three sets of plans and maps are normally required.

The customer must provide a site plan showing the proposed service and meter location and transformer location (where applicable) that comply with the requirements of this book. Additional drawings and information such as exterior building elevations, landscape, off-site improvements, gas or electric loads, etc., may be required to determine actual field conditions and help select the proper size and location of the service facilities. All transformer and electric

or gas meter locations are subject to PG&E approval. Also, residential, commercial or industrial service requests should include a completed load data summary sheet. Customers obtain copies of the Load Summary Form from the local PG&E office.

When approved construction plans are changed or conditions are encountered during construction that affect PG&E's service arrangements, customers must consult PG&E so that mutually satisfactory alternate arrangements may be made.

In the interest of assisting PG&E in its goal to deliver safe, uniform service, the following guidelines are recommended for transmitting electronic drawing files for architectural, mechanical and civil site plans.

- The PG&E electronic drawing tool is AutoCAD R14, DWG format. All submitted electronic drawings must be completely readable and compatible with AutoCAD release 12 or above. Drawings should be sent on 3.5-inch diskette, CD, or as an email attached file.

If your version of AutoCAD offers the "Pack & Go" feature, use it. Drawings for large projects should be sent in a zipped format.

The use of layering is encouraged and should be preserved when transferring files to PG&E.

- Save all drawings in model space instead of paper space.
- Drawing plans should be two dimensional, with the "Z" elevation at zero.
- Any External Reference Files (Xref) or drawing updates should maintain a consistent insertion point.
- All related drawing files are included.

If you have any questions, please contact your local PG&E representative.

1.4 Additional Commercial and Industrial Service Information

Information concerning electric installations of more than 600 Volts or large commercial or industrial gas loads are not generally covered in this book. Individual job design specifications will be provided after the customer applies for service.

1.5 Design

PG&E is responsible for planning, designing and engineering its service facilities and service laterals using PG&E's standards for design, materials and construction.

1.6 Service Connections and Sealing

Service to customers is normally established at one delivery point, through one meter and at one voltage class. The service is designed to extend from the connection to the distribution facilities along the shortest, most practical and available route to the service termination facility or service delivery point. The service delivery point is the point of connection between the facilities of the serving utility and the customer's premises wiring or gas piping system.

Only authorized PG&E employees may connect or disconnect PG&E gas or electric service to the building or structure. Seals placed by PG&E on meters and associated service equipment must not be broken or tampered with. No unauthorized person is permitted to remove, replace or interfere with PG&E meters, seals or connections. Call PG&E if it is necessary to have the service disconnected or the meter removed because of remodeling, alterations or other activities.

Any unauthorized connection to PG&E's gas or electric facilities or to facilities used to provide utility services is a violation of California Penal Code Section 498 and 593c, and California Civil Code Section 1882, et. sequitur and may be considered a felony. These sections address connections to utility meters and facilities and diversion of utility services. They specifically prohibit any person to tamper with, make, or cause to be made any connection or reconnection with property owned or used by the utility to provide utility service without the authorization or consent of the utility.

In areas where the nearest building is a considerable distance (200 feet or more) from the property line, or in PG&E's judgment there is a potential hazard between the property line and service location, PG&E may require a service location closer to the distribution facilities.

1.7 Changes in Requirements

Some of the information contained in this book is based on governmental codes and ordinances which are subject to change as determined by the governmental authority. PG&E does not assume responsibility for keeping information in this book current with these governmental codes, ordinances or other requirements. PG&E should be consulted in case of doubt regarding the applicability of any item.

Periodically, PG&E revises its construction documents that relate to customer service requirements. Except when required by law, new requirements of a revised PG&E document will not be used to establish an absolute service requirement until the revised document or requirement has been issued to holders of this book. Normally, the revised document or requirement will be incorporated into a new edition of the book. An individually revised document or requirement may be provided by the PG&E representative to the customer prior to its incorporation into a new edition.

1.8 Access to Premises

PG&E must have the right to enter and leave the customer's premises at any time for any purpose connected with the furnishing of gas and/or electric service.

1.9 Change of Customer's Load or Equipment

A customer or contractor must notify PG&E of any plans to make an appreciable change either in the amount or character of the gas or electrical load or equipment installed on the customer's premises intended to be served by PG&E. This information is required by PG&E in order to make arrangements to provide properly sized service and metering facilities for the service load.

SAFETY ALERT

Contact with overhead or underground electric lines or equipment and natural gas pipelines can cause serious injury or death. Any part of a crane, scaffold or tool that touches an overhead electric line or penetrates an underground cable can become energized. Penetration of an underground natural gas line by a backhoe or other tool can cause a violent explosion.

1.10 Overhead Electric Lines

Cal/OSHA regulations (Title 8, Section 2946) require that minimum safe working distances be maintained from overhead electric lines. The regulations are shown below.

Nominal Voltage (Phase to Phase)	Minimum Required Clearance (Feet)
600 - 50,000	10
over 50,000 - 75,000	11
over 75,000 - 125,000	13
over 125,000 - 175,000	15
over 175,000 - 250,000	17
over 250,000 - 370,000	21
over 370,000 - 550,000	27
over 550,000 - 1,000,000	42

If you have any questions about working near overhead electric lines or about nominal voltage, contact your local PG&E office.

1.11 Underground Electric Lines and Gas Pipelines

When planning underground work, and before digging, state law requires customers to contact Underground Service Alert (USA) at 1-800-227-2600 at least 48 hours before excavation (weekends excluded) to determine the location of underground gas and electric lines or equipment.

USA will arrange for participating companies to mark the location of their underground facilities at the job site at no charge. The customer must mark the area to be excavated with white paint. USA should also inform the customer if a utility is not a participating member or does not mark its facilities.

1.12 Notice of Installation of Excess Flow Valves on Residential Services

An excess flow valve is a device installed in a gas service line to stop the flow of gas if the velocity of the gas passing through the valve is greater than a specified quantity. The valve usually operates when an excavator strikes the gas service line downstream of the valve, causing gas to be released to the atmosphere at a very high rate. Excess flow valves are installed as closely as possible to the location where the service and the main are connected to protect as much of the service as possible. The excess flow valve is not a valve which is activated by seismic movement.

Excess flow valves are installed as standard equipment on all new and replaced gas services which meet the following criteria.

- A. The system pressure does not drop below 10 pounds per square inch gauge (psig). The gas planning engineer will determine if the system meets this criteria.
- B. The service is to a residential customer with only one meter.
- C. The service is not a branch service or a service with a branch off of it.
- D. The entire service is to be replaced, not just a portion of the service.
- E. The service replacement is part of an engineered job.

Excess flow valves are installed in compliance with U.S. Department of Transportation requirements.

1.13 PG&E Online (Website)

PG&E has an Internet website at www.pge.com. A series of topics and information are accessible from the home page.

1.13.1 Tariffs and Rates

Go to www.pge.com Click on "Rates & Regulation"

1.13.2 Electric and Gas Service Requirements Manual

Go to www.pge.com Click on "Business Services" Click on "Construction Services" Scroll down to "Web Resources" and click on "Greenbook"

Note: All gas and electric service arrangements must be communicated and coordinated through the local PG&E Service Planning Group.

This is important and necessary because the latest updated or revised information is provided in many locations. Customers must contact the specific Service Planning organization to ensure that they are correctly interpreting and using that information.

STANDARD SPECIFICATIONS

1. Mobilization
2. Inspections
3. Testing of Materials
4. Clearing and Grubbing
5. Earthwork
6. Utility Earthwork
7. Street Failed Area Repair
8. Dust Control and Watering
9. Sub-bases and Bases
10. Asphalt Concrete
11. Bituminous Seal Coats
12. Hot Asphalt Concrete Surface Recycling
13. Asphalt Concrete Leveling Course and Crack Fill Repairs
14. Cold Planing
15. Pavement - Miscellaneous
16. Pavement Striping, Marking, and Delineation
17. Traffic Signs
18. Traffic Signals and Lighting Systems
19. Storm Drain Facilities
20. Concrete Construction
21. Landscaping
22. Landscape Irrigation
23. Tree Trimming and Removal
24. Protection and Restoration of Existing Improvements
25. PVC Pressure Pipe
26. ABS and PVC Composite Pipe
27. Small ABS and PVC Non-Pressure Pipe
28. Vitrified Clay Pipe
29. Reinforced Concrete Pipe
30. PVC-Lined Reinforced Concrete Pipe
31. Corrugated Polyethylene Non-pressure Pipe (HDPE)
32. Ductile Iron Pipe
33. Piping, Valves, Fittings and Appurtenances
34. Fire Hydrants
35. Protective Coating

1. MOBILIZATION

- 1.01 General
- 1.02 Project Identification Sign
- 1.03 Construction Area Signs
- 1.04 Measurement
- 1.05 Payment

2. INSPECTIONS

- 2.01 Inspection Required
- 2.02 Notification
- 2.03 Removal of Uninspected Work

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SECTION 1

MOBILIZATION

1.01 GENERAL

Mobilization shall consist of preparatory work and operations including:

1. Provision of all required bonds.
2. Movement of personnel, equipment, supplies, and incidentals to the project site.
3. Establishment of all offices, buildings and other facilities necessary for work on the project.
4. Public notifications.
5. Fabricating and installing Project Identification Signs as per ♣1.02.
6. All other work and operations which must be performed or costs incurred prior to beginning work on the contract items.
7. Demobilization.

1.02 PROJECT IDENTIFICATION SIGN

Sign Layout

PROJECT TITLE

PROJECT DATES
(Begin & Complete)

CONTRACTOR NAME

Please Drive Carefully!

1.02.1 General

At least 48 hours prior to the commencement of construction the Contractor shall furnish and erect two project identification signs. The locations of the signs shall be selected by the City.

1.02.2 Materials

The information side of the sign shall be primed and painted white . Lettering shall be black and sized to maximize the 36 inches by 48 inches dimension of the sign. The signboard shall be ¼ inch exterior grade plywood or better. Post shall be 4 inches by 4 inches unpainted, construction grade redwood.

1.02.3 Installation

The Contractor shall be responsible for installing the signs.

1.02.4 Measurement

Project identification signs shall be measured on a per each basis.

1.02.5 Payment

The Contract Unit Price paid for the project identification signs shall include full compensation for fabricating, installing and maintaining the signs and for removing the signs upon completion of the project.

1.03 CONSTRUCTION AREA SIGNS

1.03.1 General

Construction area signs shall conform to Section 12-3.06 of the State Specifications. Signs shall be stationary mounted and shall be maintained throughout the life of the project. When no longer required they shall be removed. The Contractor shall notify Underground Service Alert at least 48 hours prior to excavations for the sign posts. All excavations to install signs shall be by hand.

1.03.2 Panels and Posts

Signs shall be constructed of metal with reflective coating, black on orange, and mounted on 4 inch by 4 inch wood posts. The signs shall be kept clean and in good repair.

1.03.3 Measurement

Construction area signs shall be measured on a per each basis.

1.03.4 Payment

The Contract Unit Price paid for Construction Area Signs shall include full compensation for fabricating, installing, and maintaining the signs and for removing the signs upon completion of the project.

1.04 MEASUREMENT

Except for the construction and installation of project signs, mobilization will be measured on a lump sum basis. Project Signs will be measured on a per each basis.

1.05 PAYMENT

Except for the fabrication and installation of Project Identification Signs and Construction Area Signs, payments for mobilization will be made with each progress payment on a pro-rated percentage basis or other such basis as approved by the Engineer. The pro-rated basis shall be the total for the progress billing divided by the total contract amount and adjusted in accordance with approved change orders.

The contract lump sum price paid for mobilization shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in mobilization as specified in this section, and no additional compensation shall be made. Mobilization shall be considered as a non-adjustable contract item. Any contract change orders shall be considered as including full compensation for mobilization.

When the contract does not include a contract pay item for mobilization as specified, full compensation for any necessary mobilization required shall be considered as included in the prices paid for the various contract items of work involved and no additional compensation will be allowed.

SECTION 2

INSPECTIONS

2.01 INSPECTION REQUIRED

Inspection is required by the Engineer for all work within the public right-of-way, all public easements, and for any work for which a permit has been granted by or to the City of Hercules, the East Bay Municipal Utility District, the Central Contra Costa Sanitary District and other utility companies. Inspections shall be performed at all phases of the work to ensure conformance with the requirements of the Standard Specifications. The Engineer shall be the sole judge as to the number and type of inspections required. Inspections shall be performed at the following points and as required elsewhere in the Standard Specifications and by the utility companies:

1. Prior to the placement of any fill material.
2. Immediately after the placement of all pipe and prior to completion of the bedding or beginning backfill.
3. Prior to backfill of all thrust blocks.
4. During all backfill and compaction operations.
5. Prior to placement of any aggregate base material.
6. For form and reinforcement inspections prior to pouring any concrete.
7. Prior to paving.
8. During all paving operations.
9. After layout and prior to striping.
10. Immediately prior to and immediately after integration of soil amendments.
11. Coverage tests prior to placement of plant materials.

2.02 NOTIFICATION

The Contractor shall request all inspections by giving written notice to the Engineer a minimum of two (2) working days prior to the requested inspection. The notice shall include the project name, the location of the inspection, the type of inspection, the date and time of the requested inspection and the name and phone number of the Contractor. The Engineer will contact the Contractor if a conflict exists which requires rescheduling of the inspection. All re-inspections or rescheduled inspections shall require the same notice.

2.03 REMOVAL OF UNINSPECTED WORK

Any work that has been performed without inspection as required by this section or any other provision of the Standard Specifications shall be removed as directed by the Engineer. The work shall be reinstalled at the Contractor's expense.

SECTION 3

TESTING OF MATERIALS

3.01 DESCRIPTION

Testing of materials will be performed by an agent of the City following State of California Test Methods. The statistical testing procedure will not be used. All material shall meet the requirements of the moving average.

The Contractor is responsible to request and coordinate all testing. All tests shall be performed in the presence of the project inspector. The Engineer may reject any and/or all tests that do not meet this requirement and may order a retest. The costs for all retests shall be the responsibility of the Contractor. The cost of all retests shall be charged to the Contractor at the actual cost plus 30 percent with a minimum charge of \$150.00 each.

Sampling and testing shall also comply with Chapter 3 of the State Construction Manual. The Engineer may require additional testing. Costs for testing of materials offered by the Contractor in lieu of materials specified in the Contract plans or standard provisions shall be the responsibility of the Contractor. Cost for R-value tests, when required by the Standard Specifications, Contract plans, or special provisions shall be the responsibility of the Contractor.

Testing shall only be performed on standard City working days between the hours of 8:00 AM and 4:00 PM unless other arrangements are made in advance. Tests performed outside of these hours shall be charged at twice the normal rate.

The Contractor shall request all tests in writing a minimum of twenty-four (24) hours in advance of the time desired. A minimum of 24 hours shall be allowed for testing, including retesting, to be performed. No additional material shall be placed, or work performed, until a passing test is obtained and acknowledged by the Engineer.

Concrete and asphalt shall be supplied only from suppliers approved and certified by the State Department of Transportation. Proposed mix designs for all concrete and asphalt concrete to be placed within the City of Hercules shall be provided to, and approved by the Engineer, prior to placement.

The Contractor shall coordinate with the Engineer for additional testing policies.

SECTION 4

CLEARING AND GRUBBING

4.01 GENERAL

This work shall consist of removing all objectionable materials from within the specified limits of the project whether such items are shown on the plans or not. The limits of clearing and grubbing shall be of sufficient area and depth to complete the work shown on the Contract plans and as described in this section.

The area above and below the ground surface shall be cleared of all vegetable growth and deleterious material such as trees, logs, upturned stumps, tree roots, brush, grass, weeds, rocks, concrete, pavement, and all other objectionable material that would interfere with the work.

The removal of such material shall be to a minimum depth of six (6) inches below subgrade or six (6) inches below natural ground, whichever is lower. All materials removed shall be disposed of outside of the City unless provided for otherwise in the Contract special provisions. The Contractor is encouraged to dispose of materials where materials will be recycled or reused and diverted from landfills. Flammable material shall not be stored or remain on or adjacent to the right-of-way. The street and adjacent areas shall be left with a neat and finished appearance.

All trees, stumps and large roots within embankment areas where the grading plane is two feet or more above the natural ground shall be cut off flush with the natural ground and need not be removed except where they interfere with construction or as specified by the project geotechnical engineer.

4.02 PAVEMENT REMOVAL

4.02.1 Bituminous Pavement

Bituminous pavement shall be removed to clean, straight lines. Saw cutting is preferred. Where only the surface of existing bituminous pavement is to be removed the method of removal shall be approved by the Engineer and a minimum laying depth of one inch of new pavement shall be provided at the joint. Where bituminous pavement adjoins a trench the edges adjacent to the trench shall be cut to neat straight lines before resurfacing to ensure that all areas to be resurfaced are accessible to the rollers used to compact the subgrade and paving materials.

4.02.2 Concrete Pavement

Concrete pavement shall be removed to neatly sawn edges. Saw cuts shall be made to a minimum depth of 1 ½ inches. If a saw cut in concrete pavement falls within 3 feet of a construction joint, cold joint, expansion joint, or edge, the concrete shall be removed to the joint or edge. The edges

of existing concrete pavement adjacent to trenches, where damaged after saw cutting of the pavement, shall be saw cut to neat straight lines for the purpose of removing the damaged pavement areas. The saw cuts shall be parallel to the original saw cuts.

4.02.3 Concrete Curb, Walk, Gutters and Driveways

Unless otherwise marked in the field by the Engineer prior to bids, concrete shall be removed to neatly sawed edges with saw cuts made to a minimum depth of 1 ½ inches.

Concrete sidewalk or driveway to be removed shall be neatly sawed in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk. No section to be replaced shall be smaller than thirty (30) inches in length or width. If the saw cut in the sidewalk or the driveway would fall within 30 inches of a construction joint, expansion joint, or edge, the concrete shall be removed to the joint or edge. Where the saw cut would fall within twelve (12) inches of a score mark the saw cut shall be made in and along the score mark. Curb and gutter shall be sawed to a depth of 1 ½ inches on a neat line at right angles to the face of curb.

4.03 DISPOSAL OF MATERIALS

All materials removed shall be disposed of in accordance with §7-1.13 "Disposal of Material Outside the Highway Right-of-Way" of the State Specifications and ♣ 2.18 "Disposal Outside Project Limits" of the City of Hercules Design Standards at no extra cost to the City. The contract work area shall be left with a neat and finished appearance. All trucks hauling demolition debris or other materials shall be covered.

4.04 SALVAGING OF MATERIALS

All existing materials that are designated to be salvaged shall be removed by the Contractor and cleaned and hauled to a location specified by the Engineer where the materials shall be unloaded and stockpiled by the Contractor unless otherwise approved by the Engineer.

4.05 ABANDONING PIPES AND STRUCTURES

Existing pipes shall be abandoned by one of the following methods as approved by the Engineer:

Method A: The existing pipe shall remain in place and all open ends of the pipe shall be plugged with Class 560-C-3250 concrete. The thickness of the concrete shall be equal to the pipe diameter or twelve (12) inches, whichever is greater. The Contractor shall construct and remove all falsework required for installing the concrete plug.

Method B: The existing pipe shall be filled with Class 100-E-100 sand/cement slurry.

Existing structures, pavement slabs and structural sections to be abandoned shall be demolished as per the recommendations of the project geotechnical engineer and as approved by the Engineer. All voids shall be backfilled with suitable material.

4.06 MEASUREMENT

Quantities of clearing and grubbing will be measured on a lump sum basis.

4.07 PAYMENT

Clearing and grubbing shall be paid for at the contract lump sum price. The price and payment shall constitute full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in the clearing and grubbing of areas and items otherwise not paid by other bid items in the contract as specified and as directed by the Engineer.

When the Contract does not include a pay item for clearing and removal work, and unless noted otherwise in the special provisions, full compensation for clearing and removal work shall be included in the unit price paid for the type of work involved and no additional compensation will be allowed.

SECTION 5

EARTHWORK

5.01 GENERAL

Earthwork shall consist of all excavation, grading, and embankment construction, except structural excavation and backfill. The work under this section shall consist of performing all operations necessary to:

1. Excavate earth and rock, regardless of their character and the subsurface conditions, from the roadway prism.
2. Excavate all materials, of whatever nature, necessary for the construction of foundations for structures and other facilities.
3. Excavate drainage channels and irrigation ditches.
4. Excavate select material.
5. Construct embankments.
6. Place backfill for structures and other facilities.
7. Backfill trenches and depressions.
8. Remove and replace unsuitable material.
9. Excavate and grade road approaches, driveways, and connections.
10. Remove unstable material.

Trenching and backfilling for sewer, storm drain pipes, underground utilities, and other subsurface pipes shall be as specified in ♣ 6 “Utility Earthwork”.

Finished grade shall be the finished surface of the completed facility. When the work covered by the Contract is stage construction, the relation between finished grade and the work covered by the Contract will be as shown on the Contract plans.

Unless otherwise specified, quantities of all types of existing sub-base, base, surfacing, or pavement removed will be included in the quantities of the type of excavation where they are located and no separate payment will be made.

When hauling is done over highways or City streets, all loads shall be trimmed and all material removed from the shelf areas of vehicles to eliminate spilling of material. If necessary, loads shall be watered or covered to eliminate dust.

5.02 CONTROL OF SURFACE AND GROUND WATER

The Contractor shall provide and maintain slopes, crowns, and ditches on all excavations, fills and embankments to control drainage at all times during the construction period. The Contractor shall construct temporary dams, silting basins, and other facilities as required to prevent damage

to the work. The Contractor shall ensure that material is not deposited in streams or on adjacent properties. The finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the Contractor in a satisfactory condition until sub-base, base or pavement is placed. No separate payment will be made for this work. Full payment shall include the unit bid price for the earthwork involved. The storage or stockpiling of materials on the finished subgrade will not be permitted. No sub-base, base or pavement shall be laid until the subgrade has been checked and approved.

The Contractor shall be required to prevent and remove any seepage, storm water or sewage of any kind that may be found or that may accumulate in the excavations during the progress of the work. The Contractor shall furnish, install and operate pumps or other devices necessary to remove seepage, storm water and sewage. The Contractor shall keep all excavations free from water during construction.

5.03 TOPSOIL

Where specified in the Contract special provisions or as directed by the Engineer, topsoil shall be stripped to a depth of 4 inches to 6 inches and shall be either spread on approved areas or shall be transported and deposited in approved areas. Topsoil shall be kept separate from other excavated materials. Topsoil shall not contain roots, stones, and other undesirable materials.

5.04 CLASSIFICATION OF EXCAVATION

An excavation shall be unclassified unless otherwise specified in the Contract special provisions.

No consideration will be given to the nature of the materials under the designation of unclassified excavation. Earth and rock, regardless of character and subsurface conditions, shall be excavated to the lines and grades established by the contract plans.

Where an excavation is classified in the special provisions as rock or common excavation and separate payment items have been established for the same then all excavation shall be done on a classified basis.

5.05 SUITABLE MATERIALS

Imported fill material shall consist of inert, granular soil and rock fragments and shall conform to the requirements established by the project geotechnical engineer.

All fill material, import or native, shall be free of organic materials, trash and debris, moderately to highly expansive clays, or any other deleterious material. All fill material shall be approved by the Engineer.

The top two (2) feet of import fill material below the subgrade for roadways shall conform to the most conservative requirements between those established by the project geotechnical engineer and the following requirements:

1. Fill material shall conform to the following as determined by ASTM C 117 and ASTM C 136:

Maximum particle size	3 inches
Percent passing one inch sieve	90-100 percent
Percent passing No. 200 sieve	Less than 20 percent

2. The Plasticity Index for acceptable import fill materials shall be a maximum of 15 as determined by ASTM D 4318.
3. The liquid limit shall not exceed 40 percent as determined by ASTM D 4318.
4. Import fill material shall have an R-value of 25 or greater as per ASTM D 2844.

The Contractor shall submit to the Engineer, at least ten (10) working days prior to use on the site, the Contractor's proposed source of import fill material along with a soils report and Certification from the designated source that the proposed source materials conform to the requirements of this section.

All suitable native fill material containing clods or hard lumps of earth over six (6) inches in the greatest dimension shall be broken up before compaction. All suitable native fill material consisting of large rocky material or hard lumps, such as hardpan or cemented gravel that cannot be broken readily, shall be well distributed in the lower portions of the work.

5.06 UNSUITABLE MATERIAL

Material and basement material in embankment areas that are unsuitable for the planned use shall be removed and disposed of in a legal manner.

Where removal of the unsuitable material is not shown on the Contract plans or specified in the special provisions, the removal and disposal of the unsuitable material will be paid for at the contract prices for roadway excavation for the quantities involved. If there is no contract bid price for roadway excavation or the removal of unsuitable material is not paid for under other contract bid items, the removal and disposal of the unsuitable material will be paid for as extra work as provided by § 11.03 "Extra Work" of the Design Standards.

Where unsuitable material is removed and disposed of, the resulting space shall be filled with material suitable for the planned use.

In-situ material or native materials that, in the opinion of the Engineer, would have been suitable had they not been damaged by the Contractor's operations, shall be removed and replaced to the satisfaction of the Engineer at no expense to the City.

5.07 SLIDES AND SLIP OUTS

Material outside of the planned roadway that is unstable, material that has come into the roadway or ditch, and material that has slipped out of new or old embankments shall be removed. The material shall be excavated to designated lines or slopes either by benching or in a manner approved by the Engineer. The material may be used in the construction of the embankments when approved by the Engineer.

Slide and slip-out material that did not result from any act, or failure to act, on the part of the Contractor and that must be removed and disposed will be paid for at the contract price of roadway excavation for the quantities involved. However, if, in the opinion of the Engineer, the character of the work and the removal and disposal of such material cannot be properly compensated for at the contract prices for roadway excavation, the work may be paid for as provided by §11.03 "Extra Work" of the Design Standards. Only those quantities of slide or slip-out material that are actually removed, as directed by the Engineer, will be paid for.

5.08 SLOPES

Excavation slopes shall be finished in conformance with the lines and grades shown on the Contract plans. All debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the Contract plans and no point on the completed slopes shall vary from the designated plane by more than six (6) inches as measured at right angles to the slope. Where excavation is in rock no point shall vary more than two (2) feet from the designated plane of the slope. In no case shall any portion of the slope encroach upon the roadbed or interfere with the planned use of the facility.

5.09 SURPLUS MATERIALS

Unless otherwise shown on the Contract plans or specified in the special provisions, no surplus excavated material may be disposed of within the right-of-way or on adjacent property within the project area. Surplus excavated material to be disposed of shall become the property and responsibility of the Contractor and shall be disposed outside the City at the Contractor's expense unless otherwise specified in the special provisions.

The quantities of surplus material shown on the Contract plans or in the special provisions are approximate only. The Contractor shall satisfy himself that there is sufficient material available for the completion of the work before disposing of any surplus material. Any shortage of

material, caused by premature disposal of the material by the Contractor, shall be replaced by the Contractor and no compensation will be allowed for the replacement.

5.10 SELECT MATERIAL

Select material is material excavated from the project site that is satisfactory for use in fills, embankments, as backfill or for other uses as specified and approved by the Engineer.

Select material, excluding topsoil, encountered in the excavation may be used in roadway embankments or other embankments where approved by the Engineer. Topsoil excavated within the limits of the project may be used only in areas to be planted.

Where practicable, select material shall be hauled directly from the excavation to its final position in the embankment and compacted in place. Select material may be stockpiled by the Contractor where approved by the Engineer.

Full payment for hauling, compacting, stockpiling, re-handling or other work involved in the use, or disposal, of select material shall be included in the various contract bid items of work and no additional compensation shall be made.

5.11 MEASUREMENT

Roadway excavation shall be paid for by the cubic yard. Quantities shall be measured in the original position and computed by the average end area method. The following excavations will be measured as roadway excavations:

1. Excavating for the roadway prism.
2. Excavating public and private road approaches.
3. Excavating roadside shoulders.
4. Over-excavating unsuitable materials.
5. Excavating channels.

Excavating in excess of the planned or authorized cross sections will not be paid for. The Contractor shall backfill and compact unauthorized excavations to the original ground configuration and elevation or authorized section at no expense to the City.

The excavation measurement will not include the yardage of subgrade or other material that is scarified or plowed and reused in place by road mixing or other similar in-place methods of operation.

Where it is impossible or impractical to measure quantities of common excavation by means of average end areas due to changed conditions or due to the nature of a particular operation, or for

any other reason, the Engineer will compute the quantities by a method that, in the Engineer's opinion, will obtain accurate quantities.

Where quantities of roadway excavation are computed by means of average end areas and centerline distances, a correction for curvature will not be applied to quantities within the roadway prism.

The final estimate of roadway excavation quantities shall be the quantities included within the planned or authorized cross section, excluding the rounding of the tops of excavation slopes and ends of excavations, and the quantities involved in the removal of unstable material.

5.12 PAYMENT

Classified or unclassified roadway excavations will be paid for at the contract unit price per cubic yard for the respective classification. The contract unit price shall be considered as full compensation for excavating, loading, hauling, depositing, spreading, grading, watering, and compacting of embankment construction, including sloping and rounding tops and ends of excavations and no additional compensation shall be made. If there is no bid item for Roadway Excavation, full payment shall be considered as included in the other contract items of work.

5.13 STRUCTURE EXCAVATION AND BACKFILL

5.13.1 General

Structure excavation and backfill shall consist of the removal of material for the construction of the foundations for bridges, box culverts, retaining walls, headwalls and endwalls, reservoirs, buildings, and other structures, and other excavations designated as structure excavations on the Contract plans, the Contract special provisions, or in the Standard Specifications.

Structure backfill shall consist of furnishing, placing and compacting material that supports structures to the lines designated on the Contract plans or as specified and directed by the Engineer.

Structure excavation and structure backfill shall include the furnishing of all materials and equipment and the construction or installation of all shoring, cofferdam and sheeting and/or other facilities that may be necessary to perform the excavations and place and compact the backfill. Structure excavation and structure backfill shall also include the removal of the facilities except where they are required or permitted to remain by the Contract plans.

Where shown on the Contract plans, or as directed by the Engineer, recesses of culvert inlets shall be excavated in slopes to the dimensions designated and the resulting material disposed of as approved by the Engineer. Such work will be paid for as structure excavation. Surplus material from structure excavation may be placed in embankments as provided for in §5.14 "Embankment

Construction", or disposed of as provided for in §5.09 "Surplus Materials" as approved by the Engineer. No additional compensation will be allowed for disposal of surplus material or for their incorporation into the work.

5.13.2 Foundation Subgrade Treatment

Where footing concrete or masonry is in contact with rock, the rock shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the Engineer may direct and the cost will be paid for as extra work.

Where piles are not used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation. Final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Except when over-excavation is directed by the Engineer, excavation below grade shall be replaced at the Contractor's expense with the same class of concrete specified for the structure.

The excavation for piers and abutments shall be completed to the bottom of the footings before any piles are driven. Excess material remaining in the excavation after pile driving shall be removed. When piles are used and ground displacement results from pile driving operations the Contractor, at no expense to the City, shall excavate or backfill the footing areas to the grade of the bottom of the footing as shown on the Contract plans. The Contractor shall use structure backfill material.

5.13.3 Foundation Inspection

Whenever any structure excavation is completed the Contractor shall notify the Engineer. No concrete or masonry shall be placed until the Engineer has approved the foundation.

5.13.4 Structure Backfill

Structure backfill shall not be placed until the structure footings or other portions of the structure or facility have been reviewed by the Engineer and approved for backfilling. No backfill material shall be deposited against the back of concrete abutments, concrete retaining walls, foundation walls, or the outside walls of cast-in-place concrete culverts until the concrete has developed a strength of not less than 90 percent of the design strength in compression as determined by test cylinders cured under conditions similar to those prevailing at the site.

Unless otherwise specified in the Contract special provisions, structure backfill shall consist of approved select material from the excavations that are free from stones or lumps exceeding three (3) inches in greatest dimension, vegetable matter, or other unsatisfactory material and having a minimum Sand Equivalent (per CA Test 217) of 20. When, in the opinion of the Engineer, the material from the excavation is unsuitable for use as backfill it shall be disposed of as provided for by §2-18 "Disposal Outside Project Limits" of the Design Standards.

5.13.5 Pervious Material

Pervious backfill material shall be placed behind bridge abutments, wingwalls, and retaining wall as show on the Contract plans and as provided for in the following chart:

Sieve Size	Percentage Passing
¾ inch	100
3/8 inch	80-100
No. 100	0-8
No. 200	0-3

That portion of the filter material passing the No. 4 sieve shall have a Sand Equivalent (per CA Test 217) of not less than 60.

All weep holes shall be backed with two (2) cubic feet of pervious material conforming to the requirements of the section entitled "Aggregates" of the Standard Specifications. The pervious material shall be securely tied in a burlap sack and placed in such a manner that the backing covers the weep holes and extends at least twelve (12) inches above the bottom of the opening.

A square screen (eight inches by eight inches, minimum) of ¼ inch galvanized or aluminum with a minimum wire diameter of 0.03 inch shall be firmly attached at the back of each weep hole before the material is placed.

Pervious backfill material shall be placed in layers along with and by the same methods specified for structure backfill. Pervious backfill shall be covered with a one foot thick layer of impervious soil.

There shall be no measurement or payment for furnishing and placing pervious material or weep hole backing. Full compensation for the furnishing and placing of all pervious material shall be included in the other contract bid items of work.

5.13.6 Measurement

Unless provided for in the special provisions, there shall be no separate measurement for structure excavation and backfill.

5.13.7 Payment

Unless provided for in the special provisions, there shall be no separate payment for structure excavation or backfill. The cost shall be included in the price bid for the construction or installation of the items to which the excavation or backfill is incidental or appurtenant.

5.14 EMBANKMENT CONSTRUCTION

5.14.1 General

Embankment construction shall consist of building embankments, placing fills and will include preparing the areas upon which the embankment and fills are to be placed. Embankment construction shall also include constructing buttress fills, dikes, placing and compacting of approved material within areas where unsuitable material has been removed, and the placing and compacting of material in holes and pits.

Areas over which fills are to be placed shall be cleared and scarified to provide a bond between the existing ground and the material to be deposited. When fills are to be placed over existing surface improvements that are to remain in place, the clearing and scarifying will not be required. Whenever a fill is constructed upon an existing structure or pavement, four (4) inch drainage holes shall be drilled through the structure on five (5) feet centers each way.

Rocks, broken concrete, or other solid materials that are larger than four (4) inches in greatest dimension shall not be placed in fill areas where piles are to be driven or that would interfere with the construction of other structures.

When fill is to be made and compacted on hillsides, where fill is to be compacted against existing fill, or where an embankment is built one-half width at a time, the slopes of the original hillsides and the fills shall be benched a minimum of eight (8) feet horizontally as the fill is placed. A new bench shall be started where the vertical cut for the next bench intersects the existing ground.

Clods or hard lumps of earth that are larger than six (6) inches in greatest dimensions shall be broken up before compacting the materials in embankment. When rocks, boulders, or hard lumps larger than twelve (12) inches in greatest dimension are encountered and cannot be broken down with conventional equipment they may be incorporated in embankments when authorized by the Engineer, provided they are well distributed throughout the embankment

When structure footings are to be constructed in an embankment, the embankment shall be constructed to the elevation of the grading plane before excavating for the footing, or, when foundation piling is shown on the Contract plans, before driving the piles or excavating the footing.

5.14.2 Compacting

Embankments shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements specified.

Constructing dikes, placing and compacting of approved material where unsuitable material has been removed, and filling of holes and depressions shall conform to all of the requirements specified for compacting embankments.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent but not more than 5 percent.

The loose thickness of each lift of embankment material shall not exceed that which will provide the specified relative compaction through the full depth of the lift by the compaction equipment being used. Each lift shall be compacted in accordance with the requirements of §5-15 "Compaction".

When embankment material contains over 25% by volume of rock larger than six (6) inches in greatest dimension, the material may only be used three (3) feet or more below the finished grade.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken portland cement concrete and bituminous-type pavement obtained from the project excavations will be permitted in the embankment with the following limitations:

1. The maximum dimension of any piece shall be six (6) inches.
2. Pieces larger than four (4) inches shall not be placed within twelve (12) inches of any structure.
3. Pieces larger than three (3) inches shall not be placed within twelve (12) inches of the subgrade for paving.
4. "Nesting" of pieces will not be permitted.

At locations where it would be impracticable to use mobile power compacting equipment, embankment layers shall be compacted to the specified requirements by any approved method that will obtain the required compaction.

At the time of compaction, the moisture content of the embankment material shall be such that the required relative compaction will be obtained. Embankment material that contains excessive moisture shall not be compacted until the material is dry enough to obtain the required compaction. Full compensation for any additional work involved in wetting or drying embankment material to the required moisture content shall be included in the contract unit prices and no additional compensation will be allowed.

5.14.3 Measurement

There shall be no separate measurement for embankment construction.

5.14.4 Payment

Full compensation for constructing embankments, preparing subgrade at the grading plane, doing necessary plowing or benching, constructing all dikes, placing and compacting approved material where unsuitable and unstable embankment foundation material has been removed, filling and compacting holes and depressions, backfilling excavations resulting from the removal of structures and other facilities, placing select material where required, placing topsoil excavated from within the project limits on slopes, placing select material and topsoil in stockpiles, all as shown on the Contract plans and as specified in the special provisions, shall be included in the contract price paid per cubic yard for excavating the material or the contract price paid for furnishing and placing the material. No additional compensation will be allowed for such work.

Where embankment is specified in the bid schedule, or in the Contract special provisions, the full compensation for constructing the embankments shall include the cost of all the necessary excavation in connection therewith, both within the limits of the project or otherwise, together with the cost of all grading, shaping, and other work that is required under this §5.14 "Embankment Construction". The quantities used in determining payment for embankment bid items shall be those of the completed embankments in place within the limits shown on the Contract plans.

5.15 COMPACTION

5.15.1 General

Earthwork compaction consists of obtaining the required compaction in all earthwork described in the Standard Specifications or the Contract special provisions except structure backfill.

Embankments shall be constructed in layers. The loose thickness of each layer of embankment material before compaction shall not exceed 0.67 foot, except as provided, with rocky material. When necessary to protect existing trees, the Engineer may require compaction to be reduced below that specified. To protect existing trees, the Engineer may require the Contractor to use smaller compaction equipment including hand operation tools. Existing trees, within the limits of construction, that are not to be removed shall be protected.

5.15.2 Relative Compaction (95 percent)

Unless otherwise specified in the Contract special provisions, where sub-base, base, pavement, or curb and gutter is to be placed directly on subgrade material, the top six (6) inches of subgrade material shall be compacted to a relative compaction of at least 95 percent. Where expansive soils are encountered, the Engineer may require that the expansive soils be removed and replaced.

Relative compaction of not less than 95 percent shall be obtained under sub-base, base, pavement, and curbs and gutters for a minimum depth of 2 ½ feet below finished grade in embankment areas.

Relative compaction of not less than 95 percent shall be obtained for embankments under wall footings without pile foundations and within the limits established by inclined planes sloping 45 degrees out and down from lines one foot located outside the bottom edges of the footing.

5.15.3 Relative Compaction (90 percent)

Relative compaction of not less than 90 percent shall be obtained in all embankments, except as specified in this section to be 95 percent, and under driveways and sidewalks for a minimum depth of 2 ½ feet below finished grade.

5.15.4 Measurement

There shall be no separate payment for compacting earthwork.

5.15.5 Payment

Compaction will be considered as included in the various contract items of work requiring compaction and no separate payment will be made.

5.16 FINISH AND TOLERANCE

The surface of all excavations, fills, embankments, and subgrade shall be finished to a reasonably smooth and compact surface within 0.10 foot above or below the specified elevations.

SECTION 6

UTILITY EARTHWORK

6.01 GENERAL

The Contractor shall provide all materials, equipment, and labor necessary to perform and complete all utility earthwork as shown on the Contract plans and as specified in this section.

The work of this section includes all earthwork required for construction of the project. Earthwork shall include loosening, removing, loading, transporting, depositing, and compacting all materials wet and dry, as required to complete the work. The work includes furnishing, placing and removing of sheeting, shoring and bracing necessary to support the sides of all excavations; all pumping, ditching, draining and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; and all other incidental earthwork.

Hazardous materials shall be handled in accordance with all regulatory agency requirements.

6.02 CONTRACTOR SUBMITTALS

The Contractor's attention is directed to the provisions for "Shoring and Bracing Drawings" in ♣6705 of the California Labor Code. The Contractor, prior to beginning any trench or structure excavation five (5) feet deep or over, shall submit to the Engineer for review for compliance with ♣6705, the Contractor's detailed plan of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of the trenches or structure excavation. If the plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, alternative system plans shall be prepared, stamped and signed by a civil or structural engineer registered in the State of California. The alternate plans shall be prepared at the Contractor's expense.

Certificates of Compliance shall be provided for all products and materials to be used under this section.

For all materials that are not pre-approved by the Engineer, the Contractor shall designate the source and/or submit samples of all materials in advance of their use for required testing and for the Engineer's approval. All testing costs shall be at the Contractor's expense.

6.03 QUALITY ASSURANCE

Where soil material is required to be compacted to a percentage of maximum density the maximum density at optimum moisture content shall be determined in accordance with ASTM D 1557. Where cohesionless, free-draining soil material is required to be densified to a percentage of relative density, the calculation of relative density shall be determined in accordance with ASTM D 4253 and ASTM D 4254.

Field density in-place tests shall be performed in accordance with ASTM D 2922.

Subsequent re-testing after the first re-test to show compliance shall be at the Contractor's expense.

The Contractor shall notify the Engineer at least 48 hours prior to the start of any utility excavation.

6.04 PRODUCTS

6.04.1 Suitable Backfill Material

Suitable backfill shall be a selected or processed clean, fine earth, rock, or sand, free from objectionable material, vegetation, or other deleterious substances.

The following types of backfill materials are designated and defined as follows:

- TYPE 1** Sand shall be material with 100 percent passing the 3/8-inch sieve, at least 90 percent passing the No. 4 sieve, and a sand equivalent value not less than 30.
- TYPE 2** Class 2 Aggregate Base shall be crushed rock aggregate base material meeting the requirements of ♣26 "Aggregate Bases" for 3/4 inch maximum grading of the Caltrans Standard Specifications.
- TYPE 3** Class 1, Type A or B, Permeable Material shall be crushed stone, or gravel, durable and free from slaking or decomposition under action or alternate wetting or drying, uniformly graded, and shall meet the requirements of ♣68-1.025 for Class 1 "Permeable Material" of the Caltrans Standard Specifications.
- TYPE 4** Class 2 Permeable Material shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying, uniformly graded, and shall meet the requirements of ♣68-1.025 for Class 2 "Permeable Material" of the Caltrans Standard Specifications.

- TYPE 5** Manufactured Backfill shall be manufactured, angular, granular, crushed stone, rock, or slag with 100 percent passing the one inch sieve and less than one percent passing the No. 4 sieve.
- TYPE 6** Native material shall be material obtained from on-site excavations, provided the materials are not classified as unsuitable. Native material shall be free of stones, lumps, broken concrete or bituminous surfacing over 3 inches in diameter, objectionable material, vegetation, and deleterious substances.
- TYPE 7** Topsoil material may be material which has been obtained at the site or that may be imported. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.
- TYPE 8** Aggregate Subbase shall conform to the grading and quality requirements of ♣25 "Class 2 Aggregate Subbase" of the Caltrans Standard Specifications.

6.04.2 Unsuitable Backfill Material

Unsuitable soils for backfill material shall include soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, or OL. Types CH and MH soils will be permitted in unimproved areas only where required compaction and stability can be demonstrated. Any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use shall be classified as unsuitable material.

Any material determined to be hazardous is defined as unsuitable material.

Washed, smooth rock (pea gravel) is classified as unsuitable material.

Where the moisture content of the material is not in conformance with ♣5 "Earthwork" the material will be classified as unsuitable material.

6.04.3 Use of Suitable Backfill Material Types

The Contractor shall use the types of materials as designated in this section for all required backfill construction.

Backfill material types shall be used in conformance with the following provisions:

1. Bedding backfill shall be Sand, Class 2 Aggregate Base, Class 1 Type A Permeable Material or Class 2 Permeable Material, meeting the requirements of Product Types 1, 2, 3A, or 4.
2. Pipe Zone backfill, exclusive of bedding, shall be as follows:

- A. Plastic pipe shall be backfilled with Sand meeting the requirements of Product Type 1.
- B. Mortar-coated pipe, concrete pipe, and ductile iron pipe shall be backfilled with Sand, Class 2 Aggregate Base backfill material, crushed rock or gravel, meeting the requirements of Product Types 1, 2, 3A, or 4.
- C. Coal, tar, enamel-coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Sand, or natural, rounded, non-crushed material, meeting the gradation requirements of Product Types 1, 3A, or 4.
- D. Vitrified clay pipe shall be backfilled with Sand or Manufactured Backfill material, meeting the requirements of Product Type 1 or 5, or Class 2 Aggregate Base, Class 1 Type A Permeable Material, or Class 2 Permeable Material, meeting the requirements of Product Types 2, 3A, or 4, only if properly compacted with hand tampers or vibratory compactors as appropriate.
- E. Backfill for sub-drainage systems shall be designed on a case-by-case basis.

The pipe zone backfill for all other pipelines excluding those listed above shall be Sand, Class 2 Aggregate Base, Class I Type A Permeable Material, Class 2 Permeable Material, Manufactured Backfill meeting the requirements of Product Types 1, 2, 3A, 4, or 5.

Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing the No. 4 sieve, trench plugs of impermeable clay or concrete shall be provided at minimum intervals of 200 feet.

- 3. Trench Zone backfill shall be Sand, Class 2 Aggregate Base, Class 1 Type A Permeable Material, Class 2 Permeable Material, Manufactured Backfill, Native, or Aggregate Subbase meeting the requirements of Product Types 1, 2, 3A, 4, 5, 6, 7, or 8.
- 4. Final Zone backfill shall consist of the following materials for each condition listed below.
 - A. Final Zone backfill under paved areas shall be Class 2 Aggregate Base or Class 2 Aggregate Subbase, meeting the requirements of Product Types 2 or 8.
 - B. Final Zone Backfill in unimproved areas shall be Native or Class 2 Aggregate Subbase meeting the requirements of Product Types 6 or 8.
 - C. Final Zone backfill in landscape areas shall be Native meeting the requirements of Product Type 6. Topsoil and amendments shall be Product Type 7.
 - D. Final Zone backfill under graveled roads shall be Class 2 Aggregate Base, Native, or Class 2 Aggregate Sub-base meeting the requirements of Product Types 2, 6, or 8.

5. Minor structures. Backfill materials around minor structures shall be any Trench Zone Product Type except Sand, Native, or Topsoil, Product Types 1, 6, or 7.
6. Over-excavation backfill shall be Class 1 Type B Permeable Material meeting the requirements of Product Type 3B. For wet trench conditions place a filter fabric on top and below of the permeable material to prevent migration of fines.

6.04.4 Filter Fabric

Filter fabric shall be non-woven synthetic fabric meeting the requirements of §88-1.03, "Filter Fabric" of the Caltrans Standard Specifications. Filter fabric shall be non-woven synthetic fabric with a minimum Grab Strength of 90 pounds, a minimum Burst Strength of 180 pounds, a minimum Puncture Strength of 50 pounds, a Water Flow Rate of at least 40 gallons per minute per square foot, and an Apparent Opening Size of between 60 and 110.

6.04.5 Steel Plate

When steel plate bridging is provided in-lieu of backfill and temporary asphalt, the bridging shall conform to §602.1 of the Caltrans Encroachment Permit Manual, with the following minimums:

Trench Width	Minimum Plate Thickness
Less than 10 inches	½ inch
Equal to 10 inches and less than 1 foot, 11 inches	¾ inch
Equal to 1 foot, 11 inches and less than 2 feet, 7 inches	7/8 inch
Equal to 2 feet, 7 inches and less than 5 feet, three inches	1 inch

For spans greater than 5 feet, 3 inches a structural design shall be prepared by a California registered civil engineer.

6.05 EXECUTION

6.05.1 General

Where abandoned underground structures are encountered in the street areas, remove the structures to sufficient depth to allow underground lines to cross and to backfill and compact backfill during rough grading. The Engineer may require additional work as warranted.

6.05.2 Minor Structure Excavation

Excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work, unless otherwise provided for in the Contract plans and special provisions. The removal of the materials shall conform to the lines and grades shown on the plans or as directed by the Engineer.

Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and the material shall be removed from the site prior to performing any excavation or placing any fill.

The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures required for the removal or exclusion of water, including storm water, groundwater, and wastewater reaching the site of the work from any source so as to prevent damage to the work or adjoining property.

Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926). The limits of structure excavation shall be a minimum of twelve (12) inches beyond the outside edge of the structure, and at a minimum no larger than necessary to facilitate backfill, compaction and testing operations. For structures placed against undisturbed soil, the width of the structure wall shall be no more than two (2) inches greater than that shown on the plans.

Except where otherwise specified for a particular structure or as directed by the Engineer, excavation shall be carried to the grade of the bottom of the structure. When directed by the Engineer, areas beneath minor structures shall be over-excavated. After the over-excavation is completed, and before backfill is placed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 90 percent of the maximum density as per ASTM D 1557.

6.05.3 Pipeline and Utility Trench Excavation

Trench Width: Excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as practical for the method of densification selected by the Contractor, but shall have a minimum width at the bottom of the trench equal to the outside diameter of the pipe plus twenty-four (24) inches. The maximum width at the top of the pipe shall be equal to the outside diameter of the pipe plus thirty-six (36) inches for pipe diameters 18 inches and larger, and to the outside diameter of the pipe plus twenty-four (24) inches for pipe diameters less than 18 inches. For deep trenches the maximum width requirement may be waived for constructability reasons with the written approval of the Engineer. For telecommunications conduits (electrical, telephone, cable TV/communications), street light and traffic signal conduits, the width of the trench shall be as shown on the Standard Plans.

Subgrade: The surface of the subgrade after compaction shall be hard, uniform, smooth, self-draining, and true to the grade and cross section shown on the plans.

Trench Bottom: The pipe bedding shall be such that each pipe section shall be in continuous contact with the bedding. Rounding out the trench bottom or bedding to form a cradle for the pipe will not be allowed. The Contractor shall excavate for bell holes and fittings.

Open Trench: The maximum amount of open trench permitted in any one location shall be the length necessary to accommodate the amount of pipe installed and backfilled in a single day. All trenches shall be fully backfilled at the end of each day or shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate may be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained. The Contractor is responsible for safety at all times.

Trench Over-Excavation: Trenches shall be excavated to the depths shown on the plans and then backfilled to the grade of the bottom of the Pipe Zone.

Over-Excavation: When ordered by the Engineer, whether or not indicated on the plans, trenches shall be over-excavated beyond the depth shown. The trench shall then be backfilled to the grade of the bottom of the Pipe Zone.

Where pipelines are to be installed in embankments or structure fills, the fill shall be constructed to a level a minimum of two (2) feet above the top of the pipe, as directed by the Engineer, or as recommended by the pipe manufacturer, whichever is greater, before the trench is excavated.

6.05.4 Over-Excavation Not Ordered, Specified, or Shown

Any over-excavation carried below the grade ordered, specified or shown, shall be backfilled and compacted to the required grade at the Contractor's expense.

6.05.5 Excavation in Lawn Areas

Where excavation occurs in lawn areas, the sod shall be removed, stockpiled, watered and preserved for replacement. Excavated material may be placed on the lawn provided that a tarp or other suitable method is used to protect the lawn. Material shall not remain stockpiled for more than 48 hours. Immediately after completion of the backfilling and testing of the pipeline and trench the sod shall be replaced and the lawn restored to its original condition. The Contractor shall provide new sod, in kind, if the removed sod has been stockpiled for more than 48 hours.

All other landscaping that is disturbed or damaged by the Contractor shall be replaced in kind. All irrigation systems, including piping and electrical wiring, that are damaged by the Contractor shall be repaired by the Contractor on the same day that they were damaged. The Contractor shall ensure that the irrigation system is operating properly.

6.05.6 Excavation in the Vicinity of Trees

Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over two (2) inches in diameter shall be cut without the approval of the Engineer.

If existing roots over one inch in diameter are cut during the course of the work, the cut faces shall be thoroughly coated with emulsified asphalt made especially for use on cut or damaged plants.

Exposed roots shall be covered with wet burlap to prevent them from drying.

6.05.7 Rock Excavation

Rock excavation shall include removal and disposal of the following:

1. All boulders measuring 1/3 of a cubic yard or more in volume.
2. All rock material in ledges, bedding deposits, and un-stratified masses.
3. Concrete or masonry structures that have been abandoned.
4. Conglomerate deposits that are firmly cemented and have the hardness of rock.

Use of explosives and blasting will not be permitted.

6.05.8 Disposal of Excess Excavated Material

The Contractor shall remove and dispose of all excess excavated material to a suitable site. The proper and legal disposal shall be the responsibility of the Contractor.

6.06 BACKFILL

6.06.1 General

Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any fresh concrete structure for a minimum of 72 hours or until the concrete has attained sufficient design strength to withstand the loads imposed, whichever is greater.

Except for Product Type 3B material being placed in over-excavated areas or trenches, and unless specifically excepted by the Engineer, backfill shall not be placed until after all water is removed from the excavation.

6.06.2 Pipe and Utility Trench Zones and Backfill

Pipe Zone and Backfill

1. The Pipe Zone is defined as that portion of the vertical trench cross-section between a plane located six (6) inches below the bottom surface of the pipe and a plane located twelve (12) inches above the top surface of the pipe.
2. The Pipe Zone shall be backfilled with the specified backfill material. The Contractor shall prevent damage to the pipeline coating, cathodic bonds, or to the pipe itself during the installation and backfill operations.

Bedding

The bedding is that portion of the Pipe Zone lying between a plane six (6) inches below the bottom surface of the pipe and a plane located at the elevation of the bottom of the pipe.

1. Bedding shall be provided for all pipelines.
2. After compacting the bedding the Contractor shall perform a final trim for establishing grade so that each pipe section shall be in continuous contact with the bedding along the bottom of the pipe.

Trench Zone and Backfill

After the Pipe Zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the Trench Zone may proceed.

The Trench Zone is that portion of the vertical trench cross-section located between a plane twelve (12) inches above the top surface of the pipe and a plane twenty-four (24) inches below the roadway subgrade in paved areas, or, twenty-four (24) inches below the finished surface grade in landscaped or unimproved areas.

Final Zone and Backfill

The Final Zone is the last twenty-four (24) inches between the top of the Trench Zone and the roadway subgrade in paved areas, and the last twenty-four (24) inches of the trench cross-section lying between the top of the Trench Zone and the finish grade in landscaped or unimproved areas.

Utility Crossing

For any new pipeline installation that crosses under an existing electric, gas, telephone, or cable TV utility pipe or conduit, the Contractor shall replace the existing backfill material around the existing utility pipe or conduit with PG&E sand.

PG&E sand shall be placed from a plane six (6) inches below the bottom of the lowest utility pipe or conduit to a plane twelve (12) inches above the top of the highest utility pipe or conduit and for the full width of the trench.

PG&E sand backfill shall be compacted to 95 percent maximum density in conformance with ♣6.06.4 “Compaction of Backfill Materials”.

6.06.3 Placing and Spreading Backfill Materials

Backfill materials shall be placed in horizontal layers. The backfill layers shall be evenly spread so that, when compacted, each layer shall not exceed six (6) inches in thickness.

The material shall be thoroughly mixed as necessary to promote uniformity of material in each layer and uniformity of moisture throughout backfill materials. Pipe Zone backfill materials shall be manually spread around the pipe so that, when compacted, the Pipe Zone backfill will provide uniform bearing and side support.

Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

Where the backfill material moisture content is too high to permit the specified degree of compaction, the material shall be dried until the moisture content is satisfactory.

Backfill shall be mechanically compacted by means of tamping rollers, sheep-foot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers. All such equipment shall be of a size and type subject to review by the Engineer. Impact-type pavement breakers (stompers) shall not be permitted. Approval by the Engineer 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 new improvements. The Contractor shall make his own determination in this regard.

Material for mechanically compacted backfill shall be placed in lifts that, prior to compaction, shall not exceed the thickness specified below for 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 sheep-foot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels - maximum lift thickness of 1 foot.

3. Hand-directed mechanical tampers - maximum lift thickness of 4 inches.

Mechanically compacted landfill 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 required, and then tamped or rolled until the specified relative compaction has been attained.

6.06.4 Compaction of Backfill Materials

Each layer of backfill material as defined in this section, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content range.

Flooding, ponding, or jetting shall not be used.

Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill against the structure wall at that time. Hand-operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

Compaction Requirements

The following compaction test requirements shall be in accordance with ASTM D 1557 for cohesive type materials and in accordance with ASTM D 4253 and D 4254 for "nonplastic" cohesionless free-draining granular type materials. Where other agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density	Percentage of Relative Density
Pipe Zone backfill including bedding and over-excavated zone.	90	65
Final Zone backfill beneath paved areas or structures.	95	70
Final Zone backfill beneath unpaved access areas, landscape, or unimproved areas.	90	55
Trench Zone backfill.	90	65
Backfill beneath minor structures.	95	70

Backfill around minor structures.	90	65
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Maximum Density refers to maximum dry density according to ASTM D 1557 laboratory test procedures. Percentage of Relative Density refers to ASTM D 4253 and ASTM D 4254 laboratory test procedures. Relative density should only be used for "non-plastic" cohesionless free-draining, granular-type materials.

Trench Backfill Requirements

The pipe class has been structurally designed based upon the trench configuration previously specified in this section.

1. The Contractor shall maintain the previously specified trench width up to a horizontal plane lying twelve (12) inches above the top of the pipe.
2. If, at any location under the horizontal plane, the Contractor slopes the trench walls or exceeds the maximum trench widths indicated, the Pipe Zone backfill shall be "improved" or the pipe class improved at no additional cost to the City.
3. If the allowable deflection specified for the pipe is exceeded, the Contractor shall expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the Pipe Zone material and Trench Zone backfill as specified.
4. All trenches shall have a minimum of two (2) inches of temporary asphalt placed daily and maintained unless final paving can be completed in the same day. Temporary asphalt shall be placed flush with adjacent pavement grade.

Steel plates may be used to cover open trenches in-lieu of backfill and temporary asphalt pavement

6.06.5 Steel Plate

When backfilling operations for an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a work day, steel plate bridging with a non-skid surface and shoring may be required to maintain traffic flow.

When steel plate bridging is required, the following conditions shall apply:

1. Steel plates used for bridging must extend a minimum of 12 inches beyond the edges of the trench.
2. Steel plate bridging shall be installed to operate with minimum noise.

3. The trench shall be adequately shored to support the bridging and traffic loads.
4. Temporary paving with cold asphalt concrete shall be used to feather the edges of the plates if plate installation by Method 2 is used.
5. Bridging shall be secured against displacement by using adjustable cleats, shims or other devices.

Steel plate bridging and shoring shall be installed using either Method 1 or Method 2.

Method 1: For speeds greater than, or equal to, 45 mph.

The pavement shall be cold planed to a depth equal to the thickness of the plate and to a length and width equal to the length and width of the plate.

Method 2: For speeds less than 45 mph.

Approaching plate(s) and ending plate(s), placed longitudinally to the traffic lane, shall be attached to the roadway by a minimum of 2 dowels pre-drilled into the corners of the plate and drilled 2 inches into the pavement. Adjacent plates shall be butted to each other. Fine graded asphalt concrete shall be compacted to form ramps with a maximum slope of eight (8) percent and with a minimum twelve (12) inch taper to cover all edges of the steel plates. When the steel plates are removed the dowel holes in the pavement shall be backfilled with either graded fines of asphalt concrete mix, concrete slurry, or an equivalent slurry.

SECTION 7

STREET FAILED AREA REPAIR

7.01 GENERAL

The Contractor shall remove failed pavement areas to a minimum depth of four (4) inches or as per the Contract plans and special provisions. The limits of work and depth may be adjusted by the Engineer in the field based on conditions encountered during the removal of the failed area.

Failed areas shall be removed in a manner that ensures that underground utilities are not damaged, the subgrade is not damaged, and the work is located within the planned or approved limits. Any removal beyond the planned or approved limits shall be restored by the Contractor at no expense to the City.

Prior to placing asphalt concrete, the subgrade shall be compacted to a minimum relative compaction of 95%, as per ASTM D1557, to a depth of at least six (6) inches.

The Contractor's attention is directed to the possibility that certain streets may have concrete pavement underlying the asphalt surfacing, or that the thickness of the asphalt concrete may exceed the minimum depth of repair thickness of three (3) inches. It shall be the Contractor's responsibility to determine existing conditions and to be satisfied as to the nature and thickness of the existing surfacing. No additional payment will be made for removal and repair to a depth greater than the three inch minimum.

7.02 DISPOSAL OF EXCAVATED MATERIAL

Asphalt concrete and base rock removed from the failed area may be either:

1. Removed from the project limits and properly disposed of.
2. Reused on the project site as approved by the Engineer. If reused, the following gradation shall apply:

Sieve Size	Percent Passing
3 inch	100
2 ½ inch	90-100
No. 4	40-90
No. 200	0-25

7.03 TACK COAT

Excavated areas shall have their edges thoroughly coated with an asphalt grade (RS-1 or SS-1) emulsified asphalt tack coat (in accordance with State Standard Specifications ♣94). The tack coat may be applied by spraying or by hand application.

7.04 PLACING ASPHALT CONCRETE

Asphalt concrete shall be furnished and placed in accordance with §10 "Surfacing and Pavements" of the Standard Specifications. Asphalt concrete shall be placed in failed areas as soon as possible, but not more than twenty-four (24) hours after the removal of the failed areas. The lifts of asphalt concrete shall not exceed three (3) inches.

7.05 TOLERANCES

Asphalt concrete shall be evenly spread upon the subgrade or base to a depth that, after rolling, will conform to the existing pavement. The surface shall be planar and shall not vary more than 1/8 inch from the plane. The finish surface elevation of the failed repair shall not exceed the elevation of the adjacent roadway by more than 1/8 inch.

Any area that is not within this tolerance shall be immediately brought to grade following the initial rolling. However, if the paving material has cooled below the lower limits of the spreading temperatures specified, the surface of the pavement shall be brought to a true grade and cross section by removing the paving material in the area to be refinished and by providing new pavement material at a minimum depth of one inch. Removal shall extend to neat joints and repairs shall not be made to pavement surfaces by feather-edging at joints. Any corrective work required by the Engineer shall be at the Contractor's expense.

7.06 MEASUREMENT

Failed area repairs shall be measured by the square foot or square yard based on the areas designated by the Engineer in the field. With approval of the Engineer, the Contractor may, for the Contractor's convenience, remove and repair pavement beyond the areas marked. The additional repairs beyond the approved limits shall not be included in the area used for payment.

7.07 PAYMENT

The contract unit price for failed area repairs shall include all labor, equipment, materials, excavation and incidentals, including: disposal, subgrade preparation, tack coating, asphalt concrete, and removal and repair beyond the area designated by the Engineer, and no additional compensation shall be made.

SECTION 8

DUST CONTROL AND WATERING

8.01 GENERAL

This work shall consist of applying water and dust palliative for the alleviation or prevention of dust nuisance.

Dust resulting from the Contractor's operations, either inside or outside the project area, shall be controlled by the Contractor in accordance with the provisions of §2 "Legal Relations and Responsibilities" of the Design Standards.

It is understood that the provisions of this section will not prevent the Contractor from applying water or dust palliative for the Contractor's convenience.

8.02 DUST PALLIATIVE

This work shall consist of applying a dust palliative for the prevention of dust nuisance. The dust palliative shall be applied in the amount specified and at the locations specified by the Engineer.

8.02.1 Materials

The binder may be miscible in water or may be material that is directly applied to the surface without mixing with water. Binders shall be non-toxic, non-corrosive and environmentally safe.

8.02.2 Application

Binders that are miscible in water shall be mixed with water at a rate that varies between 4 to 19 parts water to one part binder. The exact rate shall be approved by the Engineer. The resulting mixture shall be applied with a pressurized spray system.

Spray bars shall have a minimum length of nine (9) feet and shall be the full circulating type. The spray bar shall be adjustable to permit positioning at various heights above the surface. The valves shall operated by levers so that one or all valves may be quickly opened or closed in one operation. Dust palliative shall be applied at a rate of 0.2 gallons per square yard to 0.8 gallons per square yard.

Binders that are directly applied to the surface without mixing with water shall be applied with equipment approved by the Engineer. The binder shall be applied at a rate of 0.10 gallons per square yard to 0.25 gallons per square yard.

The Engineer will determine the rate and number of applications of binder.

8.03 WATERING

This work shall consist of developing, furnishing, and applying water including water used in the performance of work and paid for as extra work.

8.03.1 Application

Water shall be applied in the amounts and at the locations and for the purposes designated in the Contract, the special provisions and as ordered by the Engineer.

Water for compacting embankment material, sub-base, base and surfacing material, and for dust control shall be applied by pressure-type distributors or pipelines equipped with a spray system or hoses with nozzles that will ensure the uniform application of water.

All equipment used shall be equipped with a positive means of shut-off.

Unless otherwise permitted by the Engineer, or unless all the water is applied by means of approved pipelines, at least one mobile unit with a minimum capacity of 1,000 gallons shall be available at all times for applying water on the project.

8.03.2 Chemical Additives

The Contractor may use chemical additives in water used for compaction. Furnishing and applying the additives shall be at the Contractor's expense.

The Engineer may prohibit the use of any additive. The Engineer may designate the locations where an additive may not be used and the Engineer may limit the amount of a particular type of additive to be used at certain locations.

8.04 PENALTY FOR NON-COMPLIANCE

If, in the opinion of the Engineer, dust from the Contractor's operations or work areas, including storage and staging areas, is not being properly controlled, the Engineer may assess a monetary penalty against the Contractor. The amount of the assessment shall be \$250.00 for each violation. For the purpose of enforcement any one of the following shall constitute a violation:

1. A complaint (verbal or written) from the public.
2. A written warning from the Engineer.
3. A warning or other action taken by the Air Quality Control Board.

Upon written warning from the Engineer, each subsequent hour that passes without dust being controlled to the satisfaction of the Engineer shall constitute a separate violation. Assessments will be deducted from any payments due to the Contractor.

8.05 FAILURE TO PROVIDE ADEQUATE DUST CONTROL

Should the Contractor, in the opinion of the Engineer, not comply with written warnings to provide adequate dust control, the Engineer may order a partial or complete stop of the Contractor's work until compliance is achieved and measures are implemented that will reduce the likelihood of additional violations. Such partial or complete stoppage shall not be cause for the Contractor to request any additional compensation or extension of time to complete the project. Any costs incurred by the City to enforce the provisions shall be at the Contractor's expense and shall deducted from any payments due to the Contractor. Any partial or complete stoppage of work shall not relieve the Contractor of his responsibility to maintain the project and adjacent areas in safe and clean conditions.

8.06 MEASUREMENT

There shall be no separate measurement for dust control, dust palliative or watering.

8.07 PAYMENT

No separate payment will be made for any work performed, or material used to control dust resulting from the Contractor's performance of the work, either inside or outside the project limits, staging areas, and storage areas. Full compensation for dust control, including dust palliative and watering, will be considered as included in the prices paid for the various contract items of work and no additional compensation shall be made.

SECTION 9

SUB-BASES AND BASES

9.01 SUBGRADE PREPARATION

9.01.1 General

The subgrade shall be prepared in conformance with §19 “Earthwork” of the Caltrans Standard Specifications unless modified by this section.

The work specified in this section includes the preparation of the ground on which the sub-base, base, pavement or other surfacing materials are to be placed. The finished subgrade plane lies between the subgrade and the adjacent surfacing material placed on it. All relative compaction of the subgrade shall be at least 95 percent (as per ASTM D 1557) for a depth of six (6) inches, regardless of location. All subsequent material placed on the compacted subgrade shall have a minimum relative compaction of 95 percent unless otherwise specified in the Contract special provisions or Standard Specifications.

Subgrade preparation shall extend a minimum of two (2) feet beyond all concrete improvements and asphalt paved areas.

The finished subgrade shall be firm and unyielding. Unsuitable subgrade material, as determined by the Engineer, shall be removed and disposed of in a legal manner. Material suitable for re-use, as determined by the Engineer, may be reprocessed at no additional cost to the City. Any material removed and not incorporated in the work shall be replaced with suitable material approved by the Engineer and shall be compacted to a relative compaction of at least 95 percent.

The Contractor, at no expense to the City, shall repair any damage to the prepared subgrade caused by construction operations or by public traffic. No material shall be placed upon the prepared subgrade until the subgrade meets the specified requirements.

In order to facilitate the preparation of the subgrade, the Contractor may remove rocks, lumps, break up hardened material or temporarily construct a rough grading plane below the subgrade elevation, provided that the rough grading plane is subsequently brought up to subgrade elevation with suitable material. The materials shall be compacted to a relative compaction of at least 95 percent. Any such work shall be at the expense of the Contractor and no separate payment will be made.

9.01.2 Subgrade Tolerance

Finish subgrade shall be within the tolerances established in §19-1.03 “Grade Tolerances” of the Caltrans Standard Specifications unless modified by this section.

Subgrade for asphalt concrete, concrete, or other roadway structures, shall not vary more than 0.03 feet from the specified grade and cross section. In no case will reductions in aggregate base and surfacing material be permitted.

9.01.3 Measurement

There shall be no separate measurement for subgrade preparation unless provided for in the bid proposal.

9.01.4 Payment

Unless provided for otherwise in the bid proposal, no separate payment shall be made for preparing subgrade. Full compensation for furnishing all labor, materials, tools, equipment, water and incidentals, and for doing the work involved in preparing the subgrade as specified, shall be included in the contract price paid for the contract items of work and no additional payment shall be made.

9.02 AGGREGATE SUBBASE

9.02.1 General

Aggregate sub-base shall be spread and compacted in conformance with §25 “Aggregate Sub-bases” of the Caltrans Standard Specifications unless modified by this section. Aggregate sub-base shall be Class 2 mineral aggregate as specified in this section.

9.02.2 Materials

Mineral aggregate for the aggregate sub-base, at the time it is deposited, shall conform to the requirements of this section.

9.02.3 Quality

Aggregate furnished for the sub-base shall be hard, sound, durable aggregate of uniform quality, free from vegetable matter and other deleterious substances. It shall be able to be compacted readily under watering and rolling to form a firm and stable sub-base. Aggregate may be delivered with water added. It shall have a minimum R-value of 60 and minimum Sand Equivalent (per CA Test 217) of 18.

9.02.4 Gradation

The percentage composition by weight of aggregate sub-base shall conform to the following grading when determined by Test Method No. CA 202:

Sieve Size	Percent Passing
3 inches	100
2 ½ inches	90-100
No. 4	40-90
No. 200	0-25

9.02.5 Recycled Aggregate Sub-base

Existing and uncontaminated asphalt concrete and aggregate base that is to be removed may be recycled as aggregate sub-base. The recycled materials shall conform to the gradation requirements as specified in §9.02.3. The Sand Equivalent (per CA Test 217) and R-value requirements will not apply to recycled aggregate sub-base.

Recycled materials shall be mixed to a uniform gradation prior to spreading and compaction.

9.02.6 Spreading

Aggregate for sub-base shall be delivered to the roadbed as uniform mixtures and shall be placed in layers. Segregation shall be avoided and the material shall be free from pockets of coarse or fine material. The layers shall be shaped to such thickness that, after watering and compacting, the completed sub-base will conform to the grade and cross-section specified.

9.02.7 Compacting

Where the required thickness of the aggregate sub-base is six (6) inches or less, the aggregate sub-base may be spread and compacted in one layer. Where the required thickness is more than six (6) inches, the sub-base and base aggregate shall be spread and compacted in two or more layers of equal thickness. The maximum compacted thickness of any one layer shall not exceed six (6) inches.

Where the aggregate sub-base is to be placed over areas inaccessible to the spreading equipment, the sub-base or base may be spread and compacted by any approved means to obtain the results specified.

The relative compaction of each layer of compacted aggregate sub-base shall not be less than 95 percent as determined by CA Test Method No. 216-06-231.

9.02.8 Tolerance

The finished surface of the aggregate sub-base shall not vary more than 0.05 feet from the specified grade and cross-section. Variations from this tolerance shall be compensated for so that the grade and cross-sections specified are met.

Sub-base that does not conform to the requirements of this section, shall be reworked, moisture conditioned and re-compacted to conform to the specified requirements.

9.02.9 Tests

The aggregate sub-base shall conform to the following tests:

Characteristic	CA Test Method	Minimum Requirement
Resistance (R-value)	301	60
Sand Equivalent	217	18

The R-value requirements may be waived provided that the aggregate sub-base conforms to the specified grading and has a Sand Equivalent (per CA Test 217) value of 25 or more.

9.02.10 Measurement

Measurement shall be by the cubic yard based on the theoretical volume obtained from the planned cross section shown on the Contract plans. Areas shall be based on actual field measurement of the horizontal surface of the material placed. No allowance shall be made for aggregate sub-base placed outside of the planned dimensions, unless approved by the Engineer.

9.02.11 Payment

The Contract unit price per cubic yard shall include all materials, tools, equipment, labor, compacting, water, preparation of recycled material, and incidentals necessary to perform and complete the work as shown on the Contract plans and as directed by the Engineer and no additional compensation shall be made.

9.03 AGGREGATE BASE

9.03.1 General

Aggregate base shall be spread and compacted in conformance with §26 “Aggregate Bases” of the Caltrans Standard Specifications unless modified by this section. Aggregate base shall be Class 2 and shall consist of a crushed material aggregate as specified in this section.

9.03.2 Materials

Mineral aggregate for the aggregate base, at the time it is deposited, shall conform to the requirements of this section.

9.03.3 Quality

Base aggregate shall be hard, sound, durable aggregate of uniform quality and free from vegetable matter and other deleterious substances. It shall be of the nature that it can be compacted to form a firm and stable base. Aggregate may be delivered with water added.

9.03.4 Gradation

The percentage composition by weight of aggregate base shall conform to the following gradation:

Sieve Size	Percentage Passing Sieve	
	1 ½ inch Maximum	¾ inch Maximum
2 inches	100	---
1 ½ inches	87-100	---
1 inch	---	100
¾ inch	45-90	87-100
No. 4	20-50	30-65
No. 30	6-29	5-35
No. 200	0-12	0-12

Segregated materials shall be re-mixed until uniform.

9.03.5 Spreading

Aggregates for base shall be delivered to the roadbed as uniform mixtures and shall be spread in layers. Segregation of aggregates shall be avoided and material shall be free from pockets of large or fine material.

Where the required thickness is six (6) inches or less, the aggregate base may be spread and compacted in one layer. Where the required thickness is more than six (6) inches, the sub-base or base aggregate shall be spread and compacted in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed six (6) inches.

Where the aggregate base is to be placed over areas inaccessible to the spreading equipment, the aggregate sub-base or base may be spread and compacted by any approved means to obtain the specified results.

9.03.6 Compacting

The aggregate base shall be compacted to at least 95 percent relative compaction in conformance with ASTM D-1557. The relative compaction of each layer of compacted aggregate sub-base or base shall not be less than 95 percent as determined by CA Test Method No. 216-06-231.

9.03.7 Tolerance

The finished surface of the aggregate base shall not vary more than 0.05 feet from the specified grade and cross section. Variations within the above-specified tolerances shall be compensated for so that the grade and cross sections specified are met.

Aggregate base that does not conform to the requirements of this section shall be reworked and moisture conditioned to conform to the specified requirements.

9.03.8 Tests

The aggregate base shall conform to the following tests:

Characteristic	CA Test Method	Minimum Requirement
Resistance (R-value)	301	78
Sand Equivalent	217	22
Durability Index	217	35

The aggregate shall not be treated with lime, cement or other chemical material before the Durability Index is performed.

9.03.9 Measurement

Measurement shall be by the cubic yard based on the theoretical volume obtained from the planned cross section shown on the Contract Plans. Areas shall be based on actual field measurement of the horizontal surface of the material placed. No allowance shall be made for aggregate base placed outside of the planned dimensions unless approved by the Engineer.

9.03.10 Payment

The Contract unit price per cubic yard shall include all materials, tools, equipment, labor, compacting, water, preparation of recycled material, and incidentals necessary to perform and complete the work as shown on the Contract plans and as directed by the Engineer and no additional compensation shall be made.

SECTION 10

ASPHALT CONCRETE

10.01 GENERAL

This work shall consist of furnishing and placing asphalt concrete as shown on the Contract plans and as specified in this section.

Unless otherwise specified in the Contract plans or in the special provisions asphalt concrete shall be as follows:

Base Course: Type I, $\frac{3}{4}$ inch maximum sized aggregate, AR4000 asphalt

Surface Course: Type II, $\frac{1}{2}$ inch maximum sized aggregate, AR4000 asphalt

AC Dikes: Type III, $\frac{3}{8}$ inch maximum sized aggregate, AR8000 asphalt

10.02 ASPHALT BINDER

Asphalt binder shall be steam-refined paving asphalt conforming to the following requirements:

Mix Type	Maximum Aggregate Size	Range of Percentage of Asphalt
I	$\frac{3}{4}$ inch	4.5 – 6.0
II	$\frac{1}{2}$ inch	5.0 – 7.0
III	$\frac{3}{8}$ inch	Per Engineer's Approval

The percentage of asphalt to be used shall be determined through a complete asphalt concrete mix design performed on the materials intended for use on this project based on CA Test No. 367. The allowable tolerance in percentage of asphalt content from that percentage specified by the Engineer shall be plus or minus 0.3 percent.

TABLE 10.1 TEST REQUIREMENT FOR VISCOSITY

Character	Requirement (AR4000)	Requirement (AR8000)	AASHTO Test Method
Test on Residue from RTFC Procedure (CA346) ⁽¹⁾			
Absolute Viscosity @ 60° C, pascal sec.(x 10 ⁻¹)	3,000-5,000	6,000-10,000	T-202
Kinematic Viscosity @ 135° C, m ² /sec. x 10 ⁻⁶)	275 min	400 min	T-201
Penetration, @ 25° C, 100g/5sec.	25 min	20 min	T-49
% of Original Penetration, @ 25° C ⁽²⁾	45 min	50 min	---
Ductility, @ 25° C, mm	750 min	750 min	T-51
Test on Original Asphalt			
Flash Point. CL.O.C. °C	225 min	232 min	T-48
Solubility in Trichloroethylene, %	99 min	99 min	T-44

1. TFO (AASHTO Test Method T179) maybe used but the RTFC shall be the referee method.

2. Original penetration as well as penetration after the RTFC loss will be determined by AASTHO Test Method T49.

Asphalt shall not be heated during the manufacturing process or during construction so as to cause distress, as evidenced by the formation of carbonized particles.

No change affecting the asphalt shall be made in either the source of crude stock or the method of manufacture without notifying the Engineer of the proposed change and obtaining the Engineer's approval.

10.03 AGGREGATES

Aggregate shall be of medium gradation. Aggregate furnished for the asphalt concrete shall be hard, sound, and durable aggregate of uniform quality that is free from vegetable and organic matter and other deleterious substances. The aggregate shall conform to the following requirements:

Sieve Size	Percentage Passing Sieve		
	Type I ¾ inch max.	Type II ½ inch max.	Type III 3/8 inch
1 inch	100	---	---
¾ inch	95-100	100	---
½ inch	85-100	95-100	100
3/8 inch	65-85	80-95	90-100
No. 4	45-65	50-75	As Approved
No. 8	30-50	35-60	As Approved
No. 30	15-30	20-35	0-15

10.04 TEMPERATURE

The temperature of the mixture shall not be lower than 250° F or higher than 325° F at the time of delivery to the project site.

Asphalt concrete shall not be placed when the atmospheric temperature is below 50° F, or during unsuitable weather.

10.05 PLACEMENT

A surface course of asphalt concrete consisting of a mixture of aggregate and asphalt that has been mixed at a central mixing plant shall be spread and compacted on the prepared subgrade to the specified thickness.

The Contractor shall protect all building foundations, planters, screens, etc., from splash, roller scrape, or over spray.

Vegetation between the edge of pavement and gutter lip shall be removed and the area treated with an approved weed killer.

Any surface to be overlaid shall be cleaned by sweeping, flushing or other means to remove all loose particles of paving, all dirt, and all other extraneous material. Pavements impregnated with grease, oil, or fuel shall be thoroughly scrubbed and then flushed and swept clean.

The asphalt concrete shall be placed in a compacted thickness as indicated on the Contract plans. If the pavement is constructed in lifts using an asphalt concrete base in the first lift, the base shall be thoroughly cleaned prior to the application of the tack coat and the placement of the surface layer.

Initial rolling shall be performed when the sum of the air temperature and the temperature of the asphalt concrete is between 300° F and 375° F.

Finish rolling shall be started after the pavement has cooled sufficiently to permit removal of the roller marks. The finish rolling shall be performed in the direction necessary to produce a pavement surface that is free of indentations.

Asphalt density is to be measured through the use of a nuclear density gauge or by core testing. The nuclear gauge is preferred since results can be determined at the time of paving.

Asphalt concrete shall be compacted to a relative compaction of at least 95 percent and shall be finished to the lines, grades, and cross sections shown on the Contract plans.

Relative compaction shall be determined by CA Test 375. Laboratory specimens shall be compacted in conformance with CA Test 304. Lots shall be established for asphalt concrete areas to be tested as specified in CA Test 375.

If the test results for any lot of asphalt concrete indicate that the relative compaction is below 95.0 percent, but above 92.9 percent the Contractor shall promptly adjust the construction materials and/or methods of installation so as to attain the required relative compaction. Asphalt concrete paving operations shall not continue until the Engineer has reviewed and approved the Contractor's proposed adjustments.

If the test results for any lot of asphalt concrete indicate that the relative compaction is less than 93.0 percent the asphalt concrete represented by that lot shall be removed and replaced or deducted from contract payments at the discretion of the City. Asphalt concrete paving operations shall not continue until the Contractor makes any adjustment to the materials and/or procedures necessary to meet the required compaction. The proposed adjustments shall be reviewed and approved by the Engineer.

Areas inaccessible to spreading and compaction equipment may be placed and compacted by procedures approved by the Engineer. Relative density requirements may be reduced to 90 percent in these areas provided that the areas are not subject to vehicular traffic. Any compaction that is less than 90 percent shall be cause for rejection.

The pavement surface, when completed, shall be smooth, dense and of uniform texture and appearance. All areas shall drain and shall be free of standing water. The compacted thickness shall not be less than 0.02 feet of that shown on the Contract plans

Asphalt Concrete shall be placed in the number of layers and thickness as indicated below:

Total thickness shown on plans	No. of layers	Requirements
Less than 0.25 feet	1	
0.25 feet to 0.50 feet	2	Both layers 0.12 feet min., 0.25 feet max.
Greater than 0.50 feet	3 (min.)	Top layer 0.15 feet min., 0.25 feet max. all other layers 0.35 feet max.

Asphalt concrete shall not be placed over another layer until the temperature of the underlying layer is 160° F unless otherwise approved by the Engineer.

Longitudinal joints in the top layer shall correspond with the final lane lines or edges of traffic lanes. Longitudinal joints in underlying layers shall not be offset from the nearest joint in the top layer by more than six inches.

10.06 TOLERANCES

The asphalt concrete shall be evenly spread to a depth that yields, after rolling, the specified cross section and grade of the course being constructed. Upon completion, the pavement shall be true to grade and cross section. The surface shall be planar and shall not vary more than 1/8 inch from the plane except at intersections and at changes of grade. Areas that are not within this tolerance shall be brought to grade immediately following the initial rolling. However, if the paving material has been cooled below the lower limits of the spreading temperatures specified, the surface of the pavement shall be brought to a true grade and cross sectioned by removing the paving material and providing a layer of new pavement with a minimum depth of one inch. Repairs shall not be made to pavement surfaces by feather edging at the joining. The cost of this work shall be at the Contractor's expense.

10.07 REJECTION OF DEFECTIVE PAVING AND CORRECTIVE MEASURES

Failure to meet any test requirement (including compaction requirements), surface irregularities, and separation of fines from aggregates shall be cause for rejection. At the discretion of the Engineer the Contractor may be allowed to:

1. Attempt to correct surface defects by such measures as fog sealing or slurry sealing.
2. Attempt other corrective measures, as approved by the Engineer, that will not affect the quality or integrity of the asphalt concrete in place.
3. Place an additional layer of asphalt concrete over the defective paving.
4. Agree to a reduction in the Contract unit price for the material involved.

Such measures if allowed by the Engineer shall be solely at the Contractor's risk and expense. Should the Contractor proceed with these measures the Contractor agrees that the Engineer is not obligated to accept the work.

Should the asphalt concrete paving not be corrected to the satisfaction of the City, the asphalt shall be removed and replaced at no expense to the City.

SPECIAL QUALITY CONTROL PROVISIONS

Core samples of the installed asphalt concrete will be taken at the discretion of the Engineer. The samples shall be tested for percent air voids per Standard Test D3203-94. Test results of samples from the same lot or project location shall be averaged. An averaged air void value over 8 percent by volume shall result in the rejection of the subject lot. The asphalt concrete represented by that lot shall be removed and replaced, or the quantity shall be deducted from the contract payment. Average air void values between 7 percent and 8 percent by volume shall result in a

reduction in payment for the asphalt concrete represented by that lot. The reduction in payment shall be as follows:

Percent Air Voids in Asphalt Concrete	Payment as a Percent of the Original Bid Item
7 percent or less	100 percent
7.01 percent to 7.2 percent	97 percent
7.21 percent to 7.4 percent	94 percent
7.41 percent to 7.6 percent	91 percent
7.61 percent to 7.8 percent	88 percent
7.81 percent to 8.0 percent	85 percent
More than 8.0 percent	Work rejected

These Special Quality Control Provisions shall be in addition to all other requirements and specifications and shall not be construed to substitute, replace, or void any other provisions within the contract.

10.08 CERTIFICATES OF COMPLIANCE

At least two (2) weeks prior to the start of work the Contractor shall submit to the Engineer a complete asphalt concrete mix design together with a list of material sources and Certificates of Compliance indicating that that materials to be incorporated in the work fulfill the requirements of these specifications. The material supplier or representative shall sign the Certificates of Compliance. The Engineer may permit the use of paving materials, aggregate, cement, lime, anti-strip agents, asphalt or any combination thereof prior to sampling and testing when accompanied by a Certificate of Compliance.

10.09 EQUIPMENT

All equipment used shall be in good working condition and shall be capable of performing the work in a safe and satisfactory manner.

Asphalt concrete surfacing shall be placed with a self-propelled (vibrator type) asphalt paving machine, except where inaccessibility precludes its use. When approved by the Engineer, surfacing may be spread by means of a spreader box and, where necessary, by hand.

Self-propelled compacting rollers shall comply with the applicable requirements of the State Standard Specifications.

10.10 PRIME COAT

The prime coat shall be liquid asphalt grade MC-70 in conformance with §93 of the State Standard Specifications and as specified in this section. A prime coat shall be applied to the

finish surface of aggregate base at a rate of 0.25 gallons per square yard prior to asphalt concrete pavement construction.

10.11 TACK COAT

The tack coat shall be asphalt grade RS-1 or SS-1 in accordance with §94 of the State Standard Specifications and as specified in this section.

A tack coat shall be applied, at the rate of 0.02 gallons per square yard to 0.10 gallons per square yard, to all vertical surfaces abutting the asphalt concrete paving and to all surfaces upon which asphalt concrete overlay or resurfacing is to be constructed. The rate shall be as approved by the Engineer and shall provide a thorough coating of the area to receive asphalt concrete leveling course. The tack coat shall be applied to surfaces that are clean and free of loose and foreign material.

10.12 MEASUREMENT

Asphalt concrete shall be measured by the ton. Measurement by the ton will be based on certified weigh-meters, certificates showing gross, tare and net weight, and plant source and the type and grading of the mix for each load.

No measurement shall be made, regardless of acceptance of certifications, for any surfacing that does not meet requirements, that is not placed within the limits of the work, or that is rejected for any reason. Certificates must be given to the City at the time of delivery of the asphalt concrete; certificates will not be accepted after that time.

No payment for asphalt quantities exceeding five percent of the contract bid quantity amount plus quantities added by contract change orders will be made; the excess material shall be at no additional expense to the City.

10.13 PAYMENT

Payment shall be at the Contract unit price bid. The price and payment shall be full compensation for the work completed in accordance with the Contract plans and specifications, including all labor, materials, equipment, compacting, prime coat, and tack coat and incidentals and no additional compensation shall be made.

SECTION 11

BITUMINOUS SEAL COATS

11.01 GENERAL

11.01.1 General

The work shall consist of mixing asphalt emulsion, aggregate, set control additives, granulated reclaimed rubber and water and spreading the mixture on a surfacing or pavement where shown on the plans, as specified in the Contact special provisions, as specified in this section, or as directed by the Engineer.

The Contractor shall execute all work in a safe, orderly and expeditious manner and shall exercise care and consideration to minimize inconvenience to residents and businesses of the project areas relative to parking of vehicles, access to properties and the movement of vehicles and persons through the work areas. General clean-up and debris removal shall be completed before surface preparation and paving work.

11.01.2 Notifications and Parking Restrictions

The Contractor shall notify neighborhoods and individuals as necessary to remove and clear parked vehicles from the work area. A notification shall be placed at each residence or business and on each parked car not less than thirty-six (36) hours prior to paving operations. The notification shall be reviewed and approved by the Engineer prior to issuance.

11.01.3 Work Phasing Schedule and Traffic Control Plan

The Contractor shall submit a Work Phasing Schedule and a Traffic Control Plan to the Engineer for approval a minimum of ten (10) working days prior to the application of any bituminous seal coat.

11.01.4 Weather Limitations

The bituminous seal coat shall be applied only when the existing surface is clean and free of visible moisture. The slurry seal shall be applied only when the pavement is 50° F or greater and the atmospheric temperature is at least 60° F and rising. The slurry seal shall not be applied on any day when rain is forecast.

11.01.5 Trial Application

Prior to the start of work the Contractor shall place a test section of at least 60 square yards in an area designated by the Engineer. The test section shall be placed using the same equipment and methods as will be used on the job. The Contractor shall furnish the Engineer with a calibration

sheet for each mixing machine used to lay the test section. The slurry mixture placed in the test section shall conform to the job mix. Work shall not commence without the Engineer's approval of the test section.

11.01.6 Pre-Inspection

The bituminous seal coat shall not be applied until an inspection of the surface has been made by the Engineer and the Engineer has determined the surface is suitable for bituminous seal coat application.

11.01.7 Protection and Restoration of Pavement Delineators, Markings and Striping

Immediately prior to applying the bituminous slurry seal or cape seal, all pavement delineators, markers and striping not designated to be replaced or abandoned by the Contract plans shall be protected. Upon completion of the slurry seal or cape seal, the pavement delineators, markers and striping shall be cleaned to the satisfaction of the Engineer.

The Contractor, in lieu of protecting existing pavement delineators and markings, or when required by the Contract plans and special provisions, may remove and replace all pavement delineators and markings and striping in kind, or with those as shown on the Contract plans. Unless provided for otherwise in the bid proposal, replacement of existing pavement delineators, markings and striping shall be at no additional expense to the City. All delineators, markings and striping, not specifically shown on the Contract plans or special provisions to be replaced or abandoned, but damaged by the Contractor's operations, shall be replaced at no expense to the City.

All pavement shall be vacuum swept before placing pavement delineators, markings or striping.

11.01.8 Surface Preparation

Preparatory repair work shall be completed prior to application of the bituminous seal coat. Repairs shall be performed when the weather will not damage the quality of the finished product. Asphalt concrete patches shall be set a minimum of twenty-four (24) hours before the bituminous seal coat is applied.

Vegetation within the area to be sealed shall be removed.

The surface shall be cleaned by vacuum sweeping, flushing or other means to remove all loose particles of paving, dirt, and other extraneous material. Pavements impregnated with grease, oil, or fuel shall be thoroughly scrubbed with water and an approved detergent and then flushed and swept clean. All environmental regulations shall be adhered to during the surface preparation operations. The Contractor shall protect the storm drain system and the Bay from pollutants caused by his operations.

11.01.9 Survey Monuments, Utility and Manhole Frames and Covers

The Contractor shall locate, protect and reference all manholes, valve covers, and survey monuments prior to construction. All utility covers shall be protected with butcher paper and a thin layer of 30-mesh sand before applying the bituminous seal coat.

For double cape seals the Contractor shall adjust all monument boxes and City-owned manhole covers to finished grade. Manholes, meters and valve covers not owned by the City shall be adjusted to grade by the utility owner involved and at the utility company's expense. It shall be the responsibility of the Contractor to notify the utility companies and to coordinate the work.

All manholes, survey monuments and water valve covers shall be thoroughly cleaned of any construction debris or markings resulting from the Contractor's operations.

11.01.10 Protection from Traffic

Where necessary to provide vehicular or pedestrian crossings over the fresh seal coat, the Engineer shall direct the spreading of sufficient sand to eliminate tracking or damage to the slurry mixture. Otherwise the Contractor shall provide barricades and flagmen to keep traffic off the fresh seal coat until it can accommodate vehicular traffic without damage.

11.02 SLURRY SEAL

11.02.1 General

Unless provided for otherwise in the Contract special provisions, Slurry Seal shall be Type III conforming to the specifications contained in this section.

A bituminous seal coat shall be applied at all locations designated on the Contract plans. All incidental work, such as surfacing returns, shall be done concurrent with the surfacing of the street.

The Slurry Seal shall consist of a mixture of emulsified asphalt, mineral aggregate and water, properly proportioned, mixed and spread evenly on the surface of the existing pavement. The cured slurry shall have a homogenous, asphalt-like appearance, fill all cracks, adhere firmly to the surface and have a skid-resistant texture.

11.02.2 Materials

A. General

Emulsion-aggregate slurry shall be a stable mixture of emulsified asphalt, mineral aggregate and water. It is intended for surface sealing of bituminous seal coat pavements. The slurry seal materials shall meet the quality requirements in the Table 11.1.

TABLE 11.1 – SLURRY SEAL QUALITY REQUIREMENTS

Component/Quality	Type I	Type II	Type III
Sand Equivalent per CA Test 217	45 minimum	55 minimum	60 minimum
Durability Index per CA Test 229	55 minimum	55 minimum	55 minimum
Aggregate Wear @ 100 revolutions per ASTM C131	12 percent maximum	12 percent maximum	12 percent maximum
Aggregate Wear @ 500 revolutions per ASTM C131	35 percent maximum	35 percent maximum	35 percent maximum
Film Striping per CA 302	25 maximum	25 maximum	25 maximum
Cleanness Value per CA 227	80 minimum	80 minimum	80 minimum

The amount of emulsified asphalt shall be determined by wet track abrasion test results and by trial laboratory mixes in accordance with ASTM D 3910. The aggregate fractions and mineral filler shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula below. The combined aggregate and filler shall be graded smoothly and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

B. Job Mix Formula (JMF)

At least fourteen (14) days prior to the placement of the slurry seal, the Contractor shall furnish the Engineer with a Job Mix Formula (JMF). The JMF must represent materials that have been used within the previous six (6) months. The JMF shall indicate the:

1. Type and quantity of asphalt emulsion.
2. Quantity and type of chemical additive or diluent.
3. Residual asphalt content and the water content.
4. Aggregate type and gradation.
5. Type and quantity of mineral filler.
6. Rate of application.
7. Abrasion loss aggregate from the wet track abrasion test.
8. Results of the consistency test.
9. Set time and cure time in accordance with ASTM D3910.
10. Temperature-viscosity relationship of the asphalt cement.

When requested by the Engineer, samples of materials to be used on the job shall be submitted to the City.

The proposed slurry seal mixture shall conform to the requirements specified when tested in accordance with the tests present in Table 11.2.

TABLE 11.2 – SLURRY SEAL TESTS

Test	ISSA Test Number	Requirement
Slurry seal consistency	T106	30 minimum
Wet stripping	T114	Pass
Compatibility ⁽¹⁾	T115	Pass
Cohesion ⁽²⁾ kg-mm with one hour	T139	200 minimum
Wet track abrasion, g/m ²	T100	800 maximum

- (1) Based on expected site temperature.
- (2) Using project source aggregate and asphalt emulsion and set control agents.

The laboratory that performed the test and mix design shall sign the original laboratory report. The report, at a minimum, shall show the results of the tests on individual materials and shall compare the test results to those required by the specifications. The report shall show the minimum and maximum proportions of aggregate, filler, water, asphalt solids content (based on the dry weight of aggregate) and set-control agent usage. Previous laboratory reports covering the same materials may be accepted provided they were made within the previous six (6) months.

No substitutions for the materials used in the approved mix design shall be made. The mix design may be modified with the Engineer’s approval.

C. Consistency

The slurry seal mixture shall contain the minimum amount of water necessary to obtain the required consistency. When placing slurry seal on grades of 8 percent or greater, adjustments shall be made to the consistency of the mixture as warranted.

D. Water

Water shall be clear, potable, and compatible with the slurry mixture and shall be of such quality that the asphalt will not separate from the asphalt emulsion. A set control agent that will not adversely affect the slurry seal may be used.

E. Asphalt Emulsion

The emulsified asphalt shall be a quick setting type, Grade CQS1h cationic or Grade QS1h anionic, conforming to the requirements set forth in Table 11.3.

TABLE 11.3 – ASPHALT EMULSION REQUIREMENTS

Tests	ASTM Test	Requirements	
		Minimum	Maximum
Furol Viscosity @ 77° F second	D244	15	100
Residue from Distillation, % by weight	D244	60 minimum	
Sieve Test, percent retained on No. 20		0.10 maximum	
Particle Charge Test (cationic)	D244	Positive	
Particle Charge Test (anionic)	D244	Negative	
Storage Stability, One-Day Settlement	D244	1 percent maximum	
Residue: Penetration 0.1 mm	D5	45	80
Residue: Solubility in TCE, %	D2042	97.5 minimum	
Residue: Ductility, 77° F, cm.	D113	40 minimum	

F. Aggregate

The mineral aggregate shall consist of rock dust and plaster sand or other sands of similar nature, except that 100 percent of any aggregate or combination of aggregates larger than the 300µm sieve size used in the mixture shall be obtained by crushing rock. Smooth-textured sand of less than 1.25 percent water absorption shall not exceed 50 percent of the total combined aggregate. The aggregate shall be clean and free from dirt, vegetable matter and other deleterious substances. Aggregate shall be free of caked lumps and oversized particles.

Mineral fillers such as portland cement, limestone dust, and aluminum sulfate fly ash shall be considered as part of the blended aggregate and shall be used in the minimum required amounts. Mineral fillers shall only be used, if needed, to improve the workability of the mix.

G. Gradation of Aggregate

The combined mineral aggregated shall conform to the following gradation:

Sieve Size	Percent Passing (per CA Test 202)		
	Type I	Type II	Type III
3/8 inch	---	100	100
No. 4	100	90-100	70-90
No. 8	90-100	65-90	45-70
No. 16	60-90	45-70	28-50
No. 30	40-65	30-50	19-34
No. 50	10-20	18-36	5-15
No. 100	---	10-24	---
No. 200	---	5-15	---

Note: When the specific gravity between blends of different aggregates exceeds a difference of 0.02, CA Test 202 shall be modified by CA Test 105.

G. Accelerator or Retardant

The retardant shall be of the type stated in the job mix formula and approved by the Engineer. The amount of accelerator in the mixture shall be the amount necessary to ensure that the applied slurry can support vehicular traffic within four (4) hours after the last application.

H. Proportioning

Aggregate, asphalt emulsion, water and additives, including set-control agents, shall be proportioned by volume utilizing the mix design approved by the Engineer. If more than one kind of aggregate is used, the correct amount of each kind of aggregate used to produce the required gradation shall be proportioned separately, prior to adding the other materials of the mixture, in a manner that will result in a uniform and homogeneous blend.

The completed mixture, after addition of water and any set-control agent, shall be such that the Slurry Seal mixture has proper workability and will:

1. Permit traffic, not controlled with pilot cars, on the slurry seal within four (4) hours after placement without the occurrence of bleeding, raveling, separation or other distress.
2. Prevent development of bleeding, raveling, separation or other distress with fifteen (15) days after placing the slurry seal.

Asphalt emulsion shall be added at a rate within the following ranges or percent by weight of dry aggregate.

Slurry Seal Type	Range
I	15 - 20 percent
II	12-18 percent
III	10 – 15 percent

11.02.3 Equipment

A. General

Only equipment conforming to these specifications shall be used in performance of the work. All equipment shall be maintained in safe and satisfactory working condition at all times. The slurry seal shall be mixed in continuous pug-mill mixers of adequate size and power for the type of slurry seal to be placed.

B. After-Spreader Trucks

Mixer-spreader trucks shall be equipped to proportion emulsion, water, aggregate, and set-control additives by volume. All rotation and reciprocating equipment on mixer-spreader trucks shall be covered with metal guards. The mixer-spreader truck shall not be operated unless all low-flow and no-flow warning devices and revolution counters are in good working condition and functioning and all metal guards are in place. The mixer-spreader truck shall be equipped with appropriate indicators that are visible while walking along the side of the truck.

C. Aggregate Feeder

Aggregate feeders shall be connected directly to the drive on the emulsion pump. The drive shaft of the aggregate feeder shall be equipped with a revolution counter reading to the nearest full revolution of the aggregate delivery belt.

D. Spreader Box

The slurry mixture shall be uniformly spread by means of a controlled spreader box conforming to the following requirements:

1. The spreader shall be capable of spreading a traffic lane width and shall have strips of flexible rubber belting or similar material on each side of the spreader box and in contact with the pavement to prevent the loss of slurry from the box.
2. Spreader boxes over 7 feet 6 inches in width shall have baffles, reversible motor driven augers, or other suitable means to ensure uniform application of the seal on super-elevated sections and on shoulder slopes.
3. Spreader box skids shall be maintained in such manner as to prevent chatter (wash boarding) in the finish product.

4. Rear flexible strike-off blades shall make close contact with the pavement and shall be capable of being adjusted to the various crown shapes so as to apply a uniform slurry seal.
5. Flexible drags shall be attached to the rear of the spreader-box when necessary.

All drags and strike-off blades shall be cleaned or changed as necessary to prevent problems with cleanliness and longitudinal scour. The spreader box shall be clean and free of all slurry seal and emulsion at the start of each day.

E. Cleaning Equipment

Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old pavement.

F. Hand Tools

Hand squeegees, shovels, hand burlap drags, and other equipment shall be available for those areas inaccessible to the spreader box.

11.02.4 Application

A. General

The amount of asphalt emulsion, aggregate, and water shall be proportioned according to the approved job mix formula and as specified in this section.

B. Mixing

The mixing of the slurry shall be sufficient to produce a uniform mixture of the desired consistency in accordance with the job mix formula. Under no circumstances shall the emulsion content be changed to control the consistency of the mix. If breaking, hardening, segregation, balling, or lumping occurs during the mixing process, the batch shall be discarded. All aggregate particles shall be uniformly coated with asphalt.

C. Application

The surface shall be fogged with an SS or CSS grade asphalt emulsion paint binder directly preceding the spreader. The emulsion shall be one (1) part asphalt to two (2) parts water and applied at a rate of 0.03 gallons per square yard to 0.05 gallons per square yard.

The slurry mixture of the required consistency shall be uniformly spread on the existing surfacing within the specified application rate, without segregation, spotting, streaking, excessive build-up, solidification of the asphalt, balling or lumping of the aggregates, unsightly appearance, unsightly

joints, re-handling, or shifting of the mixture. Any material not meeting these requirements, or the presence of uncoated aggregates, shall be cause for rejection of the slurry seal.

Slurry seal shall be spread at a rate, measured in pounds of dry aggregate per square yard, within the following ranges for the type of slurry seal specified.

Slurry Seal Type	Range
I	8 – 12
II	10 – 15
II	20 – 25

Unless approved otherwise by the Engineer, longitudinal joints shall correspond with the edges of existing traffic lanes.

Asphalt impregnated building paper shall be placed at transverse joints and over previously placed slurry seal to avoid double placement of the slurry seal.

The Contractor shall prevent slurry from being deposited on other surfaces. Slurry on surfaces not designated to be sealed shall be removed to the satisfaction of the Engineer at the Contractor's expense.

Hand squeegees may be used to spread slurry in areas inaccessible to the slurry spreader. Care shall be exercised to leave no unsightly appearance from the handwork. Burlap drags, or other suitable means, to even the surface and leave a rough texture of slurry applications shall be used as necessary.

Where the completed slurry is not uniform in color, the areas affected shall be treated to eliminate the color variation at the Contractor's expense. The method of treatment shall be as approved by the Engineer. At the direction of the Engineer and at the Contractor's expense, the Contractor shall repair and reseal all areas that have not been properly sealed or completely sealed.

11.03 ASPHALT-RUBBER CAPE SEAL

11.03.1 General

This section covers various processes for incorporation of reclaimed rubber into a bituminous seal coat. The method utilizes whole scrap tire rubber or similar rubber products. The work to be accomplished under these specifications includes the equipment, personnel, materials, and skills required to place an asphalt-rubber bituminous cape seal onto an existing asphalt concrete pavement.

As referenced in these specifications, the term "cape seal" is defined as the application of an asphalt-rubber chip seal. Similarly, "double cape seal" is defined as the application of two

consecutive asphalt-rubber chip seals. The use of "GRR" refers to "Granulated Reclaimed Rubber".

11.03.2 Materials

A. General

Only materials conforming to these specifications shall be incorporated in the work. Materials shall not be contaminated and shall be undamaged. Materials shall be unloaded and stored with a minimum of handling. Aggregates shall be stored to protect them from contamination and segregation. The Engineer must approve all storage sites.

B. Job Mix Formula (JMF)

The Contractor shall furnish the Engineer with a Job Mix Formula (JMF) for the cape seal. The JMF prepared by the Contractor must represent materials that have been used within the previous six (6) months. The JMF shall be submitted no later than two (2) weeks prior to the commencement of work. The JMF shall indicate the:

1. Source, type and percentage of asphalt emulsion by total weight of asphalt-rubber mixture.
2. Source, quantity and type of chemical additives.
3. Source grade and percentage of diluent allowable by volume of asphalt-rubber mixture.
4. Aggregate source, type, gradation, and results of aggregate stripping characteristic tests.
5. Type and quantity of mineral filler.
6. Source of the GRR.
7. Percentage of GRR by total weight of the asphalt-rubber blend.
8. Rate of application.
9. Abrasion loss aggregate from the wet track abrasion test.
10. Results of consistency test.
11. Set time and cure time in accordance with ASTM D3910.
12. Temperature-viscosity relationship of the asphalt cement.

When requested by the Engineer, samples of materials to be used on the job shall be submitted to the City. If granulated reclaimed rubber from more than one source is utilized, the above information will be required for each source.

No substitutions for the materials in the approved JMF shall be made without testing and approval of the revised JMF by the Engineer.

The Contractor shall submit certified test reports stating that the asphalt, rubber and aggregates are in compliance with these specification.

The JMF submittal shall be accompanied by Certificates of Compliance indicating that the materials incorporated in the work fulfill the requirements of these specifications. The material supplier or representative shall sign the Certificates of Compliance.

C. Asphalt

The grade of asphalt cement of the asphalt-rubber mixture shall be AR-4000 and shall comply with the requirements of ASTM D 3381.

If laboratory testing so indicates, an approved anti-stripping additive may be added to the asphalt cement up to 1.0 percent by weight of asphalt.

D. Granulated Reclaimed Rubber (GRR)

The granulated reclaimed rubber used shall be produced primarily from the processing of automobile and truck tires generated within the State of California. Steel and fiber separation may employ any method. Cryogenic separation shall be performed separately from, and prior to, grinding or granulating. The GRR shall be produced by ambient temperature grinding processes only.

The gradation of the GRR, when tested in accordance with ASTM C 136 and using a 50 gram sample (plus or minus 1 gram) shall meet the following requirements:

Sieve Size	Percent Passing
No. 8	100
No. 10	95 - 100
No. 16	40 - 60
No. 30	0 - 20
No. 50	0 -10
No. 100	---
No. 200	0 -5

The use of rubber from multiple sources is acceptable provided that the overall blend of rubber meets the gradation requirements. In addition to the above gradation requirements, the GRR shall meet the following specifications: The individual GRR particles, irrespective of diameter, shall not be greater in length than ¼ inch.

Specification	Percent by Dry Weight
Wires and other contaminants, dry weight of GRR	0.10
Fabric	0.50
Wire and fabric when GRR is used in spray applications	0.10
Use of calcium carbonate or talc to prevent sticking	4.0

GRR for use in spray applications may be produced all or in part from tire tread buffings in order to meet the maximum fabric requirements.

The GRR shall have a specific gravity of 1.05 to 1.15 and shall be free of loose fabric, wire and other contaminants. The rubber shall be sufficiently dry so as to be free flowing and not produce foam when blended with the hot asphalt cement.

The whole scrap tire GRR shall conform to the following chemical analysis and additional specifications:

Characteristic Test	ASTM Test Method	Minimum	Maximum
Acetone Extract	D297	11.0 %	19.0 %
Ash Content	D297	---	8.0 %
Carbon Black Content	D297	28.0 %	38.8 %
Rubber Hydrocarbon	D297	42.0 %	52.0 %
Natural Rubber Content	D297	16.0 %	34.0 %
Specific Gravity	D297	1.1	1.2

E. Diluent

Diluent shall not be added to the first asphalt-rubber lift of the double cape seal.

The diluent shall have the following properties:

Flash Point	130° F minimum
Initial Boiling Point (per ATSM D86)	340° F minimum
Dry Point (per ASTM D86)	390° F – 415° F
Total Saturates	85 percent minimum

F. Polymer

For the second asphalt-rubber lift of a double cape seal, a granulated polymer modifier shall be added with the rubber to the asphalt. The type of polymer shall be approved by the Engineer and shall replace 2 percent to 3 percent, by weight, of the rubber in the asphalt-rubber mixture.

G. Screened Aggregate

The cover material shall be crushed stone, crushed gravel, or both, and shall consist of clean, sound, durable particles, free of soft or disintegrated fragments and foreign matter. At least 90 percent by weight of the screenings shall consist of crushed particles as determined by CA Test

Method 205, and at least 90 percent by weight of the particles shall have at least two fractured faces.

Screened aggregate shall be of such nature that a thorough coat of the bituminous material used in the work will not strip off upon contact with water. The moisture content of the aggregate shall be such that the aggregate will be readily coated with the bituminous material. Drying may be required.

The cover material shall be pre-coated, one-quarter (0.25) percent to three-quarters (0.75) percent with AR-4000 paving grade asphalt at a temperatures between 300° F and 375° F.

Maximum aggregate size for the cape seal shall conform to the following gradation:

Sieve Size	Percentage Passing	
	3/8 inch First Lift	1/2 inch Second Lift
5/8 inch	---	100
1/2 inch	100	95 – 100
1/8 inch	90 - 100	0 – 40
No. 4	5 - 30	0 – 15
No. 8	0 - 10	0 – 2
No. 16	0 - 5	---
No. 30	---	---
No. 200	0 - 1	0 – 1

Aggregate screenings shall also conform to the following requirements:

Test	Results
Loss in L.A. Rattler as per ASTM C131 (after 100 revolutions)	10% maximum
Loss in L.A. Rattler as per ASTM C131 (after 500 revolutions)	40% maximum
Film Stripping as per CA Test Method 302	25% maximum
Clearness Value as per CA Test Method 227	75 minimum

11.03.3 Equipment

A. General

Only equipment conforming to these specifications shall be incorporated in the work. All equipment shall be maintained in safe and satisfactory working conditions at all times. The Engineer may order the discontinuance of the use of any equipment that fails to produce a satisfactory distribution of asphalt-rubber.

The equipment used by the Contractor shall include a self-propelled rotary power broom or mobile pickup broom for pavement cleaning and excess cover material removal.

B. Asphalt-Rubber Equipment

All equipment utilized in the production and application of the asphalt-rubber shall be as follows:

1. Heating Tank

An asphalt heating tank with a hot oil heat transfer system or retort heating system capable of heating asphalt to the necessary temperature for blending with the granulated reclaimed rubber. This unit shall be capable of heating a minimum of 2,500 gallons of asphalt.

2. Blender

An asphalt-rubber mechanical blender with a two-stage continuous mixing process capable of producing a homogenous mixture of asphalt and granulated rubber ratios specified in the job mix formula. The unit shall be equipped with:

- a. A GRR feed system capable of supplying the asphalt cement feed system so as not to interrupt the continuity of the blending process.
- b. An asphalt feed pump.
- c. A finished product pump.
- d. An asphalt volume meter that measures volume in gallons.
- e. A flow rate meter that measures rates in gallons per minute.

C. Reaction Storage Tank

The asphalt-rubber storage tank shall be equipped with a heating system to maintain a storage/reaction temperature of 425° F during the reaction period. The unit shall be capable of thoroughly agitating the mixture to achieve a uniform mixture of asphalt and the granulated reclaimed rubber.

D. Distribution Truck or Trailer

The distribution truck or trailer shall be a mounted, self-powered truck or trailer equipped with a retort heating unit capable of evenly heating the material and maintaining a temperature of 425° F. It shall also be equipped with:

1. An internal agitation or mixing device capable of maintaining a uniform mixture of asphalt and granulated reclaimed rubber.
2. A full circulating spreader bar and a pumping system capable of applying asphalt-rubber materials within a plus or minus 0.05 gallons per square yard tolerance of the specified application rate.
3. A tachometer.

4. A pressure gauge.
5. A flow meter.
6. A thermometer sampling valve.
7. A boot board on the rear of the vehicle for the bootman.

The bootman shall ride in a position so that all spray bar tips are in full view and readily accessible for unplugging if a plugged tip should occur. The tips must provide a uniform covering of the surface being treated.

E. Material Spreader

The material (chip) spreader shall be a self-propelled machine with an aggregate receiving hopper in the rear, belt conveyors to carry the aggregate in the front and a spreading hopper equipped with a full-width distribution auger and spread roll. The spreader shall be in good mechanical condition and shall be capable of applying the cover material uniformly across the spread at the specified rate.

F. Rolling Equipment

A minimum of three operational and self-propelled pneumatic-tired rollers shall be used for the required rolling of the material. The pneumatic-tired rollers shall carry a minimum loading of 3,000 pounds on each wheel and a minimum air pressure of 100 pounds per square inch in each tire.

G. Hauling Equipment

Trucks for hauling material shall be of the tailgate discharge type and shall be equipped with a device to lock onto the hitch at the rear of the material spreader. Haul trucks shall also be compatible with the aggregate spreader so that the dump bed will not push down on the spreader when fully raised. The bed must be of sufficient length so that aggregate does not spill while being placed in the hopper.

H. Slurry Mixer

The self-contained slurry unit shall be mounted on a truck or other vehicle capable of operating at evenly controlled low rates of speed throughout the operation so that the slurry is spread evenly. The slurry-mixing machine shall be a continuous flow-mixing unit, capable of accurately delivering a predetermined proportion of aggregate, water, emulsified asphalt accelerator and retardant to the mixing chamber. The mix chamber shall thoroughly blend and be capable of rapidly discharging all ingredients on a continuous basis into the spreader.

The slurry mixer shall be equipped with:

1. A fines feeder. The feeder shall provide a method to accurately introduce a predetermined proportion of mineral filler at the same time and location that the aggregate is fed into the

mixer. The fines feeder shall be used where mineral filler is added to the aggregate blend or where a dry chemical additive is used.

2. A water pressure system.
3. A fog-type spray bar. The sprayer shall be adequate for complete fogging of the surface ahead of the spreading equipment with an application rate of up to 0.05 gallons per square yard.
4. Sufficient machine storage capacity to properly mix and apply a minimum of 5 tons of slurry.

Proportioning devices shall be calibrated prior to applying the cape seal. The Contractor shall furnish the Engineer with a calibration sheet for each mixing machine prior to its use on the job.

I. Squeegee Distributor

A mechanical type, adjustable width, squeegee distributor shall be attached to the slurry mixer. The distributor shall have controls to allow adjustment for variations of pavement grades and slopes and it shall be equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor (that may result from varying grades or crowns). A lateral control device and flexible strike-off shall be provided.

The box shall be kept clean and the build-up of asphalt and aggregate on the box will not be permitted.

J. Sweeping Equipment

Only vacuum sweepers will be permitted to clean the cape seal surface.

K. Hand Tools

Hand squeegees, shovels, hand burlap drags, and other equipment shall be available for those areas inaccessible to the spreader box.

11.03.4 Application

A. General

The cape seal shall be applied as specified in this section and as may be modified by the Contract special provisions.

B. Asphalt-Rubber Mixing Reaction

The percentage of granulated rubber shall be 23 percent by weight (plus or minus 3 percent) of total asphalt-rubber mixture. The exact granulated rubber content shall be as determined by the approved job mix formula.

During placement the granulated rubber percentage shall not fluctuate by more than one (1) percent by weight of the total asphalt-rubber mixture.

The combined asphalt-rubber binder shall meet the physical parameters as specified below:

Characteristic Test	ASTM Test	Minimum	Maximum
Brookfield Viscosity at 350° F	D2669	1,500	6,000
Needle Penetration at 77° F, 110g, 5 seconds, 1/10mm	D5	25	75
Penetration at 39.2° F, 200g, 60 seconds, 1/10mm	D5	15	---
Softening Point °F	D36	130	---
Resilience at 77° F	D3407	20	---

Note: The properties specified are to be measured before the addition of any diluent.

The temperature of the asphalt shall be between 375° F and 450° F at the addition of the granulated reclaimed rubber. The asphalt and the granulated reclaimed rubber shall be combined and mixed together in an asphalt-rubber blending unit and allowed to react in the distributor for the period required that is based on laboratory testing.

The temperature of the combined materials shall be maintained between 325° F and 450° F during the mixing period. Agitation or re-circulation shall be adequate to provide good mixing and dispersion of the combined materials. Asphalt rubber may be used immediately following a full reaction.

After the reaction has occurred between the asphalt cement and the granulated reclaimed rubber, the viscosity of the hot asphalt-rubber mixture may be adjusted for spraying and/or "wetting" of the cover material by the addition of a diluent. The diluent shall comply with the requirements set forth in this section and shall not exceed 7.5 percent by volume of the hot asphalt-rubber mixture.

When an unforeseen job delay occurs after full reaction, the asphalt-rubber may be allowed to cool. The asphalt-rubber shall be reheated slowly just prior to application but not to a temperature exceeding 425° F. An additional quantity of diluent not exceeding 3 percent by volume of the hot asphalt-rubber mixture may be added after reheating. In no event shall the combined material be reheated more than three (3) times. Reheating occurs at each time the temperature of the combined material drops below 300° F and is then elevated to the required application temperature.

C. Application of Asphalt-Rubber Material

Placement of the asphalt-rubber will be permitted only under the following conditions:

1. The pavement surface temperature is 60° F and rising.
2. The pavement surface is clean and dry.
3. The wind speed is not greater than 10 knots.
4. All construction equipment, such as asphalt-rubber distributor, cover, material spreader, haul trucks with cover material, and rollers, are in position and ready to begin the asphalt-rubber placement operations.

The asphalt-rubber mixture shall be applied at a temperature of 290° F to 340° F at a rate of 0.50 gallons per square yard or at a rate necessary to completely fill all existing pavement cracks and voids.

Transverse joints shall be constructed by placing building paper across and over the end of the previous application of asphalt-rubber. Once the spraying has progressed beyond the paper the paper shall be removed and disposed of. The overlap at longitudinal joints shall not exceed four (4) inches.

The asphalt-rubber shall not be applied until sufficient screenings are on hand for immediate cover. The maximum placement width of the cape seal shall be as follows:

Residential Streets: One-half street width at a time.

Commercial Streets: One travel lane and parking strip. The remainder of the street shall be placed only after the first section has completely cured.

The asphalt-rubber shall not be spread a greater distance than can be covered within fifteen (15) minutes by aggregate screenings.

D. Spreading of Screened Aggregate

Cover aggregates shall be spread immediately and uniformly over the asphalt-rubber at a spreading rate between 30 pounds per square yard and 34 pounds per square yard.

When the asphalt-rubber cover is applied aggregates, the surface shall be dry so as to gain proper adhesion to the asphalt-rubber material.

The joint between adjacent applications of aggregate shall coincide with the line between designated traffic lanes.

Operating the aggregate-spreading equipment at speeds that could cause the chips to roll over after striking the asphalt rubber surface will not be permitted.

The transverse cut off of screenings shall be complete and any excess screenings shall be removed from the surface prior to resuming operations.

Stockpiling of aggregate prior to pre-coating is permitted. However, any contamination resulting from storage or reloading will be cause for rejection. No stockpiling of pre-coated aggregate is permitted.

E. Compacting and Finishing

After the screenings have been spread upon the asphalt-rubber, any piles, ridges, or uneven aggregate distribution shall be carefully removed before the surface is rolled to ensure against permanent ridges, bumps or depressions in the completed surface. Additional screenings shall be spread as warranted to prevent picking up by the rollers or by traffic.

At least two (2) operational pneumatic-tired rollers shall be provided to accomplish the required embedment of the aggregate.

Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the aggregate spreader and, if the spreading is stopped for an extended period, the aggregate spreader shall be moved ahead of, or off to the side, so that all aggregate may be rolled immediately. Four complete passes with rollers shall be made with all rolling completed within one hour after the application of the cover aggregate.

Sweeping of loose aggregate shall begin a minimum of one (1) hour after placement and shall be completed as soon as possible but in no event later than twenty-four (24) hours after placement. Excess screenings shall be removed and disposed of by the Contractor at the Contractor's expense.

The completed surface shall present a uniform appearance and shall be thoroughly compacted. The surface shall be free from ruts, humps, depressions, and irregularities due to an uneven distribution of asphalt-rubber or aggregate screenings.

Where a "Double Cape Seal" has been specified, the second lift shall be applied twenty-four (24) hours after the aggregate for the first lift is placed. Any loose aggregate shall be swept prior to application.

F. Set and Cure Time

Except when necessary for hauling equipment to travel on the newly applied cape seal traffic of all types shall be kept off the surface until the seal has set properly. The speed of all hauling equipment shall not exceed 15 miles per hour when traveling over a cape seal that is not adequately set. The minimum traffic-free period shall not be less than one (1) hour.

For optimum results, the asphalt-rubber chip seal (single and double applications) should be allowed to cure for a minimum of one (1) week prior to the application of an emulsified asphalt slurry seal.

11.04 TESTING BY THE CITY

At the discretion of the Engineer, samples of individual materials or composite materials to be incorporated in the work may be taken. Samples may be tested for conformance to the job mix formula and other material specifications. The Contractor will be notified within five (5) working days of the results of any tests performed.

11.05 TOLERANCES

Tolerances for individual materials, as well as the bituminous seal coat mixtures, are as follows:

1. After the designed residual point asphalt content is determined, a one percentage point (1%) variation will be permitted.
2. The percent of aggregate passing each sieve shall not vary more than 4.0 percent from the job mix formula.
3. The percent of aggregate passing shall not go from the high end to the low end of the specified range for any two successive sieves.
4. The slurry consistency shall not vary more than 0.2 inches from the job mix formula after field adjustments.
5. The average rate of application of the cape seal mixture shall not be less than the specified rate when measured for any contiguous area of 5,000 square feet. When the total theoretical volume of cape seal mixture is less than that calculated at the minimum application rate the contract price shall be reduced proportionately.

11.06 MEASUREMENT

Measurement for bituminous seal coats shall be measured by the square foot or square yard of surface completed as shown and specified to the nearest whole unit. No deduction will be made

for manhole or utility covers. No measurement will be made for bituminous seal coat placed outside the limits of work or not furnished and installed according to specifications.

11.07 PAYMENT

The contract unit price shall include full compensation for furnishing all labor, equipment materials, tools, testing, mix design, and incidentals required to construct the bituminous seal coat (slurry seal and cape seal) including mobilization, site preparation, traffic control, cleanup, posting of notices, masking and cleaning of pavement markers, adjusting and protecting utility and manhole covers, applying paint binder, and all other incidental work required to complete the work as shown and specified.

SECTION 12

HOT ASPHALT CONCRETE SURFACE RECYCLING

12.01 GENERAL

The work in this section consists of furnishing all labor, equipment and materials and performing all operations in connection with heating, scarifying, leveling, compacting, and applying a recycling agent to asphalt pavement.

Immediately prior to the heater scarifying operation, street trees and plants adjacent to the work area shall be protected from heat and flame.

12.02 CLEANING

Prior to commencing heater-scarifying operations, the pavement shall be cleaned of all loose material and vegetation. Power brooms shall be supplemented by hand brooming and such other tools as required to bring the surface to a clean, suitable condition and free of deleterious material. Failed area repairs shall be completed prior to scarifying. The Engineer will mark the location of the failed area repairs. Concrete and asphalt concrete ramps that encroach the work shall be removed as directed by the Engineer.

12.03 EQUIPMENT

The equipment used to heat and scarify asphalt surfaces shall meet state and local air pollution standards.

The combustion chamber shall be insulated and enclosed to provide sufficient heat to the pavement to achieve the specified performance. The machine shall be equipped with multiple rows of equalized scarifiers to ensure a vigorous shearing of the heated asphalt and to provide uninterrupted scarification contiguous to rigid structures. A competent operating crew shall be provided.

The equipment used to distribute and level the scarified material shall be equipped with a heated tamping or vibratory screed. The contractor may furnish another type of screed if approved by the Engineer. The machine must be capable of screeding the full width of scarified material. A competent operating crew shall be provided.

One twelve (12) ton, or greater, pneumatic-tired roller and operator shall be furnished to compact the scarified material.

One cab-controlled, liquid spreader and operator shall be furnished to distribute the asphalt-recycling agent.

12.04 CONSTRUCTION METHODS

The Contractor shall heater-scarify the street beginning at the gutter and moving toward the center of the street. A minimum of two heater units will be utilized in tandem so that the heat emitted and the rate of travel will achieve the specified requirements. The number of additional heater units shall be determined by the Contractor; however, only the scarifier rake on the final heater unit of the series shall scarify.

The existing asphalt surface shall be heated from 6 inches to 12 inches wider than the width to be processed. The temperature of the scarified material shall be a minimum of 220° F and shall not exceed 300° F when measured with a stick thermometer immediately behind the scarifier.

The weight of the existing asphalt surface should be assumed as approximately 144 pounds per cubic foot. On this basis, a minimum of 13 pounds per square foot of existing surface shall be scarified to obtain a depth of not less than 0.1 feet.

Scarification is acceptable when the moving average of three consecutive random weight tests per hour indicates that the required depth has been scarified. The weight of the existing asphalt surface will be determined in accordance with the requirements of AASHTO T-166 and from scarified material compacted in accordance with the requirements of AASHTO T-245, with the exception that the compaction temperature shall be a minimum of 260° F.

The scarified material shall be distributed and leveled only for the width processed and shall be rolled immediately while it possesses sufficient heat to be properly compacted. The specified grade of recycling agent shall be applied within 30 minutes and in no event after 4 hours following compaction. The rate of application and diluent shall be approved by the Engineer based on pre-construction laboratory analysis and adjustments for varying field conditions.

The asphalt recycling agent shall be composed of a petroleum base resin uniformly emulsified with water and shall conform to the following physical and chemical requirements:

Asphalt Recycling Agent			
Test on Emulsion		Light of Medium Grade	
Test	ASTM	Minimum	Maximum
Viscosity @ 25° C, SFS	D244-77	15	85
Residue %	D244-77 ⁽¹⁾	60	---
Cement Mixing %	D245-77	---	2.0
Sieve %	D244-77 ⁽²⁾	---	0.1
Particle Charge	D244-77	Positive	Positive

- (1) ASTM D255 Modified Evaporation Test for percent residue is made by heating a 50 grain sample to 149° C until foaming ceases, then cool immediately and calculate results.
- (2) Test procedure is identical with ATM D244 except that distilled water shall be used in place of 2% sodium create solution.

Asphalt Recycling Agent					
Test on Base Oil, Original ⁽¹⁾		Light Grade		Medium Grade	
Test	ASTM	Minimum	Maximum	Minimum	Maximum
Viscosity @ 600° C, cST	D2170-76	80	500	1,000	4,000
Flash Point, COC °C	D92.78	204	---	201	---
Saturates % ⁽²⁾	D2007-75	---	30	---	2.5
Asphalt %	D2006-70	---	1.5	---	9.0
P/S Ratio	D2006-70	0.5	---	0.5	---
Malteness Distribution Ratio (Pc+A ₂)/(S+A ₂) ⁽³⁾	D2006-70	0.2	1.0	0.2	1.2
Residue From RTF-C Oven Test@ 163° C	D2872-77	---	---	---	---
Viscosity Ratio ⁽⁴⁾	D2170-76	---	3.0	---	2.5
RTF-C Oven Wt. Change %	D2872-77	---	6.5	---	2.0

- (1) Values obtained on the emulsion's residue may vary slightly from the base oil.
- (2) ASTM D2006-70 can be used for the determination of saturates.
- (3) In the Malteness Distribution Ration Test by ASTM Method D2006-70.

Pc = Polar Compounds A₁ = First Acidaffins
A₂=Second Acidaffins S = Saturates

- (4) Viscosity Ratio = (RTC-C Viscosity @ 60° cST) / (Original Viscosity @ 60° cST)

12.05 PRE-QUALIFICATION CLAUSE

With the bid proposal the Contractor shall provide a list of five comparable size projects performed by the Contractor or subcontractor, if applicable, using the equipment and techniques specified. The list shall include the agency, name, address and telephone number of the Engineer in charge. The Contractor's failure to submit the list shall be cause for rejection of the bid.

12.06 AIR QUALITY PRESERVATION

The machine shall be operated in compliance with the standards of the Bay Area Air Quality Control District.

12.07 APPLICATION OF ASPHALT CONCRETE OVERLAY

Asphalt concrete surfacing in accordance with §10 of the Standard Specifications shall be done immediately after hot surface recycling. The Contractor shall clean the surface of the area to be paved prior to the paving operation.

12.08 MEASUREMENT

Heating, scarifying, leveling and compacting of the pavement shall be measured by the square yard or as provided for in the bid proposal.

12.09 PAYMENT

The contract unit price paid for hot surface recycling shall include full compensation for furnishing all labor, materials, tools, recycling agents and equipment, and doing all other incidental work involved in recycling the existing asphalt concrete surface as specified and no additional payment should be made.

SECTION 13

ASPHALT CONCRETE LEVELING COURSE AND CRACK FILL REPAIRS

13.01 ASPHALT CONCRETE LEVELING COURSE

13.01.1 General

An asphalt leveling course shall be placed in areas designated by the Engineer prior to placing any designated asphalt bituminous seal coat interlayer or asphalt concrete overlay.

The area to be leveled shall be cleaned, free of all loose material and a tack coat shall be applied.

13.01.2 Tack Coat

The tack coat shall be asphalt grade RS-1 or SS-1 in accordance with §94 of the State Standard Specifications. The tack coat shall be applied at the rate of 0.02 gallons per square yard to 0.10 gallons per square yard; the application rate shall be approved by the Engineer and shall provide a thorough coating of the area to receive the asphalt concrete leveling course.

13.01.3 Asphalt Concrete

The asphalt concrete leveling course shall be of such aggregate gradation to ensure a smooth conform to the existing pavement surface. The maximum size aggregate shall be ½ inch.

13.01.4 Placement

The asphalt-leveling course shall be placed in areas marked by the Engineer. The material shall be placed and compacted to ensure that a uniform cross section is achieved with the adjacent existing surface.

The in-place density of the leveling course shall not be less than that specified by §10 "Asphalt Concrete" of the Standard Specifications.

13.01.5 Measurement

The quantity of the asphalt concrete leveling course will be measured on a square foot basis or tonnage basis as indicated in the bid proposal. Final qualities for payment purposes must be agreed to by the Engineer prior to placing any subsequent bituminous seal coat, interlayer or asphalt paving.

13.01.6 Payment

The contract unit price paid for placing an asphalt concrete leveling course shall be considered as including full compensation for furnishing all labor, materials, tools, equipment, and doing all other incidental work involved in placing and compacting an asphalt concrete leveling course as indicated by the Contract plans and as approved by the Engineer, including surface preparation and the application of the tack coat.

13.02 CRACK FILL REPAIRS

13.02.1 Procedures

The work shall consist of placing asphalt concrete and/or asphalt rubber crack sealant in pavement cracks. Cracks designated to be repaired shall be cleaned to a minimum depth of $\frac{3}{4}$ inch by blast cleaning or hand methods, followed by high pressure air jets. The cleaning shall remove all vegetation, residue, moisture and foreign matter. Exposed surfaces shall be dry at the time the sealant is applied.

Crack sealing will not be required when the existing surfacing is to be covered by an asphalt membrane, rubberized cape seal, or the area is to be repaired as a Failed Area Repair.

Summary of Crack Fill Requirements				
Type of Crack	Routing Required	Tack Coat ⁽¹⁾	Sand Filler ⁽²⁾ To one inch of Grade	Type of Filler
1/8 inch or less	No Repair	No Repair	No Repair	No Repair
Greater than 1/8 inch but less than 3/8 inch	Yes, 1 inch	No	No	Sealant
Greater than 3/8 inch but less than one inch	No	No	No	Sealant
one inch or greater in width and:				
Less than 3 inches in depth	No	Yes	No	Sealant
Greater than 3 inches in depth	No	Yes	Yes	3/8 inch AC ⁽³⁾

(1) Tack coat in accordance with §11.

(2) Sand shall be plus or minus 1% saturated surface dry at the time it is placed and compacted.

(3) Asphalt concrete shall be well compacted by hand tamping and shall be flush with the adjacent pavement.

13.02.2 Asphalt Rubber Crack Sealant

The sealant shall consist of a mixture of paving grade asphalt and vulcanized granulated crumb rubber. The mixture may contain granulated reclaimed rubber. Granulated reclaimed rubber, if used, shall conform to the following requirements:

Gradation	
Sieve Size	Percent Passing
No. 8	100
No. 10	98 – 100
No. 30	---
No. 40	0 - 10

Characteristic	Requirement	
	Minimum	Maximum
Allowable GRR, %	---	25
Cone Penetration @ 77° F	---	40
Softening Point ° F	175	---
Resilience @ 77° F, %	30	---

The sealant shall be capable of being melted and applied to cracks at temperatures below 400° F. Modifiers may be used to facilitate blending. The material shall readily penetrate cracks 3/8 inch in width.

Exposed surfaces shall be dry at the time the sealant is applied.

Sealant materials shall be heated and placed in conformance with the manufacturer's instructions. Joint sealant materials shall not be placed when the pavement surface temperature is below 50° F.

Sufficient sealing material shall be placed in the cracks so that upon completion of the work the surface of the sealant in the crack shall be flush with the adjacent pavement surface. The Contractor shall "spot up " or refill to the proper elevation, at the Contractor's expense, all unsatisfactory cracks.

All cracks shall be leveled and excess crack sealant shall be removed immediately after placement. Sand shall be applied to sealed cracks as necessary to absorb excess material. Crack sealant shall be dry or the Contractor shall cover the cracks with sand prior to allowing traffic on the crack sealed road.

The finished crack sealant shall bond to the faces of the crack. There shall be no separation or opening between the sealant and the faces and there shall be no crack, separation, or other opening in the sealant. If requested by the Engineer, a Certificate of Compliance shall be submitted prior to the application of the sealant.

13.02.3 Measurement

The quantity of crack fill repair will be measured on a linear unit of measure for the type of repair, as provided for in the Contract Bid Proposal. Final qualities for payment purposes must be agreed upon by the Engineer prior to placing any subsequent bituminous seal coat, interlayer or asphalt paving.

13.02.4 Payment

The contract unit price paid for the type of crack repair shall be considered as including full compensation for all labor, tools, material, equipment, including preparation and application of the tack coat and no additional compensation shall be made.

If there is no Contract Unit Price provided for in the "Contract Bid Proposal" form, then compensation for crack repairs designated by the City shall be paid for as extra work.

SECTION 14

COLD PLANING

14.01 GENERAL

The work in this section includes the equipment, materials, and personnel to complete all operations associated with planing an existing bituminous pavement in accordance with this section.

The term "cold plane" is defined as milling the existing asphalt concrete surface to a uniform depth. Unless specified otherwise in the Contract special provisions, or shown otherwise on the Contract plans, the depth of milling shall be 0.20 feet, except adjacent to existing curbs where the depth shall be 0.10 feet at the gutter lip and tapered to 0.00 feet at the distance designated in the Contract plans as wedge grinding. If no distance has been designated by the Contract plans the distance shall be a minimum of 4 feet.

14.02 SURFACE PREPARATION

Prior to commencing work the existing pavement shall be cleaned of all loose material and all interfering pavement markers shall be removed. Power brooms shall be supplemented by hand brooms in order to bring the surface to a clean, suitable condition, free of deleterious material and acceptable to the Engineer.

14.03 EQUIPMENT

Only equipment conforming to this section shall be used and all equipment shall be maintained in safe and satisfactory conditions.

The equipment for removing the asphalt concrete pavement shall be a commercially designed and manufactured machine capable of performing the work. The machine shall be power-operated and self-propelled, and shall have sufficient power, traction and stability to remove a thickness of bituminous surface to the specified depth and to provide a uniform profile and cross slope.

The machine shall be capable of accurately and automatically establishing profile grades (within 1/8 inch) along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe, or from an independent grade line. The machine shall have an automatic system for controlling grade elevation and cross slope. The machine shall be equipped with a means to control dust generated by the cutting operation.

14.04 PLANING OPERATION

The nature and condition of the planer and the manner in which the work is performed shall be such that the pavement is not torn, gouged, shoved, broken, or otherwise. Uniform, discontinuous longitudinal striations or other uniform patterns shall characterize the surface that results from the cold planing operation.

The Contractor shall furnish one or more planing machines and an experienced operator for each machine. Work shall not begin until a means is provided for immediate removal of loose materials generated by cold planing.

Removal shall consist of planing and cutting the pavement to form a key way header cut, or full width re-grading, and removing the loosened material. If required by the Engineer, a 0.10 foot minimum header shall be cut along structures to eliminate feathering and to permit new asphalt concrete to be laid to its full thickness.

Sufficient passes or cuts shall be made so that all irregularities and high spots are eliminated.

Asphalt concrete that cannot be removed by cold planing equipment because of physical or geometrical restraints will be removed by other methods acceptable to the Engineer.

The cut surface shall be planar and shall have an elevation tolerance of less than 0.02 feet.

Before opening the milled surface to traffic, all loose material shall be removed and the surface swept clean. If the road is to remain open to traffic, both traverse and longitudinal vertical drop-offs in excess of 0.20 feet shall be tapered with cold mix asphalt concrete. Tapers shall be maintained until they are removed for permanent surface treatment.

No aggregate shall remain on the project at the end of each workday. Aggregate material loosened and designated for removal shall become the property of the Contractor and shall be disposed of off-site, or, it may be incorporated as trench backfill in compliance with other applicable provisions of the Standard Specifications.

The Contractor shall replace damaged signal detection loops. Replacement of the damaged detectors shall be at no expense to the City.

14.05 MATERIAL DISPOSAL

The Contractor shall remove and transport debris and rubbish in a manner that will prevent spillage. Clean up of any spillage shall be at the Contractor's expense. All material removed from the site shall be disposed of in accordance with the Design Standards at the Contractor's expense.

14.06 MEASUREMENT

The quantity of asphalt cold planing will be measured on a unit basis for the type of cold planing involved and as provided for in the Contract bid proposal. Final quantities for payment purposes shall be agreed to by the Engineer prior to placing any subsequent bituminous seal coat, interlayer or asphalt paving.

14.07 PAYMENT

The contact unit price for completing the type of cold planing specified, and as indicated by the Contact bid proposal, shall be full compensation for furnishing all labor, materials, equipment, tools, and incidentals to complete the work specified, including hauling of milled material, replacement of vehicle detector loops, working around existing improvements and protecting improvements from damage and no additional compensation shall be made.

If there is no unit price in the Contract bid proposal form then compensation for asphalt concrete cold planing shall be considered as included in the payment for the other various contract bid items of work and no additional compensation shall be allowed.

SECTION 15

PAVEMENT – MISCELLANEOUS

15.01 PAVEMENT GRINDING

Grinding required to perform edge and transverse pavement conforms shall be performed on all streets to be overlaid and shall be completed in conformance with §42-2 "Grinding" of the Caltrans Standard Specifications.

Grinding at curbs, gutters, valley gutters, and street intersections shall be in conformance with the Contract plans and Standard Plans. No grinding shall be performed through an intersection if the cross street is also scheduled to be overlaid.

Damage to detector loops at City-owned traffic signals shall be reported to the Engineer and repaired by the Contractor at the Contractor's expense within 24 hours of disruption of service. If the Contractor fails to repair damaged loops within the specified time the City will repair the damage at the Contractor's expense. Damage to detector loops at traffic signals owned by other agencies shall be repaired in conformance with the appropriate agency requirements.

All materials removed shall become the property of the Contractor and shall be disposed of in a legal manner. The Contractor shall be responsible for maintaining the street in a clean condition during the course of the grinding operations. All loose materials shall be removed prior to the application of the tack coat

Areas that cannot be reached with the grinding machine shall be jack-hammered or otherwise removed by hand.

Where grinding operations proceed pavement overlay operations by more than 3 calendar days and/or the grinding exceeds 2 inches, the Contractor shall place temporary asphalt concrete ramps at all grinding limits that are adjacent to the remaining asphalt pavement surfaces. Temporary asphalt concrete ramps shall be placed the same day as the grinding operation.

Temporary asphalt concrete ramps shall be a minimum of 5 feet in length, extending the entire width of the affected travel way, and shall be sufficiently compacted so as not to deform or ravel.

The Contractor shall maintain temporary asphalt concrete ramps to the satisfaction of the Engineer and shall completely remove the ramps prior to the application of the tack coat.

15.02 SAWCUTTING FOR ROADWAY WIDENING

When removing asphalt pavement in connection with roadway widening the existing asphalt pavement shall be sawcut with a power driven asphalt saw to provide a smooth joint for the new

pavement. The Contractor shall sawcut the pavement before any pavement excavation to avoid damage to the remaining pavement section.

15.03 ADJUST IRON CASTINGS TO GRADE

All iron castings shall be set to finish grade after placing the asphalt concrete. The adjustment of structures and monuments to grade shall be in conformance with § 15-2 "Miscellaneous Highway Facilities" of the Caltrans Standard Specifications and this section. Adjustment rings will not be allowed.

When streets are overlaid existing frames and covers shall be salvaged and re-used. All iron castings damaged during construction shall be replaced by the Contractor with new iron castings at the Contractor's expense. Replacement iron castings for City utility structures shall be replaced in conformance with the Standard Specifications.

Replacement iron castings for other agency utility structures shall be replaced in conformance with the appropriate agency requirements.

All water valve covers shall be exposed on the same day in which they are covered by resurfacing operations.

All maintenance hole covers shall be raised no later than 5 working days after resurfacing is placed, and shall be patch-paved with asphalt concrete within 5 working days after being raised.

Tops of frames shall be not be set above 1/8 inch above finish grade. Frames which do not meet this tolerance shall be re-adjusted by the Contractor at his own expense.

After adjusting frames the Contractor shall ensure that all covers are removable and that they seat properly. For new iron castings the new covers shall not rock.

Hand mixing of concrete for use in raising iron castings to grade will be allowed. Concrete shall be placed and thoroughly consolidated in conformance with § 90 "Portland Cement Concrete" of the Caltrans Standard Specifications.

Asphalt concrete patch paving shall be fine asphalt concrete placed over a tack coat. Patch paving may be placed by hand using a vibratory plate compactor or roller in conformance with this section.

15.04 PAVEMENT FLOOD TESTING

Flood testing of asphalt pavement must be made prior to the placement of striping and legends. The Engineer must witness the flood tests. The Contractor shall notify the Engineer a minimum of three (3) working days prior to the flood test

The Contractor shall repair any areas that are damaged or in which excessive ponding occurs. Excessive ponding is defined as an area where water stands more than 3/16 inch in depth. Any areas requiring remedial overlay shall be prepared by grinding the ponded area and placing fine asphalt concrete patch mix over a tack coat. The corrective work shall be done prior to the placement of striping and legends.

15.05 PAVEMENT REINFORCING FABRIC

15.05.1 General

Pavement reinforcing fabric shall be placed on existing pavement to be surfaced or between layers of asphalt concrete when such work is shown on the Contract plans, specified in the special provisions, or ordered by the Engineer.

15.05.2 Materials

Pavement reinforcing fabric shall be manufactured from polyester, polypropylene, or polypropylenenylon material. The fabric shall be non-woven, and shall conform to the following:

Characteristic	ASTM Test	Requirement
Weight, ounce per square yard	D1910	3.0 to 8.0
Grab tensile Strength (1 inch grip), pounds, minimum	D1117	90
Elongation at Break, % minimum	D4632	40
Fabric Thickness, mills	D461	30 to 100

The following fabrics have been found to meet the requirements of these specifications: Amoco, Amopave, Petromat, and Fibretex AO, designed specifically for asphalt concrete overlays. When these materials are used, a mill certificate or affidavit indicating that the material to be installed is the same material as one of those named above, and that the fabric does meet the specifications, shall be submitted to the Engineer. Substitutions proposed by the Contractor shall be approved by the Engineer.

15.05.3 Surface Preparation

Before placing the pavement reinforcing fabric, a binder of paving asphalt shall be applied to the surface to receive the pavement reinforcing fabric at an approximate rate of 0.25 gallons per square yard of surface covered. The exact rate shall be approved by the Engineer. The binder shall be applied to a width equal to the width of the fabric mat plus 3 inches on each side.

The temperature of the asphalt binder shall be greater than 300° F when applied but shall not exceed 325° F when the fabric is placed. The width of the sprayed application shall be no more than 6 inches wider than the fabric and no less than 2 inches wider than the fabric.

Before applying binder, cracks, spalls and chuckholes in the existing pavement shall be repaired as required and approved by the Engineer.

15.05.4 Placing

The fabric shall be stretched, aligned, and placed with no wrinkles that lap. The test for lapping shall be made by gathering together the fabric in a wrinkle. If the height of the doubled portion of the extra fabric is ½ inch or more, the fabric shall be cut to remove the wrinkle, then lapped in the direction of paving. Laps in excess of 2 inches shall be removed.

Pavement reinforcing fabric shall not be placed in areas of conform taper where the design thickness of the overlying asphalt concrete is less than 0.08 feet.

If manual methods are used for placement of the fabric then the fabric shall be unrolled, stretched, aligned, and placed in increments of approximately 30 feet.

Adjacent borders of the fabric shall be lapped 2 inches to 4 inches. The preceding roll shall lap 2 inches to 4 inches over the following roll in the direction of the paving at the ends of the rolls or at any break. At fabric overlays, both the tack coat and the fabric shall overlap the previously placed fabric by the same amount.

Seating of the fabric with rolling equipment after placing will be permitted if in conformance with the manufacturer's recommendations. Turning of the paving machine and other vehicle shall be gradual and kept to a minimum to avoid damage.

A small quantity of asphalt concrete may be spread over the fabric immediately in advance of placing asphalt concrete surfacing in order to prevent the fabric from being picked up by construction equipment.

Public traffic shall not be allowed on the reinforcing fabric, except that public cross traffic shall be allowed to cross the fabric, under traffic control, after the Contractor has placed a small quantity of asphalt concrete over the fabric.

Care shall be taken to avoid tracking binder material onto the pavement reinforcing fabric or distorting the fabric during seating of the fabric with rolling equipment. If necessary, exposed binder material shall be covered lightly with sand.

15.05.5 Measurement

The quantity of pavement reinforcing fabric will be measured on the unit basis of horizontal surface area covered. Overlaps and materials wasted by the Contractor will not be measured for the purpose of payment.

15.05.6 Payment

The contract unit price paid for pavement reinforcing fabric shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work in finishing and placing pavement reinforcing fabric as specified and no additional payment shall be made.

SECTION 16

PAVEMENT STRIPING, MARKERS AND DELINEATION

16.01 GENERAL

The Contractor shall apply all traffic striping, markings and all other directional information or pavement delineation on the surfaces of streets, detour roads, parking lots, median strips and curbing in accordance with the Contract plans and special provisions and as specified in this section.

Where no plans for pavement delineation have been provided and the existing delineation is to be covered or obliterated by the Contractor's work, the existing delineation shall be restored. Restoration shall conform to the requirements specified in this section.

When part of a pavement marking has been removed or obliterated the entire marking shall be restored.

Unless otherwise specified in the Contract plans or special provisions all pavement striping and legends, including restoration (except temporary), shall be thermoplastic.

16.02 LAYOUT, ALIGNMENT AND SPOTTING

All layouts, spotting and tracking required shall be performed by, and at the expense of, the Contractor, and shall be approved by the Engineer prior to placement of pavement striping or markings.

When no previously applied figures, markings, or traffic striping are available to serve as a guide, suitable layouts shall be spotted in advance of the application of the permanent paint.

The Contractor shall mark or otherwise delineate the traffic lane in the new roadway or portion of the roadway, or detour, before opening them to traffic. The Contractor shall provide an experienced technician to supervise the location, alignment layout dimensions, and application of the pavement delineation.

The Contractor shall furnish all equipment, materials, labor and supervision necessary for installing pavement striping and markings in accordance with the Contract plans and for temporary detours required for the safe control of traffic through and/or around the project.

16.03 PAVEMENT MARKERS

Pavement markers shall be installed in accordance with §85 "Pavement Markers" of the State Standard Specifications and as specified in this section.

The Contractor shall remove all existing or temporary detour striping or markings that may confuse the public. When temporary detour striping or markings are no longer required they shall be removed prior to applying the new traffic stripes or markings.

Standard word markings, letters, numerals and symbols shall be as shown on the Contract plans. In the absence of such information, all stencils and templates shall conform to the State of California Department of Transportation Standard Plans, latest edition.

16.04 REMOVAL OF EXISTING AND TEMPORARY TRAFFIC STRIPES AND PAVEMENT MARKINGS

Existing and temporary striping and pavement markings that conflict with the final traffic striping and pavement marking plans shall be removed. The method of removal shall not damage the surface or texture of the pavement or surfacing. Any pavement or surfacing, in the opinion of the Engineer, that has been unreasonably damaged, shall be repaired at no expense to the City.

Sand or other material deposited on the pavement as a result of removing traffic stripes and markings shall be removed as the work progresses. Accumulations of sand or other materials that might interfere with drainage or that might constitute a hazard to traffic will not be permitted. Traffic stripes shall be removed before any change is made in the traffic pattern.

16.05 THERMOPLASTIC STRIPING AND PAVEMENT MARKINGS

The installation of thermoplastic striping and marking shall conform to §84-2 "Thermoplastic Traffic Stripes and Pavement Markings" of the State Standard Specifications.

16.06 PAINTED STRIPING AND PAVEMENT MARKINGS

Paint for pavement striping and markings shall conform to §84-3 "Painted Striping and Pavement Markings" of the State Standard Specifications.

16.07 CURB PAINTING

Curb painting shall be applied as shown on the Contract plans and as approved by the Engineer. Curb painting shall include the application of two coats of traffic paint with glass beads incorporated in the second coat. The top of the curb and the face of curb shall be painted.

16.08 GLASS BEADS

All traffic stripes, except the black separation lines, shall be beaded.

Glass beads shall be applied directly and uniformly to the traffic line with a bead dispenser machine that is placed at the proper distance behind the paint spray nozzle.

Glass beads shall be applied to pavement markings and crosswalks by a special paint spray gun developed for that purpose.

16.08.1 Application Rates

Broken Stripe, First Painting:	New Surface, first coat: 4 to 5 gallons per mile Second Coat: 7 to 7.4 gallons per mile Glass Beads: 42 pounds per mile
Broken Stripe, Re-striping:	7 to 7.4 gallons per mile Glass Beads: 42 pounds per mile
Solid Stripe, First Painting:	New Surface, first coat: 12 to 14 gallons per mile Second Coat: 16 to 18 gallons per mile Glass Beads: 110 pounds per mile
Solid Stripe, Restriping:	16 to 18 gallons per mile Glass Beads: approximately 110 pounds per mile Black Traffic paint: approximately 8 gallons per mile
Pavement Markings, First Painting:	First Painting: light application to seal pavement Second Coat: 1 gallon per 100 square feet Glass Beads: 6 pounds per gallon of paint
Pavement Markings, Restriping:	1 gallon per 100 square feet Glass Beads: 6 pounds per gallon of paint

16.09 RAISED BARS

16.09.1 General

These specifications apply to pre-cast, cast-in-place, or extruded raised bars used as traffic delineators or bumper stops. The work consists of furnishing and installing pre-cast, cast-in-place or extruded raised bars at the locations shown on the Contract plans and special provisions or as directed by the Engineer and to the requirements specified in this section.

Raised bars shall conform to the details and dimensions shown on the Contract plans.

16.09.2 Classification Type

Raised bars are classified by type in accordance with the minimum supportive strength of the bar.

The types are as follows:

Type A: 400 pounds minimum load
Type A raised bars may be pre-cast, cast-in-place, or extruded, at the option of the Contractor.

Type B: 150 pounds minimum load
Type B raised bars shall be precast.

The type of bar used shall be as shown on the Contract plans or specified in the special provisions. Type A shall be used where the type designation of the bar is not shown.

16.09.3 Materials

Pre-cast Raised Bars

Pre-cast raised bars shall be constructed of 560-D-3000 concrete. Other materials such as glass fiber and wood chips may be substituted for the aggregate in raised bars provided the portland cement content is adjusted to these materials and the Engineer approves the use of the materials.

Cast-in-Place Raised Bars

Concrete used in cast-in-place raised bars shall be 560-D-3000 concrete containing calcium chloride at the rate of 2 pounds per 100 pounds of cement. The slump of the concrete shall be not less than ½ inch and not greater than 1 ½ inch. Within these limits the consistency shall be regulated as necessary to provide a dense bar having the shape shown on the Contract plans.

Concrete used in forming bars by the extrusion process shall consist of a homogeneous mixture of portland cement, aggregate, and water; an air-entraining agent may be incorporated.

Cast-in-place, or extruded raised bars in place, represented by test bars that do not comply with the strength requirement at the end of 72 hours, shall be removed from the work and shall be replaced with acceptable bars at no expense to the City.

Each pre-cast bar shall be properly cured and, at the time of shipment, shall be capable of supporting the minimum load for each type as specified. Pre-cast bars shall be tested as described above.

Pre-cast bars shall be marked with the date of manufacture and the identifying mark of the manufacturer.

The manufacturer of pre-cast raised bars shall establish the necessary quality control and inspection practice to assure compliance with these specifications.

16.09.4 Extruded Raised Bars Equipment

The machine used for extrusion shall be capable of forming bars to the dimensions shown on the Contract plans. Raised bars shall be extruded onto a previously placed adhesive.

The extrusion machine shall produce a well-compacted mass that is free from large torn areas in the surface. If minor surface pits or small torn areas are formed, the surface of the bar shall be worked with a template-type trowel until the defects have been eliminated. The ends of the bars, while plastic, shall be formed to the shape and angle shown on the Contract plans.

Where bars are placed over an open joint or crack, an open joint shall be formed through the bar at that point.

16.10 MEASUREMENT

The quantities of traffic striping, pavement markings and pavement delineators shall be measured by units specified in the bid proposal.

16.11 PAYMENT

The contract lump sum or unit prices paid for the various types of pavement striping and markers shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals including removals and alignment and layout as shown on the Contract plans, as specified by the Standard Specifications and as directed by the Engineer and no additional payment shall be made.

Where the bid proposal contains no item for pavement delineation or restoration, full payment shall be considered as included in the various contract items of work and no additional payment shall be made.

SECTION 17

TRAFFIC SIGNS

17.01 GENERAL

Any permanent traffic control sign required on the Contract plans or specifications shall conform to the provisions of §56 of the State Standard Specifications and the Manual on Uniform Traffic Control Devices for Streets and Highways and this section.

17.02 BASE METAL

The gauge of aluminum sheet shall be 0.080 unless otherwise specified. The material shall be subject to inspection prior to installation.

The sign panels are to be cut as shown on the size specification sheets. The dimensional tolerance of the panels shall be plus or minus one-sixteenth (1/16) inch. Metal panels shall be cut to size and shape and shall be free of buckles, wrap, dents, cockles, burrs, sharp edges and any other defects resulting from fabrication.

All possible fabrication, including shearing, cutting and punching of holes, shall be completed prior to the base metal preparation.

17.03 BASE METAL PREPARATION

The aluminum base metal shall be thoroughly cleaned and anodized as per the State Standard Specifications.

17.04 REFLECTIVE SHEETING

Reflective sheeting shall be Scotchlite brand high intensity grade, or approved equal, unless otherwise indicated on the Contract plans.

Vendors shall prove that the type of reflective sheeting they intend to use in the manufacture of the signs has been used on highway signs located on California highways for a period of at least two (2) years and has proven entirely satisfactory to the State.

The surface of the reflective sheeting shall be of a flexible, transparent plastic material and shall be smooth. The backing medium shall be of synthetic sheet resin or other suitable non-cellulose material. The bonding adhesive shall have no staining effect and shall be mildew resistant. The sheeting shall permit cutting and color processing at temperatures between 60° F and 100° F at a

relative humidity between twenty (20) and eighty (80) percent. The sheeting shall be heat resistant and permit force curing of unapplied sheeting at temperatures up to 150° F and up to 200° F on applied sheeting. The sheeting surface shall be solvent resistant to gasoline, naphtha, mineral spirits, turpentine and methanol.

The reflective sheeting shall be applied to the face of the sign by an approved vacuum applicator using a combination of vacuum and heat, as recommended by the reflective sheeting manufacturer. After aging for forty-eight (48) hours, the adhesive shall produce a durable bond equal to or greater than the strength of the reflective sheeting. No air pockets or bubbles shall exist between the sheeting and the base material.

Repairs to damaged reflective sheeting due to poor workmanship or defective material will not be allowed. Defective items shall be replaced at no expense to the City.

Reflective sheeting screening coats shall be oven cured as recommended by the reflective sheeting manufacturer.

17.05 SPLICES

There shall be no splices in the reflective sheeting on panels with a minor dimension of forty-eight (48) inches or less. On all rectangular signs with a minor dimension of more than forty-eight (48) inches the splice shall be horizontal.

No finished sign shall have more than one splice and no splice shall fall within two (2) inches of the sign edge. Where splices do occur, the adjoining reflective sheeting shall be color matched under both incident and reflected light.

17.06 EDGE SEALING

The edges of each completed reflective sheeting sign face and of all cutout letters, numbers, arrows, symbols and borders shall be sealed in a manner and with a sealing solution as recommended by the manufacturer of the reflective sheeting.

17.07 FINISH

The finished sign shall be flat within a ratio of 0.04 inches per linear foot when measured across the plane of each panel. All finished signs shall have smooth flat surfaces without defects or objectionable marks of any kind on either the front face or back face.

All letters and designs shall be clearly cut and sharply defined and shall conform to the State Standard Specifications.

17.08 LEGENDS

The legend shall be of high intensity, cutout, reflective sheeting applied in the same manner as the reflective sheeting specified in this section.

17.09 MANUFACTURER'S IDENTIFICATION

The manufacturer's identification shall be according to the State Standard Specifications.

17.10 SIGN POSTS

Except as shown on the Contract plans, all traffic signs shall be mounted on galvanized posts, or an approved equal, at a mounting height that conforms to State Specifications and traffic code standards.

Signs to be located in an existing sidewalk area may be placed by drilling a hole in the sidewalk one inch larger than the pole.

17.11 INSPECTION

All materials and finished signs are subject to inspection by the Engineer. The finished signs shall be clean and free from all router chatter marks, burrs, sharp edges, loose rivets, delaminated reflective sheeting and aluminum marks. Signs with any defects or damage that would affect their appearance or serviceability will not be accepted. No repairs shall be made to the face sheet without the approval of the City. All signs not conforming to the requirements of this section will be rejected and replaced at the Contractor's cost.

17.12 REMOVAL AND RELOCATION OF EXISTING SIGNS

Traffic signs to be removed and reinstalled at a new location shall be as shown on the Contract plans. Existing mountings may be used; however, the Contractor shall furnish, at no additional expense to the City, the mountings necessary to complete the reinstallation. Relocated signs shall be installed on new signposts unless otherwise shown on the Contract plans. Relocated signs shall be installed at the new location on the same day that they are removed from the existing location.

Any damage to an existing traffic control sign that occurs during removal and reinstallation shall be repaired by the Contractor at no expense to the City.

17.13 MEASUREMENT

The quantity of each type of sign shown in the bid proposal will be measured in units determined from a count in place.

17.14 PAYMENT

The contract unit prices paid for the types of traffic signs shown in the bid proposal shall include full compensation for furnishing labor, materials, tools, equipment and incidentals, and for doing the work involved in furnishing and placing signs complete in place, including adhesives, backing, bolts, frames, posts, caps, cement and all other costs as shown on the Contract plans and as specified in this section, and as directed by the Engineer, and no additional payment shall be made.

SECTION 18

TRAFFIC SIGNALS AND LIGHTING SYSTEMS

18.01 GENERAL

The Contractor shall provide all material, equipment and labor necessary to furnish and install all traffic signals, all street lights, all associated hardware and equipment, and all appurtenant work to provide a functional installation, complete in place and operable, as shown on the Contract plans and as specified in this section.

18.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used.

The Contractor shall submit the controller cabinet schematic wiring diagram and intersection sketch on one sheet at the time the controller cabinet is delivered to the City for testing. The Contractor shall notify the Engineer seventy-two (72) hours prior to delivery of the controller cabinet for testing.

The Contractor shall furnish a maintenance manual and an operation manual for all controller units, auxiliary equipment, and vehicle detectors sensor units, control units and amplifiers. One set of traffic signal drawings and traffic signal specifications and the maintenance manual for the controller shall be submitted at the time the controllers are delivered to the City for testing. The maintenance manual shall include the following items:

1. Manufacturer's specifications.
2. Design characteristics.
3. General operation theory.
4. Function of all controls.
5. Trouble-shooting procedure (diagnostic routine).
6. Block circuit diagram.
7. Geographical layout of components.
8. Schematic diagrams.
9. List of replaceable component parts with stock numbers.

The Contractor shall submit, to the Engineer, a list of equipment and materials proposed to be used in accordance with ♣86-1.03 "Equipment List and Drawings" of the State Standard Specifications.

The controller cabinet and its components shall be tested and certified by the controller manufacturer prior to delivery to the City for testing.

18.01.2 Manufacturer's Service Representative

The Contractor shall arrange to have a signal technician, qualified to work on the controller and employed by the controller manufacturer or his representative, present at the time the traffic signal is turned on.

18.02 PRODUCTS

Traffic signals and street lights shall conform to ♣86 "Signals, Lighting and Electrical Systems" of the State Standard Specifications and the State Standard Plans and as specified in this section.

18.02.1 Foundations

Portland cement concrete for standards, steel pedestals and posts shall conform to ♣90-10 "Minor Concrete" of the State Standard Specifications.

18.02.3 Standards, Steel Pedestals and Posts

Standards, steel pedestals, and posts shall conform to ♣86-2.04 "Standards, Steel Pedestals and Posts" of the State Standard Specifications and as specified in this section.

All traffic signal standards and posts shall be galvanized steel. Locations of traffic signal standards and posts shall be marked in the field with marking chalk for review by the Engineer before beginning any installation.

Street light standards shall be galvanized steel or spun aluminum.

The decorative street light standard shall be King Luminaire Model KM22FE-14 Colonial or Lumec Model R80A-14-TBCI-BKTX or equal. The standard shall be aluminum with black polyester powder coat finish. All hardware shall be tamper resistant stainless steel. Anchor bolts shall be hot dipped galvanized.

18.02.4 Conduit

Conduit shall conform to the provisions of ♣86-2.05 "Conduit" of the Standard Specifications and this section.

Conduit and fittings to be installed underground shall be rigid and non-metallic.

Conduit installed in the concrete base shall be the same type size and quality as used for underground conduit.

The size of conduit used shall be as shown on the Contract plans. In no case shall conduit be less than 1 ½ inches in diameter. The Contractor may, at his option and expense, use conduit of

larger size than that shown or specified, provided the larger size is used for the entire length of the run from pull box to pull box. Reducing couplings will not be allowed.

The fourth sentence in the third paragraph in Section 86-2.05C "Installation" of the State Standard Specifications (July 1992 Edition) is amended to read as follows:

“When a standard coupling cannot be used for coupling metal type conduit, a UL-listed threaded union coupling, concrete-tight split coupling, or concrete-tight set screw coupling shall be used.”

18.02.5 Pull Boxes

Pull boxes shall conform to the provisions in ♣86-2.06 "Pull Boxes" of the State Standard Specifications and this section.

Pull box size shall be No. 5 for traffic signals and No. 3 ½ for street lights and interconnects unless otherwise shown on the Contract plans. The cover shall be made of reinforced concrete.

Interconnect pull boxes shall have lids embossed with "Interconnect", street light pull box lids with "Street Lighting", and traffic signal pull boxes with "Traffic Signal".

18.02.6 Conductors and Wiring

Wiring shall conform to the provisions in ♣86-2.09 "Wiring" of the State Standard Specifications and this section. Splices shall be insulated by Method B.

Street light conductors shall be copper type TW or THW. Conductors between pull boxes shall be No. 8 or larger and conductors in street light standards shall be No. 10 or larger unless otherwise noted on the plans.

The voltage drop in any street light circuit shall not exceed 4 volts. The following formula shall be used to calculate the current needed for selecting the conductor size:

$$\text{Current (amperes)} = (\text{Total wattage of fixtures served} \times 1.5) / (\text{Service Voltage})$$

Fuse holders shall be a non-compression type and shall be BUSS HEB-AA or equal.

18.02.7 Bonding and Grounding

Bonding and grounding shall conform to provisions in ♣86-2.10 "Bonding and Grounding" of the State Standard Specifications and this section.

Street lights shall be grounded by the use of a 5/8-inch diameter, 8 feet long copper weld ground rod installed in the pull box adjacent to the street light.

18.02.8 Service

Service shall conform to the provisions in ♣86-2.11 "Service" of the State Standard Specifications and this section except that the Contractor shall pay all costs and fees required by the utility company for the connection of temporary service and permanent service.

The traffic signal service equipment cabinet shall be Type III-AF 120/240 volt and shall be painted with graffiti-resistant paint to match the controller cabinet color.

The traffic signal service enclosure shall meet the requirements of PG&E and shall conform to ♣86-1.02 "Regulations and Code" of the State Standard Specifications. The enclosure shall be factory pre-wired and tested to meet NEMA 3R standards. A copy of the wiring diagram for the integrated system shall be enclosed in plastic and mounted inside the enclosure. Name plates shall be provided for each control component. The name plates shall be phenolic, black background with white lettering except the main breaker which shall be red with white lettering. All name plates shall be fastened to the enclosure by screws.

The traffic signal service enclosure shall have a separate disconnect for the traffic signal, safety lighting, and sign lighting circuits. Separate disconnects shall be provided for any other separate circuit, such as street lighting or irrigation systems, when shown on the plans. Lighting contactors shall be the mercury displacement type conforming to the functional and operational requirements of ♣86-6.07B(2) "Contactor" of the State Standard Specifications.

Painting shall conform to the provisions in ♣86-2.16 "Painting" of the State Standard Specifications.

18.02.9 Controller Assemblies

The controller assembly shall be Type 90 in conformance with ♣86-3.06 "Type 90 Controller Assemblies" of the State Standard Specifications.

The Type 90 controller shall be as indicated on the plans. The controller cabinet shall be painted with a graffiti-resistant paint conforming to color number 14672 (Light Green) of Federal Standard 595a.

Controller assemblies shall operate the traffic signal system as shown on the plans and shall be capable of interfacing with 3M "Opticom" Emergency Vehicle Preemption Equipment. The convenience receptacle shall have ground-fault circuit interruption as defined by the National Electric Code. Circuit interruption shall occur on 6 milliamperes of ground-fault current and shall not occur on less than 4 milliamperes of ground-fault current.

18.02.10 Modulated Signal Detection System

The modulated signal detection system shall be able to interface with an Opticom detection system as manufactured by 3M. The controllers shall be equipped with internal circuitry to

provide programmable channels of emergency vehicle preemption. The detector shall have a minimum range of 2,500 feet.

The modulated signal detection system shall consist of Opticom phase selector model M752, Opticom detector model 711, Opticom interface cable model M138, or an approved equal.

The controller cabinets shall be wired with a "D" connector or special function cable to provide all necessary controller connections for emergency vehicle preemption. The phase selectors or discriminators shall be wired to provide emergency vehicle preemption for the emergency vehicle phases.

18.02.11 Internally Illuminated Street Name Signs

Internally illuminated street name signs shall conform to ♣86-6.065 "Internally Illuminated Street Name Signs" of the State Standard Specifications.

Internally illuminated street name signs installed on signal mast arms shall be Type A.

The Type A internally illuminated street name sign shall consist of an extruded aluminum top, bottom, and door. The door shall open from the top and shall be held closed by three 1/4-turn airlock fasteners. The door shall have a water tight PVC gasket and shall have a continuous stainless steel hinge. The extruded aluminum doors shall have one side removable to gain access to the sign face.

Drip rails overhanging the sign face are required to prevent water intrusion. Seams connecting the top and bottom to the ends and seams of the door frame shall be Heli-Arc welded to provide a weatherproof seal. All pop rivets and hex head indented sheet metal screws shall be stainless steel.

The hinges of the sign mounting brackets shall be able to pivot in all directions.

Ballast shall be high output and shall be mounted inside on the bottom of the sign assembly. The sign shall be equipped with four 3/16 inch diameter drain holes located in the bottom of the housing, two at each end.

Internally illuminated street name signs installed on pole shafts shall be NUART Metro Mark series, or equal.

18.02.12 Vehicle Signal Faces and Signal Heads

Vehicle signal faces and signal heads shall be in conformance with ♣86-4 "Traffic Signal Faces and Fittings" of the State Standard Specifications. All lamps for traffic signal units shall be furnished by the Contractor.

Signal section housing shall be metal and shall have 12 inch sections with glass lenses and glass reflectors. Signal housings and mounting hardware shall be painted gloss black and electrically

powder coated. The backplates for mast arm mounted heads shall be ventilated. All backplates shall be designed to be removed and reinstalled without requiring the removal of the traffic signals.

The second sentence in the third paragraph in Section 86-4.03 "Backplates" of the State Standard Specifications is amended to read:

“Sections shall be joined using (1) aluminum rivets and washers painted or permanently colored to match the backplate, or (2) No. 10 machine screws with washer, lock washer and nut, painted to match the backplate.”

The red indication for all vehicle signals shall be LED indications.

18.02.13 Pedestrian Signals

Pedestrian signals shall be in conformance with ♣86-4.05 "Pedestrian Signal Faces" of State Standard Specifications.

Pedestrian signals shall be solid state and shall be illuminated by use of a neon message module with an integral power supply. The displayed messages shall be "Upraised Hand" and "Walking Person" symbols. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. The use of ballast resistors is prohibited. All components of the circuit board including the input capacitor shall be rated at 105° Celsius.

The input wires of the neon message tubes shall be rated at 10,000 volts. Pedestrian signal housings and mounting hardware shall be painted gloss black and electrically powder coated.

18.02.14 Pedestrian and Bike Push Buttons

Pedestrian and bike push buttons shall conform to the provisions in ♣86-5.02 "Pedestrian Push Buttons" of the State Standard Specifications and this section.

Pedestrian and bike push button frames shall be Type B with appropriate signs. Pedestrian push button frames and switch housing shall be painted gloss black and electrically powder coated.

Push buttons signs shall be installed using theft-proof screws PDL, Pro-Tech't machine screws, or equal. An installation tool shall be furnished to the City by the Contractor.

The switching unit shall be Synchronex, part No. ADA-2, or equal. The switching unit shall be a precision, snap-acting, single pole, single throw unit pressure-type terminals and shall be rated at 120 volts AC. The switching unit shall be UL listed. The switching unit shall permit recessed mounting in a standard Type B frame without any modifications to either unit.

The actuator shall be conical in shape with the cone extending 7/16 inch to 1/2 inch beyond the bevel of the switch housing and shall be two (2) inches in diameter.

18.02.15 Detectors

Detectors shall conform to the provisions in 86-5 "Detectors" of the State Standard Specifications and this section. Detector handholes shall be Type A. Circular loops 6 feet in diameter may be installed in lieu of 6 feet by 6 feet square loops.

Sensor units shall be Detector Systems Digital Loop Model 910, or equal.

Loop wire shall be Type 1 or Type 2. Loop detector lead-in cable shall be Type B or Type C. No more than four loops shall be connected to each sensor unit. No splices are permitted in detector lead-in cables.

The Contractor shall identify loop wires by lane number, loop number, and start/finish using tie wraps and permanent markers.

Where detector lead-in cables are connected to the terminal strips in the controller cabinet, the pressure terminal connectors shall be soldered to the detector lead-in cables.

Hot-melt rubberized asphalt sealant shall be used to fill slots in pavement when installing loops.

18.02.16 Lighting

Traffic signal lighting shall conform to the provisions in 86-6 "Lighting" of the State Standard Specifications and this section.

The lens for all luminaires shall be glass or polycarbonate.

The luminaires on traffic signal poles shall have cut-off type lenses and a Type III distribution.

The luminaires on standard street lights shall have a photoelectric control facing north, a charcoal filter, and a Type III distribution.

Ballast for street light luminaires shall be NPF or HPF for up to 150 watts, and Autoreg for 200 watts and larger.

All luminaires shall have clear, high pressure sodium bulbs except for Lumec Luminaires which shall have coated bulbs.

Luminaires for decorative street lights shall be Lumec Model Z47A - 100S-120-HS-SFPH-PH8 BKTX, King Luminaire Model K1184-LAR or equal, with a 100-watt high pressure sodium bulb, a polyester finish to match the color of the pole, a photoelectric control facing north, and a house side shield.

Pole numbers for decorative lights shall be attached to a 2 ½ inch x 15 inch x 0.020 inch aluminum plate and shall be mounted on the pole by 1/16 inch rivets.

18.02.17 Photoelectric Control

Photoelectric control shall be Type IV for standard street lights and Type V for traffic signals.

18.02.18 Interconnect

The controller cabinet shall include appropriately sized terminal facilities for connection of the interconnect cable to the local controller. All required equipment and facilities for reliable communication with the master controller shall be provided.

Each controller cabinet shall contain a sufficient number of terminals of the proper size and type to terminate and/or splice the interconnect cable.

Interconnect cable shall be 6 pair minimum, No. 20 twisted pairs. Each pair shall be equipped with shielding and shall be composed of stranded tinned copper drawn wire.

18.03 EXECUTION

18.03.1 General

Traffic signal and street light installation shall conform to §86 "Signals, Lighting and Electrical Systems" of the State Standard Specifications and as specified in this section.

18.03.2 Foundations

Controller cabinet foundation shall extend eighteen (18) inches above grade.

Foundations for decorative street lights shall be as shown on the plans and shall be based on the soil engineer's recommendations or in accordance with the State Standard Plans for a Type 15 lighting standard foundation.

Mortar is required between the foundation and the base plate of all traffic signal and lighting standards. Mortar shall consist of one part by volume of portland cement and three parts of sand as per State requirements.

18.03.3 Conduit

Conduit runs that are located behind the curbs may be installed in the street within two feet of, and parallel to, the face of the curb.

After conductors have been installed the ends of conduits terminating in pull boxes and controller cabinets shall be sealed with an approved type of sealing compound.

All conduit bends greater than forty-four (44) degrees shall be factory bends and shall have a minimum radius of eighteen (18) inches. Where factory bends are not used, conduit shall be bent without crimping or flattening using the largest radius possible. Bending of non-metallic conduit shall be accomplished by methods recommended by the conduit manufacturer and with equipment approved for that purpose.

18.03.4 Pull Boxes

Pull boxes in areas subject to traffic loads shall be installed on a concrete footing designed to withstand traffic loads. The tops of the pull boxes shall be set at grade.

The bottoms of the pull boxes shall be bedded in Class 2 permeable material. Grout in the bottom of pull boxes will not be required.

Where the sump of an existing pull box is disturbed by the Contractor's operations, the sump shall be reconstructed and if the sump was grouted, the old grout shall be removed and new grout shall be placed.

Recesses for suspension of ballasts will not be required.

Where pull boxes are to be placed in areas subject to traffic loads, a steel cover or cast iron cover shall be used instead of a concrete cover.

Maximum pull box spacing shall be 100 feet for traffic signals and 200 feet for street lights and signal interconnects.

Pull boxes are to be located behind the five (5) feet wide sidewalks and not within the sidewalk.

18.03.5 Conductors and Wiring

Identification bands shall be placed near the ends of termination points of all conductors. All wires shall be clearly marked inside the controller cabinet designating the appropriate signal phases.

When signal heads for more than one phase are mounted on the same pole, the Contractor shall identify phases by tagging wires in the nearest pull box using nylon tie wraps and permanent marker.

A five (5) amp, in-line fuse shall be installed on the hot leg of service in the pull box adjacent to each street light.

18.03.6 Bonding and Grounding

A grounding jumper shall be attached by a 3/16-inch, or larger, brass bolt in the signal and street light standards or controller pedestal, and shall be run to the conduit, ground rod, or bonding wire in the adjacent pull box. Equipment grounding conductors will not be required in conduit containing loop lead-in cables.

18.03.7 Decorative Street Lights

Decorative street lights shall be installed in accordance with the manufacturer's recommendations.

18.03.8 Controller Cabinet Assembly

Interconnect cable splices in the controller cabinet and connections of the appropriate cable pairs to the controller shall be done by the controller supplier at turn-on. Interconnect cable shall be run continuously without splices between controller cabinets. Splices shall not be made in the pull boxes. Splices shall only be made in the controller cabinets on the terminal blocks provided for that purpose by the controller manufacturer.

The base of the controller cabinet shall be sealed with silicon caulking material.

18.03.9 Functional Testing

The functional test for each signal system shall consist of not less than fourteen (14) days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until fourteen days of continuous satisfactory operations is obtained.

SECTION 19

STORM DRAINS

19.01 TRENCHING

19.01.1 General

For the purposes of shoring or bracing a trench is defined as an excavation where the depth is greater than the width at the bottom of the excavation.

Excavations for appurtenant structures, such as manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and planting holes shall, for the purposes of shoring and bracing, be categorized as trench excavations.

Excavation shall include the removal of all water and materials that interfere with construction. Removal of groundwater to a level below the structure subgrade will be mandatory only when required by the Contract plans or special provisions.

Excavation for conduits shall be by open trench unless otherwise specified or shown on the Contract plans. Should the Contractor elect to tunnel or jack any portion the Contractor shall first obtain approval from the Engineer. Payment for the work will be made as though the specified methods of construction had been used.

When necessary to protect existing trees the Engineer may require the Contractor to modify its trenching methods. The modifications may include the use of smaller equipment and hand tools. Existing trees within the limits of construction not to be removed shall be protected and treated in accordance with §24 "Protection and Restoration of Existing Improvements" of the Standard Specifications.

19.01.2 Maximum Length of Open Trench

The maximum length of open trench where prefabricated pipe is used shall be no more than the amount of pipe that can be installed and backfilled in a single day.

The maximum length of open trench in any one location where concrete structures are cast in place will be that length that is necessary to permit uninterrupted progress. Construction shall be scheduled as follows: excavation, setting of reinforcing steel, placing of floor slab, walls, and cover slab or cover arch.

Failure by the Contractor to comply with the limitations specified may result in an order to halt the work until compliance has been achieved.

19.01.3 Trench Width

The width of trench shall be as shown on the Contract plans or as specified in the special provisions. If no minimum width or maximum width of trench is specified the trench width shall be as approved by the Engineer. When pipe trenching and/or backfill is paid on a volume basis the maximum width, for the purpose of calculating the volume of trench excavation or backfill, shall be the outside diameter of the pipe plus one foot, as measured in the center section of the pipe between joints.

If the maximum trench width specified is exceeded, the Contractor, at the Contractor's expense, shall provide additional bedding, another type of bedding, or a higher strength of pipe, as approved by the Engineer.

19.01.4 Access to Trenches

Safe and suitable ladders which project 2 feet above the top of the trench shall be provided for all trenches over 4 feet in depth. One ladder shall be provided for each 50 feet of open trench, or fraction thereof, and shall be located so that workers in the trench need not move more than 25 feet to a ladder.

19.01.5 Removal and Replacement of Surface Improvements

Asphalt pavement, concrete pavement, curbs, sidewalks or driveways removed in connection with construction shall be removed and replaced in accordance with the other provisions of the Standard Specifications and the Contract plans and special provisions.

19.01.6 Bracing Excavations

The manner of bracing excavations shall be as set forth in the rules, orders, and regulations of the Division of Industrial Safety of the State of California.

Prior to commencing the excavation of a trench five (5) feet or greater in depth, and into which a person will be required to descend, the Contractor shall first obtain a permit to do so from the Division of Industrial Safety.

Where the trench bracing system utilizes steel H-beams, piles, or other similar vertical supports, the driving of the supports will not be permitted except for the last four feet. The vertical supports shall be placed in holes drilled to a depth of four feet above the proposed bottom of the pile, except where this procedure is impractical. The vertical support may then be driven to the required depth (not to exceed four feet). During the drilling and driving operations the Contractor shall not damage utilities.

Where the drilling of such holes is impractical because of the existence of rocks, running sand, or other similar conditions, and provided that the impracticability is demonstrated to the satisfaction of the Engineer by actual drilling operations by the Contractor, the Engineer may, upon request

of the Contractor, approve the use of means other than drilling for the purpose of placing the vertical support. The other means, however, must be of a nature which will accomplish, as nearly as possible, the purpose of the drilling – no damage to existing surface or sub surface improvements. All costs for this work shall be included in the various Contract bid prices for the work.

Where sheeting is used to support the excavated trench the Contractor shall remove the sheeting. Where removal of the sheeting is not possible due to the type of sheeting or due to the methods of construction used, the Engineer may permit portions of the sheeting to be cut off to a specified depth and to remain in the trench.

19.02 BEDDING

Unless shown otherwise in the Contract plans, bedding, as defined in this section, shall be that material supporting, surrounding and extending to one foot above the top of the pipe. Where it becomes necessary to remove boulders or other interfering objects at subgrade for bedding, any void below the subgrade shall be filled with the bedding material designated on the Contract plans. Where concrete is specified to cover the pipe, the top of the concrete shall be considered as the top of the bedding.

If soft, spongy, unstable, or other similar material is encountered upon which the bedding material or pipe is to be placed, this unsuitable material shall be removed to a depth beneath the bottom of the pipe as approved by the Engineer and replaced with properly placed and compacted bedding. Additional bedding so ordered, over the amount required by the Contract plans or special provisions, will be paid for as provided in the bid proposal. If the additional bedding material has been caused by an act, or failure to act, on the part of the Contractor, or is required for the control of groundwater, the Contractor shall bear all expenses for the additional excavation and bedding.

Bedding material for pipe shall first be placed to a depth of six inches below the pipe or as specified by the pipe manufacturer, whichever is greater. Bedding shall be compacted prior to backfilling. All bedding material shall be placed to achieve uniform contact with the pipe and a minimum relative compaction of at least 95 percent, as determined by ASTM D 1557. Unless the sheeting or shoring is to be cut off and left in place, compaction of the bedding shall be accomplished after the sheeting or shoring has been removed from the bedding zone.

In dry trench conditions or where otherwise specified, bedding material for pipe shall be sand, gravel, crushed aggregate or native free-draining granular material having a sand equivalent of not less than 30. Where water is encountered, or where trench de-watering is used, Wet Condition Material, meeting the requirements presented in the following table, shall be used.

Bedding Gradation for Wet Trench Condition	
Sieve Size	Percentage Passing
1 inch	100
¾ inch	22-100
3/8 inch	8-50
No. 4	0-8
No. 200	0-2

Concrete used for bedding shall be one of the classes of concrete specified in this section for the indicated time periods before backfill is placed.

When required by the Engineer in wet trench conditions, the continuity of the bedding material shall be breached by a low permeability groundwater barrier to impede the passage of water through the embedment. The barrier material shall be a low permeability clay material and shall be compacted to at least 95 percent of the maximum density as per ASTM D 1557. The Barrier material may be job excavated material free from stones, organic matter, and debris.

19.03 PIPE MATERIALS

19.03.1 General

Pipe shall be inspected in the field before and after laying. If any cause for rejection is discovered in the pipe it shall be rejected. Any corrective work shall be approved by the Engineer and shall be at the Contractor's expense.

Pipe not installed within 120 days of the latest test shall not be used without approval of the Engineer.

19.03.2 Identification and Markings

Each length of pipe, fitting or coupler shall be marked by the manufacturer with the manufacturer's name or logo, trade name, nominal size, date of manufacture and lot number. A lot is one hundred lengths of pipe, or a fraction thereof. The following information shall be clearly marked for specific type of pipe.

Pipe shall have a home mark to indicate full penetration of the spigot when the joint is made.

RCP shall be marked in accordance with AASHTO M 170. The D-load and lot number designations shall be marked on the inside of the pipe. Each coupling shall be marked with the nominal size and D-load for the pipe with which it shall be used.

Plastic pipe markings shall include the following:

1. Nominal pipe diameter.
2. PVC cell classification.
3. ASTM, SDR, and date designation.
4. Service designation or legend.

19.03.3 Acceptance and Testing

The basis for acceptance shall be the inspection of pipe, fittings and couplings, the tests specified in this section, and compliance with all specifications. When the pipe is delivered to the work site the Engineer may require additional testing to determine conformance with the specifications.

19.03.4 Causes for Rejection

The following defects are cause for rejection of individual pipe lengths:

1. Any crack extending through the wall of the pipe.
2. Any continuous surface crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of depth or position in the wall of the pipe.
3. Any shattering or flaking of concrete.
4. Any piece broken from the pipe.
5. A deficiency in wall thickness equal to or greater than $\frac{1}{4}$ inch from the specified thickness, for pipes 30 inches or smaller in diameter.
6. A deficiency in wall thickness equal to or greater than 6 percent of the specified thickness, for pipes larger than 30 inches in diameter.
7. Irregularities that indicate imperfect mixing or molding.
8. Improper machining of the ends of the pipe.
9. For circular pipe, any variation from a true circle of the specific diameter by more than one percent.
10. Rock pockets.
11. Exposed reinforcing.
12. Evidence of twisting or misplacement of reinforcing.
13. Failure to pass any required test.

When a pipe contains localized defects but is otherwise acceptable, the pipe may be accepted when the defective portion is removed and the end, or ends, re-machined. If such pipe is accepted by the Engineer, the unit price for such pipe shall be subject to a reasonable reduction in price as determined by the Engineer.

19.03.5 Reinforced Concrete Pipe (RCP)

These specifications apply to reinforced concrete pipe used for the construction of storm drains and related structures. Reinforced concrete pipe shall be circular, oval or arch as indicated on the Contract plans or as provided for in the Contract bid proposal.

The size, type, and D-load of the concrete pipe shall be as shown on the Contract plans, specified in the special provisions or as indicated in the Contract bid proposal.

When required by the Engineer, prior to the manufacture of the pipe, three sets of prints of the pipe line layout diagrams, prepared in accordance with good industry practice, shall be furnished to the Engineer. Catch basin connector pipe need not be included in the pipe line layout; in lieu thereof, a list of catch basin connector pipes shall accompany the layout. The connector pipe list shall include the size and D-load of pipe, stations at which the pipe joins the mainline, the number of sections of pipe, the length of the sections and the type of sections (straight, horizontal bevel, vertical bevel, etc.). The diagrams and lists submitted will be used by the City for reference only and their use shall not relieve the Contractor of the Contractor's responsibility for correctness.

Cast reinforced concrete pipe shall be manufactured by placing the concrete into stationary, vertical, cylindrical metal forms. The minimum wall thickness for cast pipe shall be as follows:

Cast RCP Minimum Wall Thickness	
Inside Diameter (inches)	Minimum Barrel Thickness (inches)
12	2
15,18,21	2 ¼
24,27,30,33	3

Spun reinforced concrete pipe shall be manufactured by introducing the concrete into a rotating, horizontal, cylindrical metal form. The minimum wall thickness shall be as follows:

CAST RCP Minimum Wall Thickness (Inches)			
Inside Diameter (inches)	Minimum Barrel Thickness (inches)	Inside Diameter (inches)	Minimum Barrel Thickness (inches)
12	2	36	3
15	2	39	3 3/8
18	2	42	3 ¾
21	2	45	3 7/8
24	2 ½	48	4
27	2 5/8	> 48	1/12 Inside Diameter
30	2 ¾		
33	2 7/8		

The pipe wall thickness for machine made RCP shall be one twelfth (1/12) the inside diameter plus one inch. The pipe shall be constructed with 4,000 pounds per square inch concrete.

The interior surface of the pipe shall be smooth and well finished. Joints shall be constructed so that the pipe will form a continuous conduit with a smooth and uniform interior surface.

Sockets and spigots shall be free from any deleterious substance or condition that would prevent a satisfactory joint from being formed.

The Contractor shall furnish, install, and maintain supports inside and/or outside the pipe that may be necessary to meet the limitation on cracks as specified in this section. This requirement shall apply during pipe handling, transportation, and installation.

Pipe stronger than that specified may be furnished at the Contractor's option at no additional expense to the City, provided such pipe conforms to applicable provisions of these specifications.

Materials

Pipe shall be reinforced concrete pipe in accordance with ASTM C-76. When the classification of pipe is not indicated on the Contract plans the pipe shall be Class III for pipes with a minimum cover of two feet from finish grade and shall be Class IV for pipes with less than two feet of cover from finish grade. Cement used in the manufacture of the pipe shall be in accordance with ASTM C-150, Type II and low alkali. Unless waived by the Engineer, two 3-edge bearing tests shall be made on each size of pipe.

Circular RCP shall conform to the specifications of AASHTO M-170 for the class specified.

Oval RCP shall conform to the specifications of AASHTO M-207.

Arch RCP shall conform to the specifications of AASHTO M-206.

The spigot shall be formed with a groove for the gasket.

Joints shall be a self-centering, with rubber gaskets in accordance with ASTM C 443 and shall be flexible and able to withstand expansion, contraction and settlement. All rubber gaskets shall be stored at 70° F or less and in no case shall the rubber gaskets be exposed to the rays of the sun for more than 72 hours.

Rubber gaskets shall be of the "O" ring-type requiring lubrication and shall be lubricated with the lubricant recommended and supplied by the manufacturer.

Fittings and special connections required as indicated on the Contract plans shall be constructed to the standards of the pipe manufacturer. Details of fittings and special connections shall be submitted to the Engineer for acceptance before fabrication.

Reinforcing

The reinforcing shall be a cage fabricated of bars or wire. Circumferential reinforcement shall be that required to sustain the specified test loads. Longitudinal reinforcement shall be sufficient to make the cage rigid and to hold the circumferential reinforcement firmly in place during placement and consolidation of the concrete.

Pipe to be jacked, or machine made pipe, shall have circular cage reinforcement. All reinforcing shall be clean and free from loose rust, scale, paint, grease, form oil, or other foreign matter.

Upon request, the Contractor shall furnish data to the Engineer indicating lot number, wall thickness, and the size, spacing, and positioning of the reinforcement for any pipe.

19.03.6 Plastic Pipe

Plastic pipe when specified in the Contract plans or provided for in the Contract bid proposal shall be one of the following:

1. Smooth interior High Density Polyethylene Type S Corrugated.
2. Smooth interior Ribbed Profile Wall High Density Polyethylene.
3. Smooth interior Ribbed Polyvinyl Chloride (PVC).

Material

The pipe and fittings shall conform to the provisions of this section. At the time of manufacture each lot of pipe and the fittings shall be inspected for defects and tested for impact stiffness and flattening in accordance with ASTM D 2751.

Type S corrugated polyethylene pipe shall be as specified in AASHTO M-294, except as specified otherwise in this section. Corrugated polyethylene pipe shall be manufactured from high-density polyethylene (HDPE) virgin compounds.

Ribbed profile wall polyethylene pipe shall be manufactured from high-density polyethylene (HDPE) virgin compounds and shall conform to the requirements in ASTM F 894, except as otherwise specified in this section.

High-density polyethylene compounds used in the manufacture of plastic pipe shall conform to the following cell classifications as provided in ASTM D 3350:

Property	Cell Classification
Density	3
Melt Index	2 ^(a) 3 or 4
Flexural Modulus	4, 5 or 6
Tensile Strength	4, 5 or 6
Environmental Stress Crack Resistance	1, 2 or 3
Hydrostatic Design Basis	0, 1, 2, 3, or 4
Ultraviolet Stabilizer	C ^(b)

(a) The Melt Index for cell classification 2 material used to manufacture pipe shall not be greater than 0.6. Rotationally molded couplings and end fittings may be produced from material compounds having a melt index cell classification of 1.

(b) HDPE resin shall contain not less than 1.5 percent to 2.5 percent carbon black ultraviolet stabilizer.

Ribbed polyvinyl chloride drain pipe (PVC) shall be manufactured from polyvinyl chloride (PVC) virgin compounds and shall conform to the requirements in ASTM M 304, except as otherwise specified in this section.

PVC compounds used in the manufacture of plastic pipe shall conform to the following cell classifications as provided for in ASTM D 1784:

Property	Cell Classification
Base Resin	1
Impact Strength (Izod)	2 - 6
Tensile Strength	3 or 4
Modulus of Elasticity	5 or 6
Deflection Temperature	4 or 5
Chemical Resistance	A, B or C

The residue from ignition of the HDPE and PVC compounds shall not exceed 30 percent as determined by ASTM D 2584.

The minimum wall thickness, weight (or mass) and stiffness of plastic pipe shall be as set forth in the following two tables:

Type S – HDPE Pipe			
Nominal Diameter (inches)	Wall Thickness (inches)	Weight (pounds per foot)	Stiffness (psi)
12	0.035	2.7	50
15	0.035	4.0	42
18	0.050	6.0	40
21	0.050	n/a	38
24	0.050	10.2	34
27	0.050	n/a	31
30	0.050	15.0	28
33	0.050	n/a	25
36	0.050	18.1	22

Note: n/a indicates that the pipe size is not available or not approved for use.

Ribbed PVC Pipe			
Nominal Diameter (inches)	Wall Thickness (inches)	Weight (pounds per foot)	Stiffness (psi)
18	0.095	6.4	32
21	0.105	8.3	28
24	0.115	10.2	24
27	0.125	12.3	22
30	0.135	14.8	19
36	0.155	20.1	16
42	0.170	26.0	14
48	0.190	32.5	12

Wall thickness of Type S pipe shall be the thickness of the inner liner measured between corrugated valleys. The wall thickness of ribbed PVC pipe shall be measured in the gap between the ribs.

Unit weight (mass) shall be computed as the average per foot length determined from three test specimens, taken from each manufactured run. The length of each test specimen for pipes 24 inches in diameter and less shall be equal to a minimum of two nominal pipe diameters. Specimens for pipes larger than 24 inches in diameter shall be equal to one diameter to a maximum of 36 inches in length. The weight of the pipe specimen shall be determined with any

suitable weighing device accurate to 0.10 pound. The pipe unit weight for each individual kind and size of plastic pipe shall equal or exceed the minimum unit weight value of each individual kind and size of plastic pipe listed in the two tables above.

Pipe stiffness shall be determined in accordance with ASTM D 2412 at 5 percent deflection. Average pipe stiffness shall be determined for each manufactured run. The length of each test specimen shall be equal to the nominal pipe diameter, except specimens for pipes larger than 36 inches in diameter shall be 36 inches in length. The average pipe stiffness shall be equal to or less than the pipe stiffness value for each individual kind and size of plastic pipe listed in the two tables above.

Joints

When plastic couplings are used, pipe ends shall be machined at least 1/16 inch deep for a minimum of two-thirds of the full circumference. Non-machined portions of the ends shall be sanded smooth to provide a close-fitting joint.

When requested by the Engineer, a Certificate of Compliance shall be submitted. The Certificate shall certify that the plastic pipe complies with the requirements of this section. The Certificate shall also include the resin material cell classification, the unit weight of the pipe, the average pipe stiffness and the date of manufacture.

19.03.7 Corrugated Steel Pipe (CSP)

Corrugated steel pipe shall be used only when shown specifically on the Contract plans. When specified, corrugated steel pipe shall be zinc coated or aluminum coated conforming to the requirements specified in this section and as may be further specified in the special provisions.

Materials

Corrugated steel products shall conform to AASHTO M-36 and shall be fabricated from either zinc coated steel sheet or aluminum coated steel sheet.

Zinc coated steel sheet shall conform to the requirements of AASHTO M-218 except that CA Test 652 shall be used to determine the weight of coating.

Aluminum coated steel sheet shall conform to the requirements of AASHTO M-274.

When requested by the Engineer, a Certificate of Compliance shall be submitted. The Certificate shall certify that the corrugated metal pipe complies with the requirements of this section.

Fabrication

Corrugated steel pipe shall be fabricated by using a helically corrugated steel pipe with a continuous helical seam, continuous lock seam, or continuous helical welded seam.

Continuous helical seam fabrication shall conform to the specifications of AASHTO M-36. Corrugated profiles and pitches shall conform to the following table:

Diameter (inches)	Nominal Pitch (inches)	Maximum Pitch (inches)	Nominal Depth (inches)	Seam Pitch (inches)
6 - 8	1 ½	1 7/8	¼	12
12 - 84	2 2/3	2 ¾	½	24

Continuous lock seam fabrication shall conform to the specifications of AASHTO M-36, except the profile of the sheet on at least one side of the lock seam and adjacent to the 180 degree fold shall have a minimum retaining offset of one-half the sheet thickness as defined in CA Test 662.

Sampling and testing for quality control shall conform to CA Test 662.

Continuous welded seam fabrication shall be a continuous helical welded seam oriented parallel to the corrugations. The combined width of the weld and the adjacent spelter of aluminum coating burned by the welding shall not exceed three (3) times the thickness of the metal. If the spelter is damaged by the welding outside of this specified area the weld, and the damaged spelter adjacent to the weld, shall be repaired. Sampling and testing for quality control shall conform to CA Test 665.

End Finish

The ends of helically corrugated steel pipe may be re-rolled to form annular corrugations extending at least two corrugations from the pipe end, or to form an upturned flange with or without reformed annular corrugations. The diameter of the reformed ends shall not exceed that of the pipe barrel by more than the depth of the corrugation. All types of pipe ends, whether re-rolled or not, shall be matched in a joint so that that the maximum difference in the diameter of abutting pipe ends is ½ inch.

Where the ends for helically corrugated steel lock seam pipe have been re-rolled, the lock seam in the re-rolled end shall not contain any visible cracks in the base metal and the tensile strength of the lock seam shall be not less than 60 percent of that required for the remainder of the pipe. The requirement shall not apply to the lock seam located within a flange formed in re-rolling.

Protective Coatings Linings and Paving

Unless specified otherwise by the Contract special provisions the outside and inside of all corrugated steel pipe shall be protected with a bituminous coating, or aluminum coating, as specified in this section.

Where shown on the Contract plans or specified by the special provisions, the invert of corrugated steel pipe shall be paved with bituminous material as specified in this section.

The inside and outside of all coupling bands and connecting hardware to corrugated steel pipe shall be bituminous coated or aluminum coated.

Prior to coating and paving, all moisture, dirt, oil, non-bonded paint, incompatible paint, grease, alkali, or other foreign matter shall be removed from the surfaces of all pipe, couplings, and fittings.

Bituminous coatings to corrugated steel pipe shall have a minimum thickness of 1/8 inch as provided for in AASHTO M-190, Type A.

Bituminous paving, where required, shall be applied over the bituminous coating to the invert of the pipe as provided for in AASHTO M-190, Type C, and ASTM A 849, Class M. The paving shall cover the area formed when measured 45 degrees from each side of the pipe invert (25 percent of the pipe circumference).

The Contractor, at the Contractor's expense, shall repair damaged galvanizing, protective coatings, linings and paving. Repairs shall be to the satisfaction of the Engineer and shall be as follows:

1. Damaged galvanizing shall be thoroughly wire brushed to remove all loose and cracked coating. The cleaned areas shall be painted with two (2) applications of un-thinned, zinc-rich primer (organic vehicle type).
2. Damaged aluminum coating shall be thoroughly wire brushed to remove all loose and cracked coating. The cleaned areas shall be painted with two (2) applications of un-thinned, zinc-rich primer (organic vehicle type). After the primer has dried, a coat of an approved asphalt or asphalt mastic shall be applied.
3. Damaged bituminous coatings and lining shall be thoroughly cleaned of all loose and cracked coating and lining. The cleaned areas shall be coated with an approved asphalt or asphalt mastic.

Joints and Coupling Bands

Coupling bands shall be one-piece, two-piece, or three-piece construction and shall be of the same materials as the pipe. In no case shall the thickness of the coupling be less than 0.052 inches or more than 0.109 inches. The minimum width of the coupling band shall be 10 ½ inches for annular corrugations and re-rolled ends and 12 inches for helical corrugations. All coupling band hardware shall be galvanized or electroplated in accordance with ASTM A 164, Type RS, or ASTM B 633, Class Fe/Zn 5. Bolts and nuts for all types of coupling bands shall conform to the requirements of ASTM A 307.

The distance between joined ends of pipe shall not exceed 1 ½ inches. The maximum difference in diameter between pipe ends to be joined shall not exceed ½ inch for pipe sizes 48 inches and smaller and one percent of the diameter for pipes larger than 48 inches.

Watertight joints when required by the Contract plans shall have sheet rubber or "O" ring type rubber gaskets conforming to the requirements of ASTM D 1053, Grades 41 to 43 and ASTM D 433.

19.03.8 Corrugated Aluminum Pipe (CAP)

Corrugated aluminum pipe shall be used only when shown on the Contract plans. Corrugated aluminum pipe shall be in accordance with the Contract special provisions and as specified in this section.

Materials

Corrugated aluminum pipe shall conform to AASHTO M-196 and M-197 and as specified in this section. Dimensions shown on the Contract plans or provided for in the Contract bid proposal are nominal and shall conform to AASHTO M-196.

Fabrication

Pipe fabricated with a continuous helical lock seam extending from end to end of each length may be used. Fabrication shall conform to the specifications of AASHTO M-196 except that the profile of the sheet on at least one side of the lock seam and adjacent to the 180 degree fold shall have a minimum retaining offset of one-half the sheet thickness as defined by CA Test 662.

The pipe ends may be rolled to form annular corrugations extending at least two corrugations from the pipe end. The diameter of the reformed ends shall not exceed that of the pipe barrel by more than the depth of the corrugation. All types of pipe ends, whether re-rolled or not, shall be matched in a joint such that the maximum difference in the diameter of abutting pipe ends is ½ inch.

Where the ends of the pipe have been re-rolled, the lock seam in the re-rolled end shall not contain any visible cracks in the base metal and the tensile strength of the lock seam shall not be less than 60 percent of that required for the remainder of the pipe. There shall be no open lock seams.

Pipe shall be fabricated so that it can be joined with standard coupling bands.

Sampling and testing for quality control shall conform to CA Test 662. During production of the pipe the manufacturer shall perform the specified tests for each pipe marking. When requested by the Engineer, a certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data.

Joints and Coupling Bands

Coupling bands shall conform to the requirements of AASHTO M-196, except that the minimum width of band for 12 inch and larger pipe shall be 12 inches. The minimum width of the band for pipe with one inch by 3-inch corrugations shall be 14 inches. The base metal of the bands shall be the same as the base metal of the pipe. The gauge of the connecting bands for corrugated pipe may be two standard-use thicknesses lighter than that used for the pipe, but in no case less than 0.060 inches thick. All coupling band hardware shall be galvanized or electroplated in accordance with ASTM A-164, Type RS, or ASTM B633, Class Fe/Zn 5. Bolts and nuts for all types of coupling bands shall conform to the requirements of ASTM A 307.

The distance between joined ends of pipe shall not exceed 1½ inches. The maximum difference in diameter between the pipe ends to be joined shall not exceed ½ inch for pipe sizes 48 inches and smaller and one percent of the diameter for pipes larger than 48 inches.

Watertight joints when required by the Contract plans shall be sheet rubber or "O" ring type rubber gaskets conforming to the requirements of ASTM D 1053, Grades 41 to 43 and ASTM D 433.

19.04 PIPE INSTALLATION

19.04.1 General

The ends of the pipe shall make a continuous and uniform line of pipe with a smooth and regular surface. The length and cross sectional diameter of the gasket, the annular space provided for the gasket, and all other joint details shall produce a watertight joint.

Under ordinary laying conditions the work shall be scheduled so that the socket end of the pipe faces in the direction the pipe is laid.

Pipe shall be laid to the alignment and grade shown on the Contract plans with uniform bearing under the full length of the pipe. Suitable excavation shall be made to receive the bell, coupling, or collar, which shall not bear upon the subgrade or bedding. Any pipe that is not in true alignment or shows any undue settlement after laying shall be taken up and relayed at the Contractor's expense.

At the close of work each day, or whenever the work ceases for any reason, the end of all pipes shall be securely closed.

19.04.2 Rubber Gasket Joints for RCP

Prior to placing the spigot into the socket of the pipe previously laid, the spigot groove, the gasket and the inside of the socket shall be cleaned. The spigot groove, the gasket and the first two (2) inches of the inside surface of the socket shall be lubricated with a soft vegetable soap compound.

Pipe sections shall be laid and jointed so that the offset of the inside of the pipe at any joint will be held to a minimum at the invert. The maximum offset at the invert of pipe shall be one-percent of the inside diameter of the pipe or 3/8 inches, whichever is smaller.

The lubricated gasket shall be uniformly stretched when placing it in the spigot groove so that the gasket is distributed evenly around the circumference.

After the joint is assembled, the position of the gasket shall be checked around the complete circumference of the pipe. If the gasket is not in the proper position, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe re-laid, and the gasket position checked.

19.04.3 Mortar Joints

When non-rubber gasket concrete pipe is installed, the joints shall be filled with a joint mortar. The mortar shall consist of one (1) part portland cement conforming to the requirements of ASTM C-150 for Type II cement with two (2) parts of mortar sand by volume. Sand shall be well-graded and shall pass the No. 8 sieve.

In joining socket and spigot pipe, the spigot of each pipe shall be seated in the socket of the adjacent pipe to provide a 3/8 inch annular space all around the pipe in the socket. Available offsets shall be distributed around the circumference of the pipe so that the minimum offset occurs at the invert.

Admixtures shall not be added to mortar without the prior approval of the Engineer.

19.04.4 Horizontal or Vertical Curves

Horizontal or vertical curves shall be made by using pipe with beveled ends or by slight deflections in the joints of straight pipe. Short lengths of pipe shall be made for curves of shorter radius than can be made with beveled pipes of usual length. Detailed layouts of curves shall be submitted to the Engineer by the pipe manufacturer for review and acceptance before fabrication of the beveled pipe. Curves may be made by use of angle bands at joints in lieu of beveled ends. Not more than 15 degrees of deflection angle shall be made in any one joint. Each angle joint shall lie as close as possible to the curve alignment as shown on the Contract plans.

19.04.5 Connections to Existing Pipe or other Appurtenances

When connections are to be made to any existing pipe, conduit, or other appurtenances, the actual elevation or position of which cannot be determined without excavation, the Contractor shall excavate and expose the existing improvement before laying any pipe or conduit. The Engineer shall be given the opportunity to inspect the existing pipe or conduit before the connection is made. The Engineer will make any adjustments in line or grade that may be necessary to accomplish the intent of the Contract plans.

19.04.6 Pipe Laid in Sheeted Trench

When pipe is laid in a sheeted trench, all sheeting against which concrete cradle is to be placed shall be faced with at least one thickness of building paper and the sheeting shall be withdrawn without displacing or damaging the cradle.

19.05 BACKFILL

19.05.1 General

Backfill shall be considered as starting one (1) foot above the pipe or at the top of concrete bedding over the pipe. All materials below this point shall be considered bedding for the purposes of this section.

Backfill, or fill, as the case may be, for cast-in-place structures such as manholes, transition structures, junction structures, vaults, valve boxes and reinforced concrete box conduits, shall start at the subgrade for the structure.

All backfill shall be placed as specified in this section, in the Standard Specifications and the Design Standards and as per the recommendations of the project geotechnical engineer.

Except where the pipe must remain exposed for force main leakage tests and subject to the provisions of this section, the Contractor shall proceed as soon as possible with backfilling operations. The pipe shall not be damaged or displaced. If concrete bedding placed between the trench wall and the pipe supports the pipe, the remainder of any bedding material shall be placed to one (1) foot over the top of the conduit. The backfill above the concrete bedding shall not be placed nor sheeting pulled until at least the minimum time after the placement provided by the optional classes of concrete designated in §20 "Concrete Construction" of the Standard Specifications for concrete bedding.

Unless otherwise specified, the periods of time set forth in the following table (after which the Contractor may place fill or backfill against or over the top of any cast-in-place structures) are predicated on the use of concrete to which no admixture has been added for the purpose of obtaining a high early strength:

Operation	Location	
	Against the Sides of Structures	Over the Top of Structures
Placement of Loose Backfill	5 days	21 days
Densification of Backfill	7 days	28 days

The Engineer may permit the use of admixtures or the use of additional cement in various parts of the structure in accordance with §20 "Concrete Construction".

Rocks greater than six inches in any dimension will not be permitted in backfill placed between one foot above the top of any pipe or box and one foot below pavement subgrade.

When the trench is wider than three feet, rocks not exceeding 12 inches in greatest dimension which originate from the trench, will be permitted in the backfill between one foot above the top of any pipe or box and 5 feet below the finished surface.

Rocks greater than two inches in any dimension will not be permitted in backfill placed within one foot of the pavement subgrade. Where rocks are included in the backfill they shall be mixed with suitable excavated materials to eliminate voids.

Subject to the provisions of this section, the material obtained from project excavations may be used as backfill provided that all organic material, rubbish, debris, and other objectionable materials are removed. Broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill subject to the same limitations as rocks, or provided they are processed to meet specified requirements of backfill materials. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, the voids remaining after the removal of the boulders shall be backfilled with suitable material and compacted as approved by the Engineer.

The removal of all boulders or other interfering objects and the backfilling of voids left by such removals shall be at the expense of the Contractor and no payment for the cost of such work will be made. The costs of the work shall be included in the prices paid for the various bid items of work.

Voids left by the removal of sheeting, piles and similar sheeting supports shall be promptly backfilled with clean sand, which shall be jetted into place to ensure dense and complete filling of the voids.

19.05.2 Mechanically Compacted Backfill

Backfill shall be mechanically compacted by means of tamping rollers, sheep's foot rollers, pneumatic tire rollers, vibrating rollers, or other mechanical tampers. All compaction equipment shall be of a size and type approved by the Engineer. Impact-type pavement breakers (stompers) will not be permitted over clay, asbestos, cement, plastic, cast iron, or un-reinforced concrete pipe.

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 the Contract. The Contractor shall make its 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 in the following table for the various type of equipment:

Type of Equipment	Maximum Lift (inches)
Free Fall	36
Hand Operated Mechanical Tapers & Plates	4
Impact	36
Pneumatic-Tired (Vibratory)	24
Pneumatic-Tired (Non-Vibratory)	12
Rollers (Including Vibratory and Non-Vibratory)	12
Segmented Wheel Rollers	12
Sheep's Foot	12
"Stomping"	36
Vibratory (Plates, Smooth-Wheeled)	24

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, moisture-conditioned, and then tamped or rolled until the specified relative compaction has been attained.

19.05.3 Water Densified

When approved by the Engineer, water densification of backfill shall conform to the provisions of this section. Densification 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 will not be permitted in roadways.

All backfill to be densified by water shall be jetted. Jetting shall be accomplished by the use of a jet pipe to which a hose is attached, carrying a continuous supply of water under pressure.

The jet pipe shall consist of a minimum one inch diameter pipe to which a minimum two inch diameter hose is attached at the upper end. The jet shall be of sufficient length to project to within two feet of the bottom of the lift being densified.

The Contractor shall jet to within two 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.

The lift of backfill shall not exceed that which can be readily densified by jetting, but in no case shall the undensified lift exceed six feet.

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. The Contractor shall make his own determination that jetting will not result in damage; any resulting damage shall be repaired at the Contractor's expense.

19.05.4 Import

If the Contractor is permitted or required to import material from a source outside the project limits for use as backfill, the materials shall be composed of clean soil, free from organic material, trash, debris, rubbish, and other objectionable substances.

Where the Contract plans or special provisions permit the use of imported material for backfill, the Contractor shall deliver, not less than 10 days prior to intended use, a sample of the material to the Engineer. The sample shall have a minimum dry weight of 100 pounds and shall clearly identify the source, including the street address. The Engineer will determine the suitability, the minimum relative compaction to be attained, and the placement method.

Should the imported material not be substantially the same as the approved sample, the imported material shall not be used for backfill and shall be removed from the site at the Contractor's expense.

The densification method for imported material authorized by the Engineer will be dependent upon its composition, the composition of the in-place soil at the point of placement, and the relative compaction to be obtained. Testing of import material shall be at the Contractor's expense.

19.05.5 Compaction Requirements

Except as specified otherwise, trench backfill shall be compacted to the following minimum relative compaction:

90 percent Relative Compaction:

1. Between the pipe zone and the upper 3 feet, measured from the pavement surface (or finish grade where there is no pavement) within native material.
2. Outside the traveled way, shoulders and other paved areas (or areas to receive pavement).

95 percent Relative Compaction:

1. In the upper 3 feet measured from the pavement surface (or finish grade where there is no pavement), within the existing or future traveled way, shoulders, and other paved areas (or areas to receive pavement).
2. Within engineered fill.
3. Where lateral support is required for existing or proposed structures.
4. Under sidewalks.

19.05.6 Testing Backfill

Compaction Laboratory Maximum Density

The following method shall be used for compaction tests unless otherwise specified:

Compaction tests will be performed in accordance with ASTM D 1557, Method C modified to use a 4-inch diameter mold. If the material contains more than 10 percent of particles that are retained on the 3/4-inch sieve then the compaction tests will be performed in accordance with ASTM D 1557, Method D, modified to use a 4-inch diameter mold.

The Engineer may modify ASTM D 1557, at the Engineer's option, to calculate relative compaction based on adjusted laboratory maximum wet density calculated as follows:

$$D_a = (100 D_m) / (100 \text{ plus or minus } W_a)$$

Where:

- D_a : Adjusted laboratory maximum wet density
- D_m : Maximum wet density per ASTM D 1557
- W_a : Percent change in moisture content from field moisture to laboratory optimum moisture. Use minus when field moisture content is higher than laboratory optimum moisture content. Use plus when field moisture content is lower than laboratory optimum moisture content.

Field Density

Field density of soil shall be determined by any method, approved by the Engineer, which will accurately and consistently determine the density and moisture content of the soil.

Relative Compaction

The words Relative Compaction (Relative Density): The ratio of the field dry or wet density to the laboratory maximum dry or adjusted wet density, respectively, expressed as a percentage.

Sand Equivalent

This test is intended to serve as a field test to indicate the presence or absence of plastic fine material. The test shall be run in accordance with CA Test Method 217 or ASTM D 2419. When testing material containing asphalt the test method shall be modified by drying the sample at a temperature not exceeding 100° F.

Permeability

Permeability tests for granular soils will be performed in accordance with ASTM D 2434 using samples compacted to the specified field density.

19.06 TESTING PIPELINES

19.06.1 General

All tests shall be completed and passed prior to placing of final asphalt surfacing or concrete surface improvements.

When leakage or infiltration exceeds the amount allowed by the specifications, the Contractor, at the Contractor's expense, shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests. Leakage tests shall be made on completed pipelines in accordance with Sections 19.06.2 and 19.06.3.

19.06.2 Water Exfiltration

Each section of pipe shall be tested between successive manholes by closing the lower end of the pipe to be tested and the inlet pipe of the upper manhole with stoppers. The pipe and manhole shall be filled with water to a point 4 feet above the invert of the pipe at the center of the upper manhole; or if groundwater is present, 4 feet above the average adjacent groundwater level.

If, in the opinion of the Engineer, excessive groundwater is encountered in the construction of a section of the pipe, the exfiltration test for leakage shall not be used.

The allowable leakage will be computed by the formula:

$E = 0.0001 \times L \times D \times \text{the square root of } H \text{ for mortared joints.}$

$E = 0.00002 \times L \times D \times \text{the square root of } H$ for all other joints.

Where:

L: the length of pipe tested, in feet.

E: the allowable leakage in gallons per minute.

D: the pipe diameter, in feet

H: the difference in elevation, in feet, between the water surface in the upper manhole and the invert of the pipe at the lower manhole; or if groundwater is present above the invert of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the groundwater at the lower manhole.

The Contractor shall, at Contractor's expense, furnish all water, materials and labor for making the required test. All tests shall be made in the presence of the Engineer.

19.06.3 Water Infiltration

The end of the pipe at the upper structure shall be closed sufficiently to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.

The infiltration into each individual reach of pipe between adjoining manholes shall not exceed that allowed by the formula in §19.06.2 where H is the difference in the elevation between the groundwater surface and the invert of the pipe at the downstream manhole.

Unless otherwise specified, infiltration will be measured by the Engineer using measuring devices furnished by the City.

19.06.4 Field Testing Plastic Pipe

Plastic pipe shall be inspected during installation to ensure that vertical deflections do not exceed 5 percent of the nominal inside diameter.

For pipelines with inside diameters less than 24 inches, a rigid mandrel shall be used to check deflections. For pipelines 24 inches or greater in diameter, a method approved by the Engineer shall be used to test vertical deflections, the accuracy of the test procedure shall be plus or minus 1/16 inch.

The rigid mandrel shall have a circular cross section diameter of at least 95 percent of the specified average inside diameter of the pipe. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. The mandrel shall be pulled through the pipe by hand. The inspection shall be as follows:

During Installation: The first section of the pipeline that has been installed shall be inspected to ensure that the Contractor's installation procedures result in acceptable vertical deflections. Additional sections may be inspected to ensure that the specified maximum deflection is not

exceeded. If excessive deflections are encountered, the affected pipes shall be removed, re-installed properly and re-tested.

After Installation: All mainline pipe shall be cleaned and then mandrelled to measure for obstructions (deflections, joint offsets and lateral pipe intrusions). If excessive deflections are encountered, the affected pipes shall be removed and re-installed properly and re-inspected. The Contractor, at the Contractor's expense, shall provide all material, equipment and labor to perform the test.

19.07 MANHOLES

19.07.1 General

These specifications apply to manholes and appurtenance materials.

The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer. The inspection may be made at the place of manufacture, or at the job site, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the specified requirements.

Materials rejected after delivery to the job site shall be marked for identification and shall be removed from the job site immediately.

All materials that have been damaged after delivery, prior to acceptance by the City, shall be rejected, even if installed. The Engineer's judgement shall be final on the condition of the material. The Contractor may attempt to make acceptable repairs on installed material(s); however, the Engineer's judgment on the acceptability of the repairs will be final, and if not satisfactory, the material shall be removed and replaced with satisfactory material entirely at the Contractor's expense.

19.07.2 Pre-cast Manhole Sections

Unless provided for otherwise by the Contract plans or special provisions, manhole bases shall be cast in place. All other parts of the manhole may be pre-cast.

Precast manhole sections, where not otherwise modified in the Contract plans, shall conform to ASTM C 478 and meet the following requirements:

1. The wall thickness shall not be less than 5 inches for 48-inch diameter barrel sections and 6 inches for 60-inch diameter barrel sections.
2. All sections shall be fully cured and shall not be shipped, nor subjected to loading, until the design compressive strength has been reached.

3. Pre-cast base sections shall have the base slab integral with the sidewalls. Pre-cast base sections shall be used only if the invert plan and alignment of the pipe connections in the base exactly match the field measured angles between the connecting pipes.
4. Manholes shall have ladder type, epoxy coated steps as approved by the Engineer.

19.07.3 Placing Pre-cast Manhole Sections

Pre-cast manhole sections shall be carefully inspected prior to installation. Sections with chips or cracks in the tongue shall not be used. The ends of pre-cast manhole sections shall be cleared of foreign materials.

The pre-cast sections shall be installed in a manner that will result in a watertight joint. Rubber "O" ring gaskets or preformed flexible joint sealant shall be installed in strict conformance with the manufacturer's recommendations. Only pipe primer furnished by the gasket manufacturer will be approved. If leaks appear in the manholes, the inside joint shall be caulked with non-shrink epoxy mortar to the satisfaction of the Engineer.

19.07.4 Manhole Bases

Unless provided for otherwise by the Contract plans or special provisions, manhole bases shall be cast in place. Materials used in cast-in-place concrete manhole bases shall be in accordance with the applicable requirements of §20 "Concrete Construction" of the Standard Specifications. At the option of the Contractor, and with the approval of the Engineer, pre-cast base sections with integral floor conforming to ASTM C 478 may be used.

19.07.5 Manhole Extensions

Concrete grade rings for extensions shall be a minimum of 4 inches thick and a maximum of 6 inches thick.

Manhole extensions will be used on all manholes in roads or streets or in other locations where a subsequent change in existing grade may be likely. Extensions will be limited to a total maximum height of 12 inches.

19.07.6 Jointing Manhole Sections

Male and female joints of manhole sections shall be sealed with either a round rubber "O" ring gasket or a preformed flexible joint sealant. The "O" ring shall conform to ASTM C 443. The preformed flexible joint sealant shall conform to Federal Specification SS-S-00210, and be Kent Seal No. 2 as manufactured by Hamilton-Kent, Ram-Nek as manufactured by K.T. Snyder Company, or approved equal. The size of the preformed joint sealant shall be as recommended by the manufacturer of the pre-cast manhole sections.

19.07.7 Manhole Base Channels

Concrete channels in the base of the manhole shall be constructed in the invert of the manhole. The channel shall provide smooth transitions to ensure an unobstructed flow through the manhole. All sharp edges or rough sections that tend to obstruct flow shall be removed. Where a full section of pipe is laid through a manhole, a neatly cut half-pipe shall be laid to form the channel. The exposed edges of the pipe shall be completely covered with mortar. All mortar surfaces shall be smooth. Breaking out the top half section of pipe after installation will not be allowed. The depth of channel shall be equal to one-half the depth of the outfall pipe.

19.07.8 Manhole Over Existing Pipe

Manholes shall be constructed over existing operating pipe lines at locations shown. Excavation shall be as specified in the Standard Specifications.

Flow through existing pipelines shall be maintained at all times and shall be controlled. New concrete and mortar work shall be protected for a period of one day after concrete has been placed.

The new base shall be constructed under and around the existing pipe as specified in this section. The top half of the existing pipe shall be neatly removed within the new manhole and the edges covered with smoothed mortar.

19.07.9 Connection to Existing Manhole

The Contractor shall provide all diversion facilities and perform all work necessary to maintain flow in existing pipes during connection to the existing manhole. After connection to the existing manhole, manhole bases shall be grouted as necessary to provide smooth flow into and through existing manholes. The connection procedure shall be as follows:

1. Break through an opening approximately 6 inches in diameter greater than the outside diameter of the pipe.
2. Roughen the surface of the pipe to be encased in the wall by sandblasting or other means. Plastic pipes shall be provided with a waterstop gasket.
3. Coat the surface of the existing wall edge and the area of the pipe to be encased with an epoxy bonding agent such as Sikadur Hi-Mod Epoxy Adhesive, as manufactured by the Sika Chemical Corporation, Concessive 1001-LPL, as manufactured by Adhesive Engineering Co., or approved equal. The grout must be placed while the bonding agent is still tacky.
4. Fill the space between the pipe and the existing wall with a non-shrink, non-metallic grout as manufactured by Master Builders, U.S. Grout Corp. (5 Star), or approved equal.

The grout shall have 0.01 percent shrinkage when tested according to the requirements of ASTM C-827 and Federal Specification CRD-C 62-1.

5. The pipe shall be shored in place so that there is no possibility of movement during and after the grouting operation. The shoring shall not be removed until the grout has attained a compressive strength of 3,000 psi or higher.

19.07.10 Frames and Covers

Castings shall conform to ASTM A-48, Class 35. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. The frames and covers shall be asphalt-coated. Frames and covers shall be installed on top of manholes to prevent all infiltration of surface or groundwater into manholes. Frames shall be set in a bed of mortar with the mortar carried over the flange of the ring. The frames shall be set so that the tops of the covers are at grade, unless otherwise shown or directed. Manhole collars shall be provided and manhole covers shall be stamped with "Storm Drain".

19.07.11 Hydrostatic Testing

The hydrostatic test shall consist of plugging all inlets and outlets and filling the manhole with water. Leakage in each manhole shall not exceed 0.1 gallons per hour per foot of head above the invert. All manholes that do not meet the leakage test shall be repaired to the satisfaction of the Engineer.

19.08 CONTROL OF EXISTING FLOWS

Flow in the existing pipes shall not be restricted or dammed for any period of time without the approval of the Engineer. All manhole connections shall be constructed while water is flowing in the existing pipe. All rerouting and/or bypass pumping of existing flows necessary to make the required modifications shall be made at the Contractor's expense. The Contractor must advise the Engineer of plans for diverting flow and obtain the Engineer's approval before starting. The Engineer's approval shall not relieve the Contractor of the responsibility for maintaining adequate capacity for flow at all times and for protecting new and existing work.

Where temporary pumps are required to divert flow across traffic lanes, the discharge lines crossing the traffic lanes shall be buried a minimum of 4 inches below the pavement surface and backfilled with temporary asphalt concrete surfacing.

19.09 TRENCH RESURFACING

19.09.1 Temporary

Unless permanent pavement is specified or allowed to be placed promptly, or shown otherwise in the Contract plans, or specified by the special provisions, temporary bituminous resurfacing shall be placed in trenches at locations open to pedestrian or vehicular traffic. Placement of temporary resurfacing shall immediately follow the completion of the trench backfill.

In sidewalk areas the temporary bituminous resurfacing shall be at least one inch thick; in all other areas it shall be at least 2 inches thick. At major intersections and other critical locations a greater thickness may be ordered.

Temporary resurfacing shall be placed as soon as the condition of the backfill is suitable to receive it and shall remain in place until the condition of the backfill is suitable for permanent resurfacing. The Contractor shall maintain temporary surfacing until it is removed.

Liquid asphalt binder used for temporary trench resurfacing shall be Grade SC-800, 4.8 percent to 6.5 percent. Aggregate for bituminous mixture used for temporary trench resurfacing shall conform to the following gradation.

Sieve Size	Percent Passing
½ inch	100
3/8 inch	90-100
No. 4	40-45
No. 8	20-32
No. 30	6-8
No. 50	2-12
No. 200	0-5

The minimum Stabilometer Value "S" shall be 30.

The mixture may be furnished from stockpiles or directly from the plan mixer and may be laid cold, at the option of the Contractor. The resurfacing shall be placed, rolled, maintained, and removed and disposed of by the Contractor.

19.09.2 Permanent Resurfacing

Unless otherwise shown on the Contract plans or indicated differently in the special provisions, all surface improvements damaged or removed as a result of the Contractor's operations shall be reconstructed by the Contractor to the same dimensions, except for pavement thickness, and with the same type materials used in the original work.

Trench resurfacing shall be one inch greater in thickness than existing pavement, or 3 inches, whichever is greater.

19.10 MEASUREMENT

Pipe and conduit shall be measured along the longitudinal axis between the ends as laid and shall include the actual pipe in place and shall not include the inside dimensions of structures

19.11 PAYMENT

The price per linear foot for pipe and conduit in place shall be considered full compensation for all wyes, tees, bends, monolithic catch basins, and special appurtenances as shown on the Contract plans; removal of interfering portions of existing storm drains and improvements, closing or removing of abandoned pipes, conduit and structures, trench excavations, control of ground water and surface water, preparation of subgrade, placing and joining pipe, trench backfilling, temporary surfacing, maintaining temporary surfacing, removing temporary surfacing, permanent surfacing, and all other work necessary to install the pipe complete in place.

No adjustment in the contract unit price shall be made for raising the pipe grade by any amount or lowering of the pipe grade by twelve (12) inches or less.

Payment for structures such as manholes, clean outs, junction structures, and catch basins shall be made at the Contract bid price for each structure and shall be full payment for each structure complete in place, including excavation, backfill, constructing inverts, furnishing and installing castings, restoration of the street surface and all other work, including temporary resurfacing, necessary to complete the work.

SECTION 20

CONCRETE CONSTRUCTION

20.01 PORTLAND CEMENT CONCRETE MATERIALS

20.01.1 General

Concrete shall consist of portland cement, aggregates, water, and admixtures in accordance with the following provisions. Concrete will be specified by class or by compressive strength. When specified by class, the concrete will be designated by a symbol consisting of a number, a letter and a number. The first number is the weight of cement in pounds per cubic yard, the letter is the combined aggregate gradation and the last number is the minimum 28 day compressive strength. The concrete class used shall be in accordance with this section unless otherwise specified. Concrete specified by compressive strength shall be designed by the Contractor in accordance with this section.

Approved admixtures shall be in accordance with this section. Additional cement is permitted to obtain high early strength in concrete, except that total cement shall not exceed 700 pounds of cement per cubic yard unless otherwise approved by the Engineer. Type III cement (High Early Strength) may be used in lieu of Type II cement in the same batch quantities as specified or approved for Type II cement.

Where Type V cement is specified, a combination of Type II cement with a minimum of 25 percent by weight Class F fly ash may be substituted provided the other provisions of this section are satisfied.

Concrete Specified by Class

The concrete class and maximum slump or the various types of construction shall be as designated in the Table 20.1, Concrete Classification by Use. The exact proportions of aggregate and water to be used in the concrete will be determined by tests of the materials to be used.

Concrete Specified by Compressive Strength

When specified, the Contractor shall determine the mix proportions of concrete specified on the Contract plans by the 28-day compressive strength within the minimum cement, maximum size coarse aggregate, and admixtures limitations designated in this section or in the special provisions. The concrete shall contain not less than 560 pounds of cement or cement and fly ash per cubic yard for concrete strengths of 3250 pounds per square inch or greater.

Calcium chloride may be used only with the approval of the Engineer. Admixtures proposed for use shall be evaluated in accordance with this section.

The proposed mix design shall be evaluated from field tests of a trial batch conforming to the size of load, materials, proportions, slump, mixing and placing equipment and procedures to be used in the actual work. The trial batch procedure may be waived when test data of prior performance of the proposed mix design is presented by the Contractor and approved by the Engineer.

When approved by the Engineer, trial batches may be placed in the work at designated locations where concrete of a lower quality is specified. For purpose of payment, concrete so placed will be considered to be the type of concrete specified at that location.

Test cylinders, when required by the Engineer, shall be molded from the trial batch containing the maximum water content indicated by the mix design. Fifty percent of the cylinders shall be tested at 7 days in order to establish the 7 day average compressive strength values. The remaining cylinders shall be tested at no more than 28 days after molding and the average compressive strength of the five cylinders shall be at least 600 pounds per square inch greater than the specified strength. The minimum strength of any one cylinder shall not be less than the specified strength.

The placing of concrete specified by compressive strength shall not begin until the mix design is in accordance with the test criteria presented in this section. New trial batches may be required should the source of materials, or established procedures, change.

TABLE 20.1 Concrete Classification by Use

Concrete Classification by Use		
Type of Construction	Classification	Maximum Slump
Bridges	560-C-3250	4
Box Culverts	560-B-3250	4
Drainage Inlets (Catch Basins)	560-C-3250	5
Channels (Invert)	560-B-3250	4
Channels (Walls & Deck)	560-B-3250	5
Curbs & Gutter (Formed)	560-C-2500	4
Curb & Gutters (Extruded)	560-C-2500	2
Footings (Fences, Guardrails)	560-C-2500	5
Foundations (Structures)	560-C-3250	4
Manholes	560-C-3250	5
Pavement	560-A-2500	3
Piles	560-C-3250	4
Pipe Collars	560-C-3250	5
Retaining Walls	560-C-3250	4
Slurry Backfill for Trenches	200-E-500	5
Sidewalk	560-C-2500	4

Various concrete designated Class 560-C-XXXX may be substituted with Class A concrete conforming to §90 of the State Specifications. Slurry backfill for trenches designated 200-E-500 may be substituted with slurry cement backfill conforming to §19-3.062 of the State Specifications. In all cases slurry backfill shall be hand-excavatable.

Test for Portland Cement Concrete

When required by the Engineer, portland cement concrete shall be sampled and tested in accordance with the following ASTM and CA Tests Methods present in Table 20.2.

TABLE 20.2 Test Methods and Characteristics

Test / Characteristic	Test	
	ASTM	CA
Air Content	173 or 231	---
Compressive Strength	39	---
Drilled Core Sample	42	---
Dry Shrinkage (with admixture)	---	530
Flexural Strength	78	---
Molding and Curing	31	---
Mortar Tube Test	---	515
Sampling Fresh Concrete	172	---
Setting of Mortar	191 or 266	---
Slump	143	---
Unit Weight Yield	138	---

A compressive strength test shall consist of the average strength of two cylinders fabricated from a single load of concrete except that, if any cylinder should show evidence of improper handling, molding, or testing, the cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

The Engineer will determine the sampling frequency. The Contractor shall afford the Engineer all reasonable access, without charge, for the procurement of samples of fresh concrete at the time of placement.

Concrete specified by class under this section shall attain the minimum 28-day strength designated.

Concrete specified by compressive strength under this section shall attain the following 28-day strength:

1. The average of any three consecutive strength tests shall be equal to or greater than the specified 28-day strength.
2. Not more than 10 percent of the tests shall be less than the specified 28-day strength.

3. No test shall be less than 85 percent of the specified 28-day strength.

20.01.2 Materials

Portland Cement

All cement to be used or furnished shall be Type II low alkali portland cement conforming to ASTM C 150, or Type IP (MS) portland-pozzolan cement conforming to ASTM C 595, unless otherwise specified. Either cement shall conform to the low alkali requirements of Table IA of ASTM C 150. Type IP (MS) cement shall contain no more than 20 percent pozzolan, which shall be inter-ground with the clinker.

The Contractor shall furnish a Certificate of Compliance signed by the manufacturer identifying the cement and stating that the cement complies with these requirements. Supporting test data shall be furnished when required by the Engineer.

Whenever suitable facilities are available for handling and weighing bulk cement such facilities shall be used. Otherwise the cement shall be delivered in the original unopened sacks that have been filled by the manufacturer. They shall be plainly marked with the manufacturer's name or brand, cement type and weight.

Cement shall be stored to permit ready access for the purpose of inspection and sampling and shall be suitably protected against contamination and moisture. Should any cement delivered show evidence of contamination or be otherwise unsuitable, the Engineer may reject it and require that it be removed from the site.

All portland cement used in concrete for any structure shall be of the same brand and type unless otherwise approved by the Engineer.

Aggregates

Aggregates shall conform to the requirements prescribed in this section and shall be approved by the Engineer prior to use. Aggregate shall be of such character that it will be possible to produce workable concrete within the limits of slump and water content specified in this section.

Methods of handling materials resulting in segregation, degradation or the combining of materials which results in failure to meet specifications shall not be permitted. The free moisture content of sand shall not exceed 8 percent at the time of batching.

Aggregates shall be non-reactive when tested in accordance with ASTM C 289 and evaluated in accordance with Appendix A-1 of ASTM C 33. Aggregates that have the potential to be reactive may be used only upon written approval of the Engineer.

Water

Water used for concrete shall not contain deleterious substances. Water shall not contain impurities that will cause a change in the time of setting of portland cement of more than 25 percent or a reduction in relative mortar strength at 7 days and 28 days of more than 10 percent compared to results obtained with distilled water.

In conventionally reinforced concrete work, water shall not contain more than 1,000 ppm of chlorides calculated as Cl nor more than 1,000 ppm of sulfates calculated as SO₄.

In pre-stressed concrete work, water shall not contain more than 650 ppm of chlorides calculated as Cl, nor more than 800 ppm of sulfates calculated as SO₄.

In non-reinforced concrete work, water shall not contain more than 2,000 ppm of chlorides calculated as Cl nor more than 1,500 ppm of sulfates calculated as SO₄.

Admixtures

Admixtures shall be used as specified or approved by the Engineer. The admixture shall be measured into each batch or load in liquid form by a mechanical dispensing device. The quantity dispensed shall not vary more than 5 percent from the quantity specified. If more than one admixture is used, each shall be dispensed by separate equipment in liquid form.

Samples of the admixture proposed for use shall be submitted by the Contractor to the Engineer to determine compliance with the specified requirements. Approval to use an admixture shall not relieve the Contractor of the designated concrete strength requirements.

Air-entraining Admixtures.

Air-entraining admixtures shall conform to ASTM C 260. Tests by an approved laboratory shall provide sufficient data to determine the time-strength characteristics of the concrete mix with the admixture.

When the air-entraining agent consists of a vinsol resin-water solution that has been neutralized with caustic soda (sodium hydroxide) the Contractor may use the air-entraining admixtures without presentation of test data. In lieu of test data, the Contractor shall furnish a certificate signed by the manufacturer attesting to this fact and stating: the ratio of sodium hydroxide to vinsol resin, the percentage of solids based on the residue dried at 105° C, and that no other additive or chemical agent is present in this solution.

The concentration of dilution of the admixture shall be such that it is dispensed into each batch of concrete at a rate of not less than ½ fluid ounce per 100 pounds of cement.

Adjustments shall be made in the weights of the aggregates used per batch to compensate for changes in yield due to air entrainment.

If the Contractor elects to use an air-entraining admixture, the Engineer may require that additional cement be added to the concrete mixture when the air content exceeds 4 percent. In no case shall the air content exceed 6 percent.

The air content shall not deviate from the percentage specified or permitted by more than 2 percentage points.

Water Reducing, Set Retarding and Accelerating Admixtures.

Water reducing, set retarding, and accelerating admixtures other than calcium chloride shall conform to ASTM C 494, and shall not be used in greater dosages than those recommended by the manufacturer, or permitted by the Engineer. The permitted dosage of the admixture shall not exceed that which will result in an increase in the drying shrinkage of the concrete in excess of 20 percent when used in pre-cast and pre-stressed concrete, or 10 percent when used in any other structural concrete. The strength of concrete containing the admixture in the amount proposed shall, at the age of 48 hours and longer, be not less than that of similar concrete without the admixture. The admixture shall not adversely affect the specified air content, unless permitted by the Engineer.

Calcium Chloride.

Calcium chloride may be used in reinforced concrete only upon approval of the Engineer. When calcium chloride is permitted or required to accelerate setting time and to reduce the time necessary for the concrete to reach its specified strength, it may be processed from either a brine solution or flake. If prepared from flake it shall conform to ASTM D 98. The calcium chloride solution shall contain not less than 32 percent of anhydrous calcium chloride and the hydrogen ion concentration (ph) shall be not more than 10.4 nor less than 6.0. Calcium chloride solution shall be used at the rate of not more than 3 pints per 100 pounds of cement.

Calcium chloride shall not be used in pre-stressed concrete. Admixtures containing chloride ions in excess of one percent by weight of admixtures shall not be used in pre-stressed concrete.

Admixtures to be used in grouting ducts in pre-stressed units shall not contain chloride ions in excess of 0.25 percent by weight of admixture.

Fly Ash

When approved by the Engineer, Class C or Class F fly ash may be used as a substitute for part of the required Type II portland cement in a concrete mix. The amount of Type II portland cement replaced shall be based upon trial batches in accordance with this section. An equal weight of fly ash is required as a substitute for the replaced portland cement. The maximum amount of portland cement replaced shall not exceed 30 percent by weight. Fly ash shall not be used with Type IP (MS) or Type III portland cement.

The Contractor shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C 618 and the Standard

Specifications. Supporting test data shall be furnished when requested by the Engineer. All testing and sampling procedures shall conform to ASTM C 311.

Suitable facilities shall be provided to discharge the fly ash into the cement hopper in accordance with this section. Fly ash shall be stored to permit ready access for the purpose of inspection and sampling and shall be suitably protected against contamination and moisture. Should any fly ash show evidence of contamination or moisture or be otherwise unsuitable, the Engineer may reject it and require that it be removed from the site or not used for this work.

All fly ash used in concrete for any individual project shall be from the same source and of the same class, unless otherwise approved by the Engineer. Fly ash shall conform to ASTM C 618 and the Table 20.3 – Characteristics of Fly Ash.

TABLE 20.3 Characteristics of Fly Ash

Fly Ash Characteristic	Class F (maximum)	Class C (maximum)
Loss of Ignition	4 percent	2 percent
SO ₃ Content	3 percent	4 percent
Moisture Content	1 percent	1 percent
R-Factor (When Type V cement is used)	0.75	---

$$R = (\% \text{ CaO-5}) \text{ from Fly Ash oxide analysis} / (\% \text{ Fe}_2\text{O}_3)$$

20.01.3 Proportioning

Aggregates and cement shall be proportioned by weight except that when the amount of concrete required for any one contract is 10 cubic yards or less, the materials may be measured by volume. Materials that are proportioned by volume shall be measured in containers of known capacity.

Weight hoppers shall be charged from bins located directly over them or from conveyor belts. When conveyor belts are used, there shall be a separate belt for each size aggregate. There shall be a moisture meter installed to measure the moisture content of the sand. The measurement shall be accurate to within one percent of the actual moisture content.

Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge. The cement hopper shall be attached to a separate scale for individual weighing.

The amount of water to be added to the mixture shall be measured into the mixing drum through a valve with a positive cutoff. When water is measured by weight, it shall be weighed on a separate scale.

Whenever a portable batch plant is set up at a new location, the scale assemblies shall be inspected and certified regardless of the date the scales were last tested.

Scales utilized in proportioning shall be either spring-less dial, multiple beam type, or solid-state digital strain gauge transducer. Scale graduations shall be no greater than the following:

Aggregate Scales	25 pounds
Cement Scales	5 pounds
Water Scales	5 pounds

If a multiple beam scale is used, the scale shall be provided with an indicator operated by the main beam, which will give positive visible evidence of over weight or under weight. The indicator shall operate during the addition of the last 400 pounds of any weighing. The over travel of the indicator hand shall be at least one-third of the loading travel. Indicators shall be protected against moisture and dust.

Weighing equipment shall be insulated against vibration and movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cutoff shall not vary from the weight designated by more than one percent for cement, one percent for water, one percent for any size of aggregate, and one percent for the total aggregate in any batch.

Combined Aggregate Grading

The combined aggregates shall conform to the gradations specified in Table 20.4.

TABLE 20.4 Combined Gradation for Portland Cement Concrete

Combined Gradation for Portland Cement Concrete Percentage Passing Sieves for Grades A through E					
Sieve Size	A	B	C	D	E
2 inch	100	100	---	---	---
1 ½ inch	95-00	95-00	100	---	---
1 inch	64-80	80-96	95-00	---	---
¾ inch	55-71	64-80	77-93	100	100
3/8 inch	37-53	40-52	50-70	92-00	90-00
No. 4	32-42	35-45	39-51	42-60	60-80
No. 8	25-35	28-38	31-41	33-47	50-70
No. 16	18-28	21-31	22-32	22-38	33-53
No. 30	10-18	10-20	12-22	17-25	19-35
No. 50	3-9	3-9	3-9	6-12	5-15
No. 100	0-3	0-3	0-3	1-5	2-6

No. 200	0-2	0-2	0-2	0-2	0-2
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Concrete Consistency

The amount of water added at the mixer shall be regulated to take into account the free water in the aggregates. Free water is the total water minus the water absorbed by the aggregate in a saturated surface-dry condition.

The amount of water used in the mixture shall not exceed the amount necessary to permit practical placement and consolidation of the concrete. Total free water in the mixture shall not exceed an amount producing the maximum slump specified in this section and shall not exceed amounts shown in Table 20.5 – Maximum Free Water.

TABLE 20.5 Maximum Free Water

Maximum Free Water					
Aggregate Grading	Pounds per Cubic Yard of Concrete Slump in inches				
	1 inch	2 inch	3 inch	4 inch	5 inch
A	270	280	290	300	310
B	275	285	295	305	315
C	290	300	310	320	330
D	320	335	350	365	375
E	335	350	365	380	395

When adverse or difficult conditions affect the placement of concrete, the Engineer may authorize a greater slump to be used, provided the cement content is increased accordingly. Water shall be added at a ratio not to exceed 32 percent of added cement per cubic yard of concrete and the additional water and cement shall be at the Contractor's expense.

20.01.4 Mixing

Machine mixing will be required in all cases other than those in which it would obviously prove to be impractical. Mixing shall be commenced as soon as possible after the cement is placed in contact with the aggregates, but in no event shall the intervening period exceed 30 minutes.

All concrete mixers shall provide a thoroughly mixed concrete in which the ingredients are uniformly distributed. Mixers shall be maintained in proper and serviceable working condition and any part or portion that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be repaired or replaced. Mixers shall not have any aluminum parts that will have direct contact with concrete.

Paving and Stationary Mixers

Paving and stationary mixers shall be equipped with an accurate automatic timing device to lock the discharge lever before aggregate and cement enter the drum, and to release the lever only after the specified mixing time has elapsed. The regulation of the setting of the device shall be under the supervision of the Engineer. Water control equipment shall also be provided with each concrete mixer.

The proper proportions of aggregate, cement, and water for each batch of concrete shall be placed in the mixer and shall be mixed for a period of not less than one minute for non-reinforced concrete and 1 ½ minutes for reinforced concrete.

The rotating speed of the mixer shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall not exceed the water level capacity of the mixer nor the manufacturer's guaranteed capacity of the mixer.

Transit Mixers

The type, capacity, and manner of operation of the mixing and transporting equipment for ready-mix concrete shall conform to the current Standards for Operation of Truck Mixers and Agitators of the National Ready-Mixed Concrete Association and the Truck Mixer and Agitator Standards of the Truck Mixer Manufacturer's Bureau.

Transit mix concrete trucks shall be equipped with an automatic device for recording the number of revolutions of the drum during the mixing period. Each mixer and agitator shall have attached, in a prominent place, a metal plate or plates, installed by the manufacturer, on which is marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in a location where it can be easily read from the batching platform.

The total volume of materials introduced into the mixer shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete mixed does not meet the uniformity requirements of this section the amount of materials charged into the mixer shall be reduced.

The drum of the mixer shall be empty before loading for a new mix. The proper proportions of aggregate, cement, and water for each load of concrete shall be placed in the mixer and shall be mixed for not less than 70 revolutions or more than 100 revolutions of the drum at the mixing speed designated by the manufacturer. Additional revolutions of the drum shall be at the speed

designated by the manufacturer as the agitating speed. The drum revolutions shall be continuous until the concrete is emptied from the drum.

Where concrete is being placed for pavement or concrete structures, all wash water shall be emptied from the mixer before any portion of the succeeding load is placed in the mixer. For all other work, the mixer may carry up to 10 gallons of water in the drum. Adequate control of ready-mixed concrete will normally require that additional water be added and mixed into the batch at the point of discharge. Water added shall be mixed into the load for a minimum of 30 revolutions at the rated mixing speed. Water shall not be added to the load during transit.

The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 90 minutes. Under conditions contributing to quick setting, the Engineer may reduce the total time allowed.

The Engineer shall be provided with a legible certified weigh-master certificate. The certificate shall contain the following information:

1. Name of Vendor.
2. Name of Contractor.
3. Project Location.
4. Number of cubic yards in the load.
5. Mix designation number.
6. Amount of water added at the plant (including water in aggregates).
7. Maximum allowable water.
8. Time and date of batching.

When the mix proportions are not designated by number, or when required by the Engineer, the certificate shall contain the following additional information:

1. Actual weights of cement and of each size of aggregate.
2. Brand and type of cement.
3. Brand, type, and amount of admixture.

Space shall be provided on the certificate so that amount of water added on the job may be indicated.

Hand Mixing

Hand mixing will be permitted when the amount of concrete required for any one job is one cubic yard or less. Hand mixed concrete shall be mixed on a watertight platform or in a mortar box in batches not to exceed 1/3 cubic yard. The aggregates shall first be spread in a uniform layer over which the required quantity of cement shall be evenly distributed. The entire batch shall be turned with shovels until the ingredients are thoroughly blended before adding the water. After adding the proper amount of water, the batch shall be turned with shovels until a uniform

consistency is obtained. Methods of hand mixing which allow the loss of mixing water will not be permitted.

Transporting Batched Materials and Mixed Concrete

The compartments of trucks or other equipment used for the purpose of transporting proportioned dry aggregate and cement, or mixed concrete, shall be suitably constructed to adequately protect and prevent loss or leakage of the contents during loading, transit or unloading.

20.02 STEEL REINFORCEMENT

20.02.1 General

Bar, wire and wire mesh reinforcement shall conform accurately to the dimensions and details indicated on the Contract plans. Before being placed in any concrete work, the steel reinforcement shall be cleaned of all rust, mill scale, mortar, oil, dirt or coating of any character which would be likely to destroy, reduce, or impair proper bonding with the concrete.

20.02.2 Reinforcing Steel

Unless otherwise specified, reinforcing steel shall be either Grade 40 or Grade 60 billet steel conforming to ASTM A 615.

Steel bending processes shall conform to the requirements of the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.

Bending or straightening shall be accomplished so that the steel will not be damaged. Kinked bars shall not be used.

20.02.3 Wire Reinforcement

Wire reinforcement shall conform to the requirements of ASTM A 82.

20.02.4 Wire Mesh Reinforcement

Mesh reinforcement shall conform to the requirements of ASTM A 185. The gauge of the wire and the dimensions of the mesh shall be as shown on the Contract plans or in the special provisions. The wire mesh reinforcement shall retain its original shape and form during handling. The effective cross-sectional area of the wire shall be equal to that specified or as shown on the Contract plans.

20.02.5 Samples for Testing

No reinforcing steel will be accepted until it has been approved by the Engineer. When required by the Engineer, samples shall be taken from bars selected by the Engineer and shall be cut in the Engineer's presence. The Contractor shall furnish a certified mill test report for each grade or size of steel when required by the Engineer.

20.02.6 Reinforcing Steel Bars

When required by the Engineer, two sample bars, each 3 feet long and cut from different bars, shall be taken from each bar size delivered to the job site on a cumulative tonnage basis in accordance with the following schedule:

Bar Sizes (Number)	Cumulative Weight of Steel per Bar Size Delivered to the Job Site
	Tons
2	½
3	1
4	2
5	3
6	4
7	5
8	7
9	9
10	11
11	13
14	20
18	35

Note: At least two sample bars shall be taken from each bar size.

20.02.7 Wire Reinforcement

When required by the Engineer, one sample consisting of two pieces, each 3 feet long, shall be taken from each two (2) ton lots or less of each size of wire delivered to the job site.

20.02.8 Wire Mesh Reinforcement

When required by the Engineer, two samples of a size suitable for testing shall be taken from each 3,000 square feet of fabric or fraction thereof.

20.03 EXPANSION JOINT FILLER AND JOINT SEALANTS

20.03.1 General

This section specifies joint fillers and sealant to be used for treating joints in portland cement concrete.

All joints which are to be sealed shall be formed with filler. The filler shall be placed in the proper position before the concrete is placed against it. Holes or joints in the filler shall be filled with mastic to prevent the passage of mortar or concrete from one side of the joint to the other.

20.03.2 Pre-molded Joint Filler

Pre-molded joint filler material shall consist of pre-molded strips of a durable resilient material. Unless otherwise specified, pre-molded joint filler shall be one of the following types:

Preformed Expansion Joint Filler (Bituminous Type)	ASTM D-994
Non-extruding and Resilient Filler (Bituminous Type)	ASTM D-1751
Non-extruding and Resilient Filler (Non-bituminous Type)	ASTM D-1752

20.04 CONCRETE CURING COMPOUND

20.04.1 General

Curing compound shall consist of a liquid that will, when applied to fresh concrete by means of a spray gun, form an impervious membrane over the exposed surfaces of the concrete.

The membrane may be either asphalt or parafin derivatives to which other waterproofing materials have been added. Concrete curing compounds shall be designated by type as follows:

Type 1	Clear or translucent with red fugitive dye.
Type 2	White pigmented.
Type 3	Light gray pigmented.
Type 4	Black pigmented.

All compounds shall be furnished by the Contractor and shall be delivered ready-mixed in sealed original containers bearing the manufacturer's name and product identification. At the time of use, pigmented curing compounds shall be thoroughly mixed, with the pigment uniformly dispersed throughout the mixture.

The rate of application shall be such that the compound forms a continuous, unbroken film when applied to the work. The Engineer will determine the permissible rate of coverage of a curing compound. Unless otherwise specified, Type 1 curing compound shall be used.

20.04.2 Test Requirements

Curing compounds shall be tested in accordance with ASTM C 309.

20.05 CEMENT MORTAR

20.05.1 General

Cement mortar shall consist of a mixture of portland cement, sand and water. Cement and sand shall first be combined in the proper proportions and then thoroughly mixed with the required amount of water.

Cement mortar shall be designated by class and proportioned by loose volume as follows:

Mortar Designation Class	Proportions	
	Parts Cement	Parts Sand
A	1	1
B	1	1
C	1	2
D	1	2
E	1	3
F	1	3

The quantity of water to be used in the preparation of mortar shall be that required to produce a mixture sufficiently workable for the purpose intended.

Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Re-tempering of mortar will not be permitted.

20.05.2 Cement

Cement shall conform to the requirements of this section.

20.05.3 Sand

Sand shall conform to the requirements of this section. In proportioning sand, the sand shall be measured loose (without shaking or compacting) in measuring boxes or other suitable containers of known capacity.

20.05.4 Water

Water shall conform to the requirements of this section.

20.05.5 Admixtures

No admixture shall be used in mortar unless otherwise specified or approved by the Engineer.

20.05.6 Quick Setting Grout

Quick setting grout shall be a high strength, non-staining grout approved by the Engineer prior to use. It shall reach an initial set within 90 minutes at 70° F and shall reach a minimum compressive strength of 2,500 psi within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's instructions.

20.06 CONCRETE STRUCTURES

20.06.1 General

Concrete bridges, culverts, drainage inlets, manholes, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformance with the Contract plans and special provisions. All structures shall be cast-in-place, unless provided for otherwise by the Contract plans or special provisions.

Concrete for use in work defined in this section shall conform to the requirements of this section.

The compressive strength of the concrete referred to in this section will be based on the results of concrete test cylinders made and tested by the Engineer. The cylinders shall be cured under conditions similar to those affecting the structure.

20.06.2 Subgrade for Concrete Structures

Earth subgrade shall be firm and free from water.

Groundwater shall be kept below subgrade until the concrete has set. When the subgrade is in dry earth it shall be treated with water to ensure that no moisture will be absorbed from the fresh concrete.

When the design details for the project provide for the construction of filter material or drain material consisting of gravel (or a combination of gravel and sand) and the material will be subgrade for concrete, the placing of steel reinforcement and the placing of concrete shall follow the installation of the filter material or drain material as closely as practical. The filter material or

drain material shall be kept de-watered to the extent necessary to prevent any portion of the concrete mixture from being deposited in the water.

When the concrete is to be deposited on rock, the rock shall be cleaned, and its surface shall be removed to expose sound rock. Bedrock shall be cut to horizontal and vertical steps.

Seams in the rock shall be grouted under pressure or otherwise treated as the Engineer may direct. Grouting seams in rock or otherwise treating them will be paid for as provided in the Contract special provisions and the Design Standards.

20.06.3 Forms

Forms shall be of a suitable material and of a type, size, shape, quality, and strength to ensure construction as designed. The forms shall be true to line and grade, mortar-tight, and sufficiently rigid to resist deflection during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor.

All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of the forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the concrete surfaces. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused.

Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable material that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete or reinforcing steel.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material that will provide a surface at least equal to surfaced lumber or plywood. Any lumber or material that is checked or warped shall not be used.

Forms for all exposed surfaces of bridges, viaducts, over-crossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be of the grade Exterior B-B (concrete form) conforming to the latest Product Standard for Soft Plywood, Construction and Industrial, of the National Bureau of Standards. Plywood shall be furnished and placed in 48-inch widths and in uniform lengths of not less than 96 inches except where the dimension of the member formed is less than the specified panel dimension. Plywood shall be placed with the grain of the outer plies in the direction of the span.

Where plywood is attached directly to studs or joists, the panels shall be not less than ¼-inch thick and the studs or joists shall be spaced at not more than 12 inches center to center. Plywood less than ¼-inch thick and otherwise conforming to the requirements specified in this section may be used with a continuous backing of ¾-inch sheeting.

All form panels shall be placed in a neat, symmetrical pattern with the horizontal joints level and continuous. All joints shall be filled with an approved quick-setting compound and finished flush with the interior of the form.

Wooden forms for copings and curbs shall have a thickness of not less than 1 5/8 inches and a width of not less than the full depth of coping or curb.

Unless shown otherwise on the Contract plans, all sharp edges shall be chamfered with 3/4 inch by 3/4 inch triangular fillets. Forms for curved surfaces shall be constructed and placed so that the finished surface will not deviate from the arc of the curve.

Forms shall be constructed so that portions of the forms, where finishing is required, may be removed without disturbing the portions of the forms to remain in place.

Forms for girders and slabs shall be chamfered as required by the Engineer.

Forms shall, as far as practicable, be constructed so that the form marks conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted-wire loop ties to hold forms in position will not be permitted, nor will wooden spreaders unless authorized by the Engineer. Clamps and bolts shall be of sufficient strength and number to prevent the forms from spreading. Clamps and bolts shall be of such type that they can be entirely removed or cut back one inch inside the finished surface of the concrete. All forms for outside surfaces shall be constructed with stiff wales at right angles to the studs, and all form clamps or bolts shall extend through, and fasten to, the wales.

20.06.4 Elimination of Outside Forms

When approved by the Engineer, unfinished faces of structures may be placed directly against excavated soil, provided the following conditions are met:

1. Soils must be firm, well-compacted and able to stand without sloughing.
2. The grade line of the soil must be no less than two (2) inches outside the concrete finish lines shown on the Contract plans.
3. When required by the Engineer, the entire face of the excavation, against which concrete is to be placed, shall be gunited to sufficient thickness to prevent raveling of the exposed earth faces during the placing of reinforcing steel, forms and concrete.
4. Should this method of construction prove unsatisfactory, the Contractor shall discontinue this method and construct outside forms.

5. Any additional work and materials involved in placing concrete against excavated soils shall be at no expense to the City.

20.06.5 Sheeting

When approved by the Engineer, sheeting may be used as the outside form provided:

1. Sheeting is closely fitted and all points shall be a minimum of two (2) inches outside the concrete lines shown on the Contract plans.
2. The sheet pile surface placed shall be faced with asphalt impregnated building paper.
3. Should this method of construction prove unsatisfactory, the Contractor shall discontinue this method and construct outside forms.
4. Unless approved otherwise by the Engineer, all sheeting shall be removed, but not until at least 7 days after placing concrete, or until the concrete has attained a compressive strength of at least 2,000 pounds per square inch.
5. Care shall be exercised in removing sheeting to avoid damaging the concrete.
6. Voids left by the removal of sheeting shall be backfilled with material having a Sand Equivalent (per CA Test 217) of not less than 30 and consolidated by jetting as approved by the Engineer.
7. Additional work and materials involved in the use of sheet piling for outside forms shall be at no expense to the City.

20.06.7 Removal of Forms

The periods of time for form removal set forth in this section are permissive only and subject to the Contractor assuming all risk that may be involved. The time periods are minimum with no allowance for external loads. At times of low temperature, or other conditions, the Engineer may approve or require the forms to be kept in place for longer periods of time.

The time periods are predicated on the use of concrete to which no admixtures have been added for the purpose of obtaining a high early strength, and upon the use of the same type of cement throughout the structure. The Engineer may permit the use of admixtures, additional cement, or different types of cement in accordance with this section. If such permission is granted, the minimum time periods for stripping forms shall be approved by the Engineer.

When the Contractor elects to use Type IP (MS) cement in accordance with this section the minimum form removal times may be longer than indicated in the following subsections.

Side forms for arch rings, columns, and piers shall be removed before the members of the structure they support are cast so that the quality of the placed concrete may be inspected. The forms shall be constructed so that they may be removed without disturbing other forms that support direct loads or that resist bending stress.

Form Removal Table	
Bridges	21 days or 3,000 psi
Box Culvert Outside Forms (Not Supporting Slab)	16 hrs
Box Culvert Inside Wall Forms (Not Supporting Slab)	16 hrs
Box Culvert Slabs (Type II Cement)	48 hrs or 6 hrs/foot ⁽¹⁾
Box Culvert Slabs (Type III Cement)	24 hrs or 3 hrs/foot ⁽¹⁾
Box Culvert Slabs (Type IV Cement)	56 hrs or 7 hrs/foot ⁽¹⁾
Catch Basins (Outside Forms, Not Supporting Top Slab)	16 hrs
Catch Basins (Top Slab Forms, Type II or V Cement)	48 hrs
Catch Basins (Top Slab Forms, Type III Cement)	24 hrs
Curbs (Unfinished Faces)	Upon Sufficient Set to Hold Shape
Curbs (Finished Faces)	Upon Set but in Time for Finishing
Falsework	14 days
Open Channel Walls	16 hours
Retaining Walls	7 days
Stairways	To Complete Same Day

Note (1): Per foot of unsupported span, whichever is greater.

20.06.7 Falsework

The Contractor shall submit detailed plans of the falsework proposed to be used. The plans shall be sufficiently detailed to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, and assumed soil conditions.

Falsework may be bolted or spiked at the option of the Contractor, but the use of bolts and spikes shall not be combined in the same connection. The allowable spacing and connection values of bolts and spikes shall be in accordance with the National Design Specifications for Stress-Grade Lumber and its Fastenings as recommended by National Lumber Manufacturers Association,

except that an additional allowance of 25 percent for temporary use shall be added to the connection values for bolts and spikes.

Ends of columns bearing on wedges shall be tied in both directions by girts.

20.06.8 Placing Reinforcement

Except for minor structures, driveways and sidewalk construction, the Contractor shall submit a steel reinforcement plan for approval.

Reinforcing bars shall be placed in accordance with the size and spacing shown on the plans. Reinforcing bars shall be firmly and securely held in position in accordance with the Manual of Standard Practice of the Concrete Reinforcing Steel Institute. Use concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Metal chairs which extend to the surface of the concrete (except where shown on the Contract plans) and wooden supports, shall not be used. Tack welding on reinforcing bars will not be permitted.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted. Before placing, all reinforcing steel shall be clean of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing seal has been inspected and approved.

Bar spacing is center-to-center of bars. Bar cover is clear distance between the surface of the bar closest to the face of the concrete and the face of the concrete and shall be 2 inches unless otherwise noted on the Contract plans or provided for in the Uniform Building Code and other applicable codes and standards.

Reinforcement shall terminate 2 inches from concrete surfaces and expansion joints, unless otherwise noted on the Contract plans and in accordance with the Uniform Building Code and other applicable codes and standards.

Reinforcement used in post-tensioned concrete shall be adjusted or relocated during the installation of pre-stressing products or tendons, as required, to provide planned clearances to the pre-stressing tendons, anchorage, jacks and equipment, as approved by the Engineer.

20.06.9 Splicing

Splices of bars shall be made only where shown on the Contract plans or as approved by the Engineer. Where bars are spliced, the length of overlap shall be at least 30 times the bar diameter, unless otherwise shown on the Contract plans.

Splicing shall be accomplished by placing the bars in contact with each other and wiring them together.

Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

20.06.10 Bending Reinforcement

Bends and hooks in bars shall be made in the manner prescribed in the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.

Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or unspecified bends shall not be used.

20.06.11 Welded Wire Fabric

Welded wire fabric shall be overlapped a minimum of two times the distance between wire strands measured in the same direction as the overlap. It shall be lifted carefully into its specified position after the concrete is placed but still plastic.

20.06.12 Placing Concrete

Concrete shall be conveyed, deposited, and consolidated by any method that will not result in segregation or loss of ingredients. Equipment used in conveying and depositing concrete shall not have any aluminum component in direct contact with the concrete.

All surfaces against which concrete are to be placed shall be thoroughly moistened with water immediately before placing the concrete.

Chutes used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

Where a sequence for placing concrete is shown on the Contract plans no deviation will be permitted unless approved in writing by the Engineer.

20.06.13 Grouting

Where concrete is to be deposited against hardened concrete at horizontal construction joints, placing operations shall begin by conveying a grout mixture through the placing system and equipment and depositing the mixture on the joint. The grout mixture shall consist of a modification of the concrete specified to reduce the quantity of coarse aggregate in the mix larger than pea-gravel size to one-half the quantity specified.

20.06.14 Depositing

To avoid segregation, concrete shall be deposited as near to its final position as practicable.

The use of vibrators for extensive shifting of the mass of concrete will not be permitted. Concrete that has partially hardened, has been re-tempered, or is contaminated by foreign materials shall not be deposited in the structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and proceed up grade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between construction joints and shall be terminated with square ends and level tops unless otherwise shown on the Contract plans.

Concrete shall not be permitted to fall more than six (6) feet without the use of pipes or tremies. Pipes and tremies shall be at least six (6) inches in diameter, or, the equivalent cross-sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members of sections has been consolidated and a two (2) hour period has elapsed to permit shrinkage.

20.06.15 Consolidating

Concrete shall be thoroughly consolidated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface of uniform texture free of rock pockets and excessive voids.

Structural concrete, except slope paving such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The location, manner and duration of the application of the vibrators shall achieve the maximum consolidation of the concrete without separation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least two vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed.

Approved external vibrators for consolidating concrete will be permitted when the concrete is not accessible to internal vibration. Forms and false work shall be designed and constructed to resist displacement or damage from external vibration.

20.06.16 Access Walkways

Access walkways and platforms shall be provided for personnel and equipment at a level convenient for the concrete placement and to permit the performance of all operations necessary for the completion of the work, including finishing.

Where bridge decks are to be constructed to final roadway grade, walkways shall be provided outside the deck area along each side and for the full length of the structure. The walkways shall

be of sufficient width and constructed to provide support for the bridges from which the longitudinal floats specified are to be operated.

20.06.17 Joints

The work shall be completed so that construction joints will occur at the designated places shown on the Contract plans, unless otherwise authorized by the Engineer. The Contractor shall construct, in one continuous concrete placing operation, all work located between the joints. Joints shall be kept moist until adjacent concrete is placed.

All construction joints having a key, or having a stepped or roughened surface, shall be cleaned by sandblasting prior to placement of the adjacent concrete, unless otherwise approved by the Engineer.

The sandblasting operations shall be continued until all unsatisfactory concrete, laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed to remove all loose material. The method used in disposing of the wastewater employed in washing the concrete surfaces shall be such that the wastewater will not stain, discolor, or affect exposed surfaces of the structures.

Expansion and contraction joints in concrete structures shall be formed where shown on the Contract plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the Contract plans.

No direct payment will be made for furnishing and placing asphalt paint, pre-molded asphalt filler, or other types of joint separators. The cost shall be included in the price bid for the item of work of which they are a part.

20.06.18 Application of Joint Sealant

All joint sealant shall conform to the requirements set forth by the Contract special provisions and as specified in this section.

Prior to sealing joints containing water-stops, the expansion joint filler hardboard, concrete spillage, and all foreign material shall be removed from the deck joint down to a depth of the water-stops. All such material shall be removed from the entire depth of joints in curbs, sidewalks, railings, and the overhanging portion of deck slabs.

Immediately before applying the joint sealant, the joint shall be cleaned by abrasive blasting or other approved means to remove all mortar, laitance, scale, dirt, dust oil, curing compounds and other foreign material. The joints shall be blown out with high-pressure compressed air to remove all residue.

If sealant is shown in the sidewalk joint, saw cutting of grooves at concrete railing locations shall be completed prior to constructing the railings. Joint seal material shall be protected during the construction of the railing.

At the time of applying the joint sealant the joint shall be surface dry, and acceptable to the Engineer. No sealant shall be placed during unsuitable weather or when the atmospheric temperature is below 50° F, or when weather conditions indicate that the temperature may fall below 32° F within 24 hours.

The joint shall be filled from the bottom to the top without formation of voids. The top of the finished joint seal shall be between ¼ inch and 5/8 inch below the finished surface.

All adjoining surfaces shall be carefully protected during the joint sealing operations and any stains, marks or damage, as a result of the Contractor's operations, shall be corrected in a manner satisfactory to the Engineer and at no expense to the City.

20.06.19 Placing Concrete Under Adverse Weather Conditions

Concrete for structures shall not be placed on frozen ground nor shall it be mixed or placed while the atmospheric temperature is below 35° F, unless adequate means are employed to heat the aggregates and water, and satisfactory provisions have been made for protecting the work.

Concrete slabs shall not be placed on frozen ground, nor shall concrete be mixed or placed when the atmospheric temperature is below 35° F, or when conditions indicate that the temperature may fall to 35° F within 24 hours, except with the written permission of the Engineer and only after such precautionary measures for the protection of the pavement have been taken as the Engineer may direct.

Concrete shall be effectively protected from freezing or frost for a period of 5 days after placing. Concrete placement shall be stopped when rainfall is sufficient to cause damage to the work. Concrete already placed shall be adequately protected from damage.

20.06.20 Surface Finishes

The classes of surface finish described in this section shall be applied to various parts of concrete structures as specified in the Contract special provisions and this section.

The invert of cast-in-place sewers and sewer structures shall be given a steel trowel finish. The invert in circular conduit is defined as the unlined portion of lined conduit or the bottom 60 degrees of circumference of the inside surface of the unlined conduit.

Ordinary Surface Finish

Immediately after the forms have been removed, all exterior form bolts shall be removed to a depth of at least one inch inside the surface of the concrete. The resulting holes or depressions

shall be cleaned and filled with mortar. On the interior surfaces of box girders the bolts may be removed flush with the surface of the concrete. Mortar shall be Class C. White cement shall be added to the mortar in an amount sufficient to tint the mortar a shade lighter than the concrete to be repaired. Mortar shall be mixed approximately 45 minutes in advance of use. Care shall be exercised to obtain a good bond with the concrete. After the mortar has thoroughly hardened, the surface shall be rubbed with a carborundum stone in order to obtain the same color in the mortar as in the surrounding concrete. All fins caused by form joints, and other projections shall be removed and all pockets cleaned and filled. Mortar for filling pockets shall be treated as specified for bolt holes.

Ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher-class finish. On surfaces which are to be buried underground, or surfaces which are completely enclosed (such as the cells of box girders), the removal of fins and form marks and the rubbing of a mortared surface to a uniform color will not be required. Ordinary surface finish, unless otherwise specified, shall be considered as a final finish on the following surfaces:

1. The undersurface of slab spans, box girders, filled-spandrel arch spans and floor slabs between T-girders of superstructures except for grade-separation structures.
2. The exposed surfaces of channel walls and the inside vertical surface of the girders of superstructures except for grade-separation structures.
3. Surfaces that are to be buried underground, covered with fill, or for surfaces of culverts above finish grade that are not visible from the traveled way.
4. Top surfaces which are to be buried underground shall be struck off and given a float finish.

20.06.21 Curing

After the completion of the specified finishing operations, as soon as the condition of the concrete will permit without danger of consequent damage, all exposed surfaces shall either be sprinkled with water, covered with plastic sheet, or covered with earth, sand or burlap, or when not required to be painted, sprayed with Type 1 curing compound conforming with this section.

When an impervious membrane (curing compound) is used, it shall be applied under pressure through a spray nozzle in a manner and quantity sufficient to entirely cover and seal all exposed surfaces of the concrete with a uniform film. The membrane shall not be applied to any surface until all of the finishing operations have been completed. The surfaces shall be kept damp until the membrane is applied.

All surfaces on which a bond is required, such as construction joint, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the curing compound. Any surface that the compound comes in contact with shall be cleaned

immediately. Care shall be exercised to prevent any damage to the membrane seal during the curing period. Should the seal be damaged before the expiration of 10 days after the placing of the concrete, an additional impervious membrane shall be immediately applied over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface exposed shall be immediately sprayed with a coating of the curing compound, or kept continuously moist by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When the tops of walls are cured by the curing compound method, the side forms, except for metal forms, must be kept continuously moist for the 10 days following the placing of the concrete.

If there is any likelihood of checking or cracking prior to the commencement of the curing operations (due to weather conditions, materials used, or for any other reason), the concrete shall be kept damp, but not wet, by means of an indirect fine spray of water until it is not likely that checking or cracking will occur, or until the curing operations are started in the area affected. When optional longitudinal construction joints are indicated on the Contract plans or specified in the special provisions, the Contractor will be permitted to lap the transverse reinforcing steel at the joints.

20.06.22 Measurement

Concrete

Measurement for concrete structures will be as provided for in the Contract bid proposal. Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat line of the structures as shown on the Contract plans and on the basis of the concrete having the specified dimensions.

The quantity of concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, or metal inserts or openings six (6) square feet or less in area.

Reinforcing Steel

The quantity of reinforcing steel, when scheduled as a separate Contract bid item, will be calculated for payment on the basis of the number of each type bar actually placed in accordance with the Contract plans and any approved changes. The weight will be calculated using the actual lengths of bars placed and by using the unit weights per linear foot specified in ASTM A 615, ASTM A 616, and ASTM A 617.

No payment will be made for reinforcing steel in laps (whether specified or optional) which are not used and payment will not be made for additional steel in laps which are requested by the

Contractor for the Contractor's convenience. No payment will be made for steel used in chairs or other devices for supporting the required reinforcement. The cost of tie wire shall be included in the unit price bid.

20.06.23 Payment

The contract unit price or lump sum price, shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work required to construct the structure in conformance with the Contract plans, specifications, and special provisions.

Unless a separate bid item has been provided for in the Contract bid proposal, de-watering, as may be required, shall be considered as included in the various contract bid items of work and no separate payment shall be allowed.

Unless a separate bid item has been provided for in the Contract bid proposal, all reinforcing steel, including tie wire, chairs and installation shall be considered as included in the Contract unit or lump sum price for the structure involved and no separate payment shall be allowed.

The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be included in the item of work of which the mortar is a part.

20.07 CONCRETE MINOR STRUCTURES

20.07.1 General

Concrete curbs, walks, gutters, cross gutters, access ramps, driveways and drainage inlets shall be constructed of portland cement concrete of the class and other requirements as specified in this section.

Unless otherwise specified on the Contract plans, the minimum thickness of walks shall be six (6) inches at locations subject to vehicular traffic and four (4) inches at all other locations. The minimum thickness of gutters, cross gutters, alley intersections, access ramps, driveway aprons and any concrete slab subject to vehicular traffic shall be six (6) inches.

20.07.2 Drainage Outlets Through Curb

Where existing building drains exist along the line of work, the new curb shall be suitably sleeved to provide for the drains. Sleeves shall be installed to serve low areas on adjacent property where drainage has been affected by the work.

The location and size of the sleeves and the construction of the connecting sidewalk drains shall be in accordance with the Contract plans, and as directed by the Engineer.

20.07.3 Driveway Entrances

Driveway entrances shall be provided in new curb at all existing driveways along the line of the work, at locations shown on the Contract plans, and at other locations that are designated by the Engineer.

The fully depressed curb opening at driveway entrances shall be one (1) inch above the gutter flow line at the curb face.

20.07.4 Forms

Form material shall not be warped and shall have smooth and straight upper edges. If used for the face of curb, the form shall be surfaced on the side against which the concrete is to be placed.

Wooden forms for straight work shall have a net thickness of at least one (1) inch. Metal forms for the work shall be of a gauge that will provide an equivalent rigidity and strength as the specified wood forms.

Curb face forms used on monolithic curb and gutter construction shall be of a single plank width when the curb face is 10 inches or less, except for those used on curb returns. All forms used on curb returns shall be not less than $\frac{3}{4}$ inch in thickness, cut in the length and radius as shown on the Contract plans and held rigidly in place by the use of metal stakes and clamps. The curb face form shall be cut to conform exactly with the curb face batter as well as being cut to the required length and radius. Forms shall be of sufficient rigidity and strength, and shall be supported to adequately resist springing or deflection from placing and tamping the concrete.

Form material shall be clean at the time it is used and shall be given a coating of light oil, or other equally suitable material, immediately prior to the placing of the concrete.

All forms, except back planks of curb, shall be set with the upper edges flush with the specified grade of the finished surface of the improvement to be constructed. All forms shall be not less than a depth equivalent to the full specified thickness of the concrete to be placed.

Back forms shall be held securely in place by means of stakes driven in pairs at intervals not to exceed four (4) feet, one at the face of the front form and one at the backside of the back form. Clamps, spreaders, and braces shall be used to ensure proper form rigidity. Forms for walk, gutter, and similar work shall be firmly secured by means of stakes driven flush with the upper edge of the form at intervals not to exceed five (5) feet. Form stakes shall be sufficiently sized and shall be driven to sufficient depth to resist lateral displacement.

Commercial form clamps for the curb and gutter may be used provided they fulfill the requirements specified in this section.

20.07.5 Placing Concrete

Concrete shall be placed on subgrade that is sufficiently dampened to ensure that no moisture will be absorbed from the fresh concrete.

Concrete shall be placed in curb, gutter, and curb and gutter forms in horizontal layers not exceeding six (6) inches in thickness. Each layer shall be spaded along the forms and shall be thoroughly tamped. Concrete may be placed in layers of more than six (6) inches in thickness only when authorized by the Engineer and the spading and tamping is sufficient to consolidate the concrete for its entire depth.

After the concrete for walk has been placed, a strike-off shaft shall be used to bring the surface to the proper elevation when compacted. It shall be spaded along the form faces and tamped to a dense and compact mass, and to force the larger aggregate down while bringing to the surface not less than 3/8 inch of the free mortar for finishing purposes.

Concrete shall be placed in cross gutters in horizontal layers of not more than four (4) inches in thickness, each layer being spaded along the form faces and thoroughly tamped into a dense and compact mass. If internal vibrators are used, the specified thickness may be placed in one operation.

After the concrete has been placed and tamped, the upper surface shall be struck off to the specified grade.

20.07.6 Joints

Joints in concrete curb, gutter, and walk shall be designated as expansion joints and weakened plane joints. When replacing sidewalk adjacent to an existing sidewalk with varying joints and score lines, new joints and score lines shall be placed to match the existing patterns. A weakened plane joint shall be placed at all locations where utility boxes and other similar structures are located.

Expansion Joints

Expansion joints and weakened plane joints shall be constructed in curb, walk and gutter as shown on the Contract plans or as specified in this section. No joints shall be constructed in cross gutters, alley intersections, access ramps or driveways except as approved by the Engineer.

One-quarter inch joints shall be constructed in curb and gutter at the end of all returns except where cross gutter transitions extend beyond the curb return, in which case they shall be placed at the ends of the cross gutter transition. No joints shall be constructed in returns.

Where monolithic curb and gutter is constructed adjacent to concrete pavement, no expansion joints will be required except at beginning of the curb return (BCR) and at the end of the curb return (ECR).

One-quarter inch joints shall be constructed in walk returns between the walk and the back of curb returns when required by the Engineer. At the beginning of curve (BC) and end of curve (EC) and around utility poles the joint filler-strips shall extend for the full depth of the concrete being placed. Joint filler-strips between walk and curb shall be the depth of the walk plus one inch with the top set flush with the specified grade of the top of curb.

All expansion joint filler strips shall be installed vertically and shall extend to the full depth and width of the work in which they are installed. The filler strips shall be constructed perpendicular to straight curb or radial to the line of the curb constructed on a curve. Expansion joint filler materials shall completely fill the joints to within 1/4 inch of any surface of the concrete. Excess filler material shall be trimmed off to the specified dimension. During the placing and tamping of the concrete, the filler strip shall be held rigidly and securely in proper position.

Weakened Plane Joints

Weakened plane joints shall be straight and constructed in accordance with provisions contained in this section, unless otherwise shown on the Contract plans.

In walks, joints shall be transverse to the line of work and at regular intervals not exceeding 10 feet. At curves and walk returns, the joints shall be radial.

In gutter, including gutters integral with curb, joints shall be at regular intervals not exceeding 20 feet. Where integral curb and gutter is adjacent to concrete pavement, the joints shall be aligned with the pavement joints where practical.

Control Joints

After preliminary trowelling, the concrete shall be parted to a depth of two (2) inches with a straightedge to create a division in the coarse aggregate. The concrete shall then be re-floated to fill the parted joint with mortar. Headers shall be marked to locate the weakened plane for final joint finishing which shall be accomplished with a jointer tool having a depth of 1/2 inch and a radius of 1/8 inch. The finished joint opening shall not be wider than 1/8 inch.

Plastic Control Joint (Score Line)

The joint material shall be a T-shaped plastic strip at least one inch deep, having suitable anchorage to prevent vertical movement, and having a removable stiffener with a width of at least 3/4 inch. After preliminary trowelling, the concrete shall be parted to a depth of 2 inches with a straightedge.

The plastic strip shall be inserted in the impression so that the upper surface of the removable stiffener is flush with the concrete. After floating the concrete to fill all adjacent voids, the removable stiffener shall be stripped. During final trowelling, the edges shall be finished to a radius of 1/8 inch using a slit jointer tool.

20.07.7 Finishing

Finishing shall be completed as specified in this section for the type of work being performed

Curbs

The front forms may be stripped as soon as the concrete has set sufficiently. Class B mortar, as prescribed in this section (Cement Mortar) and thinned to the consistency of grout, shall be immediately applied to the top and face of the curb if needed, or as directed by the Engineer. If monolithic curb and gutter is being constructed, the mortar shall be applied to the exposed curb face; otherwise, it shall extend two (2) inches below the gutter surface.

The face and top of the curb shall then be trowelled to a smooth and even finish. The top shall be finished to a transverse slope of $\frac{1}{4}$ inch toward the gutter and both edges shall be rounded to a radius of $\frac{1}{2}$ inch. The trowelled surface shall be finished with a fine-hair broom applied parallel to the line of the work. The edge of the concrete at all expansion joints shall be rounded to a $\frac{1}{4}$ inch radius. Joints shall conform to the provisions of this section.

Walks

The forms shall be set to place the finished surface in a plane sloping up from the top of curb at two (2) percent when measured at right angles to the curb.

Following placing, the concrete shall be screened to the required grade, tamped to consolidate the concrete and to bring a thin layer of mortar to the surface, and floated to a smooth, flat, and uniform surface. The concrete shall then be edged at all headers, given a preliminary trowelling and provided with weakened plane joints.

Walks shall be steel trowelled to a smooth and even finish. All formed edges shall be rounded to a radius of $\frac{1}{2}$ inch. Edges at expansion joints shall be rounded to a radius of $\frac{1}{8}$ inch. Preliminary trowelling may be done with a long handled trowel or "Fresno", but the finish trowelling shall be done with a hand trowel.

Walk, on grades of less than six (6) percent, shall be given a fine hair-broom finish applied transverse to the centerline. Walk, with grades exceeding six (6) percent, shall be finished by hand with a wood float. Walk shall be remarked as necessary after final finish, to assure neat uniform edges, joints, and score lines.

Scoring lines, where required, shall have a minimum depth of $\frac{1}{4}$ inch and a radius of $\frac{1}{8}$ inch. When longitudinal scoring lines are required, they shall be parallel to, or concentric with, the lines of the work. Walk 20 feet or more in width shall have a longitudinal center scoring line. In walk returns, one scoring line shall be made radial midway between the beginning of curb return (BCR) and end of curb return (ECR). Longitudinal and transverse scoring lines shall match the adjacent walk.

Headers shall remain in place for at least 16 hours after completion of the walk but must be removed before the work is accepted, or as required to accommodate other work.

Gutter

After the concrete has been thoroughly tamped in such manner as to force the larger aggregate into the concrete and bring to the top sufficient free mortar for finishing, the surface shall be worked to a true and even grade by means of a float, trowelled with a long-handled trowel or "Fresno" and wood float-finished. The flow line of the gutter shall be trowelled smooth for a width of approximately four (4) inches for integral curb and gutter and four (4) inches on either side of the flow line on cross gutters and longitudinal gutters. The outer edges of the gutter shall be rounded to a radius of 1/8 inch.

Side forms shall remain in place for at least 24 hours after completion of the gutter, but must be removed before the work will be accepted.

Access Ramps and Driveways

The final finishing for access ramps and the sloping portion of driveways shall be done by hand with a wood float and the remaining portion of the driveway finished as specified for walks in accordance with this section.

20.07.8 Curing

Immediately after finishing operations are completed, a Type 1 concrete-curing compound shall be applied.

The curing compound shall be applied under pressure, by means of a spray nozzle, in such manner and quantity as to entirely cover all exposed surfaces of the concrete with a uniform film. Curing compounds shall be as specified in this section (Concrete Curing Compound).

No power equipment used for the preparation of subgrade will be permitted adjacent to concrete curb, gutter, or alley intersections until the fourth day following placement of the concrete. The placement of bituminous pavement adjacent to concrete curb, gutter, or alley intersections will not be permitted until the seventh day following the placement of concrete and concrete paving operations will not be permitted until the seventh day where placing or finishing equipment will ride on the previously placed concrete. If admixtures, additional cement or Type III cement is used to obtain high early strength concrete in accordance with this section (Admixtures), grading operations will be permitted on the second day following the placement of the concrete and paving operations on the third day.

20.07.9 Repairs and Replacements

Any new work found to be defective or damaged prior to Project acceptance shall be replaced by the Contractor at no expense to the City.

20.07.10 Backfilling and Cleanup

Backfilling to the finished surface of the newly constructed improvement must be completed before acceptance of the work, or as required to accommodate other work.

Upon completion of the work the surface of the concrete shall be thoroughly cleaned and the site left in a neat and orderly condition.

20.07.11 Measurement

Measurements to determine the pay quantities will be made in horizontal planes, including removal of existing concrete, disposal, subgrade preparation, backfilling and cleanup. Quantities shall be measured on a unit basis or lump sum basis as provide by the Contract bid proposal.

20.07.12 Payment

Payment for concrete curbs, walks, gutters, cross gutters, access ramps and driveways will be made on a unit or lump sum basis as provided for in the Contract bid proposal.

The Contract unit or lump sum price shall be considered as including full payment for furnishing all materials, labor, equipment and incidentals, including forming and cleanup required to construct the concrete improvements in accordance with the Contract plans and special provisions.

Where existing improvements must be removed to accommodate new concrete construction, and no separate bid item has been included in the Contract bid proposal for such removal, full payment for all work required to remove and dispose of the improvements shall be considered as included in the various bid items of work and no additional compensation shall be made.

SECTION 21

LANDSCAPING

21.01 GENERAL

21.01.1 Scope

This work shall consist of furnishing all labor, materials, plant materials, tools and equipment required to grade, prepare soil, seed, fertilize, plant, and complete the landscaping as shown on the Contract plans, special provisions, and the Standard Specifications.

The Contractor shall coordinate the layout and installation of plant material with the installation of the irrigation system to ensure that there will be complete and full irrigation coverage of planting in accordance with the Contract plans and special provisions. The irrigation system shall be installed and tested prior to installation of the plant material.

The "Model Water Efficient Landscape Ordinance" by the California Department of Water Resources shall apply.

21.01.2 Planting Conditions

No planting or seeding shall occur during weather conditions that will adversely affect the materials or when the soil is muddy. The Contractor shall not plant at the end of the day, on Fridays, or on the day before a City holiday unless a crew has been assigned to care for the plants on the next calendar day, on the weekends or on the holidays.

21.01.3 Preservation of Existing Improvements

The planting and seeding operations shall be conducted so that existing improvements and plants are not damaged. The Contractor shall be responsible for any damage resulting from the Contractor's operations and the Contractor shall repair or replace any damage at the Contractor's expense and to the satisfaction of the Engineer. Vehicles shall not be allowed to pass over curbs, sidewalks, planting areas, etc., unless proper protection is provided.

Damage to utility lines, underground structures and improvements shall be repaired at the Contractor's expense to the satisfaction of the Engineer and to the satisfaction of the utility company.

Where necessary to protect existing trees, the Engineer may require the Contractor to modify his operations. Existing trees within the limits of construction that will not be removed shall be protected and treated in accordance with the Standard Specifications.

Native earth materials, debris and other materials shall not be piled against trees or stored below the drip line of trees.

21.01.4 **Underground Obstructions**

Rocks and other obstructions shall be removed to a depth necessary to permit proper planting according to the Contract plans and this section. Where underground utilities, construction or solid rock ledges are encountered, the Engineer shall be contacted to determine the extent of the obstruction. The Engineer shall select alternate locations.

21.01.5 **Personnel**

Planting shall be performed by people familiar with the procedures required of their trade and shall be supervised by a qualified foreman.

21.01.6 **Sequence of Work**

Landscaping shall not begin until all other improvements have been installed and inspected by the Engineer. The Contractor must receive approval to proceed from the Engineer prior to starting landscaping work.

21.01.7 **Inspections**

The Contractor shall request inspections a minimum of 48 hours in advance of the time of the required inspection.

21.01.8 **Quality**

All work shall be of the highest quality and shall be subject to the approval of the Engineer. Any work that is deemed unacceptable by the Engineer shall be removed by the Contractor and replaced with work that is acceptable to the Engineer. Replacement and the removal of defective work shall be at the Contractor's expense.

All plant materials shall be in prime condition when installed and accepted.

Any commercially processed or packaged materials shall be delivered to the site in the original unopened containers and shall bear the manufacturer's guaranteed analysis.

21.01.9 **Storage of Materials**

1. Plants not installed on the day of arrival at the site shall be stored and protected as follows: a) Outside storage shall be shaded and protected from wind and sun. b) Plants shall be kept in a moist condition until planted.

2. Fertilizer and lime shall not be stored with any other landscape materials.

3. Soil sterilant shall not be stored with any other landscape materials.
4. Storage of materials shall only be in designated areas, or areas approved by the Engineer.
5. Seed containers shall be stored in a dry, weatherproof structure. Any seed that has become wet, moldy, or is otherwise damaged in transit or storage will be rejected.

21.01.10 Submittals

1. The Contractor shall submit to the Engineer, within 14 days following the date of the Notice to Proceed, all descriptive data and samples for the work as required by this section and offers of alternatives, if any. The submittals shall be checked and coordinated by the Contractor with the work of other trades involved before they are submitted to the Engineer for examination.
2. Submittals shall be made by a letter of transmittal and shall contain a list of all materials submitted and shall identify all deviations from the Contract plans and specifications. The letter and all accompanying items shall be identified by project name and location and by the Contractor's name. Ample cross references to the contract documents should be used to facilitate identification of items and their location in the work.
3. Two copies of the submittals shall be presented to the Engineer.
4. The Contractor shall supply the Engineer with a list of all products (fertilizer, soil amendments, and plant materials) including the name of the nursery or supplier.
5. When requested by the Engineer, the Contractor shall supply the Engineer with a sample of all supplied materials accompanied by analytical data from an approved laboratory source illustrating compliance, or bearing the manufacturer's guaranteed analysis.

21.02 MATERIALS

21.02.1 General

Plants shall be of the variety, quantity and size indicated on the Contract plans. When total quantities are shown tabulated on the Contract plans, they shall be considered approximate and are furnished for convenience only. The Contractor is responsible for installing all of the plants shown on the Landscape Plan and for computing the quantity of ground cover required within the area specified when planted at the specified spacing. The quality and size of the plants shall conform to the State of California Grading Code of Nursery Stock, No. 1 grade. Only nursery-grown stock shall be used and the stock shall be free from pests and diseases.

All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations. Inspection certificates required by law shall accompany each shipment of plants and shall be delivered to the Engineer. All plants shall be true to the species and size indicated and shall be tagged in accordance with the standards established by the American Association of Nurserymen.

Plants shall be healthy, shapely, and well-rooted. Roots shall show no evidence of having been root bound, restricted or deformed. Plants that have just been upgraded in container size shall be rejected. The root condition of plants in containers will be inspected by the Engineer and determined by removal of earth from the roots of not less than two plants of each species, or variety, from each source.

All plants declared by the Engineer to be unsuitable for planting as a result of inspection of materials shall be removed from the site. The plants shall be replaced with specimens that conform to the specifications. The removal of rejected plants and the replacement with plants conforming to the specifications and satisfactory to the Engineer shall be at the Contractor's expense.

The Contractor shall facilitate inspection and identification by labeling trees and bundles or containers of the same shrub, groundcover or vine with a durable waterproof label and weather resistant ink. Labels shall state the correct plant name and size as specified in the project plant list and shall be legible for 60 days after delivery to the planting site. Plants that are not labeled may be rejected.

21.02.2 Transporting

All plants shall be handled and packed carefully to avoid damage. All necessary precautions shall be taken to ensure that healthy plants will be delivered to the site.

Plants shall be transported in enclosed trucks. Trees that are too large for enclosed trucks may be transported in open trucks provided that they are wrapped to prevent damage and windburn. Trees in transport or prior to shipping shall not be tipped so that the container of the tree is not leaning on the trunk of the adjacent tree. Adequate protection shall be placed between trees so that trunks are not scarred in transport and branches are not broken.

21.02.3 Plants

Plants shall have straight trunks with the leader intact, undamaged and uncut. Old abrasions and cuts shall be completely callused. All plants shall be measured when their branches are in their normal position. The height of a plant is measured from the root crown to the top of the plant. The width of the plant is measured at the branching at the widest point. Indicated sizes shown are before pruning. Plants shall not be pruned prior to delivery.

Ground cover shall be rooted plants and grown in flats unless otherwise noted on the Contract plans or as approved by the Engineer.

21.02.4 Trees

Trees shall be well tapered in the trunk so that when the nursery stake is removed the tree supports itself without further staking. Trees shall have a main leader. The main branches shall be spaced vertically and alternately along the trunk. Branching shall not be concentrated in one location nor shall there be severe crossing of branches. Branches shall be smaller in diameter than the trunk. Branch attachments shall be free of embedded bark. At least one half of the foliage on the branches shall be located along the lower two-thirds of the trunk.

Trees shall be of the specified size. The height shall be measured from the root crown. The diameter shall be measured six (6) inches above the root crown.

21.02.5 Seed

Seed mixture shall be 98 percent pure and free of weeds with a minimum germination of 88 percent. All seed shall be re-cleaned, Grade A "new crop" seed, delivered in the original unopened containers, and shall bear a guaranteed analysis and the dealer's label. The dealer may mix the seed provided a guaranteed statement of mixture composition and percentages of purity and germination of each variety is attached to the sealed container. The seed shall be pretreated with a pre-emergence fungus preventative such as "Thiram", or approved equal, in accordance with the manufacturer's specifications.

21.02.6 Topsoil

Topsoil, unless specified otherwise in the Contract plans and special provisions, shall be imported. At least 15 days prior to scheduled use, the proposed source of topsoil must be submitted in writing to the Engineer for approval. The submittal shall be accompanied by a written report of a testing agency registered by the State for agricultural soil evaluation. The report shall state that the proposed topsoil complies with these specifications.

Topsoil shall have the same relative composition and structure and a friable sandy loam character. The topsoil shall be free of roots, clods and stones larger than ½ inch in their greatest dimension

Topsoil shall meet the following requirements:

1. Sand: 50 percent to 80 percent by dry weight
Clay: 20 percent maximum by dry weight
Silt: 30 percent maximum by dry weight
2. The gradation limits shall be in accordance with ASTM D 422.
3. The permeability rate shall not be less than 0.5 inch per hour nor more than two (2) inches per hour when tested in accordance with ASTM D 2434 or CA Test 220.

4. The topsoil shall be suitable to sustain the growth of the plants specified.

21.02.7 Organic Soil Amendment

Soil amendments shall comply with the applicable requirements of the State Food and Agriculture Code and as specified in this section. Soil amendments shall be a ground or processed wood product derived from redwood, fir, or cedar sawdust, or from the bark of fir or pine, treated with a non-toxic agent to absorb water quickly, and shall comply with the following requirements: of fir and pine or cedar wood, free from weed seed, dust, and objectionable material and containing the physical properties specified in the following tables.

Topsoil Gradation	
Sieve Size	Percent Passing
3/8 inch	95 - 100
¼ inch	90 - 95
No. 8	85 - 90
No. 35	15 - 20

Topsoil Nitrogen Content	
Source	Percent by Dry Weight
Redwood	0.40 - 0.60
Fir	0.56 - 0.84
Cedar	0.56 - 0.84
Fir Bark	0.80 - 1.20
Pine Bark	0.80 - 1.20

Other Topsoil Characteristics	
Ash Content	0.0 percent to 0.8 percent by dry weight
Iron	Minimum 0.8 percent diluted acid soluble Fe by dry weight
Salinity	Maximum Saturation Extract Conductivity @ 77° F, 6.35 millimhos per inch
Wettability	When water applied to sample @ 1 part H ₂ O to 14 parts sample, the sample shall dry completely within 2 minutes

When required by the Engineer the Contractor shall submit a Certificate of Compliance stating that the material meets these specifications.

21.02.8 Fertilizer

Fertilizers shall comply with applicable requirements of the State Food and Agriculture Code and as specified in this section. The fertilizer shall be a commercial inorganic fertilizer in granular or pellet form. Fertilizer shall be delivered to the site in containers labeled in accordance with applicable State of California regulations, bearing the warranty of the producer for the grade furnished. The fertilizer shall be uniform in composition, dry and free-flowing.

Planted and Seeded Areas: Pellet type with an analysis of 6-20-20 (N-P-K) and granular type 16-6-8 (N-P-K).

Planting Holes: Tablets, 21 gram size, or approved equal, with an analysis of 20-10-5 (N-P-K).

When required by the Engineer, the Contractor shall submit a Certificate of Compliance stating that the material meets these specifications.

21.02.9 Herbicide

The Contractor shall submit a written chemical weed control program, prepared by a licensed pest control advisor, for approval by the Engineer.

Herbicide shall be compatible with the plants specified in the Contract. Proof of compatibility shall be included in the weed abatement program submitted. The program shall specify the recommended waiting period between spraying and planting.

21.02.10 Mulch

Unless otherwise specified in the special provisions, mulch shall be ¼ inch to 3/8 inch diameter fir bark.

21.02.11 Planting Hole Backfill

Backfill to be used in planting holes shall be 100 percent topsoil as specified in this section.

21.02.12 Tree Stakes and Ties

Tree stakes. Stakes shall be three (3) inches in the shortest dimension, straight and closed grained and shall be composed of lodge pole treated pine or fir, or construction heart rough sawn redwood.

Pine and fir stakes shall be treated with copper naphthanate. The treatment shall penetrate the stake to a minimum depth of ¼ inch.

Tree straps. Straps shall be corded rubber tire strips, or approved equal, one inch wide by ¼ inch to ½ inch thick. The straps shall not contain steel or have wire ties.

Guy Wire. Guy wire shall be No.12 BWG zinc-coated iron.

Plastic Ribbon Ties. Plastic ribbon ties shall be a minimum of one inch wide and have a minimum tensile strength of 500 pounds.

21.02.13 Substitutions

Substitutions will not be permitted, unless proof is submitted to the Engineer that any plant specified is not available. The Engineer will consider the use of the nearest equivalent size or variety. The proof shall be substantiated and submitted in writing by the Contractor within 14 days after the effective date of the Notice to Proceed. The Engineer will make appropriate deductive adjustments to the Contract bid items for the substitute materials and there will be no additional compensation for approved substitutions.

21.03 GRADING AND SOIL PREPARATION

21.03.1 Rough Grading

Prior to any planting bed preparation or planting, the Contractor shall grade all planting areas. Fill shall be placed, or cut removed, as required, and the areas shall be finished to a smooth and uniform grade. All planting areas shall be sloped to drain to appropriate drainage facilities. Rough grades shall be inspected and approved by the Engineer before any amendments and fertilizers are installed. All planting areas shall be thoroughly wetted down. Soil shall be dry enough to be workable and then thoroughly cultivated to a depth of six (6) inches.

21.03.2 Soil Amendments, Fertilizers and Cultivating

The soil amendment and fertilizer shall be spread evenly over all areas, including grass-from-seed areas, at the following rates:

Soil Amendment. 6 cubic yards per 1,000 square feet

Fertilizer 30 pounds of 6-20-20 per 1,000 square feet

After approval of amendment and fertilizer applications by the Engineer, they shall be incorporated into the top six (6) inches of soil.

21.03.3 Watering

All seeded and planted areas shall be kept moist during the establishment period. Where irrigation is by drip or bubblers, the Contractor may, at Contractor's option and expense, install a temporary irrigation system.

21.03.4 Spraying with Chemical Weed Killer

At the end of the watering period, the Contract shall apply an approved general chemical weed killer to eliminate all weed growth and roots, including broad leaf and grass seedlings, in non-grass areas.

The weed killer shall not sterilize the soil and shall be applied as per the manufacturer's directions. Alternate weeding methods can be used upon approval of the Engineer.

21.03.5 Finish Grading

All planting areas shall be finish graded for placement of plant materials and seeding operation. Grading shall be done when soil is at the optimum moisture content for working.

Planting areas, including seeded areas, shall be true to grade within 0.10 feet.

Grades not indicated on the Contract plans shall be composed of uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins. Finish grades shall be smooth, even, and on-plane with no abrupt changes and no erosion scars. Minor adjustments to finish grades shall be made at the direction of the Engineer, as required.

All grades shall provide for the natural runoff of water and shall be free of low spots or pockets. Flow line grades shall be accurately set and shall not have a gradient of less than two (2) percent unless otherwise shown on the Contract plans.

Finish grade of earth in planting beds shall be one (1) inch below the top of the adjacent pavement, curbs or headers, unless otherwise indicated on the Contract plans. Finish grade of earth in grass areas shall be ½ inch below the top of adjacent pavement, curbs or headers.

Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.

21.04 PLANTING

21.04.1 Staking Locations

The Contractor shall mark tree and shrub locations on site using stakes or similar means. The Engineer shall approve the locations before plant holes are dug.

21.04.2 Planting Holes

After the test hole has been completed and tested, the size of planting holes shall be determined and approved by the Engineer.

Planting holes shall be circular in outline with vertical sides. The sides shall be roughened to allow root penetration. The bottom three (3) inches of soil shall be loosened. A foot-tamped mound shall be made in the bottom of pit to support the plant at the proper level.

21.04.3 Water Test Selected Plant Holes

1. The Engineer will select tree-planting holes to be water tested. Approximately one (1) location per 80 square feet will be selected
2. The Contractor shall fill the hole with water and shall check the hole after 24 hours to see if the water has drained out. If not drained, the condition shall be brought to the attention of the Engineer.
3. An adjustment of the hole size or location will be made if drainage problem exists.

21.04.4 Plant Placement

Container plants shall not be handled by the plant tops, stems, or trunks at any time All plants shall be lifted so that root ball is supported from the underside. Plants that do not have a satisfactory root system will be rejected.

The root ball shall be cut vertically in a few places to encourage new feeder root development along the perimeter of the root ball.

All plants shall be planted immediately after the containers are cut. The containers shall be removed from the site.

The plants shall be placed in upright and plumb positions.

Spacing of groundcovers shall be a minimum of 12 inches on centers, or as shown on the Contract plans, if closer. Plants shall be evenly spaced and staggered in rows. Each plant shall be placed in the planting hole so the root system lies free without doubling and so the roots are planted vertically. The soil around the plant shall be hand tamped firmly around the plant. Plants shall be watered promptly.

21.04.5 Fertilizing and Backfill

Prior to backfill fertilizer tablets shall be placed in the bottom perimeter of the hole as follows:

Plant Size	Number of Tablets
1 gallon	1
5 gallons	3
15 gallons	5
24 inch box	7

The planting hole shall be backfilled with topsoil meeting the requirements of this section. Backfill shall be tapered around the sides and up to the top of the root-ball so that root-ball is completely covered, if appropriate for the plant type.

A three (3) inch high berm shall be constructed around the perimeter of the planting hole. The planting hole shall be thoroughly watered to the full depth of the hole and filled with water. In areas to receive grass, the berm shall be removed and seeded after the third watering.

21.04.6 Tree Staking

A minimum of two stakes shall be installed for each tree. Tree stakes shall not penetrate the root-ball. For 24-inch box trees, two (2) 30-inch long wood crosspieces shall be nailed between the stakes. Unless shown otherwise on the Contract plans, a minimum of two (2) ties shall be installed on each tree.

Ties shall be placed as low on the trunk as possible but high enough so the tree will return to an upright position after deflection.

To find the proper height for tie locations, hold the trunk in one hand, pull the top to one side and release. The height at which the trunk will just return to the upright position when the top is released is the height to attach the ties.

Ties are to form a loose loop around the tree trunk and stakes so that the trunk cannot work towards the support stakes. Tree ties shall be nailed securely in position.

Support stakes are not to be higher than six (6) inches above the top tie location. A flexible auxiliary stake shall be attached to those trees needing extra trunk support as determined by the Engineer. One tree of each size shall be staked and approved by the Engineer prior to continued staking.

21.04.7 Pruning

No pruning shall be done unless specifically requested by the Contractor.

21.04.8 Pre-emergent Herbicide Application

Pre-emergent herbicide shall be applied to all areas that support trees, shrubs, ground cover and fir bark. Chemicals used are to be submitted to the Engineer in a written chemical weed control program prepared by a licensed pest control advisor.

Pre-emergent shall be applied during a windless period. Areas to receive seed shall be protected from contamination by the pre-emergent.

Any area to receive seed that is contaminated with pre-emergent shall have the top 6 inches of soil removed and replaced with imported topsoil to the satisfaction of the Engineer and at the Contractor's expense.

21.04.9 Mulching

The Contractor shall install a 3-inch thick layer of fir bark in all planted areas not planted with grass or hydro-seed. Fir bark shall be kept away from the stems and trunks of plants a distance of four (4) inches from groundcovers and eight (8) inches from all other plants.

21.04.10 Adjustment of Plants

Plants that settle deeper than specified shall be raised by the Contractor. The Contractor shall straighten and re-stake plants that go out of plumb.

21.05 GRASS SEEDING

Installed plants and trees shall be approved by the Engineer before seeding operations begin. Just prior to seeding, areas to be seeded shall be loosened to a depth of two (2) inches, raked to remove sticks, debris, and rocks $\frac{3}{4}$ inches or larger in size, floated level, rolled and floated again. Seed shall not be sown during windy days.

Seed shall be sown evenly using a mechanical spreader. Seed mixture shall be spread at the rate of 10 pounds per 1,000 square feet of area. One half of the seed shall be sown in one direction, and the remaining seed sown in a direction 90 degrees to the initial direction.

Existing undisturbed lawn adjacent to new areas being seeded shall be over seeded to provide even grass coverage. Upon completion of sowing, fertilizer (16-6-8) at the rate of six (6) pounds per 1,000 square feet shall be uniformly spread over seeded areas.

After fertilizing, the surface shall be lightly raked to cover the seed and to mix the seed with the fertilizer. After covering, the seeded areas shall be compacted with a 200 pound roller. The soil shall be kept moist until the seed has germinated.

Unless approved otherwise by the Engineer, seeded areas shall be protected with temporary fencing. Fencing shall not interfere with pedestrian or vehicular traffic. Prior to installation, the Contractor shall obtain approval of the Engineer for fence types and locations. Fencing shall be maintained by the Contractor and shall be kept in an orderly condition at all times until the Engineer approves the removal.

21.06 CLEAN UP

The Contractor shall keep the premises free from accumulations of waste material or rubbish caused by the Contractor's work. At the completion of the work the Contractor shall remove all rubbish, tools, scaffolding, and surplus materials from the site and shall neatly dress and finish all planting areas. Streets and walks open to public traffic shall be broom cleaned at the end of the

work day and all plant materials within the construction area shall be rinsed as often as necessary to keep foliage free of dust.

21.07 PRE-FINAL INSPECTION

The Contractor shall request an inspection of the completed planting work. At the time of the pre-final inspection:

1. All planting shall be healthy and free of infestations.
2. All planting areas shall be free of weeds.
3. Grass areas shall show a uniform, smooth ground surface without eroded ruts or gullies, and shall show evidence of uniform seed germination.
4. Grass shall be mowed to two (2) inches above finish grade.
5. Stakes and ties shall be as specified.
6. Mulch shall be raked to uniform surface. Areas not mulched shall be raked to uniform surface.
7. All debris shall be removed from site, all pavements swept clean and all foliage shall be washed clean.
8. All plants shall have been installed as per the Contract plans and specifications.

Any deficiencies identified by the preliminary final inspection shall be corrected to the satisfaction of the Engineer before the final inspection for the project is scheduled.

21.08 MAINTENANCE

21.08.1 General

The Contractor shall be responsible for maintenance of the completed landscaping for a minimum period of 30 days or as specified in the Contract special provisions, if longer. The first day of the contract maintenance period shall begin the day following the date of acceptance of the completed project by the City Council.

Maintenance shall include:

1. Watering (except the cost of water).
2. Adjusting automatic irrigation timers.
3. Adjusting sprinkler heads.
4. Adjusting emitters.
5. Mowing.
6. Edging.
7. Replacing annual plants.
8. Weeding.
9. Fertilizing.

10. Cultivating.
11. Spraying / pest control.
12. Pruning.
13. Litter removal.
14. Sweeping.
15. Disposal of all debris from maintenance activities.

Maintenance shall include all other work and materials, not specifically listed above, required to keep all plants, trees, shrubs and turf healthy and growing, and to keep the planted areas neat and attractive in appearance.

Plants installed under this contract shall be properly maintained by regular watering, cultivating, weeding, re-mulching, repair of stakes, pruning, and treatment of insects and pests.

Until the completion of the required maintenance period the Contractor shall provide maintenance of grass areas by watering, weeding, seeding, mowing (includes trimming and edging), rolling and by performing all other necessary operations of maintenance including treatment for fungus diseases, insects, pests or rodents. Re-seed all bare spots at intervals of 10 days until a full stand of grass is established over the entire grass area outlined in the Contract scope of work.

Whenever the grass reaches a height of three (3) inches, but in no event less than weekly, it shall be mowed to a height of two (2) inches above the ground surface. All clippings shall be removed. After the second mowing of grass, a second application of fertilizer shall be made. The fertilizer (16-6-8) shall be uniformly applied at the rate of six (6) pounds per 1,000 square feet. A third application of fertilizer shall be made, at the same rate, two (2) weeks prior to completion of the specified maintenance period.

Maintenance shall also include treatment for fungus, diseases, rodents, and insects.

21.08.2 Watering

Except during periods of extended inclement weather, all plants shall be watered not less than twice a week. Each watering shall provide for optimum growth conditions.

21.08.3 Plant Replacement

Plants that are vandalized, damaged by herbicide, diseased, unhealthy, or dead shall be replaced by the Contractor at the Contractor's expense within two weeks after notification from the Engineer. Any plant exhibiting weakness and the probability of dying shall be replaced by the Contractor at the Contractor's expense.

Replacements of plants or grass shall be made in the same manner as specified for the original planting. Heaved, settled, or eroded areas shall be restored by excavating, filling, finish grading, and rolling as required.

Work under this section shall include the Contractor assuming complete responsibility for maintaining adequate protection for all areas. Any damaged areas shall be repaired at the Contractor's expense. At the end of the maintenance period, all plants shall be healthy and weed free.

21.08.4 Mowing

Grass shall be mowed each time it reaches three (3) inches in height and with blades set to two (2) inches above grade. Grass shall be trimmed at the edges of curbs, paving, drains and headers. Grass areas that fail to germinate shall be re-seeded at 10 day intervals until a vigorous, even stand of grass is established. Seeding operation shall follow these specifications for initial installation. Grass areas shall be kept free of weeds by hand pulling, or by spraying with the approved selective chemical herbicide before weeds exceed two (2) inches in height. Clippings and debris shall be removed from the site.

21.08.5 Weeding

During the maintenance period the Contractor shall weed all areas at intervals of not more than ten (10) calendar days. Rocks, clods, and debris, which appear on the surface, shall be removed at the time of weeding.

21.08.6 Final Maintenance Inspection

A final inspection will be conducted at the end of the required maintenance period. Notice requesting final inspection shall be submitted by the Contractor to the Engineer at least fourteen (14) calendar days prior to the end of the maintenance period.

The irrigation system shall also be tested and inspected at this time.

Prior to the final inspection, the Contractor shall also have performed weeding, repair or touch-up of paving, equipment, and structures, and the thorough cleaning of the site.

Just prior to final maintenance inspection, 16-6-8 granular form commercial fertilizer shall be applied as follows:

Plant Size	Quantity
Ground Cover	10 pounds per 1,000 square feet
Specimen	1 pint
1 gallon	¼ cup
5 gallons	½ cup
15 gallons	1 cup
24 inch box	2 cups

Mulch shall be raked away from around plant bases. Fertilizer shall be spread around plant base and worked into the top two (2) inches of soil. Mulch shall then be replaced.

The Contractor shall make any required replacements within one (1) week after final inspection. If the Contractor is not, in the opinion of the Engineer, properly maintaining the landscaping and irrigation system, the City may have the cost of any required work performed deducted from payments due to the Contractor. The costs will include a 20 percent markup for administrative costs.

21.08.7 Acceptance

Acceptance of the project by the City will be contingent upon proper maintenance and the establishment of vigorous plant materials. Any area that does not show vigorous growth is subject to continued maintenance at the Contractor's expense. If project improvements, corrective work, and maintenance have not been performed as specified, and to the satisfaction of the City, maintenance shall continue at the Contractor's expense until the work has been successfully completed and accepted by the City.

Upon written acceptance of the landscaping by the Engineer, the Contractor will be relieved from any further maintenance.

21.09 GUARANTEE

All trees, and other plant materials shall be guaranteed to take root and grow, and thrive for a period of one (1) year after final acceptance of work, or thirty (30) calendar days following acceptance of the landscaping by the City at the conclusion of the required maintenance period, whichever is later.

Any trees or other plant materials that die or lose their shape or size shall be replaced.

Within 15 calendar days of written notification by the Engineer, the Contractor shall, at the Contractor's own expense, remove and replace all guaranteed plant materials which, for any reason, fail to meet the requirements of the guarantee. Replacements shall be made to the same specifications as required for the original materials and shall carry the same guarantee starting from the time they are replaced.

21.10 MEASUREMENT

Landscaping shall be measured as a lump sum or by contract units as provided for in the Contract bid proposal. Maintenance shall be measured as a lump sum item. There shall be no separate measurement for required guarantees.

21.11 PAYMENT

21.11.1 Guarantee

There shall be no separate payment for guarantees required or provided under the Contract. Full compensation for furnishing and compliance to guarantee requirements shall be considered as included in various contract items of work and no separate compensation shall be allowed.

21.11.2 Maintenance

The contract price for maintenance will be paid in monthly payments, in arrears, on a pro-rata basis. The pro-rata basis shall be the total contract price for maintenance divided by the number of months covered by the maintenance period. The Contractor shall submit monthly invoices to the City. Payments will be paid within 30 days after receipt of the invoice subject to successful completion of the work for the monthly period being invoiced.

The compensation for maintenance shall also include full compensation for maintenance of the irrigation system.

21.11.3 Landscaping

The Contract lump sum price, or unit prices, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, incidentals and for doing all landscaping work including grading, soil preparation, fertilizing, staking, watering, as provided for in the Contract plans and specifications and no additional compensation shall be allowed.

SECTION 22

LANDSCAPE IRRIGATION

22.01 GENERAL

22.01.1 Scope

The Contractor shall furnish all labor, tools, equipment, materials, and perform all operations necessary for the proper execution and completion of all irrigation work in accordance with the Contract plans and special provisions. The work shall include trenching and backfill, water and electrical service connections, installing backflow preventers, controllers, sleeves, conduits, main lines, lateral lines, remote control valves, pressure reducing valves, hose bibs, quick coupler valves, gate valves, risers, heads, emitter flush valves, emitters, emitter line and tubing, testing, adjustment of heads, maintenance and providing as-built drawings.

The Contractor shall coordinate the installation of the irrigation system with the layout and installation of the plant materials to ensure that there will be complete and full irrigation coverage of planting in accordance with the Contract plans, the special provisions and the Standard Specifications.

The irrigation system shall be installed and tested prior to installation of plant material.

The "Model Water Efficient Landscape Ordinance" by the California Department of Water Resources shall apply.

22.01.2 Applicable Publications

The publications listed below comprise a part of this section to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specifically shown otherwise all publications shall be the latest edition.

Federal Specifications

WW-H-001220	Head, Sprinkler, (Underground Connection)
WW-V-51F	Valve, Angle, Check and Globe, Bronze; 125 pound, 150 pound, and 200 pound, Threaded End, Flange Ends, Solder Ends, and Brazed End, for Land Use.
WW-V-54D	Valve, Gate, Bronze (125 pound, 150 pound, and 200 pound, Int Am 3 Screwed, Flanged, Solder End, for Land Use)

American National Standards Institute (ANSI) Publications

- B2.1-68 Pipe Threads (Except Dryseal) Specifications, Dimensions , Tapers and Straight Pipe Threads, Including Certain Special Applications
B16.3-77 Malleable Iron Threaded Fittings, Class 150 and Class 300.

American Society for Testing and Materials (ASTM) Publications

- A53-81A Pipe, Steel, Black and Hot-Dipped, Zinc Coated

Welded and Seamless

- A120-81 Pipe, Steel, Black and Hot-Dipped Zinc Coated

(Galvanized) Welded and Seamless for Ordinary Uses

- B61-80 Steam or Valve Bronze Castings
B62-80 Composition Bronze or Ounce Metal Castings
D1785-76 (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2241-80 (Poly Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
D2287-81 Non-rigid Vinyl Chloride Polymer and Copolymer

Molding and Extrusion Compounds

- D2464-76 Threaded (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
D2466-78 (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
D2467-76A Socket-Type (Poly Vinyl Chloride) (PVC) Plastic

Pipe Fittings, Schedule 80

- D2564-80 Solvent Cements for (Poly Vinyl Chloride) (PVC)

Plastic Pipe and Fittings

- D2774-72 Underground Installation of Thermoplastic (R1978) Pressure Piping
D2855-81 Making Solvent-Cemented Joints with (Poly Vinyl Chloride) Pipe

American Society of Sanitary Engineering (ASSE) Publications

- 1013-80 Reduced Pressure Backflow Preventer
1003-1 Pressure Reducing Valve

American Water Works Association (AWWA) Publications

- C506-78 Standard for Backflow Prevention Devices-Reduced

Pressure Principle and Double Check Valve Types

C601-81	Standard for Disinfecting Water Mains
C800-66	Standard for Threads for Underground Service Line Fittings - with Appendix on Collected Standards for Service Line Materials.

International Association of Plumbing and Mechanical Officials

Uniform Plumbing Code

National Fire Protection Association (NFPA) Publications

NFPA 24	Standard for Outside Protection
NFPA 70	National Electrical Code

National Sanitation Foundation (NSF) Publications

STD No. 14-78	Plastic Piping System Components and Related Material
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Plastic Pipe Institute (PPI) Publication

PPI TN8	Making Threaded Joints with Thermoplastic Pipe and Fittings
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22.01.3 Submittals

The following items shall be submitted to the Engineer for review and approval:

1. Materials list.
2. Shop drawings.
3. Manuals.
4. As-built drawings.
5. Controller charts.

Controller Charts

1. As-built drawings shall be provided by the Contractor and approved by the Engineer before controller charts are prepared.
2. Provide one controller chart for each controller.
3. The chart shall show the area controlled by the automatic controller and shall be the maximum size that will fit inside the controller door.

4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing is reduced, the lettering shall be of a size that is readable when reduced to 1/2 scale.
5. The chart shall be a blackline or blueline ozalid print and different colors shall be used to indicate the area of coverage for each station.
6. When completed and approved, the chart shall be hermetically sealed between two (2) pieces of 10 mil plastic.
7. The charts shall be completed and approved prior to final inspection of the irrigation system.

22.01.4 Landscape and Irrigation Contract Plans

Contract plans are generally diagrammatic and indicative of the work to be performed. Due to the scale of the Contract plans, all offsets, fittings, sleeves, etc. which may be required may not be indicated. The Contractor shall investigate the structural and finished conditions affecting the work and shall plan the work accordingly. The contractor shall furnish all items that are required to complete the work. The work shall be installed to avoid conflicts between existing and the new irrigation systems, planting, existing trees and shrubs, architectural features, utilities, fire hydrants, and drainage systems.

The Contractor shall be responsible for modifications to the irrigation system to prevent blockage of sprinkler irrigation patterns, to prevent over-spray and excessive runoff, and to provide full irrigation coverage.

Modifications shall be reviewed and approved by the Engineer prior to installation. All costs associated with modifications to the irrigation system and for verification of utility and underground structure locations, including pot-holing, shall be considered as included in the Contract prices paid for the various items of work and no additional compensation will be made. Damage to utility lines, underground structures, and other improvement shall be repaired at the Contractor's expense and to the satisfaction of the Engineer.

All work called for on the Contract plans by notes or details shall be furnished and installed whether or not specifically mentioned in the Standard Specifications, the Contract special provisions or the Contract bid proposal form.

The Contractor shall not install the irrigation system as shown on the Contract plans when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering, or that will affect the layout of the planting. The obstructions or differences shall be brought to the attention of the Engineer. In the event this notification is not performed, the Contractor shall assume full responsibility for any required revisions.

22.01.5 Equipment to be Furnished

The Contractor shall furnish to the Engineer, as a part of the Contract, two (2) each of the following:

1. Any special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
2. Keys for each automatic controller.
3. Keys for each controller enclosure.
4. Quick coupler keys and matching hose swivels for each type of quick coupling valve installed.
5. Keys for the hose bib.
6. The equipment shall be turned over to the Engineer at the end of the designated maintenance period. Before the final maintenance inspection is scheduled the Contractor must show evidence that the City has received the material.

22.01.6 Handling of PVC Pipe and Fittings

The Contractor is cautioned to exercise care in handling, loading, unloading, and storing PVC pipe and fittings. All PVC pipe shall be transported in a vehicle that will allow the pipe to be laid flat and that will not subject the pipe to undue bending or concentrated external loads. Any section of pipe that has been dented or damaged will be discarded and, where installed, shall be replaced with new piping at the Contractor's expense.

22.01.7 Verification of Site Conditions and Survey

The Contractor shall, to the satisfaction of the Engineer, lay out the work according to the Contract plans and shall establish all bench marks, monuments, lines and levels necessary for the construction covered by the Contract. All dimensions shall be checked against existing conditions and discrepancies shall be immediately reported to the Engineer. The Contractor shall be responsible for establishing the layout of the area to the satisfaction of the Engineer prior to beginning any portion of construction. Any discrepancies arising from the preliminary layout shall be resolved prior to construction.

22.02 MATERIALS

22.02.1 General

The Contractor shall use only new materials of the brands and types noted on the Contract plans or specified in this section, or approved equals.

Schedule 40 pipe shall be used for pipes installed on the discharge side of control valves and Schedule 80 pipe shall be used for continuously pressurized pipe installed on the supply side of control valves. Only Schedule 80 pipe shall be supplied when threaded joints are specified.

22.02.2 Plastic Pipe for use with Solvent Weld Socket or Threaded Fittings

Plastic pipe for use with solvent welded socket or threaded fittings shall be rigid, un-plasticized polyvinyl chloride (PVC) 1120 (Type 1, Grade 2), manufactured in accordance with ASTM D 1785. Plastic pipe marked with the product standard PS-21-70 conforms to this standard. The minimum pressure rating shall not be less than the working pressures indicated for the schedule and sizes listed.

Fittings and couplings for plastic pipe shall be threaded or a slip-fitted, tapered socket, solvent-weld type. Threaded adapters shall be provided with socket pipe for connections to threaded pipe. Plastic pipe fittings and couplings shall be PVC I or PVC I/II material supplied in the same schedule size specified for the pipe. The type of plastic material and schedule size shall be indicated on each fitting or coupling. Fittings and couplings shall comply with the following specifications:

Fitting Type	ASTM Designation
Socket Fittings	
Schedule 40	D 2466
Schedule 80	D 2467
Threaded Fittings	
Schedule 80	D 2464

22.02.3 Plastic Pipe for Use with Rubber Ring Gaskets

Plastic pipe for use with rubber ring gaskets shall be rigid un-plasticized polyvinyl chloride PVC 1120 (Type 1, Grade 1), manufactured in accordance with ASTM D 2241. Plastic pipe marked with product standard PS-22-70 conforms to this standard.

Pipe shall be supplied with plain ends or with an integral thickened expanded bell with a rubber ring groove. Couplings for plain end pipe shall be a single rubber ring with a solvent weld socket on one end or shall be a double ring type coupling.

Rubber ring gaskets shall be a synthetic rubber supplied in accordance with the requirements of ASTM D 1869.

Pipe shall be furnished in the following Pressure Ratings and Standard Dimension Ratios (SDR).

160 psi	SDR 26
200 psi	SDR 21

22.02.4 Solvent Cement and Primer

Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of the type prescribed by the manufacturer.

22.02.5 PVC Pipe Markings

All PVC pipe must bear the following markings:

1. Manufacturer's name.
2. Nominal pipe size.
3. Schedule of class.
4. Pressure rating in pounds per square inch.
5. NSF (National Sanitation Foundation) approval.
6. Date of extrusion.

22.02.6 Hose Bibs

Hose bibs shall be brass construction with a removable key handle.

22.02.7 Valves

Gate valves shall conform to the specifications of the American Water Works Association and as specified in this section. Gate valves shall be installed in accordance with the Contract plans, special provisions and as specified in this section.

Valves shall be capable of satisfactory performance at a working pressure of 200 pounds per square inch. Valves shall be designed to permit easy disassembly for service or repair, without removal of the valve from the irrigation system.

Gate Valves 2 inches and Smaller

Gate valves 2 inches and smaller shall be an all bronze, double disc, wedge type with integral taper seats and a non-rising stem, shall be equipped with an operating wheel, and shall be manufactured by Stockham Valve Company, or an approved equal.

Gate Valves 2 ½ inches and Larger

Gate valves 2 ½ inches and larger shall be the same as the 2 inch or smaller size, and shall:

1. Have an iron body, bronze trimmed, double discs, parallel seats with a pin disc spreader mechanism.
2. Have a square operating nut, with an arrow cast in the metal indicating the direction of the opening.
3. Have ends compatible with the pipe with which they are being installed.
4. Be manufactured by Kennedy Valve Mfg. Company, or an approved equal.

Manual Control Valves

Manual control valves shall be brass or bronze, and shall be straight or angle pattern globe valves, full opening, key operated with replaceable compression disc and ground joint union on the discharge side.

Remote Control Valves

The Contractor shall furnish and install remote control valves as indicated on the Contract plans and as specified in this section.

Electrical control valves shall:

1. Be as listed on the Contract plans.
2. Have a manual flow adjustment.
3. Have one control valve box for each electric control valve.
4. Be equipped with an approved lock and locking assembly.
5. Have each line wire at the valve marked.

Quick Coupling Valves

Quick coupling valves shall have a brass, or bronze, two-piece body designed for a working pressure of 150 pounds per square inch and operable with quick coupler. Key size and type shall be as shown on the Contract plans.

Valves shall have a built-in flow control and self-closing valve and supplied in $\frac{3}{4}$ inch size unless otherwise required or shown on the Contract plans. The valve shall consist of the valve, the quick coupler connection and the hose swivel.

Quick coupling valves shall be installed at a distance between six (6) inches and 12 inches from a paved area.

22.02.8 Control Wiring

Connections between the automatic controllers and the electrical control valves shall be made with single strand, direct burial, solid copper wire, AWG-U.F., 600 volt, conforming to applicable provisions of ASTM D 2219 and ASTM D 2220. The wiring shall be installed in accordance with the valve manufacturer's specifications and wire chart. In no case shall the wire size be less than 14 gauge.

Wires

Control wires shall have an insulating jacket with a color that is unique for each controller. The common wire shall have a white insulating jacket with a stripe of color to match the control wire

it serves. The spare wire shall have an insulating jacket with a color that is different from all control wires or common wires.

Wiring shall occupy the same trench and shall be installed along the same route as pressure supply lines or lateral lines.

Electrical service wiring shall be placed inside a conduit. Conduit for conductor wire shall be as specified in this section.

An expansion curl shall be provided within three (3) feet of each wire connection and for at least every 100 feet of wire length. The expansion curl may be formed by wrapping five (5) turns of wire around a one-inch diameter pipe and then withdrawing the pipe. Expansion curls shall be of sufficient length at each splice connection and at each electric control valve so that, in case of repair, the valve bonnet may be brought to the surface without disconnecting the control wires.

Splices

Splices shall be made in a valve or splice box with 3M-DBY wire splice pack, DS-400, Dri-Splice Wire, or an approved equal. Use one (1) splice per connector sealing pack. Field splices between the automatic controller and electrical control valves will not be allowed without prior approval of the Engineer.

22.02.9 Automatic Controllers

Automatic controllers shall be of size and type shown on the Contract plans and shall be Rainbird, or an approved equal.

The Engineer shall approve the final location of the automatic controllers.

Power

The 120-volt electrical power to the automatic controller is to be furnished by a licensed electrical subcontractor and not by the irrigation subcontractor. The final electrical hook-up shall be the responsibility of the irrigation contractor.

Labels

Each new control line wire shall be labeled at the controller.

Rain Sensing Override

All controllers shall be equipped with an approved rain sensing override device.

22.02.10 Valve Boxes

Unless shown otherwise on the Contract plans, control valve boxes shall be as specified in this section.

Gate Valves and Quick Coupling Valves

A 10-inch, round valve box with an extension and a bolt down cover (Carson Industries 910-12B, or an approved equal) shall be used unless shown otherwise on the Contract plans, or a larger size is required to accommodate the valve. The valve box shall have a lockable bolt.

Electrical Control Valves

Use 11 ¾ inch x 17 inch x 12 inch rectangular boxes with a bolt down cover for all electrical control valves (Carson Industries 1419-12B or an approved equal). Boxes shall have lockable bolts.

22.02.11 Sprinkler Heads

Unless shown otherwise on the Contract plans, all sprinkler heads shall be Champion, or an approved equal, and as specified in this section.

Spray heads shall have a manual screw flow adjustment.

Riser units shall be fabricated in accordance with the details shown on the Contract plans.

Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.

Sprinkler heads shall be brass, and the same type shall be by the same manufacturer.

22.02.12 Sleeves

All water lines installed across streets, sidewalks, walkways and similar features shall be installed in Class 200 PVC pipe. The minimum size of the sleeve shall be equal to the outside diameter of the pipe being installed plus one inch plus twice the thickness of the coupler.

Sleeves shall extend 12 inches beyond edges of pavement. There shall be no ringtite couplings within the sleeves. Where the sleeve exceeds 15 feet in length and where ringtite pipe is designated to be installed at the sleeve location, a Class 315 solvent weld pipe and a Schedule 40 solvent weld fittings inside the sleeve shall be substituted.

The Contractor shall be responsible for coordinating sleeve and pipe locations with other trench work and paving installations prior to installation.

22.02.13 Conduit for Electrical Wiring

All low voltage electrical wire shall be installed in schedule 40 PVC gray conduit. The minimum conduit size shall be equal to the total thickness of all wires to be contained in the conduit plus one inch.

Conduit shall extend into splice boxes and other enclosures. Where the splice box is located in a paved area, provide a capped stub-out conduit piece extending out from box at least 12 inches into the planting bed area.

Splice boxes that are installed in paved areas are to be concrete valve boxes approved by the Engineer. Boxes shall not be installed in streets, driveways, or in locations where there is vehicular traffic. The Contractor shall be responsible for coordinating conduit locations with other trench work and paving installations.

22.02.14 Backflow Prevention Devices

Backflow prevention devices shall be installed in accordance with the Contract plans, special provisions and as specified in this section.

Reduced Pressure Type Backflow Preventer

An ASSE 1013 backflow preventer shall be of the reduced pressure principle type conforming to the applicable requirements of AWWA C506. A certificate of Full Approval or a current Certificate of Approval shall be furnished for each design, size, and make of backflow preventer being provided for the project. The certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluations for the respective level of approval. A Certificate of Provisional Approval will not be acceptable in lieu of the above.

Reduced pressure type backflow preventers shall be Febco 825Y, Wilkins Model 575R, or an approved equal.

The backflow preventer shall be installed in an enclosure as detailed on the Contract plans. If an enclosure is not shown on the Contract plans, the Contractor shall furnish and install an enclosure as approved by the Engineer.

Double Check Valve Assembly

Double check valve assembly where required shall be a Febco No. 805, Hershey No. 1, or an approved equal. The check valve shall be installed in a concrete box with a lockable, reinforced concrete lid, as approved by the Engineer.

22.02.15 Flushing End Plugs

The Contractor shall furnish and install one flushing end plug at the end of each lateral in any drip irrigation system installed under the contract. The flushing end plug shall be housed in a Carson Box No. 910-12B, or an approved equal.

22.02.16 Pressure Reducing Valves

Pressure reducing valves shall be Wilkins Model 90, ¾ inch, or an approved equal. The discharge pressure shall be set at 30 pounds per square inch.

22.02.17 Filters

Filters shall be installed on emitter manifolds and shall be Irri-Delco, ¾ inch, 39-0 filter with 155 mesh stainless steel screen and flush valve, or an approved equal. The emitter manifold assembly shall be installed in a lockable box.

22.02.18 Emitters

Risers. Emitter risers, where required, shall be ½ inch, IPS Flexible Hose (0.840 outside diameter). Only IPS Weld-on #795 solvent weld cement shall be used.

Emitter Assembly. Emitter assemblies, where required, shall be as provided for in the Contract plans or in this section.

Single Outlet Emitter. The emitter assembly shall consist of a ½ inch, Schedule 80, PVC, male adapter (gray), a Salco RA 125T Adapter or an approved equal, and a Salco emitter or an approved equal.

Multiple Outlet Emitter. The emitter assembly shall consist of a ½ inch, Schedule 40, PVC, male Adapter, a Salco RA 125T, ½ inch adapter, a Salco PC6-1 Multi-Outlet Emitter, Salco Distribution Tubing #CT- 125 PVC, Salco EOCV Emitter Outlet Check Valves on Tips of Distribution Tubing and a Salco DAS-8 Emitter Access Sleeve. All products shall be as specified or approved equals.

22.02.19 Backflow Preventer Enclosure

The backflow preventer shall be housed in an expanded metal enclosure as specified in this section.

Size. As shown on the Contract plans, or as specified in the special provisions, the minimum size shall be no less than the overall dimension of the backflow preventer plus six (6) inches of clearance on all sides.

Materials. The frame shall be 10-gauge, cold-rolled, formed angle steel.

Cage. The cage shall be diamond patterned, 1 ½ inch, No. 9, flattened, expanded metal, allowing full view of the backflow preventer.

Hardware. The enclosure shall be equipped with the following:

1. Locking tabs or a 3/8-inch U-bolt for padlock security.
2. Easy lift handles.
3. Hinges at one end of the base for service and testing.

Powder Coating. All metal shall be powder-coated with a high performance polymer alloy. The coating shall be dark green unless specified otherwise in the Contract special provisions, or shown otherwise on the Contract plans.

Foundation Base. The enclosure shall be mounted on a four-inch thick concrete pad.

Shop Drawings. The Engineer shall approve shop drawings of the enclosure prior to its manufacture.

22.02 PREPARATION

22.03.1 Physical Layout

Prior to installation, the Contractor shall stake out all pressure supply lines, routing, and location of sprinkler heads. The Contractor shall coordinate drip, bubbler and spray systems with the approved plant layout prior to installation of any irrigation piping.

22.03.2 Water Supply

The irrigation system shall be connected by the Contractor to the water supply as indicated on the Contract plans.

22.03.3 Electrical Source

The electrical connections for automatic controller wiring shall be made by the Contractor to electrical service points as indicated on the Contract plans. The Contractor is responsible for minor changes required to adapt to site conditions.

22.04 INSTALLATION

22.04.1 General

The Contractor is responsible for coordinating work with paving installations and/or removal and repair of all asphalt and/or concrete paving necessary to install the irrigation system as shown on the Contract plans

22.04.2 Trenching

Trenches shall be dug straight and shall support pipe continuously along the bottom of the trench. Pipe shall be laid to an even grade. Trenching excavation shall follow the layout indicated on Contract plans or as per the Contractor's layout that is approved by the Engineer.

Where it is necessary to excavate adjacent to existing trees, the Contractor shall not injure trees and roots. Excavation in areas where two (2) inch and larger roots occur shall be done by hand. All roots two (2) inches and larger in diameter, except directly in the space occupied by the pipe, shall be tunneled under and wrapped with burlap and kept damp to prevent scarring or excessive drying. Damaged or cut roots greater than two (2) inches shall be painted with an approved sealer.

To protect existing trees, the Engineer may require the Contractor to use smaller equipment, including hand-operated tools.

Trenches within the drip line of trees, which are not backfilled within twenty-four (24) hours, shall be covered with damp burlap or canvas. The burlap or canvas shall be kept moist until the trench is backfilled.

The subgrade of all trenches shall be flush with the adjoining subgrade. The Contractor shall set in place and cap and pressure test all piping located under pavement prior to the paving work.

Where shown on the Contract plans, or provided for by the bid proposal, piping under existing sidewalks and pavement shall be installed without removal or damage to the existing sidewalk or pavement. Where cutting or breaking of pavement or sidewalks is allowed or required, pavement or sidewalk shall be removed and replaced by the Contractor as part of the Contract lump sum price or unit prices paid for Irrigation and no additional compensation shall be allowed.

Removal and replacement of asphalt pavement or concrete shall be in accordance with other applicable provisions of the Standard Specifications.

No hydraulic driving will be permitted under concrete pavement or sidewalk.

Minimum Cover Requirements			
Irrigation Component	Cover Required, Under		
	Vehicle Area	Paved Walks	Landscape
Control Wiring	36 inches	24 inches	18 inches
Pipe (Pressure)	36 inches	24 inches	18 inches
Pipe (Non-Pressure)	36 inches	24 inches	18 inches
Sleeves	36 inches	24 inches	N/A

22.04.3 Assemblies

All assemblies shall be installed in accordance with the details in the Contract plans and special provisions and as specified in this section. In the absence of details or specifications pertaining to specific items required to complete the work, the performance of the work shall be in accordance with best standard practice and as approved by the Engineer.

Routing of sprinkler irrigation lines as indicated on the Contract plans is diagrammatic; the actual layout shall be as approved by the Engineer.

Multiple assemblies shall not be installed from mainlines. Each assembly shall have an outlet.

On PVC to metal connections, the Contractor shall work the metal connections first.

Pipe Joint Compound. Permatex #51 pipe joint compound, or an approved equal, shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Pipe joint compound shall not be used on threaded connections at sprinkler inlets.

22.04.4 Line Clearance

All lines shall have a minimum clearance of six (6) inches from each other and all other underground lines, except sanitary sewer clearance shall be a minimum of 12 inches at perpendicular crossings and a minimum of two (2) feet where lines are parallel. Parallel lines shall not be installed directly over one another.

22.04.5 PVC Pipe

All PVC irrigation pipe shall be installed in accordance with the details in the Contract plans and special provisions and as specified in this section.

Pipe shall be cut with a fine tooth hacksaw or approved PVC cutting tool and any burrs shall be removed. The outside surface of the pipe and the inside surface of the fittings shall be wiped with a clean cloth saturated with methyl isobutyl ketone (MIBK) to remove all dirt and moisture and primed before the cement solution is applied. The cement solution shall be applied to the pipe and fitting socket with a brush having a width approximately three-quarters the depth of the

socket. The cement solution shall be applied freely with a light wiping action to spread the cement uniformly over the surfaces. The pipe surface of fitting socket shall not be rubbed with a brush any more than is necessary to spread the cement. If the cement thickens it shall be discarded.

Immediately after the cement has been applied to the surface to be joined, the pipe shall be inserted into the fitting with a twisting motion to the full depth of the fitting socket. Immediately after the joining is completed, any excess cement shall be wiped from the pipe and fitting. The joined members shall be allowed to cure for at least five (5) minutes before they are handled. In cold or damp weather the curing period shall be increased due to slower evaporation of the solvent. An additional fitting or pipe section may be added to the completed joint within three (3) minutes if care is exercised in handling so that a strain is not placed on the previous joint. The male pipe threads of all threaded connections on PVC plastic pipe shall be coated with Permatex #51 pipe joint compound or a joint compound suitable for use with plastic pipe.

Except as shown on the Contract plans, PVC plastic pipe placed in a trench shall be laid on level, undisturbed, or well-compacted earth and solvent-weld pipe shall be snaked from side-to-side in the trench at intervals of approximately 50 feet. The pipe shall be held down between joints with small mounds of earth to prevent movement. After completing the pressure tests on the pipelines and before any backfill is placed, water shall be run through the entire line until the pipe has been cooled to the supply water temperature. The trench shall be immediately backfilled.

22.04.6 Thrust Blocks

Thrust blocks pipe shall be installed in accordance with the Contract plans and special provisions and as specified in this section. If thrust blocks are not specifically detailed on the Contract plans, the Contractor shall be responsible for providing thrust blocks where necessary to resist system pressure on ringite gasket pipes and fittings and where directed by the Engineer. Blocks shall be concrete and the size shall be based on an average safe-bearing load of soil of 2,000 pounds per square feet.

Thrust blocks shall be formed so that concrete comes in contact only with the fitting and the blocks shall be situated between undisturbed soil and the fitting.

22.04.7 Valves

Irrigation valves, where required, shall be installed in accordance with the details on the Contract plans, the special provisions, the manufacturer's specifications and as specified in this section.

Remote Control Valves

Remote control valves, where required, shall be installed as specified in this section. When grouped together the valves shall be a minimum of six (6) inches apart (clear distance).

Remote control valves shall be adjusted so the sprinkler heads operate at the pressure recommended by the head manufacturer and so a uniform distribution of water is applied by the sprinkler heads to the planting area for each individual valve system.

Each control line wire shall be labeled at each valve with a 2 ¼ inch x 2 ¼ inch polyurethane identification tag, indicating the identification number of the valve (controller and station number). The label shall be attached to the control wire.

22.04.8 Hose Bib

Hose bids, where required, shall be installed in accordance with the details on the Contract plans, the special provisions, the manufacturer's specifications, and as specified in this section.

22.04.9 Valve Boxes

Valve boxes shall be installed for all valves in accordance with the details on the Contract plans, the special provisions, the manufacturer's specifications, and as specified in this section.

All valve boxes shall be set to finish grade in lawn areas and two (2) inches above finish grade in ground cover areas.

Valve boxes located near walks, curbs, and header boards, shall be installed in alignment with those items, squarely if rectangular in shape and with the top surface matching the top plane of the items listed above.

Valve boxes shall be installed 12 inches away from, and perpendicular to, improvements. At multiple valve box groups, the boxes shall be installed a minimum of six (6) inches apart, measured at the finish grade surface. The short sides of boxes shall be oriented parallel to adjacent improvements.

22.04.10 Flushing of System

After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water shall be used to flush the system.

Sprinkler heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Engineer.

22.04.11 Sprinkler Heads

Sprinkler heads shall be installed as shown on the Contract plans and spacing of heads shall not exceed the maximum spacing indicated on the Contract plans. In no case shall the spacing exceed the maximum recommended by the manufacturer.

Nozzles on stationary sprinklers shall be tightened after installation and sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius, diameter and flow rate. The sprinklers shall be set perpendicular to finish grade.

Where sprinklers are adjacent to utility company boxes and other obstructions, the spray pattern shall be adjusted to avoid over-spray on the facilities.

22.04.12 Automatic Controller

Remote control valves shall be installed in accordance with the details on the Contract plans, the special provisions, the manufacturer's specifications, and as specified in this section.

The automatic controllers shall be installed as per the Contract plans and details and the manufacturer's instructions. Remote control valves shall be connected to the controller in numerical sequence as shown on the Contract plans.

Each control line wire shall have a label attached at the controller. The label shall have permanent, non-fading marking and shall indicate the station number of each valve being controlled.

Low Voltage Control Wiring

A single common wire, as previously described in this section, shall be installed from the controller to the control valves, in series.

For each control valve, a separate control wire shall be installed, as previously described in this section, from the controller to each control valve serviced by the controller.

A single spare wire, as previously described in this section, shall be installed from the controller and stubbed into each valve box, in series. The spare wire shall not to be connected to any equipment at the time of installation.

High Voltage Wiring for Automatic Controller

The Contractor shall provide a 120-volt power source and a service switch for the automatic controller. The Contractor shall install the wires from the 120-volt power service switch to the controller.

The Contractor shall provide and install the service unit and meter socket and make the connection between the power source and the controller.

Adequate coverage and protection of the 24-volt service wire leading from the controller shall be provided.

22.02.13 Testing

After the entire irrigation system has been installed, a test of the entire installation shall be made by the Contractor in the presence of the Engineer, prior to installation of landscaping.

Testing of Service Lines

Prior to backfill placement, each section of the pipe to be tested shall be filled with water and all air shall be expelled from the pipe. The valves controlling the admission of water into the section of pipe to be tested should be opened wide before shutting hydrants or blow off valves. After the system has been filled with water and all air expelled, all valves controlling the section to be tested shall be closed and the line shall be allowed to set for a period of not less than 24 hours.

The pipe shall then be refilled, if necessary, and subjected to a pressure of not less than 150 pounds per square inch or the service pressure plus 50 pounds per square inch, whichever is greater, for a period of four (4) hours.

All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test. Any cracked or defective pipe, fittings, or valves discovered during the test shall be removed and replaced with sound material and the test repeated until the system is satisfactory to the Engineer.

For a four-hour hydrostatic test, the allowable leakage is expressed by the following formula:

Allowable Leakage (gallons) equals Pipe diameter (inches) times Pipe length (feet) times 0.00158.

The test water shall be left in the mains until backfilling operations are completed.

After backfilling is completed, and before pavement sections are installed, the test shall be run again and no section shall be allowed leakage greater than that of the four-hour hydrostatic test.

Plastic Pipe

After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed and prior to the installation of sprinkler heads, control valves shall be opened and the system shall be flushed. After the system is flushed, risers shall be capped off and the system pressure tested. With a drip system, the tees shall be capped before a flexible riser is installed. The Contractor shall notify the Engineer in writing at least 72 hours in advance of testing. All testing shall be done in the presence of the Engineer or the Engineer's authorized representative.

A continuous static water pressure of 120 pounds per square inch shall be applied to all main lines and 60 pounds per square inch to all lateral lines. Welded plastic joints shall have cured at

least 24 hours, and all risers capped prior to pressure testing. The duration of testing shall be as follows:

1. Test main lines and sub-mains for 4 hours.
2. Test lateral lines for 2 hours.

Any leak shall be repaired and the line re-tested. Pressure testing shall continue until no leakage or loss of pressure is shown for the test period.

After the system has passed the pressure test, the heads, flexible risers and emitters shall be installed and tested for operation, under normal operating pressures, in accordance with the design requirements.

Electrical System

Prior to acceptance of the work, the Contractor shall complete the following tests:

1. Continuity of each circuit.
2. Grounding of each circuit.
3. A megger test on each circuit.
4. A functional test that demonstrates that each and every part of the system functions as specified.

22.04.14 Backfilling

Trenches shall not be backfilled until all required tests have been passed.

If settlement occurs and subsequent adjustments and/or repairs to pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments and repairs at the Contractor's expense.

Paved Streets and Walkway Areas

Backfilling of trenches within paved streets or walks shall be performed in accordance with the Standard Specifications.

Non-Street or Walkway Areas

1. Initial Backfill

Initial backfill includes pipe bedding and the section of trench six (6) inches above the pipe. A layer of approved fine granular material shall be placed and compacted around and above the

pipe. No foreign matter larger than one-half inch in size will be permitted in the initial backfill. The initial compaction shall be to at least 85 percent relative compaction.

2. Intermediate Backfill

After completion of the initial backfill the section of trench above the initial backfill to within six (6) inches of finish grade shall be backfilled with soil. Soils for intermediate backfill shall consist of clean earth, loam, sandy clay and/or sand. Backfill shall be free from large clods, stones, or deleterious materials.

Backfill shall be compacted to at least 90 percent relative compaction. The finish grade shall conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

3. Final Backfill

The final six (6) inches of trench shall be backfilled with approved topsoil to at least 85 percent relative compaction.

22.04.15 Adjustment of the System

The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent over-spray.

If adjustments in the irrigation equipment will provide better coverage, the Contractor shall make the adjustments after approval by the Engineer, and prior to planting. Adjustments may also include changes in nozzle or screen sizes and degrees of arc. The Contractor is responsible for providing coverage of all planted areas.

Lowering raised sprinkler heads by the Contractor shall be accomplished within ten (10) days after notification by the Engineer.

The irrigation system shall also be tested at the time of final inspection for planting. If, in the opinion of the Engineer, any portion of the irrigation system is found to be defective or damaged, the Contractor shall make all required repairs or replacement, at the Contractor's expense. The Contractor shall make the repairs within two (2) weeks after final inspection of the planting.

22.05 MAINTENANCE

The irrigation system shall be maintained, repaired and adjusted by the Contractor during the required landscape maintenance period and as specified in this section.

Soil moisture at the plant root balls in each watering zone shall be checked prior to watering. The Contractor shall be responsible for adjusting watering cycles so that plants receive sufficient water to ensure vigorous growth without allowing the soil to become saturated with water.

If the Contractor is not, in the opinion of the Engineer, properly maintaining the irrigation system, the City may have any required work performed and deduct any costs associated with the work, plus a 20 percent markup for administrative costs, from payment due, or to become due, to the Contractor.

22.06 FINAL MAINTENANCE INSPECTION

At the time of the performance of the final maintenance inspection of the landscaping in accordance with the Standard Specifications, the complete irrigation system shall also be inspected and tested.

22.07 ACCEPTANCE

After successful completion of the required maintenance period, the irrigation system will be accepted by the Engineer. Upon written acceptance of the landscaping by the Engineer the Contractor shall be relieved from any further maintenance.

Relief from maintenance shall not be construed as releasing the Contractor from the provisions of any applicable warranties or guarantees.

Acceptance of the irrigation system by the City will be separate from the project as a whole and will be contingent upon proper maintenance and performance of the system. Any portion of the irrigation system that does not perform as specified, will be subject to continued maintenance and correction at the Contractor's expense.

If project improvements, corrective work, and maintenance have not been performed as specified, and to the satisfaction of the Engineer, maintenance shall continue at the Contractor's expense until the work has been successfully completed and accepted by the City.

22.08 GUARANTEE

All components of the irrigation system shall be guaranteed for a period of one (1) year after final acceptance of work, or thirty (30) calendar days following acceptance of the irrigation system by the City at the conclusion of the required maintenance period, whichever is later.

During the guarantee period, and within 15 calendar days of notification by the Engineer, the Contractor shall, at the Contractor's own expense, remove and replace any defective or damaged component of the irrigation system.

Replacements shall be made to same specifications as required for original components and shall carry the same guarantee. The guarantee shall commence from the time the replacements are complete.

22.09 MEASUREMENT

The irrigation system shall be measured as a lump sum or by contract units as provided for in the Contract bid proposal. Maintenance shall be measured as a lump sum item in combination with the bid price for Landscape Maintenance. There shall be no separate measurement for required guarantees.

22.10 PAYMENT

22.10.1 General

The Contract lump sum bid price, or unit prices paid, shall be full compensation for furnishing all labor, materials, tools, equipment, incidentals and for doing all work required to construct the irrigation system, including layout, trenching, backfilling, and testing, as shown on the Contract plans and as specified, and no additional compensation shall be allowed.

When there are no separate contract items for materials necessary to complete the irrigation system, the materials shall be furnished and installed by the Contractor. Full compensation for this work and the material shall be considered as included in the prices paid for the various bid items, or lump sum price paid, for the irrigation system, and no additional payment will be made.

22.10.2 Guarantee

There shall be no separate payment for guarantees required or provided under the Contract. Full compensation for furnishing and compliance to guarantee requirements shall be considered as included in various contract items of work and no separate compensation shall be allowed.

22.10.3 Maintenance

The contract price for Landscape Maintenance, as provided for in the Standard Specifications, shall include full compensation for maintenance and repair of the irrigation system during the specified maintenance period.

SECTION 23

TREE TRIMMING AND REMOVAL

23.01 GENERAL

All work under this contract shall be performed in accordance with the Contract plans, special provisions and as specified in this section.

1. The Contractor shall provide written notification to the residents located adjacent to the work 48 hours prior to commencing work adjacent to their property.
2. Access to driveways shall be maintained unless other arrangements are made with the property owner.
3. The Contractor shall furnish water as required for the job at no cost to the City, except as provided in the contract items of work. Use of homeowner's water shall be permitted upon written consent of the property owner.
4. The Contractor shall have, at all times, a Certified Arborist supervising the work. The Contractor shall submit the Arborist's resume to the Engineer with the project schedule.
5. Trees to be removed shall not be "felled". The tree shall be removed by cutting the tree in sections and lowering the sections by rope.
6. Tree stumps shall be removed by grinding to a depth of 18 inches below finish grade or as necessary to clear other improvements. Climbing spurs will be used only with the approval of the Engineer.

Quantities of work are shown for estimating purposes only. The City reserves the right to increase or decrease any quantity, or to eliminate any item of work. No adjustment will be made in unit prices for any such increase, decrease, or deletion regardless of the percentage of the adjustment. Final payment will be made on the basis of contract unit prices for work actually accomplished.

Trees shall be trimmed to accomplish the following:

1. To select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached. The scaffold branches shall be spaced vertically between 18 inches and 48 inches and shall be radial orientated so that they do not overlap one another.
2. To eliminate narrow 'V'- shaped branch forks that lack strength.

3. To reduce the potential for toppling and wind damage by thinning out crowns.
4. To maintain growth within space limitations.
5. To maintain a natural appearance.
6. To balance the crown with the root system.

All pruning cuts should be made to lateral branches or flush with the trunk. Under no circumstances should "stubbing" be performed.

23.02 TREE PRUNING

The Contractor shall perform the following pruning services in a manner consistent with all applicable laws and regulations.

1. Follow the shape of each tree species.
2. Per WC/ISA standards, no "topping" will be allowed.
3. Cut to laterals to preserve the natural form of the tree. The head should be open so that the branching system can be seen. The cuts shall permit dead material to be easily cleaned out and shall allow light to show through the head. Tree foliage shall not be reduced by more than 30 percent.
4. All limbs one inch in diameter or over shall be undercut to avoid splitting. Where there is a chance of the bark tearing at the crotch, large limbs shall be removed with the crotch.
5. Final cuts shall be made just beyond the growth collar.
6. All water sprouts shall be removed except as needed to prevent sun scalding.
7. All deadwood within the outer two-thirds of the tree canopy that is over 3/8 inches in diameter and 12 inches in length shall be removed.
8. Thinning of trees shall be as recommended by the arborist and approved by the Engineer and as follows:
 - a. Thinning shall be uniform.
 - b. Thinning shall include the ends of limbs as well as the interior.
 - c. The pruning shall not leave a "stripped" look.
 - d. Thinning should not remove more than 30 percent of the foliage.
 - e. Thinning of trees in need of 'light reduction' shall be by the "drop crotch" method. Drop crotching shall be to the strong lateral branch (not less than 1/2 the

size of the leader being removed). The lateral, or new dominant leader, shall be reduced to prevent rapid elongation or future breakage.

9. All deadwood within the inner one third of the tree canopy that is larger than 3/8 inches in diameter and greater than four (4) inches in length shall be removed.
10. Trim to clear electric lines by a minimum of two (2) feet. A certified and qualified line clearance tree trimmer shall do the pruning around high-voltage transmission lines. Remove dead wood, hazardous branches, weak, diseased, insect-infested, broken, low or crossing limbs and all suckers, shoots and ivy. Branches with an extremely narrow angle of attachment shall be removed. Any structural weakness or decay shall be reported to the Engineer.
11. The Contractor shall provide for proper vehicle clearance at the curb. Height clearance at the curb shall be fourteen (14) feet from the street level, unless otherwise approved by the Engineer.
12. The Contractor shall allow adequate clearance for pedestrians to walk under the tree without concern for personal injury. Final head clearance shall be nine (9) feet (minimum), unless otherwise approved by the Engineer.
13. On trees known to be diseased, pruning tools as well as cut surfaces shall be disinfected with a ten percent chlorine bleach solution or sterilant after each cut and between trees where there is danger of transmitting the disease on tools.
14. Pruning with hand pruners is permitted. Small limbs, including suckers and water spouts, shall be cut close to the trunk or branch.
15. Trees with dense foliage surrounding streetlights shall be opened to allow light to penetrate through the head. A certified and qualified line clearance tree trimmer shall do pruning around high voltage transmission lines.
16. Where pruning paint is needed, a lightweight paint shall be used. The use of tar-based paint is not allowed.

The Contractor should avoid any encroachment on adjacent properties and repair and make good any damage caused to public or private property as a result of the work described in the Contract.

The Contractor will leave all portions of the work area in a safe, clean and sanitary condition to the satisfaction of the Engineer.

23.03 MEASUREMENT

Measurement shall be as indicated in the bid proposal. In general, trees shall be measured:

1. Per Each.
2. Zone.
3. Street.
4. Lump Sum.

When measured Per Each, trimming shall be designated by address or plan stationing.

When measurement by Zone, the zone shall include all City-owned trees within the zones, including parks and medians indicated on the Contract plans.

When measured by Street, the bid price per street shall include all trees on both sides of the designated street.

When no limit is specified for the beginning and end of work on the street specified, it shall mean city limit to city limit on that designated street.

23.04 PAYMENT

The Contract unit or lump sum prices shall be considered as including full compensation for furnishing all labor, materials, tools, equipment and incidentals required to complete the work including hauling, disposal costs and clean up.

SECTION 24

PROTECTION AND RESTORATION OF EXISTING IMPROVEMENTS

24.01 GENERAL

The Contractor shall protect, shore, brace, support, and maintain all existing surface and subsurface improvements not designated for removal, relocation or replacement. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, lawns, shrubs, trees, and other surface structures that are damaged by construction operations, shall be restored to match their original condition, or better.

All replacements shall be made with new materials to the satisfaction of the Engineer and at no additional cost to the City.

24.02 DOCUMENTATION OF PRE-CONSTRUCTION CONDITIONS

The City may perform a pre-construction inspection to evaluate the condition of surface improvements to remain in place and that may be affected by the Contractor's work. The City's pre-construction inspection may be in the form of written notes, video and/or still photography.

When required by the Contract special provisions the Contractor shall perform a pre-construction survey to document the condition of existing improvements. When required, the Contractor shall document the conditions for size, kind, quantity and the extent of existing surface improvements. Documentation shall be in the form of video and/or still photography.

In the absence of a pre-construction inspection and documentation the Engineer's judgment shall be final.

Full compensation for conformance to the requirements of this section shall be considered as included in the other Contract bid items of work and no additional compensation shall be made.

24.03 TREE AND PLANT PROTECTION

24.03.1 General

No tree or plant shall be removed or damaged, unless the Contractor obtains the written permission of the owner and the Engineer.

No equipment, vehicles or storage of materials will be permitted under the drip line of any tree outside of existing paved surfaces of those trees not designated on the Contract plans for removal.

A qualified landscape contractor shall perform all trimming, repair, and replacement of trees and plants.

Each tree injured beyond repair, or removed without the Engineer's approval, shall be replaced with a similar tree of the nearest size possible and shall be maintained by the Contractor until established.

When required by the Contract plans, existing trees to remain shall be protected by adequate barriers and/or fencing as follows:

1. Except the area within the drip line that is within the limits of construction as shown on the Contract plans, a six (6) foot high fence shall be erected at the drip line of the tree and along the limits of construction.
2. The Engineer shall approve the type of fencing.
3. The Engineer may require the placement of hay bales to provide additional protection of the tree.
4. The fence shall remain in place until final inspection of the project.

24.03.2 Root Protection

The Contract shall exercise care during grading, trenching and other operations to protect tree roots from damage. Construction around trees and treatment of exposed or damaged roots shall be as follows:

1. Surface roots exposed during grading shall be covered with at least six (6) inches of moist mulch.
2. Roots shall not be pulled or shredded by construction equipment. Roots larger than one (1) inch in diameter shall be cut smooth at the edge of the trench. Roots larger than two (2) inches in diameter shall be cut and treated as recommended by an arborist and as approved by the Engineer.

24.03.3 Trenching

When directed by the Engineer, trench locations will be adjusted to avoid trenching in the drip line of trees.

The Contractor shall hand-excavate as necessary to prevent injury to trees and other plants.

24.03.4 Watering

When the Engineer determines that more than 25 percent of a tree's roots have been disturbed the tree shall be watered as follows:

1. Water shall be applied to irrigate soil to a minimum depth of 12 inches for the full outer half of the canopy.
2. The area immediately adjacent to the tree trunk shall not be soaked.
3. Following the initial soaking, trees shall be soaked (as per Item 1) once a month during the months of May, June, July, August and September.
4. The Engineer may order additional soaking when conditions warrant.

24.03.5 Disposal

All trees and other vegetation that are removed shall be disposed of by the Contractor in a legal manner.

24.04 LAWN

All lawn areas that have been disturbed by the Contractor's construction activities, or by parking of equipment, shall be restored using methods approved by the Engineer. The top surface elevation of the new sod shall match the pre-construction elevation.

The soil used in the repair work shall be topsoil. Sod shall be cut in strips or rectangular sections and sized so that the sod can be lifted and rolled without breaking. All sod shall be cut to a thickness of $\frac{1}{2}$ inch to $\frac{3}{4}$ inch.

Fertilizer shall be pellet or granulated and shall have an analysis of equal parts of available nitrogen, phosphorus, and potassium in percent by weight in order to supply the number of pounds of the pure chemicals per square foot recommended by the manufacturer. Water shall be free from any substances harmful to the growth of grass and shall be from a source approved by the Engineer.

Sod shall be placed after the soil has been adequately prepared and after the fertilizer has been applied as recommended by the manufacturer. Sod shall be laid smoothly, edge to edge, and with staggered joints.

All sod shall be maintained. Maintenance shall include watering, re-sodding, repair of erosion damage, and all other operations necessary to obtain an acceptable grass cover. Watering shall be

required if natural rainfall is not sufficient to maintain the sod. The Contractor shall provide water for watering. Sod that browned prior to final acceptance of the project shall be re-sodded.

Original grades of the grass-covered areas shall be maintained.

24.05 FENCES

Unless otherwise shown on the Contract plans, all existing fences affected by the work shall be protected and maintained by the Contractor until completion of the work.

Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the Engineer and the owner of the fence, and the period of time the fence may be left relocated or dismantled has been agreed upon.

On completion of the work across any tract of land, the Contractor shall restore all fences to their original or better condition and to their original location.

24.06 DRIVEWAYS, SIDEWALKS, RETAINING WALLS, CURBS, AND GUTTERS

The Contractor shall comply with the following requirements.

Unless otherwise shown on the Contract plans, construction shall be conducted without disturbing existing concrete improvements. All concrete curbs, gutters, aprons, patios, walls, driveways, and sidewalks that are broken, crushed, or damaged by the installation of the improvements, shall be reconstructed by, and at the expense of, the Contractor.

All restoration shall be of the same kind of material, quality, and of the same dimensions as the original work, unless otherwise mandated by current standards of the engineering and construction professions. The minimum thickness for concrete slabs, etc. shall be no less than the adjoining pavement thickness, or as indicated on the plans, or as specified, whichever is the greater. In no case shall a concrete slab be less than four (4) inches thick.

The repairs shall be made by removing the damaged portions between cold joints, or to the nearest joint. Reinforcing dowels shall be placed in existing concrete as approved by the Engineer. Refinishing the damaged part is not allowed. All work shall match the appearance of the existing improvements to the extent possible.

A power-driven pavement saw shall be used to cut existing portland cement concrete sidewalks, driveways, curbs, and gutters where it is necessary to remove the concrete. The sidewalk shall be saw-cut at existing score marks. Driveway aprons shall be removed and replaced. The cuts shall be a minimum of 1 ½ inches deep and straight. If two cuts are made they shall be parallel. The cuts shall be deep enough to permit complete breakage of the concrete without ragged edges.

All edges of concrete shall be edged with a cement edger of the size 2 3/4 inches in width with a 3/16 inch radius. All joints or grooves that are indicated on the Contract plans, or that are required by the Engineer, shall be marked with cement groovers or jointers four (4) inches in width and having a groove that is 3/8 inches wide at the top and 1/2 inch deep.

All new or previously existing concrete surfaces shall be left neat, clean, and free from debris. The Contractor shall be responsible for preventing vandals from disfiguring or defacing the finished surfaces. Prior to acceptance of the work by the City, disfigured concrete shall be replaced at the Contractor's expense.

24.07 STORM DRAINS

All storm drain facilities shall be maintained throughout construction to convey upstream drainage and to prevent ponding, flooding or erosion.

The Contractor shall be responsible for the protection of all on-site and off-site drainage facilities which may be adversely affected by his construction activities. The Contractor shall construct adequate debris and sediment traps in or around drainage structures as necessary.

Measures to control debris and sediment from entering off-site and on-site drainage facilities shall be approved by the Engineer. All protective measures shall be implemented in a timely manner. Should the Contractor, in the Engineer's opinion, fail to provide adequate debris and sediment control, on-site or off-site, the Engineer may complete the work and deduct the cost of the work, plus an administrative cost of 20 percent, from any payments due the Contractor.

24.08 SANITARY SEWER LATERALS

Sanitary sewer lateral repairs and realignment shall conform to the requirements of the Central Contra Costa Sanitary District and the Standard Specifications.

Where the separation between the sewer lateral and the new utility pipe is greater than six (6) inches, the repair may be made with the same type of pipe as the existing lateral. When the separation is less than six (6) inches, the repair shall be made using cast iron pipe of equal diameter.

The new section of pipe shall be cut to fit the space between the trimmed ends of the existing sewer lateral with a maximum clearance of 1/4 inch at each end. Pipe connections shall be made using banded rubber couplings.

When the outside diameter of pipes are within one inch of each other, there shall be a 4-inch x 4-inch pad of 35-45 Durometer rubber placed between the pipes.

Maximum deflection with one fitting shall not exceed 22 ½ degrees. Long-radius bends shall be used only for changes in direction except as otherwise allowed by the Engineer.

Minimum pipe slopes shall be 2 percent unless otherwise permitted by the Engineer.

The Contractor shall be responsible for determining if a house connection sewer is abandoned. If an abandoned house connection sanitary sewer lateral is encountered, it shall be treated by plugging the open ends of the lateral with Class C grout.

24.09 ADJUSTMENT OF SURVEY MONUMENTS AND UTILITY FRAMES AND COVERS

24.09.1 General

The Contractor shall reference and protect all manholes, valve covers, survey monuments, and recorded survey points.

All manholes, survey monuments and water valve covers shall be cleaned of construction debris resulting from the Contractor's operations

24.09.2 City-owned

The Contractor shall locate, reference, protect and adjust all City-owned storm drain manhole covers and other covers as shown on the Contract plans and as specified in this section.

Survey monument covers shall be adjusted as approved by the Engineer. The Contractor shall protect the survey monument in place. For monuments requiring resetting due to disturbance by the Contractor's operation, a licensed land surveyor shall perform the work at the Contractor's expense.

After the pavement has been completed, the necessary portions of the subgrade, base, and pavement shall be neatly removed, the structure built up, and the manhole frame set to be backfilled to within 1 ½ inches of the finish surface of the street with portland cement concrete.

The Contractor shall fill the remaining 1 ½ inches with Type B asphalt concrete that shall match the surface of the existing pavement.

24.09.3 Non-City Owned

Manholes, meters and valve covers not owned by the City shall be adjusted to grade by the utility owner involved and at the utility company's expense. It shall be the responsibility of the Contractor to notify the affected utility companies at least two (2) working days in advance of paving operations and to coordinate all work required to adjust all covers to the new finish grade.

Frames and covers damaged by the Contractor shall be replaced with new, in kind, at no expense to the City.

24.09.4 Measurement

When provided for in the bid proposal, adjustment of City-owned covers shall be on a per each basis. There shall be no measurement of non-City owned covers.

24.09.5 Payment

The contract unit price for adjusting various City-owned frames and covers shall be considered as full compensation for referencing, protecting, lowering and re-setting the frame and cover, and for providing all necessary, tools, equipment, materials, labor and incidentals required and no additional payment shall be made. When there is no unit price provided for in the bid proposal, full payment for adjusting City-owned frames and covers shall be considered as included in the various contract bid items of work and no separate payment shall be made.

Payment for referencing, protecting and coordinating the adjustment of frames and covers not owned by the City shall be considered as included in the various contract bid items of work and no separate payment shall be made.

24.10 MEASUREMENT AND PAYMENT

Except for the relocation of sanitary sewer laterals in conflict with City improvements and the adjustment of survey monuments, and utility frames and covers, all costs to the Contractor for protecting, removing, and restoring existing improvements on public and private property, including damaged sewer laterals, shall be considered as included in the various contract bid items. Bid prices shall include restoration of surface as well as subsurface features to their pre-existing function and appearance to the satisfaction of the Engineer. Restoration shall include surface conditions such as street curb, gutter, sidewalk, retaining walls, patios, fences, gravel, lawn, dirt, and driveways, underground service utilities such as water, phone, power, gas, cable TV, television, and underground property improvements such as traffic signal cables, sprinklers and drain pipes.

The relocation of sanitary sewer laterals in conflict with City improvements will be paid by force account if necessary.

Payment for referencing, protecting and coordinating the adjustment of frames and covers shall be considered as included in the various contract bid items of work and no separate payment shall be made.

SECTION 25

PVC PRESSURE PIPE

25.01 GENERAL

The Contractor shall provide all materials, equipment, and labor necessary to furnish and install 4 inch to 36 inch polyvinyl chloride (PVC) pressure pipe, and all appurtenant work, complete and operable, including all connections, as shown on the Contract plans and as specified in this section.

25.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials used under this section, as specified in the referenced standards, and the following supplemental requirements:

1. Hydrostatic proof test reports.
2. Sustained pressure test reports.
3. Burst strength test reports.

All expenses incurred in making samples for certification of tests shall be the responsibility of the Contractor.

25.01.2 Quality Assurance

All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this section.

The Contractor shall have the material tests performed at no additional costs to the City. The Engineer shall have the right to witness all testing provided that the Contractor's schedule is not delayed for the convenience of the Engineer.

In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the City. The additional samples shall be furnished at no additional cost to the City.

25.02 PRODUCTS

25.02.1 General

PVC pressure pipe, 4 inch through 12 inch and 14 inch through 36 inch shall conform to the applicable requirements of AWWA C900 and AWWA C905, respectively and shall be subject to

additional requirements specified in this section. All PVC pipe shall be continuously marked in conformance with the appropriate ASTM.

25.02.2 Pipe Design

PVC pressure pipe shall be designed in accordance with the requirements of AWWA C900, or AWWA C905, as applicable, except that safety factors and surge pressure requirements of C900 shall be applied to all 4 inch through 36 inch pipe. Pressure classes shall be as shown on the Contract plans, but in no case shall the standard dimension ratio be greater than 18 for C900 or 26 for C905 pipe.

25.02.3 Pipe

The pipe shall be of the diameter and pressure class as specified or shown, furnished complete with rubber gaskets, and all specials and fittings shall be provided as required. The dimensions and pressure classes for Dimension Ratios for PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C 900, or AWWA C 905, as applicable.

All joints for buried PVC pipe shall be an integral bell manufactured on the pipe employing a rubber ring joint. The bell shall be the same or greater thickness as the pipe barrel.

Deflection at the joint shall not exceed 1.0 degrees for AWWA C 905 or 1.5 degrees for AWWA C 900 or the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.

Bending of pipe shall not exceed the recommendations of the AWWA or the manufacturer's recommendations.

25.02.4 Fittings

Fittings shall be ductile iron and shall conform to the requirements of AWWA C110 or AWWA C153, minimum Class 250. Fittings shall be composed of a mechanical joint.

Restrained joints shall be as approved in writing by the Engineer.

All fittings shall be lined and coated in accordance with the requirements of \clubsuit 32 "Ductile Iron Pipe."

Each fitting shall be clearly labeled to identify its size and pressure class.

25.03 EXECUTION

25.03.1 General

All testing for defects and for leakage shall be performed in the presence of the Engineer. All material found to have defects will be rejected and the Contractor shall remove the defective materials from the site.

Installation shall conform to the requirements of AWWA Manual M23, the manufacturer's instructions, and to the supplementary requirements or modifications specified in this section. Wherever the provisions of this section and other requirements are in conflict, the more conservative provision shall apply.

25.03.2 Pipe Handling

Pipe, fittings and accessories shall be inspected before and after installation; defective items shall be rejected. Pipe and fittings shall be free from fins and burrs. Before installation pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean and sanitary condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

25.03.3 Storage

Pipe shall be stored, if possible, at the job site in unit packages provided by the manufacturer. Compression damage or deformation to bell ends of the pipe shall not be allowed. Pipe shall be stored to prevent sagging or bending and shall be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets shall be stored in a cool, dark place and preferably in their original containers. Pipe, fittings, or accessories improperly stored may be rejected by the Engineer.

25.04 TRENCHING AND BACKFILL

Trench excavation and backfill shall conform to the requirements of this section and the Standard Specifications.

25.05 INSTALLATION

Bell and spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be set to grade in straight lines. Pipe shall not be laid when the conditions of trench or weather are unsuitable, as determined by Engineer. At the end of each day's work, open ends of pipe shall be closed temporarily with water-tight, expandable type plugs.

Pressurized lines laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Water lines shall be laid uphill on grades exceeding 10 percent.

Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavations to accommodate bells and joints.

Anchors and supports for fastening work into place shall be provided where necessary and where indicated on the Contract plans. Fittings shall be independently supported.

Joints shall be installed according to manufacturers recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

Pipe shall be cut by means of saws, power driven abrasive wheels or pipe cutters, that will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable-type sander or abrasive disc.

All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The Contractor shall assume full responsibility for any damage due to this cause and shall, at his own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

Each pipe elastomeric gasket joint shall be installed in conformance with the manufacturer's recommendations.

25.06 SERVICE CONNECTIONS

Service saddles or fittings for PVC pipe shall be used for all service connections on new pipeline installations. The maximum outlet size permitted with service saddles is 2 inches.

On existing PVC pipelines all service connections shall be tapping sleeves. Service saddles shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters or twist drills will not be allowed.

Tapping sleeves and valves shall be used for all outlets greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's recommendations.

25.07 TESTING AND DISINFECTION

25.07.1 General

The Contractor shall disinfect the pipe and test the pipe for pressure. All testing will be conducted in the presence of the Engineer. The Contractor shall furnish all materials, equipment, and labor to perform and complete flushing and testing of all pipelines and appurtenant piping and the Contractor shall disinfect all pipelines and appurtenant piping for potable water.

25.07.2 Products

All test equipment, chemicals for chlorination, temporary valves or assemblies, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor. No materials shall be used which would be injurious to the piping system or its proposed function.

Chlorine for disinfection shall be in the form of sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of AWWA B300.

25.07.3 Execution

The City will furnish the water for the first hydrostatic test, and for the first disinfection test up through the first flushing sequence. All water for any re-testing shall be paid for by the Contractor. The Contractor shall make all necessary provisions for conveying the water from the City-designated source to the points of use.

All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the Engineer.

Bacteriological testing will be performed by qualified personnel. Results of the bacteriological testing must meet the requirements of the State Department of Health Services.

25.07.4 Hydrostatic Testing of Pipelines

Connections for testing of pipe shall be in conformance with the Contract plans. Backflow assemblies shall be tested and approved by a certified backflow assembly tester. A passing test report on the backflow assembly shall be provided by the Contractor to the City before the assembly is used.

The Contractor shall test all pipelines as a single unit, or in sections if approved by the Engineer. No section of the pipeline shall be tested until all field-placed concrete or mortar has cured for at

least 72 hours. The test may be made by closing new valves when available or by placing temporary bulkheads in the pipe and filling the line slowly with water. Unless approved by the Engineer, testing shall not be performed against closed valves in the existing system.

The Contractor shall be responsible for determining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any harnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The Contractor shall provide sufficient temporary air release assemblies to allow for evacuation of all entrapped air in each pipe or section to be tested. After completion of the tests, such taps shall be permanently plugged. All air release assemblies shall be open during filling.

The pipeline shall be filled at a rate that will not cause any surges or exceed the rate at which the air can be released through the air release assemblies. After the pipeline has been filled, it shall be allowed to stand under pressure for at least 24 hours to allow the pipe concrete or mortar lining, as applicable, to absorb water and to allow air to escape from any pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures shall be taken.

The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of four (4) hours.

The test pressure for pipelines shall be 100 percent of the pipe pressure class. The test pressure for piping shall be as shown or specified, measured at the lowest point of the pipeline unit or section being tested. All visible leaks shall be repaired.

Maximum Leakage

1. The maximum allowable leakage for pressure pipelines shall be in accordance with the following formula:

Design Basis

$$L = (N \times D \times \text{the square root of } P) / (7400)$$

Where:

L:	allowable leakage (gallons per hour)
N:	number of joints in the tested line
D:	nominal diameter of pipe (inch)
P:	average test pressure (pounds per square inch)

Pipe with welded joints, flanged joints, and service lateral pipe shall have no leakage.

2. In the case pipelines fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall repair the leaks, and shall again test the pipelines.

25.07.5 Disinfecting Pipelines

All water pipelines shall be disinfected. Pipeline disinfection operations shall be performed at the Primary Jumper location in conformance with the Contract plans.

Hypochlorite shall be used to chlorinate the piping system in accordance with the requirements of AWWA C651 and as modified by this section. Chlorine solution in the pipeline being disinfected shall not flow into the water supply pipeline. Any one of the following methods as listed in the AWWA standard (brief summary of two methods as modified below) can be used for the initial disinfection. If the pipeline fails a bacteriological test, it must be disinfected again by the slug method:

1. The continuous feed method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water. The potable water shall be chlorinated so that after a minimum 24 hour holding period in the main there will be a free chlorine residual of not less than 25 milligrams per liter.
2. The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates and introducing into the main chlorinated water at a concentration of 100 milligrams per liter.

Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore forming bacteria. This period shall be at least 24 hours but disinfecting solution higher than 50 milligrams per liter shall not remain in the pipeline for more than 96 hours.

During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

After the retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the existing and upstream system. The Contractor shall apply a reducing agent to the water to thoroughly neutralize the chlorine residual remaining in the water prior to disposal of the water. The Contractor shall be solely responsible for the proper disposal of all water used for the disinfection process in accordance with regulatory agency requirements.

Pipe shall be left for a period of 24 hours after final flushing before any sample is collected. A sample, or samples, will be collected by qualified personnel and will be tested for bacteriological quality in accordance with the requirements of the State Department of Health Services. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained. All laboratory costs

for bacteriological testing shall be at the Contractor's expense. All costs for water used for flushing, and re-filling of the pipeline after failure of a bacteriological test shall be at the Contractor's expense.

25.07.6 Connections to Existing Systems

Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a sodium hypochlorite solution in conformance with the requirement of AWWA C651, except that the solution shall be 5 percent before they are installed.

SECTION 26

ABS AND PVC COMPOSITE PIPE

26.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install all acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite pipe gravity sanitary sewers, and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

The pipe shall consist of two concentric extruded thermoplastic tubes integrally braced across the annulus. The resultant annular space shall be filled with inert material such as light-weight portland cement concrete to provide continuous support between the inner and outer tubes.

26.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials proposed to be used under this section.

26.02 PRODUCTS

26.02.1 General

Composite pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, ASTM specification number, type of plastic, extrusion code, and date and location of manufacture.

26.02.2 Pipe Design

Composite pipe shall be manufactured and provided to meet the pipe strength classifications as shown on the Contract plans and in accordance with ASTM D 2680, but in no case shall the pipe stiffness be less than 200 pounds per inch.

26.02.3 Pipe and Fittings

Composite pipe and fittings shall conform to the requirements of ASTM D 2680, and shall have either solvent cement joints or elastomeric gasket joints.

WYE fittings are required on all new mains. Connections to existing mains shall be made by Taptite method, or solvent welded.

Sewer lateral connections shall accommodate solid wall pipe, PVC or ABS as specified in 27 "Small ABS and PVC Non-pressure Pipe".

26.02.4 Solvent Cement Joints

Cement for ABS joints shall be MEK containing a minimum of 20 percent by weight of dissolved ABS and shall comply with ASTM D 2564.

Cement for PVC joints shall comply with ASTM D 2564 except that the minimum resin content shall be 16 percent and the minimum viscosity shall be 3500 cP.

26.02.5 Elastomeric Gasket Joints

Composite pipe with gasketed joints shall comply with ASTM D 2680 and shall be manufactured with a socket configuration that will prevent improper installation of the gasket and that will ensure that the gasket remains in place during the joining operation. The gasket shall be manufactured from a synthetic elastomer containing not less than 50 percent by volume of a first-grade synthetic rubber.

26.03 EXECUTION

26.03.1 General

All laying, jointing, testing for defects and for leakage shall be performed in the presence of the Engineer. All defective material will be rejected and the Contractor shall remove the defective material from the site.

26.03.2 Bedding

Pipe bedding shall conform to the requirements of 6 "Utility Earthwork".

26.03.3 Pipe Laying

Composite pipe shall be installed in conformance with the requirements of the pipe manufacturer's recommendations and the provisions of this section.

Bell and spigot pipe shall be laid with the bell end at the lowest point and with the spigot end pointing in the direction of the flow.

Handling of the pipe shall be done to ensure that the pipe is not damaged in any manner during storage, loading, transit, unloading, and installation.

The pipe shall be laid to the lines and grades shown on the Contract plans. Before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.

Proper implements, tools, and facilities as recommended by the pipe manufacturer's installation instructions shall be provided and used by the Contractor for installation. All pipe and accessories shall be lowered into the trench by means of a derrick, ropes, or other suitable equipment in a manner that will not damage the pipe or fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's procedures. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or that would produce ragged and uneven edges.

The pipe and accessories shall be inspected for defects prior to placement in the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter shall be removed from the interior of the pipe before placement. Pipe shall be kept clean during and after laying. All openings in the pipe shall be closed with watertight expandable type sewer plugs or test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar plugs will not be permitted.

Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other improvements shall be provided by the Contractor at the Contractor's expense.

26.03.4 Field Jointing

The pipe shall not be deflected in excess of the manufacturer's recommendations.

When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering the pipe. Adequate backfill shall be deposited on the pipe to prevent floating of the pipe. Any pipe that has floated shall be removed from the trench, cleaned, and relaid. No pipe shall be laid when, in the opinion of the Engineer, the trench conditions or weather are unsuitable for such work.

Each solvent-weld pipe joint shall be sealed with solvent cement in conformance with the requirements of ASTM D 2680 and the manufacturer's recommendations. The spigot and socket shall be wiped clean before the solvent cement is applied. After insertion of the spigot end into the solvent-weld bell end, the surfaces shall be wiped clean of excess cement.

Each gasketed pipe joint shall be joined with a lock-in elastomeric gasket. The gasket and the gasket seal inside the bell shall be wiped clean before the gasket is inserted. Lubricant shall be applied to the gasket and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be inserted into the bell to complete the joint. On field cut spigot ends, the pipe walls shall be chamfered with a file to remove all burrs and rough spots.

SECTION 27

SMALL ABS AND PVC NON-PRESSURE PIPE

27.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install all 4-inch to 15-inch polyvinyl chloride (PVC) solid wall non-pressure pipe, all 4-inch and 6-inch acrylonitrile-butadiene-styrene (ABS) solid wall non-pressure pipe, and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section. Only 4-inch and 6-inch ABS non-pressure pipe will be allowed for sanitary sewer laterals.

27.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used under this section.

27.01.2 Quality Assurance

All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this section, the manufacturer's standards, and the Standard Specifications.

The Contractor shall be responsible for the costs of all inspections and tests.

The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

27.02 PRODUCTS

27.02.1 General

All solid wall pipe shall be continuously and permanently marked in conformance with the appropriate ASTM provisions.

The Contractor shall require the manufacturer to mark the date of extrusion on the pipe.

Pipe shall be of the pipe pressure class as shown on the Contract plans.

27.02.2 Pipe

All PVC pipe shall be joined by compression joints unless otherwise specified or shown on the Contract plans and shall conform to the following requirements:

1. Polyvinyl chloride pipe (PVC) shall conform to the requirements of ASTM D 3034, and shall have a maximum SDR of 35 and a minimum pipe stiffness of 46 pounds per square inch. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or Class 12454-C.
2. Flexible rubber rings for elastomeric gasket joints for PVC pipe and fittings shall conform to the requirements of ASTM D 1869.

ABS solid wall pipe shall conform to the requirements of ASTM D 2751, and shall have a maximum SDR of 35, or a minimum SDR of 23.5 with solvent welded joints.

27.02.3 Fittings

All fittings for PVC pipe, including wyes and sanitary sewer lateral cleanouts, shall conform to the requirements of ASTM D 2241. The ring groove and gasket ring shall be compatible with PVC pipe ends.

ABS solid wall fittings shall be of the same SDR rating as the pipe and shall be provided with solvent welded joints.

The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

27.02.4 Bedding Material

Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for bedding in \clubsuit 6 "Utility Earthwork".

27.02.5 Flexible Couplings

Flexible couplings used for repairs shall be rubber, full-circle, clamp-on type conforming with ASTM C 425 and provided with two stainless steel band screw-clamps to secure the coupling. All screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Rubber material shall be suitable for use on sewage systems.

27.02.6 Lateral Connections to Sanitary Sewer

Service lateral connections to new sewers shall be made with wye fittings.

Service lateral connections to existing sewers shall be made by the "Tap-Tite" method, or with approved Sealtite type saddle fittings that use neoprene gasket seals and stainless steel bands.

27.03 EXECUTION

27.03.1 General

Testing for defects and for leakage shall be performed in the presence of the Engineer. All defective material will be rejected and the Contractor shall remove the defective materials from the site.

Installation shall conform to the requirements of ASTM D 2321 and to the supplementary requirements or modifications specified in this section.

27.03.2 Trenching and Backfill

Trench excavation and backfill shall conform to the requirements of §6 "Utility Earthwork" and as specified in this section.

27.03.3 Pipe Laying

The pipe shall be installed in conformance with the requirements of ASTM D 2321, as specified in this section and as shown on the Contract plans. The pipe sections shall be jointed to form a smooth flow line. The bedding for the pipe shall be firm and uniform.

Proper implements, tools, and facilities, as recommended by the pipe manufacturer, shall be used by the Contractor for the execution of the work. All pipe, fittings, and accessories shall be lowered into the trench to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or that would produce ragged and uneven edges.

Installation of pipes in trenches shall start at the lowest point with the spigot ends pointing in the direction of flow.

The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter shall be removed from the interior of the pipe. The pipe shall be kept clean during and after laying. All openings in the pipe shall be closed with watertight expandable-type sewer plugs or PVC test plugs at the end of each day's operation or where the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.

The Contractor, at his expense, shall protect and maintain all underground and surface utility structures, drains, sewers, and other improvements affected by the work.

27.03.4 Pipe Handling

Pipe shall not be damaged in any manner during storage, transit, loading, unloading, and installation.

Pipe shall be inspected both prior to, and after installation, and all defective material shall be rejected and removed from the site.

27.03.5 PVC Field Jointing

Each pipe elastomeric-gasket joint shall be installed in conformance with the manufacturer's recommendations.

The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. Lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be inserted into the ring to complete the joint.

The pipe shall not be deflected in excess of the manufacturer's recommendations.

When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering the pipe. Adequate backfill shall be placed on the pipe to prevent the floating of the pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid. No pipe shall be placed when, in the opinion of the Engineer, the trench conditions or weather are unsuitable for the work.

27.03.6 ABS Field Jointing

ABS pipe shall be solvent-welded in accordance with the manufacturer's recommendations.

27.03.7 Fittings

All fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into the trench without damage to the fittings. Fittings shall be carefully connected to pipe or other facilities, and the joints shall be checked to ensure a sound and proper joint.

SECTION 28

VITRIFIED CLAY PIPE

28.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install all vitrified clay pipe and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

28.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used under this section.

28.01.2 Quality Assurance

All pipe shall be subject to a hydrostatic pressure test and a 3-edge bearing test at the manufacturer's plant. The Engineer may select at random, and test as specified in ASTM C 301, one length of pipe for each 1,000 feet or fraction thereof to be installed. The cost of the pipe and the test shall be at the Contractor's expense.

Pipe will be acceptable under the test requirements specified when all test specimens conform to the test requirements. Should any of the test specimens fail to meet the test requirements, the manufacturer will be allowed to retest two (2) additional specimens for each specimen that failed, and the pipe shall be acceptable only when all the retest specimens meet the strength requirements.

All pipe and fittings shall be true, circular, and concentric with the barrel of the pipe cut off at a right angle to the longitudinal axis of the pipe. At no point shall the thickness of the shell of the extreme outer end of the spigot be less than the thickness of the shell of the main body of the pipe.

Socket ends shall be square with the longitudinal axis and shall be true, circular, and concentric with the barrel of the pipe. All pipe shall be subject to inspection at the place of manufacture. The Contractor shall notify the Engineer, in writing, of the manufacturing start date not less than 14 days prior to the start of any phase of the pipe manufacture.

All pipe and fittings shall have smooth interiors and shall be free from cracks, checks, blisters, broken extremities, or other imperfections.

The following imperfections in the barrel or socket of a pipe or fitting will be considered as damage shall be cause for rejection:

1. A single crack in the barrel of the pipe or fitting extending through the entire thickness, regardless of the length of the crack; a single crack that extends through 1/5 of the barrel thickness and is over three (3) inches long; and any surface fire crack that is more than 1/32 inch wide.
2. Lumps, blisters, pits, or flakes on the interior surface of a pipe or fitting.
3. When the spigot or the bell of the pipe varies from a true circle more than three (3) percent of its nominal diameter.
4. Any piece broken from the spigot end and that extends through the barrel.
5. Tramp clays, grog, or other foreign matter that is fused permanently to the exterior or interior surface of the pipe or fittings.

28.02 PRODUCTS

28.02.1 Pipe and Fittings

Clay pipe and fittings shall be extra strength, unless otherwise shown, and shall conform to the requirements of ASTM C 700.

Service laterals in new sewers shall be installed using wye fittings.

28.02.2 Vitrified Clay Pipe

Vitrified clay pipe shall be extra strength pipe and shall be in accordance with ASTM C 12 and ASTM C 700.

28.02.3 Joints

Joints in vitrified clay pipe shall be made with factory-made bell and spigot compression joints for all pipe diameters. For connections to existing VCP up to 12 inches in diameter, a synthetic rubber collar may be used. The rubber collar shall have a stainless steel shear ring and stainless steel take-up clamps, bolts and nuts, and shall meet the requirements of ASTM C 425.

28.03 EXECUTION

28.03.1 General

The VCP pipe shall be constructed to the alignment and grade shown. The excavation shall be made a sufficient distance below the grade line to allow for the placing of the sewer pipe and the

embedment. Should the trench be excavated to a depth greater than required, the Contractor shall refill the over-excavation in accordance with §6 "Utility Earthwork".

28.03.2 Installation of Pipe

Installation of pipe shall be in accordance with ASTM C 12. Pipe laying shall proceed upgrade with the spigot ends pointing in the direction of flow. After a section of pipe has been lowered into the trench and immediately before joining the pipe, the ends of the pipe to be joined shall be cleaned and the gasket lubricated, in accordance with the pipe manufacturer's instructions. Assembly of the pipe length shall be in accordance with the manufacturer's recommendations for the type of joint used. All special tools and appliances required for joining the pipe shall be used by the Contractor. When cutting or machining of the pipe is necessary, only tools and methods recommended by the pipe manufacturer shall be used.

The Contractor shall take all necessary precautions to prevent material from getting into the pipe during the laying operations. At all times, when laying operations are not in progress and at the close of the day's work, the ends of the pipe in the trench shall be closed with appropriate bladders.

All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The Contractor shall assume full responsibility for any damage and shall, at the Contractor's expense, restore and replace the pipe to its specified condition and grade.

SECTION 29

REINFORCED CONCRETE PIPE

29.01 GENERAL

The Contractor shall provide all materials, equipment, and labor necessary to furnish and install all reinforced concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

29.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used in this section.

29.02 PRODUCTS

29.02.1 Materials

Reinforced concrete pipe shall conform to the requirements of ASTM C 76. Cement shall conform to ASTM C 150, Type II. Pipe shall be bell and spigot having “O” ring rubber gaskets retained in a groove on the spigot end and shall conform to ASTM C 443. All reinforcement shall be circular. Elliptical reinforcement shall not be allowed.

Cement mortar for structures or pipe connections shall consist of a mixture of portland cement, sand, and water. Mortar shall be composed of one part cement and two parts clean, well-graded sand that will pass the No. 8 sieve. Cement and sand shall first be combined in the proper proportions and then thoroughly mixed with the required amount of water.

Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Re-tempering of mortar will not be allowed.

No admixture shall be used in the mortar unless otherwise specified by the Engineer.

29.02.2 Pipe Design

Reinforced concrete pipe shall be manufactured and provided to meet the pipe strength classifications as shown on the Contract plans and in accordance with ASTM C 76. Class I and Class II pipe will not be allowed.

29.03 EXECUTION

29.03.1 Pipe Laying

Installation of pipes in trenches shall start at the lowest point with the spigot ends pointing in the direction of flow.

Pipe shall have a minimum laying length of approximately eight (8) feet, except for closure and other special pieces as approved by the Engineer. The length of the incoming and outgoing concrete pipe at each structure shall not exceed four (4) feet.

The bottom of the pipe shall be in contact with the bottom of the trench for the full length of each section.

Bell holes shall be excavated at each joint to provide barrel support of the pipe and to prevent point loading at the bells.

Unless otherwise required, all pipe shall be laid straight between changes in alignment and at a uniform grade between changes in grade.

Rubber gasket joints shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before the gasket is placed in the groove at the spigot end.

The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise damaged or forced out of position during the closure of the joint. The position of the rubber gasket after the joint has been assembled shall be checked. Where a joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed if necessary, the pipe relaid and the gasket placement rechecked.

Pointing and bonding mortar at pipe connections to structures shall be plastic and shall adhere to the pipe and structure.

SECTION 30

PVC-LINED REINFORCED CONCRETE PIPE

30.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install PVC-lined reinforced concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

30.01.1 Contractor Submittals

The Contractor shall submit certificates, test reports, shop drawings and layout diagrams for all pipe, joints and piping appurtenances.

Design calculations for each critical section of pipe wall and specials shall be submitted and shall be sufficient to determine that the pipes and fittings conform to this section. The Contractor shall be responsible for all expenses incurred in making samples for certification of tests.

Certificates of Compliance shall be provided for all products or materials to be used under this section and for the following:

1. Hydrostatic test reports of rubber gasket joints.
2. Three-edge-bearing strength (D-load) test reports as a proof of design for one pipe section of each size and strength class.
3. PVC liner test reports.

30.01.2 Quality Assurance

All pipe will be subject to inspection at the place of manufacture in accordance with the provisions of this section. The Contractor shall notify the Engineer, in writing, of the manufacturing schedule not less than 14 calendar days prior to the start of any phase of pipe manufacture.

Unless otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable standards. The Contractor shall have the material tests performed at no additional cost to the City.

The Engineer shall have the right to witness all testing conducted by the Contractor provided that the Contractor's schedule is not delayed for the convenience of the Engineer. The Engineer may request additional samples of any material for testing by the City. The additional samples shall be furnished at no additional cost to the City.

All pipe shall be subject to testing for compliance with the applicable specifications and standards, including:

1. A 3-edge-bearing strength (D-load) test in accordance with ASTM C 76.
2. A hydrostatic test of the rubber gasket joints in accordance with ASTM C 361 or AWWA C 302 except test pressure shall be 5 pounds per square inch.
3. PVC liner tests as specified in this section.

30.01.3 Basis of Acceptance for PVC-Lined Reinforced Concrete Pipe

1. The basis of acceptance of reinforced concrete pipe manufactured in compliance with this section shall be in accordance with Section 5.1.1 of ASTM C 76 and as follows:
 - a. The Engineer may review required submittals.
 - b. Three-edge-bearing test loads shall be applied to produce a 0.01 inch maximum crack except that applied test loading may be terminated without producing a 0.01 inch maximum crack if, or when, the loading has reached 110 percent of that required for the specified D-load for the pipe.
 - c. Test results shall be submitted to the Engineer prior to shipment of the pipe product to the jobsite. Results shall indicate project name, testing agency and operator performing the test, test date, pipe size, and specified D-load applied.
2. For PVC-lined pipe, all PVC liner sheets, joints, comer, or weld strips shall have the following physical properties when tested at 77° F (plus or minus 5° F).

Property	Initial	Exposure ⁽¹⁾
Tensile Strength	2,200 psi (minimum)	2,100 psi (minimum)
Elongation at Break	200 percent (minimum)	200 percent (minimum)
Shore Durometer, Type D	Within one second: 50-60 Within 10 seconds: 35-50	Plus or minus 5 ⁽²⁾ Plus or minus 5 ⁽²⁾
Weight Change	---	1.5 percent ⁽²⁾

(1) For 112 days in chemical solutions listed in ♣30.01.3, Item 3.

(2) With respect to initial test results.

- a. Tensile and elongation specimens shall be prepared and tested in accordance with ASTM D 412 using Die B.

- b. Indentation hardness test shall be in accordance with ASTM D 2240 using a Type D durometer except that a single thickness of material will be used.
 - c. Weight change and indentation hardness specimens shall be 1-inch x 3-inch samples of the sheet thickness.
 - d. Specimens may be taken from sheet and strip at any time prior to final acceptance.
3. All PVC liner sheets, joints, comer, and weld strips shall resist the following chemicals:

Chemical Solution	Concentration
Sulfuric acid	20 percent ⁽¹⁾
Sodium hydroxide	5 percent
Ammonium hydroxide	5 percent ⁽¹⁾
Nitric acid	1 percent ⁽¹⁾
Ferric chloride	1 percent
Soap	0.1 percent
Detergent (linear alkyl benzyl sulfonate or LAS)	0.1 percent

(1) Volumetric percentages of concentrated C.P. grade reagents.

- a. After conditioning to a constant weight at 110° F, test specimens shall be exposed to each of the above solutions for a period of 112 days at 77° F (plus or minus 5° F).
 - b. At 28-day intervals, test specimens shall be removed from each of the chemical solutions and tested. If any specimen fails to meet the 112 day requirements before completion of the 112 day exposure, the material will be subject to rejection.
4. PVC-liner locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment This test shall be made at a temperature of 75° F (plus of minus 5° F).
5. Shop-welded joints, used to fuse individual sections of PVC-liner together, shall be at least equal to the minimum requirements of the PVC-liner for thickness, corrosion resistance and impermeability. Welds shall show no cracks or separations and shall be tested for tensile strength. Tensile strength measured across the welded joint in accordance with ASTM D 412 using Die B and shall be at least 2,000 pounds per square inch. Test temperature shall be 77° F (plus or minus 5° F) and the measured minimum width and thickness of the reduced section shall be used.
6. All PVC-liner shall be shop-tested for holes with a spark tester set to provide from 15,000 volts to 20,000 volts. Sheets having holes shall be satisfactorily repaired in the shop prior

to shipment from the manufacturer's plant. Repairs shall be made by welders qualified in accordance with the following requirements.

30.01.4 PVC-Liner Welder Qualifications

Each PVC-liner welder shall pass a qualification welding test acceptable to the City before doing any welding field joints in PVC liners. Re-qualification may be required at any time deemed necessary by the City.

30.02 PRODUCTS

30.02.1 General

PVC-lined reinforced concrete pipe shall be a minimum of Class III and shall conform to the requirements of ASTM C 76. Class I and Class II pipe will not be allowed.

30.02.2 Pipe Design

Reinforced concrete pipe (PVC-lined) shall be manufactured and provided to meet the pipe strength classifications as shown on the Contract plans and in accordance with ASTM C 76B

30.02.3 Materials

Materials shall comply with #6 of ASTM C 76 as modified below. All reinforcement shall be circular. Elliptical reinforcing will not be allowed.

Cement used in the manufacture of reinforced concrete pipe shall be Type V in conformance with ASTM C 150.

No admixture shall be used unless otherwise specified or accepted in writing by the Engineer.

Rubber gaskets shall be neoprene and shall comply with the requirements of ASTM C 361 or AWWA C 302.

PVC-liner shall be Ameron, Amer-Plate T-Lock, Poly-Tee Inc. or an equal. The liner shall be installed with 360° of coverage over the interior surface of the pipe.

1. The material used in the liner and in all joints, comers, and welding strips shall be a combination of polyvinyl chloride resin, pigments, and plasticizers, especially compounded to remain flexible.

Polyvinyl chloride resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

2. All PVC liner sheets, including locking extensions, all joints, comers and welding strips, shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material.
3. The minimum thickness of sheets with integral locking extensions shall be 0.065 inches, plain sheet shall be 0.094 inches, joint strips shall be 0.075 inches, and weld strips shall be 0.094 inches. Locking extensions shall be approximately 2 ½ inches apart and shall be at least 0.375 inches high.
4. Pipe lining shall be supplied as pipe-size sheets, fabricated by shop-welding the basic size sheets. Shop welds shall be made by lapping sheets a minimum of ½ inch and applying heat and pressure to the lap to produce a continuous welded joint.
5. Sheets shall have transverse strap channels cut in the locking extensions so that the strap can be placed into and perpendicular to the locking extensions.
6. These channels shall be not less than ¾-inch wide and not more than 1 ¼-inch wide and shall be cut so that a maximum of 3/16 inch of the base of the locking extension remains in the base of the strap channel. Strap channels shall be provided at intervals of not less than 15 inches center-to-center or more than 20 inches center-to-center. The strap channels shall not be cut through the final 2 locking extensions on each edge of the sheet.
7. Transverse flaps shall be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that a maximum of 1/64 inch of the base of the locking extension is left on the sheet
8. Weld strips shall be approximately one (1) inch wide. The edges of weld strips shall be beveled in the manufacturing process. The thickness of the weld strip shall be equivalent to that of the liner.
9. Joint strips for pipe shall be four (4) inches wide. The thickness of joint strips shall be equivalent to that of the liner.
10. Prior to preparing the sheets for shipment, they shall be tested for holes using an electrical spark tester set at 20,000 volts (minimum). Any holes shall be repaired and retested.

30.02.4 Joints

Joint assembly design shall be with reinforced concrete bells and spigots incorporating a fully retained single rubber gasket in accordance with ASTM C 361 or AWWA C 302.

30.03 EXECUTION

30.03.1 General

PVC-lined reinforced concrete pipe shall be installed in accordance with the manufacturer's recommendations, the requirements of §6 "Utility Earthwork" and the following requirements.

30.03.2 Pipe Handling

All laying and jointing and testing for defects and for leakage shall be performed in the presence of the Engineer. Defective material shall be rejected and the Contractor shall remove the defective material from the site.

Pipe shall be lifted to minimize bending of the pipe section and to prevent damage to the pipe. The pipe shall be supported in a manner that will prevent distortion or damage to the pipe. The pipe shall be stockpiled on timber cradles or properly prepared ground. Any pipe section that becomes damaged as a result of improper handling or stockpiling shall be repaired to the satisfaction of the Engineer or shall be replaced with a new section at no additional cost to the City.

Necessary facilities shall be provided for lowering and properly placing the pipe sections and specials in the trench without damage. Slings shall bear uniformly against the pipe.

30.03.3 Pipe Laying

Bell holes shall be excavated at each joint to provide barrel support of the pipe and to prevent point loading at the bells.

All pipe shall be laid straight between the changes in alignment and at uniform grade between changes in grade. Pipe shall have a minimum laying length of approximately eight (8) feet, except for closure and other special pieces, as approved by the Engineer. The length of the incoming and outgoing concrete pipe at each structure shall not exceed four (4) feet.

Installation of pipes in prepared trenches shall start at the lowest point with the spigot ends pointing in the direction of flow.

The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end.

The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise damaged or forced out of position during the closure of the joint. The position of the rubber gasket shall be checked after the joint has been assembled. Where a joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed, if necessary, the pipe relaid and the gasket placement rechecked.

30.03.4 PVC-Liner Installation

PVC sheets for pipe, and structures shall be prepared and applied in conformance with the following:

1. Installation of the lining, including pre-heating of sheets in cold weather and the welding of all joints, shall be done in accordance with the manufacturer's recommendations.
2. Coverage of the lining shall not be less than the minimum shown.
3. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the pipe.
4. The lining shall be held firmly in place against forms by means of steel banding straps or as recommended by the manufacturer. Banding straps must be located in the pre-cut strap channels to prevent crushing or tilting of the locking extensions.
5. If banding strips are used, a steel channel, angle, or bar may be inserted along the edge locking extension of each liner sheet for concrete pipe or cast-in-place structures. Steel channel, angle, or bar shall be of sufficient stiffness to hold the longitudinal edges of the lining firmly against the form.
6. Locking extensions shall terminate not more than ½ inch from the end of the inside surface of the pipe section. Joint flaps, when used, shall extend approximately four (4) inches beyond the end of the inside surfaces.
7. Concrete poured against lining shall be vibrated, spaded, or compacted to produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
8. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from the lined surfaces. When the forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked. Form tie holes shall be marked before the ties are broken off and all areas of significant abrasion or damage shall be marked.
9. All nail and tie holes, and all cut, torn, and significantly abraded areas in the lining shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch area. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
10. Hot joint compounds, such as coal and tar, shall not be poured or applied to the lining.
11. The Contractor shall prevent damage to installed linings from equipment and materials used in the work.

Structure Connections to Concrete Pipe - Special Requirements

1. The lining shall be set flush with the inner edge of the bell or spigot end of a pipe section and shall extend to the opposite end or to approximately four (4) inches beyond the opposite end, depending upon the type of lining joint to be made with the adjoining concrete pipe.
2. Where concrete pipe, or cast-in-place structures protected with lining, join structures not so lined (such as pre-cut concrete pipe, cast-in-place structures or clay pipe) the lining shall be extended over and around the end of the pipe and back into the structure for not less than four (4) inches. This protecting cap may be molded or fabricated from the lining material but need not be locked into the pipe.
3. Where a pipe lateral (not of plastic-lined concrete) is installed through lined concrete pipe, the seal between the lined portion and the lateral shall be made by the method prescribed for cast-in-place structures under this section.
4. On pipe having complete (360°) liner coverage, the longitudinal edges of the sheet shall be butt welded.
5. No pipe with damaged lining will be accepted until the damage has been repaired to the satisfaction of the Engineer.

Field Joints in Lining for Concrete Pipe

1. The joint between sections of lined pipe shall be prepared in the following manner:
 - a. The inside joint shall be filled with non-shrink grout.
 - b. The grout shall not, at any point, extend into the pipe beyond a straight line connecting the surfaces of the adjacent pipe sections.
 - c. No lining joint shall be made until the trench has been backfilled and consolidated.
 - d. Pipe joints must be dry before lining joints are made.
2. All grout and other foreign material shall be removed from lining surfaces adjacent to the pipe joint leaving them clean and dry.
3. Field joints in the lining at pipe joints may be either of the following described types:

Type P-1: The joint shall be made with a separate 4-inch joint strip and two (2) welding strips. The 4-inch strip shall be centered over the joint, tack welded to the lining and then welded along each edge, adjacent to the liner sheets, with a one inch weld strip. The

width of the space between adjacent sheets shall not exceed two (2) inches. The 4- inch joint strip shall lap over each sheet a minimum of one (1) inch.

Type P-2: The joint shall be made with a joint flap with locking extensions removed and extending approximately four (4) inches beyond the pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of one inch and be tack-welded in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe using a 1-inch wide welding strip. Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint grouting shall be avoided. The joint flap or strip on beveled pipe shall be trimmed to a width (measured from the end of the spigot) of approximately four (4) inches for the entire circumferential length of the lining.

Welding of joints is to be performed in conformance with the manufacturer's specifications. Welding shall fuse both sheets together to provide a continuous joint equal in corrosion resistance and permeability to the liner plate. Hot-air welding guns shall provide effluent air to the sheets to be joined at a temperature between 500° F and 600° F. Welding guns shall be held approximately ½ inch from, and moved back and forth over, the junction of the materials to be joined. The gun shall be moved slowly enough to cause a small bead of molten material to be visible along both edges of the weld strip.

When groundwater is encountered, the lining joint shall not be made until pumping of groundwater has been discontinued for at least three (3) days and no leakage is evident at the joint. The following special requirement shall apply when the liner coverage is 360°.

Application to Cast-in-Place Concrete Structures - Special Requirements (where required)

1. Liner sheets shall be closely fitted and properly secured to the forms. Sheets shall be cut to fit curved and warped surfaces. If liner joints are to be type C-3 joints as described below, the adjacent sheets shall be butted with not more than a 0.125 inch opening between the sheets. A welding strip fusion-welded on the back of butt joints shall be used to prevent wet concrete from flowing around the edges.
2. The lining shall be returned four (4) inches at the surface of contact between the concrete structure and the non-concrete items (including maintenance hole frames, gate guides, clay pipe, or brick manholes, and clay or cast-iron pipes). The same procedure shall be followed at joints where the type of protective lining is changed or the new work is built to join existing unlined concrete. At each return, the return liner shall be sealed to the item in contact with the plastic-lined concrete using the adhesive system recommended by the liner manufacturer. If the liner cannot be sealed with this adhesive because the joint at the return is too wide or too rough, or because of safety regulations, the joint space shall be densely caulked with lead wool or other approved caulking material to a depth of two (2) inches.

Joints in Lining for Cast-in-Place Concrete Structures (where required)

1. Lining at joints shall be free of all grout and other foreign material and shall be clean and dry before joints are made.
2. Field joints in the lining shall be of the following types and used as prescribed:

Type C-1: The joint shall be made with a separate 4 -inch wide joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, tack welded to the liner, then welded along each edge of adjacent sheets with 1-inch weld strips. The width of the space between adjacent sheets shall not exceed two (2) inches. The 4-inch wide joint strip shall lap over each sheet a minimum of one (1) inch. It may be used at any transverse or longitudinal joint.

Type C-2: The joint shall be made by lapping sheets not less than one (1) inch. One welding strip is required. The upstream sheet shall overlap the downstream sheet. The lap shall be tack-welded into place prior to welding.

Type C-3: The joint shall be made by applying one welding strip on the back of the butt joint to prevent wet concrete from getting under the sheet. After the forms have been stripped a second welding strip shall be applied over the butt joint on the face of the sheet.

All welding is to be in strict conformance with the specifications of the lining manufacturer and this section.

Testing and Repairing Damaged Surfaces

After the pipe is installed in the trench, the Contractor shall test all surfaces covered with lining, including welds, with an approved electrical hole detector with the instrument set at 20,000 volts (minimum). Testing shall be performed in the presence of the Engineer. All imperfections detected shall be repaired to the satisfaction of the Engineer.

SECTION 31

CORRUGATED POLYETHYLENE NONPRESSURE PIPE (HDPE)

31.01 GENERAL

The Contractor shall provide all materials, equipment, and labor necessary to furnish and install 12-inch to 36-inch corrugated polyethylene non-pressure pipe with all necessary fittings and coupling systems and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

31.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used under this section.

31.01.2 Quality Assurance

All materials testing shall be based upon applicable ASTM Test Methods referenced in this section for the materials specified. The Contractor shall be responsible for all costs of the manufacturing inspections and tests.

31.02 PRODUCTS

31.02.1 General

Corrugated polyethylene pipe shall be smooth interior wall Type S and shall be as specified in AASHTO M 294, except as otherwise specified in this section. Corrugated polyethylene pipe shall be manufactured from high density polyethylene (HDPE) virgin compounds.

1. HDPE compounds used in the manufacture of corrugated polyethylene pipes shall conform to the following cell classifications as provided in ASTM D 3350:

Property	Cell Classification
Density	2
Melt Index	2 ^(a) 3, or 4
Flexural Modulus	4, 5 or 6
Tensile Strength	4, 5 or 6
Environmental Stress Crack Resistance	1, 2 or 3
Hydrostatic Design Basis	0, 1, 2, 3, or 4
Ultraviolet Stabilizer	C ^(b)

(a) The melt index for cell class factory 2 material used to manufacture pipe shall not be greater than 0.6. Rotationally-molded couplings and end fittings may be produced from material compounds having a melt index cell classification of one.

(b) HDPE resin shall contain not less than 2% (plus or minus ½ %) carbon black ultraviolet stabilizer.

The residue from ignition of the HDPE compounds shall not exceed 30% as determined by ASTM D 2584, except that the muffle furnace temperature shall be 840° F (plus or minus 45° F).

31.02.2 Pipe Thickness, Stiffness and Unit Weight

Wall thickness of Type S corrugated polyethylene pipe shall be the thickness of the inner liner measured between corrugation valleys.

The pipe stiffness shall be determined in accordance with ASTM D 2412. Pipe stiffness shall be determined for three (3) test specimens for each manufactured run. Minimum pipe stiffness and wall thickness shall be as follows:

Pipe Diameter (inches)	Minimum Wall Thickness (inches)	Minimum Pipe Stiffness (pounds per square inch)
12	0.035	50
15	0.035	42
18	0.050	40
24	0.050	34
30	0.050	28
36	0.050	22

The minimum pipe unit weight shall meet the requirements of Table 2 of Section 64-1.03 "Pipe Thickness, Stiffness and Unit Weight" of the Caltrans Standard Specifications.

The pipe unit weight shall be computed as the average weight per foot of length determined from three (3) test specimens, taken from each manufactured run. Each test specimen for pipes 24 inches in diameter and less shall be a minimum length of two (2) diameters. The length of each test specimen for pipes larger than 24 inches in diameter shall be one diameter or a maximum of 36 inches, whichever is less. The weight of pipe specimens shall be determined with any suitable weighing device that is accurate to 0.10 pound.

31.02.3 Joints

The joint shall be bell and spigot design and shall include a rubber gasket meeting the requirements of ASTM F-47.

Fittings used in the system shall not reduce or impair the overall integrity or function of the pipe. Fittings may be either molded or fabricated common corrugated fittings, including in-line joints such as tees, wyes, and end caps. Unless otherwise specified, fittings shall be installed using a

joint configuration meeting the requirements of cell Class 335420C as defined and described in ASTM D 3350. Only fittings supplied or recommended by the manufacturer shall be used.

Water tightness shall be attained by the use of approved durable, high quality, resilient joint materials. These materials shall be neoprene expanded rubber or sheet rubber gaskets, "O" ring rubber gaskets, butyl rubber base joint sealant, or other resilient materials.

31.03 EXECUTION

31.03.1 General

Testing for defects and for leakage shall be performed in the presence of the Engineer. All defective material will be rejected and the Contractor shall remove the defective material from the site.

31.03.2 Pipe Handling

Defective pipe, fittings, and accessories shall be rejected. Pipe and fittings shall be free from fins and burrs. Pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

31.03.3 Installation

Pipe shall be laid and jointed in accordance with the manufacturer's recommendations and the following provisions.

Necessary facilities shall be provided for lowering and properly placing the sections of pipe in the trench.

The pipe shall be laid to the line and grades shown on the Contract plans.

Every precaution shall be taken to prevent flooding the pipe trench before backfilling operations.

New pipe shall be connected to existing or new drainage facilities as shown on the Contract plans.

31.03.4 Connections

Connections of HDPE to existing structures and pipes shall be as follows:

1. Connections to cast-in-place structures shall include a water-stop at mid-wall of the structure.

2. Connections to pre-cast structures shall include a water-stop at mid-wall of the structure, and opening shall be filled with cement grout.
3. Connections to existing HDPE pipe shall be made with a premium split-coupling saddle tee.
4. Connections to existing PVC shall be made with a PVC saddle with a HDPE/SDR 35 PVC adaptor.
5. Connections to existing D.I.P. shall be made with a D.I.P. tap and heat shrink material around the joint. Heat shrink material shall be supplied by the HDPE pipe manufacturer.
6. Connections to existing RCP shall be as shown on the Contract plans, except that the PCC concrete encasement around the RCP shall be extended to cover the HDPE to a point located 6 inches to 12 inches beyond the RCP sleeve.

SECTION 32

DUCTILE IRON PIPE

32.01 GENERAL

The Contractor shall provide all material, equipment and labor necessary to furnish and install iron pipe and all appurtenant work, complete and operable, including all connections as shown on the Contract plans and as specified in this section.

32.01.1 Contractor Submittals

The Contractor shall submit shop drawings of the pipe and fittings in accordance with the requirements of this section and the following supplemental requirements:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.
2. For pipe 18 inches in diameter and larger, line layout and marking diagrams that indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include the pipe station and invert elevations at all changes in grade or horizontal alignment, all elements of deflected joints and fittings and the limits of each reach of restrained joints, or of concrete encasement.

Certificates of Compliance shall be provided for all products and materials used under this section, and the following supplemental requirements:

1. Physical and chemical properties.
2. Hydrostatic test reports.

All expenses incurred in making samples for certification or tests shall be the responsibility of the Contractor.

32.01.2 Quality Assurance

All pipe will be subject to inspection at the place of manufacture. The Contractor shall notify the Engineer, in writing, of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Standard Specifications.

The Contractor shall have all material tests performed at no additional cost to the City. The Engineer shall have the right to witness all testing provided that the Contractor's schedule is not delayed for the convenience of the Engineer.

The Engineer may request additional samples of any material for testing by the City. The additional samples shall be furnished at no additional cost to the City.

32.02 PRODUCTS

32.02.1 General

Mortar, coal tar-coated or polyethylene-encased ductile iron pipe shall conform to ANSI/AWWA C 104, and ANSI/AWWA C 105, subject to the following supplemental requirements: 1) the pipe shall be of the diameter and class shown on the Contract plans, 2) the pipe shall be furnished complete with rubber gaskets, and 3) all special components and fittings shall be provided as required.

Ductile iron lining options are as follows:

1. Potable Water: Mortar, Type II.
2. Storm Drains: No liner
3. Sanitary Sewer: Mortar, Type V.

The Contractor shall legibly mark specials 18 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.

The pipe shall be handled by devices in conformance with the manufacturer's recommendations. The use of equipment which might damage the pipe lining and coating will not be allowed.

Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be in conformance with the manufacturer's recommendations.

Maximum pipe laying lengths shall be 20 feet with shorter lengths provided as required.

The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

Closures and correction pieces shall be provided, as required, so that closures may be made due to different headings in the pipe laying operation and so that corrections may be made to adjust the pipe laying to conform to pipe stationing.

32.02.2 Pipe Design

Ductile iron pipe shall be designed in accordance with the pressure class requirements of ANSI/AWWA C 150 as applicable. The minimum pressure class shall be Class 350 for 4-inch through 12-inch sizes; Class 250 for 14-inch through 20-inch sizes; and Class 200 for sizes larger than 20 inches.

The minimum wall thickness shall be in accordance with ANSI/AWWA C 150.

32.02.3 Materials

Pipe materials shall conform to the requirements of ANSI/AWWA C 151.

Cement for mortar lining for water and reclaimed water systems shall conform to the requirements of ANSI/AWWA C104 provided that cement for mortar lining shall be Type II for potable water systems and Type V for sanitary sewer systems. A fly ash or pozzolan shall not be used as a cement replacement.

External coatings for buried ductile iron pipe using potable water shall be Polyethylene encasement or coal tar paint, in conformance to \clubsuit 35 "Protective Coatings". Fire hydrant laterals and fire service laterals may also be coal-tar coated for potable water use.

32.02.4 Pipe Fittings and Specials

Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C 153 or ANSI/AWWA C 110 flanged fittings only, for diameters 4 inches through 48 inches and shall have a minimum pressure rating of 250 pounds per square inch. Ductile iron fittings larger than 48 inches shall conform to the applicable portions of the ANSI/AWWA standards.

Connections to sanitary sewer mains shall be:

1. Existing lines - Tap-Tite method or cast iron saddle fittings that utilize neoprene gasket seals and stainless steel bands.
2. New lines - Wye fittings only.

Acceptable products for fittings are US Pipe, Union Foundary, Trinity, or an equal.

32.02.5 Design of Pipe

The pipe furnished shall be ductile iron pipe, lined and coated with rubber gaskets at the joints.

The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements and shall conform to ANSI/AWWA C 151.

The pipe shall be of the diameter and class shown on the Contract plans.

The fittings shall be of the diameter and class shown on the Contract plans.

Ductile iron pipe shall be furnished with mechanical joints, flanged joints and push-on joints as required. Ductile iron fittings shall be mechanical joints, flanged joints and push-on joints. Push-on joints will not be allowed for fittings and valves.

1. Mechanical and push-on joints shall conform to ANSI/AWWA C 111.
2. Flanged joints shall conform to ANSI/AWWA C 115, or ANSI/AWWA C 110.
3. When allowed by the Engineer, restrained joints shall be American Cast Iron Pipe Co. "LokFast" Restrained Joint, U.S. Pipe and Foundry "TR FLEX" Restrained Joint, MEG-A-LUG, or an equal.

Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe.

32.02.6 Lining

Interior surfaces of all ductile iron pipe, fittings and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformance with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining.

If lining is damaged or found faulty at the delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to this section. The linings shall have a minimum thickness that matches factory lining.

All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C 104.

32.02.7 Exterior Coating

Exterior Coating of Exposed Piping: The exterior surfaces of pipe that are exposed to the atmosphere shall be thoroughly cleaned and then given a factory coat of rust-inhibitive primer and a field coat of rust prohibitive finish conforming to the requirements of ♣35 "Protective Coating".

Exterior Coating of Buried Piping: Coating of buried pipe shall be as specified in this section.

32.03 EXECUTION

32.03.1 Installation of Pipe

All pipe, fittings, and appurtenances shall be protected against damage, impact shocks and free fall. All pipe handling equipment shall be in conformance with the manufacturer's recommendations.

Pipe shall not be placed directly on the ground but shall be supported in a manner that will protect the pipe against damage. No pipe shall be installed where the lining or coating shows defects. Damaged lining or coating shall be repaired or a new undamaged pipe shall be furnished and installed.

1. All damaged pipe shall be repaired or replaced by the Contractor.
2. The Contractor shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe or fitting.
3. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance. The pipe shall be kept clean at all times. The openings of all pipes and fittings in the trench shall be closed during any interruption of the work.
4. Polyethylene encasement or coal-tar coating shall be provided in accordance with ♣35 "Protective Coating".

The pipe shall be installed in accordance with AWWA C 600.

1. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted, and the bedding shall form a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for applying coatings on field joints.
2. Each section of pipe, 18 inches in diameter and larger, shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the lines and grade shown on the Contract plans.
3. On pressurized main pipelines, where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades.

Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. Changes in alignment using additional fittings shall be in conformance with the Contract plans. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water-tightness of the joint.

4. All gravity lines shall be laid uphill starting at the lowest point with the spigot end pointing in the direction of flow. Pressurized lines laid on a downhill grade shall be blocked and held in place until its movement is prevented by the placement of the adjacent pipe. All bends shall be properly installed as shown on the Contract plans. Water lines shall be laid uphill on grades exceeding 10 percent.
5. Trenches shall be in a reasonably dry condition when the pipe is laid. The Contractor shall prevent the pipe from floating, due to water entering the trench from any source. The Contractor shall assume full responsibility for any damage and shall, at the Contractor's expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

No pipe shall be installed on a foundation that is penetrated by frost or where frost or ice may form at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of frost and ice occurs.

The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance.

The Contractor shall completely clean the interior of the pipe of all sand, dirt, mortar and any other debris following completion of pipe laying and shall make any necessary repairs prior to testing the completed pipeline.

32.03.2 Rubber Gasket Joints

The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise damaged or forced out of position during the closure of the joint. The position of the rubber gasket shall be checked after the joint has been assembled. Where joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed if necessary, the pipe relaid, and the gasket placement rechecked.

32.03.2 Joint Protection

Fittings and joints between pipe sections shall be field coated with the same products as adjacent pipe sections.

Polyethylene encasement and coal tar paint shall be applied in conformance with the coating manufacturer's recommendations, and in accordance with the requirements of ♣35 "Protective Coatings".

32.03.4 Sanitary Sewer Cleanouts

Sanitary sewer clean-outs shall be installed in conformance with ♣33 "Piping, Valves, Fittings and Appurtenances".

SECTION 33

PIPING, VALVES, FITTINGS AND APPURTENANCES

33.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install all exposed and buried piping, complete, including: small steel pipe, small valves, red brass pipe, copper tubing, solvent-welded PVC pipe, fittings, gaskets, bolts, insulating connections, and all other specialties as required for a complete and operable piping system, as shown on the Contract plans and as specified in this section.

33.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used under this section.

Manufacturer's product specifications and performance details shall be provided for all products and materials to be used under this section.

33.02 PRODUCTS

33.02.1 Small Steel Pipe

Galvanized steel pipe shall conform to the requirements of ASTM A 53, and shall be Schedule 40 or Schedule 80. NPT fittings for galvanized steel pipe shall be of galvanized malleable iron.

33.02.2 Polyethylene Plastic Pipe and Tubing (for water services)

Polyethylene plastic pipe, for 1-inch Residential Joint Domestic/Fire Services only, shall be PE 3408 with SIDR 7, iron pipe size conforming to the requirements of ASTM D 2239, and a rating of 200 pounds per square inch. Polyethylene plastic tubing, for 1-inch, 1½-inch, and 2-inch services shall be PE 3408 with SIDR 9, copper tubing size conforming to the requirements of ASTM D 2239, and a rating of 160 pounds per square inch.

All joints connecting polyethylene plastic pipe or tubing shall utilize compression fittings.

33.02.3 Brass Pipe

Brass pipe shall conform to the requirements of ASTM B 43. Fittings shall be of bronze conforming to the requirements of ASTM B 62 with threaded ends, conforming to ANSI/ASME B16.15.

Two inch brass street elbows, for dead-end and in-line blow offs shall be Jones 2619, Ford F84.77G, or an equal.

33.02.4 Copper Tubing

Copper tubing shall conform to the requirements of ASTM B 88 and shall be Type K, soft temper, joint-free, for buried tubing and hard-drawn, joint-free, for above-ground applications. All fittings connecting copper tubing shall be compression fittings.

33.02.5 PVC Pressure Pipe, Solvent Welded

PVC pipe shall be made from all new, rigid, unplasticized polyvinyl chloride and shall be Schedule 40 or Schedule 80 conforming to ASTM D 1785. Joints and fittings shall be of the same material as the pipe and shall be of a solvent-welded construction.

33.02.6 Corporation Stop Valves

Tapered Plug Type

1. Tapered plug-style valves shall be brass conforming to AWWA C 800.
2. The connection joint to the service saddle shall be in conformance with AWWA C 800 iron pipe thread.
3. The connection joint to the service lateral shall be a compression joint.
4. Tapered plug-style valves on steel or ductile iron pipe shall utilize a threaded insulating bushing between the tapping outlet or service saddle on the water main and the stop valve.

Manufacturers, or Equal

1. Iron Pipe Sizes, 1-inch Residential Joint Domestic/Fire Service only:

Size	Mueller	Jones	Ford
One inch	H-15029	J-3404	F-1101

2. Copper Tubing sizes, 1-inch, 1½-inch, and 2-inch service:

Size	Mueller	Jones	Ford
One inch	H-15028	J-3403	F-1101
1 ½ inch	H-15023	---	---
2 inch	H-15023	---	---

Ball Valve Type

1. Ball valve style valves shall be brass conforming to AWWA C 800.
2. The connection joint to the service saddle shall be in conformance with AWWA C 800 iron pipe thread.
3. The connection joint to the service lateral shall be a compression joint.
4. Ball valve style valves on steel or ductile iron pipe shall utilize a threaded insulating bushing between the tapping outlet or service saddle on the water main and the stop valve.

Manufacturers, or Equal

1. Iron pipe sizes, 1-inch Residential Joint Domestic/Fire Service only:

Size	Mueller	Jones	Ford
One inch	---	J-1935	FB-100

2. Copper tubing sizes, 1-inch, 1½- inch, 2-inch services:

Size	Mueller	Jones	Ford
One inch, 1 ½ inch 2 inch	B-25028	J-1935	FB-1101

33.02.7 Angle Meter Stop Valves

Angle meter stop valves shall be a brass ball valve, brass angle meter valve, or brass ground key angle meter valve with a 180° lock wing. The connection joint to the water service line shall be a compression joint

Manufacturers, or Equal

1. Iron pipe sizes, 1-inch Residential Joint Domestic/Fire Service only:

Size	Mueller	Jones	Ford
One inch	H-14259	J-4202	KV63-444W

2. Copper tubing sizes, 1-inch, 1½-inch, 2-inch services:

Size	Mueller	Jones	Ford
One inch	H-14258	J-4201	KV43-444W
1 ½ inch	H-14277	J-4205	FV43-666W
2 inch	H-14277	J-4205	FV43-777W

33.02.8 Meter Adapters

Slotted meter adapters shall be used for piston meter sizes one inch and smaller when service lateral size is 1½-inch or 2-inch.

Manufacturers shall be Ford A47 slotted adapter, Jones, or equal.

33.02.9 Lockable Ball Valves

Lockable ball valves for commercial services shall be a brass ball valve with iron pipe threads on both ends with padlock wings.

Manufacturers, or Equal.

1. Female iron pipe threads both ends for turbine meter:

Size	Mueller	Ford
One inch	B-20200	B11-444
1 ½ inch	B-20200	B11-666
2 inch	B-20200	B11-777

2. Female iron pipe threads by meter swivel for piston meter:

Size	Mueller	Ford
One inch	B-24351	B13-444W
1 ½ inch	B-24337	BF13-666W
2 inch	B-24337	BF12-777W

33.02.10 Polyethylene Pipe and Tubing Liners

Stainless steel liners shall be used with all compression fittings on polyethylene pipe and tubing.

Manufacturers, or Equal

1. Iron pipe sizes, 1-inch Residential Joint Domestic/Fire Service only:

Size	Mueller	Jones	Ford
One inch	505142	J-2806	72

2. Copper tubing sizes, 1-inch, 1½-inch 2-inch services:

Size	Mueller	Jones	Ford
One inch	504385	J-2801	52
1 ½ inch	506139	J-2105	54
2 inch	506141	J-2805	55

33.02.11 Tapping Sleeves

Tapping sleeves shall be cast iron, mechanical-joint sleeves with a rated working pressure of at least 150 pounds per square inch, stainless steel with stainless steel nuts and bolts, or steel, mortar-lined and coated, with stainless steel nuts and bolts. Bolts and nuts on epoxy-lined sleeves shall be Type 304 or Type 316 stainless steel.

Manufacturers, or equal

Pipe Type	Clow	Mueller	Tyler	APAC	Ford
Plastic	F-5205 (4-16 inch)	H-615 (4-12 inch)	5-149	512 (4-12 inch)	FTSC (14-30 inch) ^(a)
	F-5207 (4-12inch) ^(b)	---	---	---	---
Ductile Iron	F-5205 (4-16 inch)	H-615 (4-24 inch)	5-149	512 (4-30 inch)	FTSC (4-30 inch)
	---	H-621 (24-30 inch)	---	---	---
Asbestos Cement	F-5207 (4-12 inch) ^(b)	H-619 (4-12 inch)	5-349	512 (4-30 inch) ^(a)	FTSC (14-30 inch) FTSC (SS) (4-12 inch) ^(a)
Steel	---	---	---	514 (4-36 inch)	FWS 94-16 inch)

(a) Allowed only if the pipe is out of round and it is approved by Water Resources

(b) For Class 100 pipe, 10-inch and 12-inch, use the F-5205.

33.02.12 Tapping Outlets

Tapping outlets for steel mortar-lined and coated pipe shall be designed and fabricated to comply with design procedures in AWWA Manual M-1 1. The tapping outlets shall be designed for the pressure rating of the pipeline to which they are attached, with a minimum rated working pressure of 150 pounds per square inch.

Tapping outlets for mortar-lined and coated steel pipe shall be factory fusion bonded epoxy lined and coated steel in conformance with \clubsuit 35 "Protective Coatings" with stainless steel nuts and bolts.

Manufacturers for steel pipe, or Equal

APAC	Ford
514	FWS

33.02.13 Service Saddles

Service saddles shall be bronze or stainless steel for use on plastic or bronze for use on asbestos cement and ductile iron pipe.

Service saddles will not be allowed on mortar-lined and coated steel pipe. Tapping outlets shall be used on mortar-lined and coated steel pipe.

Service saddles shall be double strap type except for service saddles on plastic pipe.

The service tap on the service saddle shall have an AWWA C 800 iron pipe thread.

Manufacturers, or Equal

Pipe Type	Mueller	Jones	Ford
Asbestos Cement	H-16105 to H-16116	J-979	202 B
Ductile Iron	H-10505 to H-10516	J-979	202
Plastic PVC C900	H-13478 to H-13485	J-996	S-91
Plastic PVC C905	---	--	202 BS

33.02.14 Weld-O-Lets

For 1-inch, 1½-inch, and 2-inch service connections to steel mortar-lined and coated pipe use 3000#, forged steel, Bonney Forge Co., "Weldolet," Allied Piping Products Co., "Branchlet", or equal.

33.02.15 Sanitary Sewer Lateral Connections to Existing Mains

Lateral connections to existing vitrified clay pipe, PVC, and ductile iron pipe sanitary sewer mains shall be made using the "Tap-Tite" Method or the Saddle-Type Method with a sewer pipe saddle manufactured by Sealtite, Romac, or equal.

Lateral connections to existing ABS and PVC composite pipe shall be made with solvent-welded saddle fittings in accordance with the manufacturer's recommendations.

33.02.16 Sanitary Sewer Lateral Cleanouts

Two-way sanitary sewer clean outs on 4-inch sanitary sewer laterals shall be cast iron ANACO, Two-way combination clean-out, American Brass and Iron, Two-way clean-out fitting (Kelly), or equal. Sanitary sewer cleanouts for 6-inch and larger pipe shall be a combination wye and 1/8th bend, ANACO, American Brass and Iron or equal.

33.02.17 Air Release Valves

Air release valves shall be Crispin P-Series, APCO 200 Series, or equal.

33.02.18 Threaded Insulating Bushing

Male threaded by compression or slip insulating bushings of PVC shall be provided at City water meters.

33.02.19 Water Sampling Station

Water sampling station housing, base flange, internal valve and support and bob will be supplied by the City. The Contractor shall furnish all other products and materials required to install water sampling stations and as shown on the Contract plans.

33.02.20 Pipe Supports

All piping systems and pipe connections to equipment shall be properly supported to prevent undue deflection, vibration and stresses on piping, equipment and structures. All supports and parts shall conform to the requirements of ANSI/ASME B31.1, except as supplemented or modified by this section.

33.02.21 Stock Parts

Where not specifically shown or detailed, use stock or production parts wherever possible. Stock parts shall be new, of best commercial quality, and designed and rated for the intended purpose.

33.02.22 Pipe Flanges

Where the design pressure is up to a maximum of 275 pounds per square inch, flanges shall conform to either AWWA C 207 Class E or ANSI B16.5 for 150 pound flanges.

Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C 207.

Blind flanges shall be in accordance with AWWA C 207.

All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

Studs and bolts shall extend through the nuts a minimum of 1/4 inch. All thread studs shall be used on all valve flange connections where space restrictions preclude the use of regular bolts. Flange bolts for fire hydrant installations shall be in accordance with \clubsuit 34 "Fire Hydrants".

Insulating flange sets shall be provided where shown on the Contract plans. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulated flanges shall have bolt hole diameter 1/4-inch greater than the bolt diameter. Insulating sleeves shall be 1/32 inch thick NEMA LI-1 (1989) Grade G-10 fiberglass epoxy. Washers shall be 5/32-inch thick NEMA LI-1 (1989) Grade G-10 fiberglass epoxy. Steel washers, bolts and nuts shall be in accordance with ASTM A 325. Insulating gaskets shall be 1/8-inch thick, full-face Neoprene-faced phenolic.

Insulating Flange Manufacturers, or Equal

1. JM Red Devil, Type E
2. Maloney Pipeline Products Co.
3. PSI Products, Inc.

Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of aramid fiber base, with nitrile binder and non-stick coating, suitable for temperatures to 700° F, a pH of 1-11, and pressures to 1000 pounds per square inch. Blind flanges shall have drop-in gaskets. Drop-in gaskets shall be 1/4 inch smaller than the inside edge of the bolt holes. Ring gaskets will not be allowed.

33.02.23 Sewer lateral Backflow Preventer

Sanitary sewer lateral backflow preventers shall be manufactured by National Diversified Sales, Lindsay, CA, Flow Control Inc., Burbank, CA, or equal.

33.03 EXECUTION

33.03.1 Installation

Galvanized steel pipe shall be coated as specified in §35 "Protective Coating".

PVC pipe joints shall be solvent-welded in accordance with the manufacturer's instructions.

Pipe couplings shall be installed in accordance with the manufacturer's recommendations, using the correct style coupling and gasket as appropriate.

Gaskets shall be installed in accordance with the manufacturer's recommendations.

All insulating connections shall be installed in accordance with the manufacturer's instructions. Care shall be exercised to prevent damage to insulating fittings while making up the joints.

Unless otherwise shown on the Contract plans, service saddles, tapping sleeves, tapping outlets and Weld-O-Lets shall be field-coated equal to the existing pipe coating.

Tapping of any existing main shall be coordinated with the Engineer. A minimum of 48 hours notice shall be given to the Engineer before installation and the Engineer will be present during the tapping process. After completion of the tap, the coupon ("cookie") shall be given to the Engineer.

Plastic water service pipe or tubing shall be installed joint free between the corporation stop valve and angle meter stop valve.

Water sampling stations shall be installed at the locations shown and in conformance with the Contract plans.

SECTION 34

FIRE HYDRANTS

34.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install fire hydrants, complete and operable including all appurtenances and accessories, as shown on the Contract plans and as specified in this section.

All valves on fire service laterals shall be gate valves for laterals eight (8) inches and less and butterfly valves for laterals larger than eight (8) inches.

34.02 PRODUCTS

34.02.1 Wet-Barrel Fire Hydrants

Fire hydrants shall be of the wet-barrel type, in accordance with AWWA C 503. Fire hydrants shall have a factory supplied buried section of mortar-lined, ductile iron and a solid spool between 6 inches long and 12 inches long connected to the hydrant head.

When located in residential areas, the hydrant shall have one 4-½ inch steamer connection and one 2-½ inch hose connection.

For commercial and industrial areas, hydrants shall have one 4-½ inch steamer connection and two 2-½ inch hose connections. The hydrant inlet shall be six (6) inches in diameter.

The hose and steamer connections shall be provided with cast iron caps and metal chains. Hose connection threads shall be American National Fire Hose Threads. The hydrants shall be tested to 300 pounds per square inch gauge pressure and they shall be suitable for a working pressure of 150 pounds per square inch gauge pressure. All interior and exterior surfaces of the fire hydrant spool, and bury shall be coated in accordance with ♣35 "Protective Coating".

Fire hydrants shall have a minimum weight of 190 pounds.

34.02.2 Manufacturers

Hydrants for residential areas shall be any of the following:

1. Clow Corporation East Bay Series, Model 5, or Ranger 900 Series, Model 950.
2. Long Beach Iron Works, Inc. East Bay Type, Model 611 or Anacapa 600 Series, Model 614.

3. Mueller Company East Bay Type Model 6, Part No. A 450.

Hydrants for commercial/industrial areas shall be any of the following:

1. Clow Corporation Ranger 900 Series, Model 960.
2. Long Beach Iron Works, Inc. Anacapa 600 Series, Model 615.

34.02.3 Identification

All valve lids on water systems shall be identified.

34.03 EXECUTION

34.03.1 Installation

All fire hydrants shall be installed in accordance with the manufacturer's recommendations, AWWA Standards, all applicable codes, and the Standard Specifications. Any deviation from the installation requirements or locations indicated on the Contract plans is subject to approval of the Fire Department.

All fire hydrant lateral gate valves shall be flanged by mechanical joint valves. All fire hydrant buries shall be installed with a concrete thrust block. Fire hydrant flange bolts shall be installed with the bolt end facing up. Slotted-on offset spools shall be used only when approved by the Engineer.

The 4-½ inch steamer connection shall be installed perpendicular to the street. The fire hydrant lateral must be installed perpendicular to the water main.

SECTION 35

PROTECTIVE COATING

35.01 GENERAL

The Contractor shall provide all materials, equipment and labor necessary to furnish and install the protective coating of all specified surfaces including all surface preparation, pre-treatment, coating application, touch-up of factory-coated surfaces, protection of surfaces not to be coated, cleanup, and all appurtenant work, complete in place, as specified in this section.

The following surfaces shall not be protective coated unless specifically shown or specified.

1. Concrete.
2. Stainless steel.
3. Machined surfaces.
4. Grease fittings.
5. Glass.
6. Equipment nameplates.

The Coating System Schedules of this section summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the plans are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

The Contractor shall be responsible for compliance with EPA and DHS regulations for all products and materials, and for and during the use of all products and materials.

35.01.1 Contractor Submittals

Certificates of Compliance shall be provided for all products and materials to be used under this section.

For each paint system to be used, the Contractor shall submit the following listed data.

1. Paint manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
2. Paint manufacturer's printed instructions and recommendations on surface preparation and application.
3. Colors available for each product (where applicable).
4. Compatibility of shop and field applied coatings (where applicable).

5. Current material safety data sheet for each product used.
6. Two sets of color samples to match each color selected by the Engineer from the manufacturer's standard color sheets. If custom mixed colors are required by this section, the color samples shall be made using color formulations prepared to match the color samples furnished by the Engineer. The color formula shall be shown on the back of each color sample.

35.01.2 Quality Assurance

Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the definitions and standard visual samples available from the SSPC, using SSPC-VIS1 Standards. The Engineer shall be the sole judge as to whether the quality of blast cleaning conforms to visual comparison standards.

On ferrous metals, the dry film coating thickness will be measured in accordance with SSPC "Paint Application Specification No. 2". Each coat will be tested for the correct thickness. No measurements will be made until at least eight (8) hours after application of the coating. On non-ferrous metals and other substrates, the coating thickness will be measured at the time of application using a wet film gauge.

35.02 PRODUCTS

35.02.1 General

The term "paint", "coatings", "linings" or "finishes" as used in this section shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, except galvanizing or anodizing, whether used as a pre-treatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be legible at the time of use.

The Contractor shall use coating materials suitable for the intended use as recommended by their manufacturer.

In any coating system only compatible materials from a single manufacturer shall be used in the work. The Contractor's attention is directed to the compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between the existing prime coat and subsequent field coats to ensure compatibility.

All colors of paint shall be as selected or specified by the Engineer. Finish colors shall be as specified from the manufacturer's standard color samples.

Products shall be standard products produced by recognized manufacturers who produce the materials for similar conditions.

Substitute or "Or Equal" Submittals

Unless otherwise specified, materials are from the catalogs of the companies listed in this section. Materials by other manufacturers are acceptable provided they are established as being compatible with, and of equal or greater quality to, the coatings and colors of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that certifies that the material meets the specified requirements and is equivalent or better than the specified materials.

35.02.2 Coating Systems

Each of the manufacturers listed in this section can supply many of the coating materials specified. Where manufacturers and paint numbers are listed, the list is intended to show the type and quality of coatings that are required. Proposed substitute materials must satisfy the material descriptions and shall equal or exceed the properties of the listed materials as required in the paragraph entitled "Substitute or "Or Equal" Submittals". The decision of the Engineer as to acceptable color substitutions will be final.

System 1. Alkyd Enamel: High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer. Hydrant colors shall be as follows:

1. Potable Water System
 - a. City Water Systems
 - (1) New Hydrants:
 - i. Manufacturers standard color compatible with Rustoleum Enamel No. 7448, Caterpillar Yellow.
 - (2) Repair and Maintenance:
 - i. Fuller O'Brien, Heavy Duty Gloss Enamel No. 312-74 or 612-35, Hi-Way Yellow.
 - ii. Kelly Moore, Kel-Guard Rust Inhibiting Enamel No. 1700-63, Safety Yellow.

2. Fire Hydrant Valve Lids and Potable Water Main Valves
 - a. Potable System: Valve cover lids on fire hydrant laterals in potable systems shall be painted white with Bauer Zone-lac Traffic Paint or Pervo Traffic Paint
 - b. Potable water main valve cover lids shall be painted blue with Handicap Blue Traffic Paint manufactured by Pervo Paint or equal.
3. Guard posts shall be installed as shown on the Contract plans. All guard posts for water systems shall be painted white with gloss enamel paint as approved by the Engineer.
4. Paint manufacturers for all other uses shall be as follows:
 - a. Prime Coat: Sherwin Williams, Kem-Kremik Universal Primer, DuPont 681 FD, or equal.
 - b. Finish Coat: Sherwin Williams, Industrial Gloss Enamel, DuPont 31 PSG, or equal.
6. Coating requirements shall be as follows:
 - a. Prime Coat DFT=3 mils each
 - b. Finish Coats (2 or more) DFT=3 mils each
 - c. Total System DFT=6 mils, minimum

System 2. Fusion Bonded Epoxy: The coating material shall be a 100-percent powder epoxy applied in conformance with AWWA C 550, except that the surface preparation shall be as specified in the Coating System Schedule of this section.

1. Liquid Epoxy. For field repairs the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a total DFT of 12 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.
2. Field repair coating (DFT = 12 mils), Scotchkote 306 or 312, DURA-POX 646, or equal.

System 3. Polyethylene Encasement: Application of polyethylene encasement shall be in conformance with ANSI/AWWA C 105 using Method A.

System 4. Cement Mortar Coating: Unless otherwise specified on the Contract plans, mortar coating and reinforcement shall be in conformance with AWWA C 205.

System 5. Factory Applied Epoxy: The coating material shall be a liquid epoxy applied in conformance with AWWA C 550.

System 6. Coal Tar Paint: High solids content coal tar paint for use on buried pipeline and fittings.

1. Prime coat and finish coats (2 or more, total DFT=24 mils), Protecto Wrap CA-1200, Polyguard No. CA-14, Kop-Coat Bitumastic Super Service Black, or equal.

35.03 EXECUTION

35.03.1 Storage, Mixing and Thinning of Materials

Unless otherwise specified in this section, the coating manufacturer's recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating, shall be adhered to. The Contractor shall supply the Engineer with copies of each manufacturer's recommendations and instructions for review prior to use of any coating product.

All protective coating material shall be used within the manufacturer's recommended shelf life.

Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

35.03.2 Preparation for Coating

All surfaces to receive protective coatings shall be cleaned as specified in this section prior to the application of the coatings. The Contractor shall examine all surfaces to be coated, and shall correct all surface defects before applying any coating. All marred or abraded spots on shop-primed and on factory-finished surfaces shall be restored prior to any coating application.

Surfaces that will not receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

All hardware, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces that will not be coated shall be protected. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

Adjacent work shall not be damaged during blast cleaning operations. Spray painting shall be conducted under controlled conditions. The Contractor shall be solely and fully responsible for, and shall repair all damage to, adjacent work that results from the Contractor's blast cleaning or coating operations.

Cleaning and coating shall be completed so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

35.03.3 Surface Preparation Standards

The following referenced surface preparation specifications of the Steel Structures Painting Council's "Steel Structure Painting Manual, Volume 2, Systems and Specifications" shall form a part of this section:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent vapor, alkali, emulsion, or steam.
2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.
3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.
4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using sand, grit, or shot.
5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
6. Brush-Off Blast Cleaning (SSPC-SP7): Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal.

25.03.4 Metal Surface Preparation (Ungalvanized)

The minimum abrasive blasting surface preparation shall be as specified in the "Coating System Schedules" specified in this section. Where there is a conflict between these specifications and the coating manufacturer's recommendations the higher degree of cleaning shall apply.

Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this section. Blast-cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70.

All oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 prior to blast cleaning.

All sharp edges shall be rounded or chamfered, and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.

The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained and properly operating compressors equipped with oil/moisture separators that remove at least 95 percent of the contaminants.

Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning or vacuuming prior to coating.

Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.

If the specified abrasive blast cleaning performed in the field will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2, hand tool cleaning or SSPC-SP3, power tool cleaning may be used.

For unburied surfaces, shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings.

Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

Shop primed surfaces shall be solvent cleaned per SP1 in the field before finish coats are applied.

35.03.5 Surface Preparation for Galvanized Ferrous Metal

Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.

Pre-treatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

33.30.6 Surface Preparation of Ferrous Surfaces With Existing Coatings

All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning per SP1 prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined as necessary to assure compatibility with field applied coatings.

The Contractor shall provide the degree of cleaning specified in the Coating System Schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, with the remaining thickness of existing coating not to exceed 3 mils.

If coatings to be applied are not compatible with existing coatings, the Contractor shall apply intermediate coatings per the coating manufacturer's recommendations for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to coating large areas.

Coatings of unknown composition shall be completely removed prior to application of new coatings.

Surface preparation shall be performed in strict compliance with applicable regulations governing worker safety, disposal and removal of used solvents and abrasives, and disposal of materials removed.

35.03.7 Workmanship

Skilled craftsmen and experienced supervision shall be used on all work.

All damage to surfaces resulting from the work shall be cleaned, repaired, and refinished to their original condition.

All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure that they have been thoroughly cleaned and that they receive adequate coating. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Improvements shall be protected by the use of drop cloths or other approved precautionary measures.

35.03.8 Shop Coating Requirements

Unless otherwise indicated, all items of equipment, or parts of equipment that are not in service, shall be shop-primed and then finish-coated in the field after installation with the selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires top coating within a specified period of time, the equipment shall be finish-coated in the shop and then touch-up painted after installation.

All items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.

For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify, as part of the shop drawings, that the surface preparation is in conformance with this section. The coating material data sheet shall be submitted with the shop drawings for the equipment.

For certain small pieces of equipment, the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than two (2) months before being topcoated, or less time if recommended by the coating manufacturer.

Damage to shop-applied coatings shall be repaired in accordance with this section and the coating manufacturer's instructions.

The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this section. Copies of applicable coating manufacturer's data sheets shall be submitted to the Engineer.

35.03.9 Application of Coatings

The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1 (SSPC-PA1)" Steel Structures Painting Council.

Cleaned surfaces and all coats shall be inspected by the Contractor prior to each succeeding coat and treated as warranted.

Blast-cleaned ferrous metal surfaces shall be coated before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

Coatings shall be applied in accordance with the manufacturer's instructions and the recommendations and this section.

Special attention shall be given to materials that will be joined so closely that proper surface preparations and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

Coatings shall not be applied under the following conditions:

1. Temperature above or below the manufacturer's recommended maximum and minimum allowable.
2. Heavy concentrations of dust or smoke.
3. Damp or humid weather.

All field coating shall be in conformance with the manufacturer's recommendations.

35.03.10 Curing of Coatings

The Contractor shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this section, whichever is the most conservative, requirement prior to placing the completed coating system into service.

35.03.11 Coating System Schedules - Ferrous Metals

Coating System Schedule, Ferrous Metal - Not Galvanized:

	Item	Surface Preparation	System Number
FM-1	All surfaces, indoors and outdoors, exposed or covered, except those surfaces included below.	Commercial Blast Cleaning SSPC-SP6	(1) Alkyd Enamel
FM-2	Exposed FHs, valve lids, marker posts, backflow preventers lettering, exposed pipe and fittings, and vent pipe.	Solvent Cleaning SSPC-SP1	(1) Alkyd Enamel
FM-3	Buried pipe with a nominal diameter of less than 6 inches and greater than 2 inches,	Solvent Cleaning SSPC-SP1	(6) Coal Tar Paint

	excluding ductile iron pipe.		
FM-4	Fittings and flanged joints, where the piping is plastic. Buried fittings on ductile iron pipe used for FH laterals, fire service laterals, and backflow prevention assemblies. Joints, and fittings on ductile iron pipe with coal tar coating.	Commercial Blast Cleaning SSPC-SP6	(6) Coal Tar Paint
FM-5	Buried pipe couplings, fittings, and flanged joints, including epoxy-coated surfaces, except valves where the piping is polyethylene-encased ductile iron.	As specified by reference specification for appropriate fittings.	(3) Polyethylene Encasement
FM-6	Buried pipe couplings, fittings, and flanged joints, where piping is cement mortar coated and lined steel pipe, excluding epoxy coated surfaces.	Solvent Cleaning SSPC-SP1	(4) Cement Mortar Coating
FM-7	Buried cast couplings, buried sleeve-type tapping sleeves, welded tapping outlets. Ferrous surfaces of gate valves.	White Metal Blast Cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-8	External ferrous surfaces of check valves.	White Metal Blast Cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-9	Ferrous internal surfaces of fire hydrants.	White Metal Blast Cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-10	Internal/external	Ferrous White Metal	(5)

	surfaces of butterfly valves	Blast Cleaning SSPC-SP5	Factory Applied Epoxy
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Coating System Schedule, Ferrous Metal - Galvanized:

Pre-treatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces except for floor gratings and frames, shall be coated unless coating is required by other sections:

	Item	Surface Preparation	System Number
FMG-1	All exposed surfaces, indoors or outdoors, including exposed galvanized pipe, except those surfaces included below.	Alkaline Cleaning per SSPC-SP1	(1) Alkyd Enamel
FMG-2	Buried pipe with a nominal diameter of 2 inches and less, including valves and fittings.	Alkaline Cleaning per SSPC-SP1	(6) Coal Tar Paint