

SPECIFICATIONS FOR PLACEMENT OF STRUCTURAL FILL ON SCVWD LEVEES

INTRODUCTION

This specification for structural fill is to be used where fill is placed on a levee in conjunction with projects that construct levees, raise levee heights or include cuts into levees for placement of outfalls or utilities.

FILL MATERIAL

Fill material for trench backfill of levees and for levee embankment may be either imported backfill material or suitable material from trench excavation blended with imported earthfill material. The fill material is to be free of debris, organic or deleterious material and not contain rocks or lumps over 4 inches in greatest dimension; no more than 15% of the rocks or lumps should be larger than 2 ½ ". The fill material shall contain at least 75% finer than the #4 U.S. Standard Sieve and 50% finer than the #200 Sieve. The liquid limit shall be less than 40 and the plasticity index shall be between 10 and 20. Levee fill material should be relatively impervious (permeability less than 10 to the minus 6cm/sec).

ADDITIONAL GUIDELINES

Surfaces exposed by stripping or excavation shall be scarified to a minimum depth of 6 inches and compacted to a relative compaction of not less than 95% based on (American Society of Testing Materials) ASTM D 1557 standard. The loose thickness of each layer of embankment material before compaction shall not exceed 8 inches, and each lift shall be compacted to at least 90% relative compaction based on ASTM D1557 standard. The field density and moisture content of compacted fill will be determined according to ASTM D 1556, D2922 and D3017 standard procedures. Any backfilled area not meeting the minimum test requirements shall be removed and recompacted until tests meet the minimum requirements. Jetting or ponding is not permitted

No thin, sliver fills will be accepted. Where compacted channel embankment is required or where replacement in over excavated areas must be accomplished, the new embankment must be placed in thin, maximum 8 inch thick horizontal layers with a minimum width of 6 feet. This specified width may be any combination of new fill plus cut into existing slope, except that a minimum cut of 2 feet into existing slope per layer of fill must be made. Slopes shall be trimmed to conform to existing section after placement of fill has been completed.

OUTFALL STANDARDS

INTRODUCTION

The details in this Design Guide are intended to provide clarification on slope protection standards for outfalls to be designed to meet SCVWD minimum engineering standards using softer slope protection methods wherever possible. This Design Guide also includes a plan view to show how the outfall would intersect with a natural channel so as to not impede surface flows or create a barrier to fish passage. The diagrams depicted are models and should be used unless stream conditions dictate otherwise. For placement of outfalls into streams with levees, floodwalls or structural linings, SCVWD will need to be consulted.

GENERAL GUIDELINES

1. Outfalls should not overhang the streambank or streambed as this can lead to excessive channel erosion.
2. Outfalls, bridge abutments and other structures should be placed within the first half of the straight section after the bend (page 3.24) in order to minimize erosion, prevent turbulence and prevent redirection of flow.
3. Outfalls should be aligned downstream in the direction of the flow, at an angle no greater than 30 degrees. **In natural streams where possible, a narrow channel should be created** for the outfall so that the discharge merges into the streams in order to minimize erosion, prevent turbulence and prevent redirection of flow.
4. Any outfall pipe should be cut off flush with the face of slope protection.
5. Outfalls with flap gates require dormers or similar designs to isolate the flap gate and keep them out of flow area. (See Detail #18/1 and 28/1).

TYPICAL MATERIALS TO USE

Where the pipe must be cut flush with the side slope (typically in engineered channels and on steep slopes where hard slope protection measures are needed, use corrugated metal or appropriate plastic pipes for outfalls. For outfalls, with rock slope protection, or where pipe is constructed into a concrete headwall, reinforced concrete pipe may be used.

TYPES OF OUTFALLS AND WHEN TO USE THEM

The selection of an outfall is dependent on the condition of the stream bank into which the outfall is directed. Below is a table that

describes when certain outfalls would be most appropriate.

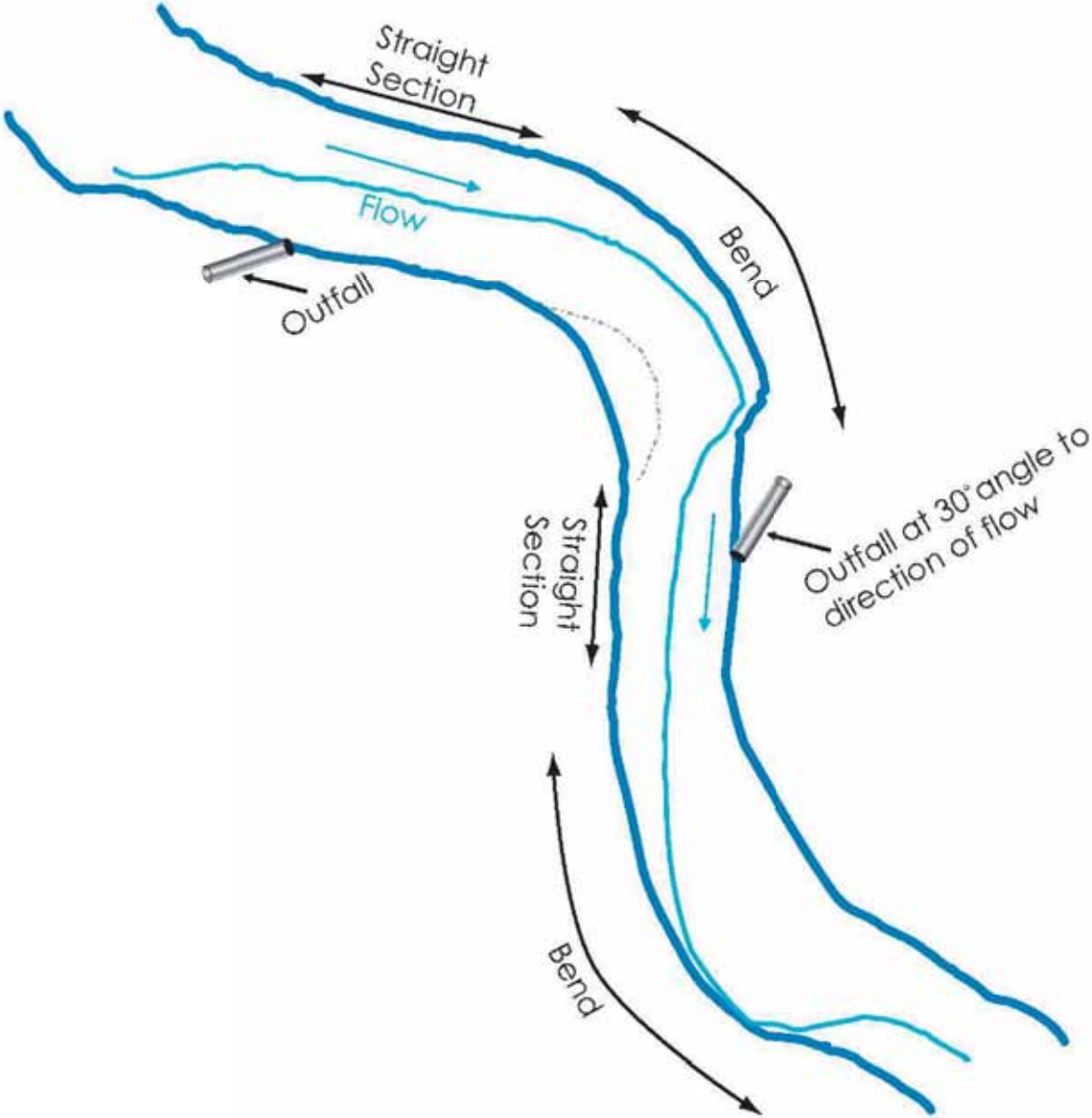
In addition to these measures, SCVWD has also developed model details for outfalls into mattress and stepped gabions, an emergency overflow into a stream, and an outfall into a deep ravine. These will be available on the District’s web site. Other soft methods of slope protection that incorporate vegetation are shown in the Bank Protection section. An outfall may also be incorporated into a vegetated bank design provided there is sufficient slope protection to prevent bank erosion.

Type of Outfall	Detail Number	When to Use	Benefits/Limitations
Outfalls with rock slope protection	6-1, 6-2, 6-3	For unlined streams where slopes are flatter than 1.5:1 and where an incision into the bank is not possible.	Preferred option because vegetation can be re-established and rocks are more resilient to movement and stream degradation.
Outfall with a drainage swale	27-1	For natural streams where a bank incision can be made	Reduced potential for erosion from outfall but an incorrect placement in channel can increase turbulence and erosion
Outfall into RCB Wall with one or two steel curtains	1-1, 1-2, 1-3 2-1, 2-2	If the stream is contained in a Reinforced Concrete Box. The detail used will depend on the steel rebar configuration in the box	Reduced need for additional bank protection. Size of pipe is limited: larger pipes can impact hydraulics.
Pipe to Pipe Outfall	3-1	If the stream is contained in a reinforced Concrete or corrugated metal pipe	Outfall pipe is limited to ¼ the size of the stream pipe
Pipe Outfall into Channel Lining	4-1, 4-2	If the stream is contained in a concrete lined channel	
Pipe Outfall with Sacked Concrete Rip Rap	5-1, 5-2, 5-3, 5-4, 5-5, 5-6	For steep slopes 1.25:1 or greater where other measures will not be structurally sound	This treatment is not preferred if it deflects flow, is not resilient in degrading channel

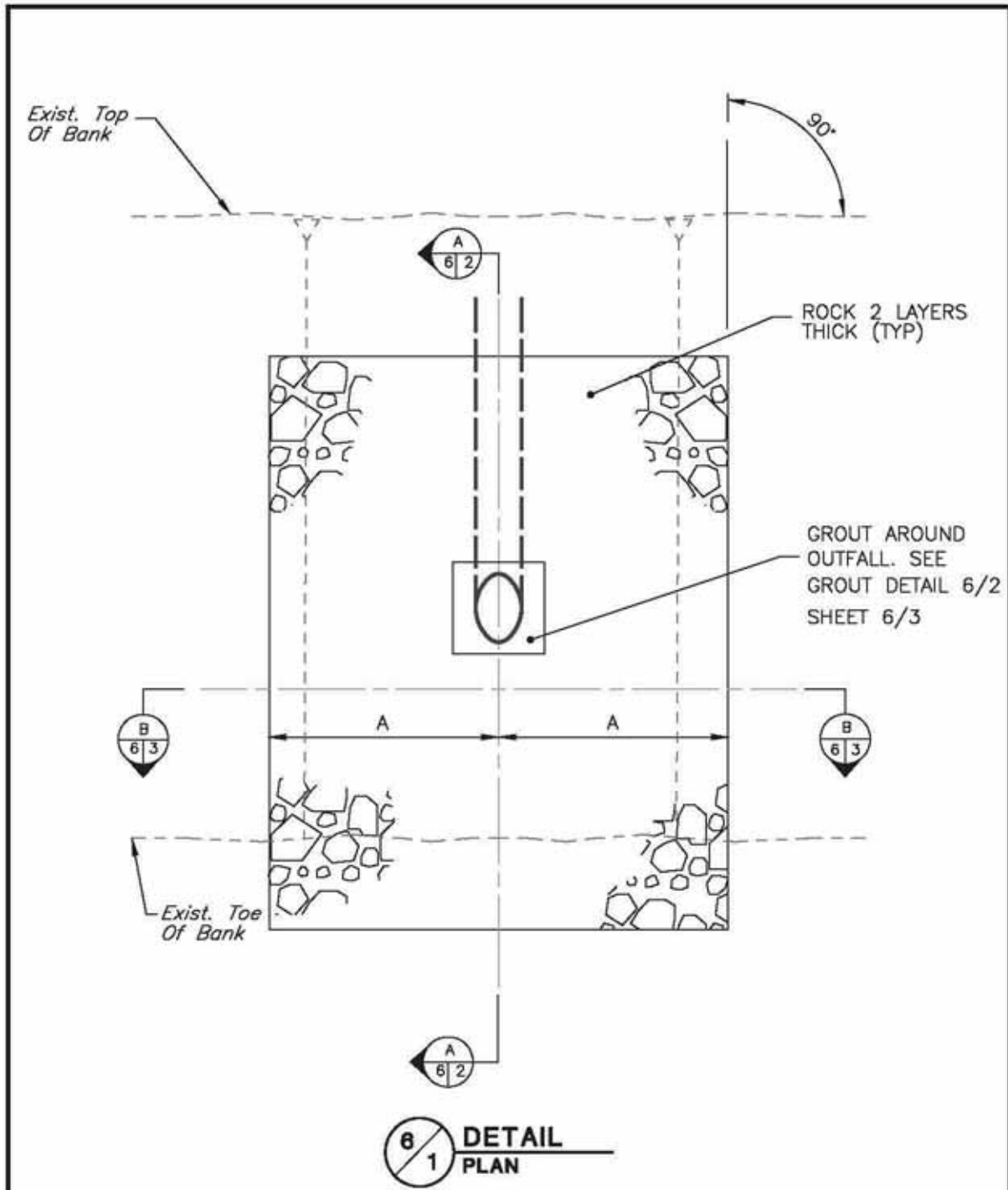
OUTFALL STANDARDS

Outfalls, bridge abutments and other structures should be placed within the first half of the straight section after the bend.

Outfalls should be aligned downstream in the direction of the flow, at an angle of less than 30 degrees.



OUTFALL WITH ROCK SLOPE PROTECTION



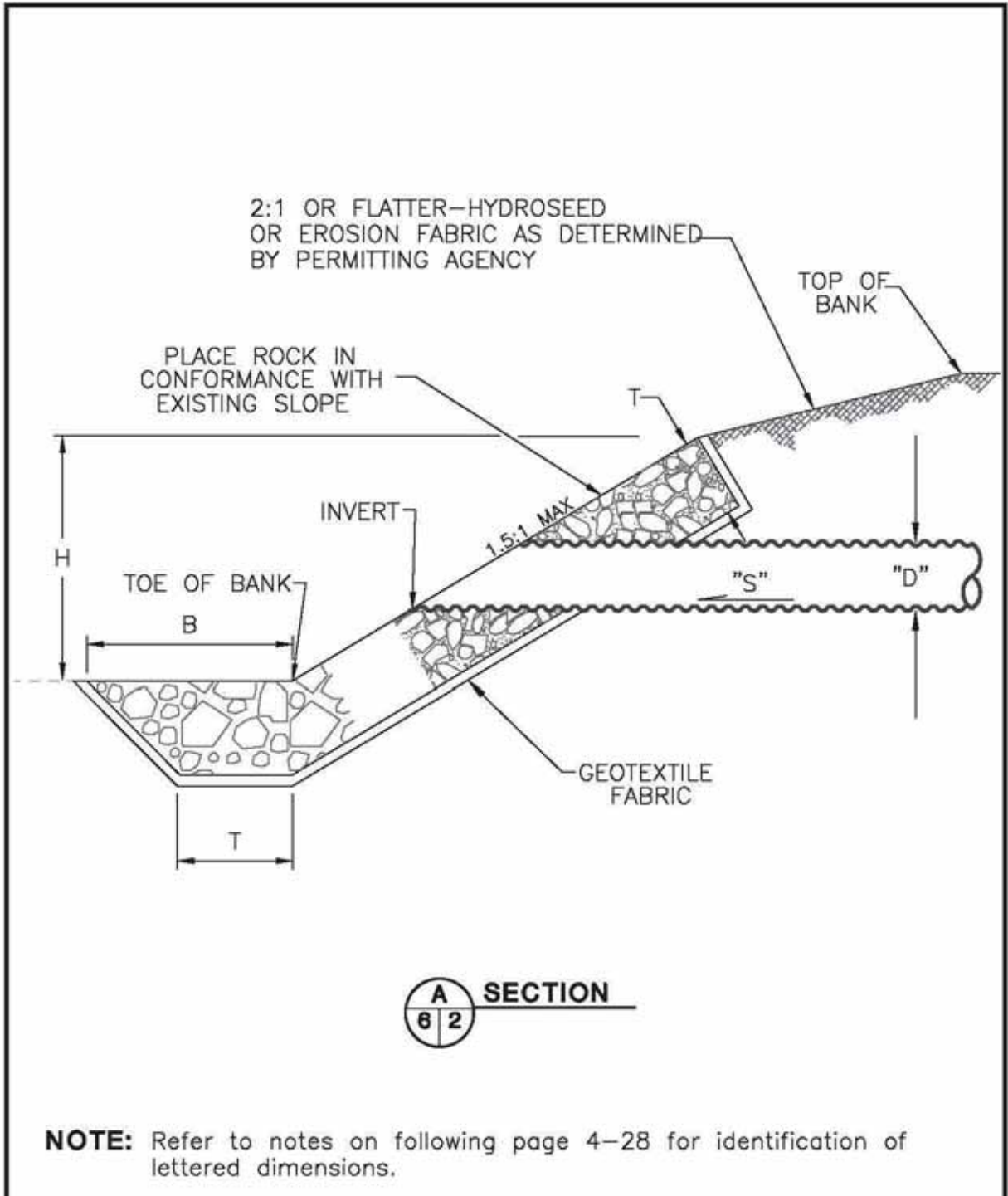
6/1 DETAIL PLAN

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OUTFALL WITH ROCK SLOPE PROTECTION

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OUTFALL WITH ROCK SLOPE PROTECTION



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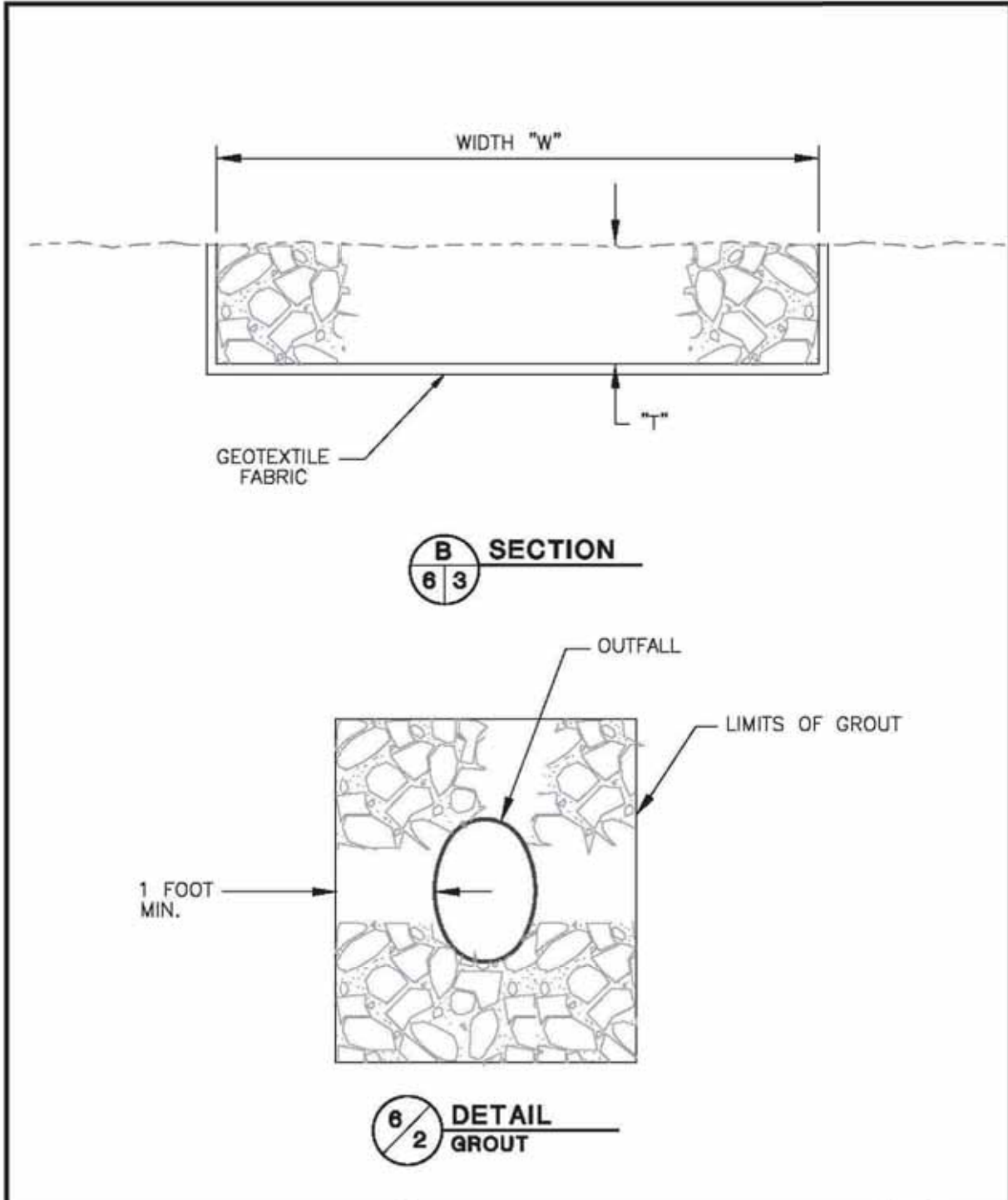
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 SLOPE PROTECTION**

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SLOPE PROTECTION**

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NOTES FOR CONSTRUCTION OF OUTFALL

1. IT IS MANDATORY THAT THE SCVWD INSPECTOR BE NOTIFIED AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. COMPLETE REMOVAL OF PORTIONS OF THE WORK INSTALLED WITHOUT INSPECTION MAY BE REQUIRED IF THIS REQUIREMENT IS NOT MET.
2. ALL WORK IS TO BE IN ACCORDANCE WITH THE STATE STANDARD SPECIFICATIONS SECTION 72-2. NO WHITE ROCK MAY BE USED. METHOD B PLACEMENT SHALL BE USED. GROUT TO BE IN CONFORMANCE WITH PARAGRAPH 65-1.06 FOR CEMENT MORTAR.
3. THE OUTFALL PIPE IS TO BE CUT OFF FLUSH WITH THE SLOPE PROTECTION.
4. ANY BACKFILL NECESSARY FOR THE INSTALLATION OF THE OUTFALL SHOULD BE COMPACTED TO 90 PERCENT RELATIVE COMPACTION IN CONFORMANCE WITH ASTM STANDARD TEST METHOD D1557.
5. ANY EXCESS SOIL FROM EXCAVATION SHALL BE DEPOSITED OFF OF DISTRICT RIGHT OF WAY UNLESS APPROVED BY THE DISTRICT'S INSPECTOR.

CRITERIA TO BE USED FOR DESIGN OF OUTFALL

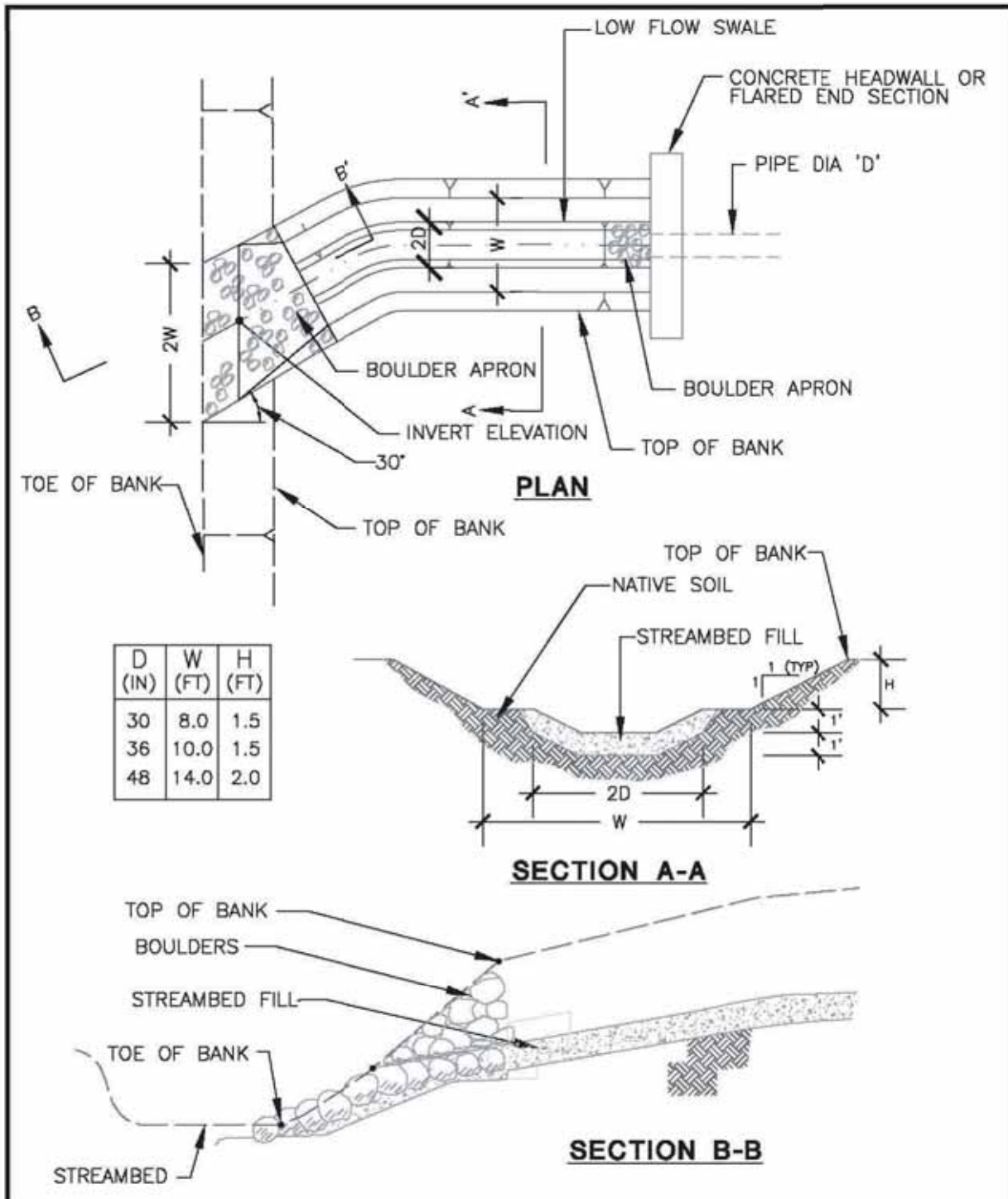
1. ROCK SLOPE PROTECTION FOR OUTFALLS MAY NOT BE USED FOR SLOPES STEEPER THAN 1.5:1.
2. THE PLAN VIEW, SECTION A 6/2 AND SECTION B 6/3 ARE TO BE DRAWN TO SCALE ON THE PLANS WITH SCALE PROVIDED AND SHOULD REFLECT EXISTING CONFIGURATION OF THE CHANNEL WHERE THE OUTFALL IS PROPOSED.
3. PLANS SHOULD SPECIFY THE FOLLOWING DIMENSIONS/ELEVATIONS:

PIPE DIAMETER "D"	TOP OF BANK ELEVATION
1/2 SLOPE PROTECTION WIDTH "A"	TOE OF BANK ELEVATION
ROCK THICKNESS "T"	PIPE INVERT ELEVATION
CHANNEL BOTTOM ROCK WIDTH "B"	PIPE OUTFALL SLOPE "S"
SLOPE PROTECTION WIDTH "W"	
HEIGHT OF ROCK "H"	
4. ROCK THICKNESS "T", HEIGHT OF ROCK PROTECTION "H" AND ROCK CLASS (gradation) ARE TO BE DETERMINED BY SCVWD BASED ON LOCATION OF OUTFALL AND FIELD CONDITIONS. ONE-HALF SLOPE PROTECTION WIDTH "A" IS TO BE THE GREATER OF TWICE THE PIPE DIAMETER "D" OR 2 FEET. CHANNEL BOTTOM ROCK WIDTH "B" IS TO BE 2 TIMES THE ROCK THICKNESS "T".
5. THE OUTFALL PIPE IS TO HAVE THE FOLLOWING CHARACTERISTICS:

MATERIAL:	CORRUGATED METAL PIPE
DIAMETER:	12-INCH MINIMUM
THICKNESS AND SLOPE:	SEE TABLE 5/1 ON SHEET 5/3

REINFORCED CONCRETE PIPE MAY BE USED IN ROCK SLOPE PROTECTION.
6. GEOTEXTILE FABRIC SHALL BE MIRAFI 700X OR EQUAL.
7. ROCK SLOPE PROTECTION MAY BE COVERED WITH SOIL AND PLANTED.
8. THE OUTFALL PIPE SHOULD POINT DOWNSTREAM.

OUTFALL WITH DRAINAGE SWALE



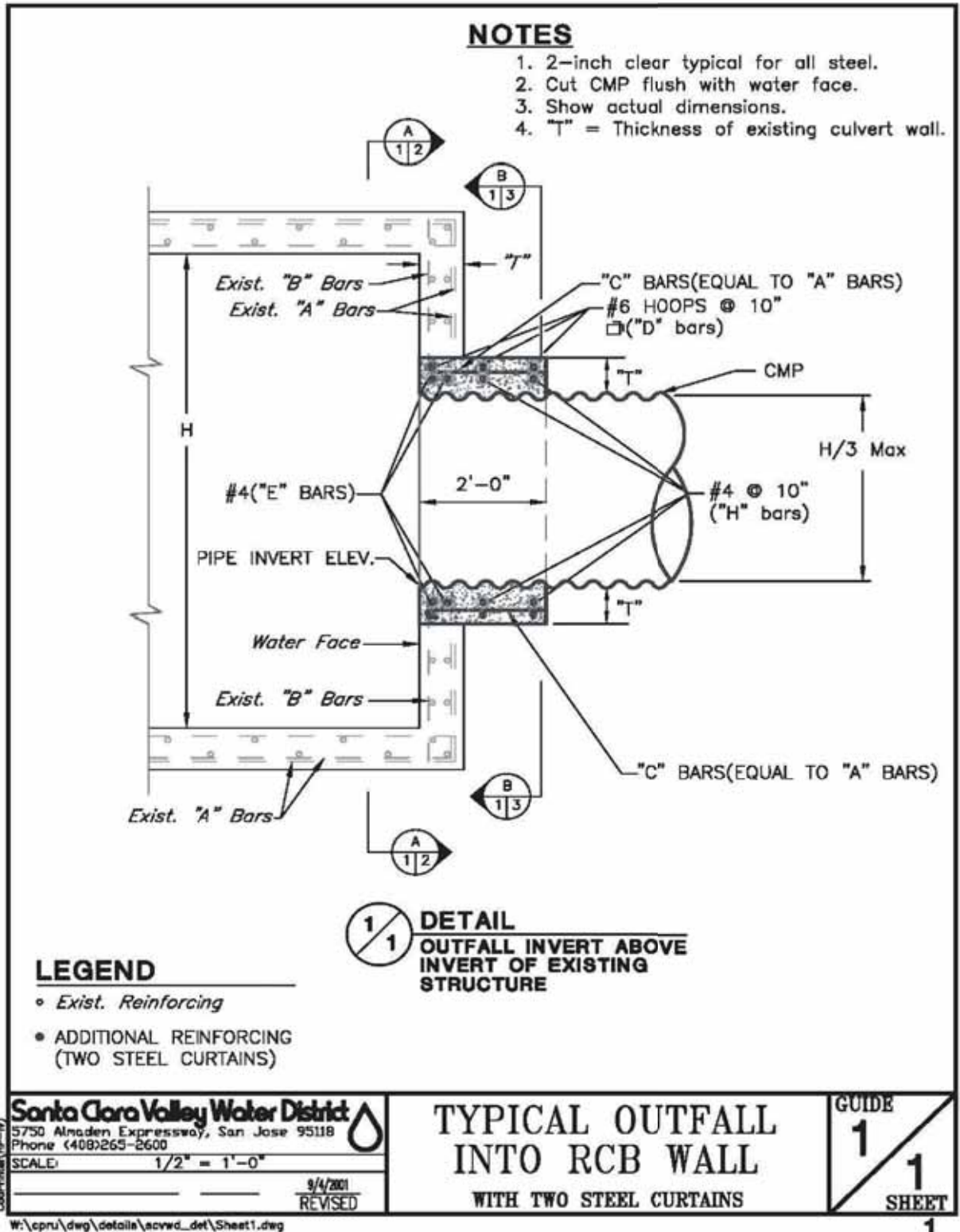
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OUTFALL WITH DRAINAGE SWALE

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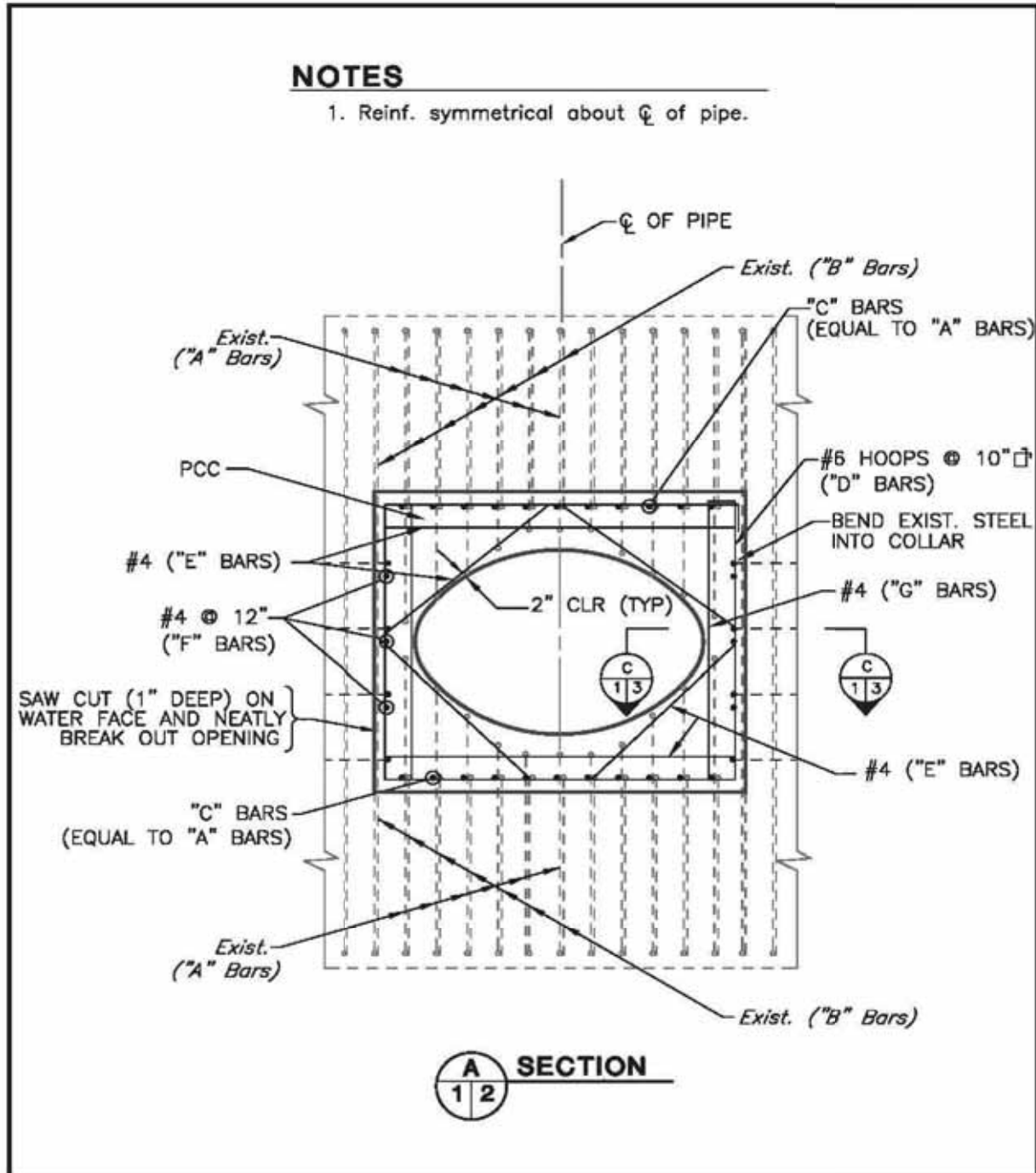
TYPICAL OUTFALL INTO REINFORCED CONCRETE BOX WALL

with two steel curtains



TYPICAL OUTFALL INTO REINFORCED CONCRETE BOX WALL

with two steel curtains



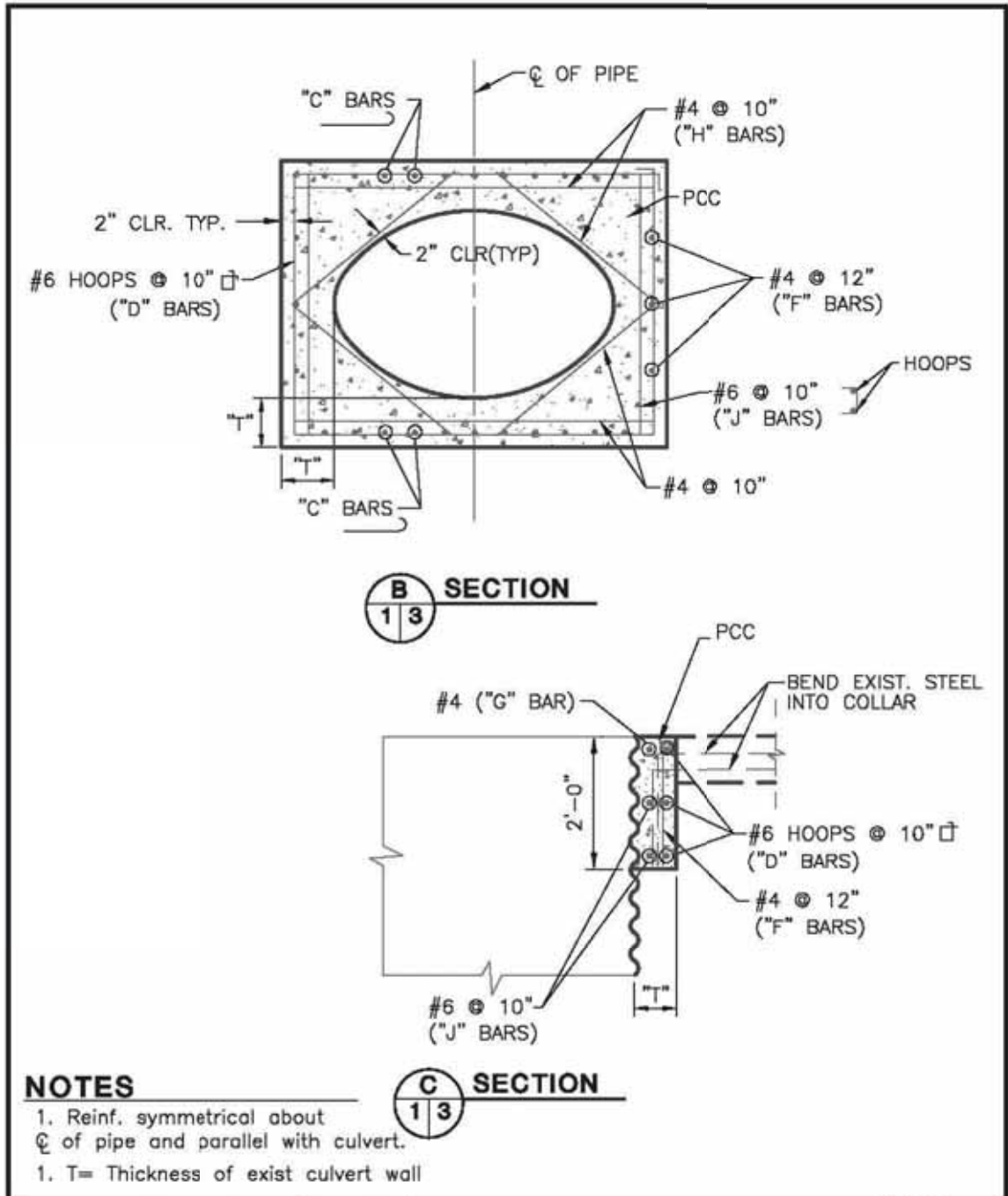
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TYPICAL OUTFALL INTO REINFORCED CONCRETE BOX WALL

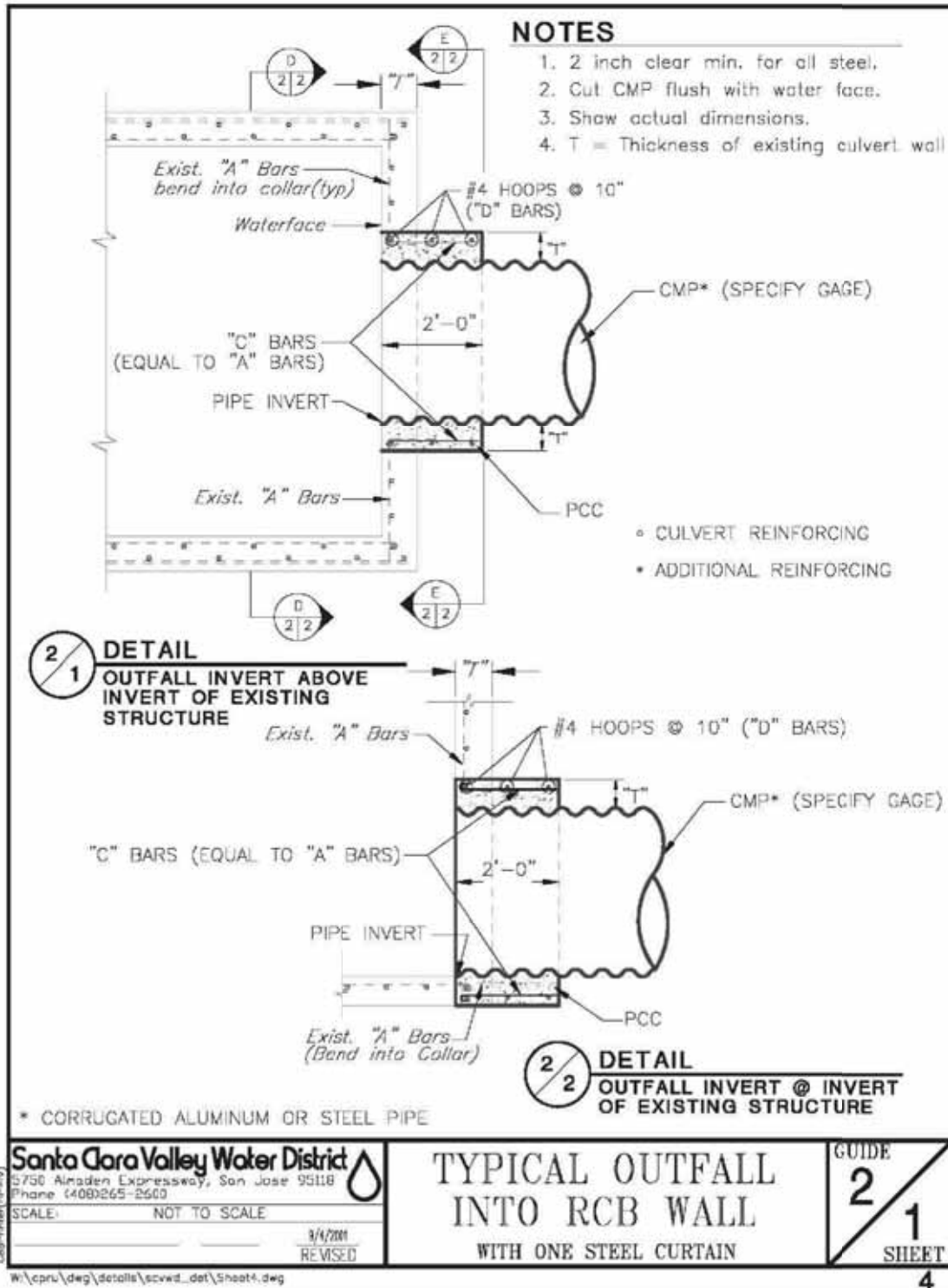
with two steel curtains



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TYPICAL OUTFALL INTO REINFORCED CONCRETE BOX WALL

with one steel curtains



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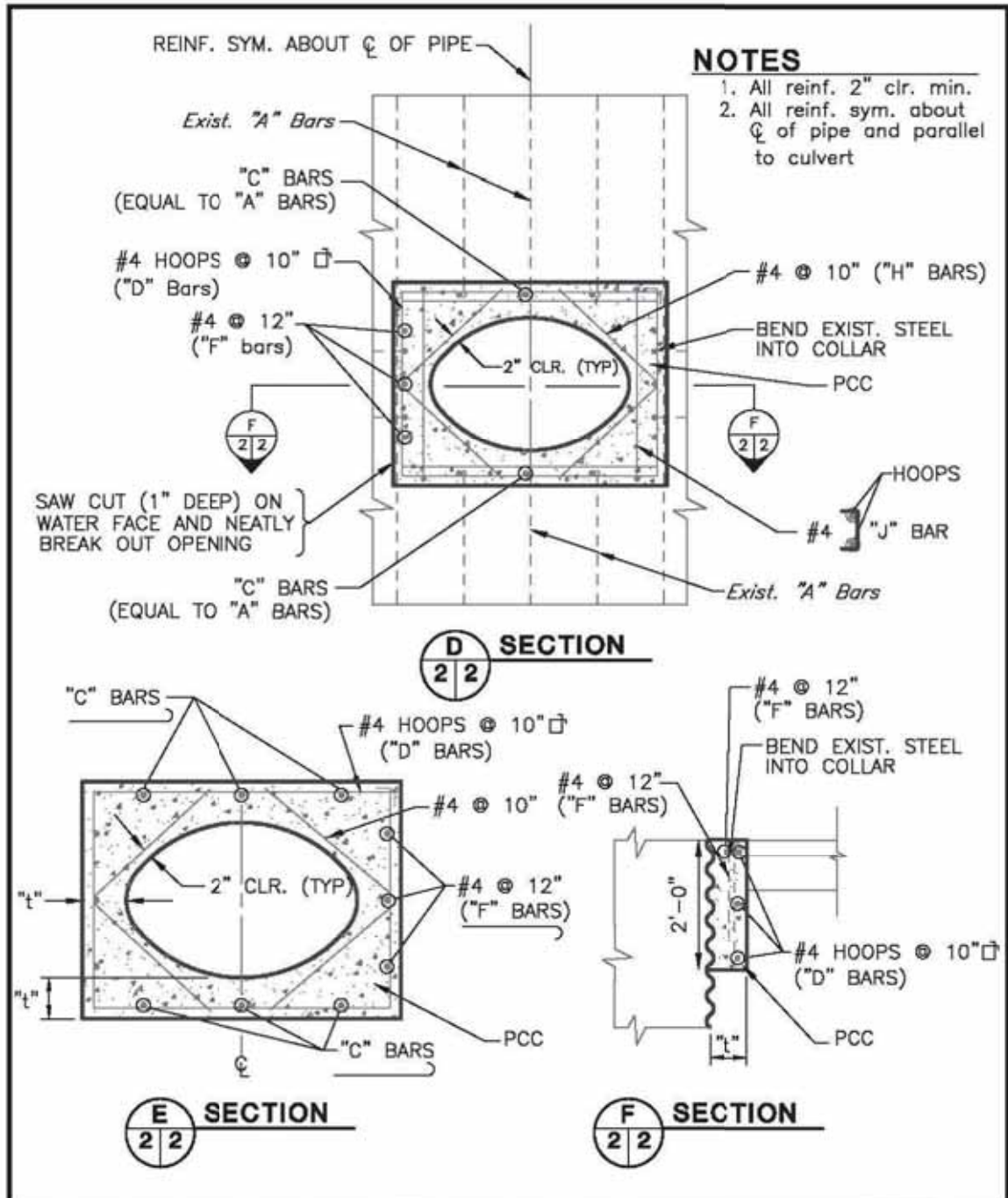
TYPICAL OUTFALL
INTO RCB WALL
WITH ONE STEEL CURTAIN

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TYPICAL OUTFALL INTO REINFORCED CONCRETE BOX WALL

with one steel curtain



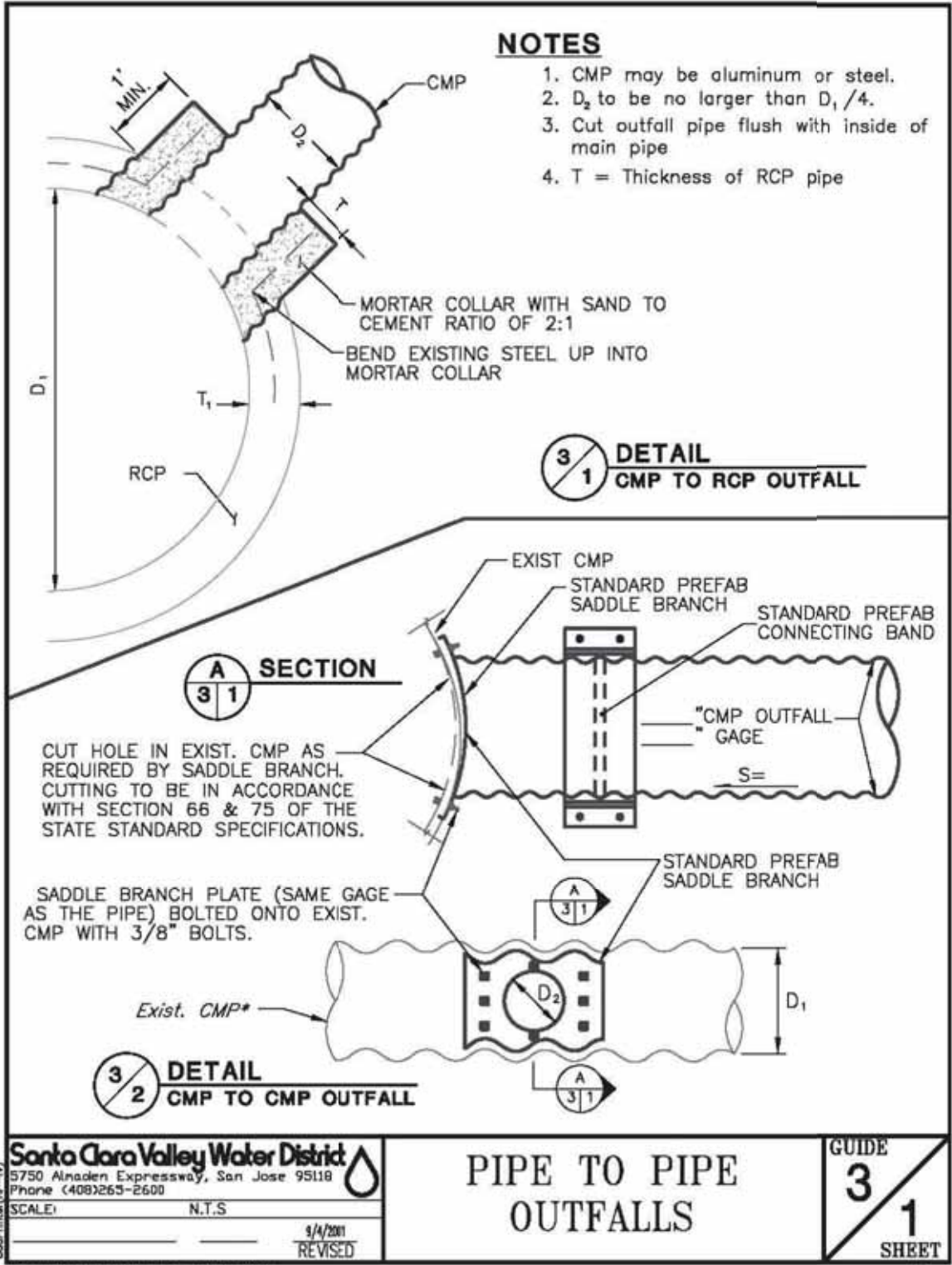
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TYPICAL OUTFALL INTO RCB WALL
 WITH ONE STEEL CURTAIN

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PIPE TO PIPE OUTFALLS

The size of the pipe is limited to 1/4 the diameter of the receiving pipe.



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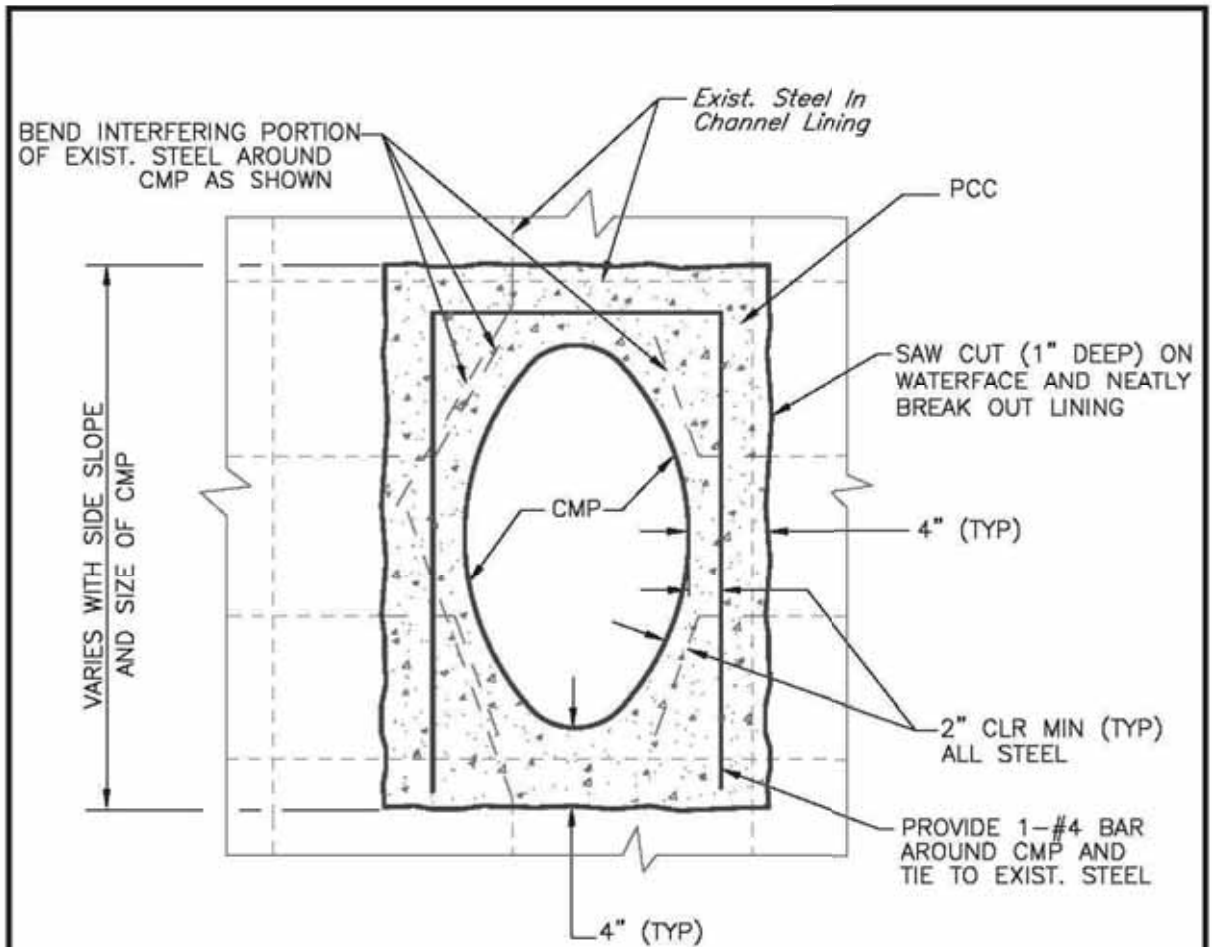
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PIPE TO PIPE OUTFALLS

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PIPE OUTFALL INTO CHANNEL LINING



4/1 **DETAIL**
CHANNEL SIDESLOPE 1:1 OR FLATTER

NOTES

1. Cut CMP flush with water face of lining.
2. CMP may be aluminum or steel.
3. This Detail is typical for both curtains of exist. steel.

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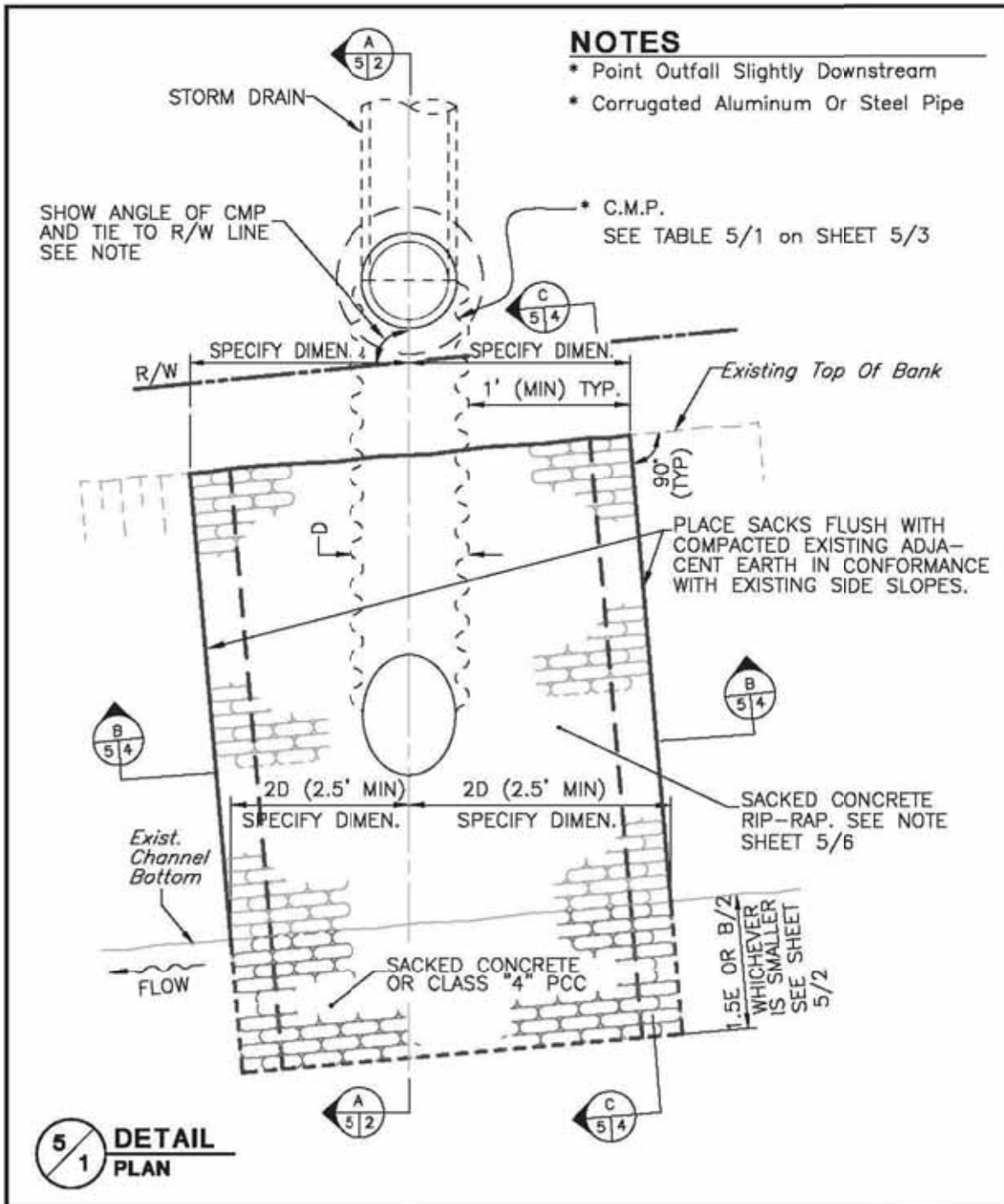
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**PIPE OUTFALL
 INTO CHANNEL LINING**

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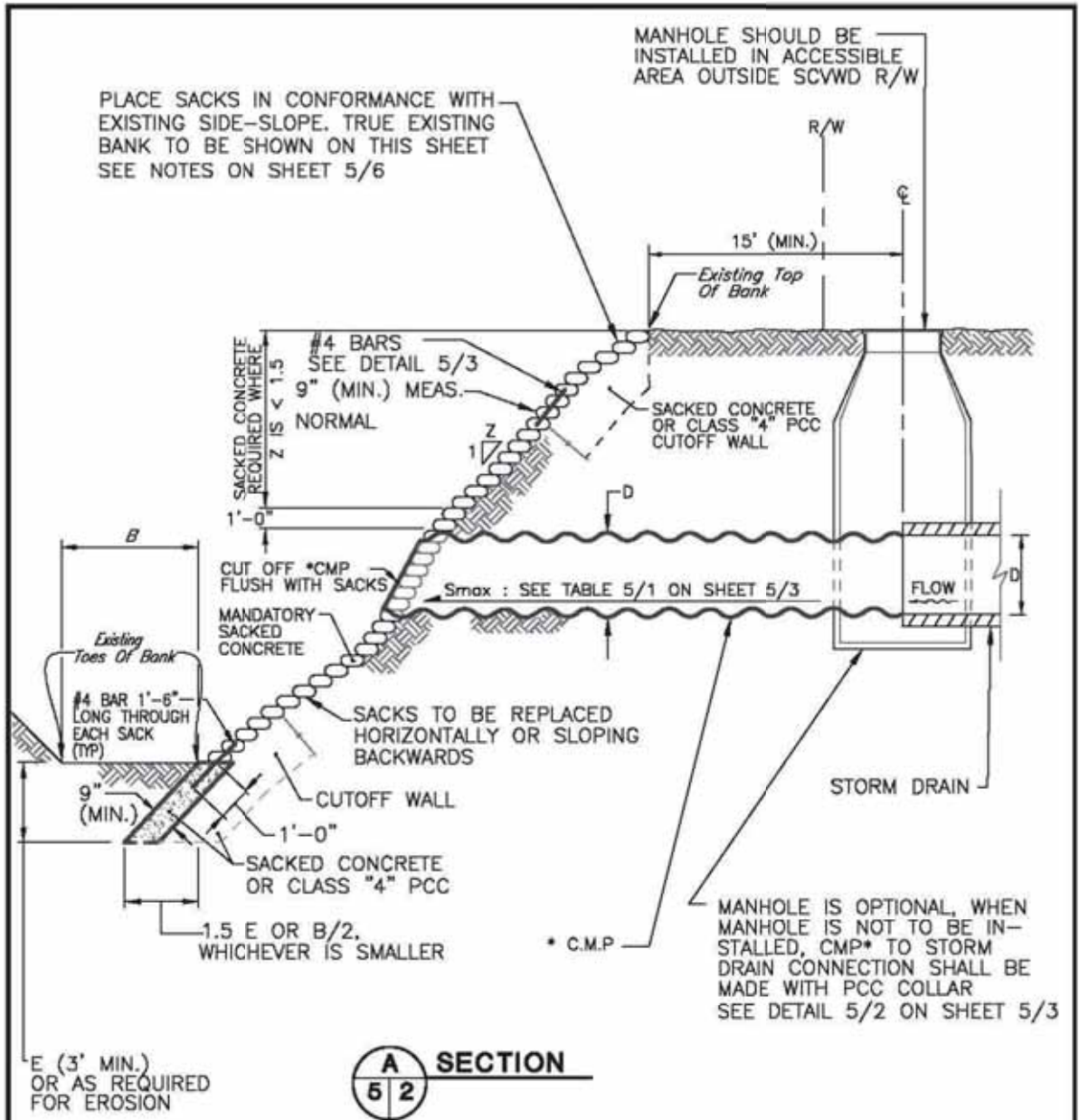
PIPE OUTFALL WITH SACKED CONCRETE RIP RAP



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PIPE OUTFALL WITH SACKED CONCRETE RIP RAP



NOTES:

Place outfall invert 2-feet above stream bottom in locations where there is sediment deposition

* Corrugated Aluminum Or Steel Pipe

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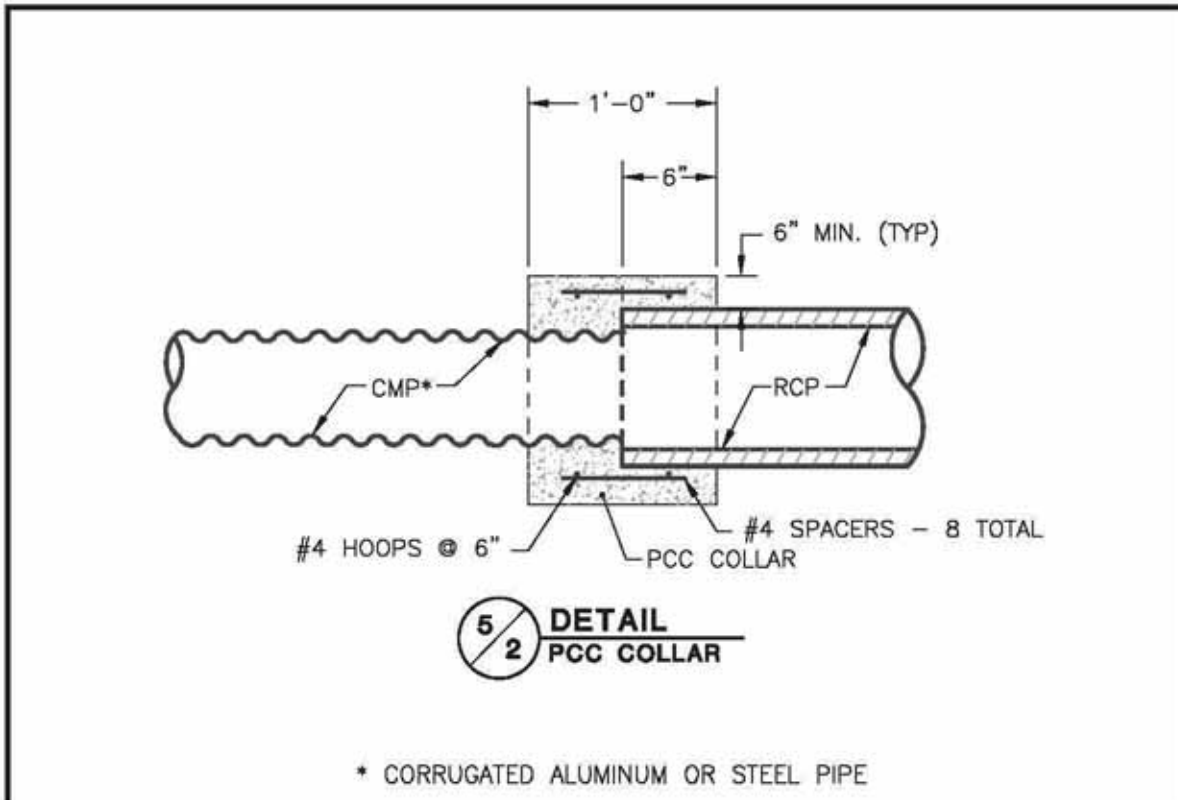
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PIPE OUTFALL WITH SACKED CONCRETE RIP RAP

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PIPE OUTFALL WITH SACKED CONCRETE RIP RAP



CMP	GAGE	Smax.*
12"	16	.0778
18"	16	.0659
24"	14	.0580
30"	14	.0530
36"	12	.0491

CMP	GAGE	Smax.*
42"	12	.0459
48"	12	.0432
54"	12	.0411
60"	10	.0394
66"	10	.0379

CMP	GAGE	Smax.*
72"	10	.0365
78"	8	.0354
84"	8	.0343

5 / 1 **TABLE**

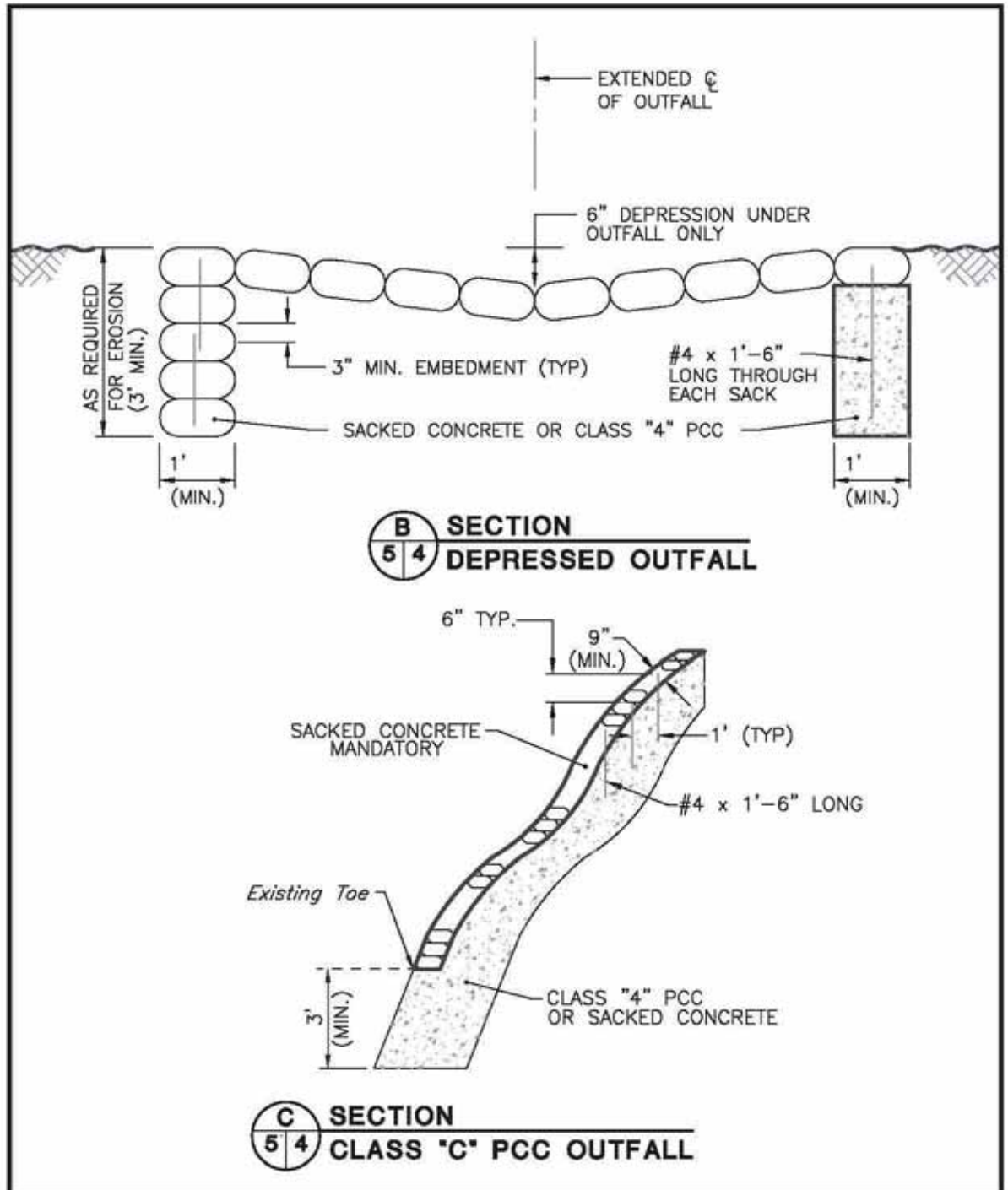
$$S_{max} = \frac{112 n^2}{D^{1/3}} \text{ (MEASURED IN FT.)}$$

REQUIRED PIPE GAGE AND MAXIMUM ALLOWABLE SLOPES * FOR CMP OUTFALLS

* THE ABOVE SLOPES ARE BASED ON CMP WITH STANDARD CORRUGATIONS.

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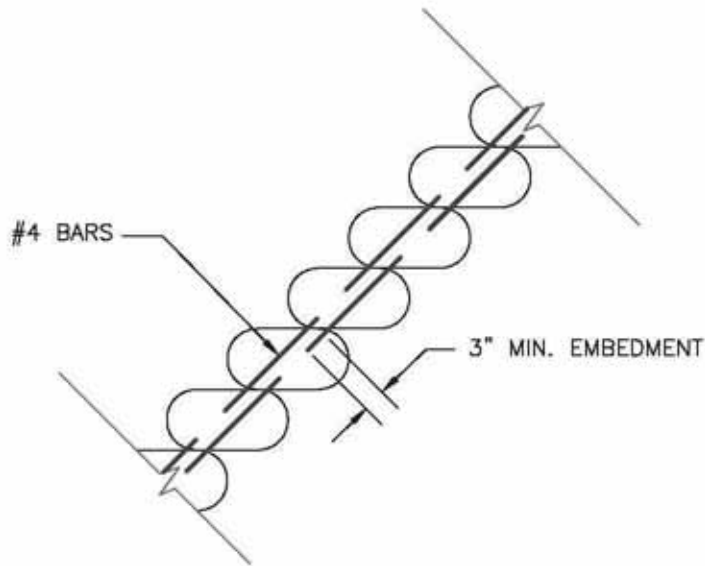
PIPE OUTFALL WITH SACKED CONCRETE RIP RAP



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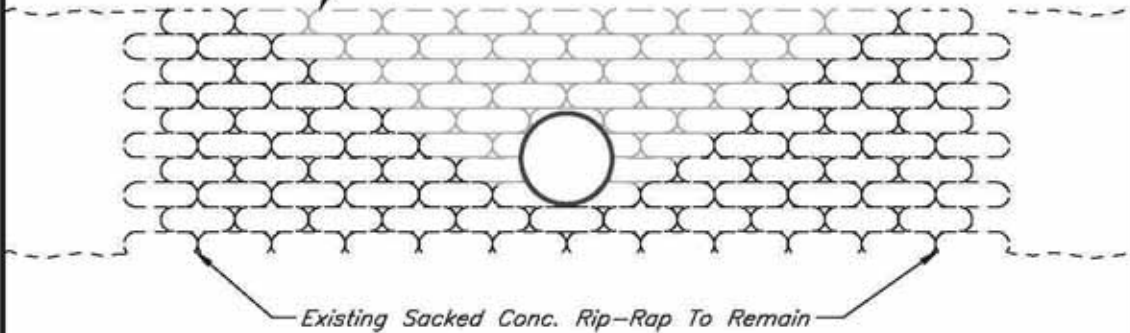
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PIPE OUTFALL WITH SACKED CONCRETE RIP RAP



5/3 **DETAIL**
SACK REINFORCING

SACKED CONC. RIP-RAP TO BE REMOVED & REPLACED
IN ACCORD WITH NOTES ON THIS SHEET AND SHEET
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5/4 **DETAIL**
PIPE INSTALLATION IN EXIST. SACKED CONCRETE RIP-RAP

NOTES

1. The removal of only a portion of a sack is not allowed.

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**PIPE OUTFALL WITH
SACKED CONCRETE
RIP-RAP**

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PIPE OUTFALL WITH SACKED CONCRETE RIP RAP

NOTES FOR SACKED CONCRETE RIP-RAP

THESE NOTES ARE TO APPEAR ON PLANS

1. SACKS FOR SLOPE PROTECTION SHALL BE 10oz. BURLAP MEASURING 19 1/2" BY 36" INSIDE THE SEAMS WHEN LAID FLAT. CONCRETE SHALL BE CLASS 4 IN ACCORDANCE WITH THE CURRENT STATE STANDARD SPECIFICATION. THE AMOUNT OF WATER ADDED AT THE TIME OF MIXING SHALL BE SUCH TO PRODUCE A MIXTURE WITH A MAXIMUM SLUMP OF 4 INCHES. SACKED DRY MIXES ARE NOT PERMITTED. THE VOLUME OF CONCRETE PLACED IN EACH SACK IS TO BE CONTROLLED BY A CHUTE MEASURING DEVICE AND SHALL BE APPROXIMATELY 1/2 CUBIC FOOT OF PLASTIC CONCRETE LOOSELY PLACED SO AS TO LEAVE ROOM FOR FOLDING AT THE TOP.
2. FACE OF RIPRAP TO BE COINCIDENT WITH EXISTING SIDE SLOPE OF CHANNEL. DO NOT PACK UNTIL SMOOTH; LEAVE AS ROUGH AS POSSIBLE.
3. EXTEND RIPRAP UP TO THE TOP OF BANK, UNLESS OTHERWISE SPECIFIED ON PLAN.
4. INSTALL CUTOFF WALL (3-FOOT MINIMUM DEPTH) AT UPSTREAM AND DOWNSTREAM ENDS. CUTOFF WALLS TO EXTEND UP SIDES OF CHANNEL.
5. DRIVE ONE #4 REINFORCING BAR THROUGH EACH SACK. MINIMUM LENGTH OF BARS TO BE 18 INCHES. DO NOT LEAVE ENDS OF BARS EXPOSED, NOR DRIVE INTO DIRT OR JOINT BETWEEN ENDS OF SACKS - SEE DETAIL 5/3
6. ALL BACKFILL SHALL BE WITH SUITABLE MATERIAL FROM EXCAVATION AND SHALL BE COMPACTED TO 90 PERCENT RELATIVE COMPACTION IN ACCORDANCE WITH ASTM TEST METHOD D1557
7. SACKS SHALL BE PLACED SO THAT THEY ARE HORIZONTAL OR SLOPING TOWARDS BANK. SACKS SLOPING AWAY FROM BANK WILL NOT BE ACCEPTED.
8. IT IS MANDATORY THAT SCVWD INSPECTOR BE NOTIFIED AT LEAST 48 HOURS BEFORE CONSTRUCTION BEGINS. COMPLETE REMOVAL MAY RESULT IF THIS REQUIREMENT IS NOT MET.

THE FOLLOWING NOTES ARE TO BE ADHERED TO BUT ARE NOT TO APPEAR ON THE PLANS

- A. OBTAIN CONSTRUCTION/ENCROACHMENT PERMIT FROM THE SCVWD FOR ALL STORM OUTFALL BY SUBMITTING IMPROVEMENT PLANS BEFORE CONTRACT IS OUT TO BID.
- B. ON PLAN SUBMITTALS SHOW SUFFICIENT INFORMATION SO THAT THE CROSS SECTION OF EXISTING CREEK AT THE OUTFALL AND FOR A MINIMUM DISTANCE OF 20 FEET BOTH UPSTREAM AND DOWNSTREAM OF OUTFALL CAN BE DETERMINED. ADDITIONAL CROSS SECTION INFORMATION MAY BE REQUESTED BY SCVWD.
- C. SHOW ALL INFORMATION REQUIRED ON SHEET 5/1 & 5/2 AND INDICATE THE SIZE AND LOCATION OF TREES NEAR THE OUTFALL.
- D. PLAN SUBMITTALS NOT SHOWING THE INFORMATION REQUIRED BY NOTES B AND C WILL NOT BE PROCESSED.
- E. USE SAME HORIZONTAL AND VERTICAL SCALE FOR SECTION OF EXISTING CREEK AT OUTFALL.

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PIPE OUTFALL WITH SACKED CONCRETE RIP-RAP

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