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TABLE OF VARIABLE DIMENSIONS AND QUANTITIES FOR ONE HEADWALL (4)

SLOPE	DIA OF PIPE, D	Values for one pipe						Values to be added for each addt'l pipe		
		W	X	Y	L	Reinf (Lbs)	Conc (CY) (1)	X and W	Reinf (Lbs)	Conc (CY) (1)
3:1	33"	14'- 5 3/4"	4'- 8"	9'- 6"	10'-11 3/4"	310	3.4	4'- 8"	84	1.2
	36"	15'- 7 3/4"	4'-11 1/2"	10'- 3"	11'-10"	343	3.8	5'- 1"	96	1.4
	42"	17'-11 1/2"	5'- 6 1/2"	11'- 9"	13'- 6 3/4"	424	4.9	5'-10"	119	1.8
	48"	21'- 1 3/4"	6'- 1 1/2"	14'- 0"	16'- 2"	527	6.5	6'- 7"	146	2.4
	54"	23'- 5 1/2"	6'- 8 1/2"	15'- 6"	17'-10 3/4"	618	7.8	7'- 6"	186	3.0
	60"	25'- 9 1/4"	7'- 3 1/2"	17'- 0"	19'- 7 1/2"	707	9.2	8'- 3"	219	3.5
	66"	28'- 1"	7'-10 1/2"	18'- 6"	21'- 4 1/4"	797	10.7	8'- 9"	242	4.0
	72"	30'- 4 3/4"	8'- 5 1/2"	20'- 0"	23'- 1 1/4"	910	12.3	9'- 4"	272	4.6
4:1	33"	18'- 1 3/4"	4'- 8"	12'- 8"	14'- 7 1/2"	417	4.8	4'- 8"	101	1.5
	36"	19'- 7"	4'-11 1/2"	13'- 8"	15'- 9 1/4"	464	5.5	5'-1"	115	1.7
	42"	22'- 5 3/4"	5'- 6 1/2"	15'- 8"	18'- 1"	575	7.0	5'-10"	141	2.2
	48"	26'- 6 1/4"	6'- 1 1/2"	18'- 8"	21'- 6 3/4"	720	9.4	6'- 7"	175	3.0
	54"	29'- 5"	6'- 8 1/2"	20'- 8"	23'-10 1/4"	863	11.3	7'- 6"	226	3.7
	60"	32'- 3 3/4"	7'- 3 1/2"	22'- 8"	26'- 2"	984	13.4	8'- 3"	264	4.4
	66"	35'- 2 1/2"	7'-10 1/2"	24'- 8"	28'- 5 3/4"	1126	15.6	8'- 9"	300	5.0
	72"	38'- 1 1/4"	8'- 5 1/2"	26'- 8"	30'- 9 1/2"	1283	18.0	9'- 4"	334	5.7
6:1	33"	25'- 5 1/2"	4'- 8"	19'- 0"	21'-11 1/4"	667	8.3	4'- 8"	127	2.1
	36"	27'- 5 3/4"	4'-11 1/2"	20'- 6"	23'- 8"	727	9.5	5'- 1"	144	2.4
	42"	31'- 6 1/4"	5'- 6 1/2"	23'- 6"	27'- 1 1/2"	914	12.1	5'-10"	179	3.1
	48"	37'- 3 1/2"	6'- 1 1/2"	28'- 0"	32'- 4"	1181	16.6	6'- 7"	231	4.1
	54"	41'- 4 1/4"	6'- 8 1/2"	31'- 0"	35'- 9 1/2"	1412	20.0	7'- 6"	300	5.1
	60"	45'- 4 3/4"	7'- 3 1/2"	34'- 0"	39'- 3"	1619	23.8	8'- 3"	353	6.1

(1) Quantities shown are for concrete pipe and will increase slightly for Metal Pipe installation.

(2) For vehicle safety, curbs shall project no more than 3" above finished grade. Curb heights shall be reduced, if necessary, to meet these requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.

(3) Provide a 1'-0" footing as shown where required to maintain 4" minimum cover for pipes.

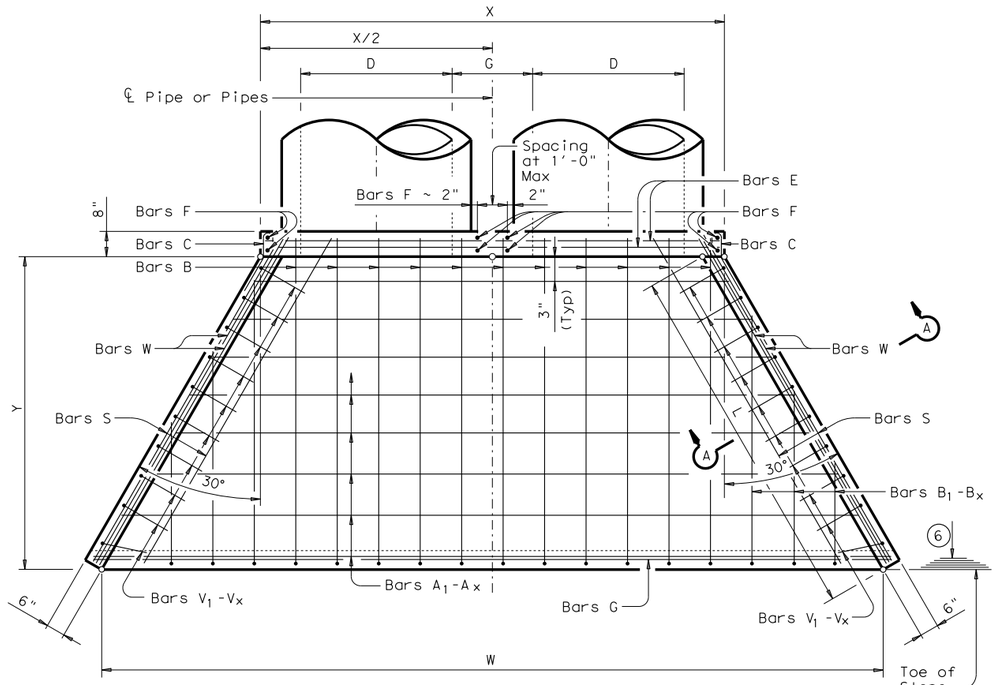
(4) Quantities shown are for one structure end. (One headwall)

(5) Min Length = $6" + 3" \times \left(\frac{12 \times H - 7}{12 \times L}\right)$

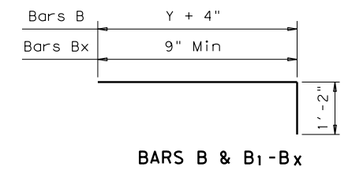
Max Length = $12 \times H - 3" \times \left(\frac{12 \times H - 7}{12 \times L}\right) - 1"$

(6) Lengths of wings based on SL:1 Slope along this line.

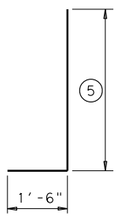
ELEVATION
Showing dimensions



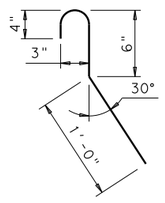
PLAN



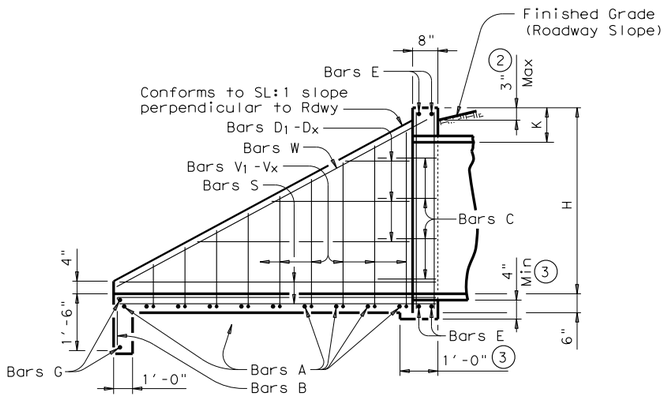
BARS B & B_1-B_x



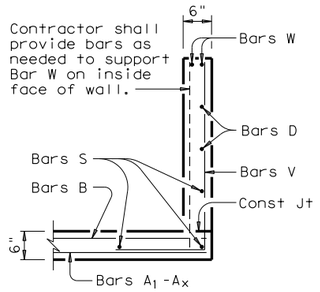
BARS V



BARS C
(2'-0" long)



TYPICAL WING ELEVATION



SECTION A-A

TABLE OF (4) REINFORCING STEEL

Bar	Size	Spa	No.
A	# 4	1'-0"	~
B	# 3	1'-6"	~
C	# 4	1'-0"	~
D	# 3	1'-0"	~
E	# 5	~	4
F	# 5	~	~
G	# 3	~	2
S	# 4	~	6
V	# 4	1'-0"	~
W	# 5	~	4

TABLE OF CONSTANT DIMENSIONS

DIA OF PIPE, D	G	K	H
33"	1'-11"	1'- 0"	3'- 9"
36"	2'- 1"	1'- 0"	4'- 0"
42"	2'- 4"	1'- 0"	4'- 6"
48"	2'- 7"	1'- 3"	5'- 3"
54"	3'- 0"	1'- 3"	5'- 9"
60"	3'- 3"	1'- 3"	6'- 3"
66"	3'- 3"	1'- 3"	6'- 9"
72"	3'- 4"	1'- 3"	7'- 3"

GENERAL NOTES:

Designed according to AASHTO LRFD Specifications.

The Safety End Treatment shown herein are intended for use in those installations where out of control vehicles are likely to traverse the openings approximately perpendicular to the pipe runners.

The Safety Pipe Runners are designed for a traversing load of 1,800 pounds at yield as recommended by Research Report 280-1, "Safety Treatment of Roadside Cross-Drainage Structures", Texas Transportation Institute, March 1981.

Reinforcing steel shall be placed with the center of the outside layer of bars 2" from the surface of the concrete.

All reinforcing steel shall be Grade 60.

All concrete shall be Class "C" and shall have a minimum compressive strength of 3600 psi.

All bolts, nuts, washers, brackets, angles and pipe runners are considered parts of the Safety End Treatment for payment.

Pipe Runners shall conform to the requirements of ASTM A53 (Type E or S, Grade B), ASTM A500 (Grade B), or API 5LX52.

Bolts and nuts shall conform to ASTM A307. Steel plates shall conform to ASTM A36. All steel components, except reinforcing, shall be galvanized. Galvanizing damaged during transport or construction shall be repaired in accordance with the specifications.

Texas Department of Transportation

Bridge Division Standard

SAFETY END TREATMENT WITH FLARED WINGS

FOR 0 SKEW PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-0

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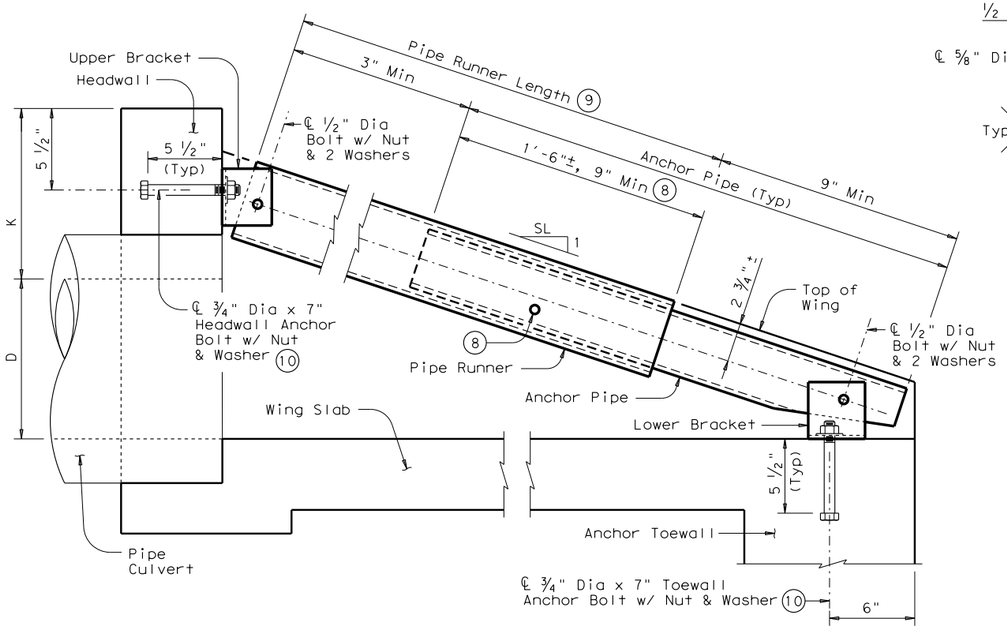
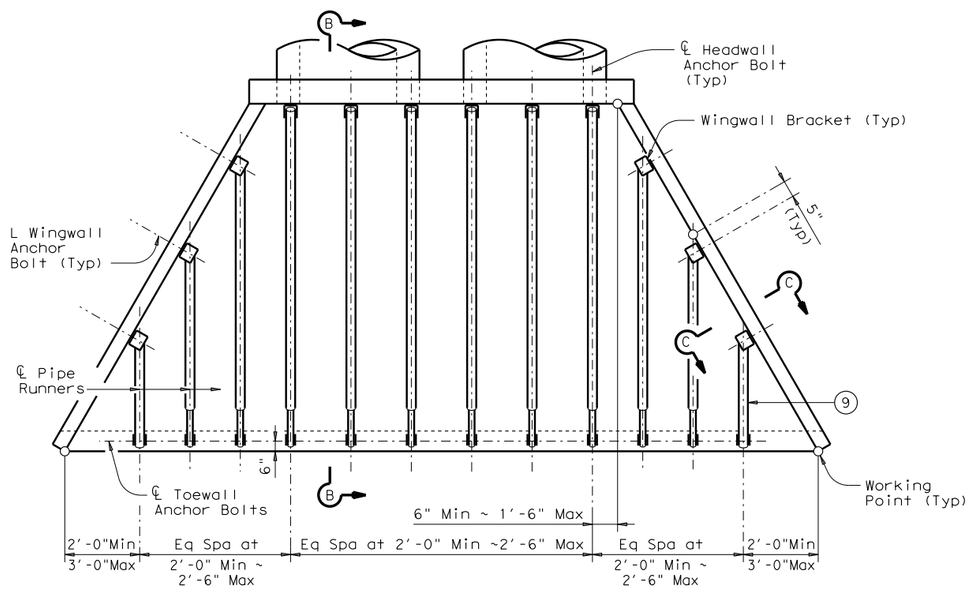
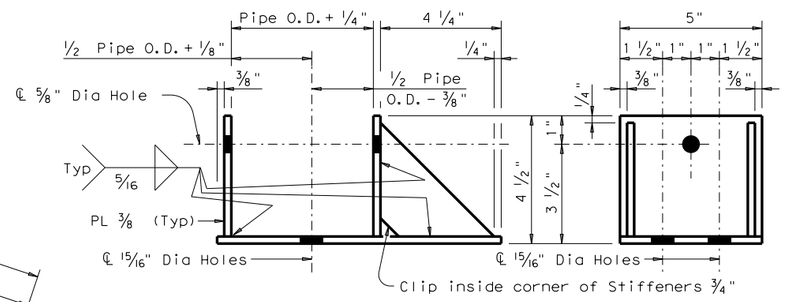


SECTION B-B

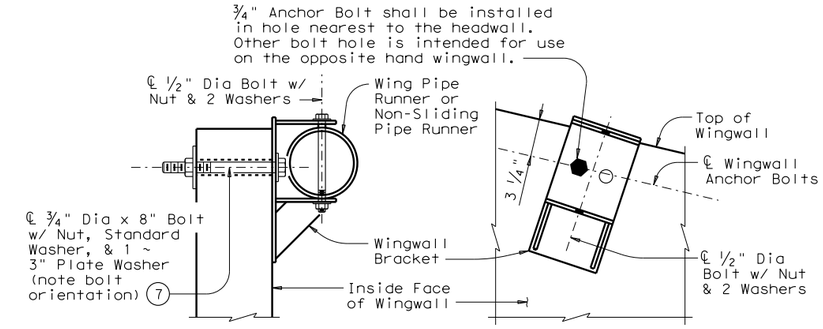
(Showing Headwall Pipe Runner. Except for upper bracket, Wingwall Pipe Runners are similar.)



PIPE RUNNER PLAN



ELEVATION SIDE VIEW

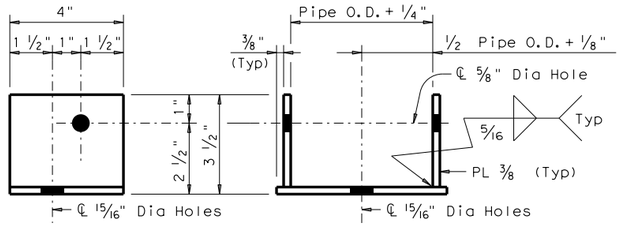


SECTION C-C (Showing installed bracket.)

ELEVATION (Showing installed bracket normal to Wall. Pipe not shown for clarity.)

NOTE: Wingwall Bracket shall match the Upper Bracket size.

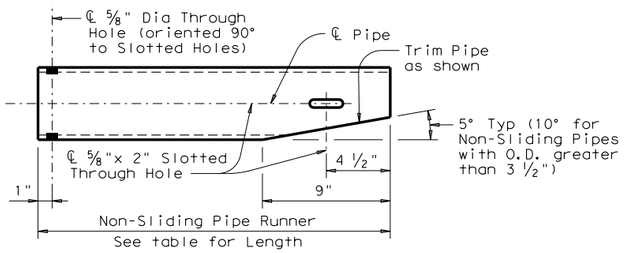
WINGWALL BRACKET DETAILS



SIDE VIEW ELEVATION

NOTE: Upper and Lower Brackets shall, except for the Brackets used with Non-Sliding Pipe Runners, match the required pipe diameters as shown in the table.

UPPER & LOWER BRACKET DETAILS



Note: Pipe size shall be same as required for headwall pipe runner. Adjust the corresponding Lower Bracket accordingly.

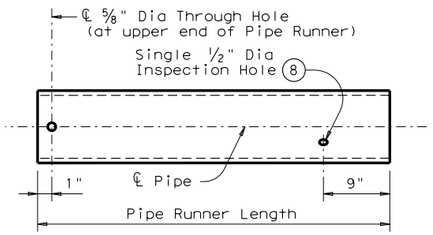
NON-SLIDING PIPE RUNNER DETAILS (9)

(7) At Contractor's option, ⅞" diameter hole may be formed or cored drilled. Percussion drilling is not permitted. Adjust placement of reinforcing steel as necessary to avoid bolt holes.

(8) After installation of the Pipe Runner, the ½" inspection hole shall be utilized to ensure that the lap of the Anchor Pipe with the Pipe Runner is adequate.

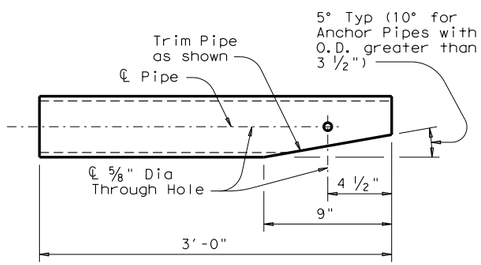
(9) Non-Sliding Pipe Runners are used for those installations that would require Pipe Runner lengths of 1'-9" or less. The Non-Sliding Pipe Runner, when required, replaces the outermost Pipe Runner and Anchor Pipe. See table on Sheet 3 of 3 to determine if the Non-Sliding Pipe Runner is required.

(10) At Contractor's option, an epoxy anchorage system may be used. Anchorage system chosen must be able to achieve an ultimate tensile resistance of 20 kips. Anchor diameter shall be ¾". The Contractor must provide evidence to the Engineer that this can be achieved. Evidence of adequate tensile resistance can be based on the manufacturer's published values of ultimate tensile strength (anchor spacing and edge distance must be accounted for). Anchor installation, including hole size, drilling, and clean-out, must be in accordance with the manufacturer's recommendations.



Note: Pipe diameter required for Headwall pipe runner shall also be used for wingwall pipe runner.

PIPE RUNNER DETAILS



ANCHOR PIPE DETAILS

SHEET 2 OF 3

Texas Department of Transportation — Bridge Division Standard

SAFETY END TREATMENT WITH FLARED WINGS

FOR 0 SKEW PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-0

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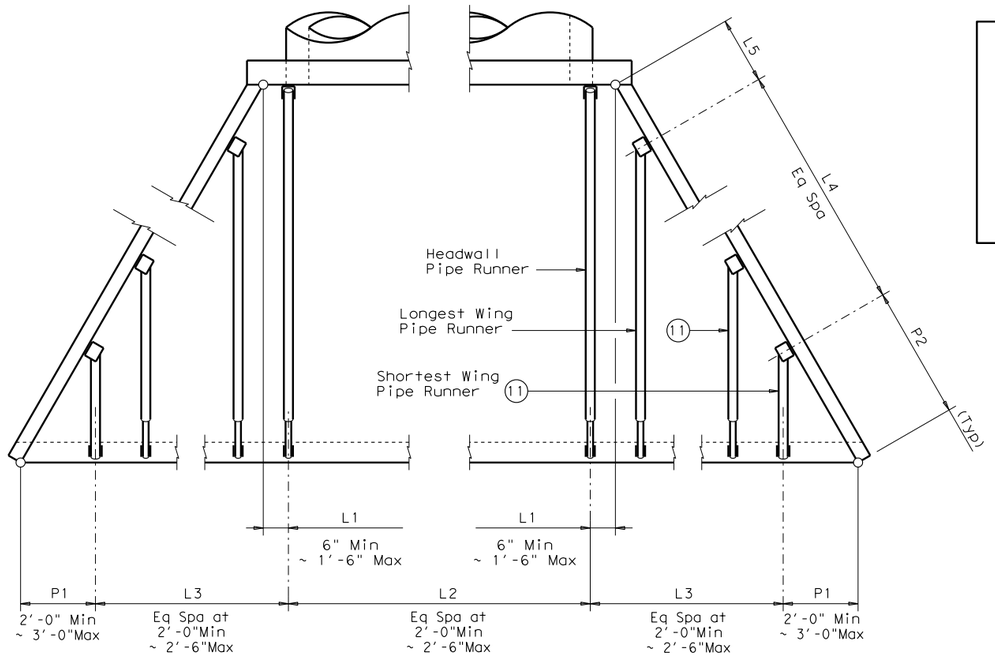
Side Slope	Pipe Culvert Dia (In)	L1 (Ft-In)	P1 (Ft-In)	Number of Spaces in L3	L3 Overall Dimension (Ft-In)	P2 (Ft-In)	Number of Spaces in L4	L4 Overall Dimension (Ft-In)	Headwall Pipe Runner Length (Ft-In)	No. of Wing Pipes (12)	Longest Wingwall Pipe Runner Length (Ft-In)	Shortest Wingwall Pipe Runner Length (Ft-In)	Non-Sliding Pipe Length (Ft-In)	Pipe Runner Size (13)	Total Length of Wingwall Pipe Runners (Ft-In) (12)
3:1	33"	9"	2'- 0"	2	4'- 2 3/4"	3'- 7"	1	4'- 2 3/4"	8'- 4"	4	5'- 5 1/2"	N/A	3'- 1"	3" STD	17'- 1"
	36"	9"	2'- 0"	2	4'- 8"	3'- 7"	1	4'- 8"	9'- 1 1/2"	4	5'-10 1/4"	N/A	3'- 1"	3" STD	17'-10 1/2"
	42"	1'- 0"	3'- 0"	2	4'- 9 1/2"	5'- 7"	1	4'- 9 1/2"	10'- 8 1/4"	4	7'- 9 1/2"	3'- 5"	N/A	4" STD	22'- 5"
	48"	1'- 3"	2'- 0"	3	7'- 4"	3'- 7"	2	9'- 9 1/4"	13'- 0 3/4"	6	10'- 6 1/4"	6'- 0 3/4"	3'- 1"	4" STD	39'- 4"
	54"	6"	2'- 0"	3	7'- 5 1/2"	3'- 7"	2	9'-11 1/4"	14'- 7 3/4"	6	10'- 8"	6'- 1 1/2"	3'- 1"	4" STD	39'- 9"
	60"	9"	2'- 0"	4	8'- 6 3/4"	3'- 7"	3	12'-10 1/4"	16'- 2 3/4"	8	13'- 3 3/4"	5'- 6"	3'- 1"	4" STD	62'- 7 1/4"
	66"	1'- 0"	2'- 0"	4	9'- 8 1/4"	3'- 7"	3	14'- 6 1/4"	17'- 9 3/4"	8	14'-10 1/4"	6'- 0"	3'- 1"	4" STD	68'- 8 3/4"
	72"	1'- 3"	3'- 0"	4	9'- 9 1/2"	5'- 7"	3	14'- 8 1/4"	19'- 4 3/4"	8	16'-10"	3'- 5"	N/A	5" STD	81'- 0"
4:1	33"	9"	2'- 0"	3	6'- 0 3/4"	3'- 7"	2	8'- 1"	11'- 4 1/2"	6	8'- 8 3/4"	5'- 1 1/4"	3'- 0"	4" STD	33'- 8"
	36"	9"	2'- 0"	3	6'- 7 3/4"	3'- 7"	2	8'-10 1/4"	12'- 4 3/4"	6	9'- 5"	5'- 5 1/2"	3'- 0"	4" STD	35'- 9"
	42"	1'- 0"	2'- 9"	3	7'- 3 1/2"	5'- 1"	2	9'- 8 3/4"	14'- 5 1/2"	6	11'- 6 1/4"	2'-10 1/4"	N/A	4" STD	43'- 1 1/2"
	48"	1'- 3"	2'- 3"	4	9'- 9 1/4"	4'- 1"	3	14'- 8"	17'- 6 3/4"	8	15'- 0 1/2"	1'-11 1/2"	N/A	4" STD	68'- 0"
	54"	6"	2'- 6"	4	9'-11 1/4"	4'- 7"	3	14'-10 3/4"	19'- 7 1/2"	8	15'- 8 1/4"	2'- 4 3/4"	N/A	5" STD	72'- 4"
	60"	9"	2'- 0"	5	11'-10"	3'- 7"	4	18'-11 1/4"	21'- 8 1/4"	10	18'- 5"	5'- 8 3/4"	3'- 0"	5" STD	102'- 7"
	66"	1'- 0"	2'- 9"	5	12'- 6"	5'- 1"	4	19'-11 3/4"	23'- 9"	10	20'- 8 1/4"	2'-10 1/4"	N/A	5" STD	117'- 8 1/2"
	72"	1'- 3"	2'- 0"	6	14'- 7 3/4"	3'- 7"	5	24'- 5"	25'- 9 3/4"	12	23'- 3 1/2"	5'-10 1/4"	3'- 0"	5" STD	151'- 8 3/4"
6:1	33"	9"	2'- 0"	4	9'- 8 3/4"	3'- 7"	3	14'- 7"	17'- 7"	8	14'- 3"	5'- 8 1/2"	2'-11 1/2"	4" STD	65'- 9 1/2"
	36"	9"	2'- 9"	4	9'-10"	5'- 1"	3	14'- 9"	19'- 1 1/4"	8	15'- 8 3/4"	2'- 9 1/4"	N/A	5" STD	74'- 0"
	42"	1'- 0"	2'- 3"	5	12'- 3 3/4"	4'- 1"	4	19'- 8 1/2"	22'- 1 3/4"	10	19'- 2 1/4"	1'-10 3/4"	N/A	5" STD	105'- 5"
	48"	1'- 3"	2'- 6"	6	14'-11"	4'- 7"	5	24'-10 1/4"	26'- 8 1/2"	12	24'- 1 3/4"	2'- 4"	N/A	5" STD	158'-10 1/2"
	54"	6"	2'- 0"	7	16'- 4 3/4"	3'- 7"	6	28'- 1 1/4"	29'- 9"	14	26'- 1 1/2"	5'- 6 3/4"	2'-11 1/2"	5" STD	196'- 0 1/2"
	60"	9"	3'- 0"	7	17'- 4 1/2"	5'- 7"	6	29'- 9 1/2"	32'- 9 1/2"	14	29'- 4 1/4"	3'- 2 1/2"	N/A	5" STD	227'-11 1/4"



PIPE RUNNER LAYOUT

(11) If the outermost Wing Pipe Runner is a Non-Sliding Pipe Runner, the next outermost Wing Pipe Runner shall be considered the Shortest.

(12) Quantities shown include, if present, the Non-Sliding Pipes.

(13) Anchor Pipe size shall be the next smaller size than the Pipe Runner size.

STANDARD PIPE RUNNER AND ANCHOR PIPE SIZES (13)

Pipe Size	Pipe O.D.	Pipe I.D.
2" STD	2.375"	2.067"
3" STD	3.500"	3.068"
4" STD	4.500"	4.026"
5" STD	5.563"	5.047"

TOTAL PIPE LENGTHS FORMULAS:

$$\text{Total Length of All Pipe Runners} = \text{Total Length of Wingwall Pipe Runners} + \left(\text{No. of Headwall Pipe Runners}\right)\left(\text{Headwall Pipe Runner Length}\right)$$

$$\text{Total Length of All Anchor Pipes} = \left(3.000'\right)\left(\text{No. of Wing Pipe Runners} + \text{No. of Headwall Pipe Runners} - \text{No. of Non-Sliding Pipe Runners}\right)$$

SPECIAL NOTE:

Note that the tabular quantities are given for estimating purposes only. It is likely that these quantities will change due to field conditions. Therefore, all dimensions shall be verified by the Contractor in the field prior to fabrication of the Safety End Treatment components.

Pipe Culvert Dia (In)	Number of Pipe Culverts	No. of L2 Spaces	L2 Overall Dimension (Ft-In)	Number of Headwall Pipes
33"	1	1	2'- 0 1/4"	2
	2	3	6'- 8 1/4"	4
	3	5	11'- 4 1/4"	6
	4	7	16'- 0 1/4"	8
	5	9	20'- 8 1/4"	10
	6	11	25'- 4 1/4"	12
36"	1	1	2'- 3 3/4"	2
	2	3	7'- 4 3/4"	4
	3	5	12'- 5 3/4"	6
	4	7	17'- 6 3/4"	8
	5	10	22'- 7 3/4"	11
	6	12	27'- 8 3/4"	13
42"	1	1	2'- 4 3/4"	2
	2	4	8'- 2 3/4"	5
	3	6	14'- 0 3/4"	7
	4	8	19'-10 3/4"	9
	5	11	25'- 8 3/4"	12
	6	13	31'- 6 3/4"	14
48"	1	1	2'- 5 3/4"	2
	2	4	9'- 0 3/4"	5
	3	7	15'- 7 3/4"	8
	4	9	22'- 2 3/4"	10
	5	12	28'- 9 3/4"	13
	6	15	35'- 4 3/4"	16
54"	1	2	4'- 6 3/4"	3
	2	5	12'- 0 3/4"	6
	3	8	19'- 6 3/4"	9
	4	11	27'- 0 3/4"	12
	5	14	34'- 6 3/4"	15
	6	17	42'- 0 3/4"	18
60"	1	2	4'- 7 3/4"	3
	2	6	12'-10 3/4"	7
	3	9	21'- 1 3/4"	10
	4	12	29'- 4 3/4"	13
	5	16	37'- 7 3/4"	17
	6	19	45'-10 3/4"	20
66"	1	2	4'- 8 3/4"	3
	2	6	13'- 5 3/4"	7
	3	9	22'- 2 3/4"	10
	4	13	30'-11 3/4"	14
	5	16	39'- 8 3/4"	17
	6	20	48'- 5 3/4"	21
72"	1	2	4'- 9 3/4"	3
	2	6	14'- 1 3/4"	7
	3	10	23'- 5 3/4"	11
	4	14	32'- 9 3/4"	15
	5	17	42'- 1 3/4"	18
	6	21	51'- 5 3/4"	22

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Bridge Division Standard

SAFETY END TREATMENT WITH FLARED WINGS

FOR 0 SKEW PIPE CULVERTS
TYPE I ~ CROSS DRAINAGE

SETP-FW-0

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