

# Standard Details & Specifications Sewers



CITY OF PHILADELPHIA  
WATER DEPARTMENT  
DESIGN BRANCH

## STANDARD DETAILS and SPECIFICATIONS for SEWERS

APPROVED:

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**DETAILS**

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<b>PIPE</b>	Vitrified Clay Pipe Sewer	JAN 2019	PIPE-01	1
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	Vit. Clay Pipe Sewer with R.C. Pipe SW. Conduit	JAN 2019	PIPE-03	1
	Typical Street Section	JAN 2019	PIPE-04	1
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	Pipe Headwall	JAN 2019	PIPE-10	0
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<b>CONNECTION</b>	Concrete Cut-off Wall	JAN 2019	CONN-01	NEW
	INTENTIONALLY LEFT BLANK		CONN-02	
	Saddle Connection	JAN 2019	CONN-03	1
	Modified Saddle Connection to Circular Brick Sewer	JAN 2019	CONN-04	NEW
	Modified Saddle Connection to Egg-shaped Brick Sewer	JAN 2019	CONN-05	NEW
	Doghouse Manhole Connection for Existing 2'-0" & 2'-6" Brick Sewer and Proposed RCP 24" or Smaller	JAN 2019	CONN-06	NEW
	Doghouse Manhole Connection for Existing Brick Egg Sewers 4'-0" x 2'-8" or Smaller and Proposed RCP 27" or Smaller	JAN 2019	CONN-07	NEW
	Combined System Vent Connection	JAN 2019	CONN-08	NEW
<b>MANHOLE</b>	Precast Concrete Manhole Riser and Cone	JAN 2019	MH-01	0
	Concrete Manhole Base - Pipe $\phi \leq 30"$ - Combined	JAN 2019	MH-02	0
	Doghouse Manhole - Pipe $\phi \leq 30"$	JAN 2019	MH-03	NEW
	Precast Concrete Manhole Bases - Pipe $\phi \leq 30"$	JAN 2019	MH-04	0
	Concrete Manhole Base - Pipe $\phi \geq 36"$ - Combined	JAN 2019	MH-05	0
	Concrete Manhole Base - Pipe $\phi \leq 30"$ - Separate	JAN 2019	MH-06	0
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	Concrete Manhole Base - Junction Manhole	JAN 2019	MH-08	0
	Summit Manhole	JAN 2019	MH-09	0
	Precast Concrete Drop Manhole	JAN 2019	MH-10	1
	Precast Concrete Interior Drop Manhole (1 of 3)	JAN 2019	MH-11-A	NEW
	Precast Concrete Interior Drop Manhole (2 of 3)	JAN 2019	MH-11-B	NEW
	Precast Concrete Interior Drop Manhole (3 of 3)	JAN 2019	MH-11-C	NEW
	Wellhole (1 of 2)	JAN 2019	MH-12-A	0
Wellhole (2 of 2)	JAN 2019	MH-12-B	0	
Gray Iron Manhole Frame & Covers (1 of 2)	JAN 2019	MH-13-A	0	
Gray Iron Manhole Frame & Covers (2 of 2)	JAN 2019	MH-13-B	0	
Manhole Steps	JAN 2019	MH-14	0	

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	Highway Grate Inlet Assembly	JAN 2019	INLET-03	NEW
	Gutter Grate Inlet Assembly	JAN 2019	INLET-04	NEW
	Open Mouth Inlet Assembly	JAN 2019	INLET-05	NEW
	Inlet and Trap Installation (1 of 2)	JAN 2019	INLET-06-A	NEW
	Inlet and Trap Installation (2 of 2)	JAN 2019	INLET-06-B	NEW
	Two Piece Precast Catch Basin	JAN 2019	INLET-07	1
	Inlet Trap	JAN 2019	INLET-08	0
	Precast Reinforced Concrete Inlet Hood	JAN 2019	INLET-09	0
	Highway Grate and Gutter Grate Inlet Adjustment Risers	JAN 2019	INLET-10	1
	Inlet Frames	JAN 2019	INLET-11	0
	Inlet Grates	JAN 2019	INLET-12	0
	Concrete Apron At Open Mouth Grate Inlet	JAN 2019	INLET-13	NEW
	Open Mouth Inlet Adjustment Riser	SEP 2019	INLET-14	2
	Precast Concrete Top Slabs	JAN 2019	INLET-15	0
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Concrete Apron At Open Mouth Inlet	JAN 2019	INLET-17	NEW	

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**SPECIFICATIONS**

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# Detail – Vitrified Clay Pipe Sewer

## PIPE-01

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades
- [D-6](#): Width of Trenches
- [D-7](#): Installation of Pipes
- [D-8](#): Protection of Pipes
- [D-9](#): Length of Pipes
- [D-10](#): Provisions for Lateral Connections
- [D-15](#): Vitrified Clay Pipe

### Approved Suppliers

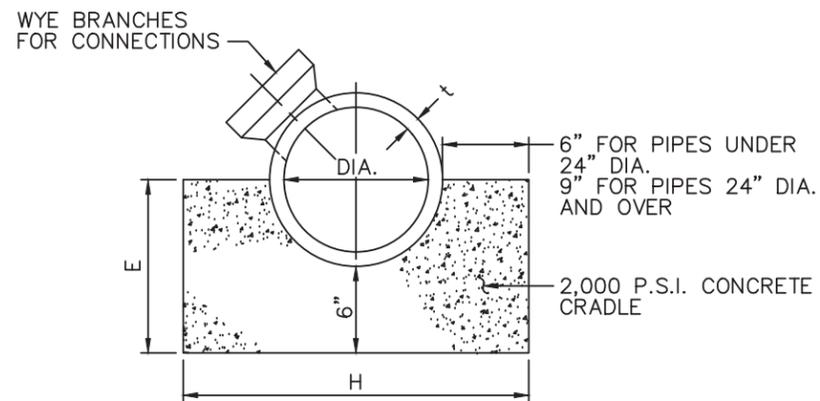
- QC-9: Vitrified Clay Pipe & Fittings

### Miscellaneous Comments

- The .dwg file located on the website at phillywaterdesign.org has drawings of all sizes of Vit. Clay Pipe Sewer in the model space.
- The thickness (t) of Vitrified Clay Pipe varies with each manufacturer. See the manufacturer's website for the actual thickness.

### Revisions

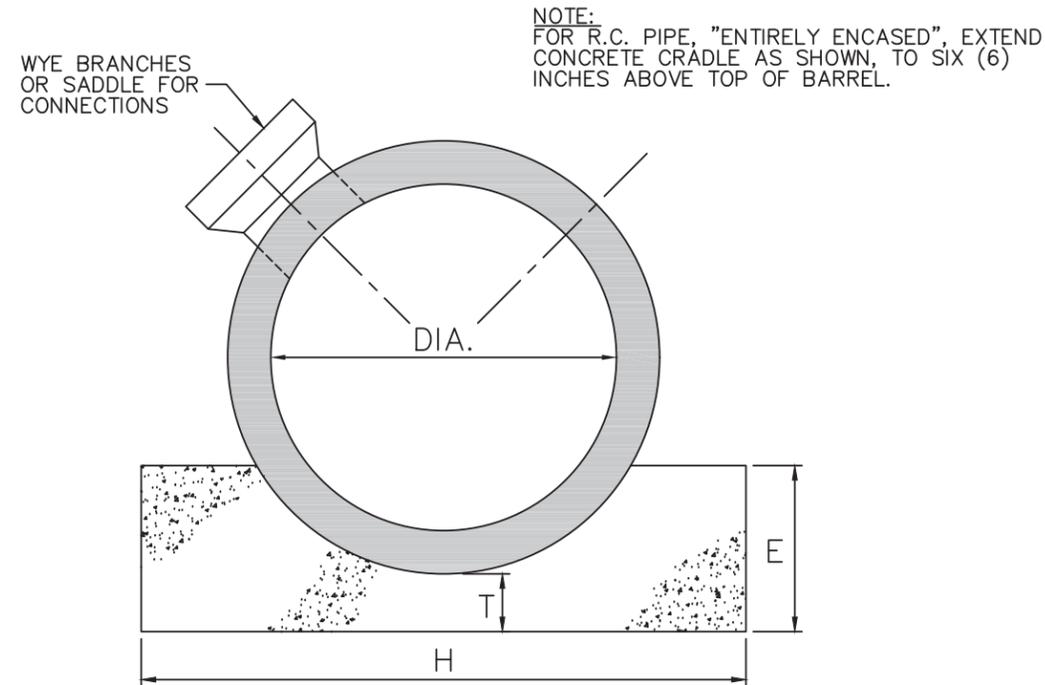
Rev 1 – Jul. 2018 – CY/LF of Concrete corrected, (t) column removed from table.



DIA.	H	E	CONC. C.Y./L.F.	BELL O.D. ±
10"	2'-0"	12"	0.060	16"
12"	2'-2 <sup>3</sup> / <sub>8</sub> "	13"	0.067	19"
15"	2'-6"	15"	0.083	24"
18"	2'-9 <sup>3</sup> / <sub>4</sub> "	17"	0.100	28"
21"	3'-1 <sup>1</sup> / <sub>2</sub> "	19"	0.115	33"
24"	3'-11"	20 <sup>1</sup> / <sub>2</sub> "	0.163	37"
27"	4'-2 <sup>1</sup> / <sub>2</sub> "	22"	0.182	39"
30"	4'-6"	2'-0"	0.202	44"
36"	5'-1"	2'-3 <sup>1</sup> / <sub>2</sub> "	0.245	50"
42"	5'-8"	2'-7"	0.290	60"

**NOTE:**

- VITRIFIED CLAY PIPE SHALL BE EXTRA STRENGTH
- FOR VITRIFIED CLAY PIPE, ENTIRELY ENCASED, EXTEND CONCRETE CRADLE AS SHOWN, TO SIX (6) INCHES ABOVE TOP OF BARREL.



Dia.	T	E	H	CONC. C.Y./L.F.
15"	4"	9"	2'-7"	0.052
18"	4"	10"	3'-0"	0.070
21"	4"	11"	3'-3"	0.084
24"	4"	11½"	3'-6"	0.089
27"	4"	12½"	3'-9"	0.100
30"	4"	13"	4'-1"	0.112
36"	4"	15"	4'-8"	0.140
42"	4"	17"	5'-4"	0.174
48"	4½"	19"	6'-0"	0.219
54"	5"	21"	6'-8"	0.269
60"	5½"	23½"	7'-2"	0.315
66"	6"	26"	7'-9"	0.373
72"	6½"	28"	8'-4"	0.428
78"	7"	30"	8'-11"	0.499
84"	7½"	32½"	9'-6"	0.558
90"	7½"	34"	9'-10"	0.586
96"	7½"	36"	10'-5"	0.644
102"	7½"	38"	10'-11"	0.695
108"	7½"	39½"	11'-8"	0.775

## Detail – R.C. Pipe Sewer or Stormwater Conduit

### PIPE-02

#### Associated Details

- [CONN-03](#): Saddle Connection

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades, [D-6](#): Width of Trenches, [D-7](#): Installation of Pipes, [D-8](#): Protection of Pipes, [D-9](#): Length of Pipes
- [D-10](#): Provisions for Lateral Connections
- [D-11](#): Measurement for Payment
- [D-16.0](#): Reinforced Concrete Pipe, [D-16.1](#): Compression Joints, [D-16.2](#): Installing Pipe, [D-16.3](#): Changes in Alignment, [D-16.4](#): Connections

#### Approved Suppliers

- QC-6: Reinforced Concrete Pipe & Fittings

#### Miscellaneous Comments

- The wall thickness of Class III, Wall B, R.C. Pipe is the Diameter (in inches) divided by 12 plus 1 inch. The wall thickness of a 24" Dia. R.C. Pipe would be 3".
- All dimensions for R.C. Pipe Sewer or Stormwater Conduit are the same as the 1985 Standard Details.
- Oldcastle uses the Tylox SuperSeal instead of "O" ring joints (model 135 for 30" and 36" Reduced Bell and model 165 for all other sizes).
- Oldcastle may use a Reduced Bell Concrete Pipe (Modified Offset Joint Pipe with Offset Gasket-Folsom, model: 1236 OJPG using the Tylox 135 joint) for 30" and 36" RC Pipe Sewers or Stormwater Conduits because they must use it for stormwater conduits in separate systems to avoid hitting the bell of the Vit. Clay sewer beneath it.
- The .dwg file located on the website at [phillywaterdesign.org](http://phillywaterdesign.org) has drawings of all sizes of R.C. Pipe Sewer or Stormwater Conduit in the model space.

#### Revisions

Rev. 1 – Jan. 2019 – Conc. CY/LF corrected.

<b>PHILADELPHIA WATER DEPARTMENT</b>	<b>R.C. PIPE SEWER OR STORMWATER CONDUIT</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: PIPE-02	REV.: 1	

# Detail – Vit. Clay Pipe Sewer w/ R.C. Stormwater Conduit

## PIPE-03

### Associated Details

- [CONN-03](#): Saddle Connection

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades, [D-6](#): Width of Trenches, [D-7](#): Installation of Pipes, [D-8](#): Protection of Pipes, [D-9](#): Length of Pipes
- [D-11](#): Measurement for Payment
- [D-10](#): Provisions for Lateral Connections
- [D-15](#): Vitrified Clay Pipe
- [D-16](#): Reinforced Concrete Pipe

### Approved Suppliers

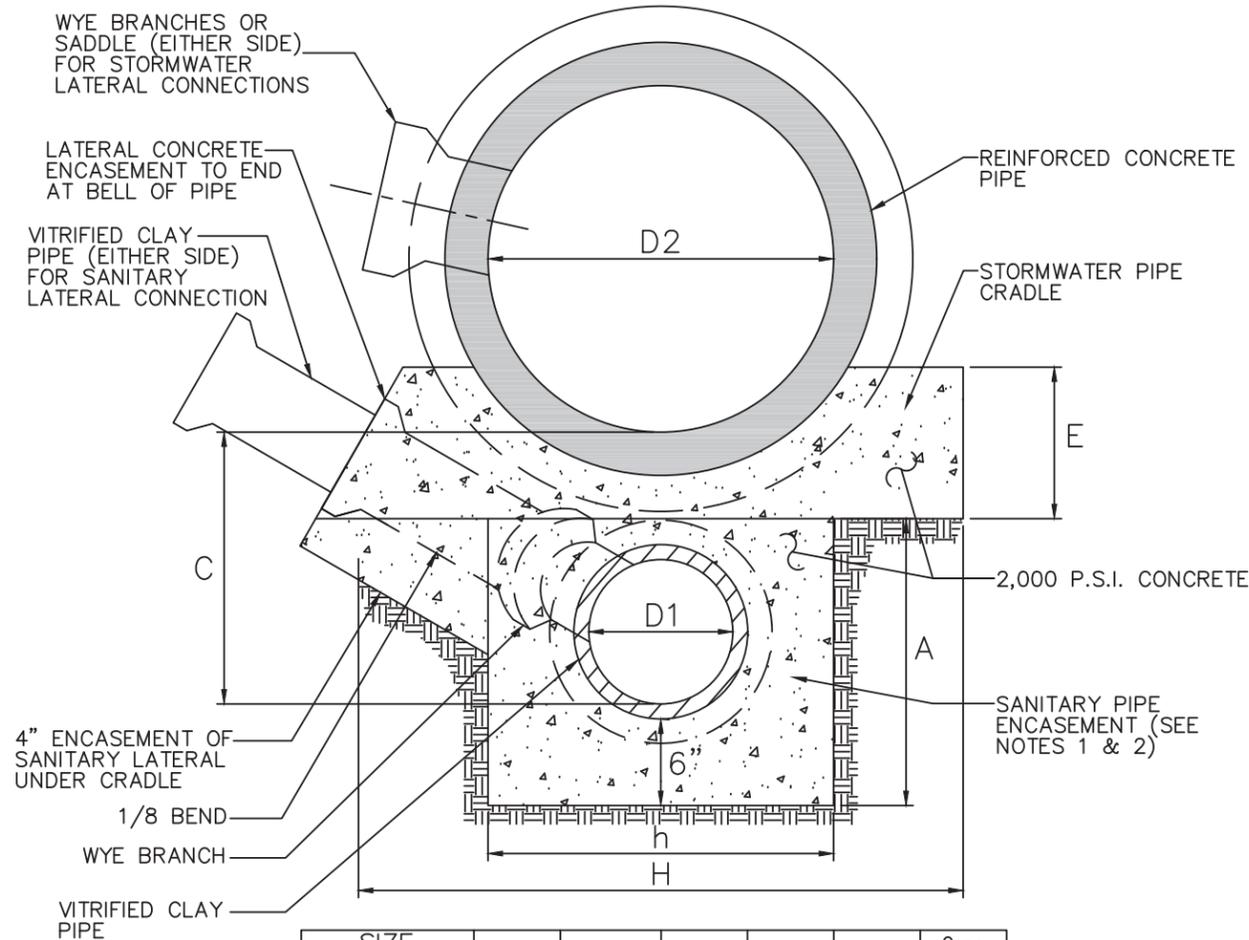
- QC-6: Reinforced Concrete Pipe & Fittings
- QC-9: Vitrified Clay Pipe & Fittings

### Miscellaneous Comments

- The distance between the Stormwater Conduit and Sanitary Sewer was retained to maintain compatibility with the existing system.
- Smaller bells must be used on the 30" and 36" R.C. Stormwater Conduits to prevent them from interfering with the bells on the Vit. Clay Sewer underneath.
- Oldcastle uses the Tylox SuperSeal instead of "O" ring joints (model 135 for 30" and 36" Reduced Bell and model 165 for all other sizes).
- Oldcastle uses a Reduced Bell Concrete Pipe (Modified Offset Joint Pipe with Offset Gasket-Folsom, model: 1236 OJPG using the Tylox 135 joint) for 30" and 36" RC Pipe Stormwater Conduits in separate systems to avoid hitting the bell of the Vit. Clay sewer beneath it.
- The .dwg file located on the website at [phillywaterdesign.org](http://phillywaterdesign.org) has drawings of all sizes of Vit. Clay Pipe Sewer w/ R.C. Stormwater Conduit in the model space.

### Revisions

Rev. 1 – Jan. 2019 – Cradle altered to facilitate two pours during construction. Reduced bells for 30" and 36" RC Stormwater Conduit. VC pipe encasement flush to bell.



SIZE		A	h	H	E	C	Conc. C.Y./L.F.
D1	D2						
10"	18"	1.66'	2'-0"	3'-0"	9"	1.53'	0.154
10"	21"	1.66'		3'-3"	10"	1.55'	0.163
10"	24"	1.66'		3'-6"	10½"	1.57'	0.171
10"	27"	1.66'		3'-9"	11½"	1.59'	0.181
10"	30"*	1.68'		4'-1"	13½"	1.63'	0.194
10"	36"***	1.66'		4'-8"	15"	1.65'	0.217
10"	42"	1.92'		5'-4"	17"	2.04'	0.287
10"	48"	1.92'		6'-0"	19"	2.04'	0.322
10"	54"	1.86'		6'-8"	20½"	2.06'	0.358
12"	24"	1.84'	2'-2¾"	3'-6"	10½"	1.74'	0.185
12"	27"	1.84'		3'-9"	11½"	1.76'	0.195
12"	30"*	1.86'		4'-1"	13½"	1.79'	0.208
12"	36"***	1.83'		4'-8"	15"	1.81'	0.230
12"	42"	2.10'		5'-4"	17"	2.21'	0.302
12"	48"	2.06'		6'-0"	19"	2.21'	0.338
12"	54"	2.04'		6'-8"	20½"	2.23'	0.375
12"	60"	2.00'		7'-2"	22"	2.23'	0.402
12"	66"	1.88'		7'-9"	25"	2.23'	0.457

NOTES:  
 1. SANITARY PIPE ENCASEMENT MUST CURE FOR 48 HOURS PRIOR TO SECOND POUR  
 2. HIGH EARLY STRENGTH (HES) CONCRETE MAY BE USED IF PROVEN TO NOT EXCEED 2000 PSI

\*FOR 30" STORMWATER PIPE THE MAXIMUM BELL DIAMETER IS 39" TO AVOID IMPACT TO THE SANITARY PIPE  
 \*\*FOR 36" STORMWATER PIPE THE MAXIMUM BELL DIAMETER IS 46" TO AVOID IMPACT TO THE SANITARY PIPE

	<h2>VIT. CLAY PIPE SEWER WITH RCP SW. CONDUIT</h2>			
	DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
	CHECKED BY:	WD	DETAIL ID:	PIPE-03

## Detail – Typical Street Section

### PIPE-04

#### Associated Details

- [CONN-03](#) – Saddle Connection

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades
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- [D-11](#): Measurement for Payment
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipes, [D-15.4](#): Connections

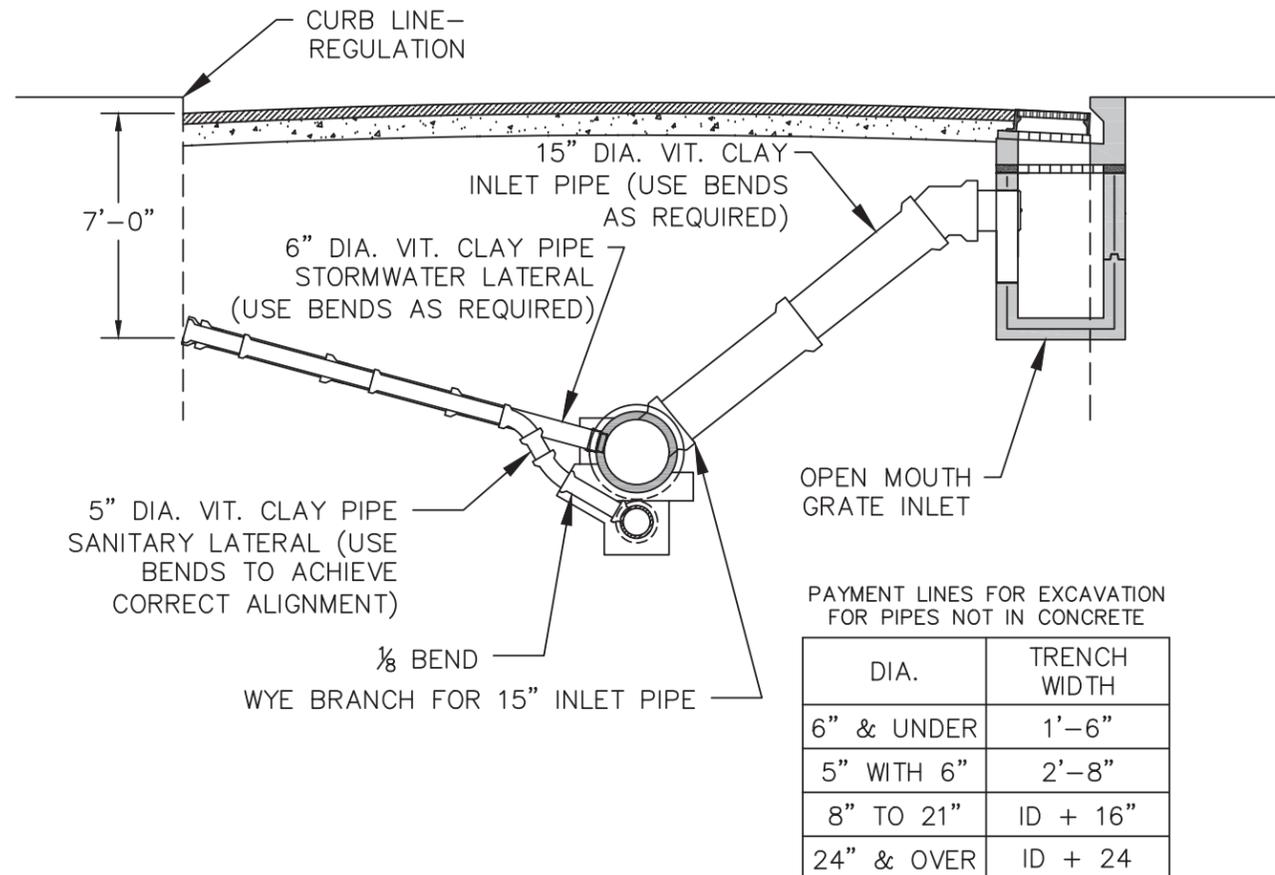
#### Approved Suppliers

- QC-9: Vitrified Clay Pipe & Fittings

#### Miscellaneous Comments

#### Revision

Rev. 1 – Jan. 2019 – Use bends to achieve correct alignment.



#### NOTE:

- LATERAL MINIMUM SLOPE TO BE NO LESS THAN 2%.
- LATERAL MAXIMUM SLOPE NOT TO EXCEED 1:1. IF THE PIPE GRADE EXCEEDS 1:1, A RISER MUST BE USED, SEE TYPICAL LATERAL RISERS, PIPE-05

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	TYPICAL STREET SECTION		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: PIPE-04	REV.: 1	

## Detail – Typical Lateral Risers

PIPE-05

### Associated Details

- [CONN-03](#) – Saddle Connection

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades
- [D-6](#): Width of Trenches
- [D-7](#): Installation of Pipes
- [D-8](#): Protection of Pipes
- [D-9](#): Length of Pipes
- [D-10](#): Provisions for Lateral Connections
- [D-11](#): Measurement for Payment
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipes, [D-15.4](#): Connections

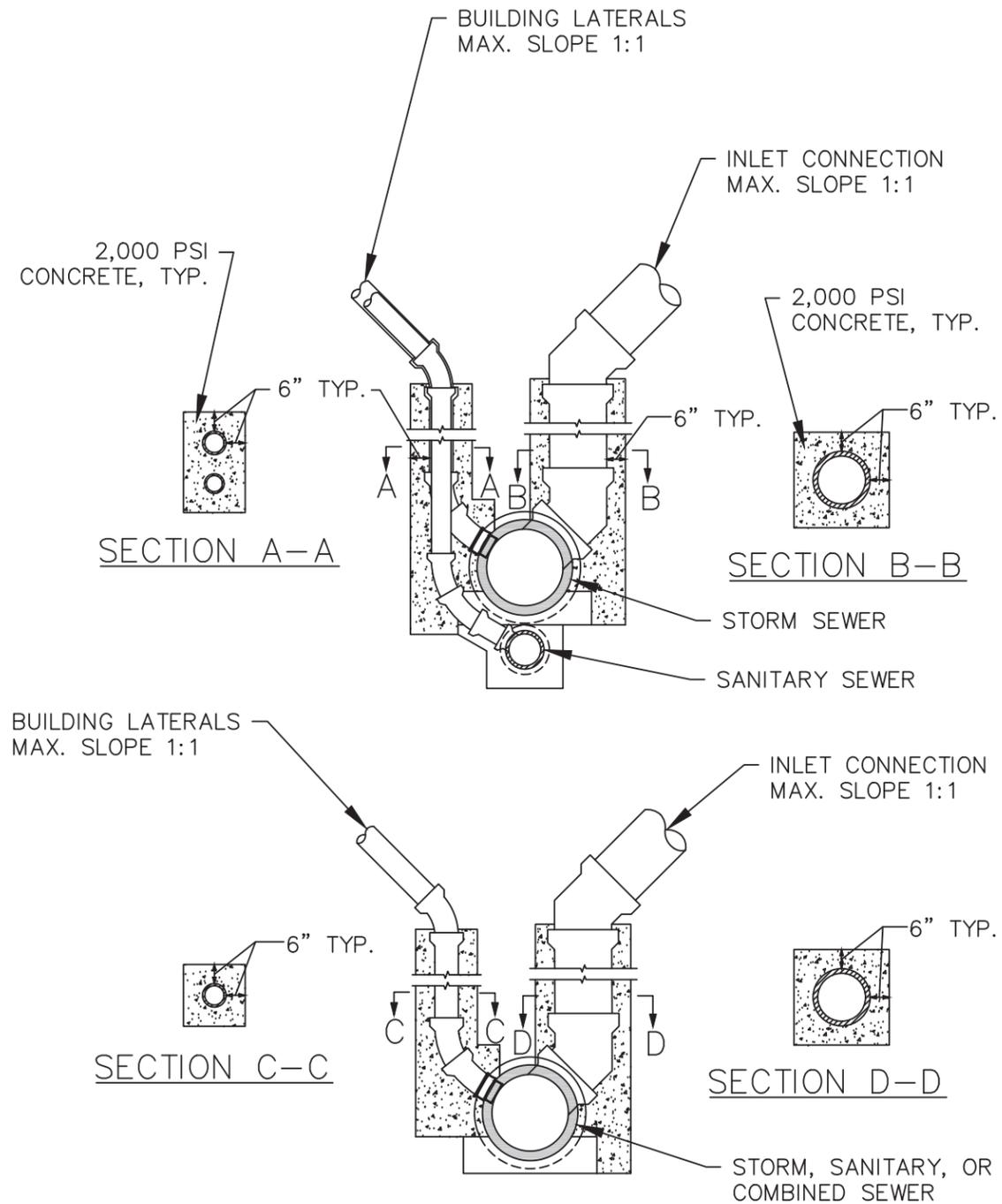
### Approved Suppliers

- QC-9: Vitrified Clay Pipe & Fittings

### Miscellaneous Comments

### Revision

Rev. 1 – Jan. 2019 – Added combined system lateral risers.



**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## TYPICAL LATERAL RISERS

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	PIPE-05
		REV.:	1

# Detail – Vit. Clay Pipe Sewer w/ R.C.P. Stormwater Conduit Turnout

## PIPE-06

### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [PIPE-03](#) – Vit. Clay Pipe Sewer w/ R.C. Pipe SW. Conduit
- [MH-02](#) – Concrete Manhole Base – 30" Dia. & Under
- [MH-04](#) – Precast Concrete Manhole Bases – 30" Dia. & Under
- [MH-05](#) – Concrete Manhole Base – 36" Dia. & Over
- [MH-06](#) – Concrete Manhole Base – Separate System – SW. Pipe 30" Dia. & Under
- [MH-07](#) – Concrete Manhole Base – Separate System – SW. Pipe 36" Dia. & Over
- [MH-08](#) – Concrete Manhole Base – Junction Manhole

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-5](#): Lines and Grades
- [D-6](#): Width of Trenches
- [D-7](#): Installation of Pipes
- [D-8](#): Protection of Pipes
- [D-9](#): Length of Pipes
- [D-10](#): Provisions for Lateral Connections
- See associated specifications of associated details

### Approved Suppliers

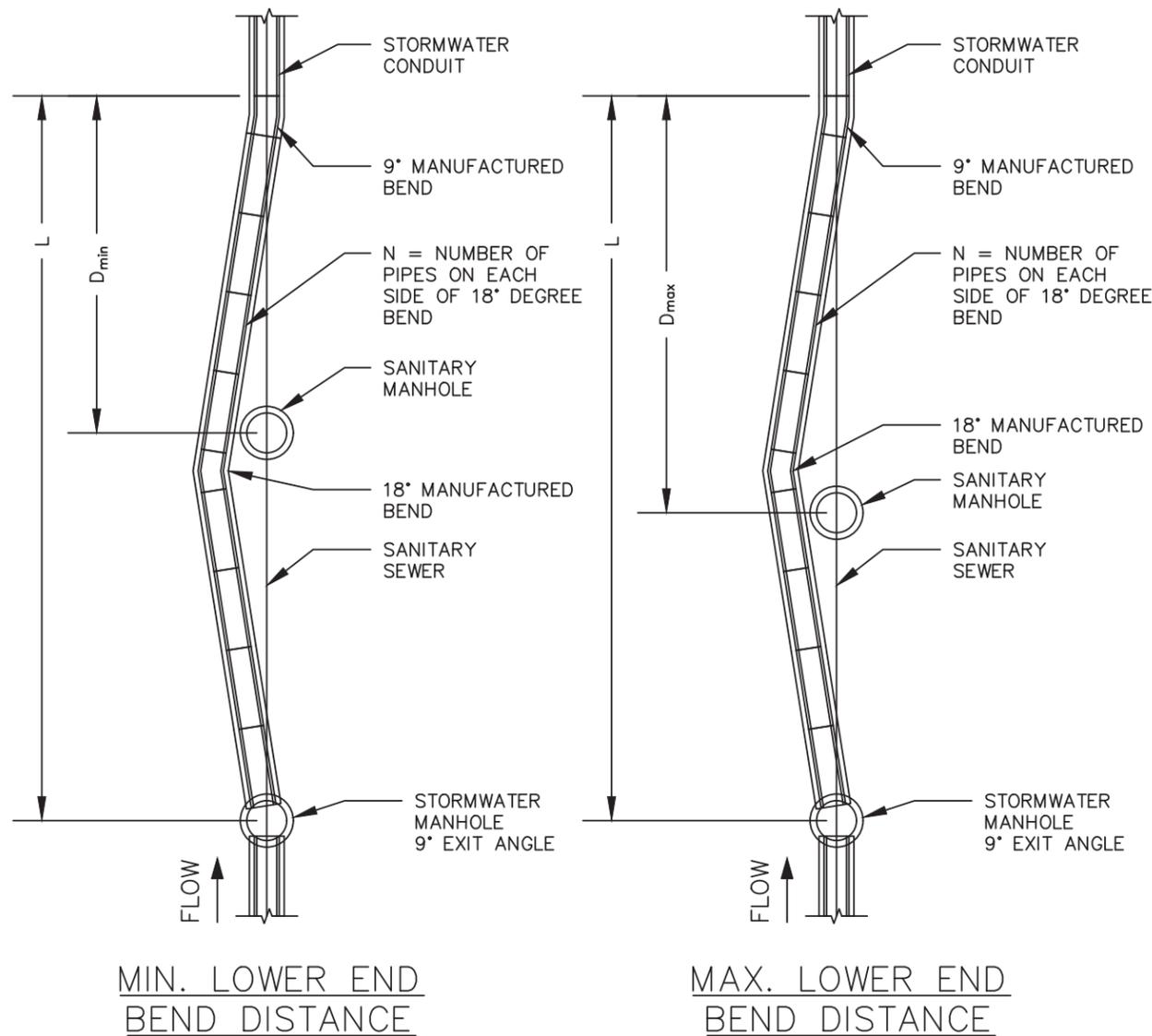
- QC-6: Reinforced Concrete Pipes & Fittings
- QC-9: Vitrified Clay Pipes & Fittings

### Miscellaneous Comments

- The turnout has been updated to include an additional manufactured bend in order to facilitate installation.

### Revision

Rev. 1 – Jan. 2019 – Geometry of Turnout changed and additional bend added.

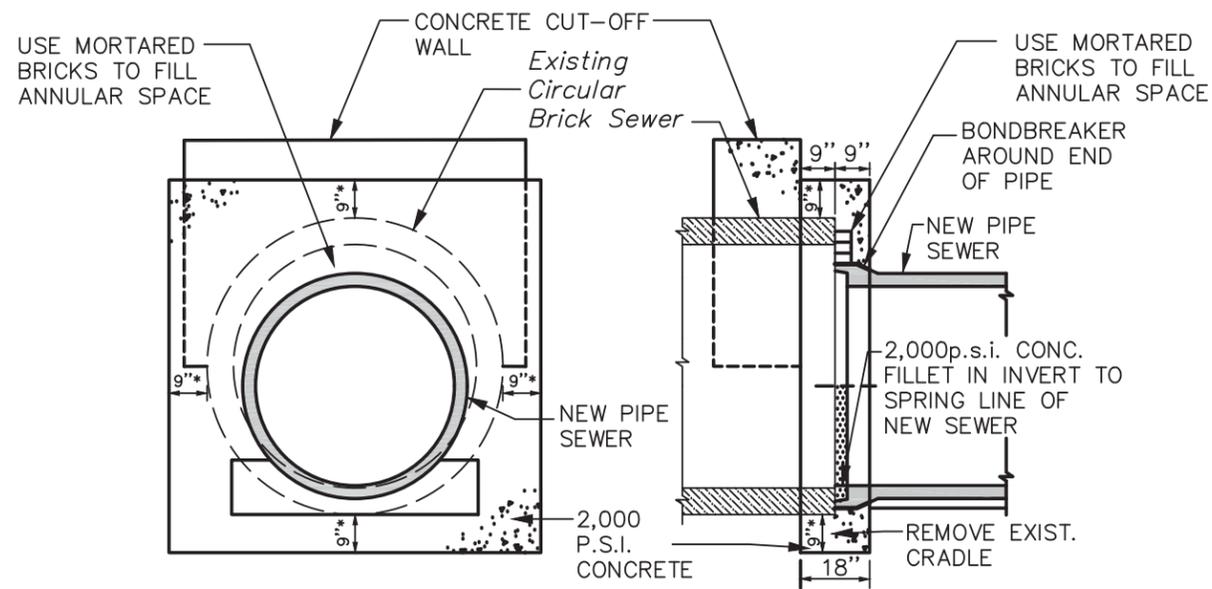


Dia.	L	D <sub>min</sub>	D <sub>max</sub>	N
18"	72'-10"	33'-7"	41'-7"	4
21"	72'-9"	33'-7"	41'-7"	4
24"	72'-7"	33'-7"	41'-7"	4
27"	72'-5"	33'-7"	41'-7"	4
30"	72'-4"	33'-7"	41'-7"	4
36"	72'-2"	33'-7"	41'-7"	4
42"	87'-6"	41'-5"	49'-5"	5
48"	87'-1"	41'-5"	49'-5"	5
54"	88'-11"	41'-5"	49'-5"	5
60"	104'-5"	49'-4"	57'-4"	6
66"	104'-5"	49'-4"	57'-4"	6

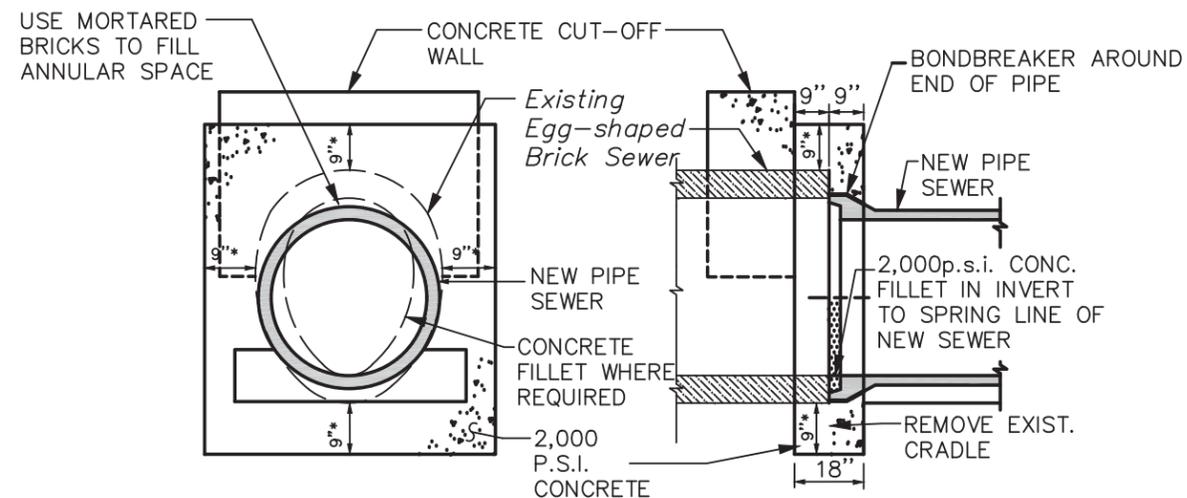
#### NOTE:

- SANITARY SEWER TO BE ENTIRELY ENCASED IN CONCRETE THROUGHOUT TURNOUT
- RC STORMWATER CONDUIT PIPES SHALL BE IN 8 FOOT LENGTHS

	<b>VIT. CLAY PIPE SEWER WITH R.C.P. STORMWATER CONDUIT TURNOUT</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
	CHECKED BY: WD	DETAIL ID: PIPE-06	REV.: 1



**PIPE AND CIRCULAR BRICK SEWERS**



**PIPE AND EGG-SHAPED BRICK SEWERS**

\*WHERE OUTSIDE SURFACE OF NEW SEWER EXTENDS BEYOND EXISTING SEWER, THE 9" DIMENSION SHALL BE FROM THE NEW SEWER

NOTE:  
TO BE USED FOR UPSTREAM BRICK TO CONCRETE SEWER CONNECTIONS AND ANY 2 CONCRETE PIPE CONNECTONS

## Detail – Concrete Collars

### PIPE-07

#### Associated Details

- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [CONN-01](#) – Concrete Cut-Off Wall

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See applicable specifications of associated details

#### Approved Suppliers

- QC-6: Reinforced Concrete Pipe & Fittings

#### Miscellaneous Comments

#### Revision

## Detail – Embankment Over Pipes

### PIPE-08

#### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [PIPE-03](#) – Vit. Clay Pipe Sewer with R.C. Pipe SW. Conduit

#### Applicable Specifications

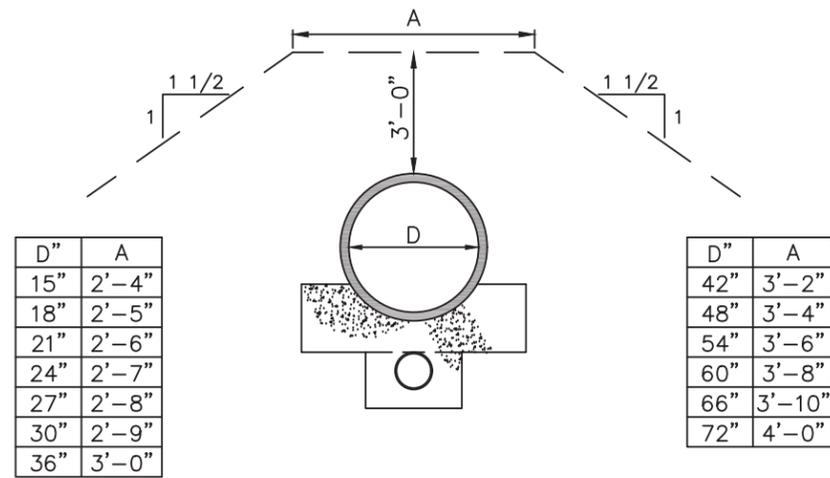
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See Applicable specifications of associated details

#### Approved Suppliers

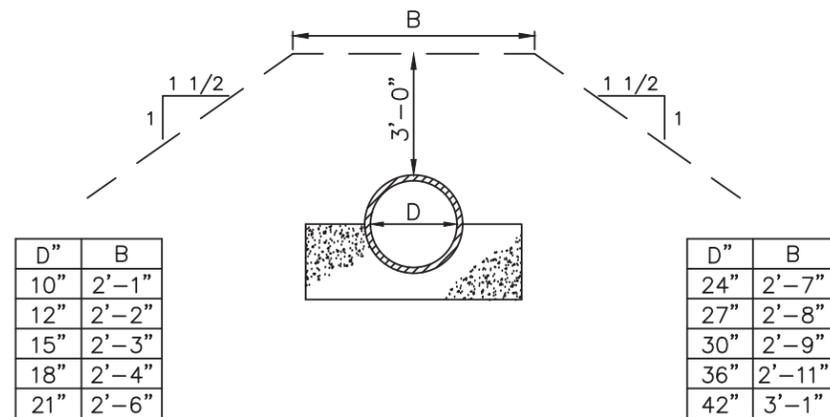
- See Vitrified Clay Pipe Sewer for Approved Suppliers of Vitrified Clay Pipe
- See R.C. Pipe Sewer or Stormwater Conduit Narrative for Approved Suppliers of R.C. Stormwater Conduit

#### Miscellaneous Comments

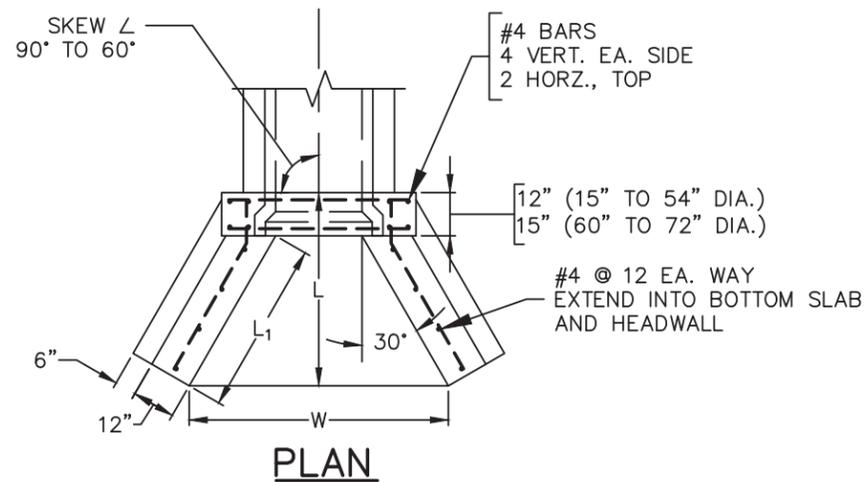
#### Revision



R.C. PIPE – SEPARATE OR COMBINED SYSTEM



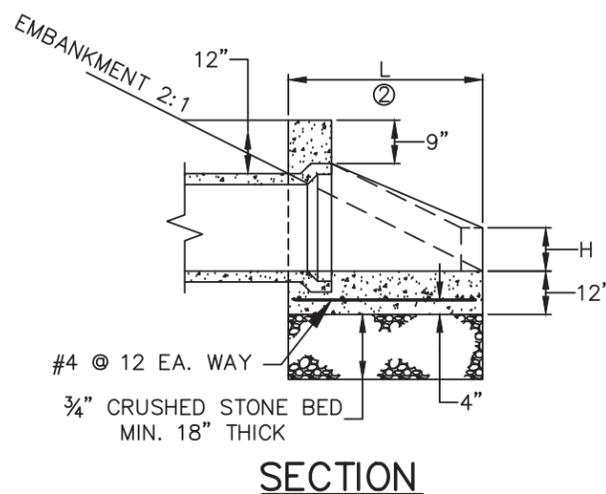
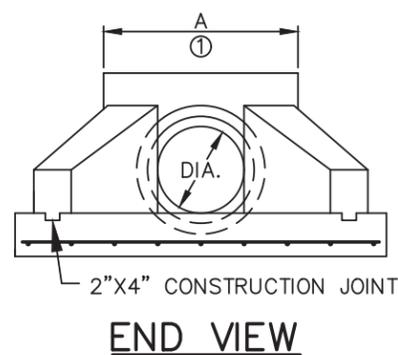
VIT. CLAY PIPE SEWER



① INSTALLATION OF STANDARD CHAIN LINK FENCE ON HEADWALL TO BE DETERMINED BY THE CHIEF OF DESIGN

② LENGTH OF PAVED OUTLET TO BE CHECKED OR DETERMINED BY VELOCITY OF FLOW

CONCRETE - 3,500 PSI AIR-ENTRAINED REINFORCING BARS SHALL CONFORM TO ASTM A615 GRADE 40



DIA.	A	L	L <sub>1</sub>	W	H
15"	3'-9"	3'-0"	2'-4"	3'-7"	12"
18"	4'-0"	3'-6"	2'-10"	4'-5"	12"
21"	4'-3"	4'-0"	3'-6"	5'-3"	12"
24"	4'-6"	4'-6"	4'-0"	6'-0"	12"
27"	4'-9"	4'-6"	4'-0"	6'-3"	14"
30"	5'-0"	4'-6"	4'-0"	6'-6"	15"
36"	5'-10"	4'-8"	4'-3"	7'-3"	18"
42"	6'-4"	5'-9"	5'-6"	9'-0"	21"
48"	6'-11"	6'-10"	6'-9"	10'-9"	2'-0"
54"	7'-6"	7'-11"	8'-0"	12'-6"	2'-3"
60"	8'-1"	9'-0"	8'-11"	14'-0"	2'-6"
72"	9'-3"	11'-2"	11'-5"	17'-5"	3'-0"

## Detail – Pipe Endwall

PIPE-09

### Associated Details

- [PIPE-11](#) – Chain Link Fence

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See Applicable specifications of associated details

### Approved Suppliers

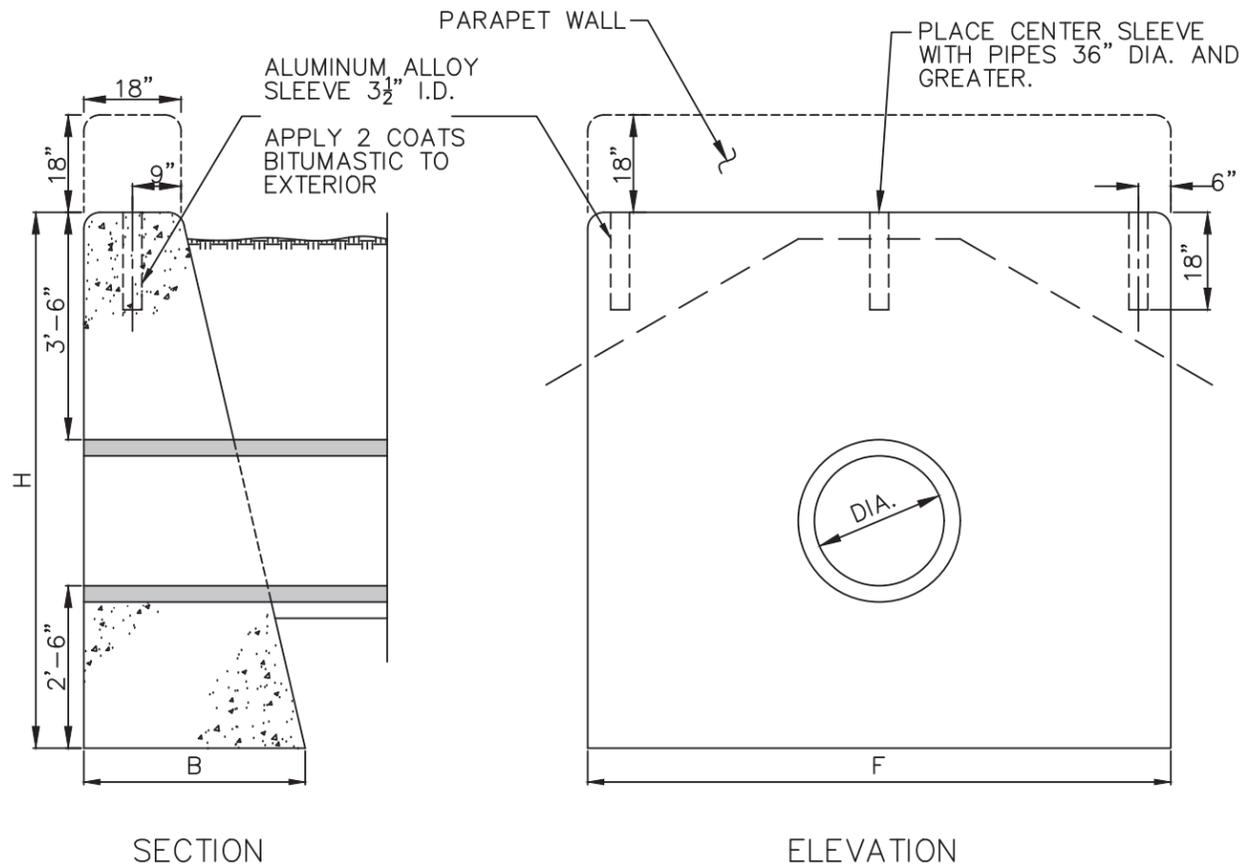
### Miscellaneous Comments

### Revision

**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## PIPE ENDWALL

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	PIPE-09
		REV.:	0



NOTE:  
 WALLS TO BE 3500 P.S.I. AIR-ENTRAINED CONCRETE OR RUBBLE MASONRY POINTED.  
 ALL EXPOSED CONCRETE EDGES TO BE CHAMFERED ONE INCH  
 PARAPET WALL TO BE USED ONLY WHERE REQUIRED AND ORDERED

HEADWALL DIMENSIONS				
DIA.	H	B	F	C.Y.
18"	7'-8½"	3'-3"	8'-0"	5.23
21"	7'-11¾"	3'-4"	8'-6"	5.71
24"	8'-3"	3'-5"	9'-0"	6.29
27"	8'-6¼"	3'-8"	9'-6"	7.12
30"	8'-9½"	3'-9"	10'-0"	7.78
36"	9'-4"	4'-0"	11'-0"	9.31
42"	9'-10½"	4'-3"	12'-0"	11.37
48"	10'-5"	4'-5"	13'-0"	12.69
54"	10'-11½"	4'-9"	14'-0"	14.91
60"	11'-6"	5'-0"	15'-0"	16.13
66"	12'-0½"	5'-3"	16'-0"	19.53
72"	12'-7"	5'-6"	17'-0"	22.12

## Detail – Pipe Headwall

### PIPE-10

#### Associated Details

- [PIPE-11](#) – Chain Link Fence

#### Applicable Specifications

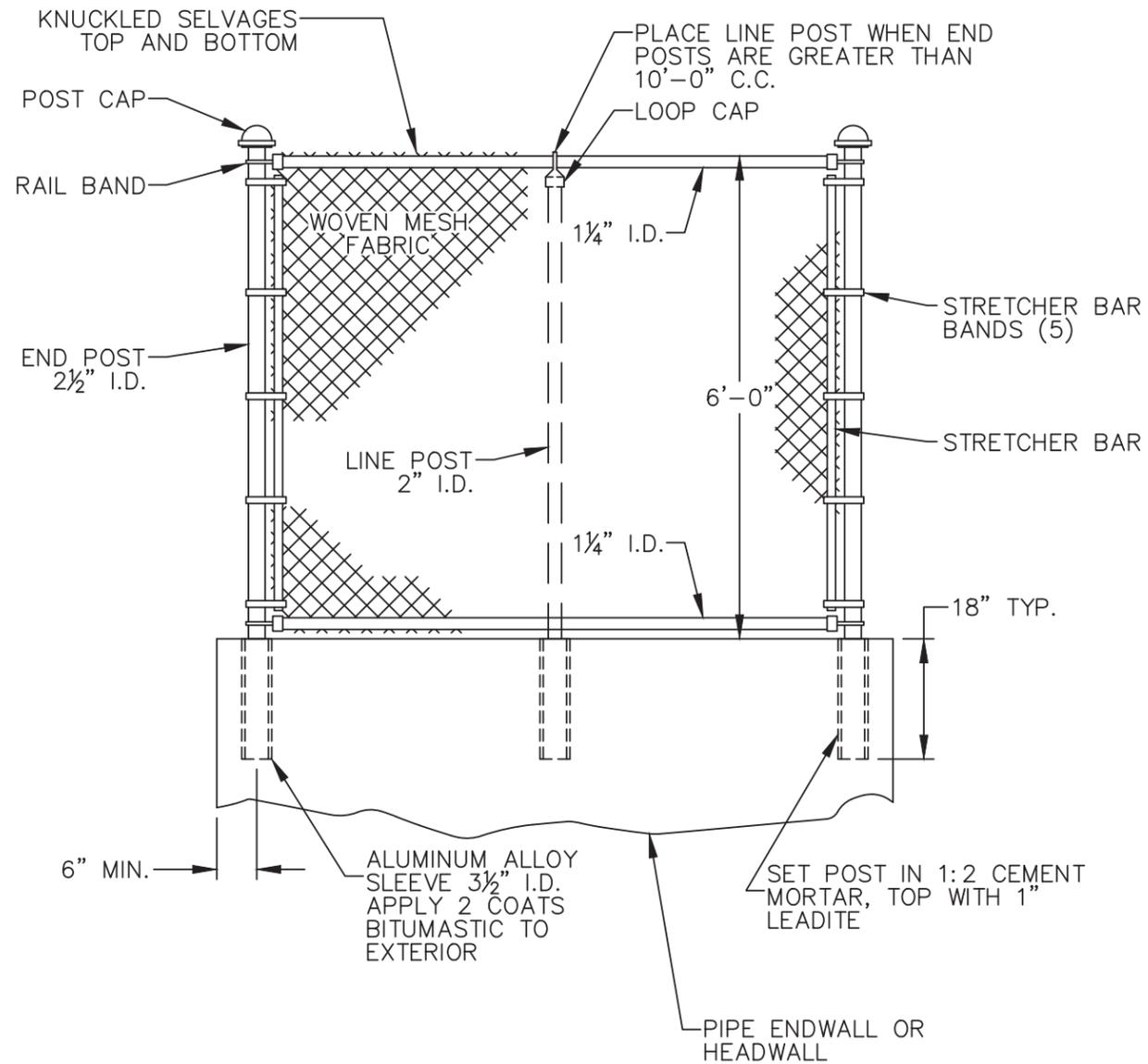
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See Applicable specifications of associated details

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision

	<b>PIPE HEADWALL</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: PIPE-10	REV.: 0	



## Detail – Chain Link Fence

### PIPE-11

#### Associated Details

- [PIPE-09](#) – Pipe Endwall
- [PIPE-10](#) – Pipe Headwall

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-24.0](#): Chain Link Fence, [D-24.1](#): Fabric, [D-24.2](#): Post and Rails, [D-24.2.1](#): Posts, [D-24.2.2](#): Rails, [D-24.2.3](#): Rail Ends and Post Cap Fittings, [D-24.2.4](#): Truss Rods and Fabricated Turnbuckles, [D-24.2.5](#): Nuts and Bolts, [D-24.2.6](#): Fasteners, [D-24.3](#): Sleeves

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision

<b>PHILADELPHIA WATER DEPARTMENT</b>	<h2>CHAIN LINK FENCE</h2>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: PIPE-11	REV.: 0	

## Detail – Concrete Cut-Off Wall

CONN-01

### Associated Details

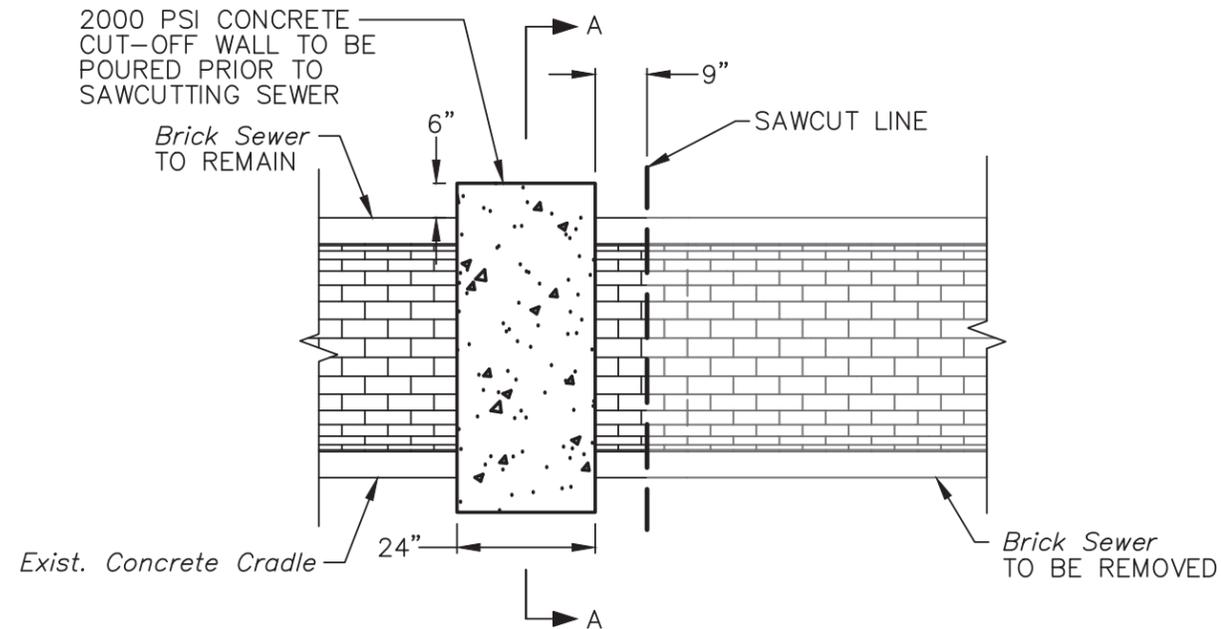
### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections

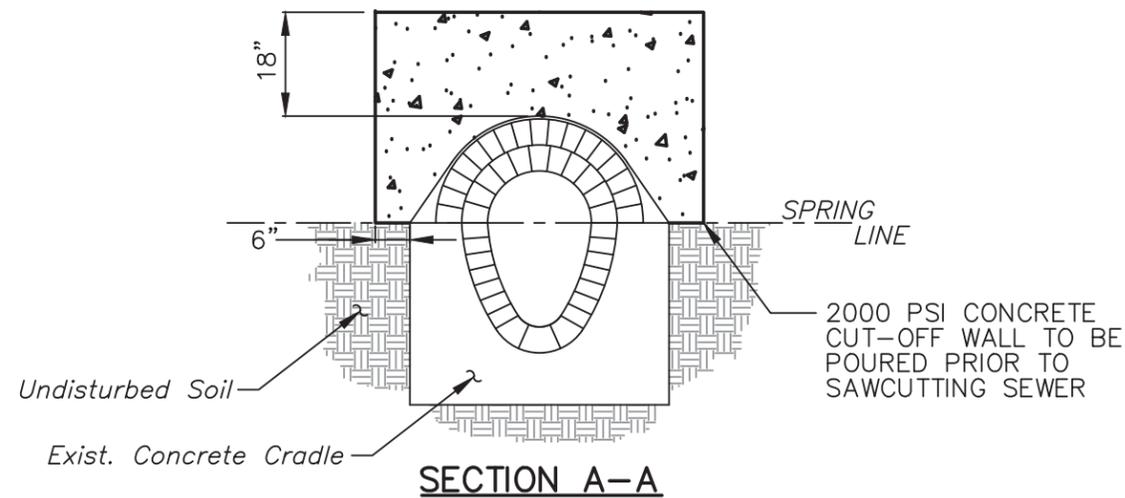
### Approved Suppliers

### Miscellaneous Comments

### Revision



**PLAN VIEW**



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CONN-02

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CONN-02

## Detail – Saddle Connection

CONN-03

### Associated Details

### Applicable Specifications

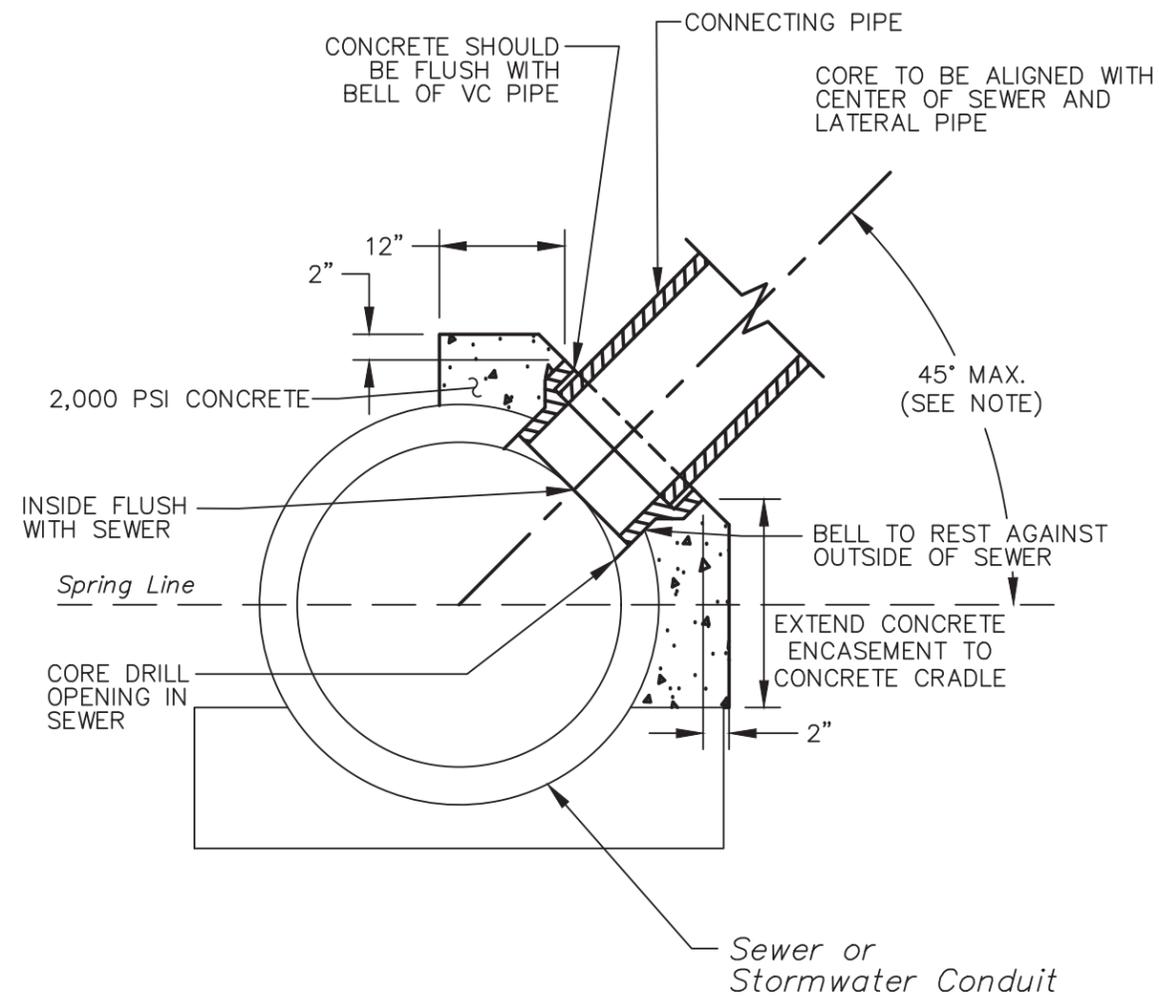
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections

### Approved Suppliers

### Miscellaneous Comments

### Revision

Rev 1 – Jan. 2019 – Concrete encasement of Vitrified Clay lateral to be flush with bell of pipe as recommended by Logan Clay Products.



NOTE:  
CONNECTIONS REQUIRING ANGLES GREATER THAN  
45° SHALL USE LATERAL RISERS – PIPE-05

<b>PHILADELPHIA WATER DEPARTMENT</b>	<b>SADDLE CONNECTION</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: CONN-03	REV.: 1	



# Detail – Modified Saddle Connection to Egg-Shaped Brick Sewer

CONN-05

## Associated Details

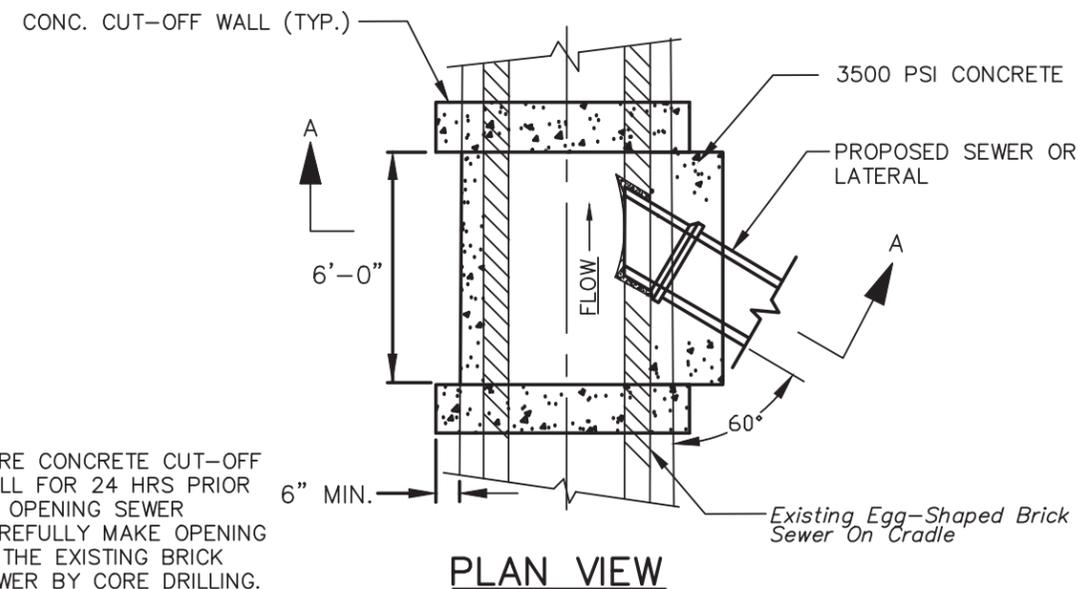
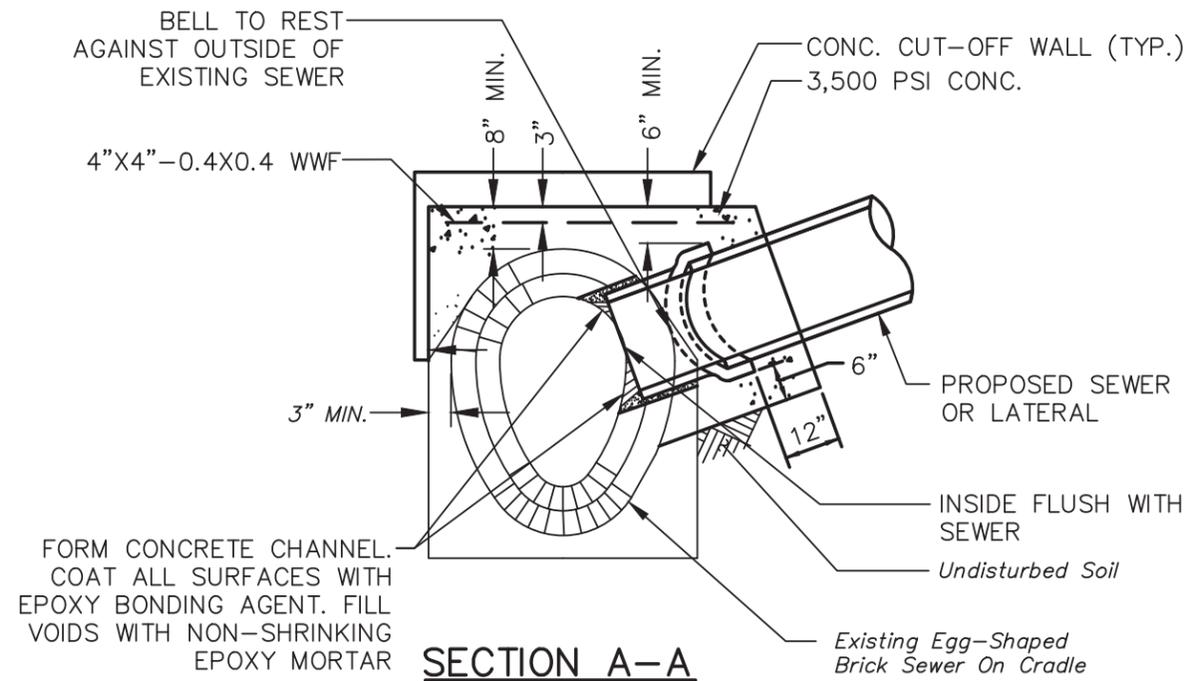
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections

## Approved Suppliers

## Miscellaneous Comments

## Revision



**NOTES:**

1. CURE CONCRETE CUT-OFF WALL FOR 24 HRS PRIOR TO OPENING SEWER
2. CAREFULLY MAKE OPENING IN THE EXISTING BRICK SEWER BY CORE DRILLING.
3. COAT EXISTING SURFACES WITH EPOXY BONDING AGENT.

<b>PHILADELPHIA WATER DEPARTMENT</b>	<b>MODIFIED SADDLE CONNECTION TO EGG-SHAPED BRICK SEWER</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: CONN-05	REV.: NEW	

# Detail – Doghouse Manhole Connection Detail to Circular Brick Sewer

CONN-06

## Associated Details

- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser & Cone
- [MH-14](#) – Manhole Steps

## Applicable Specifications

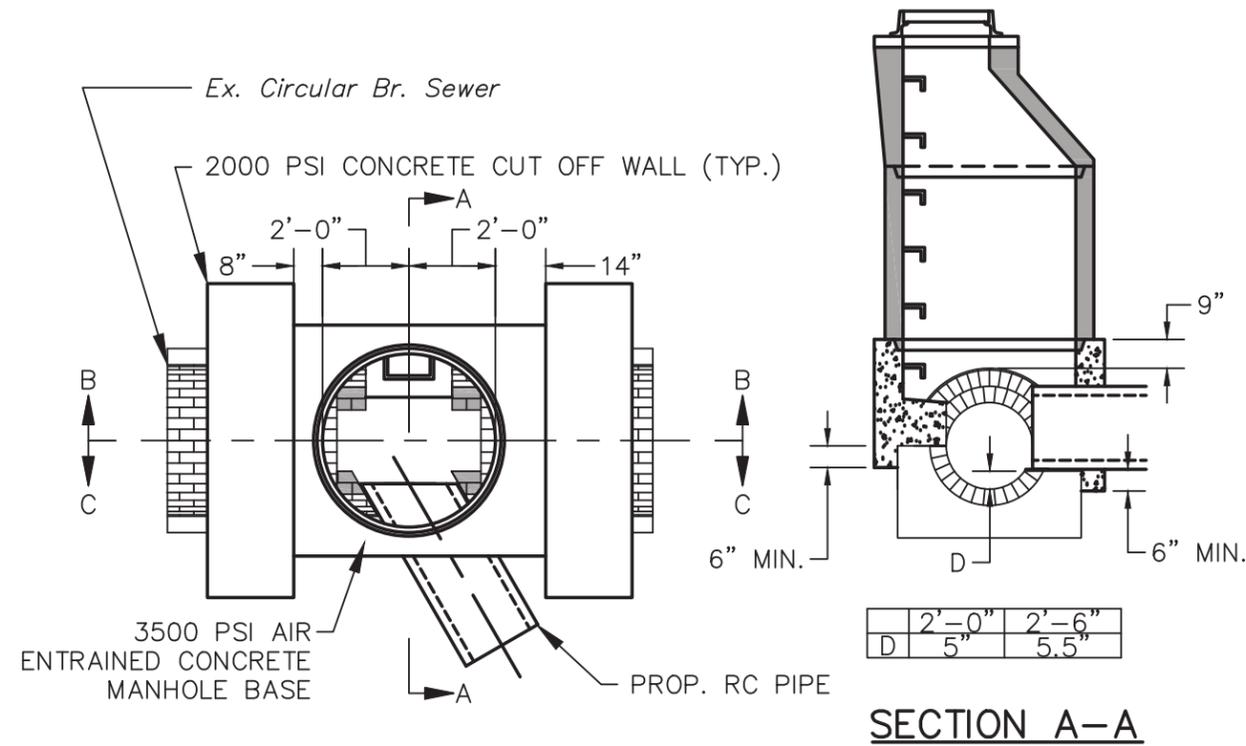
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- [D-21.2](#): Ladder Bars and Steps, [D-21.2.1](#): Plastic
- See Applicable specifications of associated details

## Approved Suppliers

- QC-6: Reinforced Concrete Pipe & Fittings

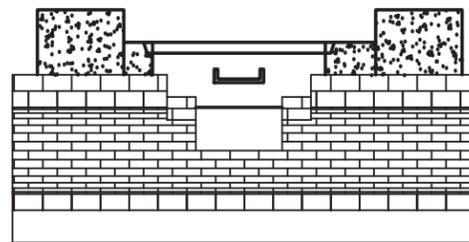
## Miscellaneous Comments

## Revision

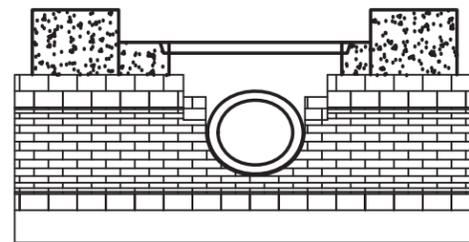


PLAN VIEW

SECTION A-A



SECTION B-B



SECTION C-C

### NOTES:

- SEE CONNECTIONS MANUAL FOR CONSTRUCTION GUIDANCE PROCEDURES WITH ADDITIONAL DIMENSIONS.
- THE "D" DIMENSION IS TO A POINT ON THE EXISTING SEWER THAT IS THE PROPOSED PIPE WALL THICKNESS PLUS 1/2" FOR MORTAR BELOW THE INVERT OF THE PROPOSED PIPE. THE EXISTING SEWER SHOULD NOT BE DISTURBED BELOW THIS POINT. THIS WILL ALLOW THE EXISTING SEWER TO CARRY DRY WEATHER FLOW UP TO 10% OF IT'S CAPACITY IN ADDITION TO A LITTLE SPACE FOR TOOLS. IF THE DRY WEATHER FLOW EVER EXCEEDS DWF, BYPASS PUMPING WILL BE REQUIRED.

**PHILADELPHIA**  
**WATER**  
— DEPARTMENT —

DOGHOUSE MANHOLE CONNECTION  
FOR EXISTING 2'-0" & 2'-6" BRICK SEWER AND PROPOSED  
RCP 24" OR SMALLER

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	CONN-06
		REV.:	NEW

# Detail – Doghouse Manhole Connection Detail to Egg-Shaped Brick Sewer

CONN-07

## Associated Details

- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser & Cone
- [MH-14](#) – Manhole Steps

## Applicable Specifications

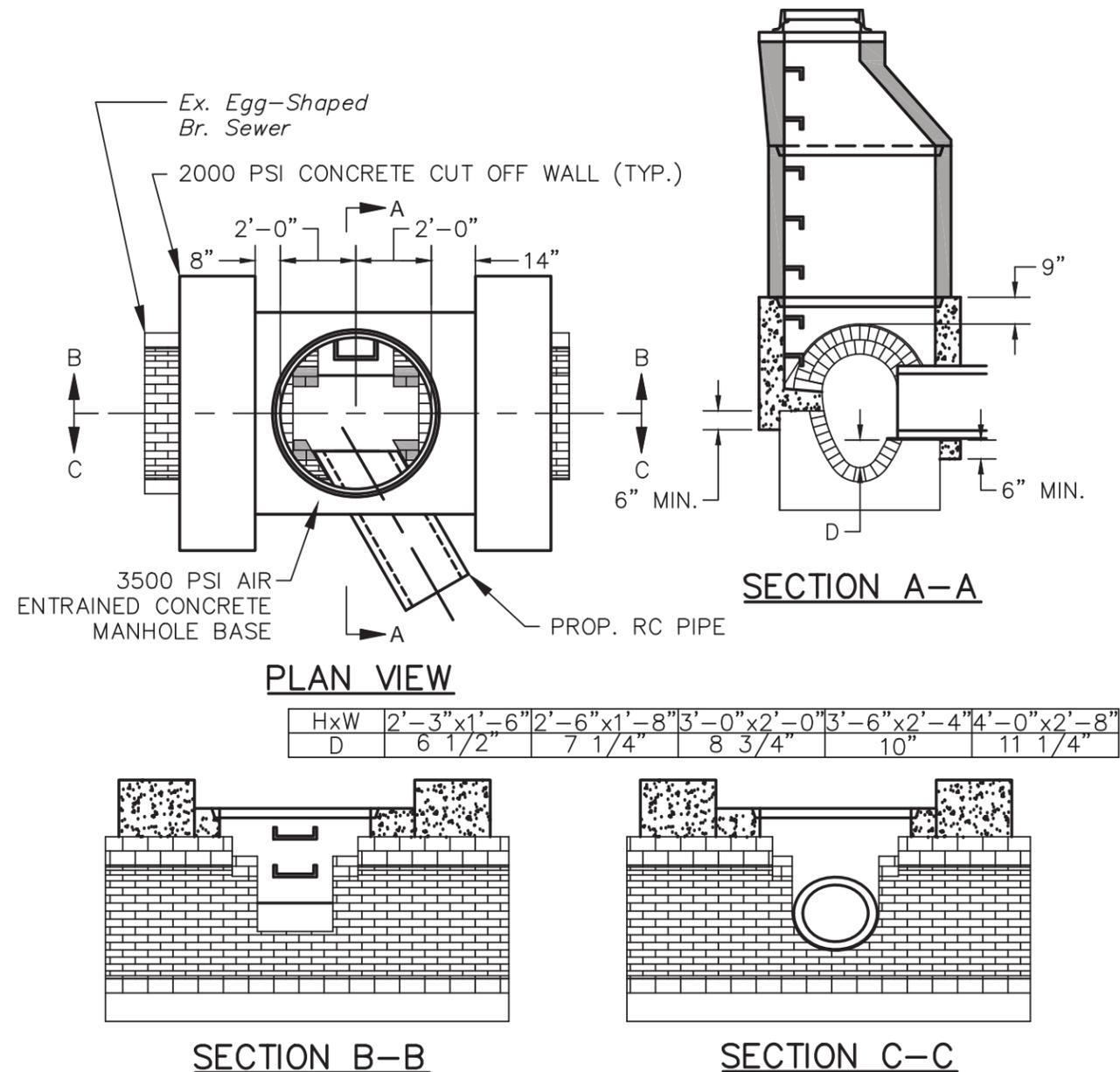
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- [D-21.2](#): Ladder Bars and Steps, [D-21.2.1](#): Plastic
- See Applicable specifications of associated details

## Approved Suppliers

- QC-6: Reinforced Concrete Pipe & Fittings

## Miscellaneous Comments

## Revision



### NOTES:

- SEE CONNECTIONS MANUAL FOR CONSTRUCTION GUIDANCE PROCEDURES WITH ADDITIONAL DIMENSIONS.
- THE "D" DIMENSION IS TO A POINT ON THE EXISTING SEWER THAT IS THE PROPOSED PIPE WALL THICKNESS PLUS 1/2" FOR MORTAR BELOW THE INVERT OF THE PROPOSED PIPE. THE EXISTING SEWER SHOULD NOT BE DISTURBED BELOW THIS POINT. THIS WILL ALLOW THE EXISTING SEWER TO CARRY DRY WEATHER FLOW UP TO 10% OF IT'S CAPACITY IN ADDITION TO A LITTLE SPACE FOR TOOLS. IF THE DRY WEATHER FLOW EVER EXCEEDS DWF, BYPASS PUMPING WILL BE REQUIRED.

	DOGHOUSE MANHOLE CONNECTION FOR EXISTING BRICK EGG SEWERS 4'-0"x2'-8" OR SMALLER AND PROPOSED RCP 27" OR SMALLER			
	DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
	CHECKED BY:	WD	DETAIL ID:	CONN-07
			REV.:	NEW

# Detail – Combined System Vent Connection

CONN-08

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser & Cone

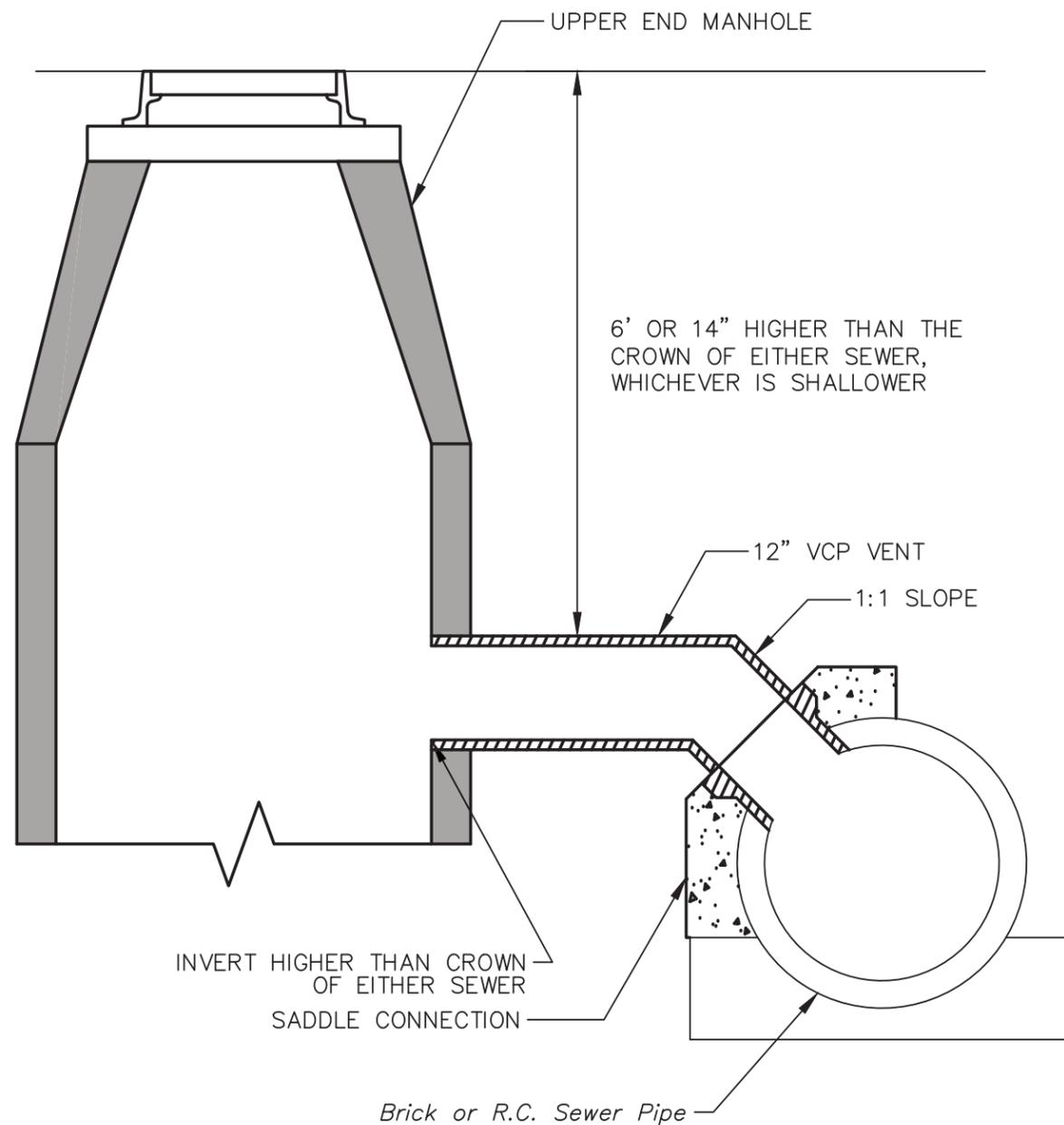
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.1](#): Catch Basins, [D-23.1.2](#): Concrete Catch Basins, [D-23.1.3](#): Precast Concrete Catch Basins, [D-23.8](#): Installation of Precast Inlets
- See Applicable specifications of associated details

## Approved Suppliers

- QC-9: Vitrified Clay Pipes & Fittings

## Miscellaneous Comments



NOTE:  
12" VCP VENT MAY BE RUN TO MANHOLE  
IN LIEU OF AN EXISTING SEWER.

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>COMBINED SYSTEM VENT CONNECTION</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: CONN-08	REV.: NEW	



## Detail – Concrete Manhole Base – 30" Dia. & Under

MH-02

### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser and Cone

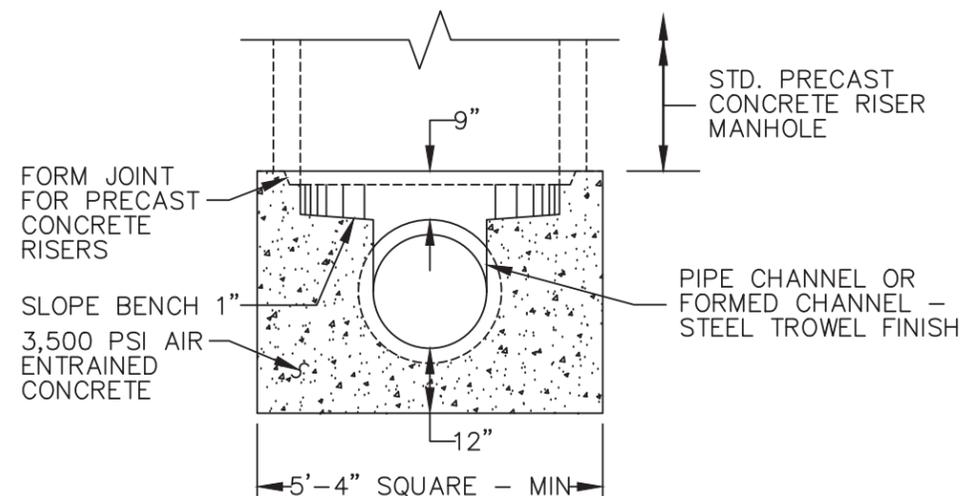
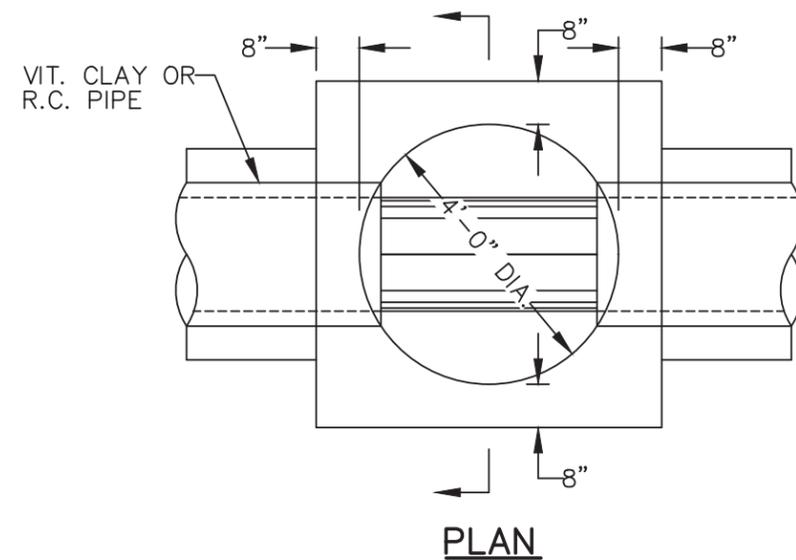
### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

### Approved Suppliers

### Miscellaneous Comments

### Revision



**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## CONCRETE MANHOLE BASE 30" DIA. AND UNDER

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-02
		REV.:	0

## Detail – Doghouse Manhole on 30" & Under Sewer

MH-03

### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser & Cone
- [MH-14](#) – Manhole Steps

### Applicable Specifications

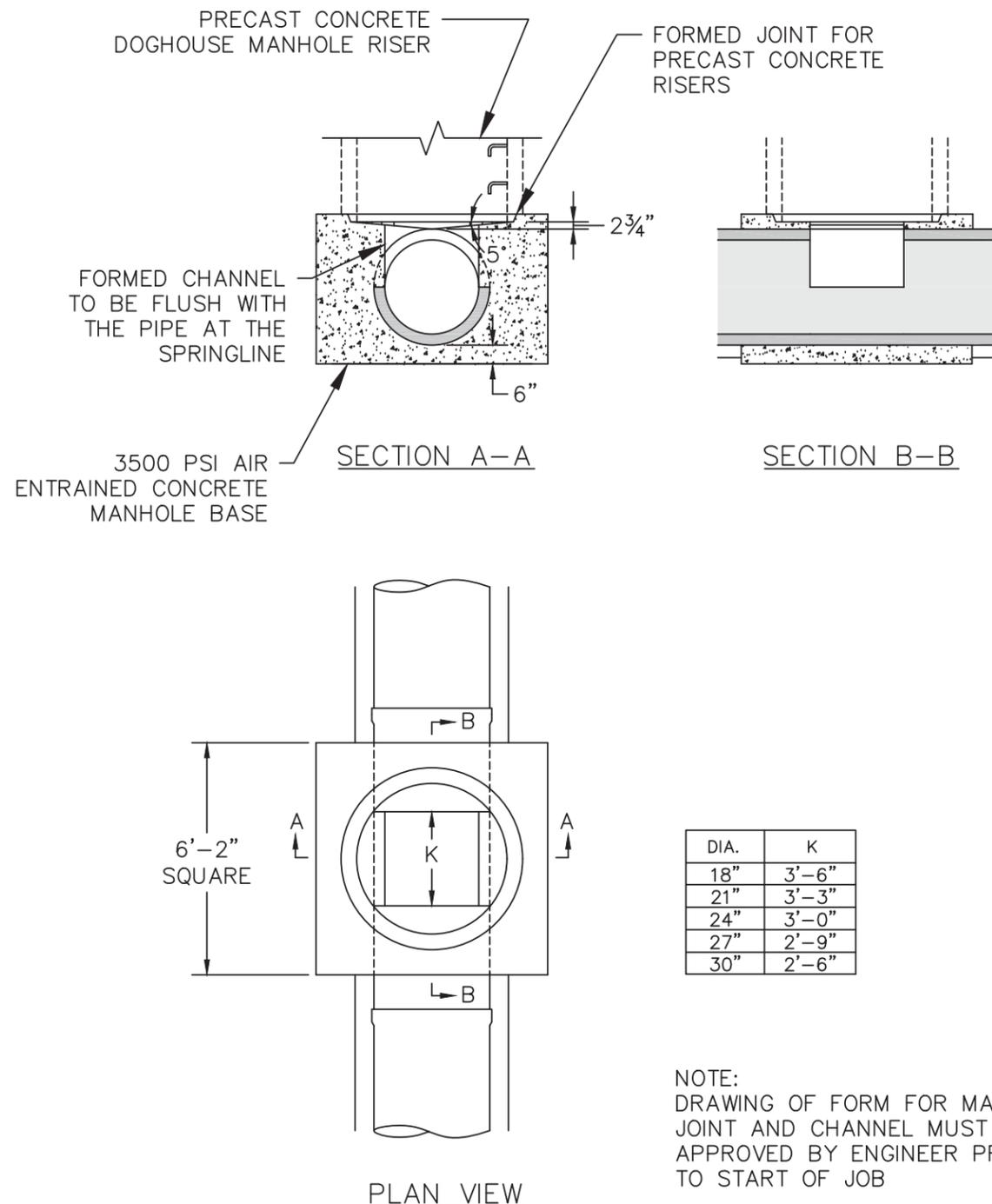
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- [D-21.2](#): Ladder Bars and Steps, [D-21.2.1](#): Plastic
- See Applicable specifications of associated details

### Approved Suppliers

- QC-6: Reinforced Concrete Pipe & Fittings

### Miscellaneous Comments

### Revision



#### NOTES:

- COAT CUT EDGES OF RC PIPE WITH EPOXY COATING WITHIN 8 HRS OF CUT
- NO PIPE BELL IS TO BE LOCATED IN THE MANHOLE AND THE MANHOLE IS TO BE CENTERED ON AN 8' SECTION OF PIPE

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>DOGHOUSE MANHOLE ON 30" &amp; UNDER SEWER</b>			
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019		
CHECKED BY: WD	DETAIL ID: MH-03	REV.: NEW		

## Detail – Precast Concrete Manhole Bases

MH-04

### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser & Cone

### Applicable Specifications

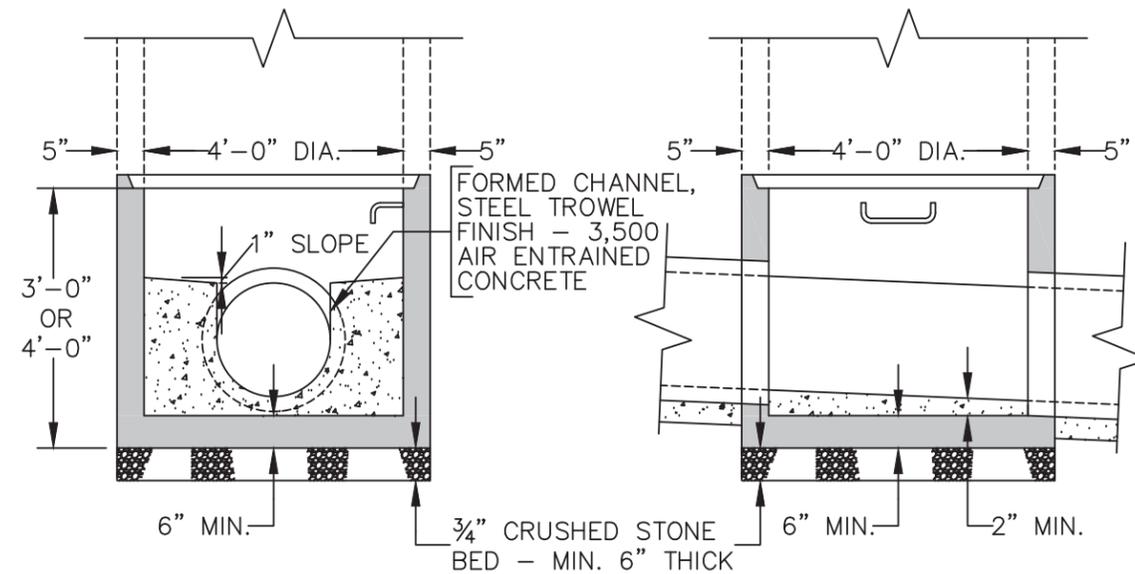
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes
- [D-21.2](#): Ladder Bars and Steps, [D-21.2.1](#): Plastic
- See applicable specifications of associated details

### Approved Suppliers

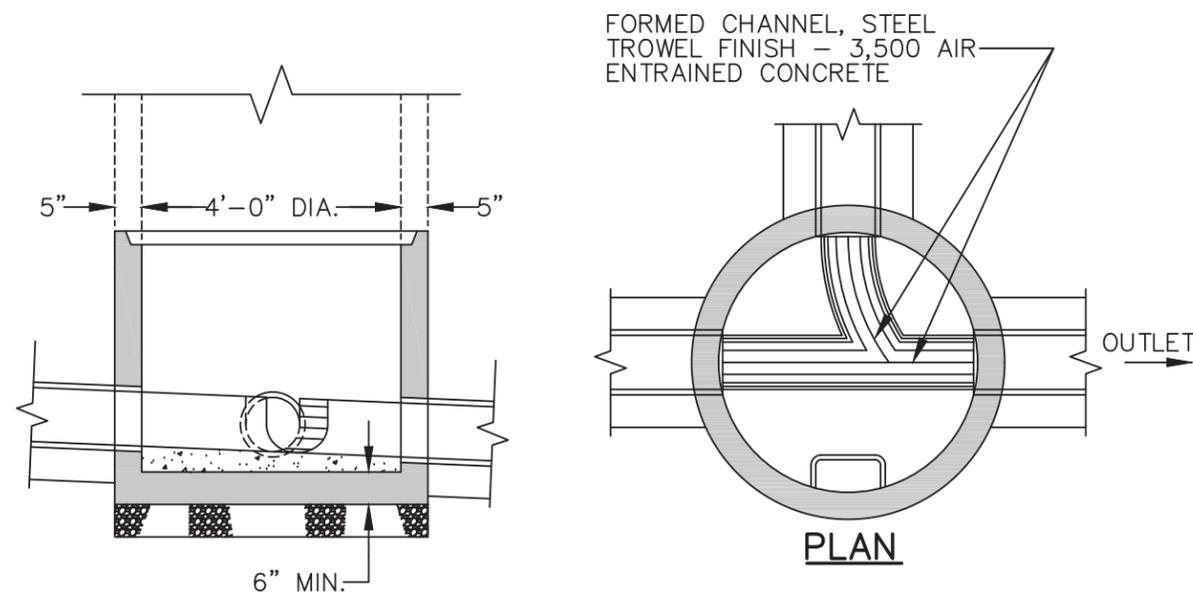
- QC-1: Precast Concrete

### Miscellaneous Comments

### Revision



**PIPE – 30" DIA. AND UNDER**



**JUNCTION MANHOLE**

**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## PRECAST CONCRETE MANHOLE BASES - 30" DIA. AND UNDER

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-04
		REV.:	0

## Detail – Concrete Manhole Base – 36” Dia. & Over

MH-05

### Associated Details

- [PIPE-01](#) – Vitrified Clay Pipe Sewer
- [PIPE-02](#) – R.C. Pipe Sewer or Stormwater Conduit
- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-14](#) – Manhole Steps

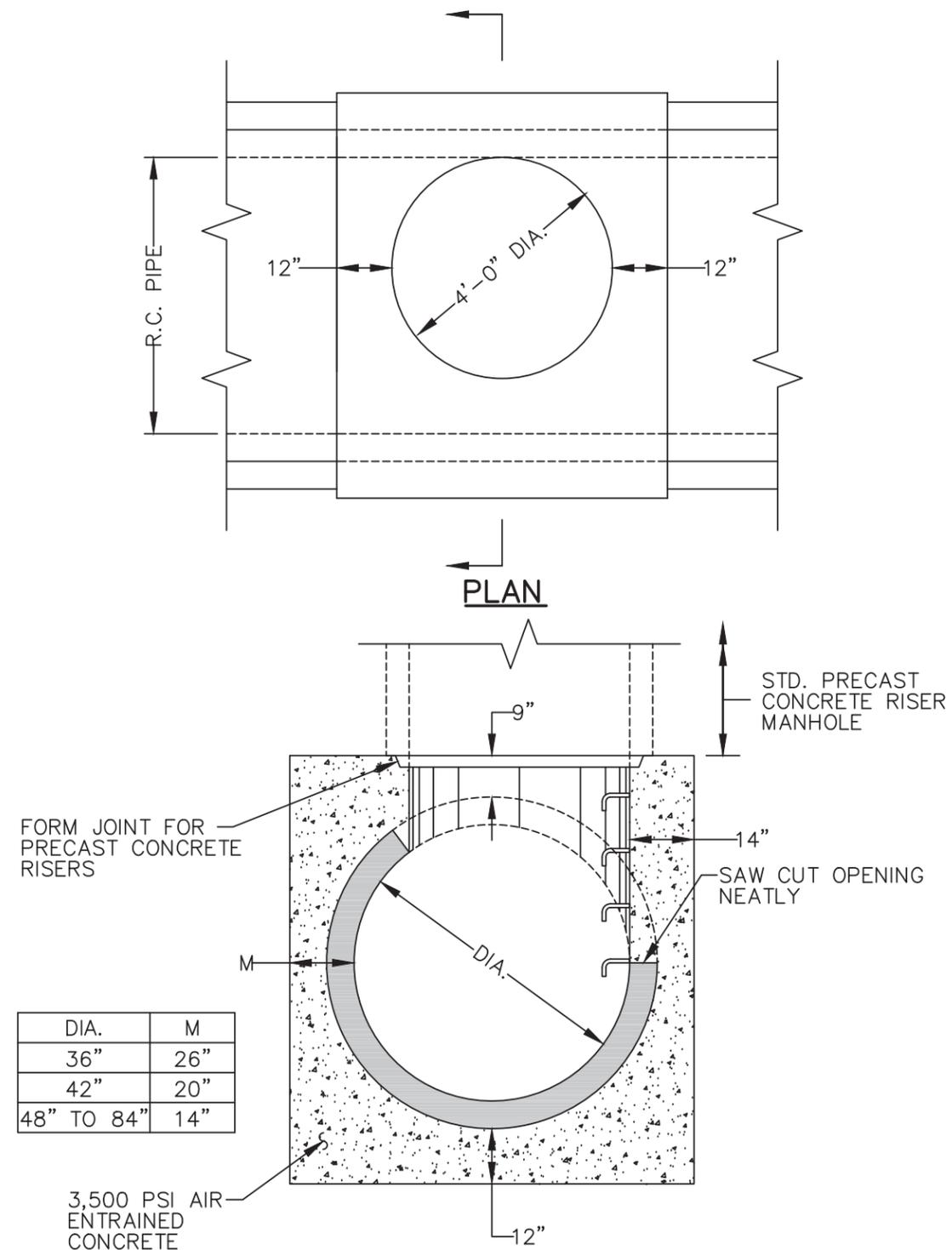
### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

### Approved Suppliers

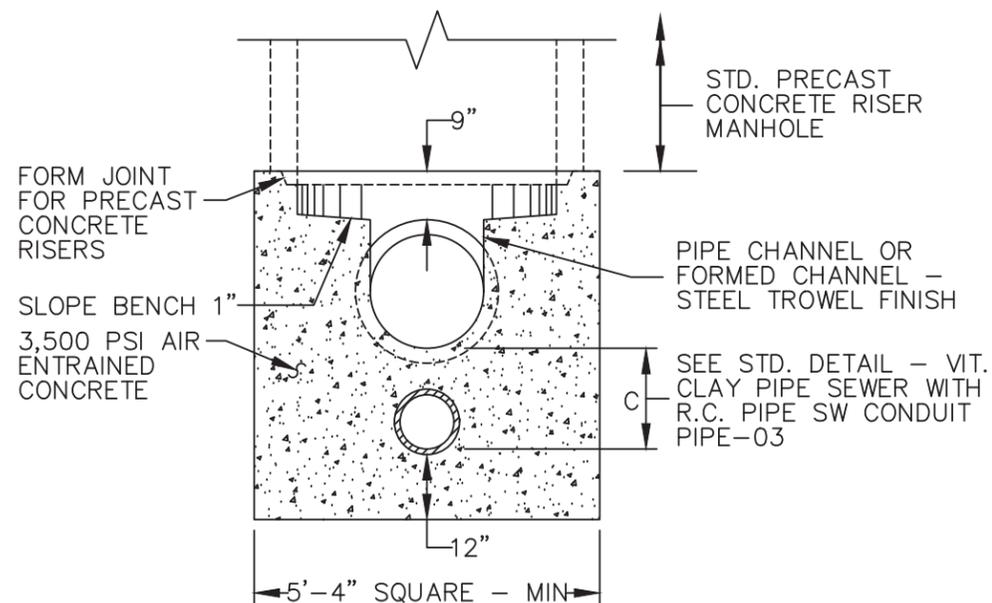
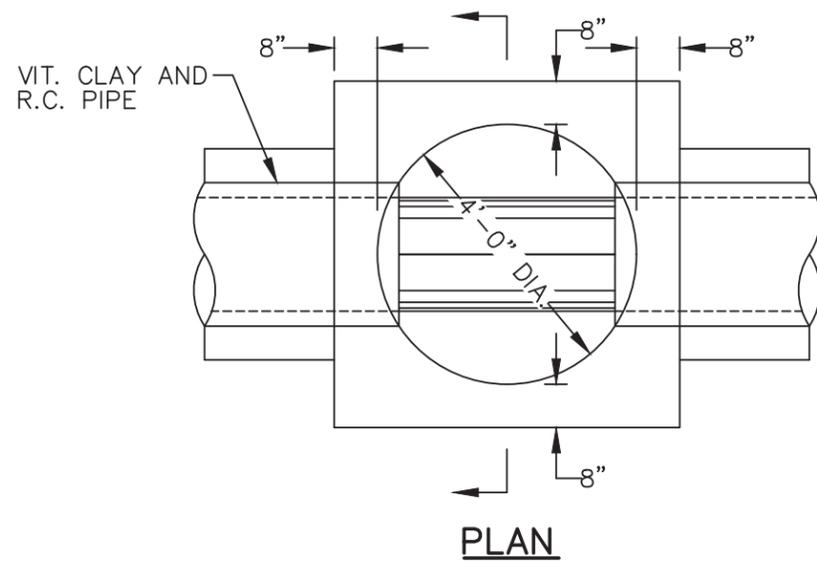
### Miscellaneous Comments

### Revision



<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>CONCRETE MANHOLE BASE</b> <b>36" DIA. AND OVER</b>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: MH-05	REV.: 0

# Detail – Concrete Manhole Base – Separate System – 30" Dia. And Under



MH-06

## Associated Details

- [PIPE-03](#) – Vit. Clay Pipe Sewer w/ R.C. Pipe SW. Conduit
- [MH-01](#) – Precast Concrete Manhole Riser and Cone

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

## Approved Suppliers

## Miscellaneous Comments

## Revision

**PHILADELPHIA**  
**WATER**  
DEPARTMENT

CONCRETE MANHOLE BASE - SEPARATE SYSTEM  
STORMWATER PIPE 30" DIA. AND UNDER

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-06
		REV.:	0

## Detail – Concrete Manhole Base – Separate System – 36” Dia. And Over

MH-07

### Associated Details

- [PIPE-03](#) – Vit. Clay Pipe Sewer w/ R.C. Pipe SW. Conduit
- [PIPE-06](#) – Vit. Clay Pipe Sewer w/ R.C.P. Stormwater Conduit Turnout
- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-14](#) – Manhole Steps

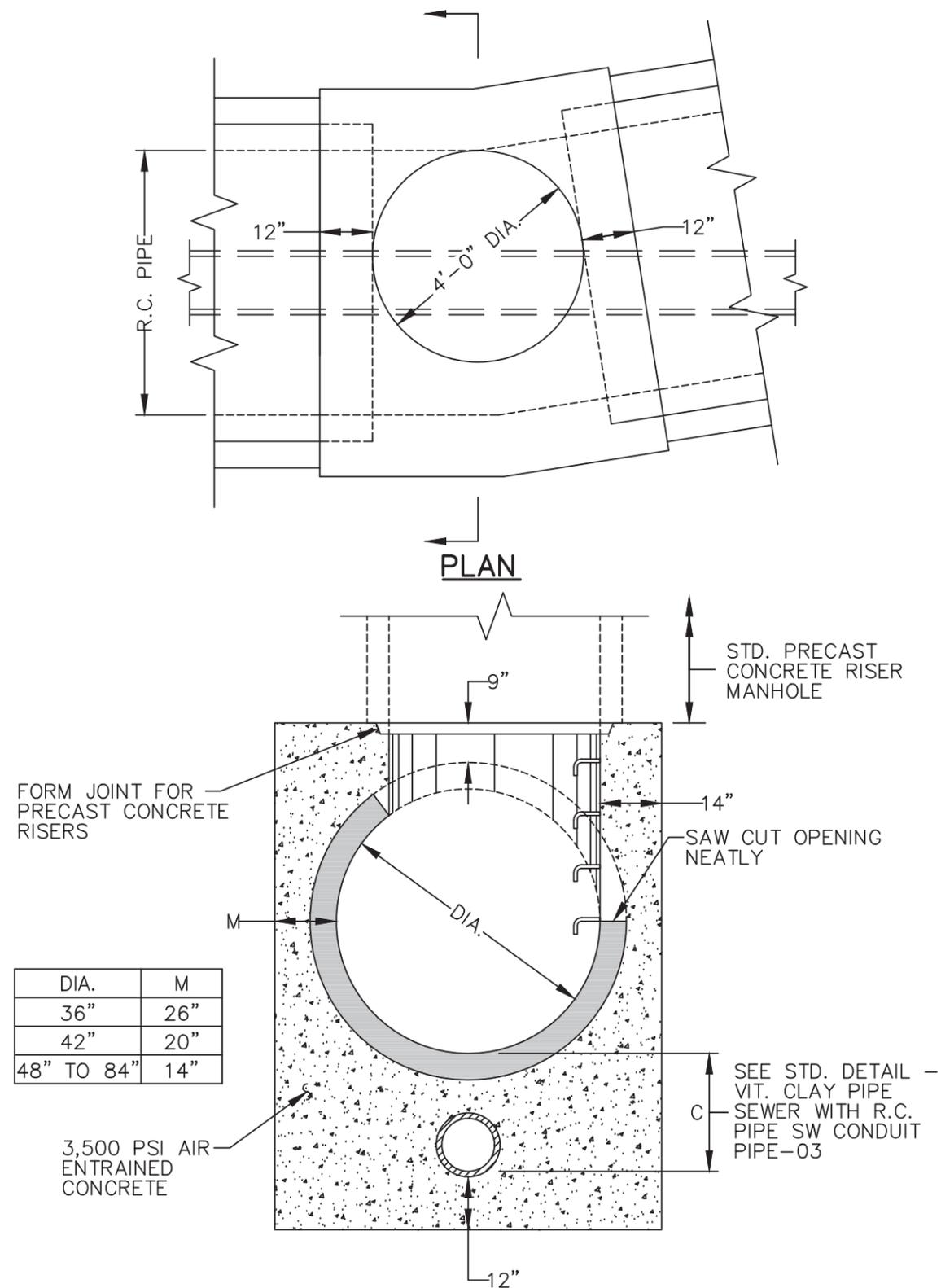
### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

### Approved Suppliers

### Miscellaneous Comments

### Revision



**PHILADELPHIA**  
**WATER**  
— DEPARTMENT —

CONCRETE MANHOLE BASE - SEPARATE SYSTEM  
STORMWATER PIPE 36" DIA. AND OVER

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-07
		REV.:	0

## Detail – Concrete Manhole Base – Junction Manhole

MH-08

### Associated Details

- [PIPE-01](#) – Vit. Clay Pipe Sewer
- [MH-01](#) – Precast Concrete Manhole Riser and Cone

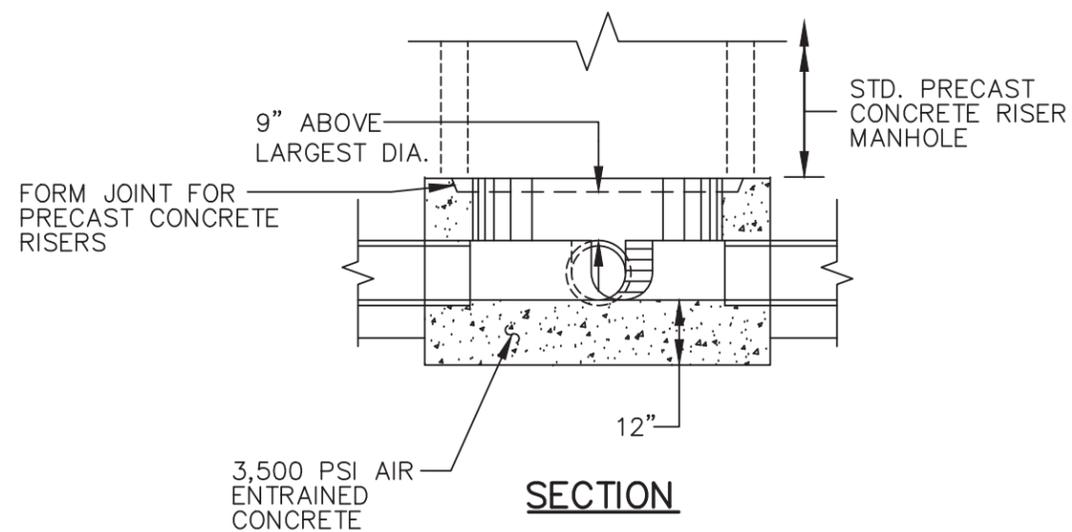
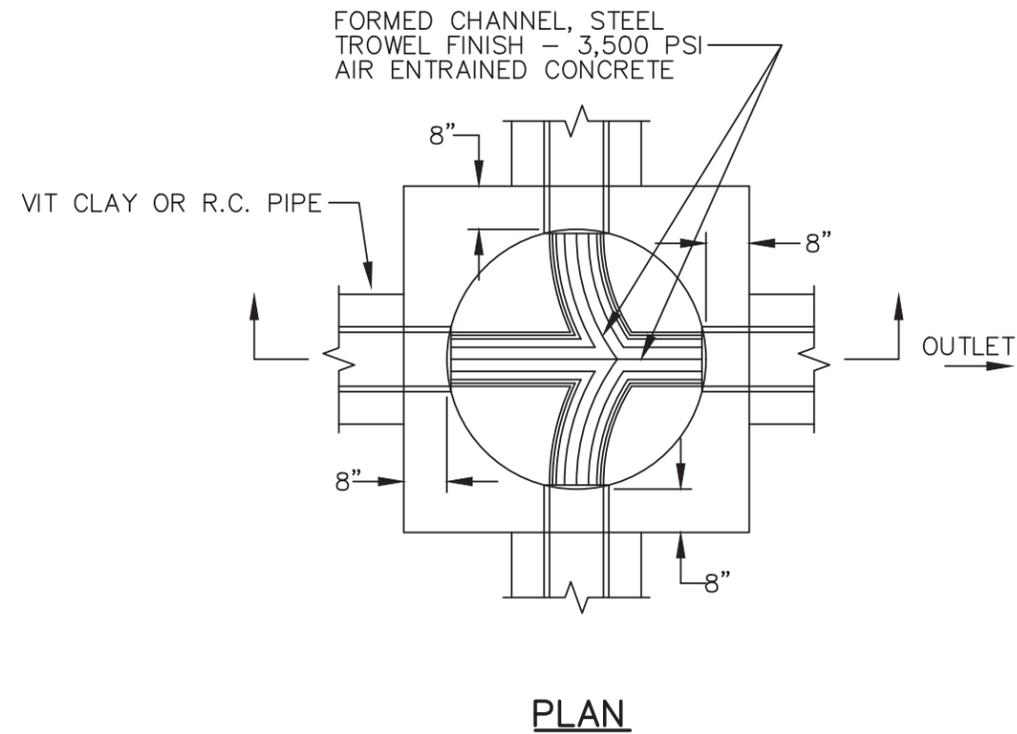
### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

### Approved Suppliers

### Miscellaneous Comments

### Revision



**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## CONCRETE MANHOLE BASE JUNCTION MANHOLE

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-08
		REV.:	0

# Detail – Summit Manhole

MH-09

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-14](#) – Manhole Steps

## Applicable Specifications

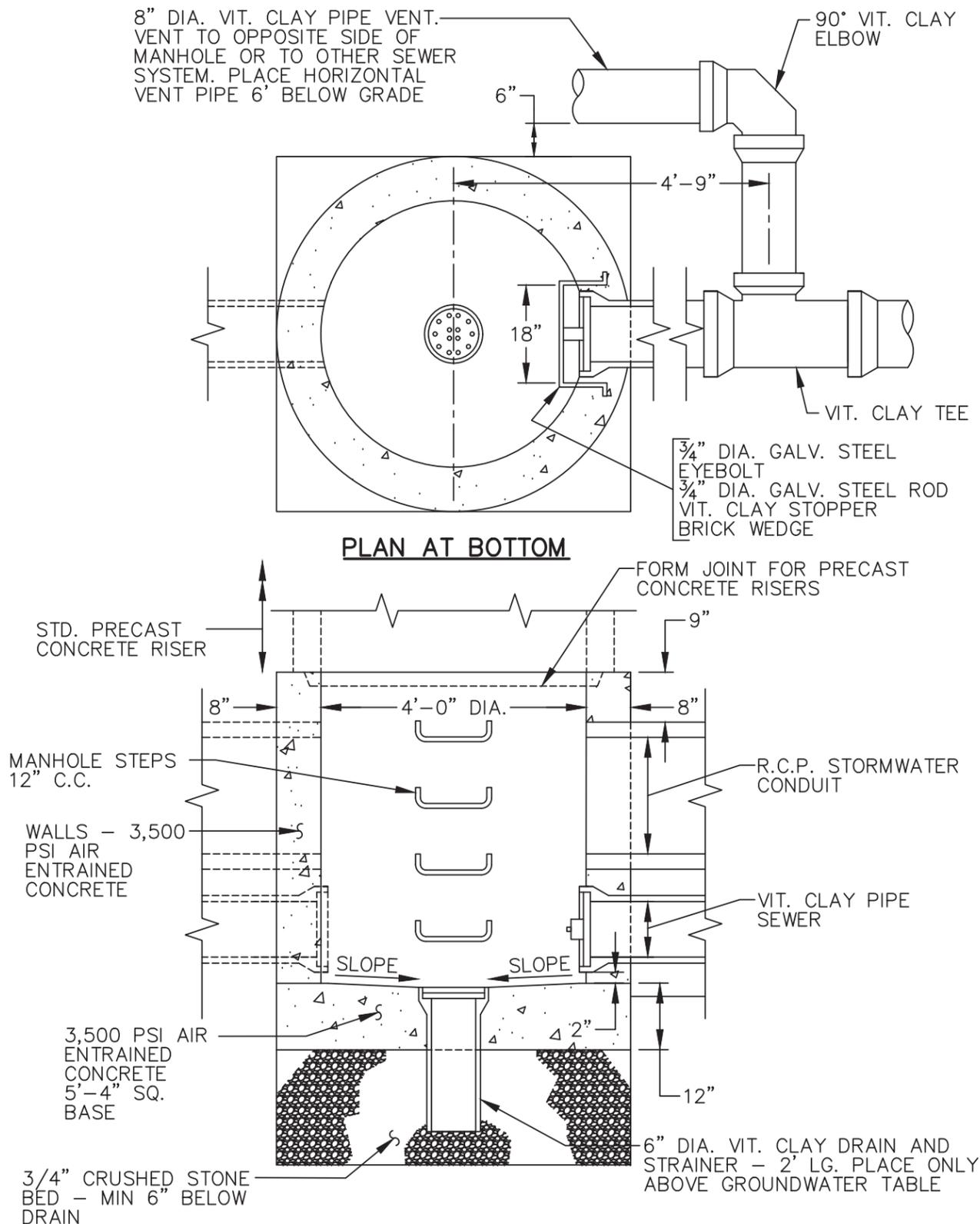
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipe
- [D-21.0](#): Manholes, [D-21.1.2](#): Cast-in-Place Concrete Manholes
- See applicable specifications of associated details

## Approved Suppliers

- QC-9: Vitrified Clay Pipes & Fittings

## Miscellaneous Comments

## Revision



**PHILADELPHIA**  
**WATER**  
— DEPARTMENT —

## SUMMIT MANHOLE

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-09
		REV.:	0

# Detail – Precast Concrete Drop Manhole

MH-10

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-04](#) – Precast Concrete Manhole Bases
- [MH-14](#) – Manhole Steps

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipe
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes

## Approved Suppliers

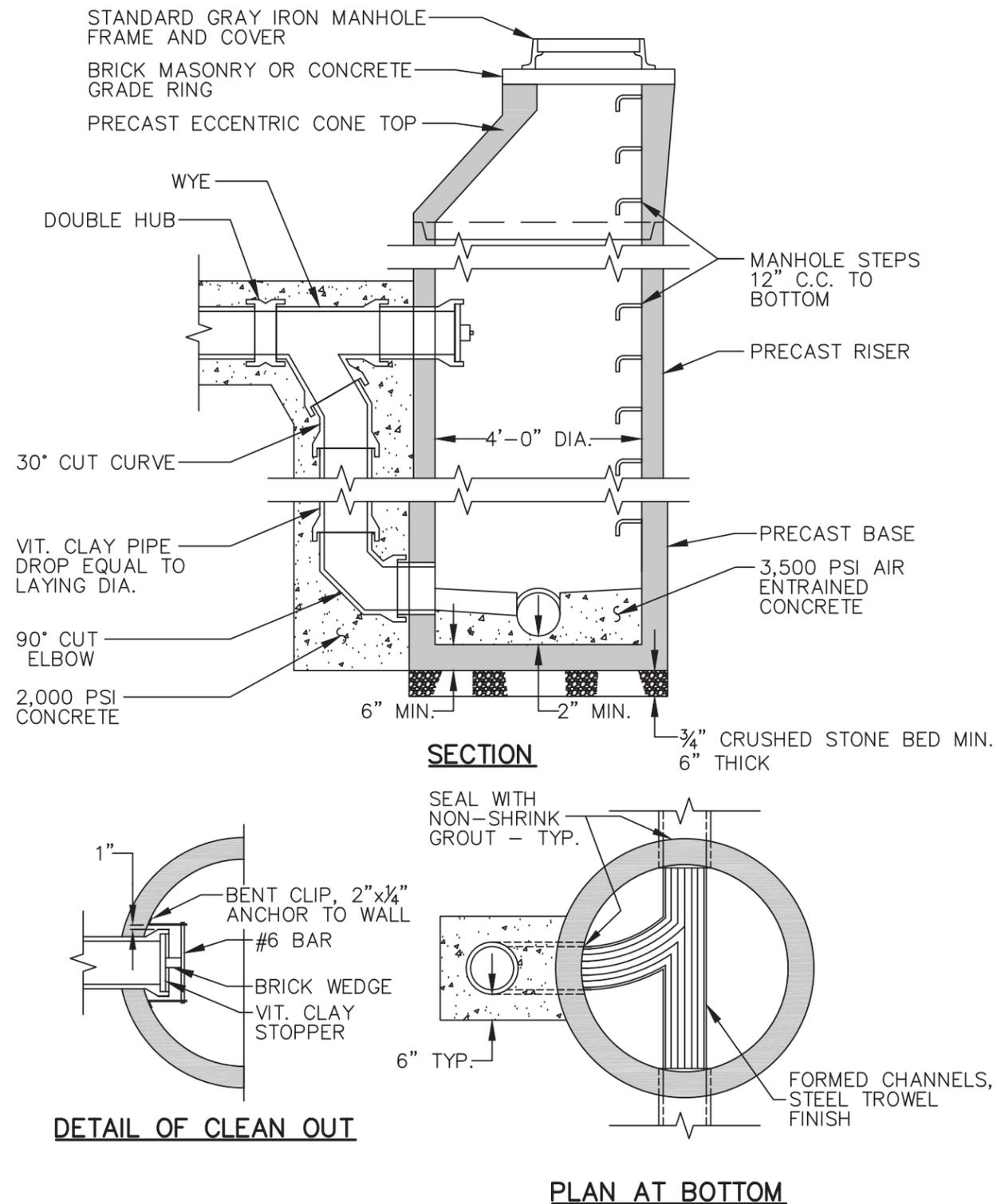
- See Vitrified Clay Pipe Sewer Narrative for Approved Suppliers of Vit. Clay Pipe Sewer

## Miscellaneous Comments

- The drop manhole has been modified to no longer include a reverse wye as they are not available from the approved suppliers.
- 3'-3¾" is the minimum drop possible.

## Revision

Rev. 1 – Jan. 2019 – Reversed drop pipes laying direction.



	<h2>PRECAST CONCRETE DROP MANHOLE</h2>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: MH-10	REV.: 1

# Detail – Precast Concrete Interior Drop Manhole

MH-11-A,B,C

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-04](#) – Precast Concrete Manhole Bases
- [MH-14](#) – Manhole Steps

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipe
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes

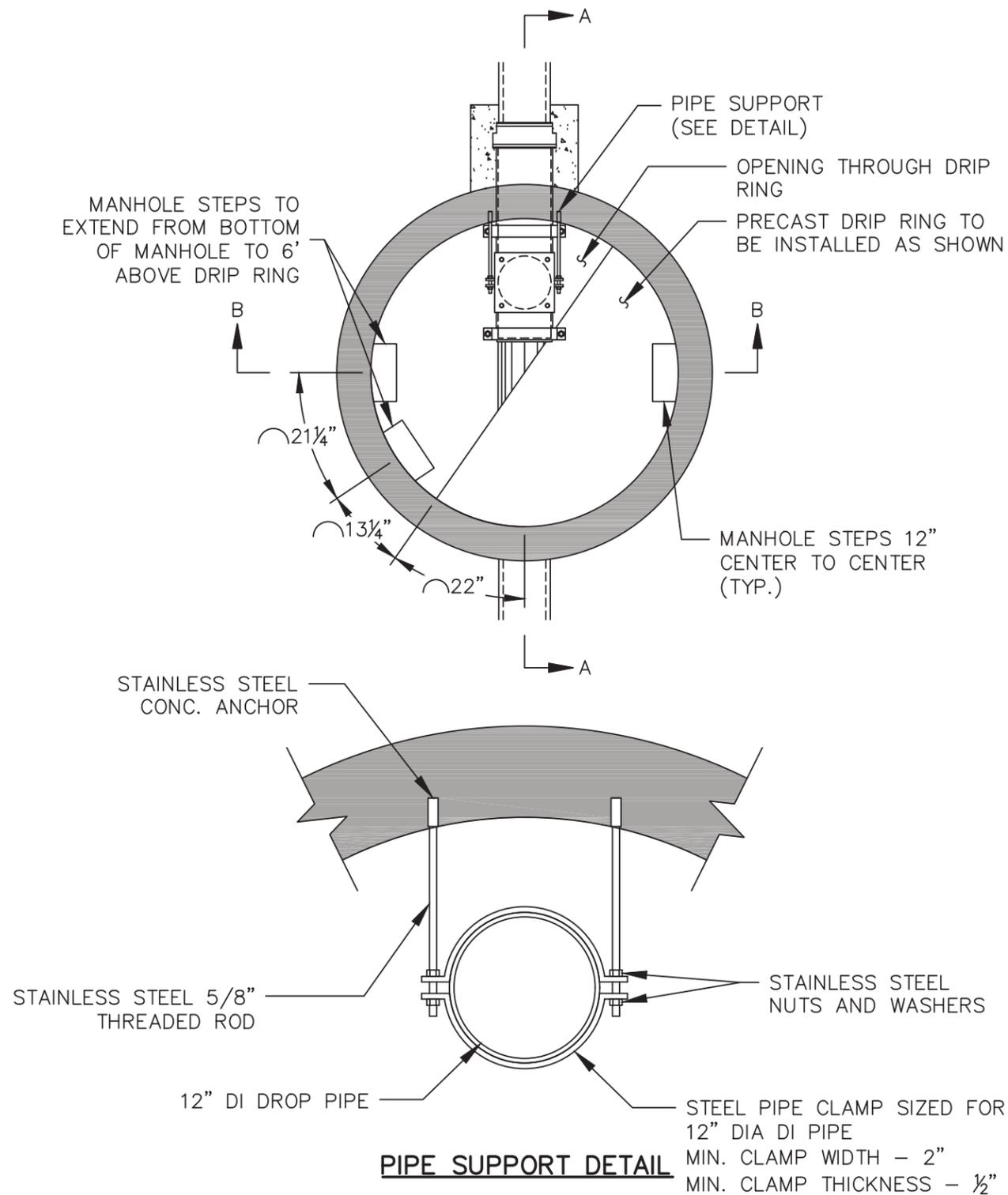
## Approved Suppliers

- See Vitrified Clay Pipe Sewer Narrative for Approved Suppliers of Vit. Clay Pipe Sewer

## Miscellaneous Comments

- The interior drop should be used on deep drops.

## Revision



<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>PRECAST CONCRETE INTERIOR DROP MANHOLE</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: MH-11-A	REV.: NEW	

# Detail – Precast Concrete Interior Drop Manhole

MH-11-A,B,C

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-04](#) – Precast Concrete Manhole Bases
- [MH-14](#) – Manhole Steps

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipe
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes

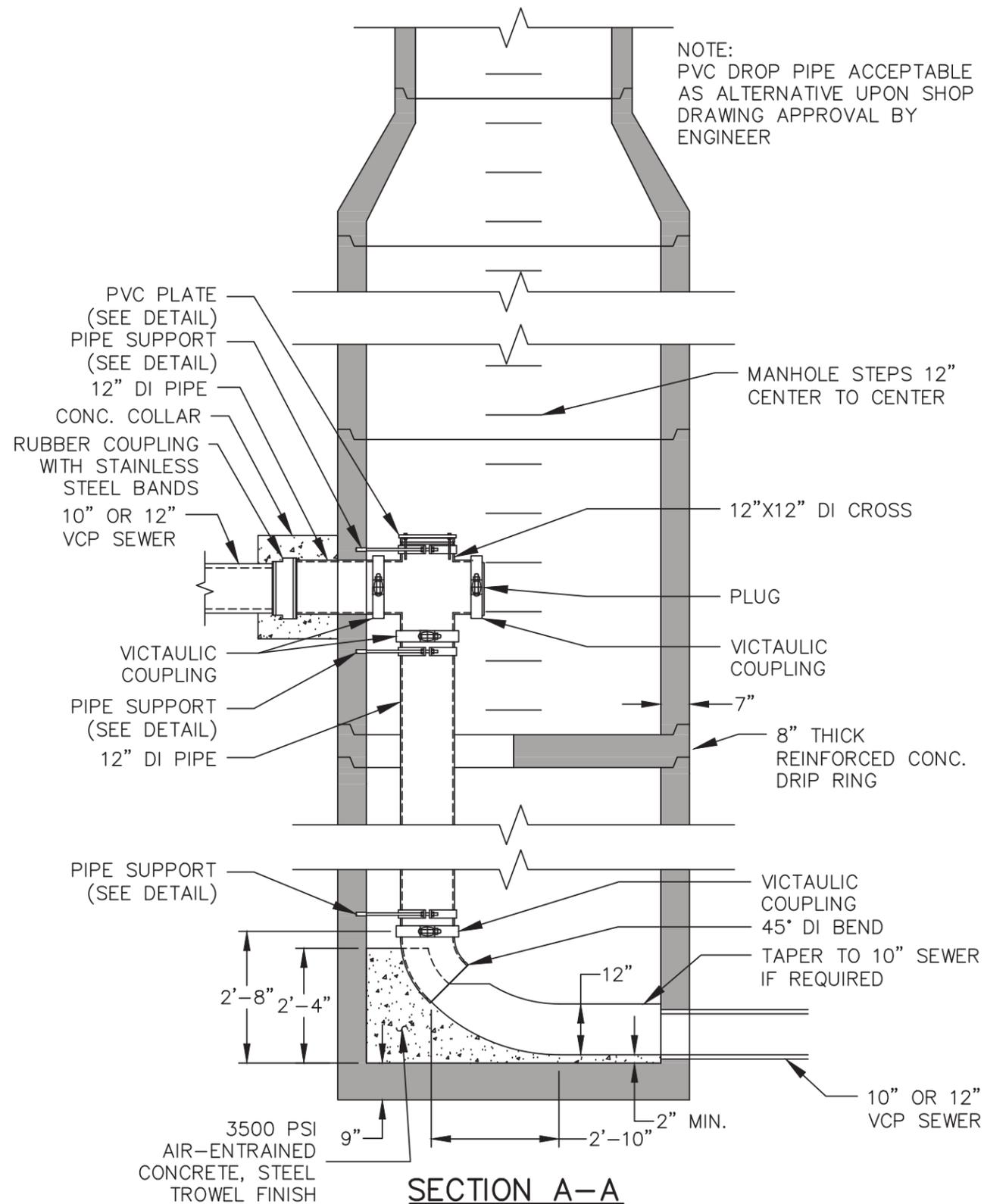
## Approved Suppliers

- See Vitrified Clay Pipe Sewer Narrative for Approved Suppliers of Vit. Clay Pipe Sewer

## Miscellaneous Comments

- The interior drop should be used on deep drops.

## Revision



**PHILADELPHIA  
WATER  
DEPARTMENT**

## PRECAST CONCRETE INTERIOR DROP MANHOLE

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-11-B
		REV.:	NEW

# Detail – Precast Concrete Interior Drop Manhole

MH-11-A,B,C

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser and Cone
- [MH-04](#) – Precast Concrete Manhole Bases
- [MH-14](#) – Manhole Steps

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-15.0](#): Vitrified Clay Pipe, [D-15.1](#): Compression Joints, [D-15.2](#): Installing Pipe
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes

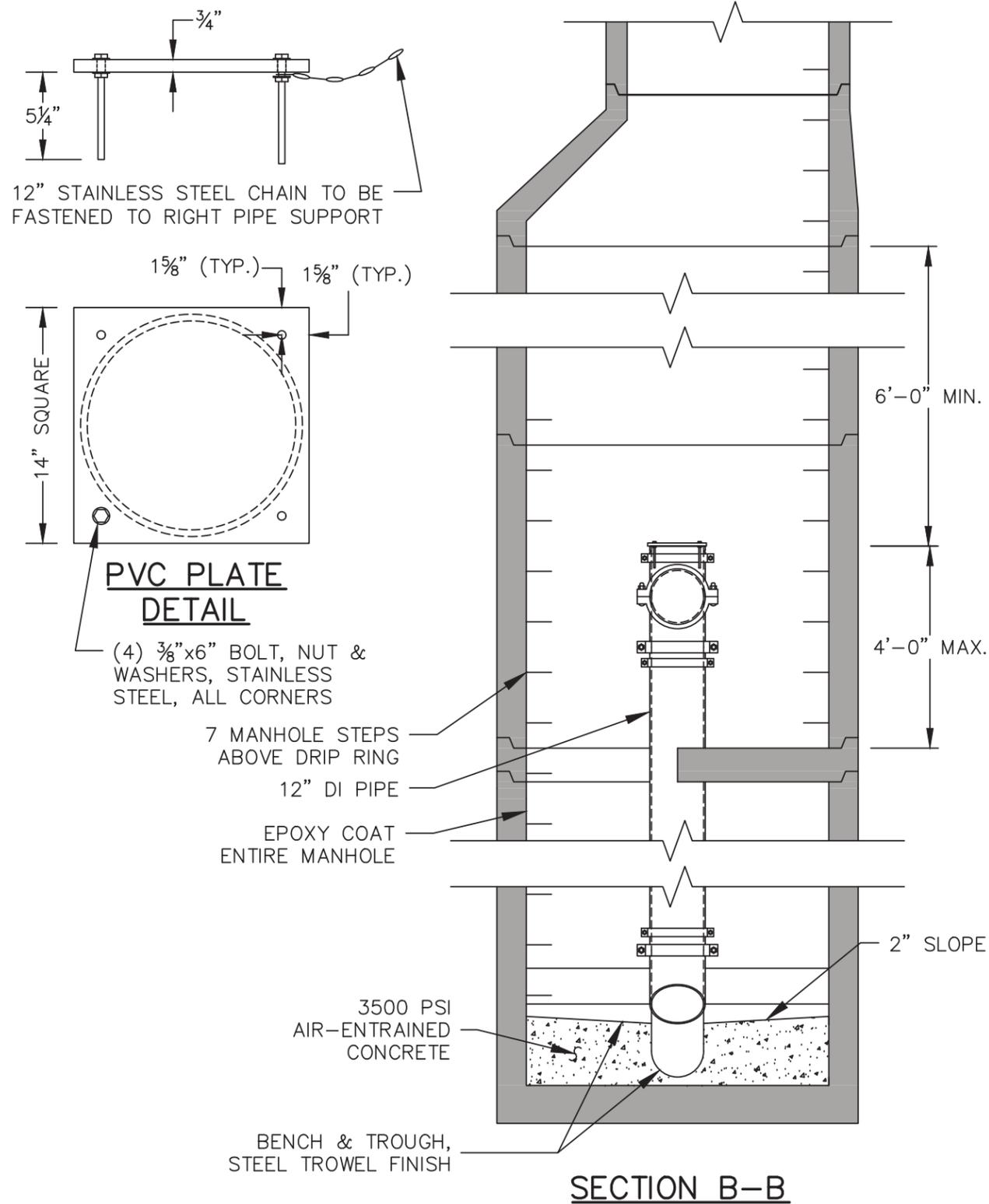
## Approved Suppliers

- See Vitrified Clay Pipe Sewer Narrative for Approved Suppliers of Vit. Clay Pipe Sewer

## Miscellaneous Comments

- The interior drop should be used on deep drops.

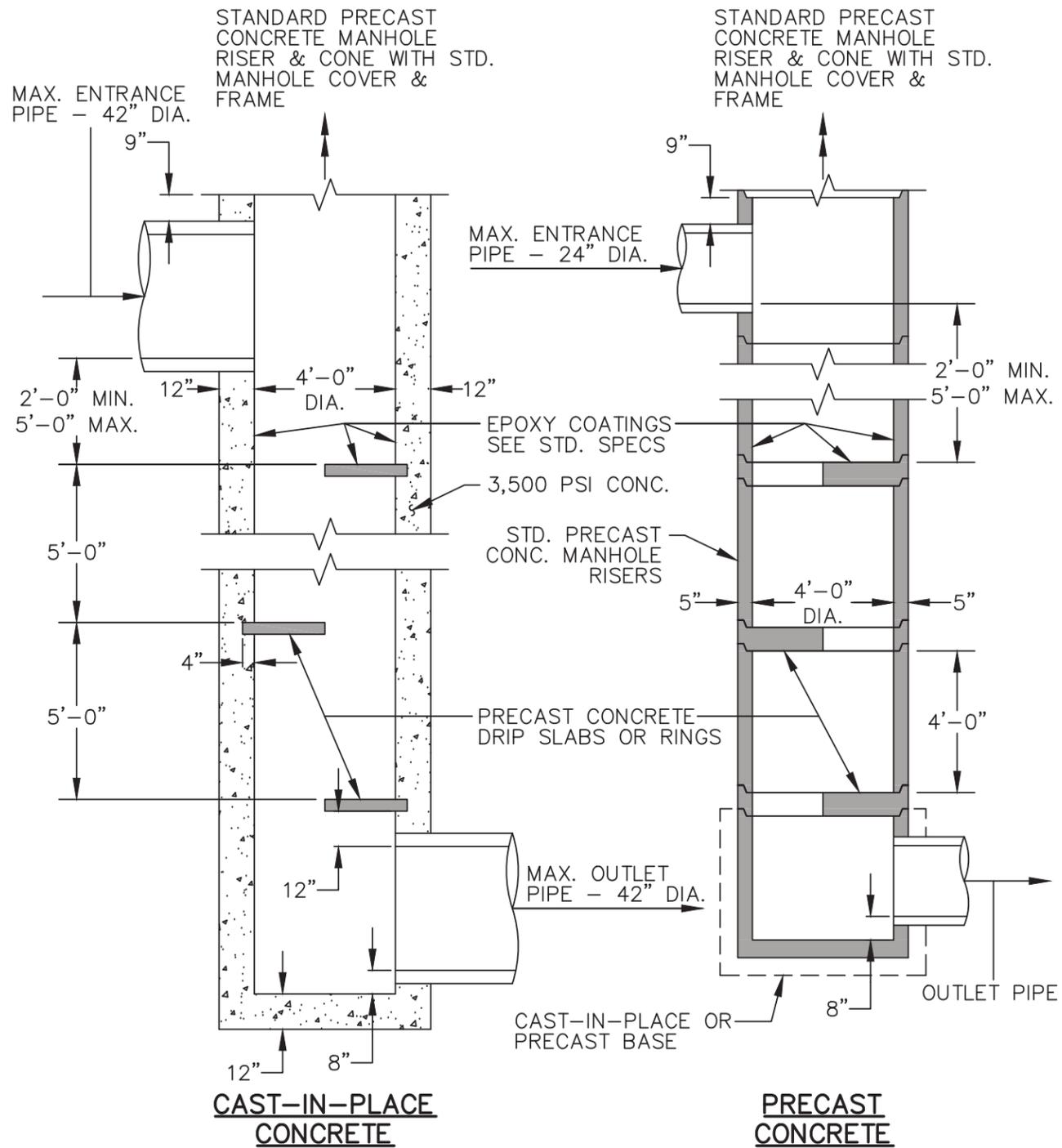
## Revision



**PHILADELPHIA  
WATER  
DEPARTMENT**

## PRECAST CONCRETE INTERIOR DROP MANHOLE

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-11-C
		REV.:	NEW



## Detail – Wellhole

MH-12-A&B

### Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser
- [MH-04](#) – Precast Concrete Manhole Bases

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes, [D-21.3](#): Manhole Frames and Covers
- [D-22.0](#): Wellholes, [D-22.1](#): Concrete Wellholes, [D-22.1.2](#): Precast Reinforced Concrete Wellholes, [D-22.2](#): Ladder Bars and Steps, [D-22.3](#): Wellhole Frames and Covers, [D-22.4](#): Drip Slabs and Drip Rings, [D-22.5](#): Epoxy Coating

### Approved Suppliers

- QC-1: Precast Concrete
- QC-3: Ready Mix Concrete

### Miscellaneous Comments

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>WELLHOLE</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: MH-12-A	REV.: 0	

# Detail – Wellhole

MH-12-A&B

## Associated Details

- [MH-01](#) – Precast Concrete Manhole Riser
- [MH-04](#) – Precast Concrete Manhole Bases

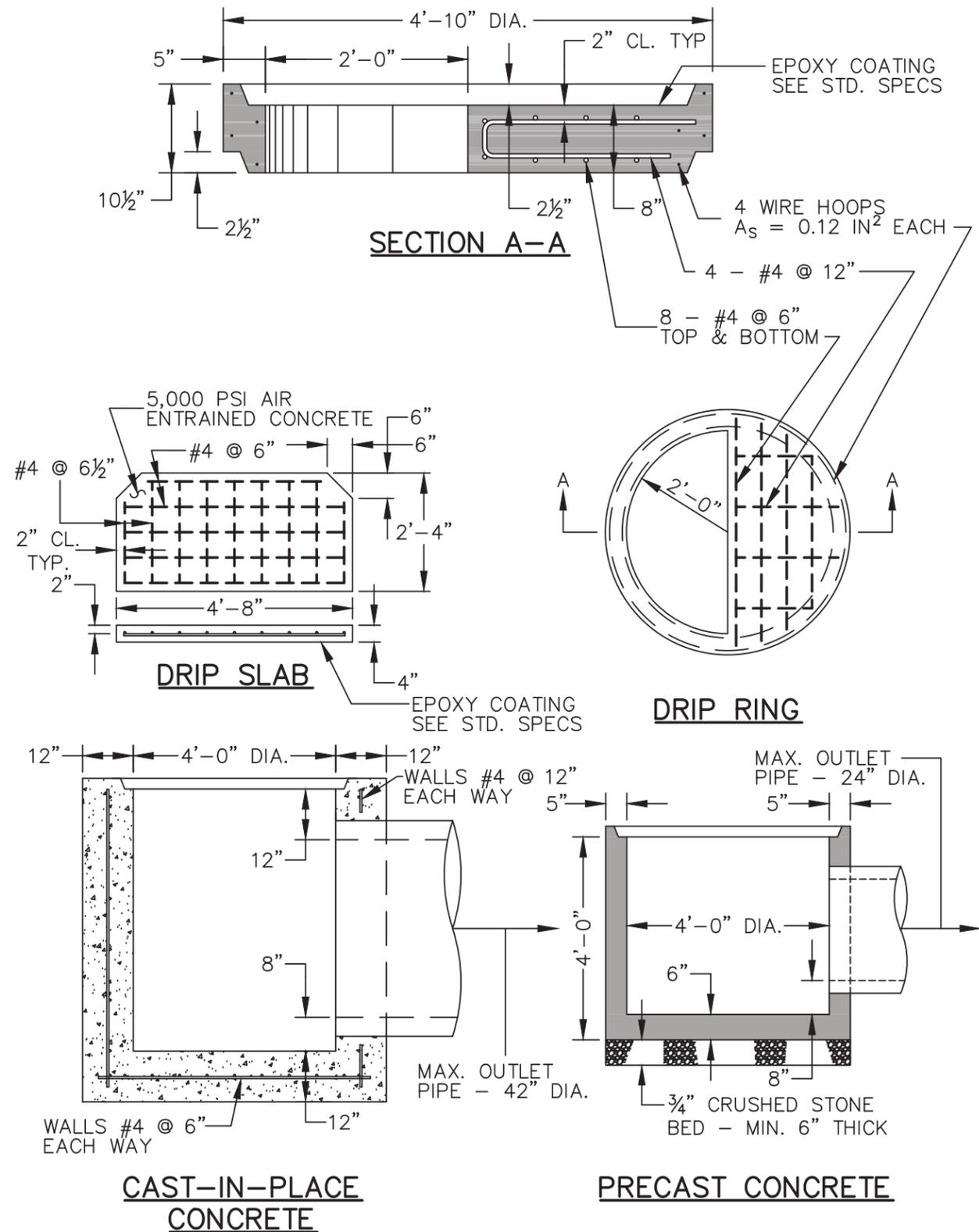
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.1.3](#): Precast Reinforced Concrete Manholes, [D-21.3](#): Manhole Frames and Covers
- [D-22.0](#): Wellholes, [D-22.1](#): Concrete Wellholes, [D-22.1.2](#): Precast Reinforced Concrete Wellholes, [D-22.2](#): Ladder Bars and Steps, [D-22.3](#): Wellhole Frames and Covers, [D-22.4](#): Drip Slabs and Drip Rings, [D-22.5](#): Epoxy Coating

## Approved Suppliers

- QC-1: Precast Concrete
- QC-3: Ready Mix Concrete

## Miscellaneous Comments



<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>WELLHOLE</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: MH-12-B	REV.: 0	

# Detail – Gray Iron Manhole Frame & Covers

MH-13-A&B

## Associated Details

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.3](#): Manhole Frames and Covers

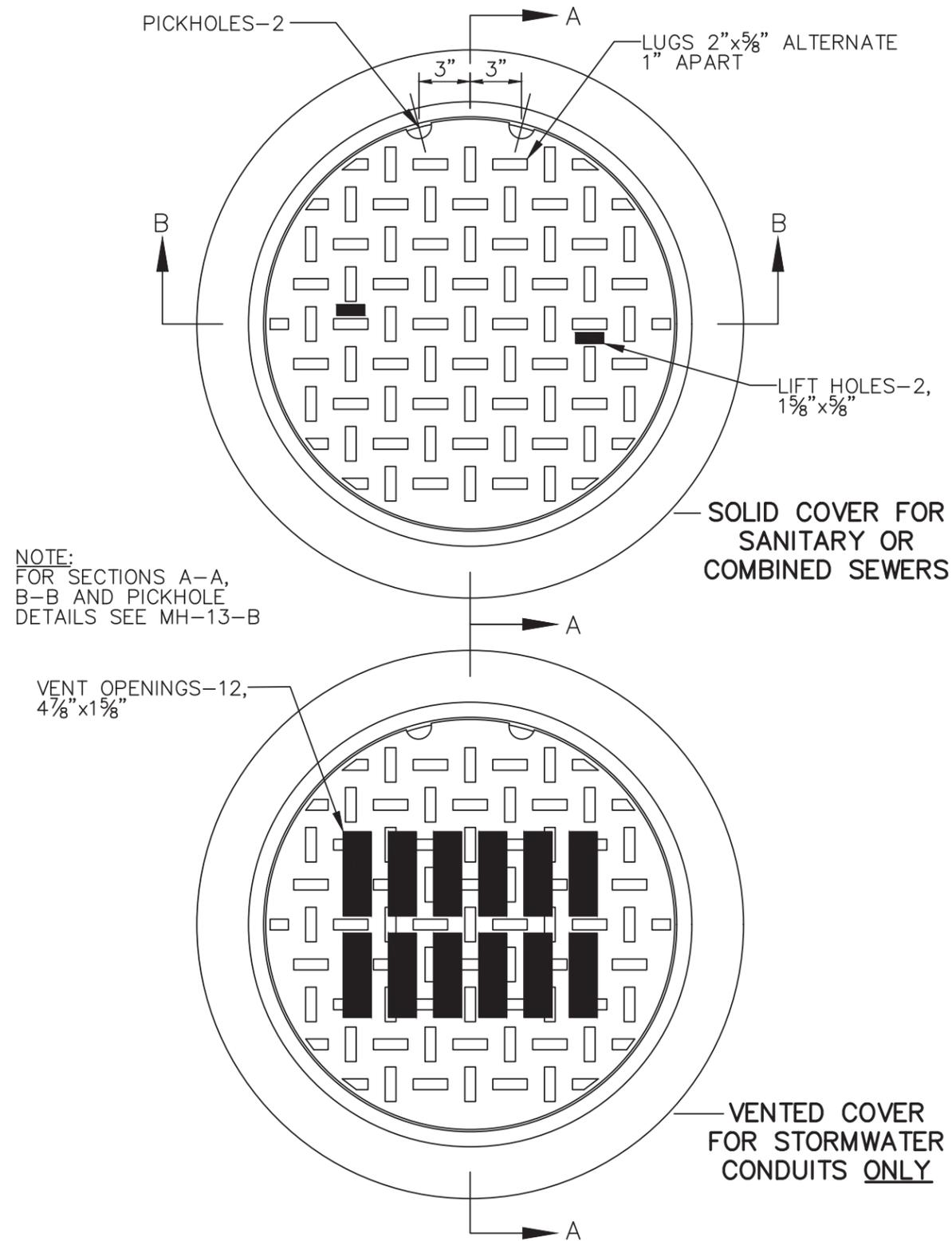
## Approved Suppliers

- QC-2: Grey/Ductile Iron

## Miscellaneous Comments

- EJ USA model numbers for manhole covers are
  - Solid: 1835 Solid Cover
  - Vented: 1835 Vented Cover
- EJ USA model number for frame is 1835
- Neenah Foundry model numbers for manhole covers are
  - Solid: R-1788-A1
  - Vented: R-1788-B
- Weights per 1956 Std. Details are
  - Solid Cover: 215 lbs.
  - Vented Cover: 200 lbs.
  - Frame: 270 lbs.

## Revision



<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>GRAY IRON MANHOLE          FRAME &amp; COVERS</b>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: MH-13-A	REV.: 0

# Detail – Gray Iron Manhole Frame & Covers

MH-13-A&B

## Associated Details

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.0](#): Manholes, [D-21.3](#): Manhole Frames and Covers

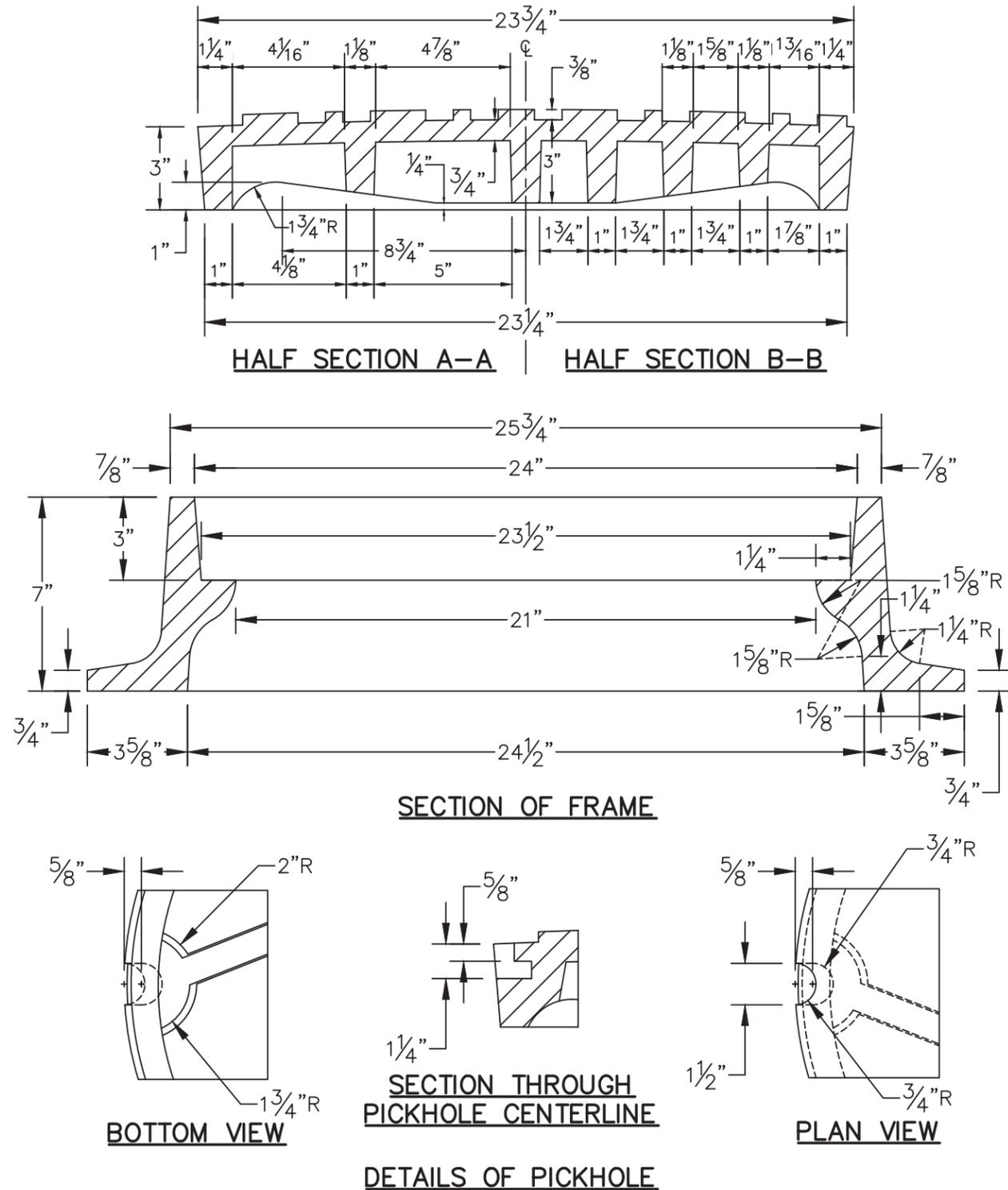
### Approved Suppliers

- QC-2: Grey/Ductile Iron

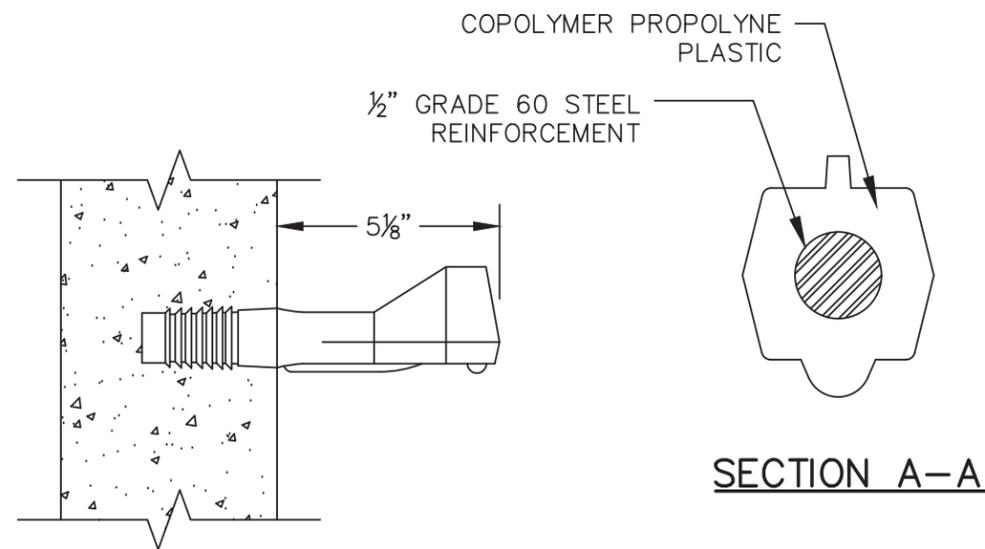
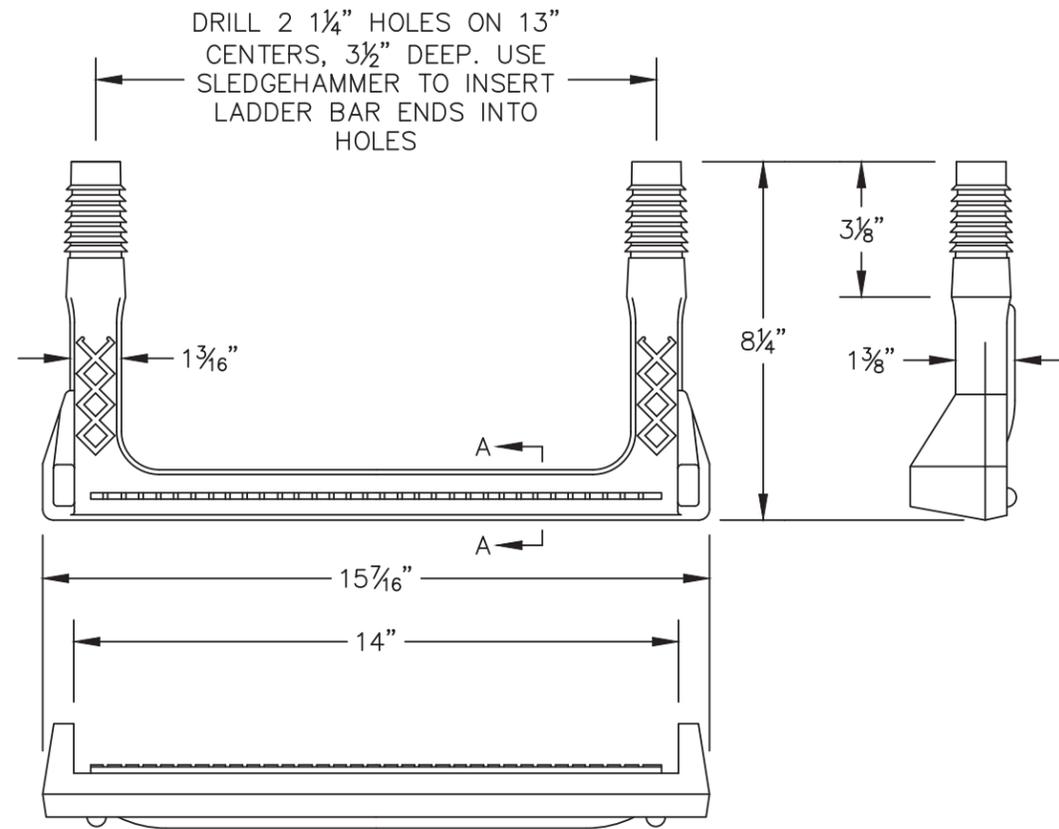
### Miscellaneous Comments

- EJ USA model numbers for manhole covers are
  - Solid: 1835 Solid Cover
  - Vented: 1835 Vented Cover
- EJ USA model number for frame is 1835
- Neenah Foundry model numbers for manhole covers are
  - Solid: R-1788-A1
  - Vented: R-1788-B
- Weights per 1956 Std. Details are
  - Solid Cover: 215 lbs.
  - Vented Cover: 200 lbs.
  - Frame: 270 lbs.

### Revision



	<h2>GRAY IRON MANHOLE FRAME &amp; COVERS</h2>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: MH-13-B	REV.: 0



## Detail – Manhole Steps

MH-14

### Associated Details

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-21.2](#): Ladder Bars and Steps, [D-21.2.1](#): Plastic

### Approved Suppliers

### Miscellaneous Comments

### Revision

Rev. 1 – Jan. 2019 – Removed Ladder Bars and Aluminum Manhole Steps, replaced with Plastic Manhole Steps.

**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## MANHOLE STEPS

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	MH-14
		REV.:	0

# Detail – Assembly of Precast Inlets

## INLET-01

### Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly
- [INLET-03](#) – Highway Grate Inlet Assembly
- [INLET-04](#) – Gutter Grate Inlet Assembly
- [INLET-05](#) – Open Mouth Inlet Assembly

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

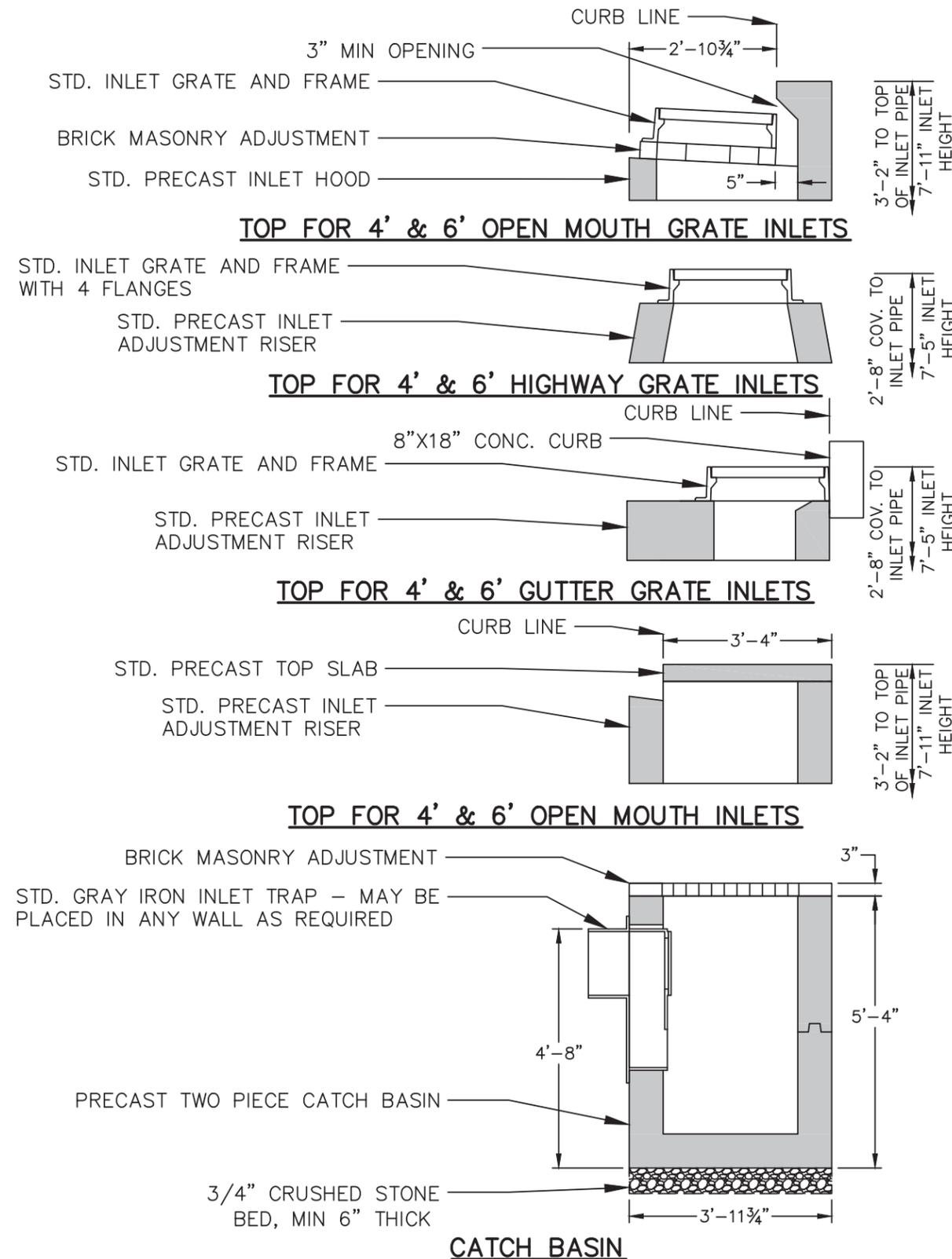
### Approved Suppliers

### Miscellaneous Comments

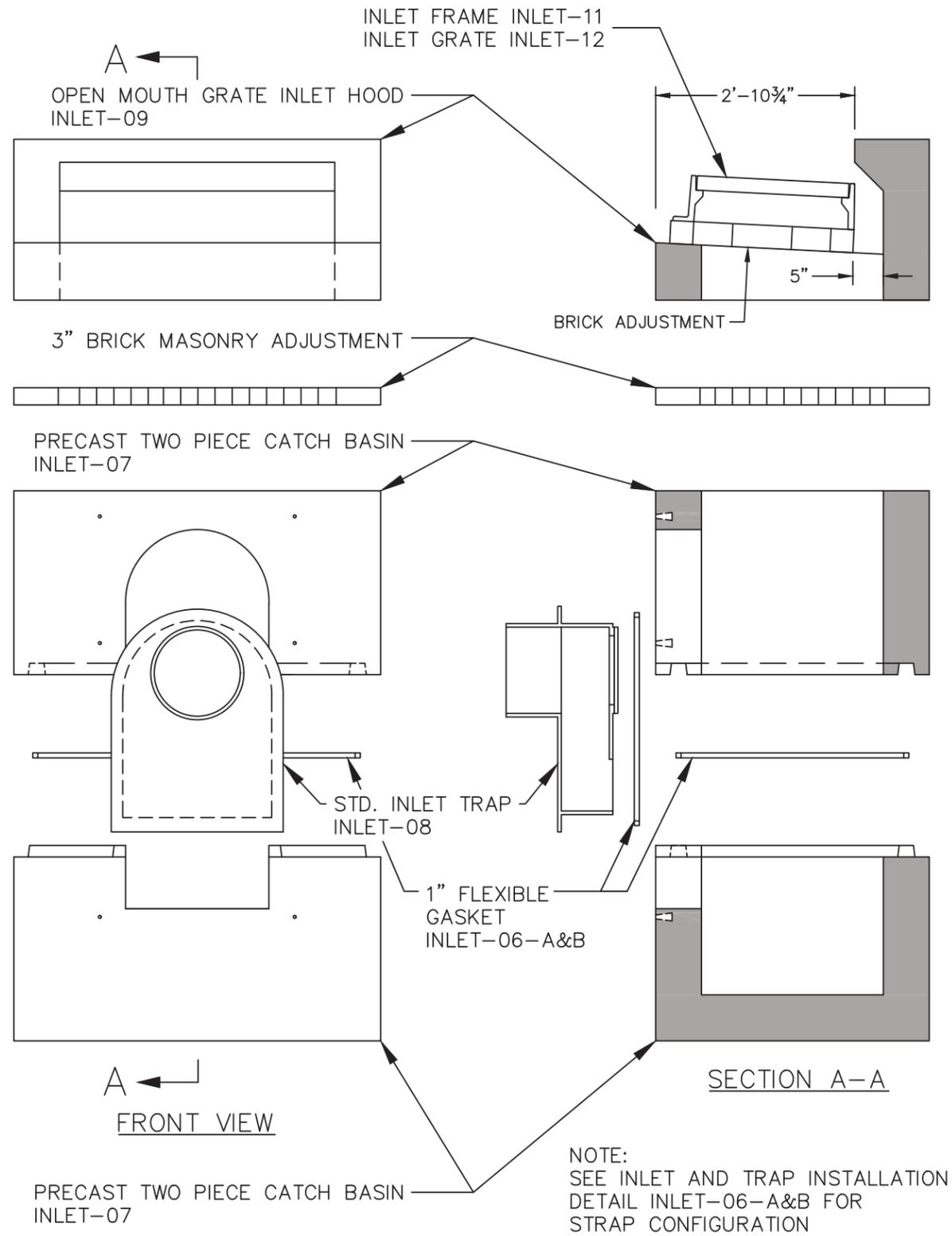
- This detail shows how all inlet details use the same catch basin detail.

### Revision

Rev. 1 – Jul. 2018 – Added Gutter Grate Inlet



	<h2>ASSEMBLY OF PRECAST INLETS</h2>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: INLET-01	REV.: 1



## Detail – Open Mouth Grate Inlet Assembly

### INLET-02

#### Associated Details

- [INLET-07](#) – Two Piece Catch Basin
- [INLET-08](#) – Inlet Trap
- [INLET-06-A&B](#) – Inlet and Trap Installation
- [INLET-11](#) – Inlet Frames
- [INLET-12](#) – Inlet Grates
- [INLET-09](#) – Precast Reinforced Concrete Inlet Hood

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision

	<h3>OPEN MOUTH GRATE INLET ASSEMBLY</h3>		
	DRAWN BY: D&B GUARINO CHECKED BY: WD	DATE: JAN. 2019 DETAIL ID: INLET-02	REV.: NEW

## Detail – Highway Grate Inlet Assembly

### INLET-03

#### Associated Details

- [INLET-07](#) – Two Piece Catch Basin
- [INLET-08](#) – Inlet Trap
- [INLET-06-A&B](#) – Inlet and Trap Installation
- [INLET-11](#) – Inlet Frames
- [INLET-12](#) – Inlet Grates
- [INLET-10](#) – Highway Grate and Gutter Grate Inlet Adjustment Risers

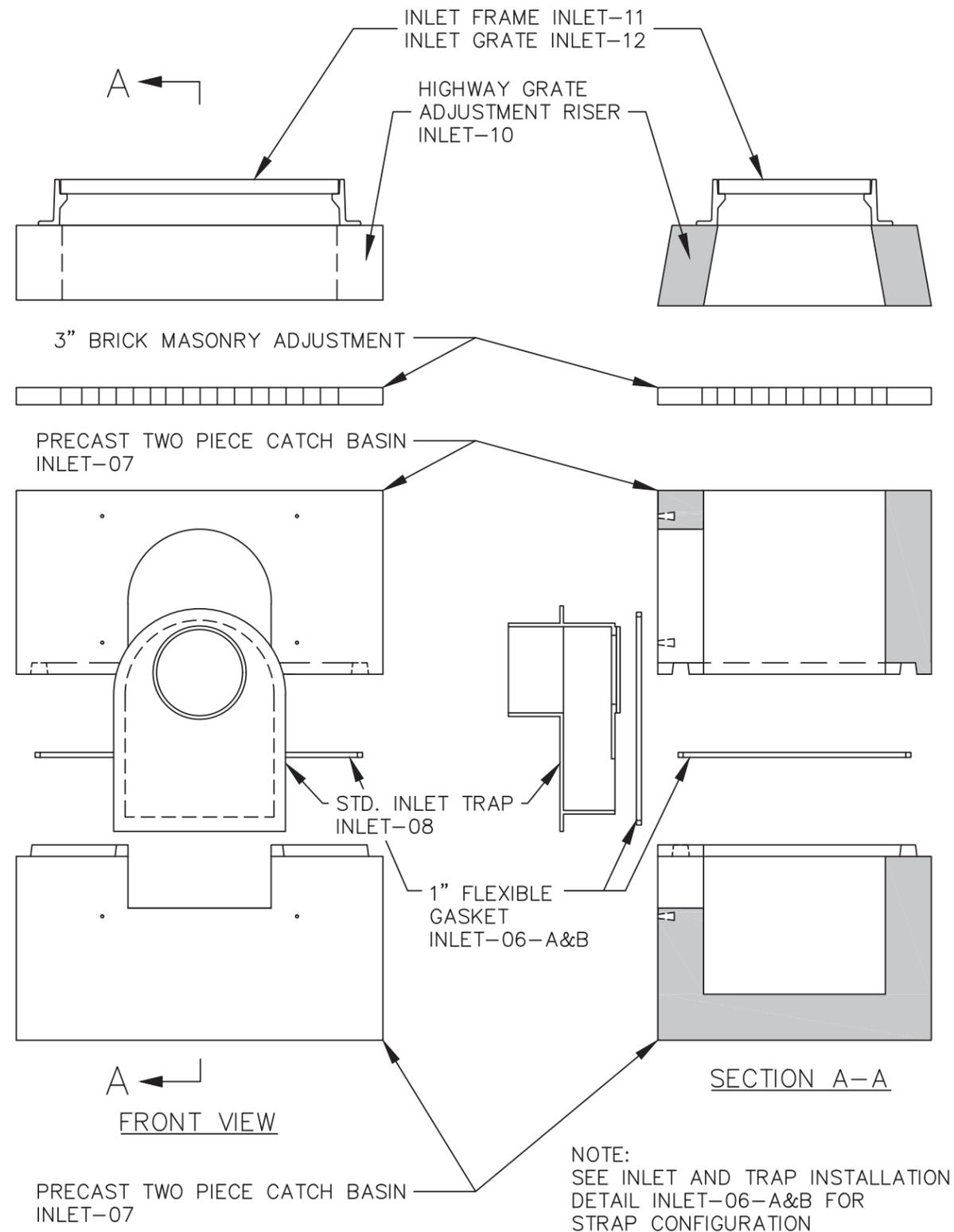
#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision



## HIGHWAY GRATE INLET ASSEMBLY

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-03
		REV.:	NEW

## Detail – Gutter Grate Inlet Assembly

### INLET-04

#### Associated Details

- [INLET-07](#) – Two Piece Catch Basin
- [INLET-08](#) – Inlet Trap
- [INLET-06-A&B](#) – Inlet and Trap Installation
- [INLET-11](#) – Inlet Frames
- [INLET-12](#) – Inlet Grates
- [INLET-10](#) – Highway Grate and Gutter Grate Inlet Adjustment Risers

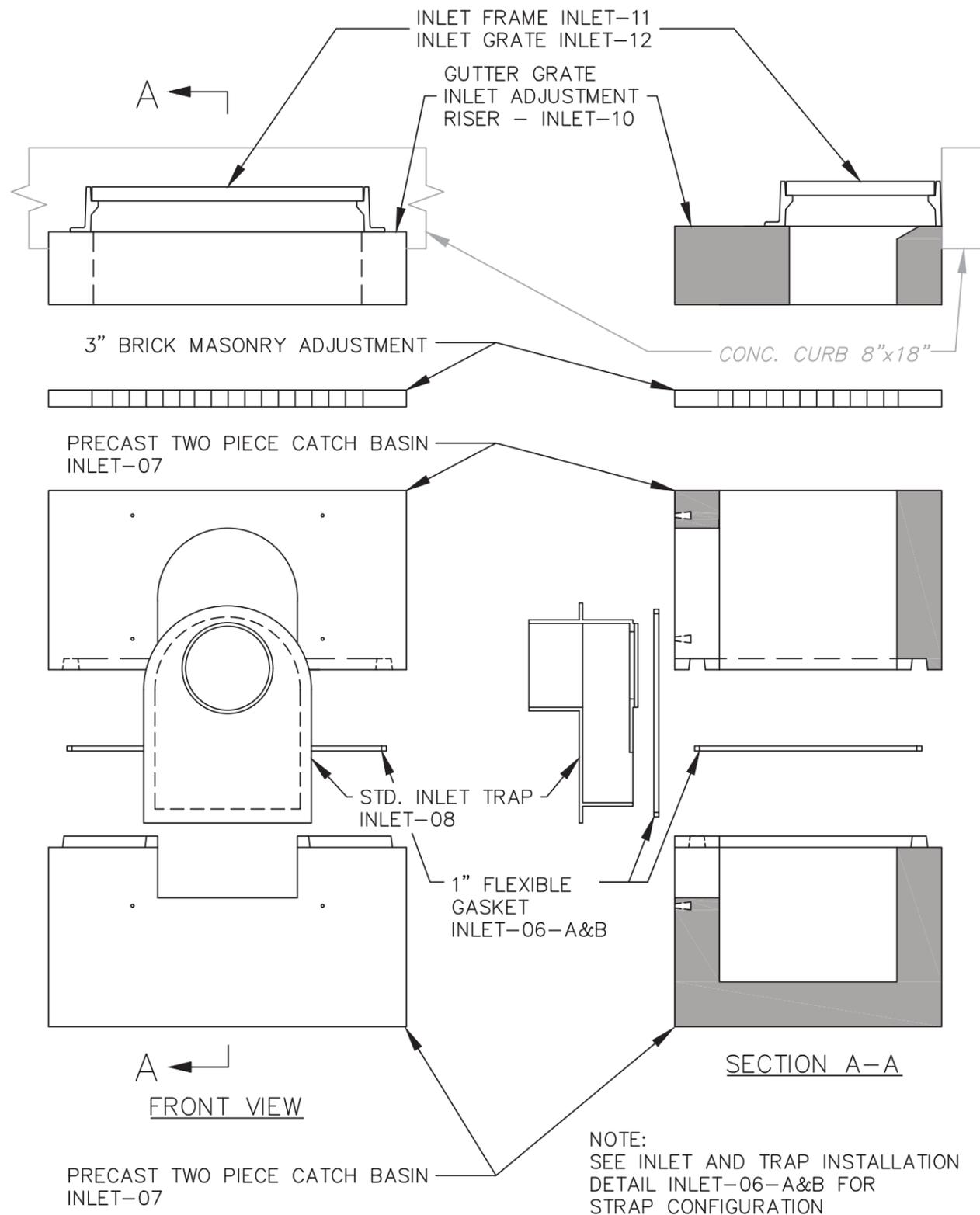
#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision



## GUTTER GRATE INLET ASSEMBLY

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-04
		REV.:	NEW

## Detail – Open Mouth Inlet Assembly

### INLET-05

#### Associated Details

- [INLET-07](#) – Two Piece Catch Basin
- [INLET-08](#) – Inlet Trap
- [INLET-06-A&B](#) – Inlet and Trap Installation
- [INLET-15](#) – Precast Concrete Top Slabs
- [INLET-14](#) – Open Mouth Inlet Adjustment Risers

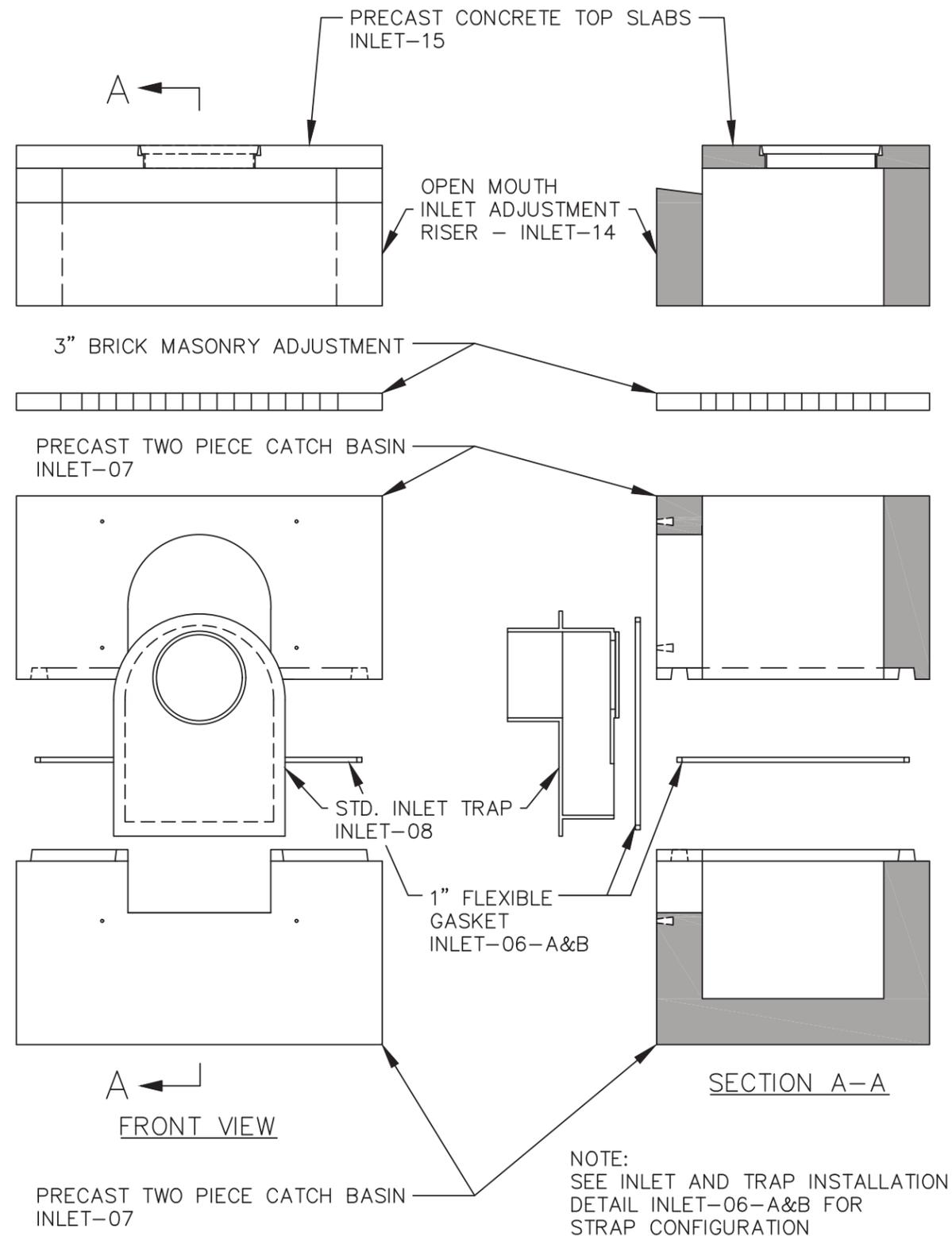
#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

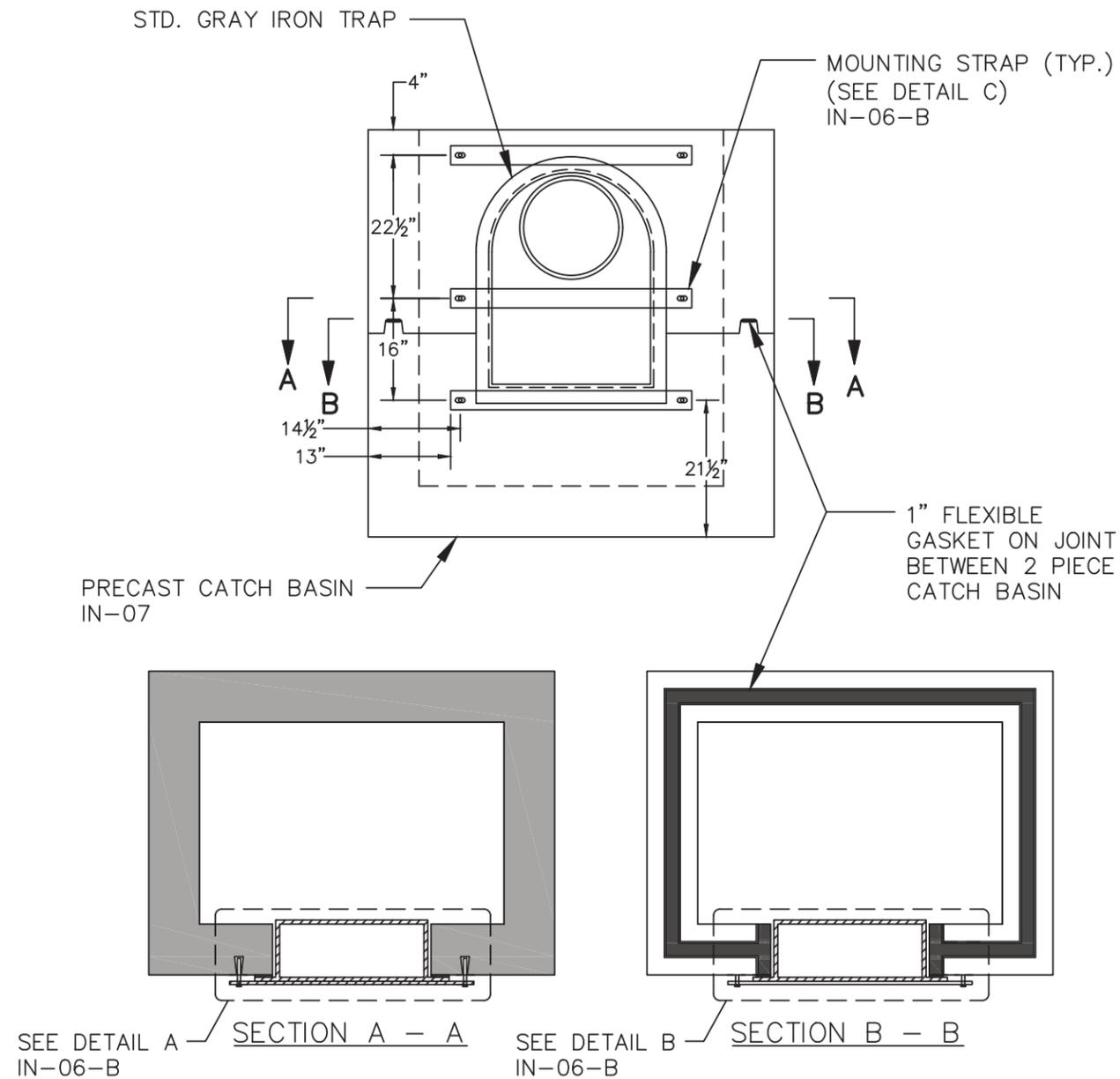
#### Approved Suppliers

#### Miscellaneous Comments

#### Revision



	<b>OPEN MOUTH INLET ASSEMBLY</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: INLET-05	REV.: NEW	



**NOTE:**

- FLEXIBLE GASKET SHALL BE 1" RU106-RUB'R NEK® BY HENRY COMPANY OR APPROVED EQUAL
- GASKET SHALL BE COMPRESSED TO 3/8" MINIMUM

## Detail – Inlet and Trap Installation

### INLET-06-A&B

#### Associated Details

- [INLET-07](#) – Two Piece Precast Catch Basin
- [INLET-08](#) – Inlet Trap

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See applicable specifications of associated details

#### Approved Suppliers

- QC-1: Precast Concrete
- QC-2: Grey/Ductile Iron

#### Miscellaneous Comments

#### Revision

<b>PHILADELPHIA WATER DEPARTMENT</b>	<b>INLET &amp; TRAP INSTALLATION</b>			
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019		
CHECKED BY: WD	DETAIL ID: INLET-06-A	REV.: NEW		

# Detail – Inlet and Trap Installation

## INLET-06-A&B

### Associated Details

- [INLET-07](#) – Two Piece Precast Catch Basin
- [INLET-08](#) – Inlet Trap

### Applicable Specifications

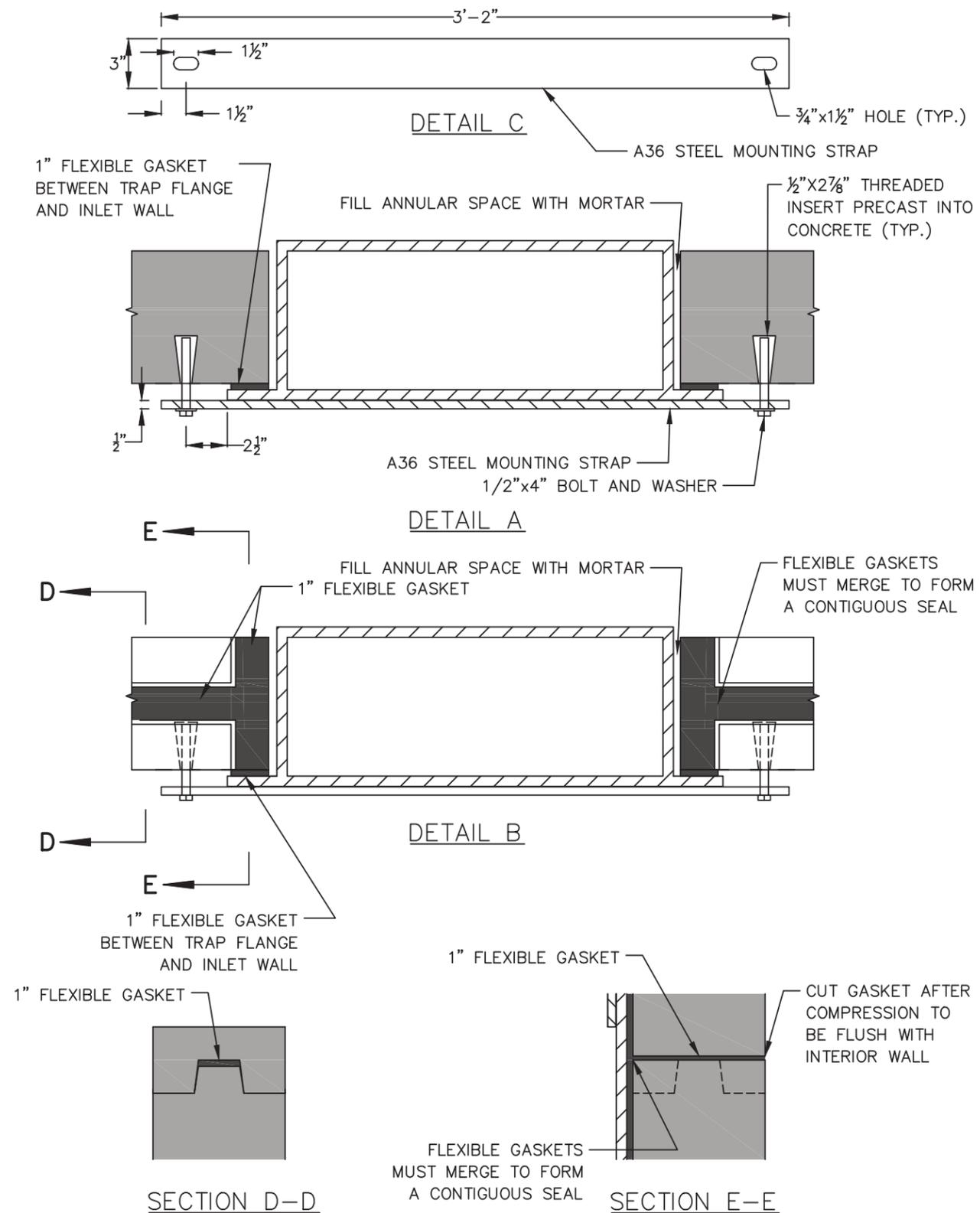
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See applicable specifications of associated details

### Approved Suppliers

- QC-1: Precast Concrete
- QC-2: Grey/Ductile Iron

### Miscellaneous Comments

### Revision



	<b>INLET &amp; TRAP INSTALLATION</b>			
	DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-06-B	REV.: NEW

# Detail – Two Piece Precast Catch Basin

INLET-07

## Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly
- [INLET-03](#) – Highway Grate Inlet Assembly
- [INLET-04](#) – Gutter Grate Inlet Assembly
- [INLET-05](#) – Open Mouth Inlet Assembly
- [INLET-06-A&B](#) – Inlet and Trap Installation
- [INLET-08](#) – Inlet Trap

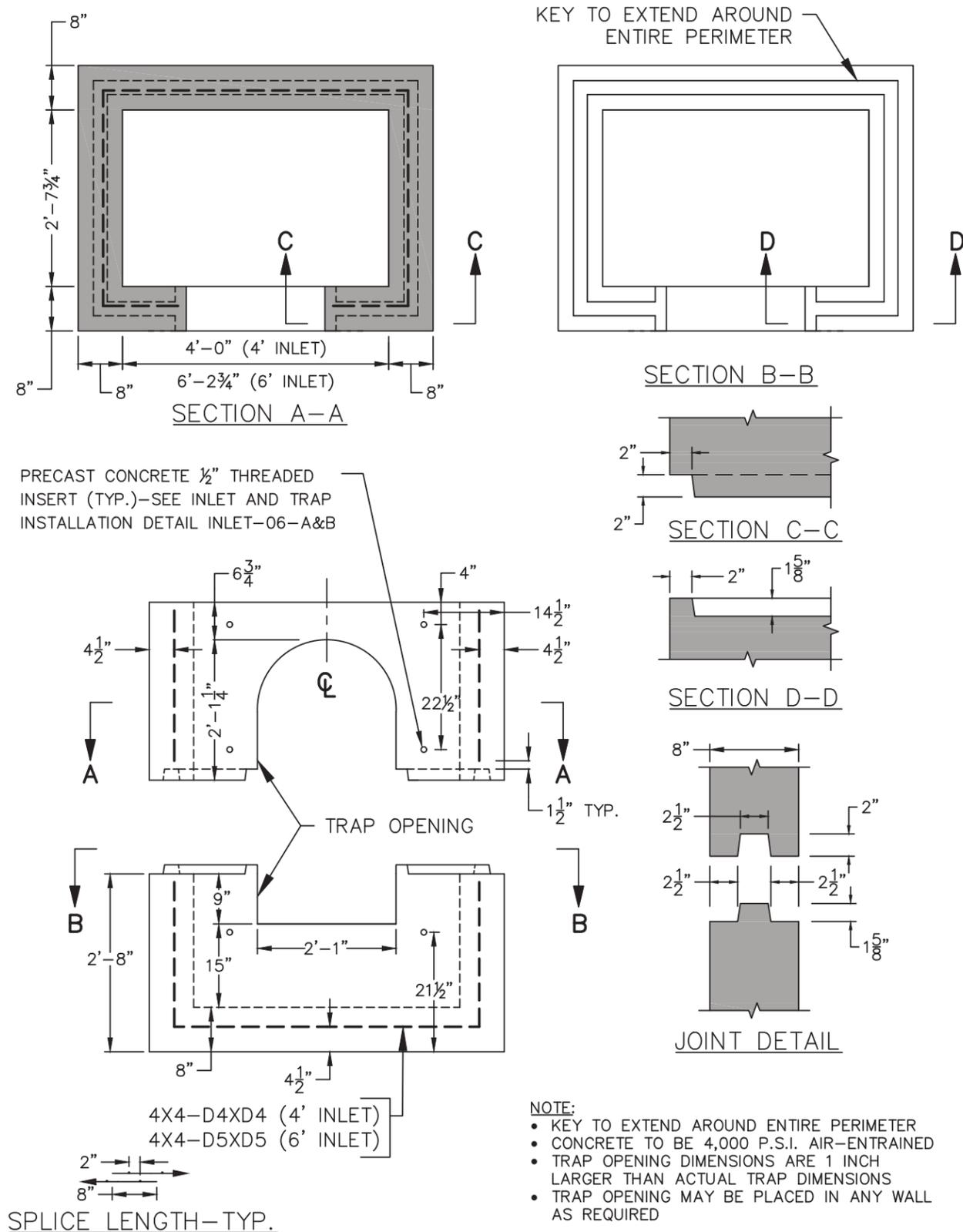
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.1](#): Catch Basins, [D-23.1.2](#): Concrete Catch Basins, [D-23.1.3](#): Precast Concrete Catch Basins, [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

## Approved Suppliers

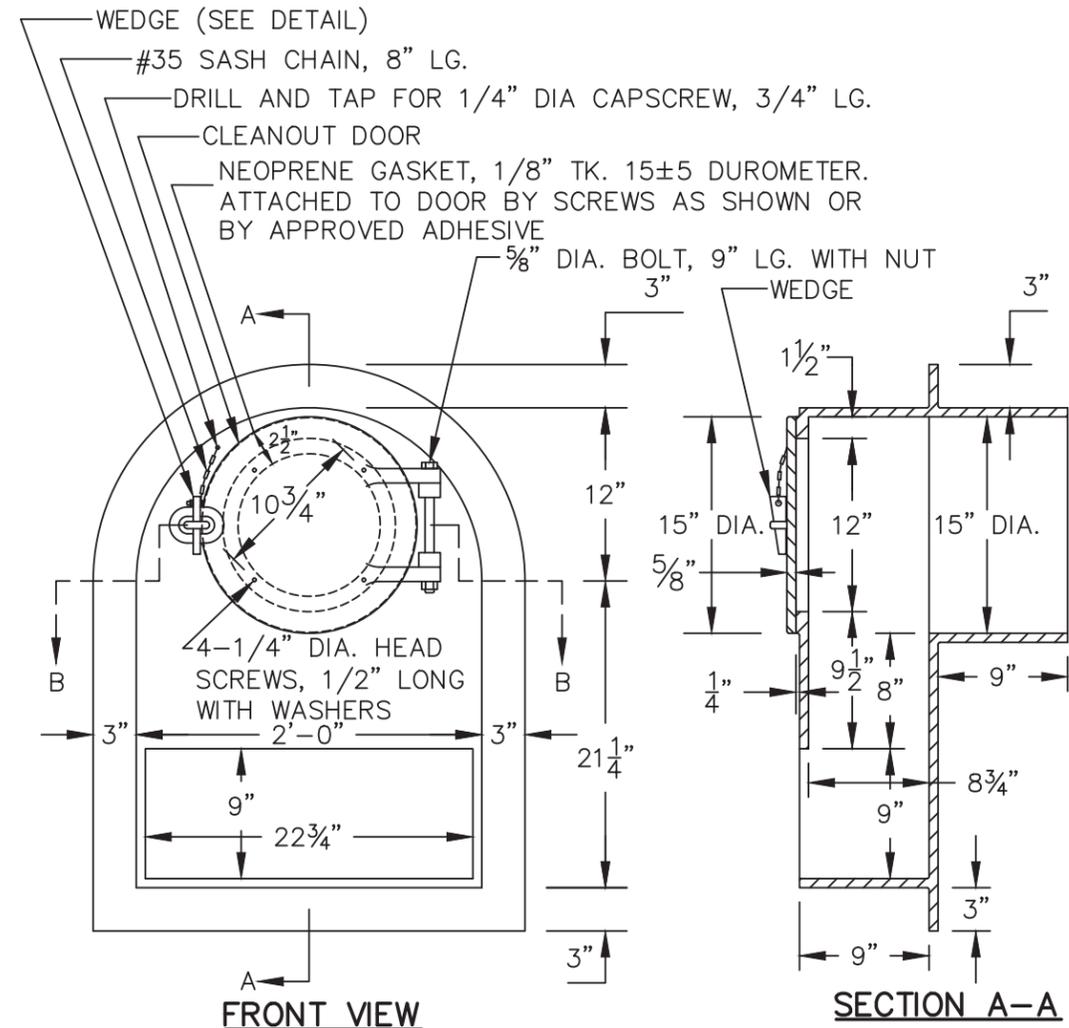
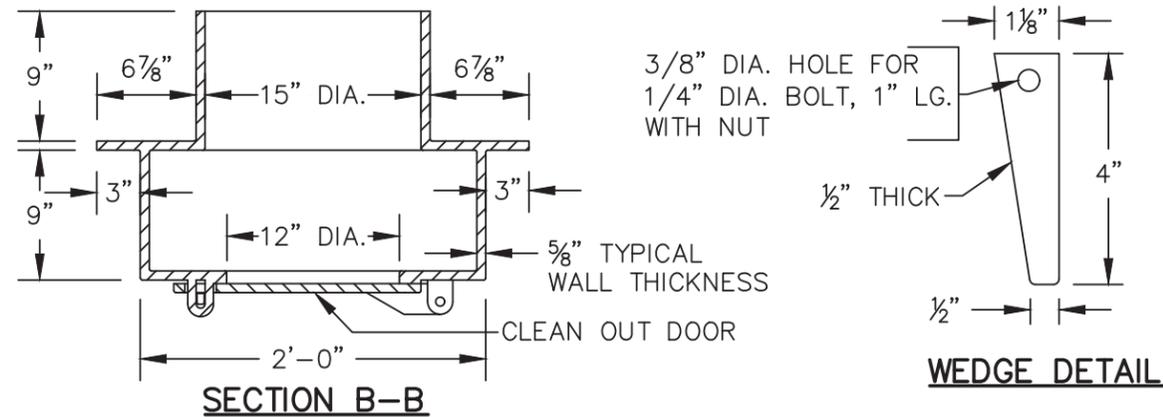
- QC-1: Precast Concrete

## Miscellaneous Comments



## TWO PIECE PRECAST CATCH BASIN

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-07
		REV.:	1



NOTE:  
TRAP AND DOOR ARE GRAY IRON. APPURTENANT MATERIALS  
ARE EITHER BRASS OR STAINLESS STEEL TYPE 304

# Detail – Inlet Trap

INLET-08

## Associated Details

- [INLET-06-A&B](#) – Inlet and Trap Installation

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.5](#): Traps, [D-23.5.1](#): Appurtenances
- See applicable specifications of associated details

## Approved Suppliers

- QC-2: Grey/Ductile Iron

## Miscellaneous Comments

- Weight per 1956 Std. Details is 456 lbs.

## Revision

	INLET TRAP		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: INLET-08	REV.: 0	

# Detail – Precast Concrete Inlet Hood

INLET-09

## Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly

## Applicable Specifications

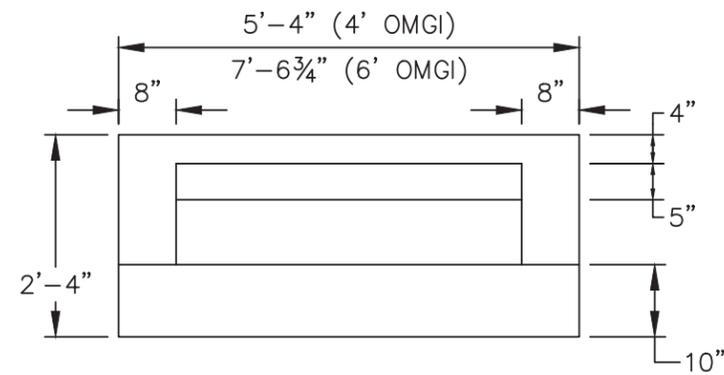
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.2](#): Precast Reinforced Concrete Hood
- See applicable specifications of associated details

## Approved Suppliers

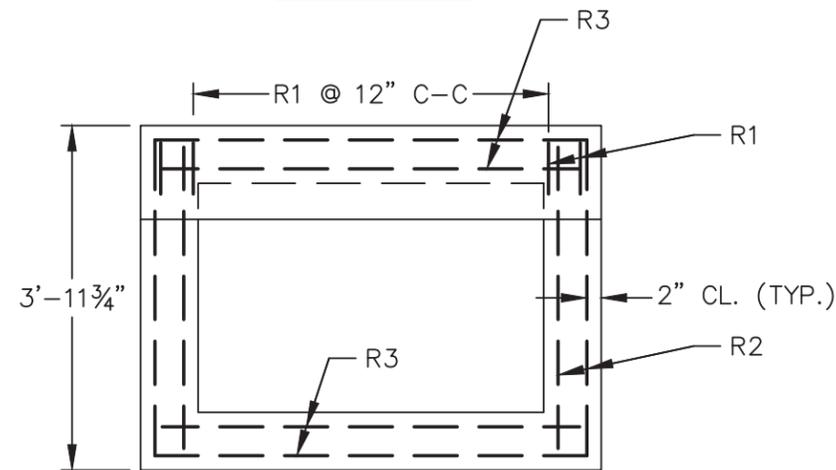
- QC-1: Precast Concrete

## Miscellaneous Comments

## Revision

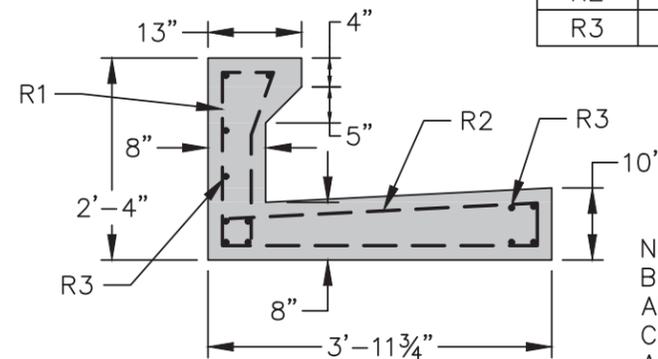


**FRONT VIEW**



**TOP VIEW**

	4' INLET		6' INLET	
	Qty.	Length	Qty.	Length
R1	7	4'-8"	9	4'-8"
R2	4	7'-9 1/2"	4	7'-9 1/2"
R3	12	5'-0"	12	7'-2 3/4"



**SECTION**

NOTE:  
BEND R1 & R2 AS SHOWN.  
ALL BARS NO. 4, GRADE 40.  
CONCRETE: 4,000 PSI,  
AIR-ENTRAINED



## PRECAST CONCRETE INLET HOOD

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-09
		REV.:	0

# Detail – Highway Grate and Gutter Grate Inlet Adjustment Risers

## INLET-10

### Associated Details

- [INLET-03](#) – Highway Grate Inlet Assembly
- [INLET-04](#) – Gutter Grate Inlet Assembly

### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.4](#): Precast Reinforced Concrete Inlet Adjustment Risers
- See applicable specifications of associated details

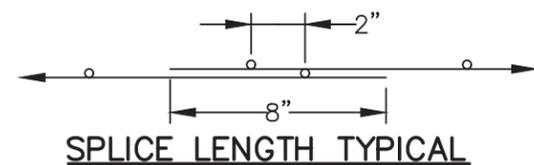
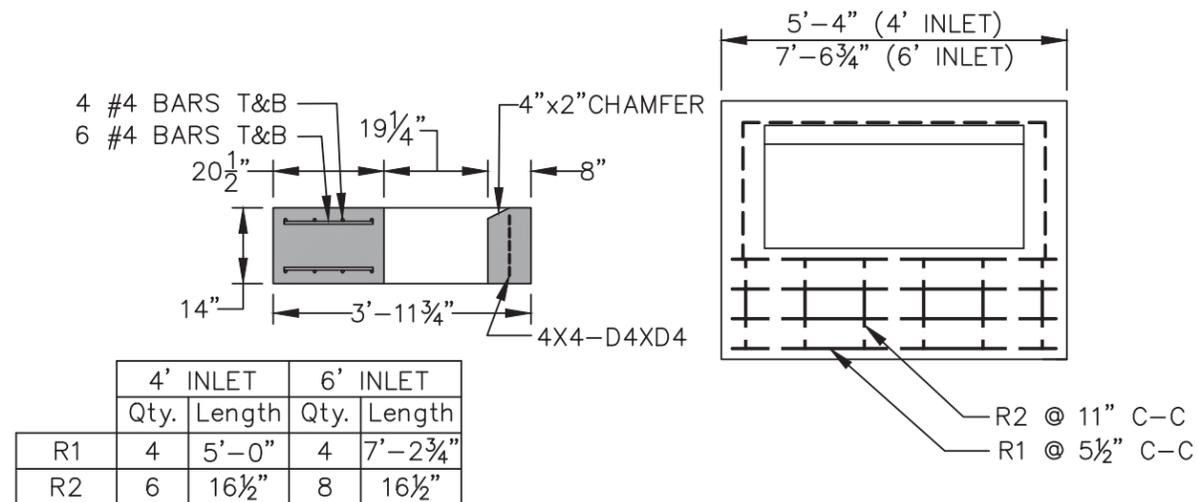
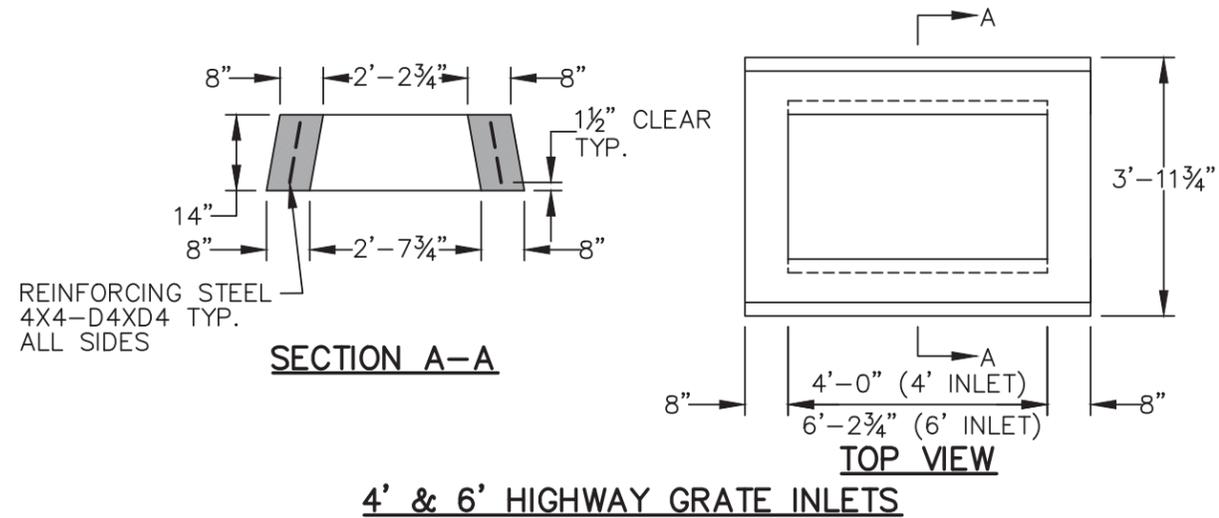
### Approved Suppliers

- QC-1: Precast Concrete

### Miscellaneous Comments

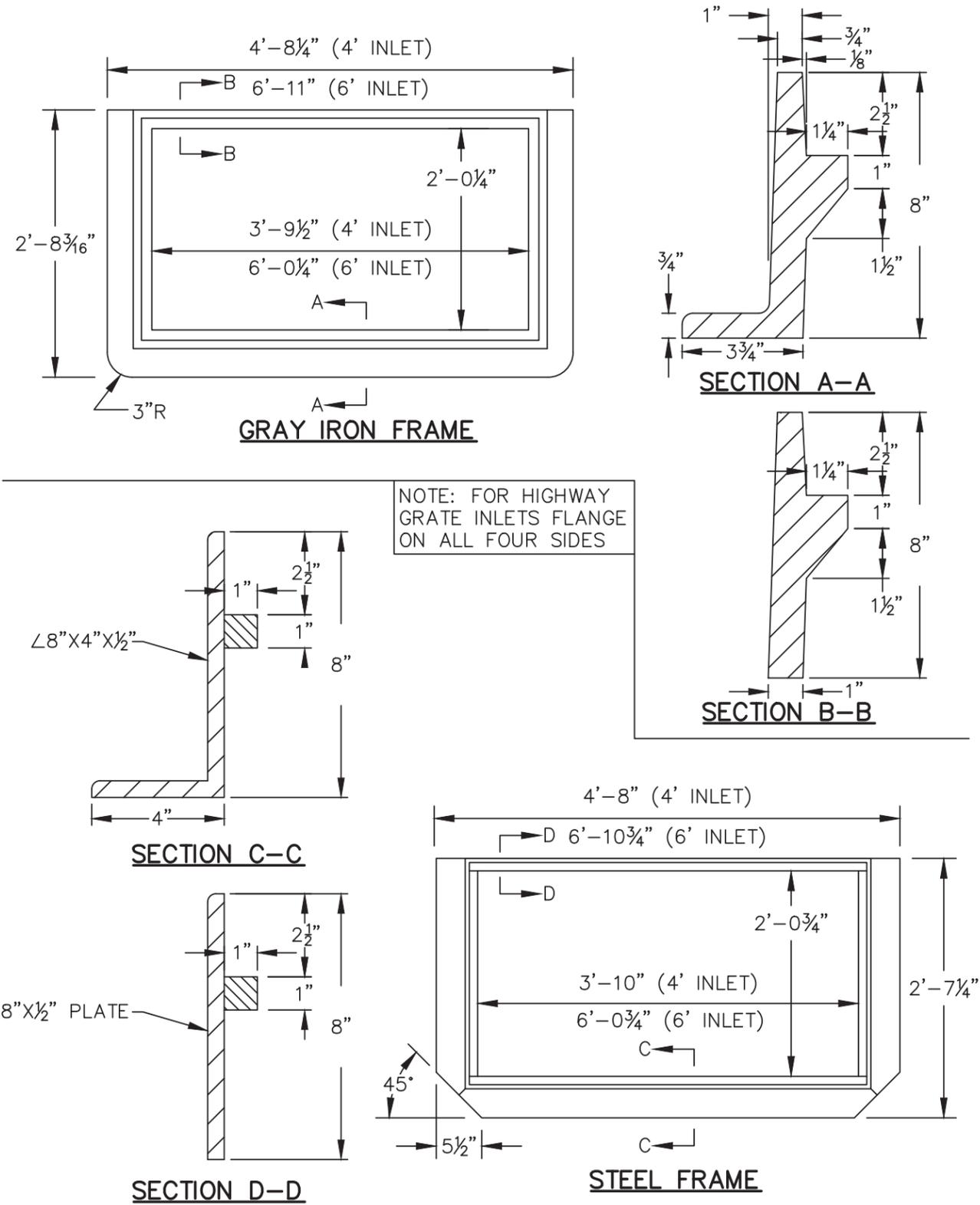
### Revision

Rev. 1 – Jan. 2019 – Increased height of riser sections.



NOTE:  
• CONCRETE TO BE 4,000 PSI, AIR ENTRAINED

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>HIGHWAY GRATE AND GUTTER</b> <b>GRATE INLET ADJUSTMENT RISERS</b>			
	DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
	CHECKED BY:	WD	DETAIL ID:	INLET-10
			REV.:	1



## Detail – Inlet Frames

### INLET-11

#### Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly
- [INLET-03](#) – Highway Grate Inlet Assembly
- [INLET-04](#) – Gutter Grate Inlet Assembly
- [INLET-12](#) – Inlet Grates

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.6](#): Grates and Frames, [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

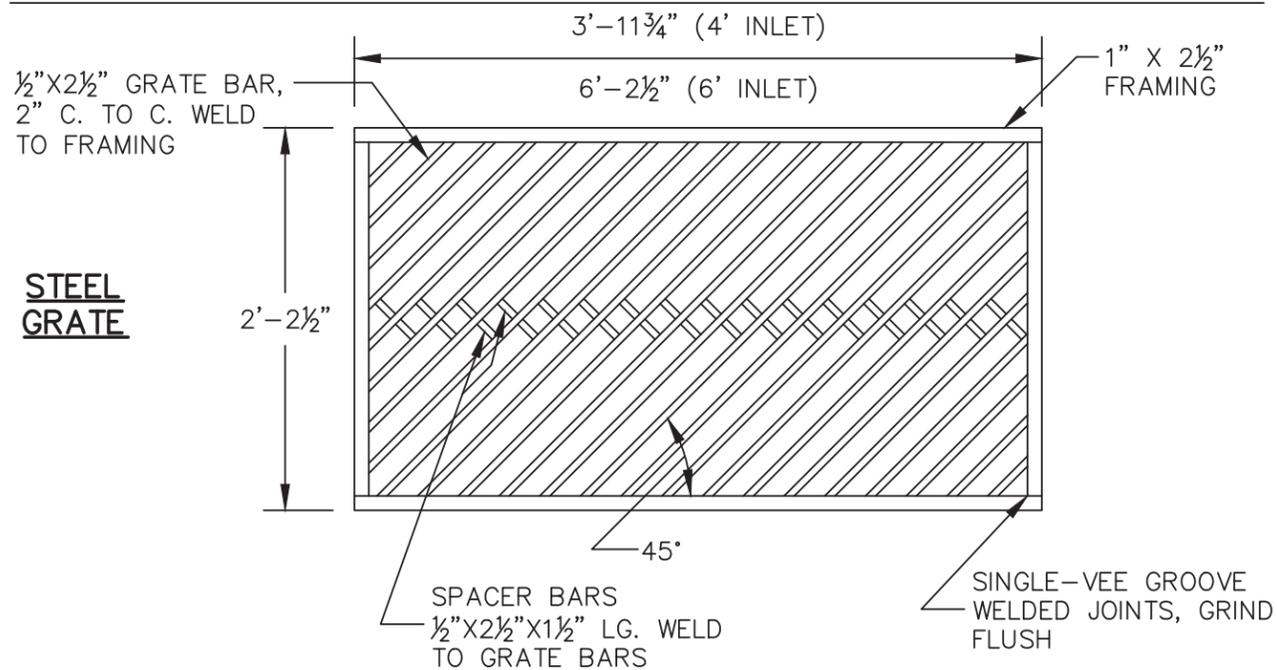
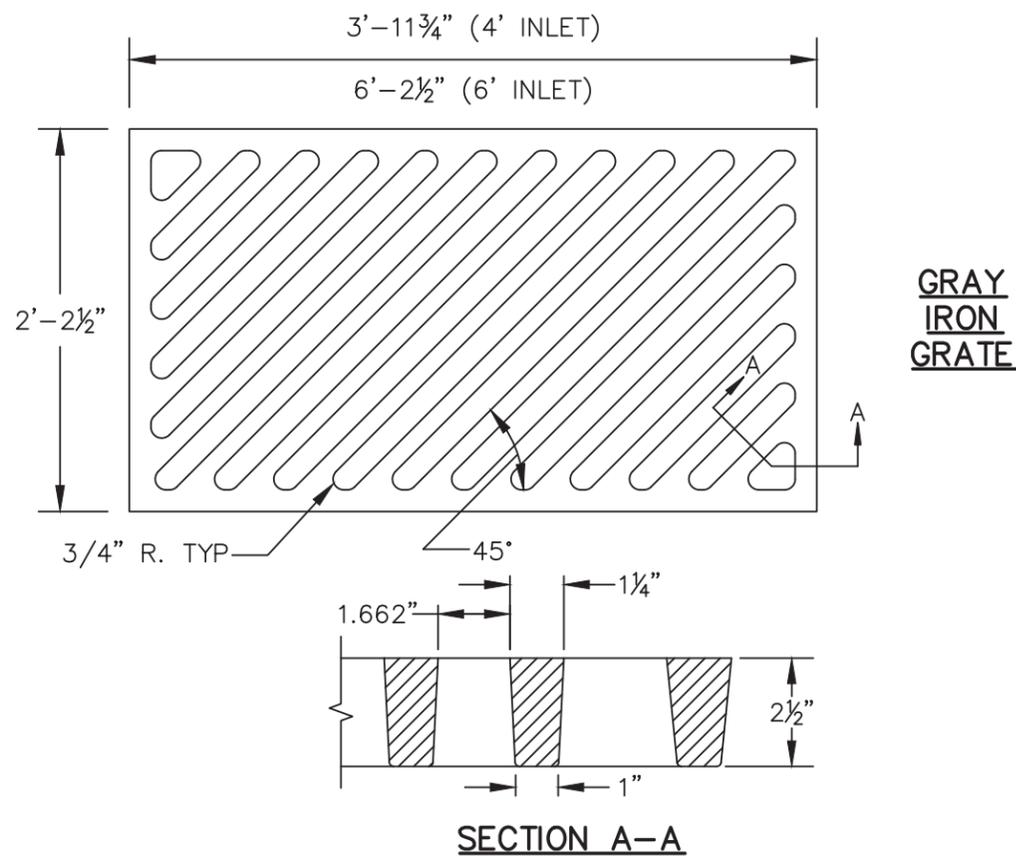
#### Approved Suppliers

- QC-4 Steel Frames & Grates

#### Miscellaneous Comments

#### Revision

<b>PHILADELPHIA</b> <b>WATER</b> DEPARTMENT	<b>INLET FRAMES</b>		
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019	
CHECKED BY: WD	DETAIL ID: INLET-11	REV.: 0	



FOR BICYCLE SAFE GRATE SEE PENNDOT PUBLICATION 72M – DETAIL RC-45M



## INLET GRATES

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-12
		REV.:	0

## Detail – Inlet Grates

### INLET-12

#### Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly
- [INLET-03](#) – Highway Grate Inlet Assembly
- [INLET-04](#) – Gutter Grate Inlet Assembly
- [INLET-11](#) – Inlet Frames

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.6](#): Grates and Frames, [D-23.8](#): Installation of Precast Inlets
- See applicable specifications of associated details

#### Approved Suppliers

- QC-4: Steel Frames & Grates

#### Miscellaneous Comments

- PennDOT Bicycle Safe Grate is located [here](#).

#### Revision

# Detail – Concrete Apron at Open Mouth Grate Inlet

INLET-13

## Associated Details

- [INLET-02](#) – Open Mouth Grate Inlet Assembly

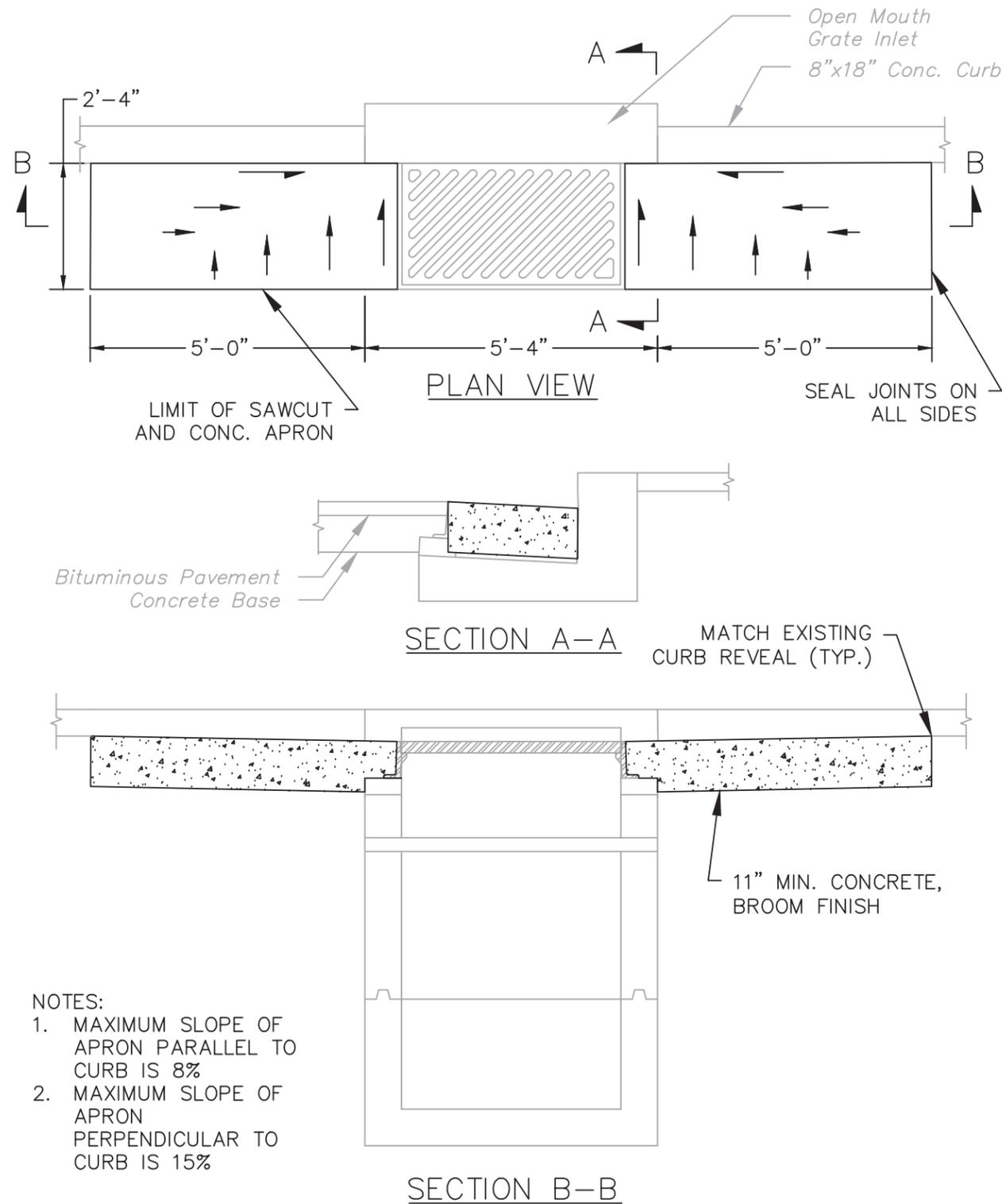
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See applicable specifications of associated details

## Approved Suppliers

## Miscellaneous Comments

## Revision



**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## CONCRETE APRON AT OPEN MOUTH GRATE INLET

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-13
		REV.:	NEW

# Detail – Open Mouth Inlet Adjustment Risers

INLET-14

## Associated Details

- [INLET-05](#) – Open Mouth Inlet Assembly

## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.4](#): Precast Reinforced Concrete Inlet Adjustment Risers
- See applicable specifications of associated details

## Approved Suppliers

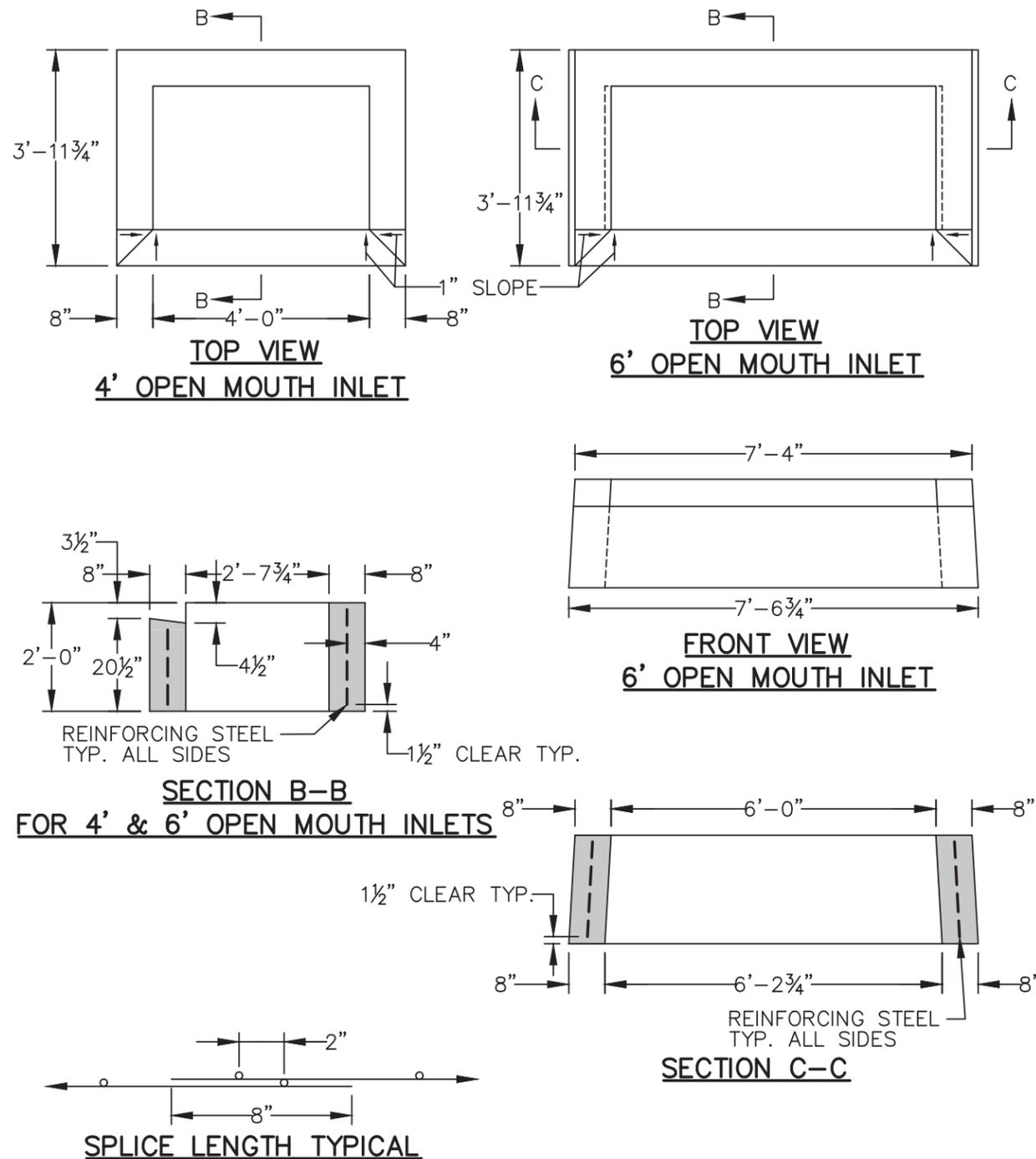
- QC-1: Precast Concrete

## Miscellaneous Comments

## Revision

Rev. 1 – Jan. 2019 – Increased height of riser section.

Rev. 2 – Sep. 2019 – Corrected erroneous 18" dimension callout denoting the height of the riser at the gutter to 20½". The existing total riser height of 2'-0" has not changed.

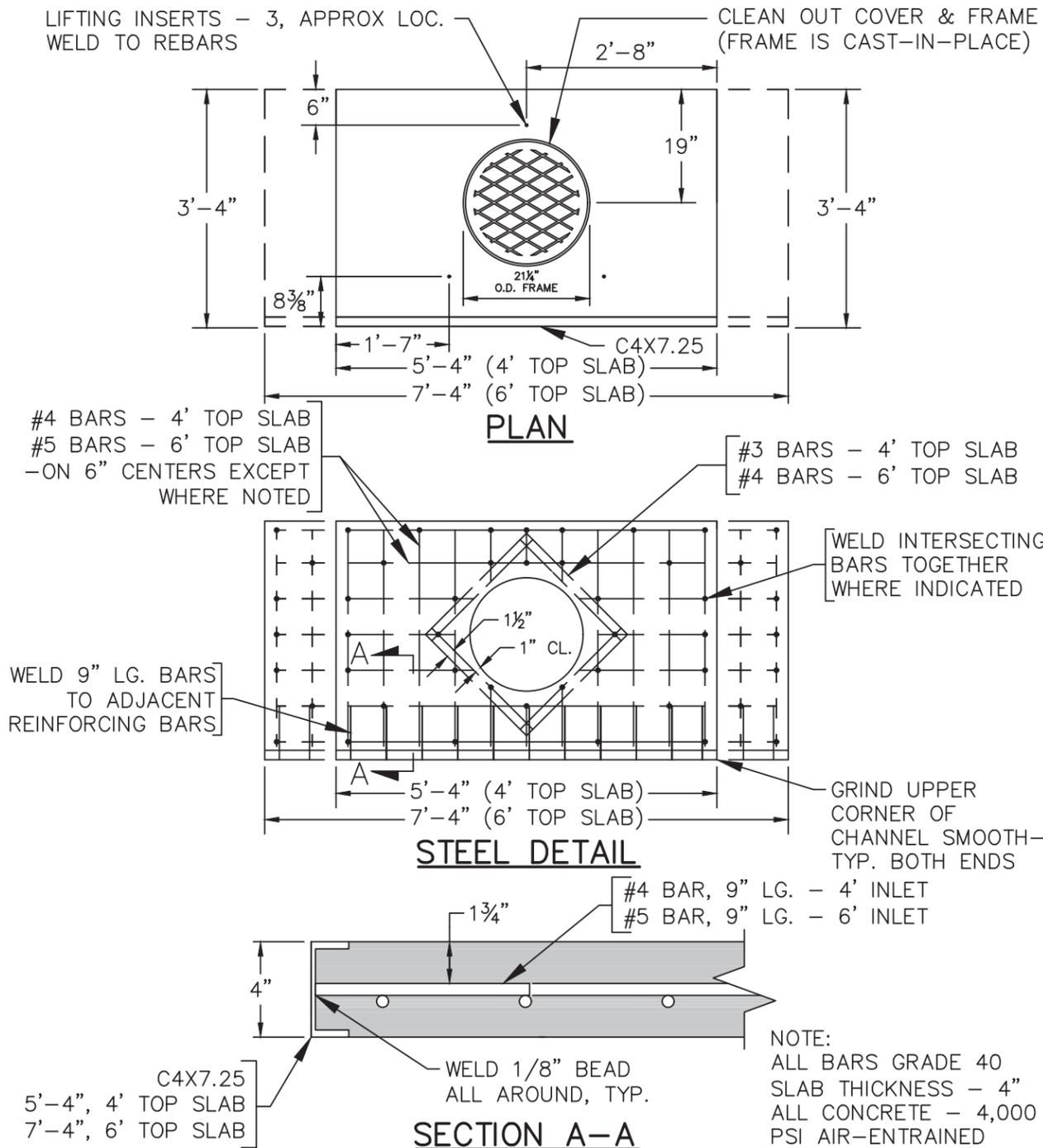


- NOTE:
- CONCRETE TO BE 4,000 PSI, AIR ENTRAINED
  - STEEL REINFORCING TO BE 4X4-D4XD4

**PHILADELPHIA**  
**WATER**  
DEPARTMENT

## OPEN MOUTH INLET ADJUSTMENT RISERS

DRAWN BY:	D&B GUARINO	DATE:	SEP. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-14
		REV.:	2



The curb nosing shall be a self-weathering steel channel and shall conform to ASTM A 242 Standard Specification for High-Strength Low Alloy Structural Steel or ASTM A 588 Standard Specification for High-Strength Low Alloy Structural Steel with 50 ksi Minimum Yield Point to 4 inches thick.

## Detail - Precast Concrete Top Slabs

### INLET-15

#### Associated Details

- [INLET-05](#) - Open Mouth Inlet Assembly

#### Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.3](#): Precast Reinforced Concrete Top Slabs, [D-23.3.1](#): Curb Nosing, [D-23.3.2](#): Lifting Inserts
- See applicable specifications of associated details

#### Approved Suppliers

#### Miscellaneous Comments

#### Revision

## Detail – Top Slab Clean-Out Cover & Frame

INLET-016

### Associated Details

- [INLET-15](#) – Precast Concrete Top Slabs

### Applicable Specifications

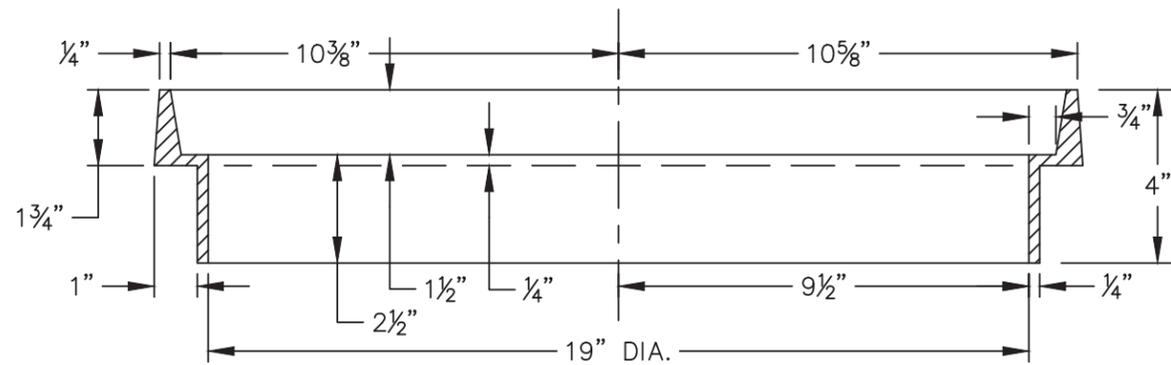
- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- [D-23.7](#): Clean-Out Covers and Frames
- See applicable specifications of associated details

### Approved Suppliers

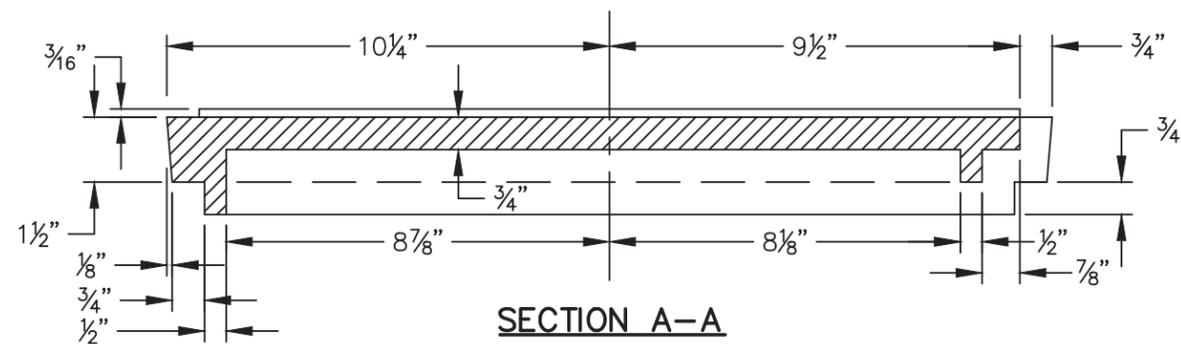
### Miscellaneous Comments

- Weights per 1956 Std. Details are
  - Cover: 59 lbs.
  - Frame: 21 lbs.

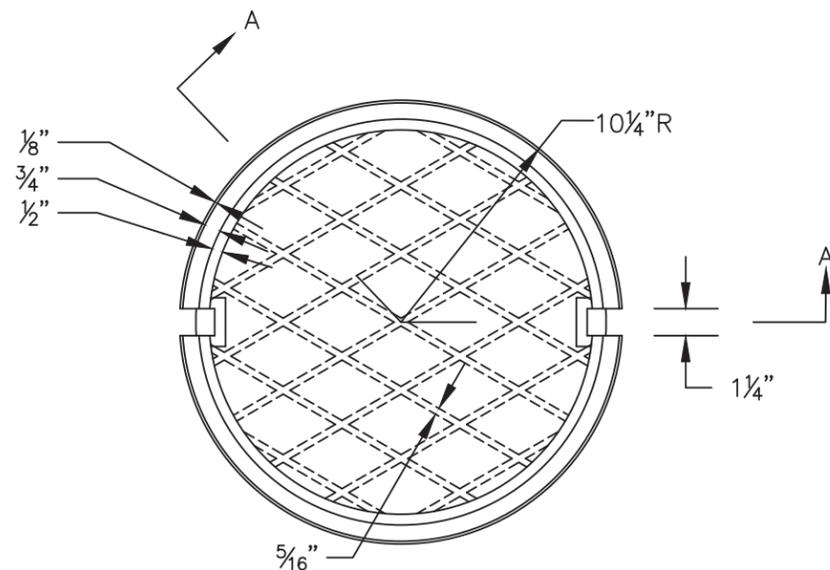
### Revision



**CROSS SECTION OF FRAME**



**SECTION A-A**



**BOTTOM VIEW OF COVER**

<b>PHILADELPHIA WATER DEPARTMENT</b>	<b>TOP SLAB CLEAN OUT COVER AND FRAME</b>			
	DRAWN BY: D&B GUARINO	DATE: JAN. 2019		
CHECKED BY: WD	DETAIL ID: INLET-16	REV.: 0		

# Detail – Concrete Apron at Open Mouth Grate Inlet

INLET-17

## Associated Details

- [INLET-05](#) – Open Mouth Inlet Assembly

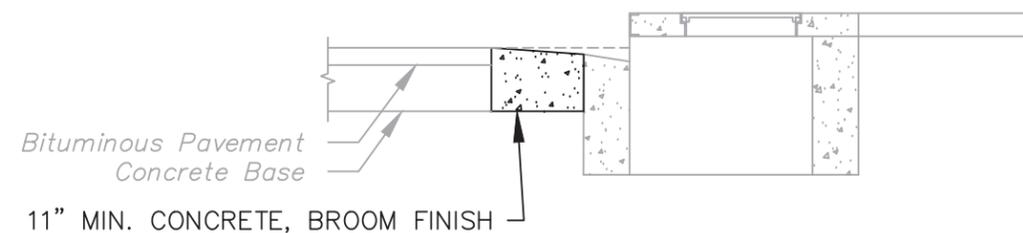
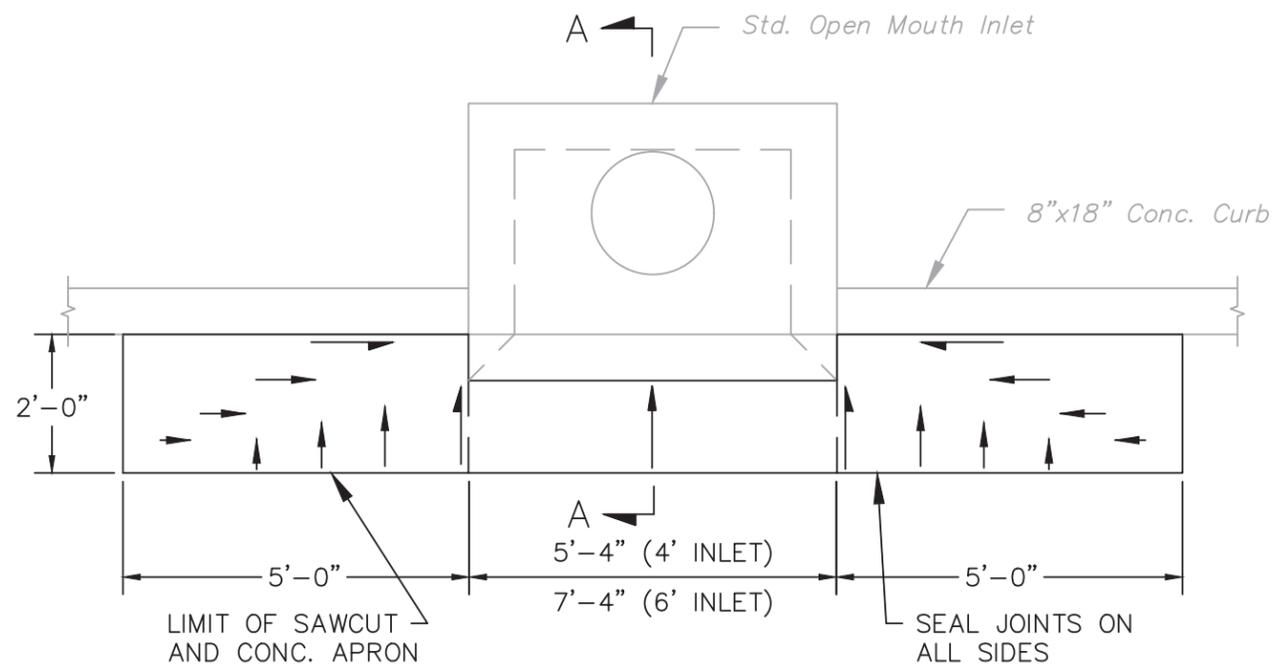
## Applicable Specifications

- [D-1](#): General, [D-2](#): Standard Details, [D-3](#): Abbreviations and Definitions, [D-4](#): Requirements, Tests and Inspections
- See applicable specifications of associated details

## Approved Suppliers

## Miscellaneous Comments

## Revision



SECTION A-A

**NOTES:**

1. MAXIMUM SLOPE OF APRON PARALLEL TO CURB IS 8%
2. MAXIMUM SLOPE OF APRON PERPENDICULAR TO CURB IS 15%

**PHILADELPHIA  
WATER  
DEPARTMENT**

## CONCRETE APRON AT OPEN MOUTH INLET

DRAWN BY:	D&B GUARINO	DATE:	JAN. 2019
CHECKED BY:	WD	DETAIL ID:	INLET-17
		REV.:	NEW

### **D-1 GENERAL**

These specifications shall apply to all sewers and/or stormwater conduits that are constructed for the City of Philadelphia or that are paid for by private cost and inspected by the Water Department. All sewers and/or stormwater conduits that will or that may eventually be maintained by the City must be inspected by the Water Department.

### **D-2 STANDARD DETAILS**

The Philadelphia Water Department's Standard Details for Sewers shall apply to sewers and/or stormwater conduits constructed under these specifications, except where the Standard Details are modified by the Plans or Specified Specifications of work, whereupon the Contractor will be required to construct the section, as modified in the Plans or Specifications, at the prices bid in the Proposal.

### **D-3 ABBREVIATIONS AND DEFINITIONS**

The following abbreviations have been used throughout these specifications:

ACI	-	American Concrete Institute
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASTM	-	ASTM International (formerly American Society for Testing and Materials)
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CRD	-	Capstone Requirements Document (Army Corps of Engineers)
DIPRA	-	Ductile Iron Pipe Research Association
FTMS	-	Federal Test Method Standard
PWD	-	Philadelphia Water Department
QCS	-	(PWD) Quality Control Standard

The following definitions have been used throughout these specifications:

City	-	City of Philadelphia
Engineer	-	General Manager of Planning and Engineering of the Water Department or his duly authorized representative
Inspector	-	A representative of the Engineer responsible for inspection
Construction	-	New construction and reconstruction
Sanitary Sewer	-	A sewer that carries sewage only
Combined Sewer	-	A sewer that carries sewage and stormwater
Stormwater Conduit	-	A conduit that carries stormwater only
Separate System	-	A collection system that consists of a separate stormwater conduit and a sanitary sewer.
Interceptor or Intercepting Sewer	-	A main branch of the collection system that leads directly to another interceptor or a water pollution control plant.
Standard Details for Sewers	-	The Philadelphia Water Department's Standard details that are included with this publication.

### **D-4 REQUIREMENTS, TESTS AND INSPECTIONS**

All materials used in Water Department contracts for the construction of sewers and stormwater conduits shall conform to the requirements as noted in the Standard Details for Sewers, and these specifications, except where noted on the Plans or revised in the Contract Specifications.

Materials shall be obtained from suppliers on the "Lists of Approved Suppliers of Materials for Water Department Contracts". The Contractor shall submit to the Engineer his/her list of suppliers for the Contract.

All materials shall be tested for conformance to the current specifications, and in accordance with the current standard test methods, of technical societies, institutes, associations or Federal and State specifications, as called for in these specifications, in the Contract Specifications or as called for by the Engineer. Current specifications and current standard test methods are defined as the latest editions, amendments or revisions that are current at the time of the receipt of bids. The Contractor shall transport, without charge, the test specimens to the Materials Testing Laboratory of the Water Department.

Construction of sewers, stormwater conduits and appurtenances shall be inspected by the Water Department. Final inspection may be made by use of a closed circuit television system. The Contractor will be required to assist the Inspector in making this inspection. See City Standard Contract Requirement for additional information regarding inspection.

All work shall be done in accordance with the Standard Details and Standard Specifications for Sewers except if directed by the engineer.

### **D-5 LINES AND GRADES**

All pipes and reinforced concrete sections shall be laid in an upstream direction to the line and grades furnished by the Engineer. All pipes shall be laid with the bell end upgrade. All pipes and reinforced concrete sections, when laid together, shall make a continuous and uniform line with a smooth, regular interior surface.

### **D-6 WIDTH OF TRENCHES**

The width of the trenches for sewers shall be the outside edge of the cradle as detailed in the current Standard Details for Sewers or as shown on the plans. The width of the trenches for pipe(s) not in concrete cradle shall be as shown on Typical Street Section (PIPE-04) or as shown on the plans.

### **D-7 INSTALLATION OF PIPES**

Care shall be taken in placing the pipe into the trench to prevent damaging the joints or joint-material and to prevent disturbing the trench.

The manufacturer's recommendations for pipe assembly must be closely followed. Care must be taken to clean the mating surfaces of the joints before jointing. The jointing surfaces shall be lubricated as recommended by the manufacturer. The pipe ends shall be aligned and assembled by hand, bar or the use of come-along. In all instances the ends of the pipe must be protected against damage.

#### **D-8 PROTECTION OF PIPES**

The mouth of the pipes, in the trenches, shall be carefully protected from blasts, rock falls or damage from any other source. In all cases the excavation shall be fully completed at least thirty feet in advance of laying the pipe. In addition, the mouth of the pipes shall be provided with means to prevent earth or any other substance other than sewage or stormwater from entering. Except when pipes are actively being laid, a metal debris grill with a maximum of 6" x 6" openings shall be positioned over the mouth of the pipes in order to prevent any substance other than sewage or stormwater from entering the sewer or stormwater conduit.

#### **D-9 LENGTH OF PIPES**

All pipes used in the construction of sewers, stormwater conduits and other connects shall be the maximum length produced, except where shorter lengths are required for closures, curved sewers or to secure proper locations for laterals or inlet connections.

#### **D-10 PROVISIONS FOR LATERAL CONNECTIONS**

Unless otherwise specified, provisions shall be made for lateral connections on each side of the sewer and/or stormwater conduit in accordance with existing or proposed building developments.

Laterals shall be constructed to have a minimum 2% slope -with no bellies between the curb line and the connection at the sewer or stormwater conduit. Bends shall be included with the lateral so that the tie-ins are square at the points of connection to the lateral (or trap) and also to the saddle connection or wye branch in the sewer or stormwater conduit. The maximum joint deflection in laterals shall be three eighths of an inch.

The depth of laterals at the curb line, for branch sewer projects or sewers in newly developing areas, shall be 7 feet unless otherwise specified.

The depth of laterals at the curb line, for sewer reconstruction projects, shall be as required to make the connection to the existing traps. Only active laterals or laterals servicing buildings shall be connected to sewers.

#### **D-11 MEASUREMENT FOR PAYMENT**

Unless otherwise noted on the Plans or in the Contract Specifications, all distances shown on the Plans are in District Standard measurements. Payment for all the lengths of work will be based upon that standard.

Inlet, lateral and drain connections shall be paid for by linear measurement. No extra allowance will be made for the necessary bends and branches.

#### **D-12 FILLING ABANDONED SEWERS**

Where existing sewers are reconstructed in another location, the abandoned sewer shall be completely filled after the ends are sealed. Abandoned sewers shall be filled through their manholes or an opening to not exceed 20 square feet in area at the low point of the sewer.

Materials for filling abandoned sewers shall be a 25PCF wet cast density cellular concrete with an average compressive strength of 70psi at 28 days. It shall have high flowability characteristics and between 20 and 25% air content. It shall consist of Portland cement, water and an additive to produce the air content. It shall have a 0.5 water:cement ratio. No aggregate, fly ash or slag shall be added. It shall be pumped from the low point to the high point after appropriate bulkheads are constructed unless otherwise noted on the Plans and/or in the Contract Specifications for the work.

Pipes 15 inches in diameter and under are not required to be filled.

#### **D-13 FILLING ABANDONED MANHOLES**

Unless otherwise noted on the Plans existing manholes on sewers to be abandoned shall be removed to 4 feet below the surface of the street. The remaining portion of the manhole shall be filled with cellular concrete as specified in D-12 or with selected earth materials placed in 6" lifts and compacted to 95% proctor density, after the sewer is filled.

#### **D-14 FILLING ABANDONED INLETS**

Where an inlet location is to be changed the existing inlet shall be abandoned and filled. The top of the existing inlet, including brick masonry and castings, shall be removed to a depth of the 12 inches below the roadway paving. The cast iron trap shall be removed, the outlet pipe sealed with brick masonry and the basin of the inlet filled with cellular concrete as specified in D-12 or with selected earth materials placed in 6" lifts and compacted to 95% proctor density, to the level of the footway paving subgrade or roadway paving. The castings shall be hauled to the Sewer Maintenance Storage Yard at 3257 FOX ST. Phila, PA 19129 unless otherwise stated in the Contract Specifications.

#### **D-15.0 VITRIFIED CLAY PIPE**

Vitrified clay pipe used in the construction of sewers, connections and other fittings, including bends, cut curves and wye branches, shall be extra strength clay pipe, and shall conform to ASTM C700 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated. It shall be tested in accordance with ASTM C 301 Standard Methods of Testing Vitrified Clay Pipe. Tables 1 and 2 of ASTM C 700 shall be modified to include 5 inch diameter pipe. The values for the 5 inch diameter pipe shall be the same as those shown for the 6 inch diameter pipe. Manufacturers shall also be certified in accordance with QC-9 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

#### **D-15.1 Compression Joints**

All vitrified clay pipes used in the construction of sewers and connections shall have gasket joints. The joints and joint materials shall conform to ASTM C 425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings. The use of polyvinyl chloride (PVC) for the outside sheath (bell) of the compression joints will not be permitted.

### **D-15.2 Installing Pipes**

All vitrified clay pipes shall be installed in accordance with ASTM C 12 Standard Recommended Practice for Installing Vitrified Clay Pipe Lines. Pipe sewers in concrete cradles shall be constructed as detailed in the Standard Details for Sewers. Pipes not in concrete cradles shall have class D bedding.

### **D-15.3 Changes in Alignment**

All changes in alignment in vitrified clay pipe sewers shall be at manholes. No bends are permitted.

### **D-15.4 Connections**

Existing laterals shall be connected to vitrified clay pipe with wye branches.

Provisions shall be made for future lateral connections by the use of wye branches and stoppers. No extra payment will be made for the stoppers.

All spur and inlet connections shall be made with wye branches.

### **D-16.0 REINFORCED CONCRETE PIPE**

Circular reinforced concrete pipe used in the construction of sewers and/or stormwater conduits, including wye branches, bends and fittings, shall conform to ASTM C76 Standard Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Class III, Wall B. Quadrant reinforcing of the pipe will not be permitted. Manufacturers shall also be certified in accordance with QC-6 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Elliptical reinforced concrete pipe used in the construction of sewers and/or stormwater conduits, including wye branches, bends and fittings shall conform to ASTM C507 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe, Class HE-111 or Class VE-111.

### **D-16.1 Compression Joints**

All reinforced concrete pipe used in the construction of sewers and/or stormwater conduits shall have rubber gasket joints. The joints and the gasket materials shall conform to ASTM C443 Standard Specification for joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets. The Joints shall consist of a bell or groove on one end of a unit of pipe and a spigot or tongue on the adjacent end of the joining pipe.

### **D-16.2 Installing Pipe**

After the pipes are placed in the trench, they shall be prepared for coupling by thoroughly cleaning and then lubricating the joint. For pipes manufactured to accept "O" ring gaskets, they shall be lubricated as recommended by the manufacturer. The gasket shall be placed in the groove and the tension shall be equalized by inserting a suitable tool under the gasket and running it around the pipes 3 times.

For pipes manufactured to accept fin type gaskets, the inside surface of the bell or groove and the gasket shall be lubricated as recommended by the manufacturer.

After the joint is lubricated, the pipes shall be coupled immediately. The pipes shall be pulled up tightly by using a winch, come-along or other appropriate method. A visual check shall be made to see the pipe is properly connected.

Lift holes in pipes are prohibited.

### **D-16.3 Changes in Alignment**

All changes of directions in reinforced concrete pipe that exceed allowable joint deflection shall be made with factory manufactured bends. Field fabricated bends are not permitted.

### **D-16.4 Connections**

Factory manufactured wye branches shall be used to connect intersecting reinforced concrete pipe sewers, stormwater conduits, spurs and drains to the main sewer or stormwater conduit. Field fabricated wye branches and connections are not permitted.

Inlet pipes, vent pipes and laterals, 10 inches in diameter and over, shall be connected to reinforced concrete pipe, 27 inches in diameter and under with factory manufactured wye branches.

Inlet pipes, vent pipes and laterals, 10 inches in diameter and over, shall be connected to reinforced concrete pipe, 30 inches in diameter and over with factory manufactured wye branches or saddles.

Laterals, 8 inches in diameter and under, shall be connected to reinforced concrete pipe with a saddle connection.

The use of a maul to create openings in the reinforced concrete pipe for saddles or inserts is not permitted. All openings in the reinforced concrete pipe shall be cored with the use of a coring machine. Saddle connections shall be grouted around the opening.

### **D-17.0 CAST-IN-PLACE, REINFORCED CONCRETE SEWERS, STORMWATER CONDUITS AND SPECIAL SECTIONS**

Cast-in-place, reinforced concrete sewers, stormwater conduits and special sections, such as junction chambers, intercepting chambers and flares, shall be designed and constructed as recommended by ACI 350 Concrete Sanitary Engineering Structures. The concrete shall be watertight and resistant to naturally occurring and commonly used chemicals. The concrete shall be ready-mixed and shall be batched, mixed and transported in accordance with ASTM C 94 Standard Specifications for Ready-Mixed Concrete.

The reinforcement shall be deformed steel bars that are rolled from new billet-steel and shall conform to ASTM A 615 Standard Specifications for Deformed and Plain Billet-Steel Bars for concrete Reinforcement. The bars shall be tested in accordance with ASTM A 370 Standard Methods and Definitions for Mechanical Testing of Steel Products. Bar sizes up to #6 may be Grade 40. Bar sizes #7 through #11 shall be Grade 60. Grade 40 and Grade 60 reinforcing bars shall not be mixed for main steel. Grade 60 shall take precedence.

### D-17.1 Construction Joints

Longitudinal construction joints shall be used in the sidewalls. Transverse construction joints shall be constructed at the end of each section at a distance not to exceed 50 feet. Transverse and longitudinal construction joints shall have a keyway 2 inches deep and 4 inches wide and a PVC ribbed type waterstop.

### D-17.2 PVC Ribbed Type Waterstops

The material used for waterstops shall be formulated from virgin polyvinyl chloride (PVC) without pigments, and shall conform to the following:

Hardness—Shore A durometer hardness shall be 80±5 per ASTM D 2240.

Elongation—The elongation shall be a minimum of 350% per ASTM D 638.

Tensile Strength—The strength shall be a minimum of 2000 pounds per square inch per ASTM D 638.

100% Modulus –The 100% Modulus shall be a minimum of 725 pounds per square inch per ASTM D 638.

Water Absorption – the water absorption shall be a maximum of 0.15% by weight per ASTM D 570.

Waterstops shall also conform to CRD-C 572 requirements.

Unless specified, a waterstop profile shall be selected and submitted by the contractor to suit the requirements of the Joint.

-For non-movement joints where 100% of rebar is spliced across the joint, use a flat ribbed water stop minimum **9 inches wide and 3/8 inch thick**.

-For movement joints use a ribbed centerbulb or ribbed tear-web profile minimum 9 inches wide and 3/8 inch thick. Select a profile with bulb inside diameter no less than the anticipated joint movement.

-In any case, provide a waterstop with a head pressure rating no less than 150 feet and ribs no less than 1/8 inch high.

#### D-17.2.1 Installation of Waterstops

Waterstops shall be installed as recommended by ACI 504 Guide to Joint Sealants for Concrete Structure, according to all manufacturer's recommended procedures, and as follows.

Waterstops shall be securely held in position so that they are not displaced during concreting operations. Center the width of the waterstop on the joint. If not otherwise specified, locate the waterstop at mid-thickness of the concrete pour. Do not pierce the waterstop. Utilize hog-rings, a profile with integral holes or eyelets, or another approved method to secure the waterstop. Thoroughly and systematically vibrate concrete around waterstop to avoid air entrapment and to provide a positive contact between the waterstop and the concrete. Care shall be taken to avoid tearing waterstops and to

keep waterstop from being contaminated with dirt, form coating, or other foreign substances. Damaged or contaminated waterstops will be cleaned, repaired, or replaced prior to pouring concrete.

Waterstops shall be made continuous. **Factory fabricated waterstop fittings (Flat Crosses)** shall be used to splice the intersections of each longitudinal construction joint to each transverse construction joint. **Factory fabricated waterstop fittings (Vertical Ells)** shall be used at the corners of transverse construction joints. Additionally, factory fabricated fittings shall be used at any abrupt change in direction. Lapping of waterstops will not be accepted under any circumstances. Straight butt joint splices shall be joined by using a Teflon covered thermostatically controlled waterstop splicing iron recommended by the waterstop manufacturer at approx. 380° F. The procedures, tools, and fittings as prescribed by the manufacturer of the waterstops shall be followed.

### D-17.3 Inverts

The inverts of rectangular concrete sewers shall be constructed with a 156° vee shape at 12° off the horizontal. Rectangular reinforced concrete stormwater conduits shall be constructed with flat inverts.

Steel troweled concrete inverts may be used for velocities of flow from 2-1/2 feet per second to 12 feet per second. For flows between 12 feet per second and 15 feet per second a coating or special consideration will be required. Under no circumstances shall velocities of flow exceed 15 feet per second for full flows.

It is extremely important to maintain lines and grades and to avoid dips.

#### D-17.3.1 Stone Blocks

A stone block invert shall consist of granite or trap rock block with square heads and sides as follows: depth 6 to 7 inches; length, 10 to 14 inches; width, 3-1/2 to 5 inches. The block shall be sorted at the quarry and delivered in a uniform size. All faces of the block shall be true, parallel, not warped and free of lumps, protuberances, depressions and inequalities exceeding 1/4 inch. Blocks of equal width shall be laid in a continuous course. Worn paving blocks shall not be used. The joints between the blocks shall be filled with an acid resistant mortar as described in Section D-17.3.3, struck smooth, after the blocks are set.

#### D-17.3.2 Redressed Blocks

Redressed granite blocks shall consist of selected granite blocks cut or split to the dimensions required below and so dressed as to have the top and side faces substantially rectangular in shape in order to form, when laid, end and side joints not exceeding 1/2 inch in width.

The blocks after dressing shall be 5 to 6-1/2 inches in length, 3-1/2 to 5 inches width and shall have a depth of 4-3/4 to 5-1/4 inches, averaging 5 inches as determined by gauging at the time of cutting. Blocks shall not vary in depth by more than 1/2 inch. The heads of blocks shall not show irregularities after redressing exceeding 3/8 of an inch.

The joints between the blocks shall be filled with an acid resistant mortar as described in Section D-17.3.3, struck smooth, after the blocks are set.

### **D-17.3.3 Mortar**

The acid resistant mortar shall be a potassium silicate liquid binder and shall be manufactured and tested in accordance with ASTM C 466 Standard Specification for Chemically Setting Silicate and Silica Chemical-Resistant Mortars.

The invert shall be cleaned of all excess mortar before the sewer or stormwater conduit is put into service.

### **D-18.0 PRECAST, REINFORCED CONCRETE SEWERS AND STORMWATER CONDUITS**

Precast reinforced concrete sections used in the construction of sewers and/or stormwater conduits, including bends and other fittings, shall conform to ASTM C 789 Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm, Drains and Sewers.

#### **D-18.1 Joints**

All precast reinforced concrete box sections shall have tongue and groove or lap joints. The joints shall be made so that when the sections are laid together they will form a continuous line with a smooth interior that is free of appreciable irregularities.

The materials used in the joints shall be non-porous and not affected by materials found in sewage. Joints shall be designed to prevent infiltration and exfiltration. The manufacturer shall furnish the City with a detailed design of the watertight joint to be used. The manufacturer shall furnish the City and the Contractor with proper handling, storage and installation procedures.

#### **D-18.1.1 Performance Requirements for Joints**

The city will require that assembled joints pass the following performance tests without leakage at the joints.

- A. Box Sections in straight Alignment—Hydrostatic pressure tests on joints shall be made on the assembly of two box sections, properly connected in accordance with the joint design. A second such test may be required. Suitable bulkheads may be provided within the box section adjacent to and on either side of the joint, or the outer ends of the two joints box sections may be bulkhead. No mortar or concrete coatings, fillings, or packings shall be placed prior to water tightness tests. After the box sections are fitted together with the proper joint design in place, the assembly shall be subjected to an internal hydrostatic pressure of 13psi (90kPa) (30ft) (9.14m) pressure head for 10 min. Moisture or beads of water appearing on the surface of the joint will not be considered as leakage. Should leakage of the joints initially occur, the manufacturer shall have the option to extend the test period up to 24 hours.
- B. Box Sections in Maximum Deflected Position—Upon completion of the test box section in straight alignment, the test sections shall be deflected to create a position 1/2 in. (12.7mm) wider than the assembled position on one side of the outside perimeter. The joint shall be subjected to an internal hydrostatic pressure of 10 psi (69kPa) for 10 min. Moisture beads of water appearing on the surface of the joint will not be considered as leakage.

### **D-18.1.2 Additional Requirements**

Additional joint requirements shall apply as they are developed and/or recognized by the City.

#### **D-18.2 Inverts**

The inverts of precast rectangular reinforced concrete sewers shall be constructed with a 156° vee shape at 12° off the horizontal. Precast rectangular reinforced concrete stormwater conduits shall be constructed with flat inverts.

### **D-19.0 DUCTILE IRON PIPE**

Ductile iron pipe used in the construction of sewers and laterals including bends, wye branches and other fittings, shall be manufactured and tested in accordance with the American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquid, ANSI/AWWA C151/A21.51.

In addition to the standard acceptance test specified in ANSI/AWWA C151/A21.51, the manufacturer shall perform either the ball impression test or the ring test to ascertain and assure the ductility of the pipe. Manufacturers shall also be certified in accordance with QC-8 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Unless otherwise noted in the Contract Specifications the pipe shall be Class 56 for pipe 12" in diameter and smaller and Class 54 for pipe larger than 12" in diameter. The interior of the pipes and fittings shall be cement lined and seal coated. The exterior of the pipes and fittings shall be bituminous coated. The cement lining and coating shall be in accordance with the American National Standard for Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4 and shall be 1/8 inch thick for pipe sizes 3 inches diameter to 12 inches diameter inclusive.

#### **D-19.1 Compression Joints**

All ductile iron pipes and fittings used in the construction of sewers, including bends and wye branches shall have gasket joints. Unless otherwise noted in the Contract Specifications, the pipe and fittings shall have push on joints.

The gaskets shall be manufactured and tested in accordance with the American National Standard for Rubber-Gasket Joints for Cast Iron and Ductile Iron Pressure Pipes and Fittings, ANSI/AWWA A21.11/C111.

The outside edges of field cut pipes and fittings shall be beveled back 1/8 inch from the cut edges on a 30-degree angle in order to avoid damaging the gasket.

#### **D-19.2 Installing Pipe**

The pipe shall be installed as described in the Ductile Iron Pipe Research Association's "Guide for the Installation of Ductile Iron Pipe".

## **D-20.0 CAST IRON SOIL PIPE**

Where called for on the Plans or where directed by the Engineer, cast iron soil pipe shall be used for laterals, vent pipes, and inlets connections. The cast iron soil pipe shall be manufactured and tested in accordance with ASTM A 74 Standard Specification for Cast Iron Soil Pipe and Fittings, Service, Size, Single Hub. The pipe shall have nominal laying lengths of 5 feet and 10 feet all size diameters.

### **D-20.1 Compression Joints**

Joints in cast iron soil pipes and fittings shall be sealed with pre-formed rubber gaskets. The gaskets shall be manufactured and tested in accordance with ASTM C 564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

## **D-21.0 MANHOLES**

Manholes shall be brick, cast-in-place concrete, or precast reinforced concrete manhole sections. Manholes built into sanitary sewers with inverts below elevation 0.00 City datum or into any intercepting sewers shall be restricted to cast-in-place concrete or precast reinforced concrete sections.

Manholes shall be constructed with steps and/or ladder bars from the inverts of the sewer or stormwater conduit to the top of the manhole.

Manholes built into sanitary sewers or combined sewers shall be fitted with cast iron frames and solid covers. Manhole built into stormwater conduits shall be fitted with cast iron frames and solid or vented covers.

### **D-21.1.1 Brick Manholes**

Brick used for manholes shall be manufactured in accordance with ASTM C 32 Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) and tested in accordance with ASTM C 67 Standard Method of Sampling and Testing Brick and Structural Clay Tile. The bricks used for manholes shall be grade MS.

### **D-21.1.2 Cast-in-Place Concrete Manholes**

Cast-in-place concrete manholes shall be built according to the Plans and Contract Specifications. The concrete shall be in accordance with ASTM C 94 Standard Specification for Ready-Mix-Concrete, Alternate 2.

### **D-21.1.3 Precast Reinforced Concrete Manholes**

Precast reinforced concrete manhole sections, including grade rings, eccentric cones, riser sections and base sections, shall comply with ASTM C478 Standard Specification for Precast Reinforced Concrete Manhole Sections, and shall be tested and registered with the Quality Certification Staff in accordance with the Quality Certification Standard QC-1 for Precast Concrete Products. In addition, manufacturers must be certified in accordance with QC 1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Precast reinforced concrete manholes built into sanitary, combined and intercepting sewers shall have rubber gasket joints which shall conform to ASTM C 443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets. Precast reinforced concrete manholes built into stormwater conduits shall have rubber gasket joints or mortar joints.

Resilient connectors shall be used to insert pipe into precast reinforced concrete manholes that are built into sewers (sanitary or combined) with inverts below elevation 0.00 City datum or into any intercepting sewers. Resilient connectors shall meet the requirements of ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes and must be approved by the Water Department Design Branch prior to use.

Joints between pipes and precast reinforced concrete manholes that are built into sewers (sanitary or combined) above elevation 0.00 City datum or stormwater conduits, shall be sealed with non-shrink, non-metallic mortar. The mortar shall meet the requirements of Section D-23.8, paragraph 3.

In addition to the requirements specified in ASTM C478, the concrete mix shall meet the following: The minimum compressive strength shall be 4,000 psi. The water-cement ratio shall be 0.45. The minimum cement content shall be 564 lb./cu. yd. The cement shall be Portland Cement Type I, IA, II, IIA, III or IIIA. The slump shall be 3 inches maximum and 1 inch minimum. The air content shall be  $6 \pm 1$  %. Air-entraining admixtures must meet the requirements of ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete. Coarse aggregate shall be No.67 or No. 57.

### **D-21.2. Ladder Bars and Steps**

The materials for ladder bars and steps shall be as follows:

#### **D-21.2.1 Plastic**

Plastic manhole steps shall be No. 4 deformed steel reinforcing bars encapsulated within a molding of copolymer polypropylene.

Steel reinforcing bars shall be grade 60, rolled from new billet-steel and shall conform to ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement and shall be tested in accordance with ASTM A 370 Methods and Definitions for Mechanical Testing of Steel Products.

The plastic encasement shall be manufactured and tested in accordance with ASTM D 5857 Standard Specification for Polypropylene Injection and Extrusion Materials Using ISO Protocol and Methodology.

### **D-21.3 Manhole Frames and Covers**

Manhole frames and covers shall be tested and registered with the Quality Certification Staff in accordance with the Quality Certification Standard QC-2 for Gray Iron Castings. In addition, manufacturers must be certified in accordance with QC-2 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Manhole frames and covers shall be made of Class 30B gray iron which is tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings. The name of the foundry and the heat and lot number shall be cast into the frame and into the exterior side of the cover.

Manholes frames and covers shall be thoroughly cleaned. All projections and roughness shall be ground smooth. The bearing surfaces of the frame and cover shall not rock or jam. Frames and covers shall not be painted.

#### **D-22.0 WELLHOLES**

The base and the portion of the wellhole that contains the drip slabs or rings, shall be cast-in-place concrete or precast reinforced concrete. Cast-in-place wellholes shall have brick or precast reinforced concrete manhole risers and cones. Precast wellholes shall have precast reinforced concrete manhole risers and cones.

Manholes ladder bars and/or steps shall be constructed from the highest drip slab or drip ring to the top of the wellholes. Two epoxy coatings (see Section D-22.5) shall be applied to the drip slabs or drip rings and to the inside surface of the wellhole.

Wellholes built into combined sewers shall be fitted with gray iron frames and solid covers. Wellholes built into stormwater conduits shall be fitted with gray iron frames and solid or vented covers.

#### **D-22.1. Concrete Wellholes**

Cast-in-place concrete wellholes shall have precast reinforced concrete drip slabs as described in Section D-22.4. Brick risers and cones shall be built to the dimensions shown in the 1985 Standard Detail for Brick Manhole: Riser and Cone and shall meet the requirements of Section D-21.1.1.

#### **D-22.1.2 Precast Reinforced Concrete Wellholes**

Precast reinforced concrete wellholes, including risers and cones, shall be constructed from precast reinforced concrete manhole sections as described in Section D-21.1.3 and as shown in the Standard Detail for Precast Concrete Manhole: Riser and Cone. Precast wellholes shall have precast reinforced concrete drip rings as described in Section D-22.4.

Precast reinforced concrete wellholes shall have rubber gasket joints which shall conform to ASTM C 443 Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

#### **D-22.2 Ladder Bars and Steps**

Wellhole ladder bars and steps shall be of the same size, configuration and materials as manhole ladder bars and steps and shall conform to Sections D-21.2 and D-21.2.1.

#### **D-22.3 Wellholes Frames and Covers**

Wellholes frames and covers shall consist of manhole frames and covers and shall conform to Section D-21.3.

#### **D-22.4 Drip Slabs and Drip Rings**

Drip slabs and drip rings shall be precast reinforced concrete, shall comply with ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections and shall be certified and registered with the Quality Certification Staff in accordance with the Quality Certification Standard QC-1 for Precast Concrete Products. In addition, manufacturers must be certified in accordance with QC-1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

In addition to the requirements specified in ASTM C 478, the concrete mix shall meet the following: The minimum compressive strength shall be 5,000 psi. The water-cement ratio shall be 0.45. The minimum cement content shall be 564 lb./cu. yd. The cement shall be Portland Cement Type 1, IA, II, IIA, III or IIIA. The slump shall be 3 inches maximum and 1 inch minimum. The air content shall be 6% ± 1 %. Air entraining admixtures must meet the requirements of ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete. Coarse aggregate shall be No. 67.

#### **D-22.5 Epoxy Coating**

The entire inside surface of the wellhole, from and including the wellhole invert to 2 feet above the crown of the top entrance pipe, shall be given two coats of an epoxy coating such as Sikagard 62 or an approved equal. The epoxy coating shall be a solvent free, 100% solids, epoxy resin that dries to a hard, tile-like finish. Each coat shall be a different color. The first coat shall be gray. The final coat shall be white.

Precast reinforced concrete wellhole sections, including risers, bases, drip slabs and drip rings, shall be coated by the precast manufacturer after the concrete has cured for the amount of time recommended by the epoxy manufacturer and for a minimum of 3 weeks. The Contractor shall repair any chips, cracks or abrasions in the coating that occur during installation by applying 2 additional coats to the affected area.

Poured-in-place concrete wellholes shall be coated by the Contractor after the concrete has cured for the amount of time recommended by the epoxy manufacturer and for a minimum of 3 weeks. If the wellhole has been in use then the Contractor shall flume the flow, clean the wellhole as recommended by the manufacturer, apply the epoxy coating and shall continue to flume the flow until the coating has cured. If the wellhole has not been in use, the epoxy coating shall be applied by the Contractor and allowed to cure before the wellhole is put in service.

#### **D-23.0 INLETS**

Inlets shall not be built until the locations are approved at the site.

The use of 90° bends in the pipe connection between the inlet and the sewer is prohibited.

#### **D-23.1 Catch Basins**

Inlet catch basins shall be precast reinforced concrete.

All inlet catch basins shall have gray iron traps which may be placed in any wall as required.

All catch basins shall be watertight.

#### **D-23.1.1 Precast Reinforced Concrete Catch Basins**

Precast reinforced concrete catch basins shall comply with ASTM C 913 Standard Specification for Precast Concrete Water and Wastewater Structures and shall be tested and registered according to the Quality Certification Standard QC-1 for Precast Concrete Products. In addition, manufacturers must be certified in accordance with QC-1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

In addition to the requirements specified in ASTM C 913, the concrete mix shall meet the following: The minimum compressive strength shall be 4,000 psi. The water-cement ratio shall be 0.45. The minimum cement content shall be 564 lb. /cu. yd. The cement shall be Portland Cement Type 1, IA, 11, IIA, III or IIIA. The slump shall be 3 inches maximum and 1 inch minimum. The air content shall be 6% ± 1%. Admixtures, other than air-entraining, must be approved prior to use. Coarse aggregate shall be No. 67 or 57.

The reinforcing shall be as described in ASTM C 913. The welded wire fabric used for reinforcing shall be the sheet type.

Precast Catch Basin(s) shall have a continuous keyway along all concrete to concrete mating surfaces.

#### **D-23.1.2 Gasket Material**

The gasket material between the concrete to concrete mating surfaces and between the catch basin and the trap shall be RUB'R NEK flexible gasket as manufactured by The Henry Company or approved equal. Ensure that a continuous seal will be achieved and that joints in sections of gasket material will not allow leaks after trap and catch basin are brought together; follow all manufacturers' installation instructions.

#### **D-23.1.3 Threaded Inserts**

1/2"x2 7/8" threaded inserts shall be precast into the two-piece catch basin and shall be Heckman Building Products #444 Threaded Inserts or approved equal.

#### **D-23.1.4 Mounting Straps**

Mounting straps shall be type A36 steel.

#### **D23.1.5 Watertight Test**

Shield the catch basins from weather, tampering, and run off for the duration of the pre-test and testing procedures.

Plug the outlet of the trap to stop water from exiting the inlet and invalidating the test results. The seal must be completely watertight.

Flood the catch basin and observe and record the drop in water level every hour as the dry concrete absorbs water. Replace the lost water after each observation. Record depth measurements to within 1/8-inch accuracy. Repeat this procedure for six hours or until the water level no longer

decreases, whichever is less. Depth measurements shall be taken from the inside bottom of the inlet up to the water surface. Take each measurement at the same location within the inlet. Confirm there are no obvious signs of leakage on the exterior of the inlet.

The leakage test shall be performed prior to backfill. The plug established in the pre-test procedures shall remain in-place. The inlet shall be filled with water to the top of the precast concrete. The depth of water shall be recorded at the beginning and end of each day. Depth measurements shall be taken from the inside bottom of the inlet up to the water surface and recorded to within 1/8-inch accuracy. Each measurement shall be taken at the same location within the inlet. The time, date, and weather conditions of each measurement shall be noted. Measurements shall be recorded for three days. The inlet shall **not** be refilled between measurements. Allowable leakage is 1/8 inch per day.

#### **D-23.2 Precast Reinforced Concrete Hood**

Precast reinforced concrete hoods shall conform to ASTM C 913 and QC-1 as stated in Section D-23.1.1. Manufacturers shall also be certified in accordance with QC-1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

The concrete mix shall conform to the requirements stated in Section D-23.1.1.

The reinforcing shall be in accordance with ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 40.

#### **D-23.3 Precast Reinforced Concrete Inlet Top Slabs**

Precast reinforced concrete inlet top slabs shall conform to ASTM C 913 and QC-1 as stated in Section D-23.1.1. Manufacturers shall also be certified in accordance with QC-1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

The concrete mix shall conform to the requirements stated in Section D23.1.1 except that coarse aggregate shall be No. 67 only.

The reinforcing shall be in accordance with ASTM A 615 Standard Specification for Deformed or Plain Billet-Steel Bars for Concrete Reinforcement, Grade 40.

Reinforcing bars shall be welded to other bars and to the steel channel as shown in the Standard Details for Sewers. Welds shall be in accordance with Section M2.4 of ANSI /AISC 360 Specification for Structural Steel Buildings. Welders shall be qualified as required by the AWS to perform the type of work required.

#### **D-23.3.1 Curb Nosing**

The curb nosing shall be a self-weathering steel channel and shall conform to ASTM A 242 Standard Specification for High-Strength Low Alloy Structural Steel or ASTM A 588 Standard Specification for High-Strength Low Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.

#### **D-23.4 Precast Reinforced Concrete Inlet Adjustment Risers**

Precast reinforced concrete inlet adjustment risers for Open Mouth Inlets, Highway Grate Inlets and Gutter Grate Inlets shall conform to ASTM C 913 and QC-1 as stated in Section D-23.1.1.

Manufacturers shall also be certified in accordance with QC-1 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

The concrete mix shall conform to the requirements stated in Section D23.1.3

The reinforcing shall be as described in ASTM C 913.

#### **D-23.5 Traps**

Traps shall be tested and registered with the Quality Certification Staff in accordance with the Quality Certification Standard QC-2 for Gray Iron Castings. In addition, manufacturers must be certified in accordance with QC-2 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Traps shall be made of Class 30B gray iron which is tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings.

The name of the foundry and the heat and lot number shall be cast into the face of the clean-out door and into the body of the trap.

The trap shall be thoroughly cleaned. All projections and roughness shall be ground smooth. Traps shall not be painted.

##### **D-23.5.1 Appurtenances**

The neoprene gasket shall be attached to the cleanout door by 4 screws as shown in the Standard Details for Sewers or by a neoprene adhesive such as Neoprene Adhesive F-1 manufactured by Carboline, St. Louis, MO or an approval equal. The adhesive shall be specifically made for bonding neoprene to metals.

#### **D-23.6 Grates and Frames**

Inlet grates and frames shall be gray iron or structural steel. Gray iron grates and steel grates shall be interchangeable.

Gray iron used to make grates and frames shall be Class 30B gray iron tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings. The name of the foundry and the heat and lot number shall be cast into the frame and the top of the grate. Manufacturers shall also be certified in accordance with QC-2 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

Steel used to fabricate grates and frames shall conform to ASTM A 36 Standard Specification for Structural Steel. Welds shall be in accordance with Section M2.4 of ANSI /AISC 360 Specification for Structural Steel Buildings. Welders shall be qualified as required by the AWS to perform the type of work required. Manufacturers shall also be certified in accordance with QC-4 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

#### **D-23.7 Clean-Out Covers and Frames**

Inlet clean-out covers and frames shall be manufactured from Class 30B gray iron tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings. The name of the foundry and the heat and lot number shall be cast into the frame and into the exterior side of the cover.

Manufacturers shall also be certified in accordance with QC-2 by the Quality Certification Staff and shop drawings must be approved by the Water Department Design Branch.

#### **D-23.8 Installation of Precast Inlets**

After excavation has been completed, level off the area where the base section will be located. Provide a 3/4" crushed stone bed to obtain a level and solid foundation. Do not use wood, brick or other materials to shim the base section.

When installing a 2 piece catch basin remove all foreign materials such as dirt, mud and stones from the joint surfaces. Apply a bitumen-type sealing compound to seal the joint. The sealing compound shall be approved by the Water Department Design Branch prior to application.

Seal all lifting holes and the adjustment area around the trap with nonshrink, non-metallic mortar. The mortar shall not contain gas-forming agents and shall be tested in accordance with ASTM C 827 Standard Test Method for Early Volume Change of Cementitious Mixtures, C 191 Standard Test Method for Time Setting of Hydraulic Cement by Vicat Needle and C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars. The change in volume shall be 0 or shall increase slightly. The time of set shall be 45 minutes minimum. The minimum compressive strength shall be 6000 psi at 28 days.

Shut the clean-out door of the trap and secure the wedge.

The hood, adjustment risers, top slab and the grate frame shall be adjusted to the sidewalk or street grade with paving bricks and non-shrink mortar. Maintain a minimum opening of 3 inches in the mouth of the inlet. If necessary, dish the street around the mouth or grate of the inlet to provide the minimum opening.

Brick used for adjustments in inlets shall conform to ASTM C 32 Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) and shall be tested in accordance with ASTM C 67 Standard Methods of Sampling and Testing Brick and Structural Clay Tile. Brick shall be Grade MS.

Backfill shall be deposited in layers of 8 inches or less and tamped. Compaction of the backfill through puddling is not allowed.

The work area shall be restored to its original or better condition. Restoration includes, but is not limited to, repairs or replacement of footway and curbing that is cracked or broken by the Contractor and replacing brick in brick footways.

#### **D-24.0 CHAIN LINK FENCE**

Chain link fences shall be erected on headwalls and end walls as shown in the Standard Details for Sewers or as detailed on the Plans. The fence shall be placed by means of sleeves.

#### **D-24.1 Fabric**

The fence fabric shall be aluminum alloy and shall conform to ASTM B 211 Standard Specification for Aluminum-Alloy Bars, Rods and Wires, Alloy 6061, Temper T94. The wire diameter shall be 0.148 inch. The fabric shall be made up of individual wire pickets, free of splices, woven throughout to form a uniform mesh. The height of the fabric shall be as shown on the drawings and shall have knuckled selvages on the top and bottom. The mesh opening shall be 2 inches as measured from inside to inside, at right angles to the wire.

#### **D-24.2 Posts And Rails**

Pipes for posts, top rails, bottom rails and brace rails shall be manufactured of aluminum using ANSI Schedule 40 pipe having plain ends. The aluminum pipe shall be in accordance with ASTM B 241 Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube, Alloy 6063, Temper T6.

##### **D-24.2.1 Posts**

Corner and end posts shall be 2-1/2 inches in diameter and shall be fitted with post caps to exclude moisture from the post.

Line and center posts shall be 2 inches in diameter and shall be fitted with post tops which are formed to allow top rails to pass through.

##### **D-24.2.2. Rails**

Top rails, bottom rails and brace rails shall be 1-1/4 inches in diameter.

Brace rails shall be provided at all end and corner posts, midway between the top and bottom rail and shall extend from the end or corner post to the adjacent line posts.

Bottom rails and brace rails shall be fastened to the end, corner and line posts by means of rail ends, brace ends and brace bands. Truss rods shall be trussed between the brace end of the brace rail and the bottom rail.

Top rails shall be furnished in 20 foot lengths or as detailed on the Plans, with coupling or expansion devices to join the top rail lengths to form a continuous brace for the length of fence. Top rails shall be securely fastened to the end or corner posts by means of rail ends and brace ends.

##### **D-24.2.3 Rail Ends and Post Cap Fittings**

Rail ends and post cap fittings shall be of the sizes necessary for the rails and post. They shall be aluminum and conform to ASTM B 26 Standard Specification for Aluminum-Alloy Sand Castings, Alloy SG70A, Temper T6.

##### **D-24.2.4 Truss Rods and Fabricated Turnbuckles**

Truss rods and fabricated turnbuckles shall be aluminum and shall conform to ASTM B 211 Standard Specification for Aluminum-Alloy Bars, Rods and Wire, Alloy 6061, Temper T6.

#### **D-24.2.5 Nuts and Bolts**

Nuts and bolts shall be aluminum. Nuts shall conform to ASTM F467 Standard Specification for Non-Ferrous Nuts for General Use, Aluminum Alloy 6061, Temper T6. Bolts shall conform to ASTM F 468 Standard Specification for Non-Ferrous Bolts, Hex Cap Screws and Studs for General Use, Aluminum Alloy 2024, Temper T4. The bolts shall be 5/16-inch diameter.

#### **D-24.2.6 Fasteners**

The fence fabric shall be securely fastened to the line posts, top rails, bottom rails and bracer rails with fabric wires spaced not more than 24 inches apart. The fence fabric shall be attached to the end post or corner posts by means of a stretcher bar threaded through the mesh fabric and using stretcher bar bands around the posts and stretcher bars.

Stretcher bars shall be aluminum, 1/4 inch thick and 3/4 inch wide. Stretcher bars shall have square edges.

Stretcher bar bands and bracer bands shall be aluminum 1/8 inch thick and 7/8 inch wide. Stretcher bar bands shall have beveled edges. Bolts 3/8 inch diameter and 1-1/2 inches long shall be furnished with the stretcher bar bands and bracer bar bands. These bolts shall be non-removable.

The stretcher bar bands shall conform to ASTM B 221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes, Alloy 6063, Temper T6. The fabric tie wire shall be aluminum conforming to ASTM B211 Alloy 110-H18. The bolts shall be Alloy 2024, Temper T4.

#### **D-24.3 Sleeves**

The sleeves shall be aluminum and shall conform to ASTM B 241 Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube, Alloy 6063, Temper T6. The sleeve shall be 3-1/2 inches in diameter and the outside surface shall have two (2) coats of bitumastic.

**Standard, Codes, and other references in order of appearance in the Standard Specs**

<i>Current</i>				
Section	Agency	Standard	Title	Year Revised
D-12	ASTM	D6103/ D6103M	Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)	2017
D-15.0	ASTM	C700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated	2013
D-15.0	ASTM	C301	Standard Methods of Testing Vitrified Clay Pipe	2013
D-15.1	ASTM	C425	Standard Specification for Compression Joints for Vitrified Clay Pipe Lines	2013
D-15.2	ASTM	C12	Standard Recommended Practice for Installing Vitrified Clay Pipe Lines	2017
D-16.0	ASTM	C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe	2018
D-16.0	ASTM	C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe	2018
D-16.1	ASTM	C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets	2017
D-17.0	ACI	350	Code Requirements for Environmental Concrete Structures	2006
D-17.0	ASTM	C94	Standard Specification for Ready-Mixed Concrete	2017
D-17.0	ASTM	A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement	2016
D-17.0	ASTM	A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products	2017
D-17.2	ASTM	D 638	Standard Test Method for Tensile Properties of Plastics	2014
D-17.2	ASTM	D2240	Standard Test Method for Rubber Property—Durometer Hardness	2015
D-17.2	ASTM	D570	Standard Test Method for Water Absorption of Plastics	1998
D-17.2	CRD	C 572	Corps of Engineers Specifications For Polyvinylchloride Waterstop	1974
D-17.2.1	ACI	504R	Guide to Joint Sealants for Concrete Structures**	1990
D-17.3.1	ASTM	C479	Standard Specification for Vitrified Clay Liner Plates	2017
D-17.3.4	ASTM	C466	Standard Specification for Chemically Setting Silicate and Silica Chemical-Resistant Mortars	2012
D-18.0	ASTM	C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers	2016
D-19.0	ANSI	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast	2009
D-19.0	ANSI	AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings	2008
D-19.1	ANSI	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	2016
D-21.1.1	ASTM	C32	Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)	2017
D-21.1.1	ASTM	C67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile	2018
D-21.1.3	ASTM	C478	Standard Specification for Circular Precast Reinforced Concrete Manhole Sections	2018
D-21.1.3	QCS	QC-1	Precast Concrete Structures	<i>current year</i>
D-21.1.3	ASTM	C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals	2013
D-21.1.3	ASTM	C260/C20M	Standard Specification for Air-Entraining Admixtures for Concrete	2016

**Standard, Codes, and other references in order of appearance in the Standard Specs**

<i>Current</i>				
Section	Agency	Standard	Title	Year Revised
D-21.2.1	ASTM	B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes	2014
D-21.2.2	ASTM	A536	Standard Specification for Ductile Iron Castings	2014
D-21.2.3	ASTM	D4101	Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials	2017
D-21.2.3	ASTM	D5857	Standard Specification for Polypropylene Injection and Extrusion Materials Using ISO Protocol and Methodology	2017
D-21.3	PWD QCS	QC-2	Gray Iron Castings	<i>current year</i>
D-21.3	ASTM	A48	Standard Specification for Gray Iron Castings	2016
D-23.1.3	ASTM	C913-18	Standard Specification for Precast Concrete Water and Wastewater Structures	2018
D-23.3.1	ASTM	A242	Standard Specification for High-Strength Low-Alloy Structural Steel	2018
D-23.3.1	ASTM	A588	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance	2015
D-23.6	ASTM	A36	Standard Specification for Carbon Structural Steel	2014
D-23.8	ASTM	C287	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures	2016
D-23.8	ASTM	C191	Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle	2013
D-23.8	ASTM	C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)	2016
D-24.1	ASTM	B211	Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire	2012
D-24.2	ASTM	B241	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube	2016
D-24.2.3	ASTM	B26	Standard Specification for Aluminum-Alloy Sand Castings	2014
D-24.2.5	ASTM	F467	Standard Specification for Nonferrous Nuts for General Use	2013
D-24.2.5	ASTM	F468	Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use	2016

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