Appendix G:
Hydrology and Water Quality Supporting Information

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G.1 - Preliminary Drainage Study

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DRAINAGE STUDY

FOR

PARR BOULEVARD

Parr Boulevard
Richmond, California

Prepared For:
Scannell Properties
8801 River Crossing Blvd. #300
Indianapolis, IN 46240

Prepared By:
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Prepared:
January 26, 2018
Revised: June 15, 2018
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Revised: March XX, 2020
Revised: March 04, 2021

CSW|ST2 File No.:
5.1431.03

CSW | ST2

TABLE OF CONTENTS

1. INTRODUCTION

In this Drainage Study, the existing and proposed condition hydrology was analyzed for the Parr Boulevard project site. The study analyzed the 10- and 100-year 6- and 12-hour storm events for drainage flow rates to analyze the existing culverts flowing from the site below Richmond Parkway and discharging into San Pablo Bay.

The proposed swales, and linear wetland mitigation have been analyzed to confirm 100-year storm event is contained and conveyed to the discharge culverts below Richmond Parkway (identified on the Swale Sizing Hydrology Map as Discharge Point's A and B). The swales and linear wetland mitigation analyzed in these calculations are identified as Swale 1 – Sections A and B, Swale 2, Linear Wetland Sections G, H and I; see Appendix 7.1 for Swale Sizing Hydrology Map.

The study analyzed the 10- and 100-year storm events to confirm sufficient sizing for the proposed pipe conveyance network. The pipes are identified on the Storm Drain System Hydrology Map; see Appendix 7.1.

2. EXISTING CONDITIONS

The Parr Boulevard project site is located in Contra Costa County, in Unincorporated Richmond. The site is bounded to the west and north by Richmond Parkway, to the south by Parr Boulevard and to the east by existing commercial/industrial development. Access to the site is from Parr Boulevard.

The project site consists of two (2) tributary areas. The areas include onsite and offsite areas and are identified as EX 1 and EX 2. The off-site tributaries are comprised of existing industrial development and portions of Parr Blvd and Richmond Parkway. Stormwater runoff flows on to the project site via overland flow and is captured in existing drainage channels within the project site and discharge to two (2) culverts (Discharge Points A and B) which convey stormwater runoff under Richmond Parkway into San Pablo Bay. Discharge Point A consists of two (2) 36-inch culverts and Discharge Point B consists of one (1) 36-inch culvert. The existing site is identified as having a Hydrologic Soil Group of "C."

See Appendix 7.1 for the Existing Conditions Hydrology Map.

3. PROPOSED CONDITIONS

The project proposes to split the site into two (2) lots. On each lot construction of a building (warehouse and offices), a parking lot, truck docks and access, stormwater treatment facilities, and wetland mitigation is proposed.

The project watershed consists of four (4) tributary areas (identified as 1A, 1B, 2A and 2B). Tributary areas 1A and 2A comprise the proposed development, Lot 1 and Lot 2 respectively. Tributary area 1B comprise a portion of the proposed Lot 2 development and off-site area draining towards the project site. Tributary area 2B is off-site and drains towards the project site. The off-site tributaries are comprised of existing industrial development. A portion of the existing watershed identified as EX2 is removed from the proposed condition calculations, due to the development of the Goodrick Industrial (2601 Goodrick Avenue) project diverts runoff that historically discharged onto the Parr Boulvard project site (see Appendix 7.10 for excerpt from the Goodrick Industrial project). Stormwater runoff flows on to the project site via overland flow and captured into existing drainage channels within the project site. Tributaries 1A and 1B discharge at Discharge Point A and tributaries 2A and 2B discharge at Discharge Point B. Due to the increase in peak discharge rate at Discharge Point B an increase in culvert size (through pipe bursting) is proposed.

See Appendix 7.1 for the Proposed Conditions Hydrology Map.

4. METHOD OF ANALYSIS

The Contra Costa County Flood Control & Water Conservation District Unit Hydrograph Method was used to analyze the 10- and 100-year 6- and 12-hour storm events for drainage flow rates for the existing and proposed conditions.

The Modified Rational Method was used to size the proposed storm drain system. The basis for the analysis was derived from the Contra Costa County Rational Method Guidelines.

5. FACTORS USED IN ANALYSIS

a. Subbasins: The subbasins identified in these calculations were determined from a topographic survey of the project site and aerial photography.

   See Appendix 7.1 for the Existing and Proposed Conditions Hydrology Maps.

b. 100-Year Flood Elevation: Flood information for the project site can be found on FIRM Flood Insurance Rate Map 06013C0226G and 06013C0228G dated September 20, 2015. The project site is identified as "this area is shown as being protected from the 1-percent-annual-chance or greater flood hazard by a levee system that has been provisionally accredited. Overtopping or failure of any levee system is possible."

   See Appendix 7.9 for FEMA Flood Maps.

c. Hydrographs: The hydrographs for the 10-year 6-hour, 10-year 12-hour, 100-year 6-hour and 100-year 12-hour storm events were determined using the Contra Costa County Flood Control & Water Conservation District Unit Hydrograph Method. The hydrographs were developed using the County's HEC-HMS template and the model was developed in accordance with the *HEC-HMS Guidance for the Contra Costa County Flood District Unit Hydrograph Method.*

d. Modified Rational Method: The Modified Rational Method calculates peak runoff, Q, in cubic feet per second and is described by the equation Q=CIAf. The terms are defined as follows:

$$Q = CiAf$$

Where: Q = Flow Rate (cubic feet per second, cfs)
C = Runoff Coefficients
f = Adjusting factor for 25, 50 and 100-year storms[1]
I = Rainfall Intensity (inches per hour, in/hr)
A = Tributary Area (acres, ac)

1. Adjusting Gactors (f) for 25, 50 and 100-year storms (Modified Rational Formula):
   Q_{10} = 1.00
   Q_{25} = 1.10
   Q_{50} = 1.20
   Q_{100} = 1.25
   Note: The product Cf must be less than 1.0

e. Rainfall Intensity: Storm Intensity (I) was derived using the Contra Costa County Rational Method Guidelines, the Contra Costa County Mean Seasonal Isohyet Map (Drawing B-166), and the 10- and 100- Precipitation Duration-Frequency-Depth Curves (Drawings B-159 and B-162 respectively). See Appendix 7.X-Rainfall Intensity

f. Runoff Coefficient: The runoff coefficients for the project site were developed using a best judgement based on the values given in CCCFCD (Contra Costa County Flood Control District) Standard – Runoff Coefficients and knowledge of the project site.

g. Time of Concentration: The time of concentration, used for the modified rational method, was calculated from the Kerby Equation for overland flow described by the equation $tc^{2.14} = 2Ln/3S^{1/2}$ per the Rational Formula Calculations: Contra Costa County Flood Control District Hydrology Class Presentation. The terms are defined as follows:

$$tc^{2.14} = {}^{2Ln}\!/_{3\sqrt{S}}$$

Where: tc = Time of Concentration in minutes
L = Length in feet
n = Surface retardant factor
S = Slope in feet/feet

h. Hydraulic Modeling: The proposed Storm Drain System was sized for capacity using the AutoCAD Civil 3D 2018 Hydraflow Storm Sewers Program. The Storm Sewers program models storm drains systems based on the use of the Rational Method. See Appendix 7.12 for Hydraulic Calculations – Storm Drain System.

   The proposed swales and linear wetland mitigation were sized for capacity using the Autocad Civil 3D 2018 Hydraflow Express Extension and the Modified Rational Method. See Appendix 7.11 for Hydraulic Calculations – Swales and Linear Wetlands

i. Starting Hydraulic Grade Line (HGL): For the 10-year analysis, the starting HGL was assumed to be the invert of the pipes. For the 100-year analysis, the starting HGL was assumed to be elevation 10.0 per the FEMA 100 year flood plain elevation.

6. RESULTS AND CONCLUSIONS

Results:

The project site discharges at two (2) locations, Discharge Points A and B (See Appendix 7.1 for the Existing Condition Hydrology Map). Table 6.1 and 6.2 depicts the 10- and 100-year peak discharge rate at Discharge Point A for the 6- and 12-hour storm events. Table 6.3 and 6.4 indicates the 10- and 100-year peak discharge rate at Discharge Point B for the 6- and 12-hour storm events. See Appendix 7.11 and 7.12 for Swale, Linear Wetlands, and Storm Drain Sizing Calculations results.

Table 6.1: 10-Year Rain Event – Discharge Point A

Condition	10-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	10-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	39.8	42.2
Proposed	24.1	25.2

Table 6.2: 100-Year Rain Event – Discharge Point A

Condition	100-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	100-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	60.5	64.2
Proposed	36.5	38.3

Table 6.3: 10-Year Rain Event – Discharge Point B

Condition	10-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	10-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	28.1	29.7
Proposed	25.3	26.5

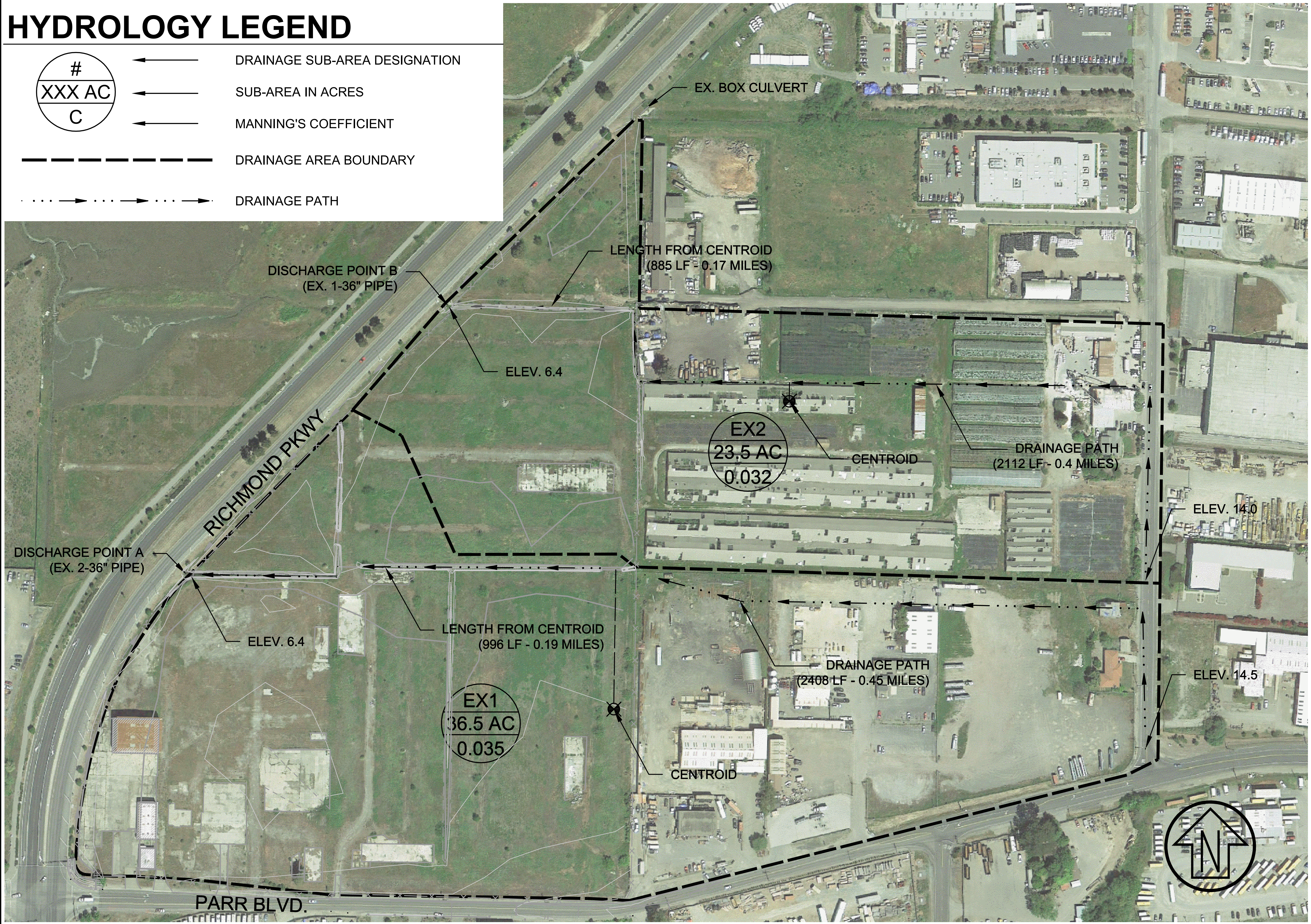
Table 6.4: 100-Year Rain Event – Discharge Point B

Condition	100-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	100-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	42.3	44.8
Proposed	38.1	40.3

Conclusion: The proposed peak discharge rates at Discharge Point A and Discharge Point B do not exceed the existing condition for the 10-year 6-hour, 10-year 12-hour, 100-year 6-hour and 100-year 12-hour storm events. Per Division 914 of the County Ordinance Code, the two (2) existing 36-inch culvert, at Discharge Point A, and the one (1) existing 36-inch culvert, at Discharge Point B, is sufficient capture and convey runoff from the project site. The proposed swales and linear wetland mitigation have sufficient capacity to convey the 100-year 12-hour storm event. The proposed storm drain system has sufficient capacity to convey the 10-year storm event.

7.0 APPENDICES

Appendix 7.1
Maps



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PARR BLVD. COMMERCIAL EXISTING CONDITIONS HYDROLOGY MAP

CONTRA COSTA COUNTY
CALIFORNIA

Prepared Under the Direction of:

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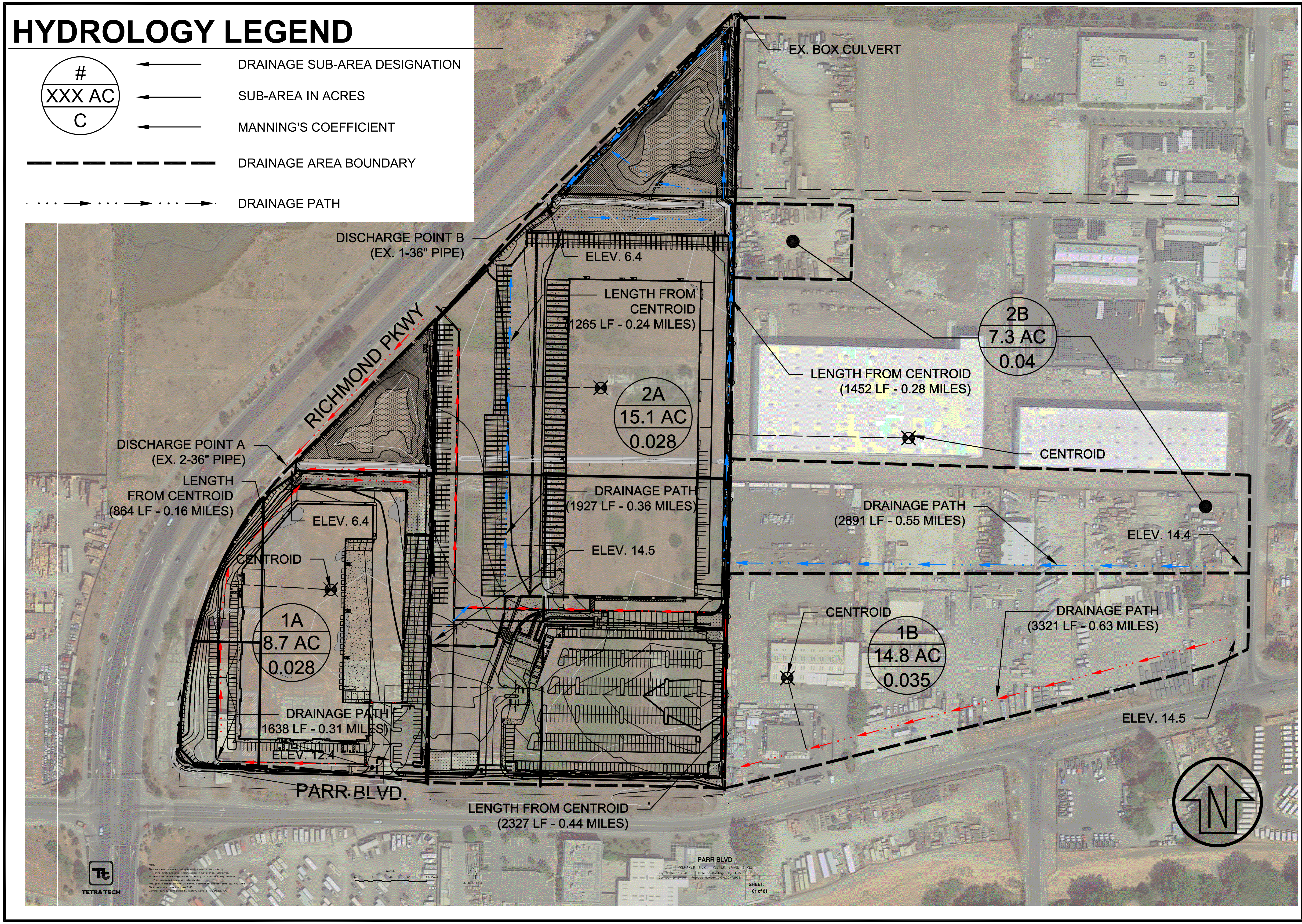

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Date: 03/04/21
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PARR BLVD. COMMERCIAL PROPOSED CONDITIONS HYDROLOGY MAP

CONTRA COSTA COUNTY
CALIFORNIA

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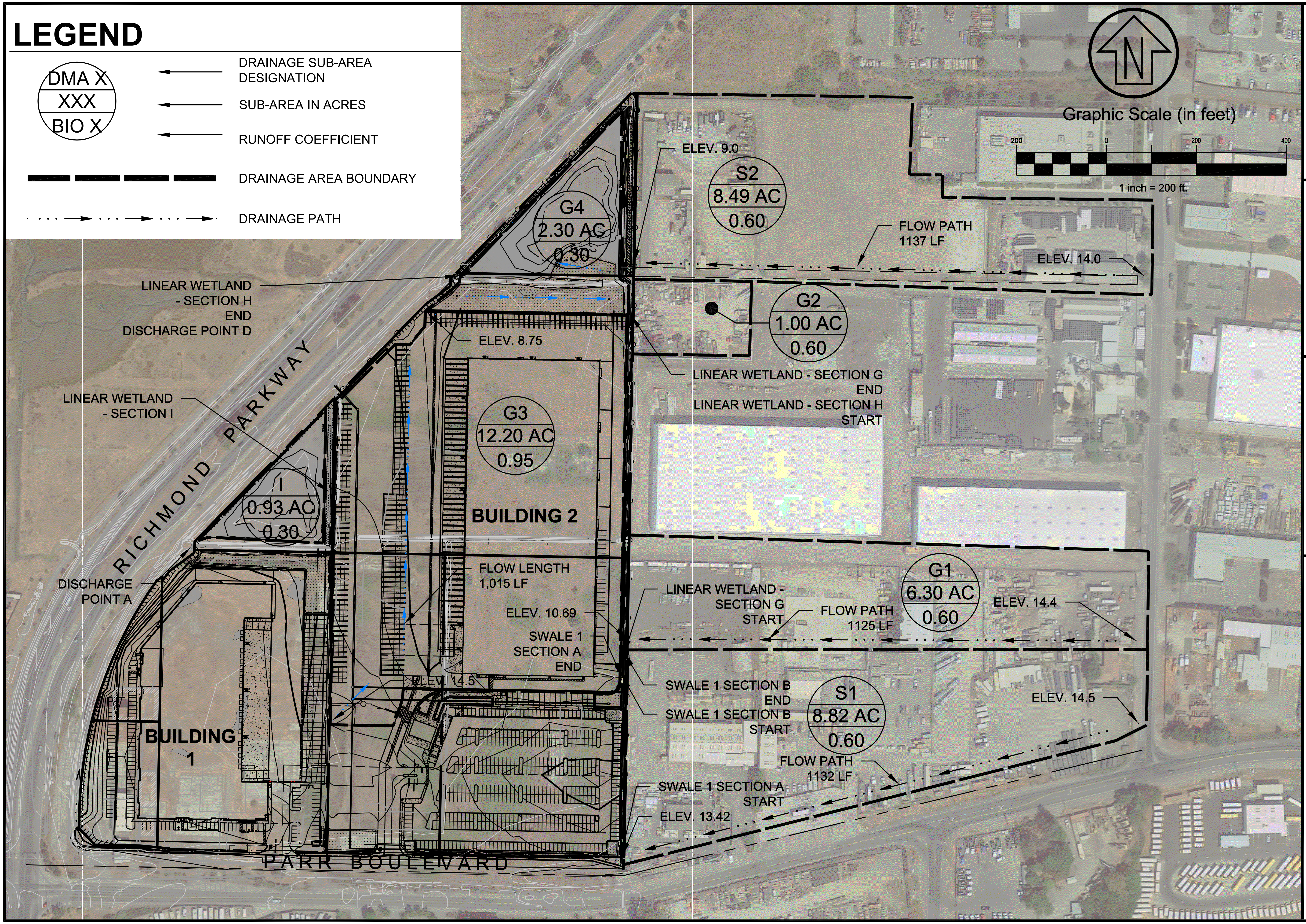

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Job No. 5.1431.03

PARR BLVD. RICHMOND PKWY. HYDROLOGY MAP

SWALE SIZING

CONTRA COSTA COUNTY CALIFORNIA

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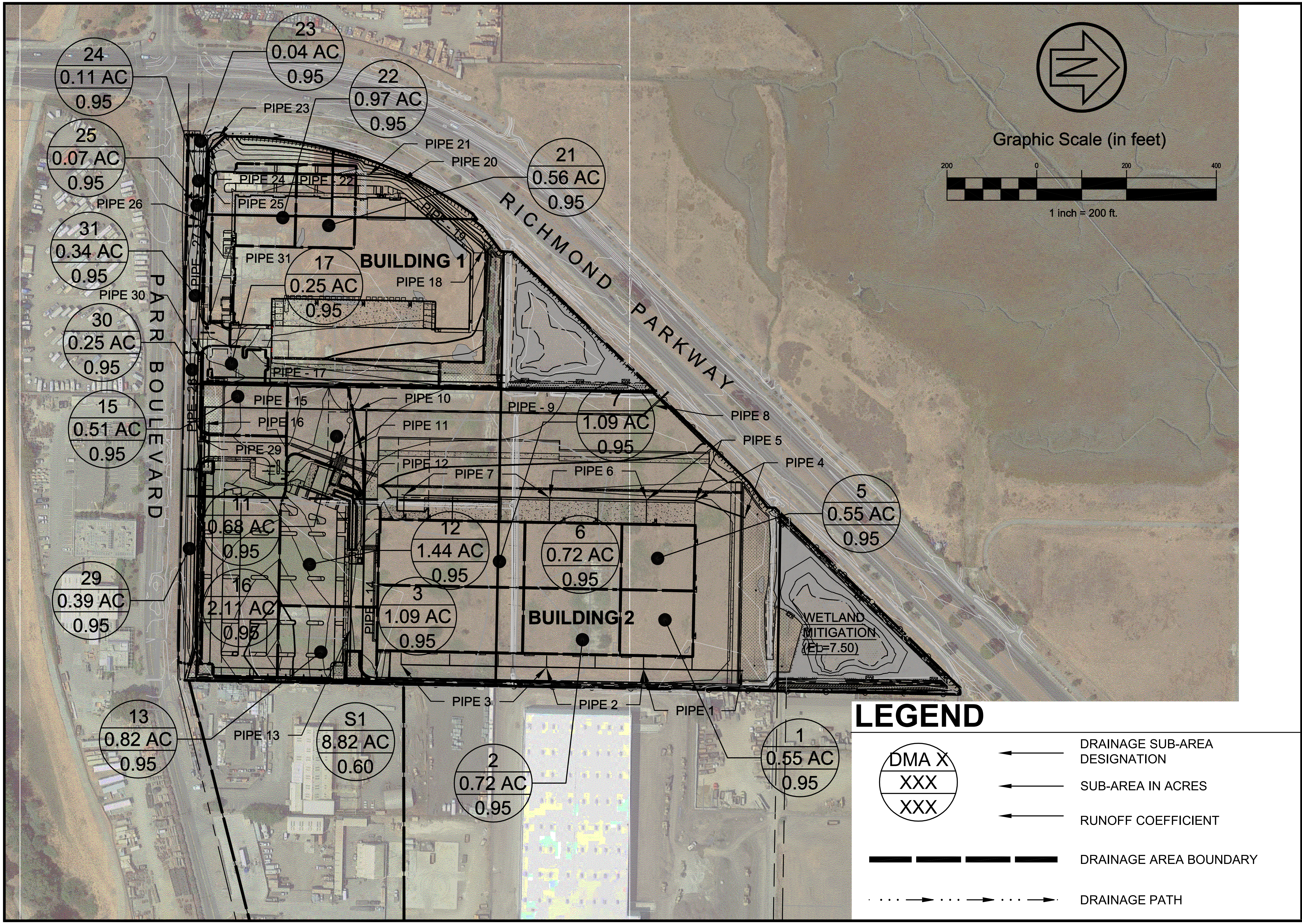

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PARR BLVD. RICHMOND PKWY. HYDROLOGY MAP

STORM DRAIN SIZING

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Appendix 7.2
Input Data Tables

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 6/15/2018

By: Julia Harbers, CSW|ST2

Existing Condition - Basin 1

Watershed Parameters	***Value***	***Units***
Drainage Area	0.057	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.11	Inches/Hour
Channel Length	0.45	Miles
Channel Length from Centraoid	0.19	Miles
Elevation Difference	8.1	Feet
N Value	0.035	(Dimensionless)

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 3/13/2020

By: Julia Harbers, CSW|ST2

Existing Condition - Basin 2

Watershed Parameters	***Value***	***Units***
Drainage Area	0.037	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.09	Inches/Hour
Channel Length	0.40	Miles
Channel Length from Centraoid	0.17	Miles
Elevation Difference	7.6	Feet
N Value	0.032	(Dimensionless)

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 3/13/2020

By: Julia Harberson, CSW|ST2

Proposed Condition - Subbasin 1A

Watershed Parameters	***Value***	***Units***
Drainage Area	0.014	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.05	Inches/Hour
Channel Length	0.31	Miles
Channel Length from Centraoid	0.16	Miles
Elevation Difference	6.0	Feet
N Value	0.028	(Dimensionless)

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 3/13/2020

By: Julia Harberson, CSW|ST2

Proposed Condition - Subbasin 1B

Watershed Parameters	***Value***	***Units***
Drainage Area	0.023	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.11	Inches/Hour
Channel Length	0.63	Miles
Channel Length from Centraoid	0.44	Miles
Elevation Difference	8.1	Feet
N Value	0.035	(Dimensionless)

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 3/13/2020

By: Julia Harberson, CSW|ST2

Proposed Condition - Subbasin 2A

Watershed Parameters	***Value***	***Units***
Drainage Area	0.024	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.05	Inches/Hour
Channel Length	0.36	Miles
Channel Length from Centraoid	0.24	Miles
Elevation Difference	8.1	Feet
N Value	0.028	(Dimensionless)

INPUT DATA

Location: Parr Blvd & Richmond Parkeway

Date: 3/13/2020

By: Julia Harberson, CSW|ST2

Proposed Condition - Subbasin 2B

Watershed Parameters	***Value***	***Units***
Drainage Area	0.011	Square Miles
Mean Seasonal Rainfall	21.5	Inches
Storm Frequency	10, 100	Year
Storm Duration	6, 12	Hour
Infiltration Rate	0.15	Inches/Hour
Channel Length	0.55	Miles
Channel Length from Centraoid	0.24	Miles
Elevation Difference	8	Feet
N Value	0.040	(Dimensionless)

Appendix 7.3
Storm Rainfall Depth Calculations

Storm Depth Calculation - Simplified Tables

D= C1 + MSP x C2

where: D = storm rainfall depth (inches)
MSP = mean seasonal precipitation depth (inches)
C1 = constant based on rainfall duration and frequency from Table A-3
C2 = constant based on rainfall duration and frequency from Table A-4

Storm Depth (inches)

	3-hr	6-hr	12-hr	24-hr
10-yr	1.54	2.15	2.98	4.04
25-yr	1.80	2.55	3.52	4.79
50-yr	2.07	2.90	4.02	5.48
100-yr	2.25	3.17	4.40	6.02

MSP = 21.5 inches

Table A-3 C1 Constants for Storm Rainfall Depths-Simplified

C1	3-hr	6-hr	12-hr	24-hr
10-yr	0.434	0.520	0.588	0.636
25-yr	0.492	0.584	0.680	0.736
50-yr	0.592	0.674	0.768	0.840
100-yr	0.620	0.760	0.888	0.968

Table A-4 C2 Constants for Storm Rainfall Depths-Simplified

C2	3-hr	6-hr	12-hr	24-hr
10-yr	0.0516	0.0760	0.1112	0.1584
25-yr	0.0608	0.0916	0.1320	0.1884
50-yr	0.0688	0.1036	0.1512	0.2160
100-yr	0.0760	0.1120	0.1632	0.2352

Appendix 7.4
N-Value Calculations

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1310 Redwood Way, Suite 220, Petaluma, CA 94954 Tel 707.795.4764 www.cswst2.com

SHEET NO. 1

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE

CLIENT SUBJECT Weighted Watershed Manning's Coefficient CHK'D DATE

Existing Conditions - Basin 1

Total Basin Area = 36.5 ac

Industrial/Commercial = 15.1 ac N = 0.028

Grass/Old Industrial = 21.4 ac N = 0.04

$$N_{weighted} = \frac{(15.1)(0.028) + (21.4)(0.04)}{(36.5)} = \underline{\underline{0.035}}$$

Existing Conditions - Basin 2

Total Basin Area = 23.5 ac

Industrial/Commercial = 15.1 ac N=0.028

Grass/Old Industrial = 8.4 ac N=0.04

$$N_{weighted} = \frac{(15.1)(0.028) + (8.4)(0.04)}{23.5} = \underline{0.032}$$

Proposed Conditions - Subbasin 1A

Subbasin Area = 8.7 ac

Industrial/Commercial = 8.7 ac $\underline{\underline{N = 0.028}}$

SHEET NO. 2

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE 6/7/19

CLIENT SUBJECT Weighted Watershed Manning's Coefficient CHK'D DATE

Proposed Conditions – Subbasin 1B

Subbasin Area = 14.8 ac

Industrial/ Commercial = 6.0 ac N = 0.028

Grasses/ Old Industrial = 8.8 ac N = 0.04

$$N_{weighted} = \frac{(6.0)(0.028) + (8.8)(0.04)}{(14.8)} = 0.035$$

Proposed Conditions – Subbasin 2A

Subbasin Area = 15.1 ac

Industrial /Commercial = 15.1ac N = 0.028

Proposed Conditions – Subbasin 2B

Subbasin Area = 7.3 ac

Grasses/ Old Industrial = 7.3 ac N = 0.04

Appendix 7.5
Lag Time Calculations

CSW | ST2
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SHEET NO. 1

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE 6/7/19

CLIENT ______ SUBJECT Lag Time Calculations CHK'D ______ DATE ______

Existing Conditions – Basin 1

$$T_{Lag} = 24 \times N \times \left(\frac{L \times L_{ca}}{S^{0.5}} \right)^{0.38}$$

$L = 0.45$ miles

$L_{CA} = 0.19$ miles

$S = \frac{14.5' - 6.4'}{0.45 mi} = 18.0$ ft/mile

$N = 0.035$

$$T_{Lag} = 24 \times 0.035 \times \left(\frac{0.45 \times 0.19}{(18.0)^{0.5}} \right)^{0.38} = \underline{0.19 \text{ hrs}}$$

Existing Conditions – Basin 2

$L = 0.40$ miles

$L_{CA} = 0.17$ miles

$S = \frac{14.0' - 6.4'}{0.40 mi} = 19.0$ ft/mi

$N = 0.032$

$$T_{Lag} = 24 \times 0.032 \times \left(\frac{0.40 \times 0.17}{(19.0^{\wedge}0.5)} \right)^{0.38} = \underline{0.16 \text{ hrs}}$$

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SHEET NO. 2

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE 6/7/19

CLIENT ____ SUBJECT Lag Time Calculations CHK'D ____ DATE ____

Proposed Conditions – Subbasin 1A

L = 0.31 miles

L_{CA} = 0.16 miles

$S = \frac{12.4' - 6.4'}{0.31 \text{ miles}} = 19.4$ ft/miles

N = 0.028

$T_{Lag} = 24 \times 0.028 \times \left(\frac{0.31 \times 0.16}{(19.4^{0.5})} \right)^{0.38} = \underline{0.12 \text{ hrs}}$

Proposed Conditions – Subbasin 1B

L = 0.63 miles

L_{CA} = 0.44 miles

$S = \frac{14.5' - 6.4'}{0.63 \text{ miles}} = 12.9$ ft/miles

N = 0.035

$T_{Lag} = 24 \times 0.035 \times \left(\frac{0.63 \times 0.44}{(12.9^{0.5})} \right)^{0.38} = \underline{0.32 \text{ hrs}}$

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SHEET NO. 3

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE 6/7/19

CLIENT SUBJECT Lag Time Calculations CHK'D DATE

Proposed Condition - Subbasin 2A

L = 0.36 miles

L_{CA} = 0.24 miles

$$S = \frac{14.5'-6.4'}{0.36 \text{ miles}} = 22.5 \text{ ft/miles}$$

N = 0.028

$$T_{Lag} = 24 \times 0.028 \times \left(\frac{0.36 \times 0.24}{(22.5^{0.5})}\right)^{0.38} = \underline{0.15 \text{ hrs}}$$

Proposed Condition - Subbasin 2B

L = 0.55 miles

L_{CA} = 0.28 miles

$$S = \frac{14.4'-6.4'}{0.55 \text{ miles}} = 14.5 \text{ ft/miles}$$

N = 0.04

$$T_{Lag} = 24 \times 0.04 \times \left(\frac{0.55 \times 0.28}{(14.5^{0.5})}\right)^{0.38} = \underline{0.28 \text{ hrs}}$$

Appendix 7.6
Infiltration Rates

CSW | ST2
CSW/Stuber-Stroeh Engineering Group, Inc.
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1310 Redwood Way, Suite 220, Petaluma, CA 94954 Tel 707.795.4764 www.cswst2.com

SHEET NO. 1
JOB NO. 5143103 JOB Parr Blvd BY JAH DATE 6/7/19
CLIENT ____ SUBJECT Infiltration Rates CHK'D ____ DATE ____

Existing Conditions - Basin 1

Total Basin Area = 34.7 ac

Industrial/Commercial = 15.1 ac $i = 0.05$ in/hr

Grasses/Old Industrial = 19.6 ac $i = 0.15$ in/hr

$$i_{weighted} = \frac{(15.1)(0.05) + (19.6)(0.15)}{(34.7)} = \underline{0.11 \text{ in/hr}}$$

Existing Conditions - Basin 2

Total Basin Area = 23.5 ac

Industrial/Commercial = 15.1 ac $i = 0.05$ in/hr

Grasses / Old Industrial = 8.4 ac $i = 0.15$ in/hr

$$i_{weighted} = \frac{(15.1)(0.05) + (8.4)(0.15)}{23.5} = \underline{0.09 \text{ in/hr}}$$

Proposed Conditions - Subbasin 1A

Total Subbasin Area = 8.7 ac

Industrial/Commercial = 8.7 ac $\underline{i = 0.05 \text{ in/hr}}$

Proposed Conditions - Subbasin 1B

Total Subbasin Area = 14.8 ac

Industrial/Commercial = 6.0 ac $i = 0.05$ in/hr

Grasses/ Old Industrial = 8.8 ac $i = 0.15$ in/hr

$$i_{weighted} = \frac{(6.0)(0.05) + (8.8)(0.15)}{14.8} = \underline{0.11 \text{ in/hr}}$$

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45 Leveroni Court, Novato, CA 94949 Tel 415.883.9850 Fax 415.883.9835
1310 Redwood Way, Suite 220, Petaluma, CA 94954 Tel 707.795.4764 www.cswst2.com

SHEET NO. 2

JOB NO. 5143103 JOB Parr Blvd. BY JAH DATE 6/7/19

CLIENT ______ SUBJECT Infiltration Rates CHK'D ______ DATE ______

Proposed Conditions – Subbasin 2A

Total Subbasin Area = 15.1 ac

Industrial/Commercial = 15.1 ac

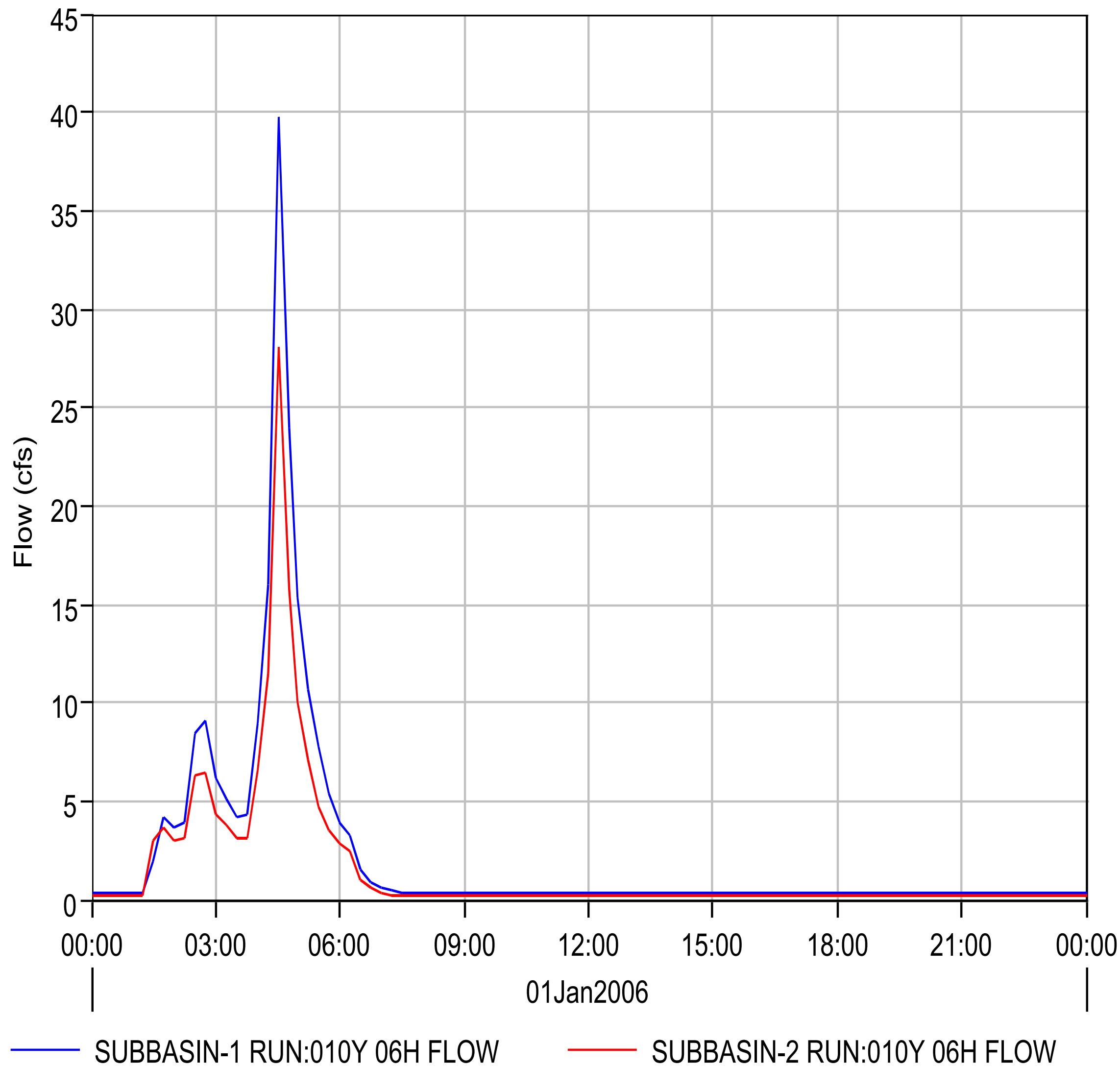
i = 0.05 in/hr

Proposed Conditions – Subbasin 2B

Total Subbasin Area = 7.3 ac

Grasses/ Old Industrial = 7.3 ac i = 0.15 in/hr

Appendix 7.7
Existing Conditions HEC-HMS Hydrograph Output



Flow (cfs)
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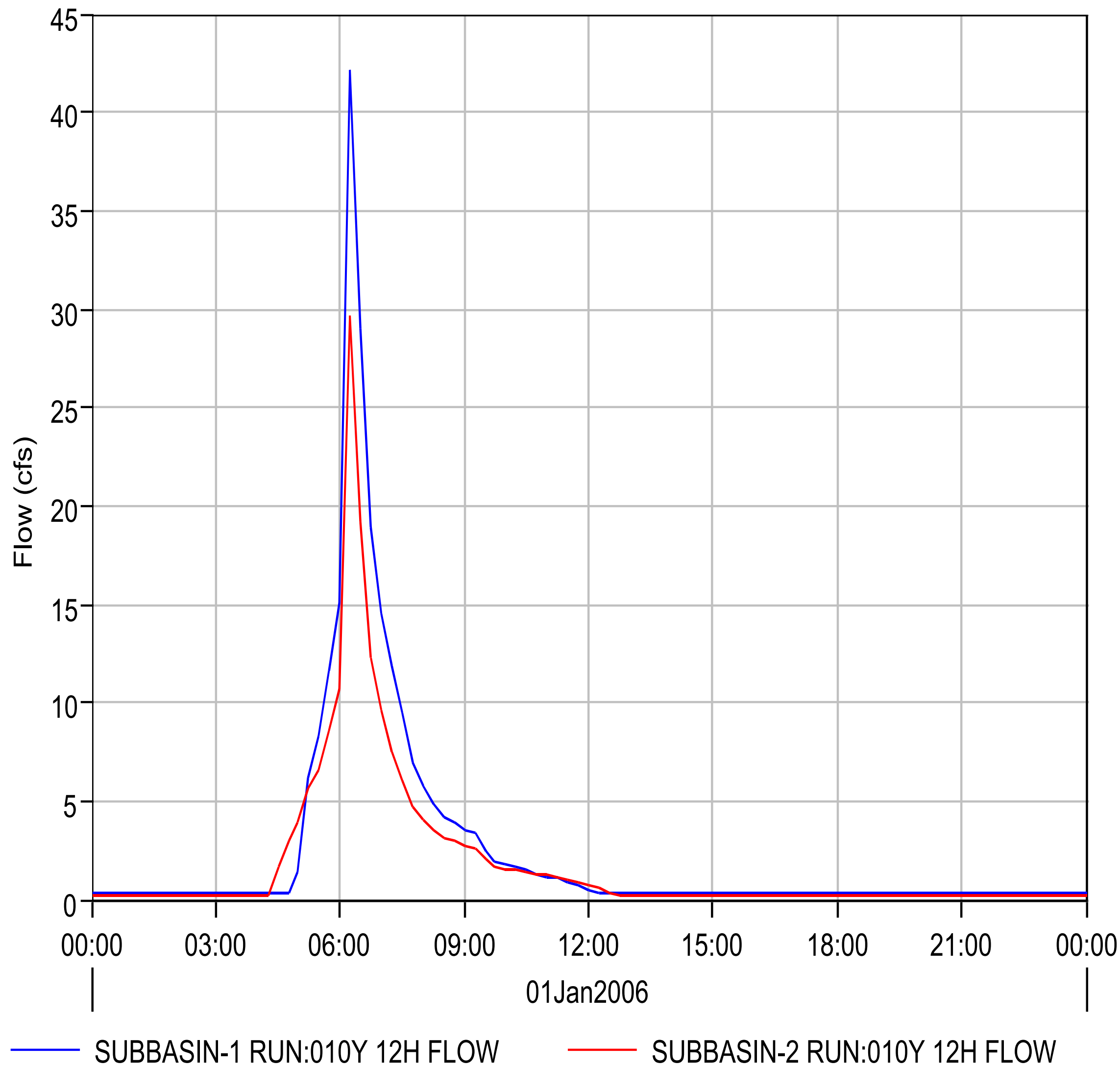
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan2006
SUBBASIN-1 RUN:010Y 06H FLOW
SUBBASIN-2 RUN:010Y 06H FLOW

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 06H	SUBBASIN-2 FLOW RUN:010Y 06H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.285	0.185
2	01 Jan 06, 00:15	0.285	0.185
3	01 Jan 06, 00:30	0.285	0.185
4	01 Jan 06, 00:45	0.285	0.185
5	01 Jan 06, 01:00	0.285	0.185
6	01 Jan 06, 01:15	0.285	0.185
7	01 Jan 06, 01:30	1.961	2.960
8	01 Jan 06, 01:45	4.137	3.621
9	01 Jan 06, 02:00	3.585	2.965
10	01 Jan 06, 02:15	3.904	3.180
11	01 Jan 06, 02:30	8.484	6.339
12	01 Jan 06, 02:45	9.072	6.494
13	01 Jan 06, 03:00	6.127	4.358
14	01 Jan 06, 03:15	5.104	3.750
15	01 Jan 06, 03:30	4.186	3.060
16	01 Jan 06, 03:45	4.271	3.140
17	01 Jan 06, 04:00	8.929	6.532
18	01 Jan 06, 04:15	16.031	11.438
19	01 Jan 06, 04:30	39.810	28.074
20	01 Jan 06, 04:45	23.921	15.777
21	01 Jan 06, 05:00	15.272	10.013
22	01 Jan 06, 05:15	10.708	7.051
23	01 Jan 06, 05:30	7.715	4.650
24	01 Jan 06, 05:45	5.434	3.469
25	01 Jan 06, 06:00	3.973	2.845
26	01 Jan 06, 06:15	3.291	2.518
27	01 Jan 06, 06:30	1.480	0.981
28	01 Jan 06, 06:45	0.857	0.536
29	01 Jan 06, 07:00	0.582	0.347
30	01 Jan 06, 07:15	0.421	0.228
31	01 Jan 06, 07:30	0.319	0.188
32	01 Jan 06, 07:45	0.288	0.185
33	01 Jan 06, 08:00	0.285	0.185
34	01 Jan 06, 08:15	0.285	0.185
35	01 Jan 06, 08:30	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 06H	SUBBASIN-2 FLOW RUN:010Y 06H
36	01 Jan 06, 08:45	0.285	0.185
37	01 Jan 06, 09:00	0.285	0.185
38	01 Jan 06, 09:15	0.285	0.185
39	01 Jan 06, 09:30	0.285	0.185
40	01 Jan 06, 09:45	0.285	0.185
41	01 Jan 06, 10:00	0.285	0.185
42	01 Jan 06, 10:15	0.285	0.185
43	01 Jan 06, 10:30	0.285	0.185
44	01 Jan 06, 10:45	0.285	0.185
45	01 Jan 06, 11:00	0.285	0.185
46	01 Jan 06, 11:15	0.285	0.185
47	01 Jan 06, 11:30	0.285	0.185
48	01 Jan 06, 11:45	0.285	0.185
49	01 Jan 06, 12:00	0.285	0.185
50	01 Jan 06, 12:15	0.285	0.185
51	01 Jan 06, 12:30	0.285	0.185
52	01 Jan 06, 12:45	0.285	0.185
53	01 Jan 06, 13:00	0.285	0.185
54	01 Jan 06, 13:15	0.285	0.185
55	01 Jan 06, 13:30	0.285	0.185
56	01 Jan 06, 13:45	0.285	0.185
57	01 Jan 06, 14:00	0.285	0.185
58	01 Jan 06, 14:15	0.285	0.185
59	01 Jan 06, 14:30	0.285	0.185
60	01 Jan 06, 14:45	0.285	0.185
61	01 Jan 06, 15:00	0.285	0.185
62	01 Jan 06, 15:15	0.285	0.185
63	01 Jan 06, 15:30	0.285	0.185
64	01 Jan 06, 15:45	0.285	0.185
65	01 Jan 06, 16:00	0.285	0.185
66	01 Jan 06, 16:15	0.285	0.185
67	01 Jan 06, 16:30	0.285	0.185
68	01 Jan 06, 16:45	0.285	0.185
69	01 Jan 06, 17:00	0.285	0.185
70	01 Jan 06, 17:15	0.285	0.185
71	01 Jan 06, 17:30	0.285	0.185
72	01 Jan 06, 17:45	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 06H	SUBBASIN-2 FLOW RUN:010Y 06H
73	01 Jan 06, 18:00	0.285	0.185
74	01 Jan 06, 18:15	0.285	0.185
75	01 Jan 06, 18:30	0.285	0.185
76	01 Jan 06, 18:45	0.285	0.185
77	01 Jan 06, 19:00	0.285	0.185
78	01 Jan 06, 19:15	0.285	0.185
79	01 Jan 06, 19:30	0.285	0.185
80	01 Jan 06, 19:45	0.285	0.185
81	01 Jan 06, 20:00	0.285	0.185
82	01 Jan 06, 20:15	0.285	0.185
83	01 Jan 06, 20:30	0.285	0.185
84	01 Jan 06, 20:45	0.285	0.185
85	01 Jan 06, 21:00	0.285	0.185
86	01 Jan 06, 21:15	0.285	0.185
87	01 Jan 06, 21:30	0.285	0.185
88	01 Jan 06, 21:45	0.285	0.185
89	01 Jan 06, 22:00	0.285	0.185
90	01 Jan 06, 22:15	0.285	0.185
91	01 Jan 06, 22:30	0.285	0.185
92	01 Jan 06, 22:45	0.285	0.185
93	01 Jan 06, 23:00	0.285	0.185
94	01 Jan 06, 23:15	0.285	0.185
95	01 Jan 06, 23:30	0.285	0.185
96	01 Jan 06, 23:45	0.285	0.185
97	01 Jan 06, 24:00	0.285	0.185



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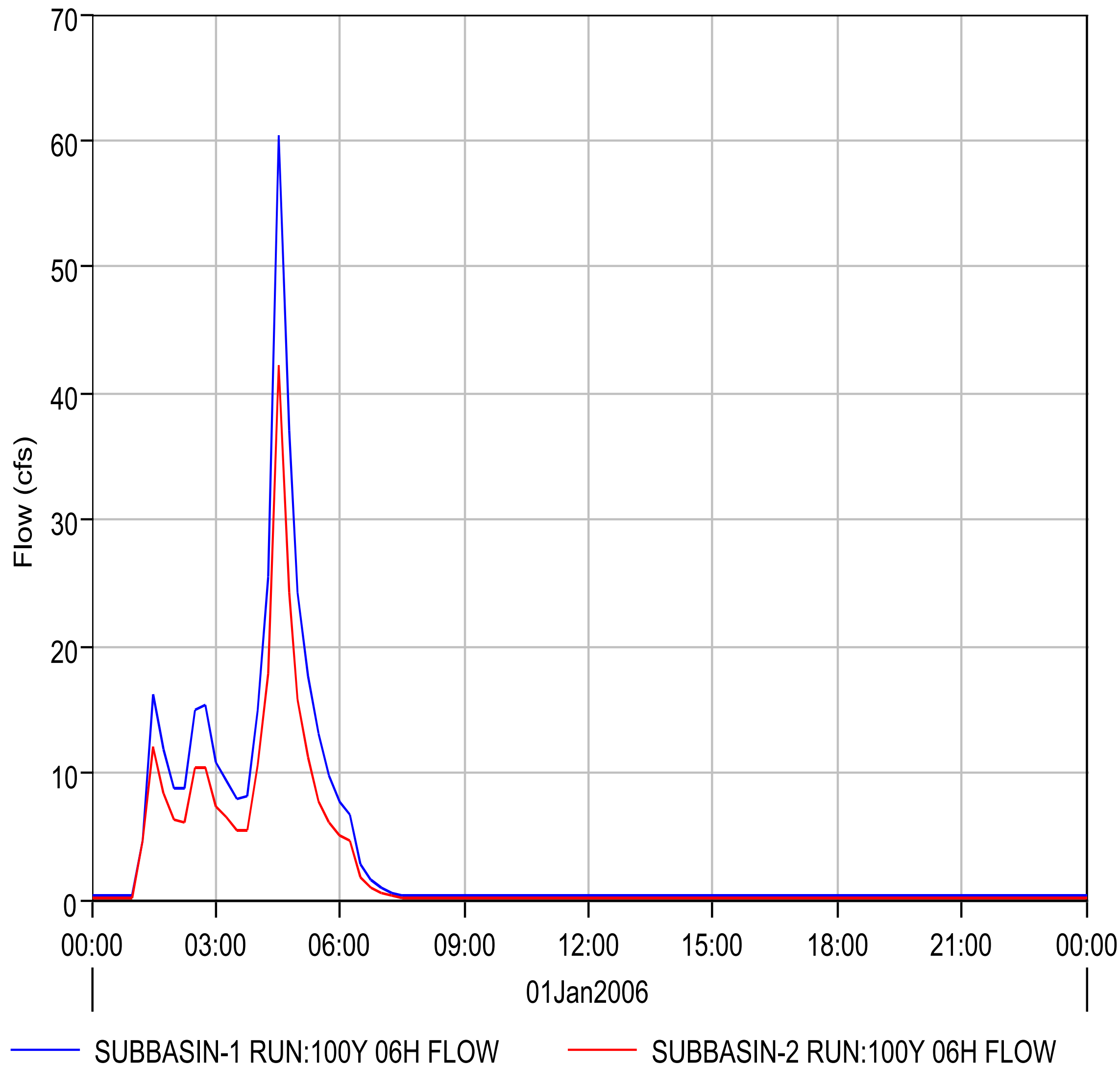
Flow (cfs)
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan2006
SUBBASIN-1 RUN:010Y 12H FLOW
SUBBASIN-2 RUN:010Y 12H FLOW

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 12H	SUBBASIN-2 FLOW RUN:010Y 12H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.285	0.185
2	01 Jan 06, 00:15	0.285	0.185
3	01 Jan 06, 00:30	0.285	0.185
4	01 Jan 06, 00:45	0.285	0.185
5	01 Jan 06, 01:00	0.285	0.185
6	01 Jan 06, 01:15	0.285	0.185
7	01 Jan 06, 01:30	0.285	0.185
8	01 Jan 06, 01:45	0.285	0.185
9	01 Jan 06, 02:00	0.285	0.185
10	01 Jan 06, 02:15	0.285	0.185
11	01 Jan 06, 02:30	0.285	0.185
12	01 Jan 06, 02:45	0.285	0.185
13	01 Jan 06, 03:00	0.285	0.185
14	01 Jan 06, 03:15	0.285	0.185
15	01 Jan 06, 03:30	0.285	0.185
16	01 Jan 06, 03:45	0.285	0.185
17	01 Jan 06, 04:00	0.285	0.185
18	01 Jan 06, 04:15	0.285	0.185
19	01 Jan 06, 04:30	0.285	1.647
20	01 Jan 06, 04:45	0.285	2.943
21	01 Jan 06, 05:00	1.405	3.931
22	01 Jan 06, 05:15	6.164	5.632
23	01 Jan 06, 05:30	8.328	6.558
24	01 Jan 06, 05:45	11.629	8.591
25	01 Jan 06, 06:00	15.092	10.744
26	01 Jan 06, 06:15	42.191	29.731
27	01 Jan 06, 06:30	28.943	19.154
28	01 Jan 06, 06:45	18.859	12.291
29	01 Jan 06, 07:00	14.535	9.638
30	01 Jan 06, 07:15	11.943	7.462
31	01 Jan 06, 07:30	9.451	6.036
32	01 Jan 06, 07:45	6.914	4.680
33	01 Jan 06, 08:00	5.803	4.101
34	01 Jan 06, 08:15	4.857	3.510
35	01 Jan 06, 08:30	4.205	3.106

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 12H	SUBBASIN-2 FLOW RUN:010Y 12H
36	01 Jan 06, 08:45	3.920	2.967
37	01 Jan 06, 09:00	3.526	2.718
38	01 Jan 06, 09:15	3.373	2.640
39	01 Jan 06, 09:30	2.512	2.045
40	01 Jan 06, 09:45	1.950	1.683
41	01 Jan 06, 10:00	1.729	1.557
42	01 Jan 06, 10:15	1.613	1.489
43	01 Jan 06, 10:30	1.539	1.458
44	01 Jan 06, 10:45	1.242	1.263
45	01 Jan 06, 11:00	1.147	1.210
46	01 Jan 06, 11:15	1.108	1.188
47	01 Jan 06, 11:30	0.819	0.984
48	01 Jan 06, 11:45	0.714	0.926
49	01 Jan 06, 12:00	0.465	0.714
50	01 Jan 06, 12:15	0.372	0.646
51	01 Jan 06, 12:30	0.326	0.345
52	01 Jan 06, 12:45	0.303	0.253
53	01 Jan 06, 13:00	0.289	0.215
54	01 Jan 06, 13:15	0.285	0.193
55	01 Jan 06, 13:30	0.285	0.186
56	01 Jan 06, 13:45	0.285	0.185
57	01 Jan 06, 14:00	0.285	0.185
58	01 Jan 06, 14:15	0.285	0.185
59	01 Jan 06, 14:30	0.285	0.185
60	01 Jan 06, 14:45	0.285	0.185
61	01 Jan 06, 15:00	0.285	0.185
62	01 Jan 06, 15:15	0.285	0.185
63	01 Jan 06, 15:30	0.285	0.185
64	01 Jan 06, 15:45	0.285	0.185
65	01 Jan 06, 16:00	0.285	0.185
66	01 Jan 06, 16:15	0.285	0.185
67	01 Jan 06, 16:30	0.285	0.185
68	01 Jan 06, 16:45	0.285	0.185
69	01 Jan 06, 17:00	0.285	0.185
70	01 Jan 06, 17:15	0.285	0.185
71	01 Jan 06, 17:30	0.285	0.185
72	01 Jan 06, 17:45	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:010Y 12H	SUBBASIN-2 FLOW RUN:010Y 12H
73	01 Jan 06, 18:00	0.285	0.185
74	01 Jan 06, 18:15	0.285	0.185
75	01 Jan 06, 18:30	0.285	0.185
76	01 Jan 06, 18:45	0.285	0.185
77	01 Jan 06, 19:00	0.285	0.185
78	01 Jan 06, 19:15	0.285	0.185
79	01 Jan 06, 19:30	0.285	0.185
80	01 Jan 06, 19:45	0.285	0.185
81	01 Jan 06, 20:00	0.285	0.185
82	01 Jan 06, 20:15	0.285	0.185
83	01 Jan 06, 20:30	0.285	0.185
84	01 Jan 06, 20:45	0.285	0.185
85	01 Jan 06, 21:00	0.285	0.185
86	01 Jan 06, 21:15	0.285	0.185
87	01 Jan 06, 21:30	0.285	0.185
88	01 Jan 06, 21:45	0.285	0.185
89	01 Jan 06, 22:00	0.285	0.185
90	01 Jan 06, 22:15	0.285	0.185
91	01 Jan 06, 22:30	0.285	0.185
92	01 Jan 06, 22:45	0.285	0.185
93	01 Jan 06, 23:00	0.285	0.185
94	01 Jan 06, 23:15	0.285	0.185
95	01 Jan 06, 23:30	0.285	0.185
96	01 Jan 06, 23:45	0.285	0.185
97	01 Jan 06, 24:00	0.285	0.185


Flow (cfs)
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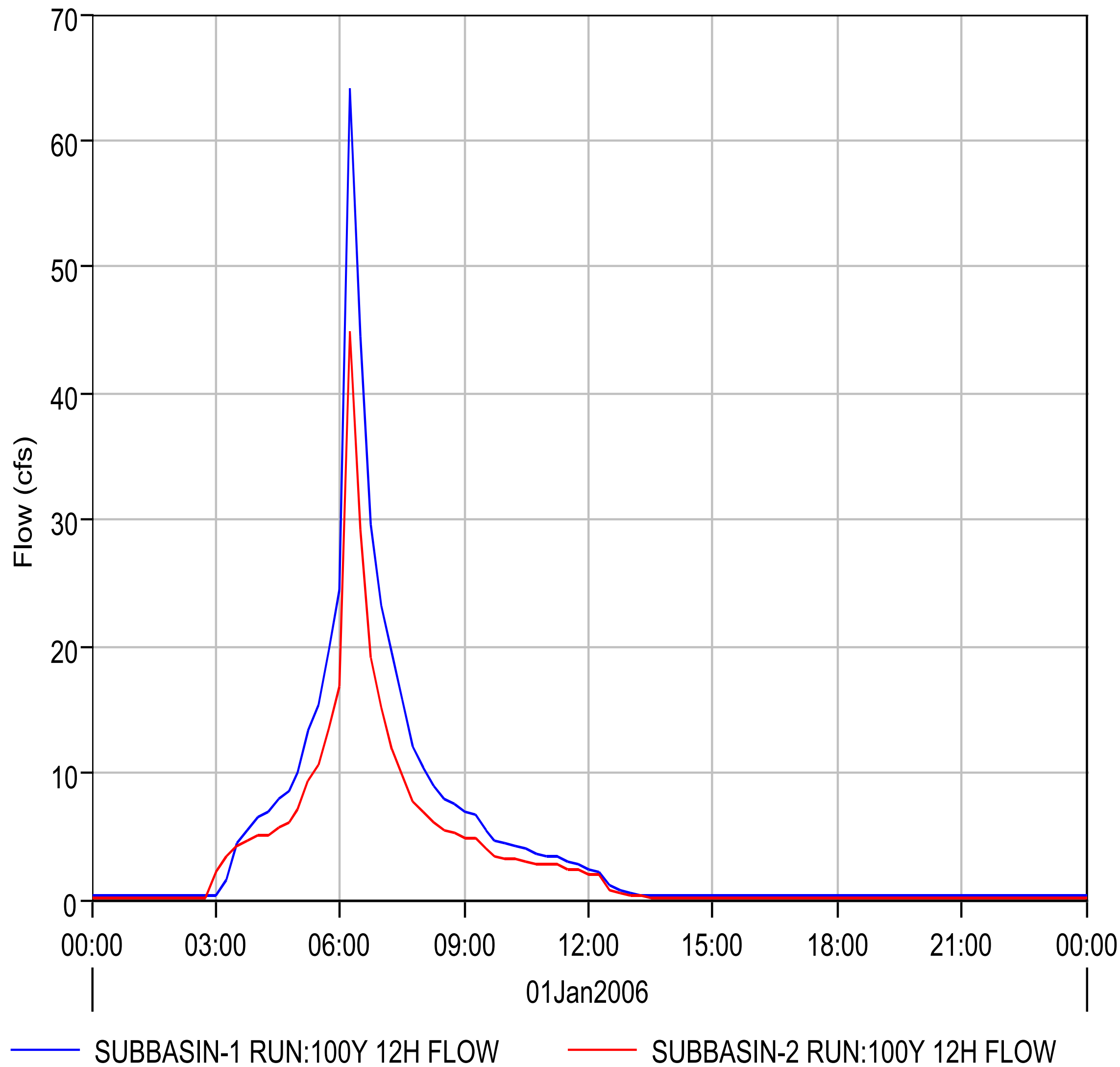
01Jan2006
SUBBASIN-1 RUN:100Y 06H FLOW
SUBBASIN-2 RUN:100Y 06H FLOW

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 06H	SUBBASIN-2 FLOW RUN:100Y 06H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.285	0.185
2	01 Jan 06, 00:15	0.285	0.185
3	01 Jan 06, 00:30	0.285	0.185
4	01 Jan 06, 00:45	0.285	0.185
5	01 Jan 06, 01:00	0.285	0.185
6	01 Jan 06, 01:15	4.635	4.548
7	01 Jan 06, 01:30	16.209	12.021
8	01 Jan 06, 01:45	11.784	8.272
9	01 Jan 06, 02:00	8.838	6.276
10	01 Jan 06, 02:15	8.694	6.190
11	01 Jan 06, 02:30	15.027	10.447
12	01 Jan 06, 02:45	15.374	10.520
13	01 Jan 06, 03:00	10.838	7.357
14	01 Jan 06, 03:15	9.310	6.461
15	01 Jan 06, 03:30	7.956	5.444
16	01 Jan 06, 03:45	8.082	5.562
17	01 Jan 06, 04:00	14.949	10.563
18	01 Jan 06, 04:15	25.421	17.797
19	01 Jan 06, 04:30	60.480	42.325
20	01 Jan 06, 04:45	37.054	24.193
21	01 Jan 06, 05:00	24.302	15.695
22	01 Jan 06, 05:15	17.573	11.328
23	01 Jan 06, 05:30	13.159	7.788
24	01 Jan 06, 05:45	9.797	6.047
25	01 Jan 06, 06:00	7.643	5.127
26	01 Jan 06, 06:15	6.636	4.644
27	01 Jan 06, 06:30	2.807	1.703
28	01 Jan 06, 06:45	1.499	0.858
29	01 Jan 06, 07:00	0.925	0.499
30	01 Jan 06, 07:15	0.582	0.268
31	01 Jan 06, 07:30	0.359	0.191
32	01 Jan 06, 07:45	0.291	0.185
33	01 Jan 06, 08:00	0.285	0.185
34	01 Jan 06, 08:15	0.285	0.185
35	01 Jan 06, 08:30	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 06H	SUBBASIN-2 FLOW RUN:100Y 06H
36	01 Jan 06, 08:45	0.285	0.185
37	01 Jan 06, 09:00	0.285	0.185
38	01 Jan 06, 09:15	0.285	0.185
39	01 Jan 06, 09:30	0.285	0.185
40	01 Jan 06, 09:45	0.285	0.185
41	01 Jan 06, 10:00	0.285	0.185
42	01 Jan 06, 10:15	0.285	0.185
43	01 Jan 06, 10:30	0.285	0.185
44	01 Jan 06, 10:45	0.285	0.185
45	01 Jan 06, 11:00	0.285	0.185
46	01 Jan 06, 11:15	0.285	0.185
47	01 Jan 06, 11:30	0.285	0.185
48	01 Jan 06, 11:45	0.285	0.185
49	01 Jan 06, 12:00	0.285	0.185
50	01 Jan 06, 12:15	0.285	0.185
51	01 Jan 06, 12:30	0.285	0.185
52	01 Jan 06, 12:45	0.285	0.185
53	01 Jan 06, 13:00	0.285	0.185
54	01 Jan 06, 13:15	0.285	0.185
55	01 Jan 06, 13:30	0.285	0.185
56	01 Jan 06, 13:45	0.285	0.185
57	01 Jan 06, 14:00	0.285	0.185
58	01 Jan 06, 14:15	0.285	0.185
59	01 Jan 06, 14:30	0.285	0.185
60	01 Jan 06, 14:45	0.285	0.185
61	01 Jan 06, 15:00	0.285	0.185
62	01 Jan 06, 15:15	0.285	0.185
63	01 Jan 06, 15:30	0.285	0.185
64	01 Jan 06, 15:45	0.285	0.185
65	01 Jan 06, 16:00	0.285	0.185
66	01 Jan 06, 16:15	0.285	0.185
67	01 Jan 06, 16:30	0.285	0.185
68	01 Jan 06, 16:45	0.285	0.185
69	01 Jan 06, 17:00	0.285	0.185
70	01 Jan 06, 17:15	0.285	0.185
71	01 Jan 06, 17:30	0.285	0.185
72	01 Jan 06, 17:45	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 06H	SUBBASIN-2 FLOW RUN:100Y 06H
73	01 Jan 06, 18:00	0.285	0.185
74	01 Jan 06, 18:15	0.285	0.185
75	01 Jan 06, 18:30	0.285	0.185
76	01 Jan 06, 18:45	0.285	0.185
77	01 Jan 06, 19:00	0.285	0.185
78	01 Jan 06, 19:15	0.285	0.185
79	01 Jan 06, 19:30	0.285	0.185
80	01 Jan 06, 19:45	0.285	0.185
81	01 Jan 06, 20:00	0.285	0.185
82	01 Jan 06, 20:15	0.285	0.185
83	01 Jan 06, 20:30	0.285	0.185
84	01 Jan 06, 20:45	0.285	0.185
85	01 Jan 06, 21:00	0.285	0.185
86	01 Jan 06, 21:15	0.285	0.185
87	01 Jan 06, 21:30	0.285	0.185
88	01 Jan 06, 21:45	0.285	0.185
89	01 Jan 06, 22:00	0.285	0.185
90	01 Jan 06, 22:15	0.285	0.185
91	01 Jan 06, 22:30	0.285	0.185
92	01 Jan 06, 22:45	0.285	0.185
93	01 Jan 06, 23:00	0.285	0.185
94	01 Jan 06, 23:15	0.285	0.185
95	01 Jan 06, 23:30	0.285	0.185
96	01 Jan 06, 23:45	0.285	0.185
97	01 Jan 06, 24:00	0.285	0.185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Flow (cfs)
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12:00
15:00
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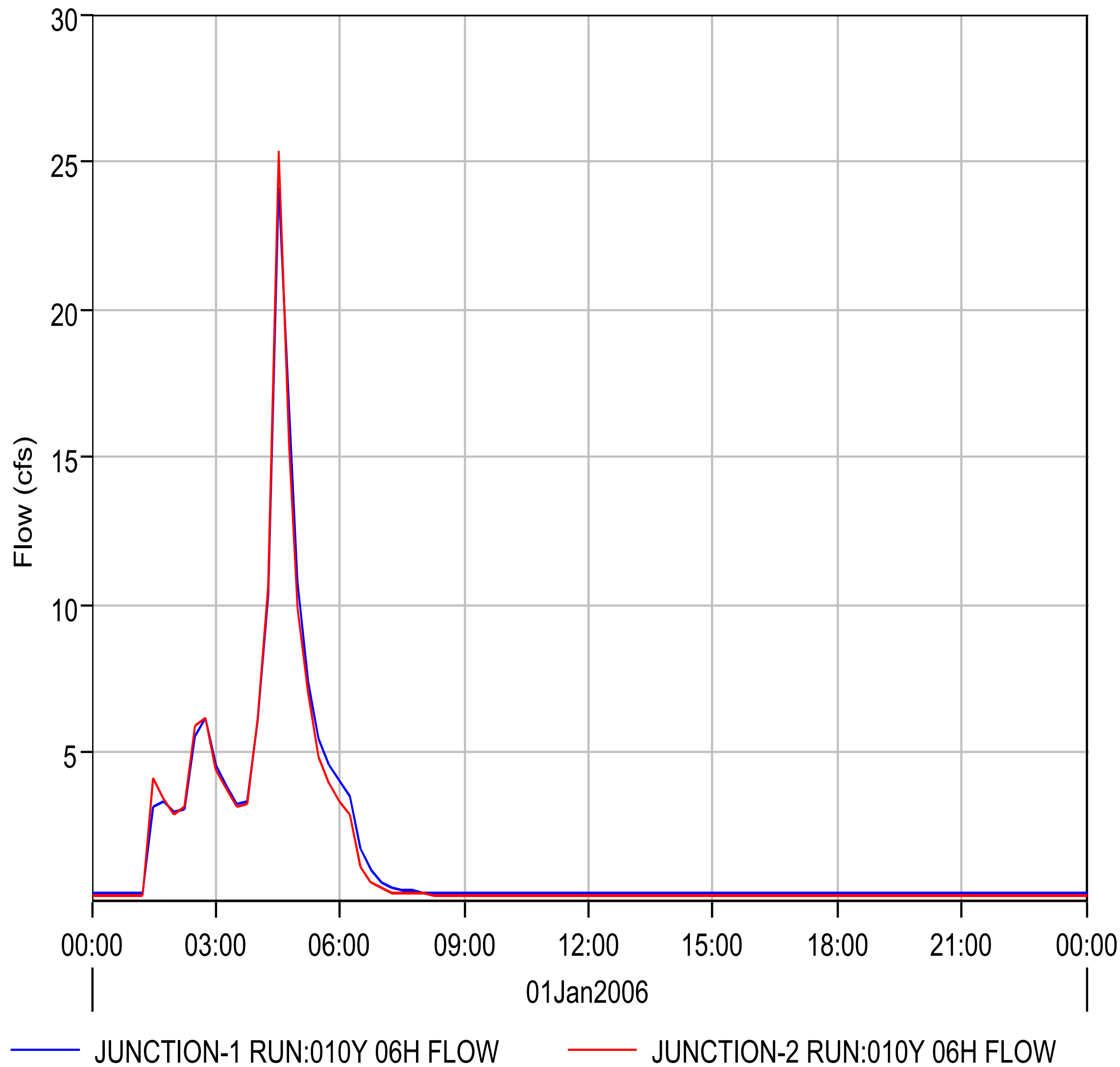
01Jan2006
SUBBASIN-1 RUN:100Y 12H FLOW
SUBBASIN-2 RUN:100Y 12H FLOW

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 12H	SUBBASIN-2 FLOW RUN:100Y 12H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.285	0.185
2	01 Jan 06, 00:15	0.285	0.185
3	01 Jan 06, 00:30	0.285	0.185
4	01 Jan 06, 00:45	0.285	0.185
5	01 Jan 06, 01:00	0.285	0.185
6	01 Jan 06, 01:15	0.285	0.185
7	01 Jan 06, 01:30	0.285	0.185
8	01 Jan 06, 01:45	0.285	0.185
9	01 Jan 06, 02:00	0.285	0.185
10	01 Jan 06, 02:15	0.285	0.185
11	01 Jan 06, 02:30	0.285	0.185
12	01 Jan 06, 02:45	0.285	0.185
13	01 Jan 06, 03:00	0.285	2.115
14	01 Jan 06, 03:15	1.530	3.479
15	01 Jan 06, 03:30	4.517	4.217
16	01 Jan 06, 03:45	5.560	4.549
17	01 Jan 06, 04:00	6.438	4.979
18	01 Jan 06, 04:15	6.879	5.106
19	01 Jan 06, 04:30	7.902	5.706
20	01 Jan 06, 04:45	8.643	6.163
21	01 Jan 06, 05:00	10.091	7.151
22	01 Jan 06, 05:15	13.358	9.413
23	01 Jan 06, 05:30	15.315	10.653
24	01 Jan 06, 05:45	19.643	13.623
25	01 Jan 06, 06:00	24.397	16.799
26	01 Jan 06, 06:15	64.167	44.834
27	01 Jan 06, 06:30	44.534	29.216
28	01 Jan 06, 06:45	29.637	19.084
29	01 Jan 06, 07:00	23.253	15.166
30	01 Jan 06, 07:15	19.426	11.954
31	01 Jan 06, 07:30	15.747	9.848
32	01 Jan 06, 07:45	12.001	7.846
33	01 Jan 06, 08:00	10.361	6.990
34	01 Jan 06, 08:15	8.963	6.119
35	01 Jan 06, 08:30	8.001	5.522

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 12H	SUBBASIN-2 FLOW RUN:100Y 12H
36	01 Jan 06, 08:45	7.581	5.316
37	01 Jan 06, 09:00	6.999	4.949
38	01 Jan 06, 09:15	6.772	4.833
39	01 Jan 06, 09:30	5.501	3.956
40	01 Jan 06, 09:45	4.672	3.420
41	01 Jan 06, 10:00	4.345	3.235
42	01 Jan 06, 10:15	4.174	3.134
43	01 Jan 06, 10:30	4.065	3.089
44	01 Jan 06, 10:45	3.627	2.801
45	01 Jan 06, 11:00	3.486	2.722
46	01 Jan 06, 11:15	3.428	2.689
47	01 Jan 06, 11:30	3.002	2.388
48	01 Jan 06, 11:45	2.846	2.303
49	01 Jan 06, 12:00	2.390	1.991
50	01 Jan 06, 12:15	2.223	1.890
51	01 Jan 06, 12:30	1.066	0.767
52	01 Jan 06, 12:45	0.662	0.441
53	01 Jan 06, 13:00	0.480	0.305
54	01 Jan 06, 13:15	0.375	0.217
55	01 Jan 06, 13:30	0.308	0.187
56	01 Jan 06, 13:45	0.287	0.185
57	01 Jan 06, 14:00	0.285	0.185
58	01 Jan 06, 14:15	0.285	0.185
59	01 Jan 06, 14:30	0.285	0.185
60	01 Jan 06, 14:45	0.285	0.185
61	01 Jan 06, 15:00	0.285	0.185
62	01 Jan 06, 15:15	0.285	0.185
63	01 Jan 06, 15:30	0.285	0.185
64	01 Jan 06, 15:45	0.285	0.185
65	01 Jan 06, 16:00	0.285	0.185
66	01 Jan 06, 16:15	0.285	0.185
67	01 Jan 06, 16:30	0.285	0.185
68	01 Jan 06, 16:45	0.285	0.185
69	01 Jan 06, 17:00	0.285	0.185
70	01 Jan 06, 17:15	0.285	0.185
71	01 Jan 06, 17:30	0.285	0.185
72	01 Jan 06, 17:45	0.285	0.185

Ordinate	Date / Time	SUBBASIN-1 FLOW RUN:100Y 12H	SUBBASIN-2 FLOW RUN:100Y 12H
73	01 Jan 06, 18:00	0.285	0.185
74	01 Jan 06, 18:15	0.285	0.185
75	01 Jan 06, 18:30	0.285	0.185
76	01 Jan 06, 18:45	0.285	0.185
77	01 Jan 06, 19:00	0.285	0.185
78	01 Jan 06, 19:15	0.285	0.185
79	01 Jan 06, 19:30	0.285	0.185
80	01 Jan 06, 19:45	0.285	0.185
81	01 Jan 06, 20:00	0.285	0.185
82	01 Jan 06, 20:15	0.285	0.185
83	01 Jan 06, 20:30	0.285	0.185
84	01 Jan 06, 20:45	0.285	0.185
85	01 Jan 06, 21:00	0.285	0.185
86	01 Jan 06, 21:15	0.285	0.185
87	01 Jan 06, 21:30	0.285	0.185
88	01 Jan 06, 21:45	0.285	0.185
89	01 Jan 06, 22:00	0.285	0.185
90	01 Jan 06, 22:15	0.285	0.185
91	01 Jan 06, 22:30	0.285	0.185
92	01 Jan 06, 22:45	0.285	0.185
93	01 Jan 06, 23:00	0.285	0.185
94	01 Jan 06, 23:15	0.285	0.185
95	01 Jan 06, 23:30	0.285	0.185
96	01 Jan 06, 23:45	0.285	0.185
97	01 Jan 06, 24:00	0.285	0.185

Appendix 7.8
Proposed Conditions HEC-HMS Hydrograph Output



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Flow (cfs)
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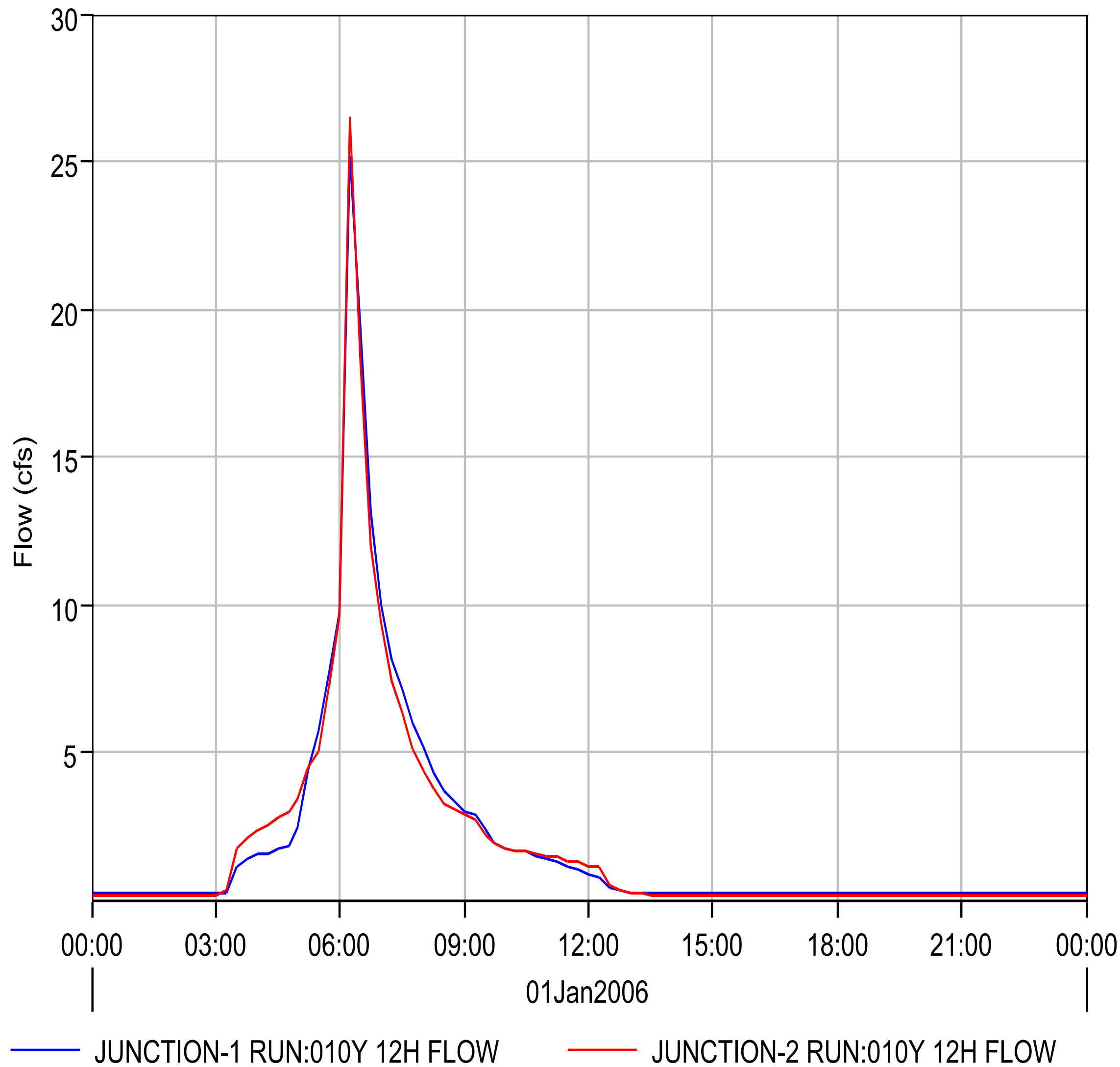
01Jan2006
JUNCTION-1 RUN:010Y 06H FLOW
JUNCTION-2 RUN:010Y 06H FLOW

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 06H	JUNCTION-2 FLOW RUN:010Y 06H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.185	0.175
2	01 Jan 06, 00:15	0.185	0.175
3	01 Jan 06, 00:30	0.185	0.175
4	01 Jan 06, 00:45	0.185	0.175
5	01 Jan 06, 01:00	0.185	0.175
6	01 Jan 06, 01:15	0.185	0.175
7	01 Jan 06, 01:30	3.154	4.150
8	01 Jan 06, 01:45	3.285	3.417
9	01 Jan 06, 02:00	2.972	2.864
10	01 Jan 06, 02:15	3.012	3.129
11	01 Jan 06, 02:30	5.537	5.855
12	01 Jan 06, 02:45	6.137	6.154
13	01 Jan 06, 03:00	4.593	4.354
14	01 Jan 06, 03:15	3.863	3.745
15	01 Jan 06, 03:30	3.245	3.119
16	01 Jan 06, 03:45	3.304	3.200
17	01 Jan 06, 04:00	6.036	6.186
18	01 Jan 06, 04:15	10.339	10.599
19	01 Jan 06, 04:30	24.143	25.312
20	01 Jan 06, 04:45	16.523	15.360
21	01 Jan 06, 05:00	10.748	9.897
22	01 Jan 06, 05:15	7.416	7.014
23	01 Jan 06, 05:30	5.449	4.860
24	01 Jan 06, 05:45	4.600	3.936
25	01 Jan 06, 06:00	3.998	3.322
26	01 Jan 06, 06:15	3.479	2.857
27	01 Jan 06, 06:30	1.757	1.139
28	01 Jan 06, 06:45	0.981	0.600
29	01 Jan 06, 07:00	0.593	0.371
30	01 Jan 06, 07:15	0.407	0.239
31	01 Jan 06, 07:30	0.326	0.199
32	01 Jan 06, 07:45	0.274	0.187
33	01 Jan 06, 08:00	0.235	0.180
34	01 Jan 06, 08:15	0.207	0.176
35	01 Jan 06, 08:30	0.192	0.175

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 06H	JUNCTION-2 FLOW RUN:010Y 06H
36	01 Jan 06, 08:45	0.187	0.175
37	01 Jan 06, 09:00	0.185	0.175
38	01 Jan 06, 09:15	0.185	0.175
39	01 Jan 06, 09:30	0.185	0.175
40	01 Jan 06, 09:45	0.185	0.175
41	01 Jan 06, 10:00	0.185	0.175
42	01 Jan 06, 10:15	0.185	0.175
43	01 Jan 06, 10:30	0.185	0.175
44	01 Jan 06, 10:45	0.185	0.175
45	01 Jan 06, 11:00	0.185	0.175
46	01 Jan 06, 11:15	0.185	0.175
47	01 Jan 06, 11:30	0.185	0.175
48	01 Jan 06, 11:45	0.185	0.175
49	01 Jan 06, 12:00	0.185	0.175
50	01 Jan 06, 12:15	0.185	0.175
51	01 Jan 06, 12:30	0.185	0.175
52	01 Jan 06, 12:45	0.185	0.175
53	01 Jan 06, 13:00	0.185	0.175
54	01 Jan 06, 13:15	0.185	0.175
55	01 Jan 06, 13:30	0.185	0.175
56	01 Jan 06, 13:45	0.185	0.175
57	01 Jan 06, 14:00	0.185	0.175
58	01 Jan 06, 14:15	0.185	0.175
59	01 Jan 06, 14:30	0.185	0.175
60	01 Jan 06, 14:45	0.185	0.175
61	01 Jan 06, 15:00	0.185	0.175
62	01 Jan 06, 15:15	0.185	0.175
63	01 Jan 06, 15:30	0.185	0.175
64	01 Jan 06, 15:45	0.185	0.175
65	01 Jan 06, 16:00	0.185	0.175
66	01 Jan 06, 16:15	0.185	0.175
67	01 Jan 06, 16:30	0.185	0.175
68	01 Jan 06, 16:45	0.185	0.175
69	01 Jan 06, 17:00	0.185	0.175
70	01 Jan 06, 17:15	0.185	0.175
71	01 Jan 06, 17:30	0.185	0.175
72	01 Jan 06, 17:45	0.185	0.175

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 06H	JUNCTION-2 FLOW RUN:010Y 06H
73	01 Jan 06, 18:00	0.185	0.175
74	01 Jan 06, 18:15	0.185	0.175
75	01 Jan 06, 18:30	0.185	0.175
76	01 Jan 06, 18:45	0.185	0.175
77	01 Jan 06, 19:00	0.185	0.175
78	01 Jan 06, 19:15	0.185	0.175
79	01 Jan 06, 19:30	0.185	0.175
80	01 Jan 06, 19:45	0.185	0.175
81	01 Jan 06, 20:00	0.185	0.175
82	01 Jan 06, 20:15	0.185	0.175
83	01 Jan 06, 20:30	0.185	0.175
84	01 Jan 06, 20:45	0.185	0.175
85	01 Jan 06, 21:00	0.185	0.175
86	01 Jan 06, 21:15	0.185	0.175
87	01 Jan 06, 21:30	0.185	0.175
88	01 Jan 06, 21:45	0.185	0.175
89	01 Jan 06, 22:00	0.185	0.175
90	01 Jan 06, 22:15	0.185	0.175
91	01 Jan 06, 22:30	0.185	0.175
92	01 Jan 06, 22:45	0.185	0.175
93	01 Jan 06, 23:00	0.185	0.175
94	01 Jan 06, 23:15	0.185	0.175
95	01 Jan 06, 23:30	0.185	0.175
96	01 Jan 06, 23:45	0.185	0.175
97	01 Jan 06, 24:00	0.185	0.175



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Flow (cfs)
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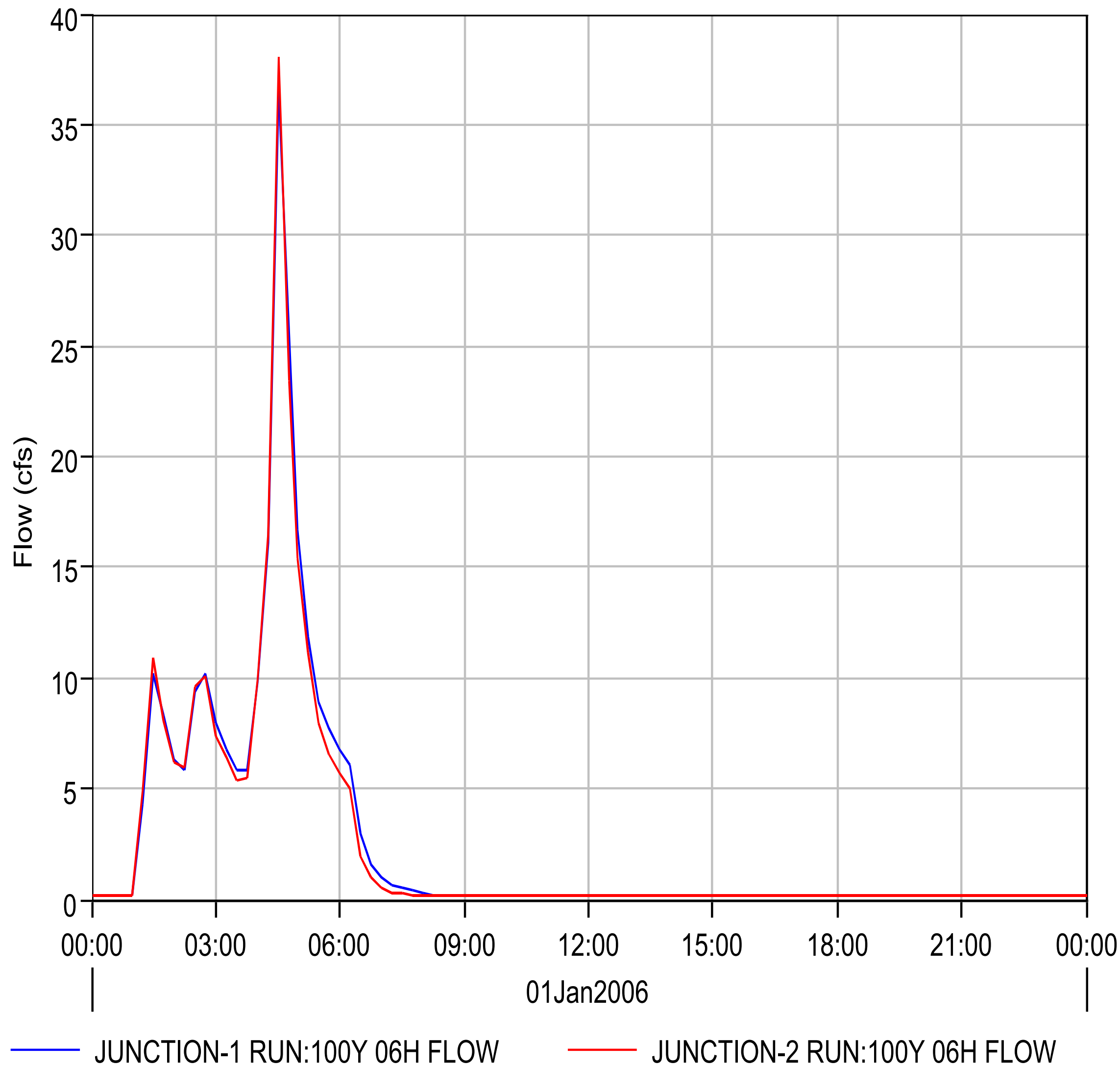
01Jan2006
JUNCTION-1 RUN:010Y 12H FLOW
JUNCTION-2 RUN:010Y 12H FLOW

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 12H	JUNCTION-2 FLOW RUN:010Y 12H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.185	0.175
2	01 Jan 06, 00:15	0.185	0.175
3	01 Jan 06, 00:30	0.185	0.175
4	01 Jan 06, 00:45	0.185	0.175
5	01 Jan 06, 01:00	0.185	0.175
6	01 Jan 06, 01:15	0.185	0.175
7	01 Jan 06, 01:30	0.185	0.175
8	01 Jan 06, 01:45	0.185	0.175
9	01 Jan 06, 02:00	0.185	0.175
10	01 Jan 06, 02:15	0.185	0.175
11	01 Jan 06, 02:30	0.185	0.175
12	01 Jan 06, 02:45	0.185	0.175
13	01 Jan 06, 03:00	0.185	0.175
14	01 Jan 06, 03:15	0.247	0.272
15	01 Jan 06, 03:30	1.148	1.691
16	01 Jan 06, 03:45	1.342	2.066
17	01 Jan 06, 04:00	1.513	2.356
18	01 Jan 06, 04:15	1.554	2.491
19	01 Jan 06, 04:30	1.723	2.780
20	01 Jan 06, 04:45	1.839	2.982
21	01 Jan 06, 05:00	2.405	3.424
22	01 Jan 06, 05:15	4.375	4.439
23	01 Jan 06, 05:30	5.706	4.978
24	01 Jan 06, 05:45	7.632	7.228
25	01 Jan 06, 06:00	9.728	9.621
26	01 Jan 06, 06:15	25.171	26.469
27	01 Jan 06, 06:30	19.328	18.235
28	01 Jan 06, 06:45	13.098	11.988
29	01 Jan 06, 07:00	9.926	9.370
30	01 Jan 06, 07:15	8.111	7.419
31	01 Jan 06, 07:30	7.118	6.321
32	01 Jan 06, 07:45	5.944	5.103
33	01 Jan 06, 08:00	5.158	4.397
34	01 Jan 06, 08:15	4.313	3.720
35	01 Jan 06, 08:30	3.669	3.260

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 12H	JUNCTION-2 FLOW RUN:010Y 12H
36	01 Jan 06, 08:45	3.331	3.082
37	01 Jan 06, 09:00	3.006	2.833
38	01 Jan 06, 09:15	2.852	2.734
39	01 Jan 06, 09:30	2.321	2.197
40	01 Jan 06, 09:45	1.926	1.865
41	01 Jan 06, 10:00	1.746	1.743
42	01 Jan 06, 10:15	1.657	1.676
43	01 Jan 06, 10:30	1.609	1.645
44	01 Jan 06, 10:45	1.428	1.505
45	01 Jan 06, 11:00	1.338	1.463
46	01 Jan 06, 11:15	1.291	1.445
47	01 Jan 06, 11:30	1.116	1.308
48	01 Jan 06, 11:45	1.038	1.272
49	01 Jan 06, 12:00	0.868	1.132
50	01 Jan 06, 12:15	0.793	1.090
51	01 Jan 06, 12:30	0.371	0.467
52	01 Jan 06, 12:45	0.269	0.299
53	01 Jan 06, 13:00	0.218	0.229
54	01 Jan 06, 13:15	0.198	0.185
55	01 Jan 06, 13:30	0.192	0.175
56	01 Jan 06, 13:45	0.188	0.175
57	01 Jan 06, 14:00	0.186	0.175
58	01 Jan 06, 14:15	0.185	0.175
59	01 Jan 06, 14:30	0.185	0.175
60	01 Jan 06, 14:45	0.185	0.175
61	01 Jan 06, 15:00	0.185	0.175
62	01 Jan 06, 15:15	0.185	0.175
63	01 Jan 06, 15:30	0.185	0.175
64	01 Jan 06, 15:45	0.185	0.175
65	01 Jan 06, 16:00	0.185	0.175
66	01 Jan 06, 16:15	0.185	0.175
67	01 Jan 06, 16:30	0.185	0.175
68	01 Jan 06, 16:45	0.185	0.175
69	01 Jan 06, 17:00	0.185	0.175
70	01 Jan 06, 17:15	0.185	0.175
71	01 Jan 06, 17:30	0.185	0.175
72	01 Jan 06, 17:45	0.185	0.175

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:010Y 12H	JUNCTION-2 FLOW RUN:010Y 12H
73	01 Jan 06, 18:00	0.185	0.175
74	01 Jan 06, 18:15	0.185	0.175
75	01 Jan 06, 18:30	0.185	0.175
76	01 Jan 06, 18:45	0.185	0.175
77	01 Jan 06, 19:00	0.185	0.175
78	01 Jan 06, 19:15	0.185	0.175
79	01 Jan 06, 19:30	0.185	0.175
80	01 Jan 06, 19:45	0.185	0.175
81	01 Jan 06, 20:00	0.185	0.175
82	01 Jan 06, 20:15	0.185	0.175
83	01 Jan 06, 20:30	0.185	0.175
84	01 Jan 06, 20:45	0.185	0.175
85	01 Jan 06, 21:00	0.185	0.175
86	01 Jan 06, 21:15	0.185	0.175
87	01 Jan 06, 21:30	0.185	0.175
88	01 Jan 06, 21:45	0.185	0.175
89	01 Jan 06, 22:00	0.185	0.175
90	01 Jan 06, 22:15	0.185	0.175
91	01 Jan 06, 22:30	0.185	0.175
92	01 Jan 06, 22:45	0.185	0.175
93	01 Jan 06, 23:00	0.185	0.175
94	01 Jan 06, 23:15	0.185	0.175
95	01 Jan 06, 23:30	0.185	0.175
96	01 Jan 06, 23:45	0.185	0.175
97	01 Jan 06, 24:00	0.185	0.175


Flow (cfs)
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01Jan2006
JUNCTION-1 RUN:100Y 06H FLOW
JUNCTION-2 RUN:100Y 06H FLOW

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 06H	JUNCTION-2 FLOW RUN:100Y 06H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.185	0.175
2	01 Jan 06, 00:15	0.185	0.175
3	01 Jan 06, 00:30	0.185	0.175
4	01 Jan 06, 00:45	0.185	0.175
5	01 Jan 06, 01:00	0.185	0.175
6	01 Jan 06, 01:15	4.255	4.903
7	01 Jan 06, 01:30	10.156	10.926
8	01 Jan 06, 01:45	8.265	8.030
9	01 Jan 06, 02:00	6.310	6.176
10	01 Jan 06, 02:15	5.891	5.938
11	01 Jan 06, 02:30	9.405	9.664
12	01 Jan 06, 02:45	10.226	10.039
13	01 Jan 06, 03:00	7.925	7.355
14	01 Jan 06, 03:15	6.789	6.399
15	01 Jan 06, 03:30	5.788	5.427
16	01 Jan 06, 03:45	5.814	5.519
17	01 Jan 06, 04:00	9.811	9.912
18	01 Jan 06, 04:15	16.146	16.416
19	01 Jan 06, 04:30	36.498	38.110
20	01 Jan 06, 04:45	25.263	23.437
21	01 Jan 06, 05:00	16.748	15.381
22	01 Jan 06, 05:15	11.835	11.131
23	01 Jan 06, 05:30	8.935	7.955
24	01 Jan 06, 05:45	7.683	6.593
25	01 Jan 06, 06:00	6.796	5.687
26	01 Jan 06, 06:15	6.031	5.002
27	01 Jan 06, 06:30	3.031	1.990
28	01 Jan 06, 06:45	1.641	1.001
29	01 Jan 06, 07:00	0.964	0.581
30	01 Jan 06, 07:15	0.630	0.336
31	01 Jan 06, 07:30	0.476	0.252
32	01 Jan 06, 07:45	0.372	0.217
33	01 Jan 06, 08:00	0.291	0.192
34	01 Jan 06, 08:15	0.232	0.180
35	01 Jan 06, 08:30	0.201	0.176

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 06H	JUNCTION-2 FLOW RUN:100Y 06H
36	01 Jan 06, 08:45	0.188	0.175
37	01 Jan 06, 09:00	0.185	0.175
38	01 Jan 06, 09:15	0.185	0.175
39	01 Jan 06, 09:30	0.185	0.175
40	01 Jan 06, 09:45	0.185	0.175
41	01 Jan 06, 10:00	0.185	0.175
42	01 Jan 06, 10:15	0.185	0.175
43	01 Jan 06, 10:30	0.185	0.175
44	01 Jan 06, 10:45	0.185	0.175
45	01 Jan 06, 11:00	0.185	0.175
46	01 Jan 06, 11:15	0.185	0.175
47	01 Jan 06, 11:30	0.185	0.175
48	01 Jan 06, 11:45	0.185	0.175
49	01 Jan 06, 12:00	0.185	0.175
50	01 Jan 06, 12:15	0.185	0.175
51	01 Jan 06, 12:30	0.185	0.175
52	01 Jan 06, 12:45	0.185	0.175
53	01 Jan 06, 13:00	0.185	0.175
54	01 Jan 06, 13:15	0.185	0.175
55	01 Jan 06, 13:30	0.185	0.175
56	01 Jan 06, 13:45	0.185	0.175
57	01 Jan 06, 14:00	0.185	0.175
58	01 Jan 06, 14:15	0.185	0.175
59	01 Jan 06, 14:30	0.185	0.175
60	01 Jan 06, 14:45	0.185	0.175
61	01 Jan 06, 15:00	0.185	0.175
62	01 Jan 06, 15:15	0.185	0.175
63	01 Jan 06, 15:30	0.185	0.175
64	01 Jan 06, 15:45	0.185	0.175
65	01 Jan 06, 16:00	0.185	0.175
66	01 Jan 06, 16:15	0.185	0.175
67	01 Jan 06, 16:30	0.185	0.175
68	01 Jan 06, 16:45	0.185	0.175
69	01 Jan 06, 17:00	0.185	0.175
70	01 Jan 06, 17:15	0.185	0.175
71	01 Jan 06, 17:30	0.185	0.175
72	01 Jan 06, 17:45	0.185	0.175

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 06H	JUNCTION-2 FLOW RUN:100Y 06H
73	01 Jan 06, 18:00	0.185	0.175
74	01 Jan 06, 18:15	0.185	0.175
75	01 Jan 06, 18:30	0.185	0.175
76	01 Jan 06, 18:45	0.185	0.175
77	01 Jan 06, 19:00	0.185	0.175
78	01 Jan 06, 19:15	0.185	0.175
79	01 Jan 06, 19:30	0.185	0.175
80	01 Jan 06, 19:45	0.185	0.175
81	01 Jan 06, 20:00	0.185	0.175
82	01 Jan 06, 20:15	0.185	0.175
83	01 Jan 06, 20:30	0.185	0.175
84	01 Jan 06, 20:45	0.185	0.175
85	01 Jan 06, 21:00	0.185	0.175
86	01 Jan 06, 21:15	0.185	0.175
87	01 Jan 06, 21:30	0.185	0.175
88	01 Jan 06, 21:45	0.185	0.175
89	01 Jan 06, 22:00	0.185	0.175
90	01 Jan 06, 22:15	0.185	0.175
91	01 Jan 06, 22:30	0.185	0.175
92	01 Jan 06, 22:45	0.185	0.175
93	01 Jan 06, 23:00	0.185	0.175
94	01 Jan 06, 23:15	0.185	0.175
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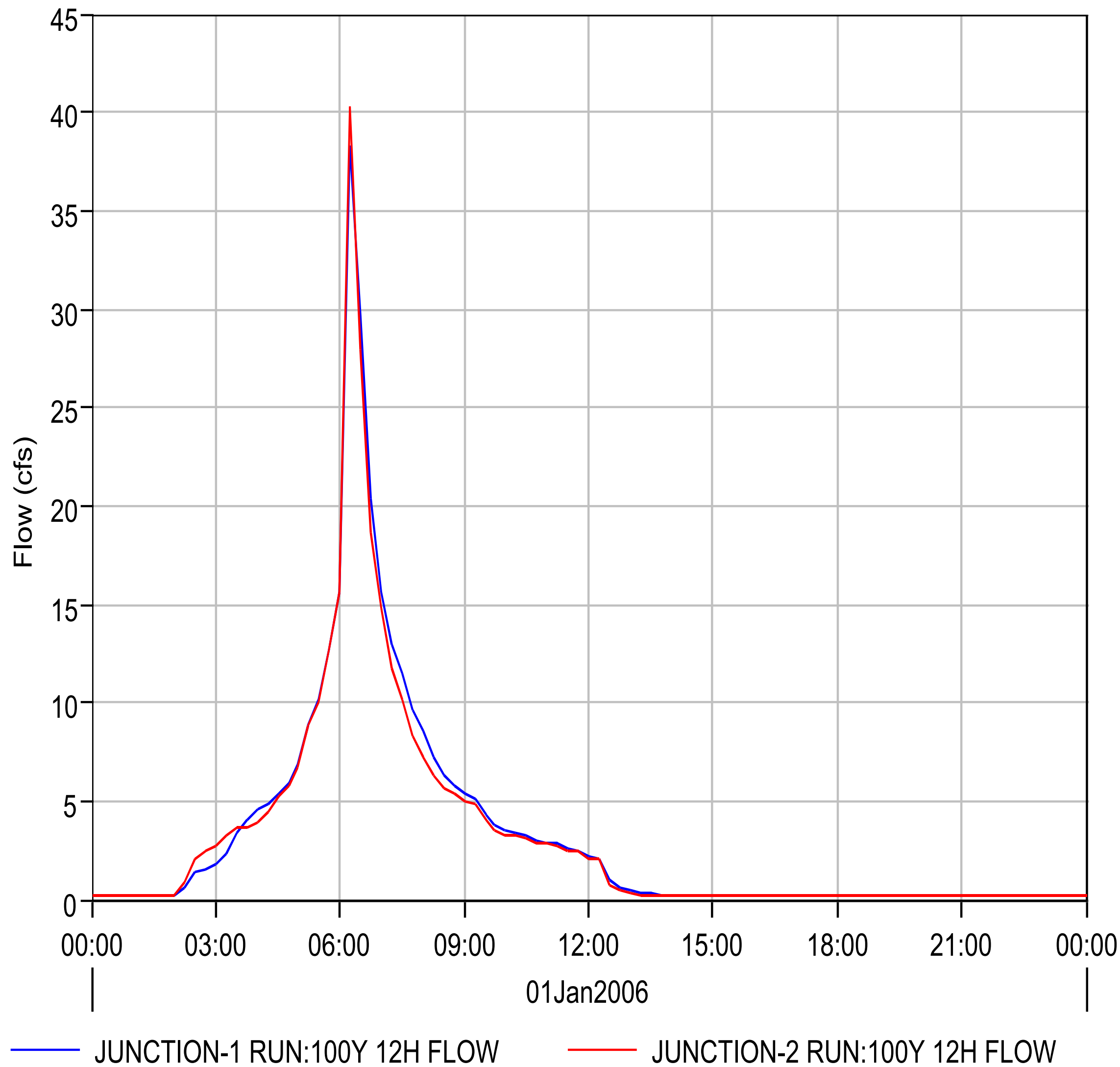
96	01 Jan 06, 23:45	0.185	0.175
97	01 Jan 06, 24:00	0.185	0.175



Flow (cfs)
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01Jan2006
JUNCTION-1 RUN:100Y 12H FLOW
JUNCTION-2 RUN:100Y 12H FLOW

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 12H	JUNCTION-2 FLOW RUN:100Y 12H
Units		CFS	CFS
Type		INST-VAL	INST-VAL
1	31 Dec 05, 24:00	0.185	0.175
2	01 Jan 06, 00:15	0.185	0.175
3	01 Jan 06, 00:30	0.185	0.175
4	01 Jan 06, 00:45	0.185	0.175
5	01 Jan 06, 01:00	0.185	0.175
6	01 Jan 06, 01:15	0.185	0.175
7	01 Jan 06, 01:30	0.185	0.175
8	01 Jan 06, 01:45	0.185	0.175
9	01 Jan 06, 02:00	0.185	0.175
10	01 Jan 06, 02:15	0.595	0.819
11	01 Jan 06, 02:30	1.360	2.050
12	01 Jan 06, 02:45	1.544	2.401
13	01 Jan 06, 03:00	1.742	2.753
14	01 Jan 06, 03:15	2.346	3.262
15	01 Jan 06, 03:30	3.422	3.584
16	01 Jan 06, 03:45	4.039	3.689
17	01 Jan 06, 04:00	4.534	3.926
18	01 Jan 06, 04:15	4.792	4.434
19	01 Jan 06, 04:30	5.380	5.229
20	01 Jan 06, 04:45	5.899	5.771
21	01 Jan 06, 05:00	6.823	6.724
22	01 Jan 06, 05:15	8.800	8.787
23	01 Jan 06, 05:30	10.123	10.015
24	01 Jan 06, 05:45	12.704	12.711
25	01 Jan 06, 06:00	15.637	15.648
26	01 Jan 06, 06:15	38.339	40.265
27	01 Jan 06, 06:30	29.630	27.982
28	01 Jan 06, 06:45	20.355	18.684
29	01 Jan 06, 07:00	15.611	14.751
30	01 Jan 06, 07:15	12.898	11.807
31	01 Jan 06, 07:30	11.418	10.147
32	01 Jan 06, 07:45	9.682	8.333
33	01 Jan 06, 08:00	8.520	7.286
34	01 Jan 06, 08:15	7.274	6.285
35	01 Jan 06, 08:30	6.322	5.606

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 12H	JUNCTION-2 FLOW RUN:100Y 12H
36	01 Jan 06, 08:45	5.824	5.343
37	01 Jan 06, 09:00	5.344	4.975
38	01 Jan 06, 09:15	5.116	4.829
39	01 Jan 06, 09:30	4.332	4.037
40	01 Jan 06, 09:45	3.749	3.514
41	01 Jan 06, 10:00	3.484	3.315
42	01 Jan 06, 10:15	3.352	3.208
43	01 Jan 06, 10:30	3.281	3.158
44	01 Jan 06, 10:45	3.014	2.892
45	01 Jan 06, 11:00	2.881	2.796
46	01 Jan 06, 11:15	2.811	2.753
47	01 Jan 06, 11:30	2.553	2.485
48	01 Jan 06, 11:45	2.437	2.396
49	01 Jan 06, 12:00	2.163	2.114
50	01 Jan 06, 12:15	2.037	2.009
51	01 Jan 06, 12:30	0.966	0.790
52	01 Jan 06, 12:45	0.581	0.448
53	01 Jan 06, 13:00	0.404	0.300
54	01 Jan 06, 13:15	0.318	0.208
55	01 Jan 06, 13:30	0.275	0.183
56	01 Jan 06, 13:45	0.243	0.179
57	01 Jan 06, 14:00	0.218	0.176
58	01 Jan 06, 14:15	0.199	0.175
59	01 Jan 06, 14:30	0.190	0.175
60	01 Jan 06, 14:45	0.186	0.175
61	01 Jan 06, 15:00	0.185	0.175
62	01 Jan 06, 15:15	0.185	0.175
63	01 Jan 06, 15:30	0.185	0.175
64	01 Jan 06, 15:45	0.185	0.175
65	01 Jan 06, 16:00	0.185	0.175
66	01 Jan 06, 16:15	0.185	0.175
67	01 Jan 06, 16:30	0.185	0.175
68	01 Jan 06, 16:45	0.185	0.175
69	01 Jan 06, 17:00	0.185	0.175
70	01 Jan 06, 17:15	0.185	0.175
71	01 Jan 06, 17:30	0.185	0.175
72	01 Jan 06, 17:45	0.185	0.175

Ordinate	Date / Time	JUNCTION-1 FLOW RUN:100Y 12H	JUNCTION-2 FLOW RUN:100Y 12H
73	01 Jan 06, 18:00	0.185	0.175
74	01 Jan 06, 18:15	0.185	0.175
75	01 Jan 06, 18:30	0.185	0.175
76	01 Jan 06, 18:45	0.185	0.175
77	01 Jan 06, 19:00	0.185	0.175
78	01 Jan 06, 19:15	0.185	0.175
79	01 Jan 06, 19:30	0.185	0.175
80	01 Jan 06, 19:45	0.185	0.175
81	01 Jan 06, 20:00	0.185	0.175
82	01 Jan 06, 20:15	0.185	0.175
83	01 Jan 06, 20:30	0.185	0.175
84	01 Jan 06, 20:45	0.185	0.175
85	01 Jan 06, 21:00	0.185	0.175
86	01 Jan 06, 21:15	0.185	0.175
87	01 Jan 06, 21:30	0.185	0.175
88	01 Jan 06, 21:45	0.185	0.175
89	01 Jan 06, 22:00	0.185	0.175
90	01 Jan 06, 22:15	0.185	0.175
91	01 Jan 06, 22:30	0.185	0.175
92	01 Jan 06, 22:45	0.185	0.175
93	01 Jan 06, 23:00	0.185	0.175
94	01 Jan 06, 23:15	0.185	0.175
95	01 Jan 06, 23:30	0.185	0.175
96	01 Jan 06, 23:45	0.185	0.175
97	01 Jan 06, 24:00	0.185	0.175

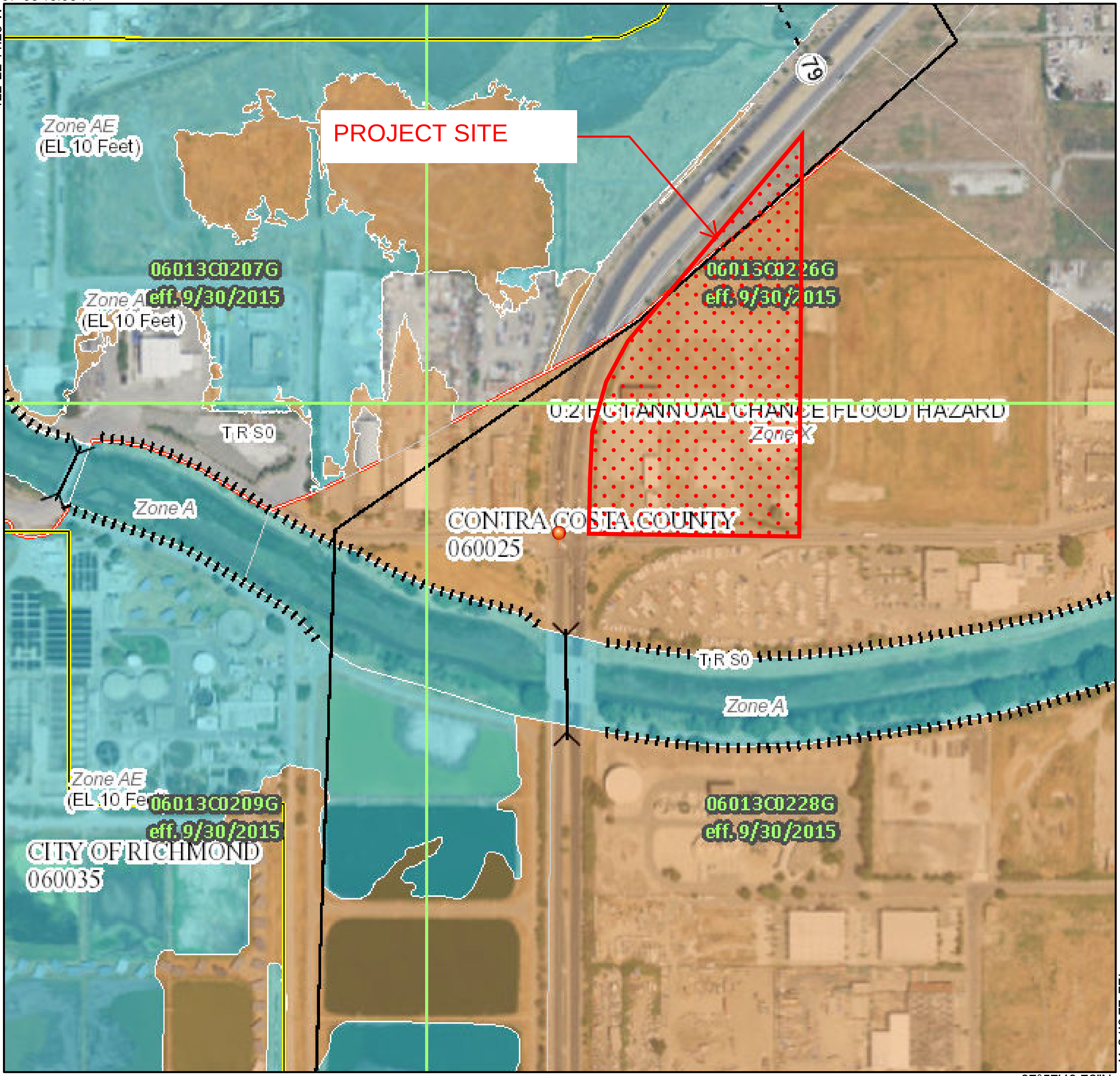
Appendix 7.9
FEMA Flood Maps

National Flood Hazard Layer FIRMette

FEMA

37°58'18.08"N

122°22'44.23"W



122°22'6.78"W

37°57'49.72"N

Feet

0 | 250 | 500 | 1,000 | 1,500 | 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

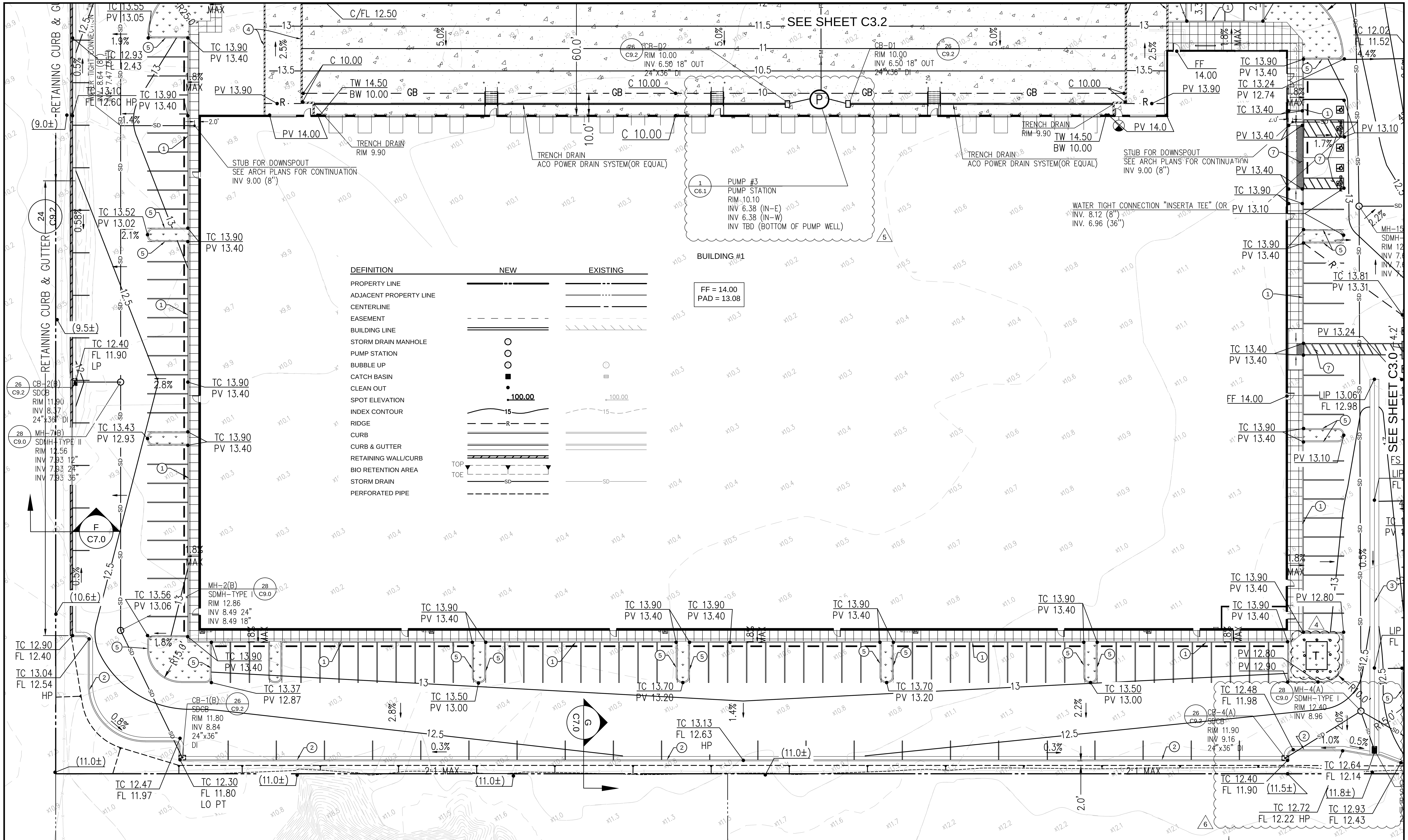
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/24/2020 at 12:44:27 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix 7.10
Excerpt from Goodrick Industrial Project

CAUTION: IF THIS SHEET IS NOT 24"x36" IT IS A REDUCED PRINT



DEFINITION	NEW	EXISTING
PROPERTY LINE		
ADJACENT PROPERTY LINE		
CENTERLINE		
EASEMENT		
BUILDING LINE		
STORM DRAIN MANHOLE		
PUMP STATION		
BUBBLE UP		
CATCH BASIN		
CLEAN OUT		
SPOT ELEVATION	100.00	100.00
INDEX CONTOUR	15	15
RIDGE	R	
CURB		
CURB & GUTTER		
RETAINING WALL/CURB		
BIO RETENTION AREA	TOP / TOE	
STORM DRAIN	SD	SD
PERFORATED PIPE		

CONSTRUCTION NOTES

1	CONCRETE CURB PER DETAIL 1/C9.0
2	CONCRETE CURB & GUTTER PER DETAIL 2/C9.0
3	CONCRETE VALLEY GUTTER PER DETAIL 4/C9.0
4	SEE ARCH PLANS FOR DOCK WALL HEIGHT AND DETAILS
5	KEYED CONCRETE CURB PER DETAIL 5/C9.0
6	KEYED CONCRETE CURB AND GUTTER PER DETAIL 6/C9.0
7	SEE ARCH PLANS FOR ACCESSIBLE CURB RAMP DETAILS AND ALL SIGNING AND STRIPING
8	APPROXIMATE LOCATION OF SIDEWALK TRENCH DRAIN. SEE ARCHITECTURAL PLANS FOR ACTUAL LOCATION AND DETAIL

PAVING LEGEND

- PROPOSED CONCRETE SIDEWALK
- PROPOSED LANDSCAPING

Know what's **below.**
Call 811 before you dig.

0 20 40 60
Scale 1" = 20 ft

PERMIT NO.: DP16-3023

M:\Jobs15\Mark Heavey\SNR15-0014-00_14177_Goodrick_Avenue\Civil\CAD\C3\0014_C3.0_GRAD.dwg

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p 925.244.9620
f 925.244.9621

REGISTERED PROFESSIONAL ENGINEER MICHAEL G. MURPHY No. 43696 CIVIL STATE OF CALIFORNIA

GRADING & DRAINAGE PLAN

GOODRICK INDUSTRIAL

2601 GOODRICK AVENUE
RICHMOND, CALIFORNIA 94801

	DATE	
	07/29/2017	2ND SUBMITTAL
	08/10/2017	GRADING PERMIT SUBMITTAL
	08/28/2017	3RD SUBMITTAL
	10/23/2017	OUTFALL/GRADING REVISION
	01/17/2018	4TH SUBMITTAL
4	02/22/2018	5TH SUBMITTAL
5	03-16-2018	MISC COORD./VALUE ENG.
	04-04-2018	MISC COORD./VALUE ENG.
6	04-24-2018	FIRE COMMENTS

PA / PM:	MM / GP
DRAWN BY:	BN
JOB NO.:	SNR15-0014-00

SHEET
C3.1

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CONSTRUCTION NOTES

1	CONCRETE CURB PER DETAIL 1/C9.0
2	CONCRETE CURB & GUTTER PER DETAIL 2/C9.0
3	CONCRETE VALLEY GUTTER PER DETAIL 4/C9.0
4	SEE ARCH PLANS FOR DOCK WALL HEIGHT AND DETAILS
5	KEYED CONCRETE CURB PER DETAIL 5/C9.0
6	KEYED CONCRETE CURB AND GUTTER PER DETAIL 6/C9.0
7	SEE ARCH PLANS FOR ACCESSIBLE CURB RAMP DETAILS AND ALL SIGNING AND STRIPING
8	APPROXIMATE LOCATION OF SIDEWALK TRENCH DRAIN, SEE ARCHITECTURAL PLANS FOR ACTUAL LOCATION AND DETAIL.
9	MAINTAIN POSITIVE DRAINAGE AS SHOWN.

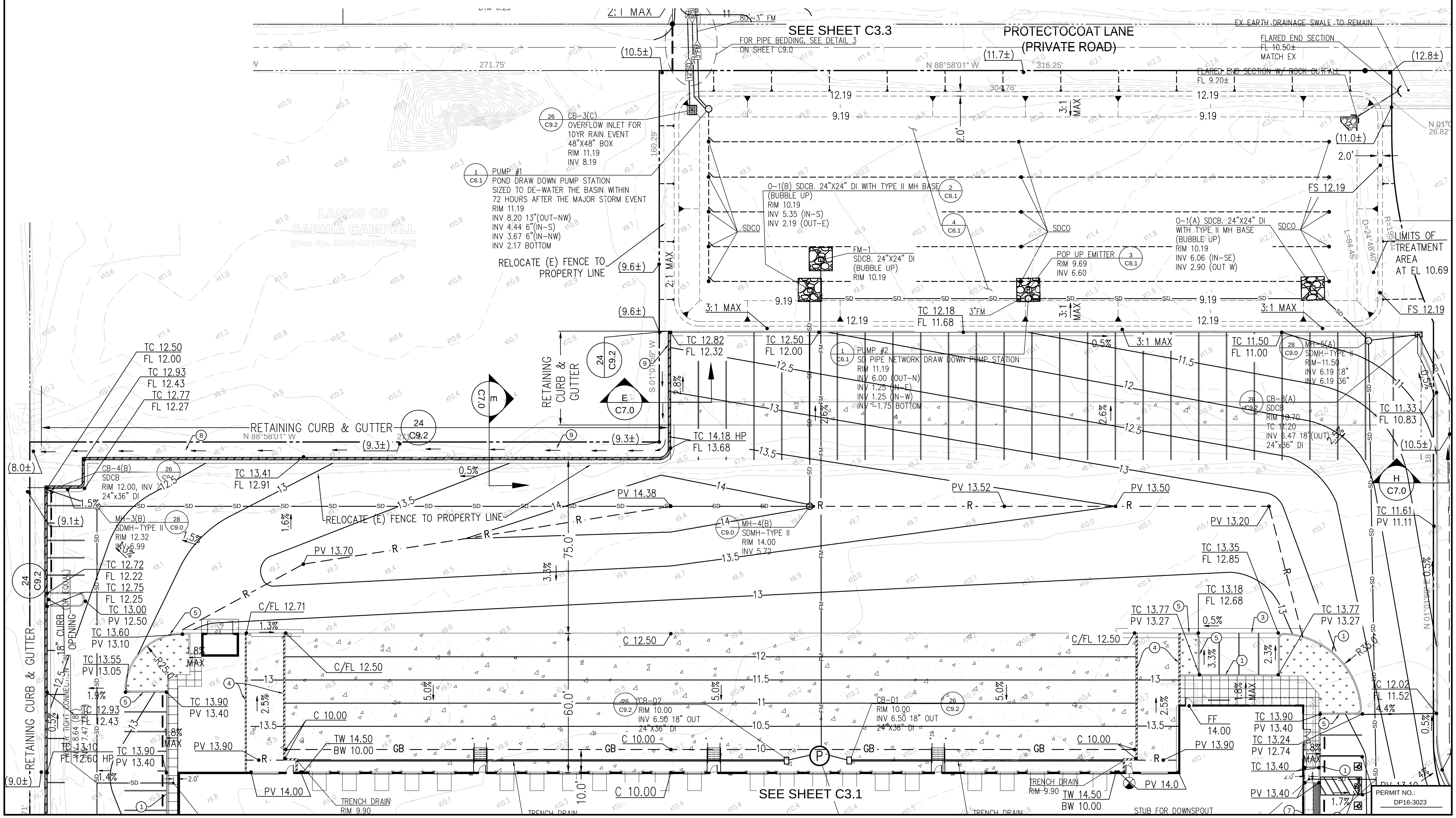
DEFINITION	NEW	EXISTING
PROPERTY LINE		
ADJACENT PROPERTY LINE		
CENTERLINE		
EASEMENT		
BUILDING LINE		
STORM DRAIN MANHOLE	D	
PUMP STATION	P	
BUBBLE UP	B	B
CATCH BASIN	■	
CLEAN OUT	•	
SPOT ELEVATION	100.00	100.00
INDEX CONTOUR	15	15
RIDGE	R	
CURB		
CURB & GUTTER		
RETAINING WALL/CURB		
BIO RETENTION AREA	TOP / TOE	
STORM DRAIN	SD	SD
PERFORATED PIPE		

PAVING LEGEND

PROPOSED CONCRETE SIDEWALK	
PROPOSED LANDSCAPING	

811 Know what's below. Call 811 before you dig.

0 20 40 60
Scale 1" = 20 ft



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2601 GOODRICK AVENUE
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	DATE	
	07/29/2017	2ND SUBMITTAL
	08/10/2017	GRADING PERMIT SUBMITTAL
	08/28/2017	3RD SUBMITTAL
	10/23/2017	OUTFALL/GRADING REVISION
	01/17/2018	4TH SUBMITTAL
	02/22/2018	5TH SUBMITTAL
4	03-16-2018	MISC COORD./VALUE ENG.
5	04-04-2018	MISC COORD./VALUE ENG.
6	04-24-2018	FIRE COMMENTS

PA / PM:	MM / GP
DRAWN BY:	BN
JOB NO.:	SNR15-0014-00

SHEET
C3.2

M:\Jobs15\Mark Heavey\SNR15-0014-00_14177_Goodrick_Avenue\Civil\CAD\C3\0014_C3.0_GRAD.dwg

Appendix 7.11
Hydraulic Calculations – Swales and Linear Wetlands

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SHEET NO. 1

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - SWALE SIZING CHK'D DATE

SWALE 1 - ESTIMATE PEAK DISCHARGE RATE

TOTAL AREA = TRIBUTARY AREA = 8.82 AC

ELEV. UP = 14.5 ft
ELEV. DN = 13.42 FT
LENGTH, L = 1132 FT

SLOPE: $S = \frac{14.5 - 13.42}{1132}$

$S = 0.001$ FT/FT

TIME OF CONCENTRATION, T_c:

$t_c^{2.14} = 2Ln / 3S^{1/2}$ ← KERBY EQUATION

$t_c = (2Ln/3S^{1/2})^{1/2.14}$

$= [2(1132 \text{ FT})(0.04) / (3\sqrt{0.001})]^{1/2.14}$

$t_c = 24.7$ MIN, USE $T_c = 25$ MIN

WHERE: L = 1132 FT
n = 0.04 (SURFACE RETARDANT FACTOR)
S = 0.001 FT/FT

RAINFALL INTENSITY, i:

MEAN SEASONAL RAINFALL = 21.5 IN.

10 YR ⇒

PRECIPITATION DEPTH, D = 0.57 IN

$i_{10} = P/t_c = (0.57 \text{ IN})(\frac{1}{25 \text{ MIN}})(\frac{60 \text{ MIN}}{\text{HR}}) = 1.37$ IN/HR

100 YR ⇒

PRECIPITATION DEPTH, D = 0.72 IN

$i_{100} = P/t_c = (0.72 \text{ IN})(\frac{1}{25 \text{ MIN}})(\frac{60 \text{ MIN}}{\text{HR}}) = 1.73$ IN/HR

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SHEET NO. 2

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - SWALE SIZING CHK'D DATE

SWALE 1 - ESTIMATE PEAK DISCHARGE RATE: CONTINUED

PEAK DISCHARGE RATE, Q:

$Q = CiAf$;

WHERE: C = 0.6 (GRASS/OLD INDUSTRIAL)
A = 8.82 AC
ADJUSTMENT FACTOR; f *
$f_{10} = 1.0$
$f_{100} = 1.25$
* $Cf < 1.0$

$Q_{10} = (0.6)(1.37\ \text{IN/HR})(8.82\ \text{AC})(1.0)$

$Q_{10} = 7.25$ CFS

$Cf_{100} = (0.6)(1.25) = 0.75$, OK

$Q_{100} = (0.60)(1.81\ \text{IN/HR})(8.82\ \text{AC})(1.25)$

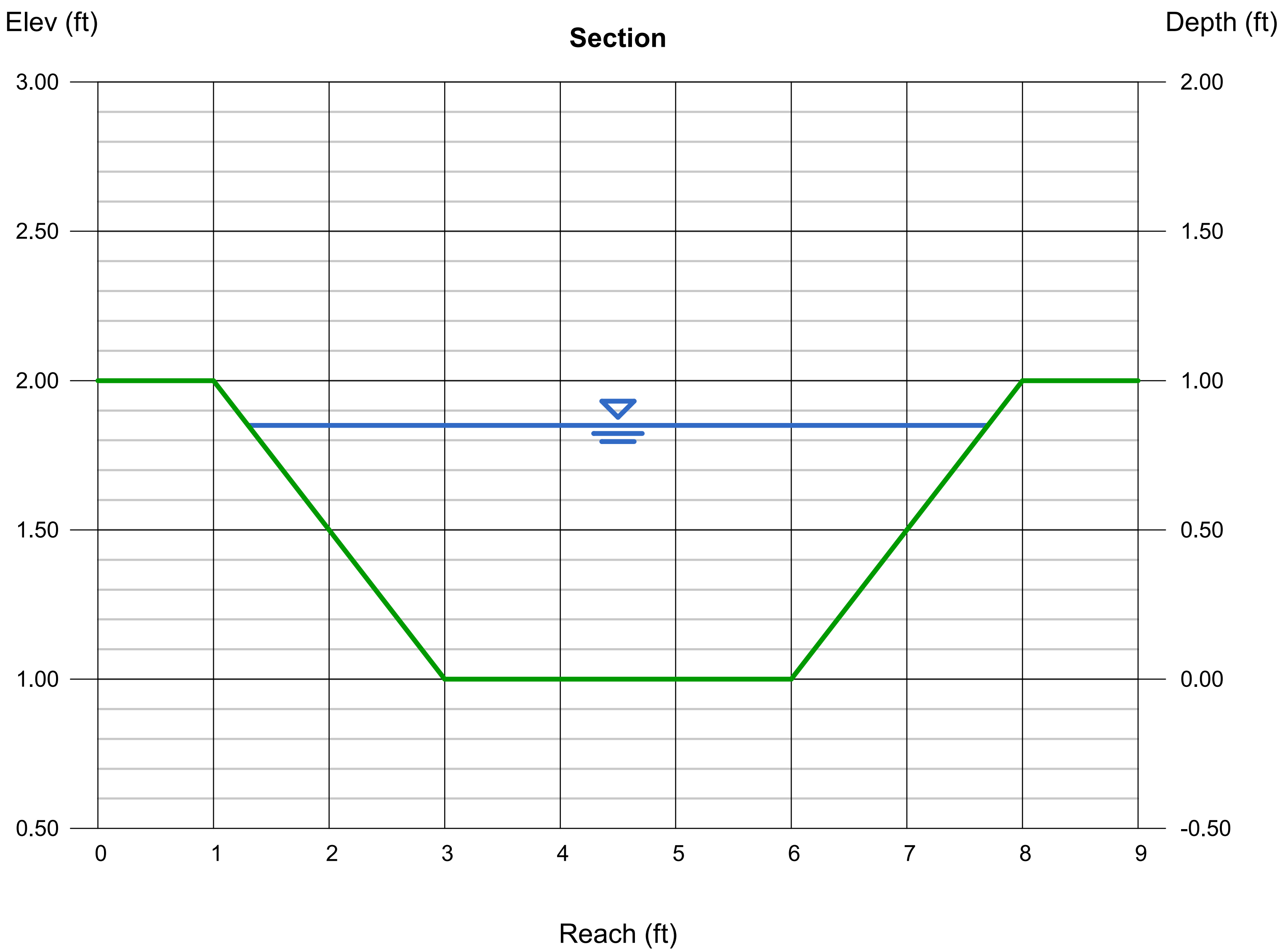
$Q_{100} = 12.0$ CFS

∴ PER CHANNEL REPORT 'PRO. COND. - SWALE 1 SECTION A - 100 YR' AND 'PRO. COND. - SWALE 1 SECTION B - 100 YR', SWALE 1 IS SUFFICIENTLY SIZED.

Channel Report

PRO. COND. - SWALE 1 SECTION A - 100 YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.85
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 12.00
Total Depth (ft)	= 1.00	Area (sqft)	= 3.99
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.00
Slope (%)	= 0.75	Wetted Perim (ft)	= 6.80
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.68
		Top Width (ft)	= 6.40
Calculations		EGL (ft)	= 0.99
Compute by:	Known Q		
Known Q (cfs)	= 12.00		

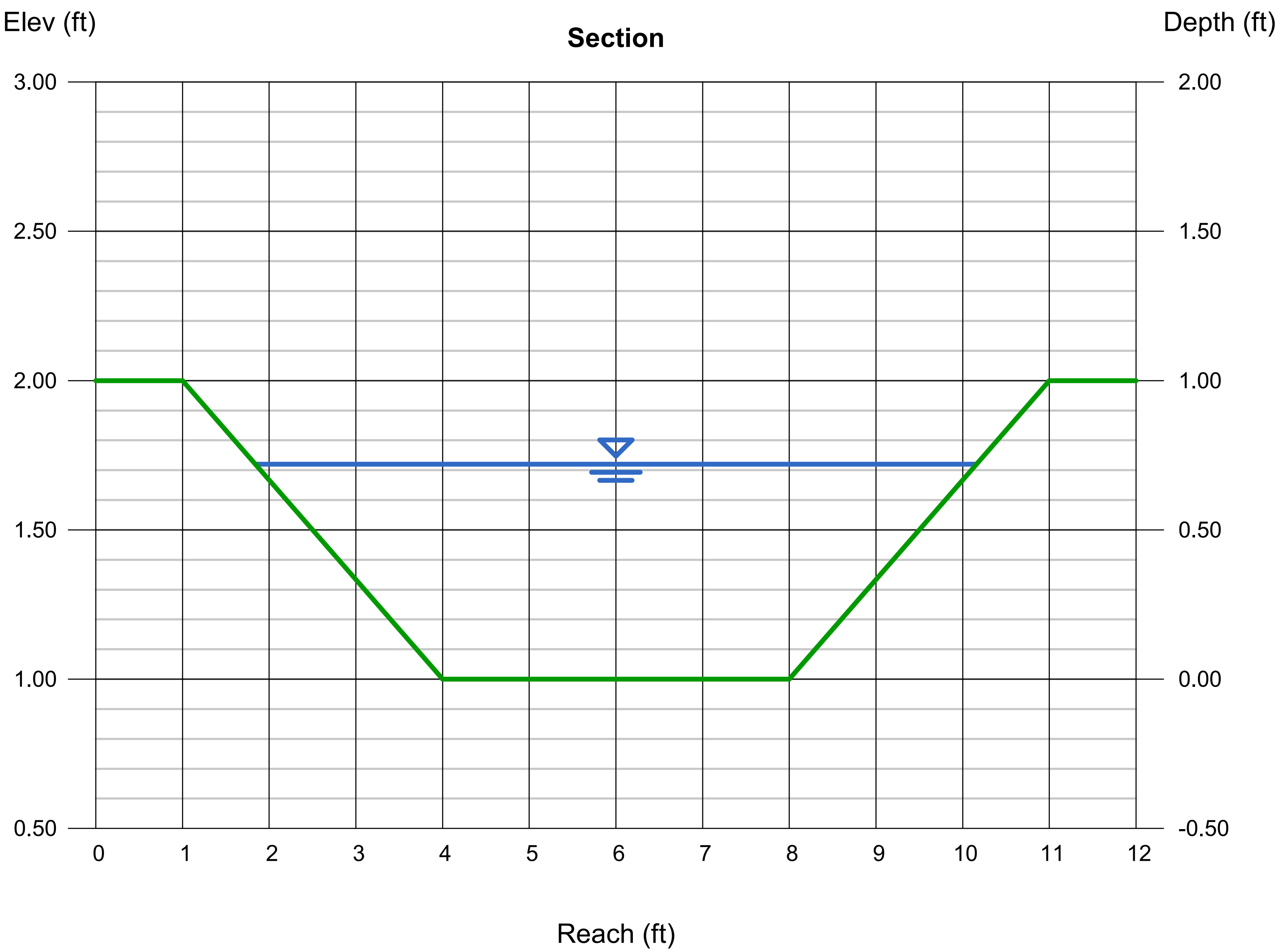


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 26 2020

PRO. COND. - SWALE 1 SECTION B - 100 YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.72
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 12.00
Total Depth (ft)	= 1.00	Area (sqft)	= 4.44
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 2.71
Slope (%)	= 0.75	Wetted Perim (ft)	= 8.55
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.57
		Top Width (ft)	= 8.32
Calculations		EGL (ft)	= 0.83
Compute by:	Known Q		
Known Q (cfs)	= 12.00		



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JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE
CLIENT SUBJECT HYDRAULICS - SWALE SIZING CHK'D DATE

SWALE 2 - ESTIMATE PEAK DISCHARGE RATE

TOTAL AREA = TRIBUTARY AREA = 8.5 AC

ELEV. UP = 14.0 FT
ELEV. DN = 9.0 FT
L = 1149 LF

SLOPE; $S = \frac{14.0\ FT - 9.0\ FT}{1149\ FT}$

$S \approx 0.004\ FT/FT$

TIME OF CONCENTRATION, T_c:

$t_c^{2.14} = 2Ln/3S^{1/2}$

$t_c = (2Ln/3S^{1/2})^{1/2.14}$

$t_c = [2(1149\ FT)(0.04)/(3\sqrt{0.004})]^{1/2.14}$

$t_c = 18.0\ MIN$

WHERE; L = 1149 FT
n = 0.04
S = 0.005 FT/FT

RAINFALL INTENSITY, i:

MEAN SEASONAL RAINFALL = 21.5 IN

10 YR ⇒

PRECIPITATION DEPTH, D = 0.48 IN

$i_{10} = D/T_c = (0.48\ IN)\left(\frac{1}{18.0\ MIN}\right)\left(\frac{60\ MIN}{HR}\right) = 1.60\ IN/HR$

100 YR ⇒

PRECIPITATION DEPTH, D = 0.60 IN

$i_{100} = D/T_c = (0.60\ IN)\left(\frac{1}{18.0\ MIN}\right)\left(\frac{60\ MIN}{HR}\right) = 2.00\ IN/HR$

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SHEET NO. 4

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - SWALE SIZING CHK'D DATE

SWALE 2 - ESTIMATE PEAK DISCHARGE RATE

PEAK DISCHARGE RATE, Q:

$Q = CiAf$

WHERE: $C = 0.60$ (GRASS/OLD INDUSTRIAL)

$A = 8.5$ AC

$f_{10} = 1.0$

$f_{100} = 1.25$

$^{*}Cf < 1.0$

$Q_{10} = (0.60)(1.60\ \text{IN/HR})(8.5\ \text{AC})(1.0)$

$Q_{10} = 8.16$ CFS

$Cf_{100} = (0.60)(1.25) = 0.75$ ∴ OK

$Q_{100} = (0.60)(2.00\ \text{IN/HR})(8.5\ \text{AC})(1.25)$

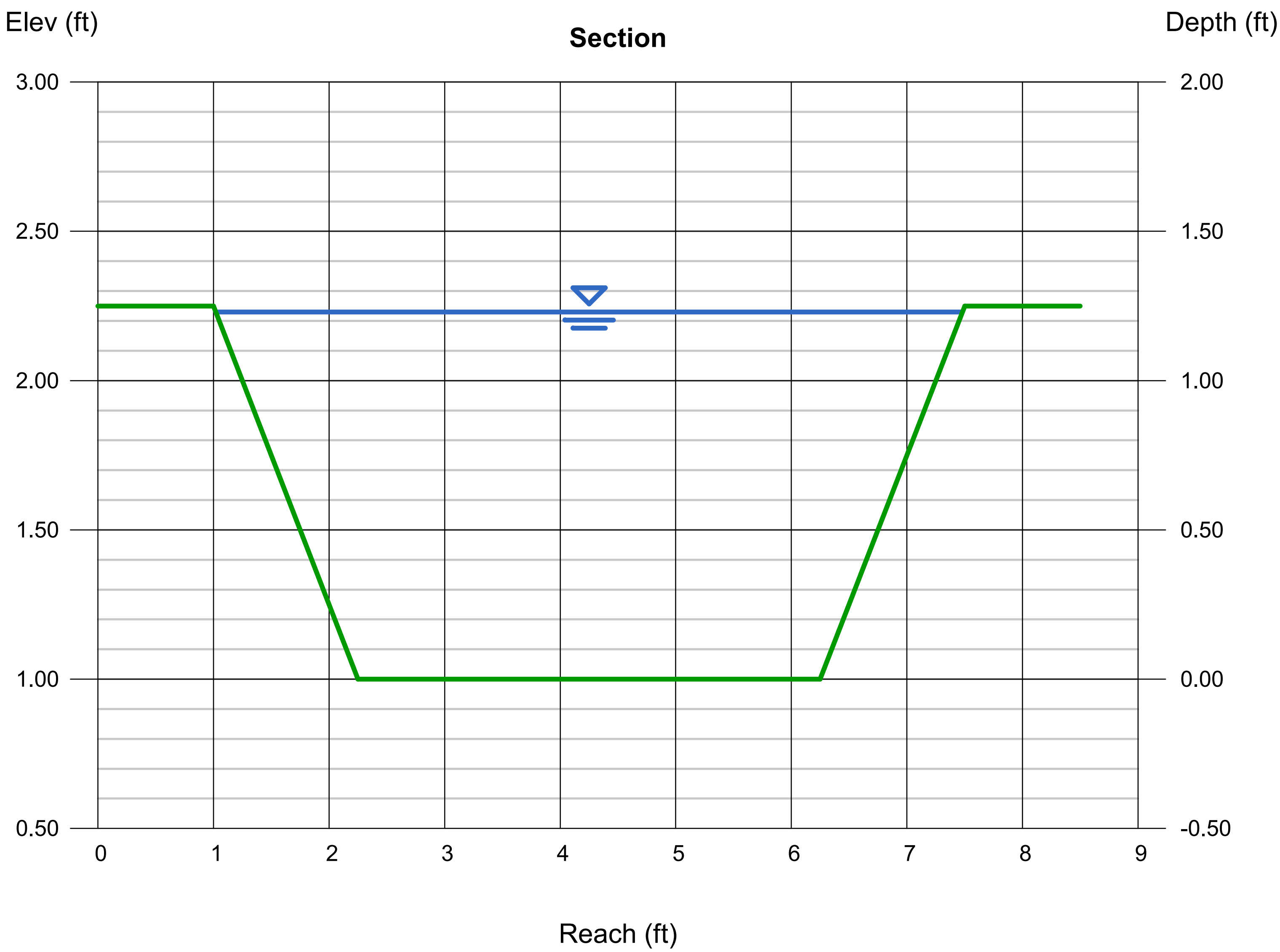
$Q_{100} = 12.8$ CFS

∴ PER CHANNEL REPORT 'PRO. COND.-SWALE 2 - 100 YR', SWALE 2 IS SUFFICIENTLY SIZED.

Channel Report

PRO. COND. - SWALE 2 - 100 YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.23
Side Slopes (z:1)	= 1.00, 1.00	Q (cfs)	= 12.80
Total Depth (ft)	= 1.25	Area (sqft)	= 6.43
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 1.99
Slope (%)	= 0.20	Wetted Perim (ft)	= 7.48
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.65
		Top Width (ft)	= 6.46
Calculations		EGL (ft)	= 1.29
Compute by:	Known Q		
Known Q (cfs)	= 12.80		



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SHEET NO. 5/

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - LINEAR WETLAND SWALE SIZING CHK'D DATE

LINEAR WETLAND SWALE SECTION G - ESTIMATE PEAK DISCHARGE RATE

TRIBUTARY AREA: $A_{TRIB} = 6.30$ AC

ELEV. UP = 14.4 FT

ELEV. DN = 10.69 FT

LENGTH; $L = 1125$ FT

SLOPE; $s = \frac{14.4 - 10.69}{1125}$

$s = 0.003$ FT/FT

TIME OF CONCENTRATION, T_c:

$t_c^{2.14} = 2Ln/3s^{1/2}$

$t_{c(1)} = [2(1125FT)(0.04)/(3\sqrt{0.003})]^{1/2.14}$

$t_{c(1)} = 19.0$ MIN

WHERE: L = 1125 FT

n = 0.04 (SURFACE RETARDANT FACTOR)

S = 0.003 FT/FT

RAINFALL INTENSITY, i:

MEAN SEASONAL RAINFALL = 21.5 IN

10 YR =>

PRECIPITATION DEPTH, D = 0.49 IN

$i_{10} = D/t_c = (0.49\,IN)(\frac{1}{19\,MIN})(\frac{60\,MIN}{HR}) = 1.55$ IN/HR

100 YR =>

PRECIPITATION DEPTH, D = 0.63 IN

$i_{100} = D/t_c = (0.63\,IN)(\frac{1}{19\,MIN})(\frac{60\,MIN}{HR}) = 1.99$ IN/HR

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SHEET NO. 61

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - LINEAR WETLAND CHK'D DATE

LINEAR WETLAND SWALE SECTION G - ESTIMATE PEAK DISCHARGE RATE: CONTINUED

PEAK DISCHARGE RATE, Q:

$Q = CiAf$;

WHERE $A_{TRIB} = 6.30$ AC

$A_{TOT} = 7.30$ AC

$C = 0.75$ (OLD INDUSTRIAL

$f_{10} = 1.0$

$f_{100} = 1.25$

$*C_f < 1.0$

$Q_{TRIB} = C i A_{trib} f$

$Q_{trib(10)} = (0.75)(1.55 \text{ IN/HR})(6.30 \text{ AC})(1.0)$

$Q_{TRIB(10)} = 7.32$ CFS

$Cf = (0.75)(1.25) = 0.94 < 1.0 \therefore$ OK

$Q_{TRIB(100)} = (0.75)(1.99 \text{ IN/HR})(6.30 \text{ AC})(1.25)$

$Q_{TRIB(100)} = 11.75$ CFS

PEAK DISCHARGE RATE PER AREA, Q_{TRIB}/A_{TRIB}:

$\frac{Q_{TRIB(10)}}{A_{TRIB}} = \frac{7.32 \text{ CFS}}{6.3 \text{ AC}} = 1.16$ CFS/AC

$\frac{Q_{TRIB(100)}}{A_{TRIB}} = \frac{11.75 \text{ CFS}}{6.3 \text{ AC}} = 1.87$ CFS/AC

ESTIMATE PEAK DISCHARGE RATE, Q_{EST}:

$Q_{EST} = \left(\frac{Q_{TRIB}}{A_{TRIB}}\right)(A_{TOT})$

$Q_{EST(10)} = (1.16 \text{ CFS/AC})(7.30 \text{ AC}) = \underline{8.47 \text{ CFS}}$

$Q_{EST(100)} = (1.87 \text{ CFS/AC})(7.30 \text{ AC}) = \underline{13.65 \text{ CFS}}$

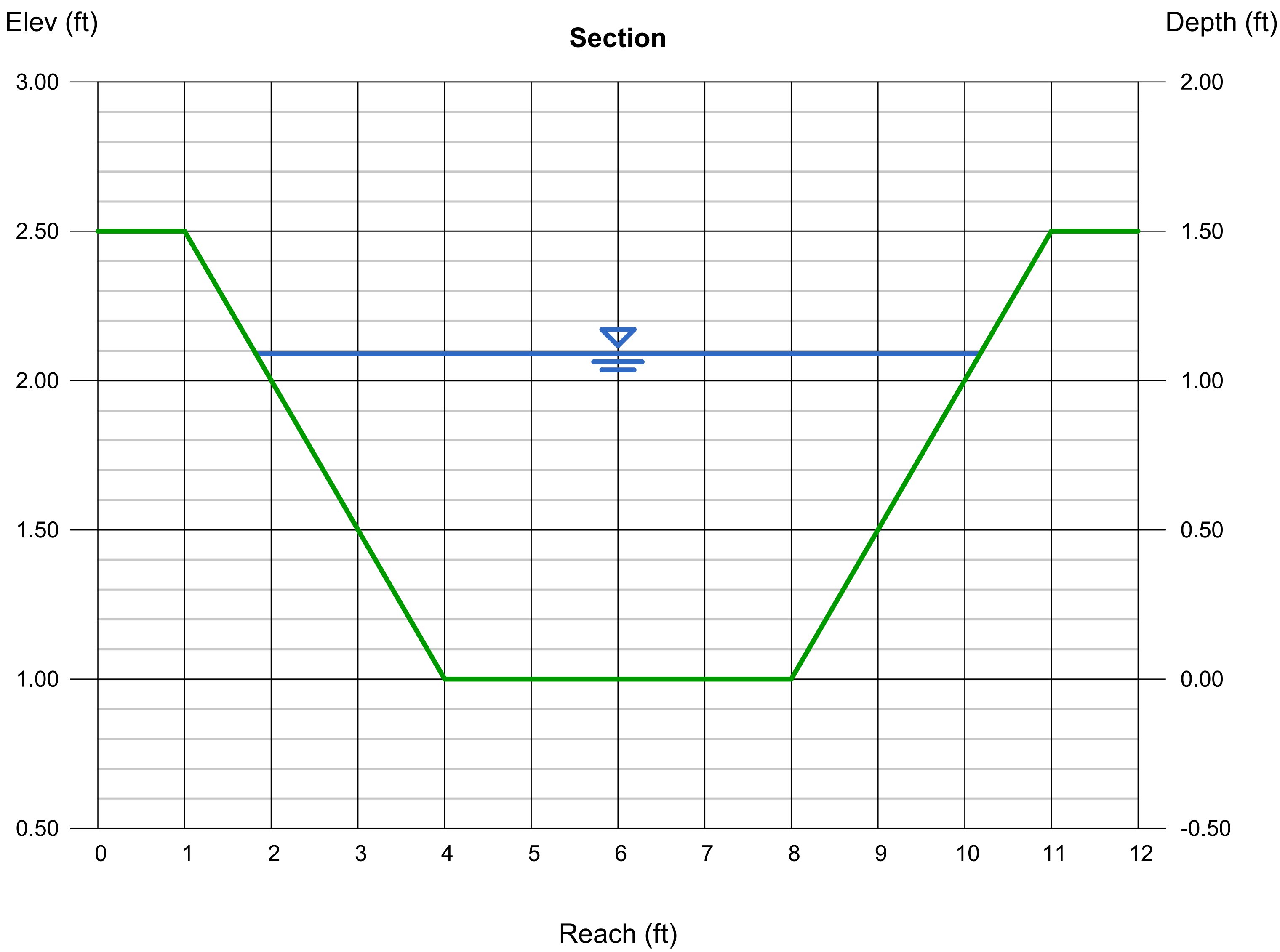
$\therefore$ PER CHANNEL REPORT 'PRO. COND. - LINEAR WETLAND SECTION G - 100 YR'

LINEAR WETLAND SECTION G IS SUFFICIENTLY SIZED

Channel Report

PRO. COND. - LINEAR WETLAND SECTION G

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.09
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 13.65
Total Depth (ft)	= 1.50	Area (sqft)	= 6.74
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 2.03
Slope (%)	= 0.25	Wetted Perim (ft)	= 8.87
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 8.36
Calculations		EGL (ft)	= 1.15
Compute by:	Known Q		
Known Q (cfs)	= 13.65		



CSW | ST2
CSW/Stuber-Stroeh Engineering Group, Inc.
45 Leveroni Court, Novato, CA 94949 Tel 415.883.9850 Fax 415.883.9835
1310 Redwood Way, Suite 220, Petaluma, CA 94954 Tel 707.795.4764 www.cswst2.com

SHEET NO. 7

JOB NO. 514310 3 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE
CLIENT SUBJECT HYDRAULICS - LINEAR WETLAND SWALE SIZING CHK'D DATE

LINEAR WETLAND SWALE - SECTION H - ESTIMATE PEAK DISCHARGE RATE

TOTAL AREA: $A_{TOT} = 21.8\ AC$

OFFSITE AREA: $A_{OFF} = 7.3\ AC$

ONSITE AREA: $A_{ON} = 12.2\ AC$

WETLAND AREA: $A_{WET} = 2.3\ AC$

$C_{PERV} = 0.30$; $C_{ON} = 0.95$; $C_{OFF} = 0.60$

$$C_w = \frac{(0.30)(2.3\ AC) + (0.95)(12.2\ AC) + (0.60)(7.3\ AC)}{21.8\ AC} = \underline{\underline{0.76}}$$

TOTAL LENGTH = 1,728 LF

TIME OF CONCENTRATION:

OVERLAND FLOW ⇒ $t_{co}^{2.14} = 2Ln/3\sqrt{s}$

$L = 1{,}015\ FT$

ELEV. UP = 14.5 FT

ELEV. DN = 8.75 FT

SLOPE: $s = \frac{14.5 - 8.75}{1{,}015}$

$s = 0.006\ FT/FT$

$n_{on} = 0.028$

$n_{off} = 0.04$

$n_{wet} = 0.03$

$$n_w = \frac{(0.028)(12.2\ AC) + (0.04)(7.3\ AC) + (0.03)(2.3\ AC)}{21.8\ AC}$$

$n_w = \underline{0.032}$

$$t_{co} = \left(\frac{2Ln}{3\sqrt{s}}\right)^{1/2.14} = \left(\frac{2(1{,}015\ FT)(0.032)}{3\sqrt{0.006\ FT/FT}}\right)^{1/2.14}$$

$t_{co} = \underline{\underline{14\ MIN}}$

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SHEET NO. 8

JOB NO. 5143/03 JOB PARR BLVD. & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - LINEAR WETLAND SWALE SIZING CHK'D DATE

LINEAR WETLAND SWALE - SECTION H - ESTIMATE PEAK DISCHARGE RATE CONTINUED

TIME OF CONCENTRATION CONTINUED:

BIORETENTION / WETLAND MITIGATION =>

$A_{WET} = 2.3\ AC$

ASSUMED $t_{cw} = 15$ MIN.

$T_c = t_{co} + t_{cw} = 14_{MIN} + 15_{MIN} = \underline{29_{MIN}}$

RAINFALL INTENSITY, i:

MEAN SEASONAL RAINFALL = 21.5 IN

10 YR =>

PRECIPITATION DEPTH, D = 0.61 IN

$i_{10} = D/t_c = (0.61\ IN)\left(\frac{1}{29\ MIN}\right)\left(60\ \frac{MIN}{HR}\right) = \underline{1.26\ IN/HR}$

100 YR =>

PRECIPITATION DEPTH, D = 0.77 IN

$i_{10} = D/t_c = (0.77\ IN)\left(\frac{1}{29\ MIN}\right)\left(60\ \frac{MIN}{HR}\right) = \underline{1.59\ IN/HR}$

ESTIMATE PEAK DISCHARGE RATE, Q:

$Q = CiAf$

WHERE: $C_w = 0.76$
$A = 21.8\ AC$
$f_{10} = 1.0$
$f_{100} = 1.25$ *
$Cf < 1.0$

$Q_{10} = (0.76)(1.26\ IN/HR)(21.8\ AC)(1.0)$

$Q_{10} = 20.9\ CFS$

$Cf = (0.76)(1.25) = 0.95 < 1.0$ ∴ OK

$Q_{100} = (0.76)(1.59\ IN/HR)(21.8\ AC)(1.25)$

$Q_{100} = 32.9\ CFS$

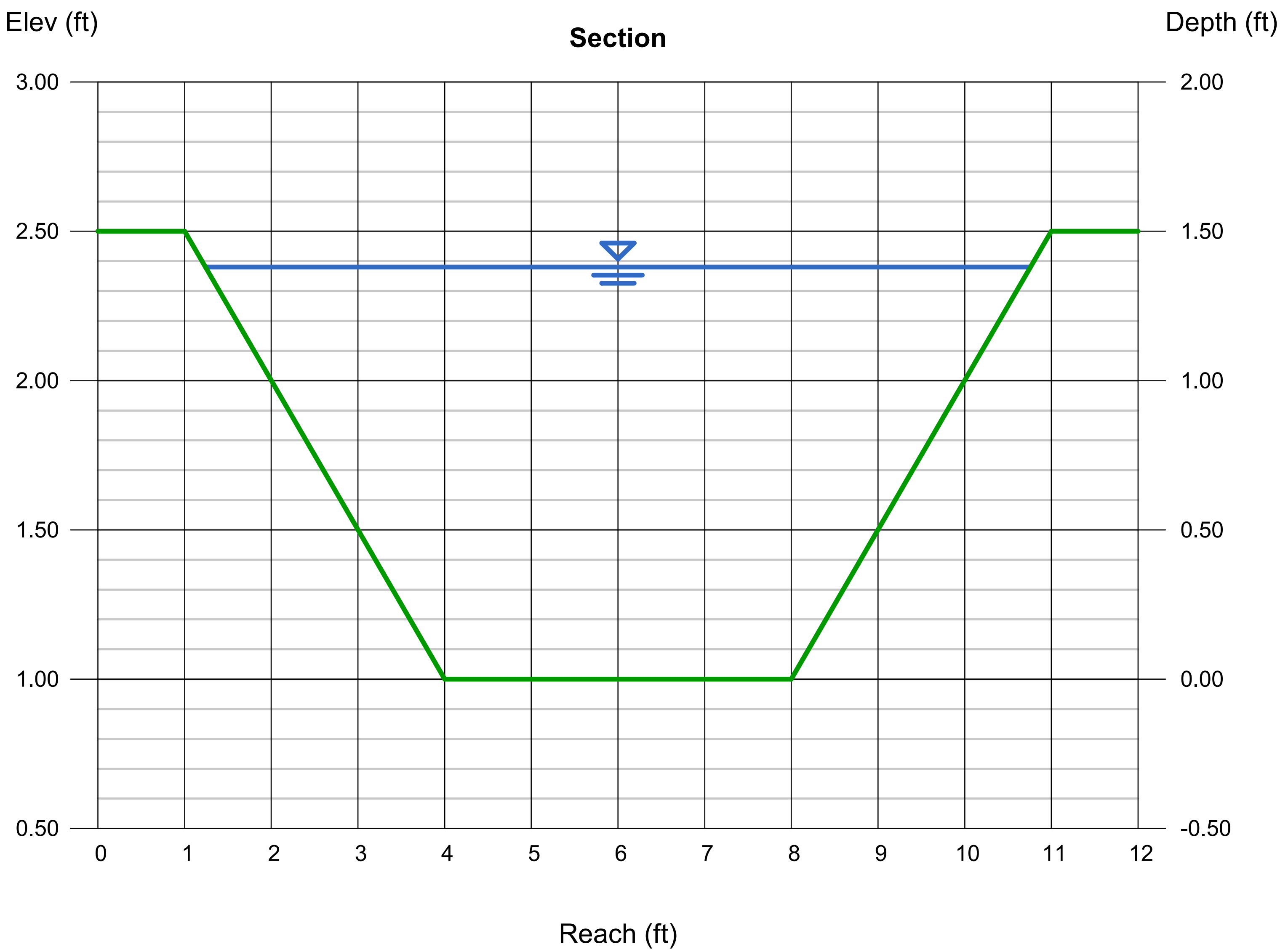
Therefore, per channel report 'PRO. COND. - LINEAR WETLAND SECTION H - 100 YR' linear wetland section H is sufficiently sized

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 17 2020

PRO. COND. - LINEAR WETLAND SECTION H

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.38
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 13.65
Total Depth (ft)	= 1.50	Area (sqft)	= 9.33
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 1.46
Slope (%)	= 0.10	Wetted Perim (ft)	= 10.17
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 9.52
Calculations		EGL (ft)	= 1.41
Compute by:	Known Q		
Known Q (cfs)	= 13.65		



CSW | ST2
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SHEET NO. 9.

JOB NO. 5143103 JOB PARR BLVD & RICHMOND PKWY BY BRB DATE

CLIENT SUBJECT HYDRAULICS - LINEAR WETLAND SWALE SIZING CHK'D DATE

LINEAR WETLAND SWALE - SECTION 1 - ESTIMATE PEAK DISCHARGE RATE:

TOTAL AREA: $A_{TOT} = 0.93\,AC$

$C_{WETLAND} = 0.30$

TIME OF CONCENTRATION, T_C:

$0.5\,AC < A_{TOT} = 0.93\,AC < 1.0\,AC \rightarrow$ ASSUMED $T_C = \underline{10\,MIN}$

RAINFALL INTENSITY, i:

10 YR ⇒

PRECIPITATION DEPTH, $D = 0.36\,IN$

$i_{10} = D/T_C = (0.36\,IN)\left(\frac{1}{10\,MIN}\right)\left(\frac{60\,MIN}{HR}\right) = \underline{2.16\,IN/HR}$

100 YR ⇒

PRECIPITATION DEPTH, $D = 0.45\,IN$

$i_{100} = \frac{D}{T_C} = (0.45\,IN)\left(\frac{1}{10\,MIN}\right)\left(60\,\frac{MIN}{HR}\right) = 2.70\,IN/HR$

ESTIMATE PEAK DISCHARGE RATE, Q:

$Q = CiAf$

$Q_{10} = (0.30)(2.16\,IN/HR)(0.93\,AC)(1.00)$

$\boxed{Q_{10} = 0.60\,CFS}$

$Q_{100} = (0.30)(2.70\,IN/HR)(0.93\,AC)(1.25)$

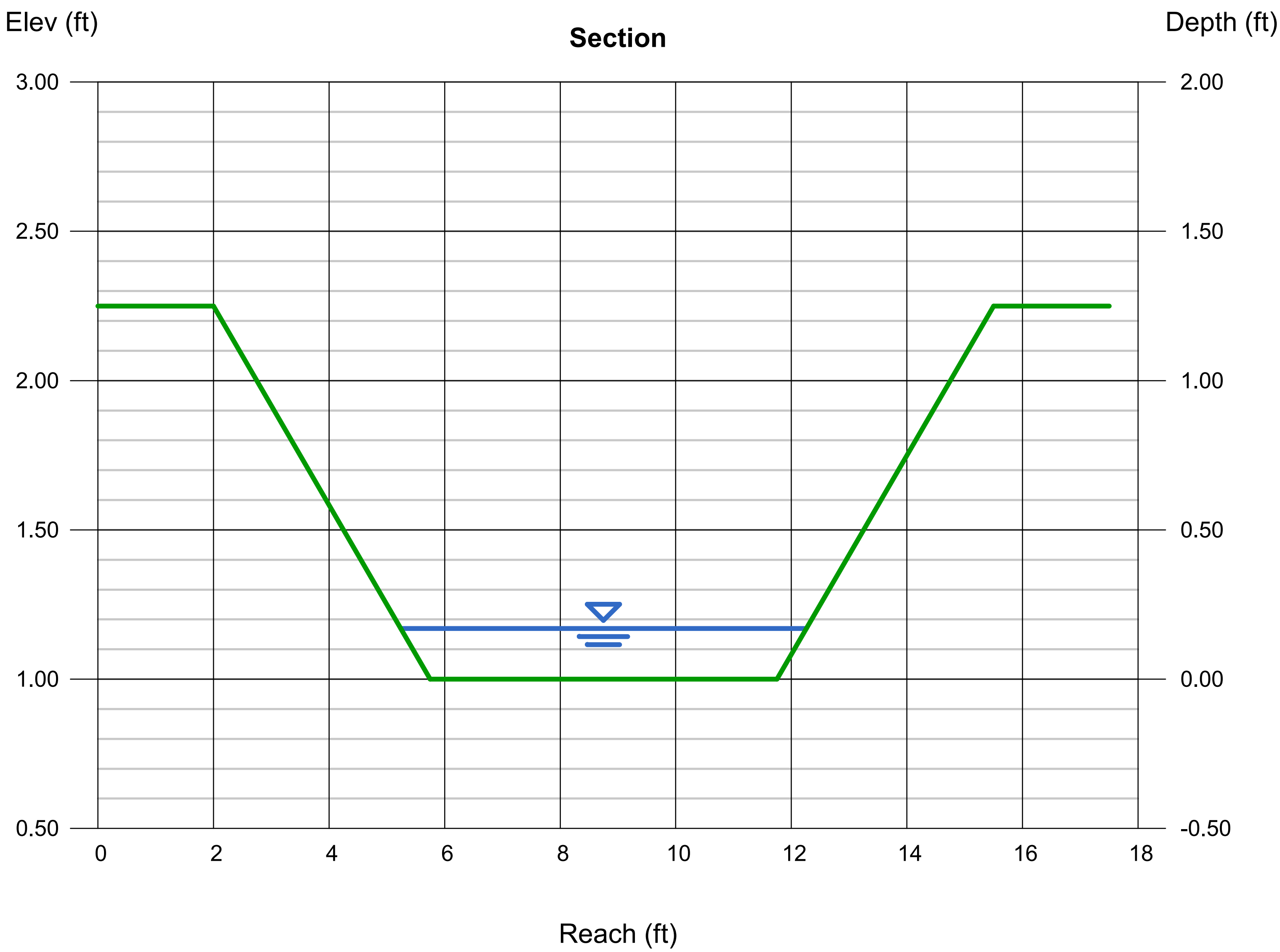
$\boxed{Q_{100} = 0.94\,CFS}$

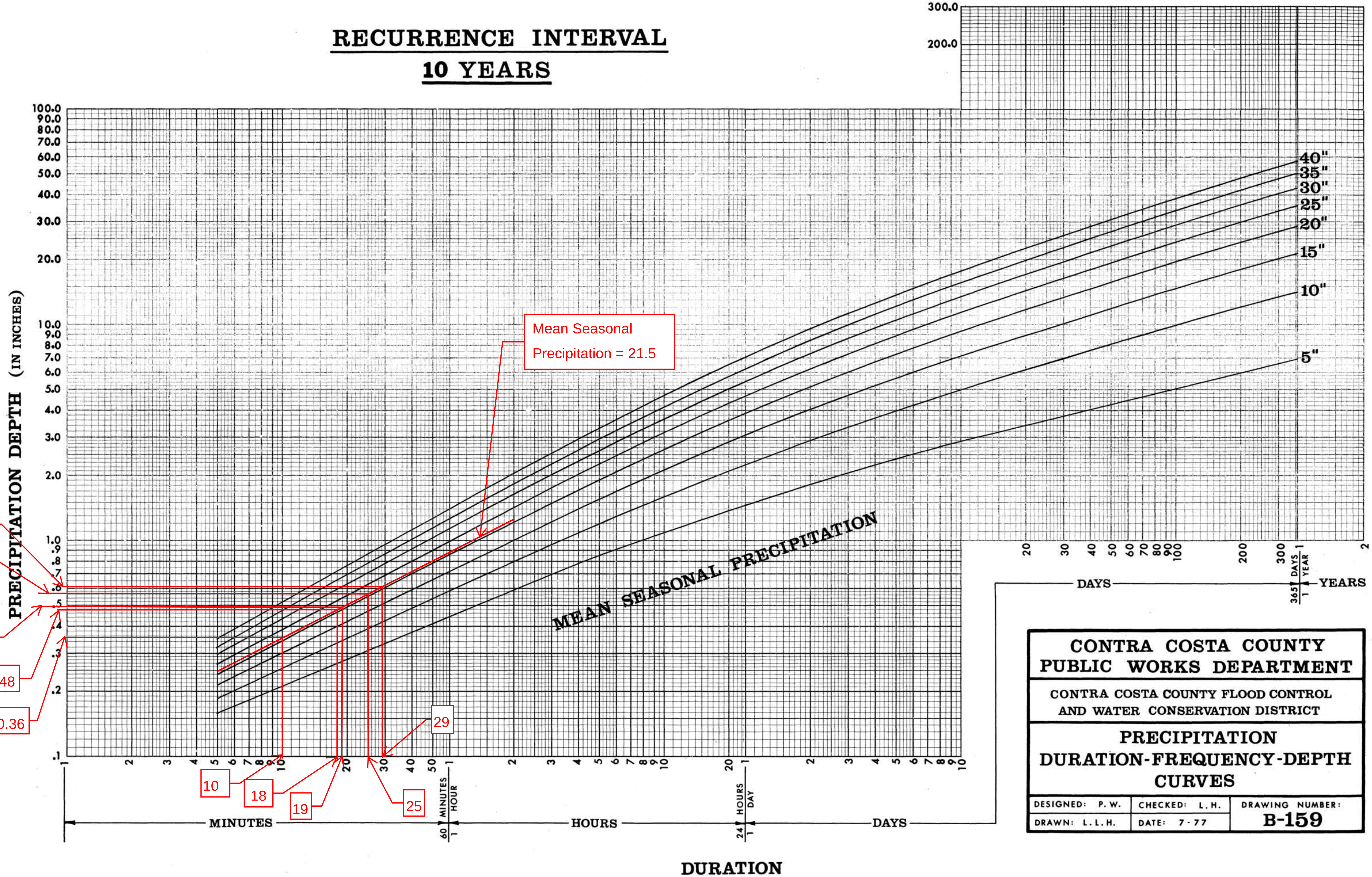
Channel Report

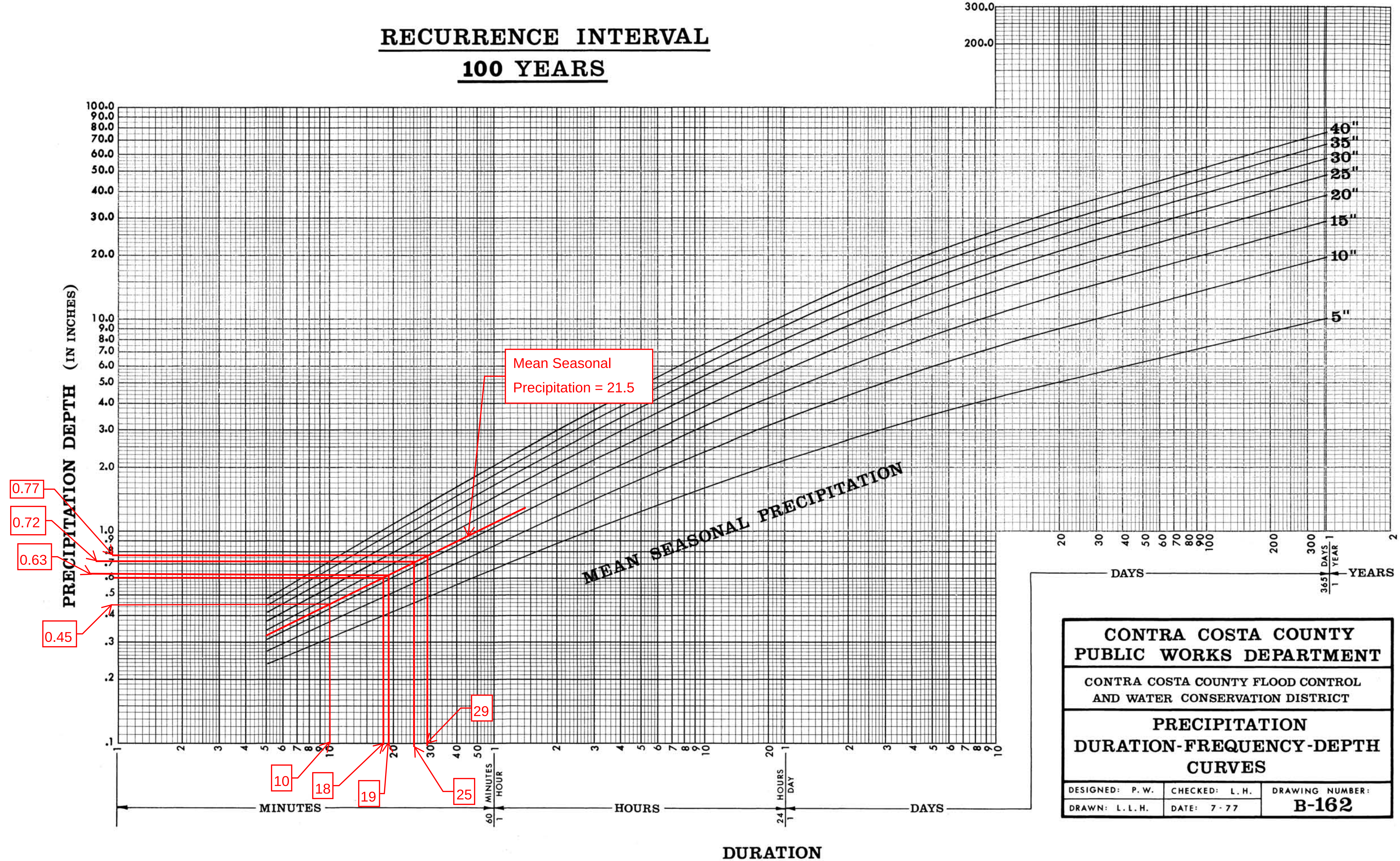
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Tuesday, Apr 7 2020

PRO. COND. - LINEAR WETLAND SECTION I - 100 YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.17
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 0.940
Total Depth (ft)	= 1.25	Area (sqft)	= 1.11
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 0.85
Slope (%)	= 0.37	Wetted Perim (ft)	= 7.08
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.09
		Top Width (ft)	= 7.02
Calculations		EGL (ft)	= 0.18
Compute by:	Known Q		
Known Q (cfs)	= 0.94		

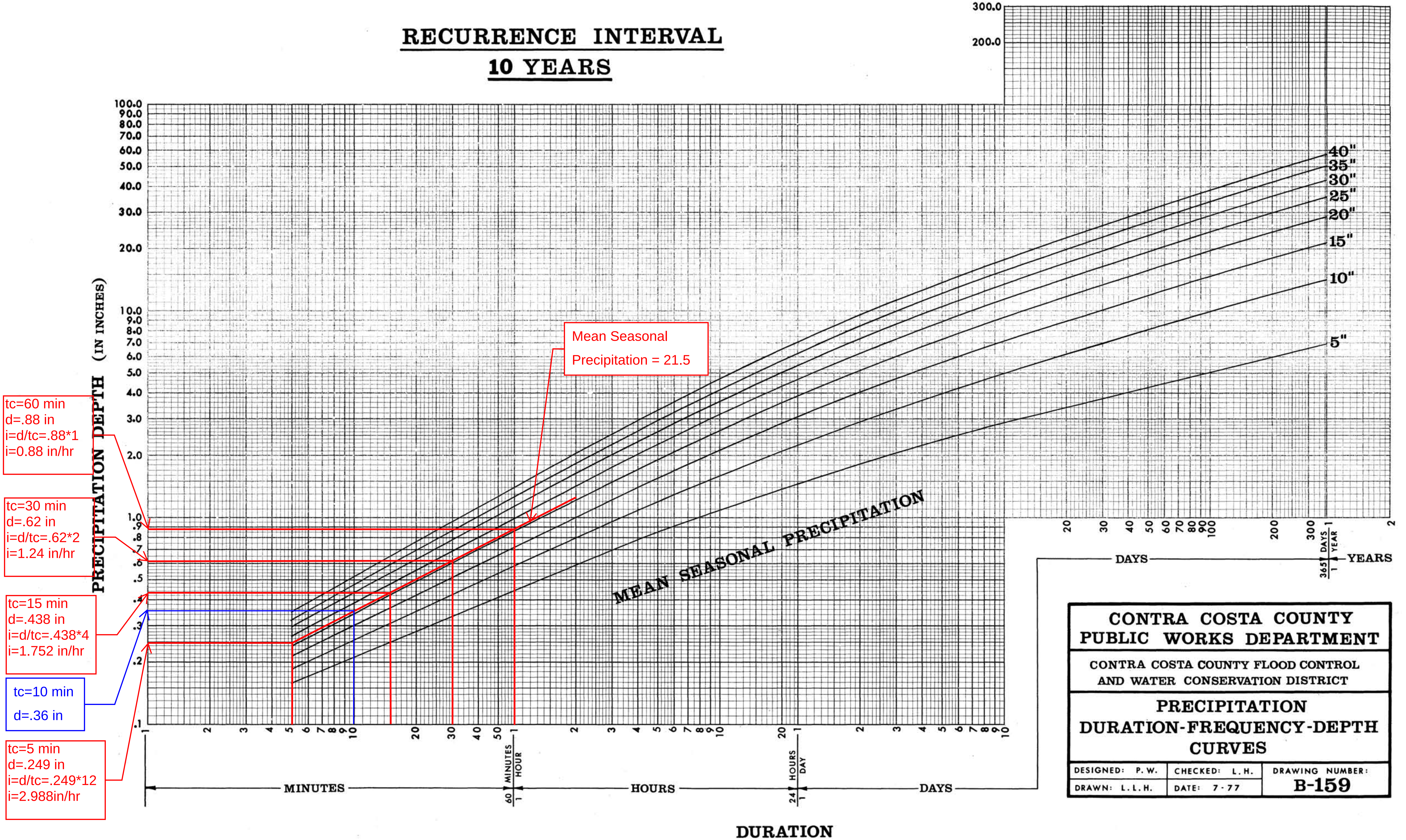



RECURRENCE INTERVAL
10 YEARS
PRECIPITATION DEPTH (IN INCHES)
DURATION
MINUTES
HOURS
DAYS
YEARS
60 MINUTES 1 HOUR
24 HOURS 1 DAY
365 DAYS 1 YEAR
MEAN SEASONAL PRECIPITATION
40"
35"
30"
25"
20"
15"
10"
5"
Mean Seasonal Precipitation = 21.5
0.61
0.57
0.49
0.48
0.36
10
18
19
25
29
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
B-159
DRAWN: L. L. H.
DATE: 7-77

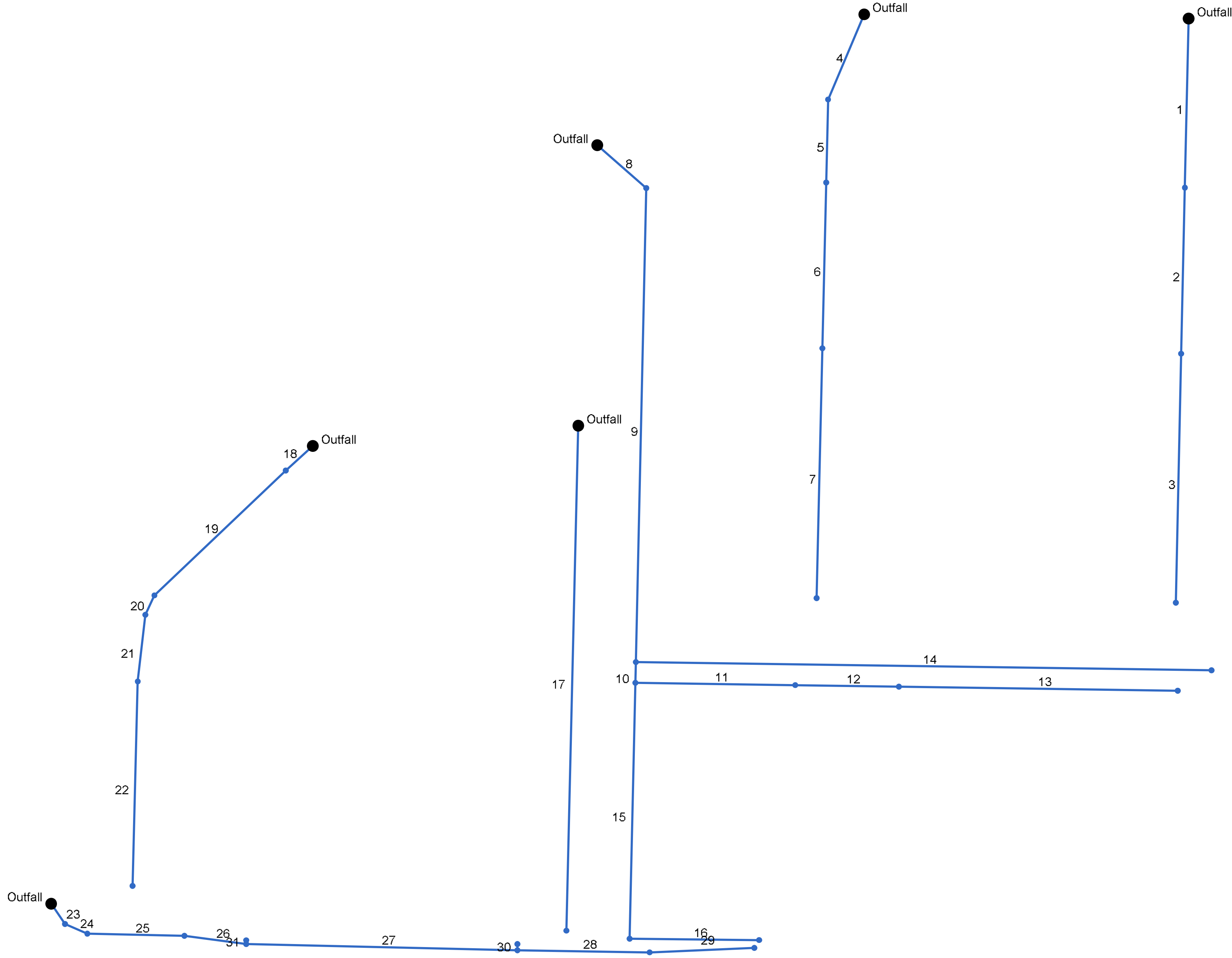


RECURRENCE INTERVAL
100 YEARS
PRECIPITATION DEPTH (IN INCHES)
DURATION
MINUTES
HOURS
DAYS
YEARS
60 MINUTES 1 HOUR
24 HOURS 1 DAY
365 DAYS 1 YEAR
MEAN SEASONAL PRECIPITATION
40"
35"
30"
25"
20"
15"
10"
5"
Mean Seasonal Precipitation = 21.5
0.77
0.72
0.63
0.45
10
18
19
25
29
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
DRAWN: L. L. H.
DATE: 7-77
B-162

Appendix 7.12
Hydraulic Calculations – Storm Drain System


RECURRENCE INTERVAL
10 YEARS
PRECIPITATION DEPTH (IN INCHES)
DURATION
MINUTES
HOURS
DAYS
YEARS
60 MINUTES 1 HOUR
24 HOURS 1 DAY
365 DAYS 1 YEAR
MEAN SEASONAL PRECIPITATION
40"
35"
30"
25"
20"
15"
10"
5"
Mean Seasonal Precipitation = 21.5
tc=60 min
d=.88 in
i=d/tc=.88*1
i=0.88 in/hr
tc=30 min
d=.62 in
i=d/tc=.62*2
i=1.24 in/hr
tc=15 min
d=.438 in
i=d/tc=.438*4
i=1.752 in/hr
tc=10 min
d=.36 in
tc=5 min
d=.249 in
i=d/tc=.249*12
i=2.988in/hr
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER: B-159
DRAWN: L. L. H.
DATE: 7-77

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: pipe networks.stm	Number of lines: 31	Date: 3/4/2021

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	220.000	0.55	2.36	0.95	0.52	2.24	8.0	12.6	1.9	4.26	6.64	4.03	18	0.40	5.16	6.04	5.95	7.00	7.75	9.53	Area 1
2	1	216.000	0.72	1.81	0.95	0.68	1.72	8.0	11.6	2.0	3.41	4.07	3.54	15	0.40	6.04	6.90	7.03	7.75	9.53	9.68	Area 2
3	2	324.000	1.09	1.09	0.95	1.04	1.04	10.0	10.0	2.1	2.20	2.52	3.44	12	0.50	6.90	8.52	7.79	9.20	9.68	9.90	Area 3
4	End	117.000	0.00	2.36	0.00	0.00	2.24	0.0	13.8	1.8	4.07	5.23	3.71	18	0.25	5.58	5.87	6.35	6.96	7.75	9.17	
5	4	108.000	0.55	2.36	0.95	0.52	2.24	8.0	13.2	1.9	4.16	5.25	3.00	18	0.25	5.87	6.14	7.01	7.20	9.17	9.18	Area 5
6	5	216.000	0.72	1.81	0.95	0.68	1.72	8.0	12.1	1.9	3.34	3.54	3.08	15	0.30	6.14	6.79	7.23	7.77	9.18	9.23	Area 6
7	6	325.000	1.09	1.09	0.95	1.04	1.04	10.0	10.0	2.1	2.20	3.55	2.64	15	0.30	6.79	7.77	7.80	8.46	9.23	9.55	Area 7
8	End	76.000	0.00	14.38	0.00	0.00	10.57	0.0	31.3	1.2	12.84	25.37	4.52	36	0.14	6.00	6.11	7.14	7.55	6.00	10.34	
9	8	617.000	0.00	14.38	0.00	0.00	10.57	0.0	28.4	1.3	13.46	25.89	3.61	36	0.15	6.11	7.04	7.72	8.56	10.34	12.48	
10	9	27.000	0.00	5.56	0.00	0.00	5.28	0.0	20.3	1.5	7.94	25.67	1.89	36	0.15	7.04	7.08	8.78	8.79	12.48	12.86	
11	10	168.000	0.68	2.94	0.95	0.65	2.79	10.0	18.5	1.6	4.40	7.19	1.54	24	0.10	7.08	7.25	8.84	8.90	12.86	10.83	Area 11
12	11	109.000	1.44	2.26	0.95	1.37	2.15	10.0	17.0	1.6	3.52	7.19	1.30	24	0.10	7.25	7.36	8.91	8.93	10.83	10.83	Area 12
13	12	293.000	0.82	0.82	0.95	0.78	0.78	10.0	10.0	2.1	1.66	7.12	0.69	24	0.10	7.36	7.65	8.94	8.96	10.83	11.08	Area 13
14	9	605.000	8.82	8.82	0.60	5.29	5.29	25.0	25.0	1.4	7.18	10.11	2.92	24	0.20	7.04	8.25	8.78	9.53	12.48	11.51	Swale 1
15	10	333.000	0.51	2.62	0.95	0.48	2.49	10.0	10.7	2.1	5.12	7.05	3.31	18	0.45	7.08	8.58	8.84	9.67	12.86	11.67	Area 15
16	15	136.000	2.11	2.11	0.95	2.00	2.00	10.0	10.0	2.1	4.26	7.03	3.19	18	0.45	8.58	9.19	9.89	10.11	11.67	11.94	Area 16
17	End	657.000	0.25	0.25	0.95	0.24	0.24	10.0	10.0	2.1	0.51	2.35	2.36	12	0.43	6.15	9.00	6.44	9.34	6.15	11.00	Area 17
18	End	43.000	0.00	1.53	0.00	0.00	1.45	0.0	12.5	1.9	2.77	5.02	4.17	15	0.60	7.25	7.51	7.91	8.18	7.25	11.53	
19	18	213.000	0.00	1.53	0.00	0.00	1.45	0.0	11.7	2.0	2.87	5.01	4.21	15	0.60	7.51	8.79	8.19	9.47	11.53	12.44	
20	19	27.000	0.00	1.53	0.00	0.00	1.45	0.0	11.6	2.0	2.88	4.97	4.19	15	0.59	8.79	8.95	9.47	9.63	12.44	12.59	
21	20	87.000	0.56	1.53	0.95	0.53	1.45	10.0	11.2	2.0	2.93	4.99	3.97	15	0.60	8.95	9.47	9.72	10.16	12.59	12.76	Area 21
22	21	266.000	0.97	0.97	0.95	0.92	0.92	10.0	10.0	2.1	1.96	2.76	3.71	12	0.60	9.47	11.07	10.16	11.67	12.76	13.05	Area 22
23	End	30.000	0.04	1.20	0.95	0.04	1.14	10.0	16.7	1.7	1.89	3.32	2.94	18	0.10	8.15	8.18	8.67	8.87	9.50	11.71	Area 23
24	23	27.000	0.11	1.16	0.95	0.10	1.10	10.0	16.4	1.7	1.84	4.04	2.11	18	0.15	8.18	8.22	8.92	8.96	11.71	11.71	Area 24
25	24	102.000	0.07	1.05	0.95	0.07	1.00	10.0	15.6	1.7	1.71	4.03	1.95	18	0.15	8.22	8.37	8.99	9.09	11.71	11.71	Area 25
26	25	66.000	0.00	0.98	0.00	0.00	0.93	0.0	15.1	1.7	1.62	2.51	2.17	15	0.15	8.37	8.47	9.10	9.20	11.71	11.71	

Project File: pipe networks.stm | Number of lines: 31 | Run Date: 3/4/2021

NOTES:Intensity = 6.75 / (Inlet time + 0.20) ^ 0.50; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
27	26	285.000	0.00	0.64	0.00	0.00	0.61	0.0	12.4	1.9	1.16	2.89	1.81	15	0.20	8.47	9.04	9.27	9.59	11.71	13.35	
28	27	139.000	0.00	0.39	0.00	0.00	0.37	0.0	10.9	2.0	0.76	2.90	1.51	15	0.20	9.04	9.32	9.67	9.79	13.35	11.90	
29	28	110.000	0.39	0.39	0.95	0.37	0.37	10.0	10.0	2.1	0.79	1.59	2.02	12	0.20	9.32	9.54	9.82	10.04	11.90	11.44	Area 29
30	27	8.000	0.25	0.25	0.95	0.24	0.24	10.0	10.0	2.1	0.51	1.12	2.94	6	4.00	9.04	9.36	9.67	9.72	13.35	11.68	Area 30
31	26	5.000	0.34	0.34	0.95	0.32	0.32	10.0	10.0	2.1	0.69	1.12	3.50	6	4.00	8.47	8.67	9.27	9.35	11.71	11.84	Area 31

Sample Total Flow Calculation:

Total A = 0.25 ac; C=0.95; MSP= 21.5
d_{10} = 0.36 in
i_{10} = (0.36in)(1/10min)(60min/1hr) = 2.16 in/hr

Q_{10} = (0.95)(2.16in/hr)(0.25 ac) = 0.51 cfs

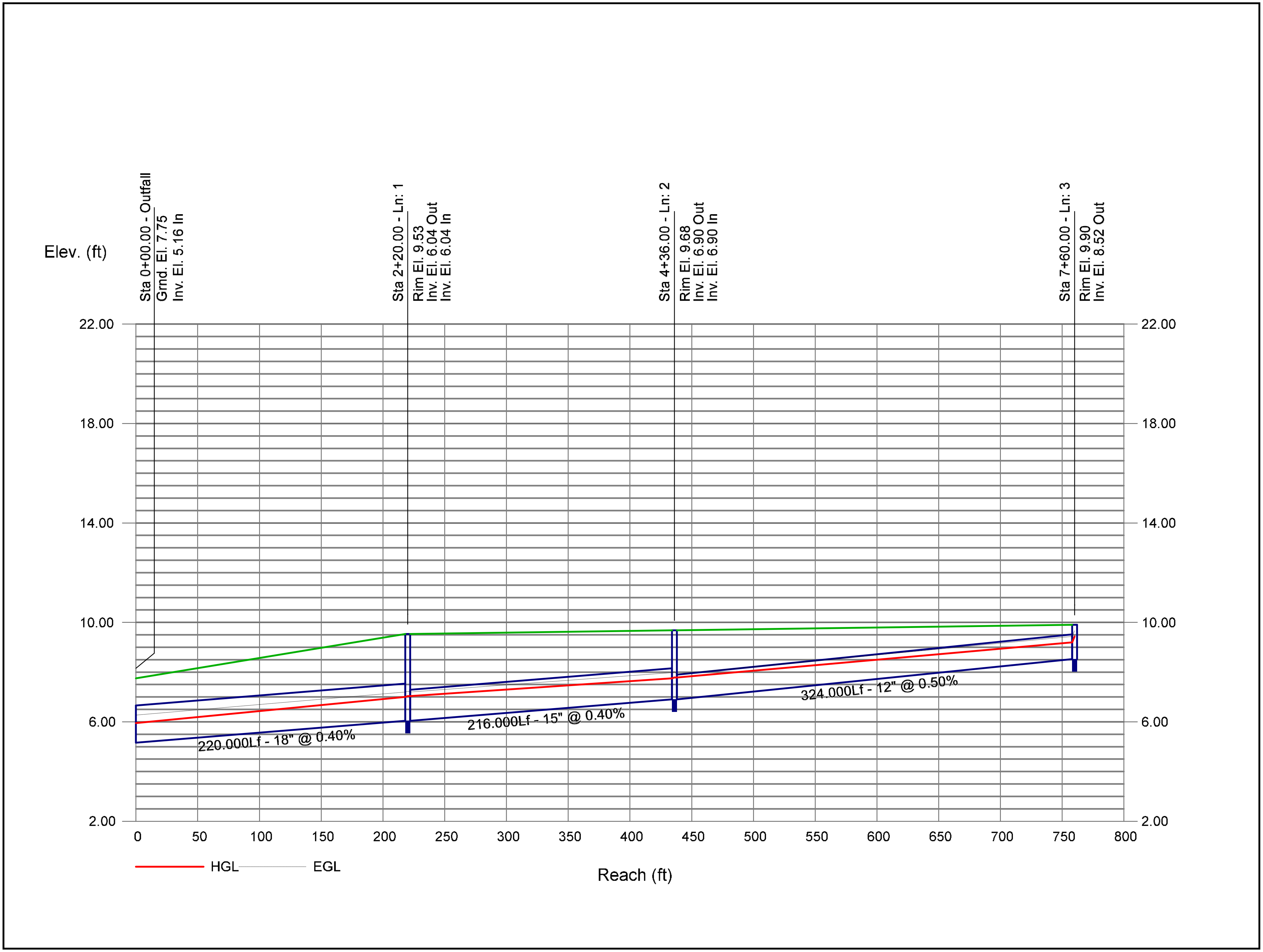
Project File: pipe networks.stm	Number of lines: 31	Run Date: 3/4/2021

NOTES:Intensity = 6.75 / (Inlet time + 0.20) ^ 0.50; Return period =Yrs. 10 ; c = cir e = ellip b = box

10-Year Storm Event - Profiles

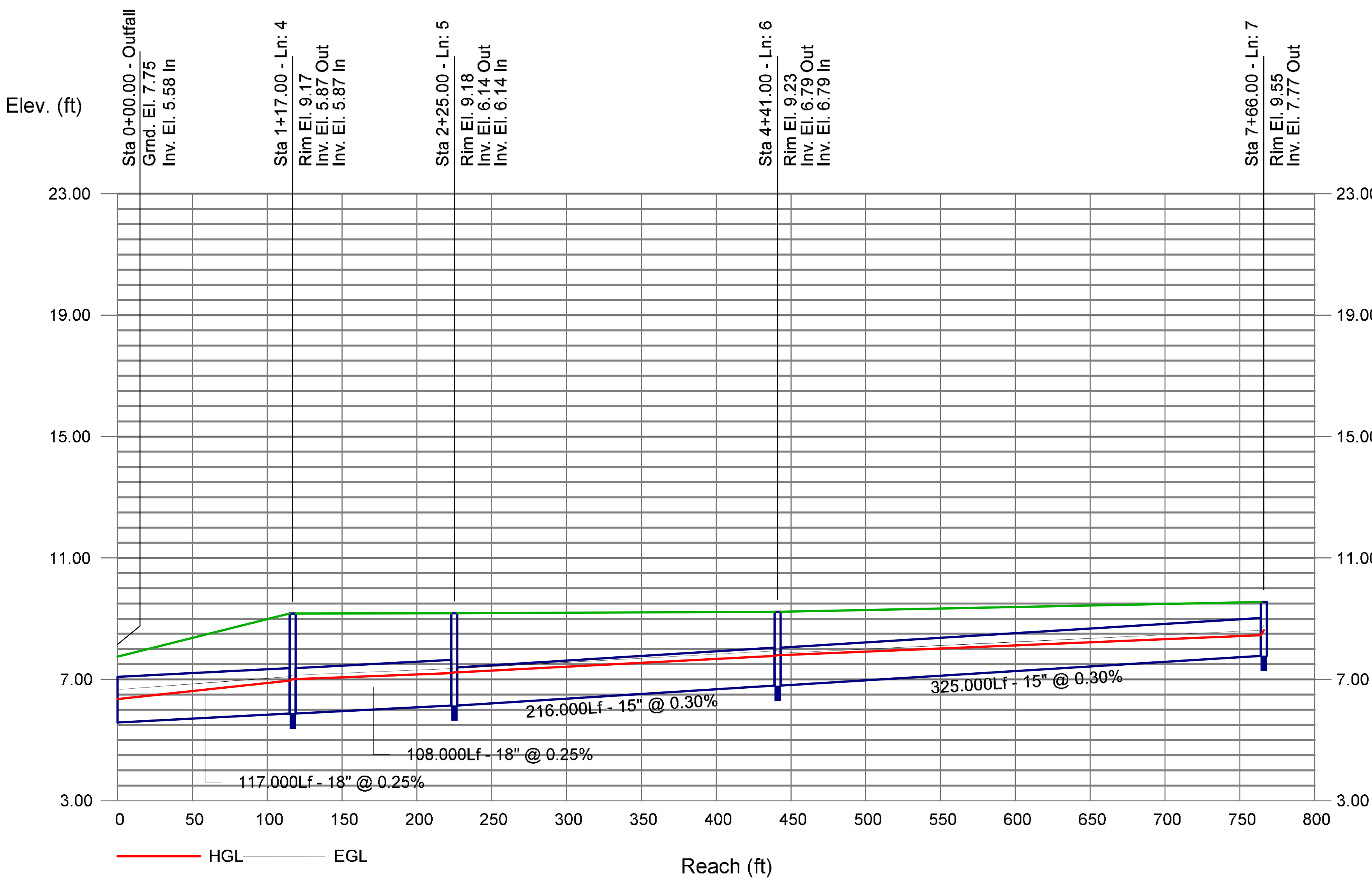
Storm Sewer Profile

Proj. file: pipe networks.stm



Storm Sewer Profile

Proj. file: pipe networks.stm



Storm Sewer Profile

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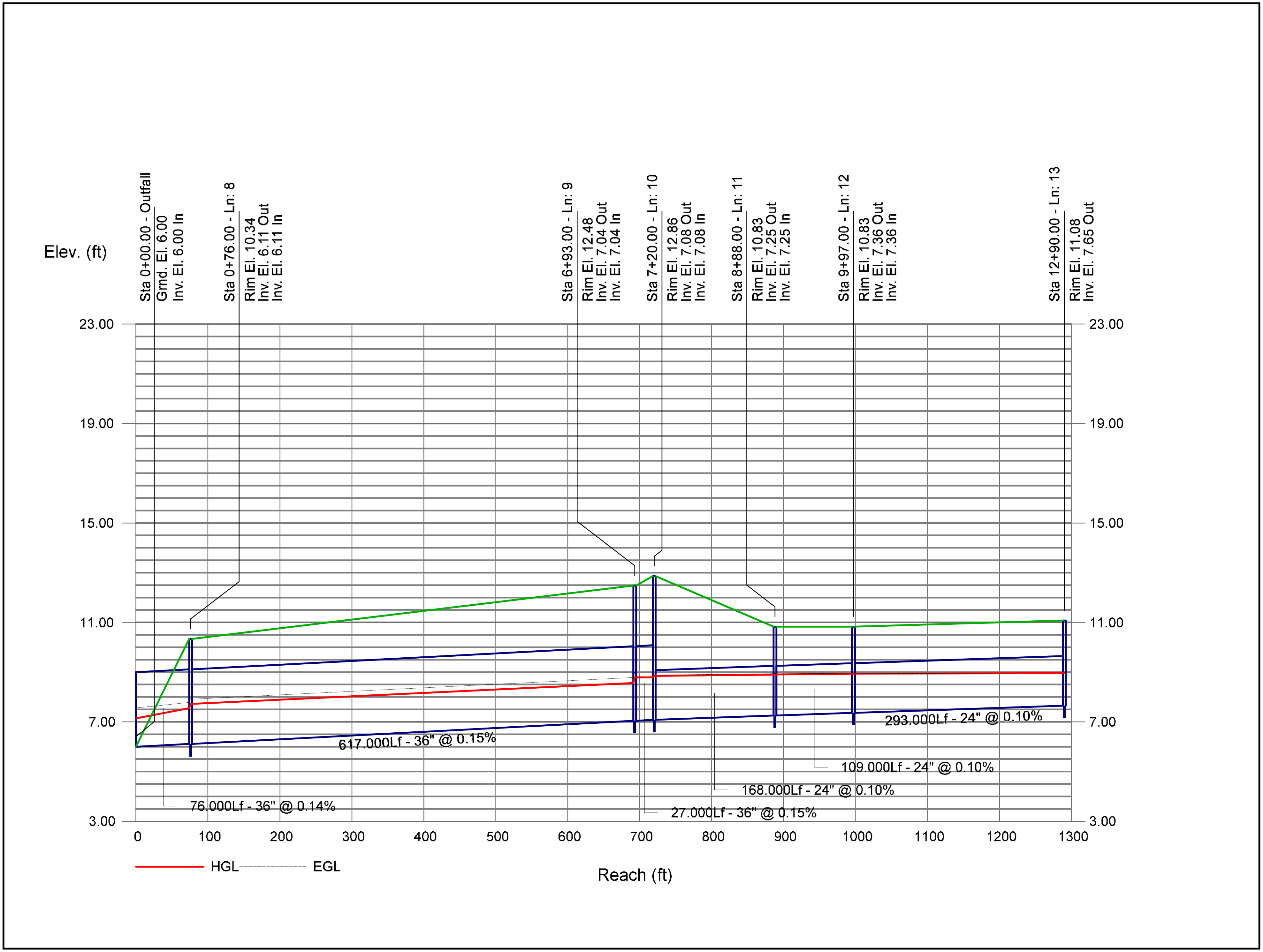
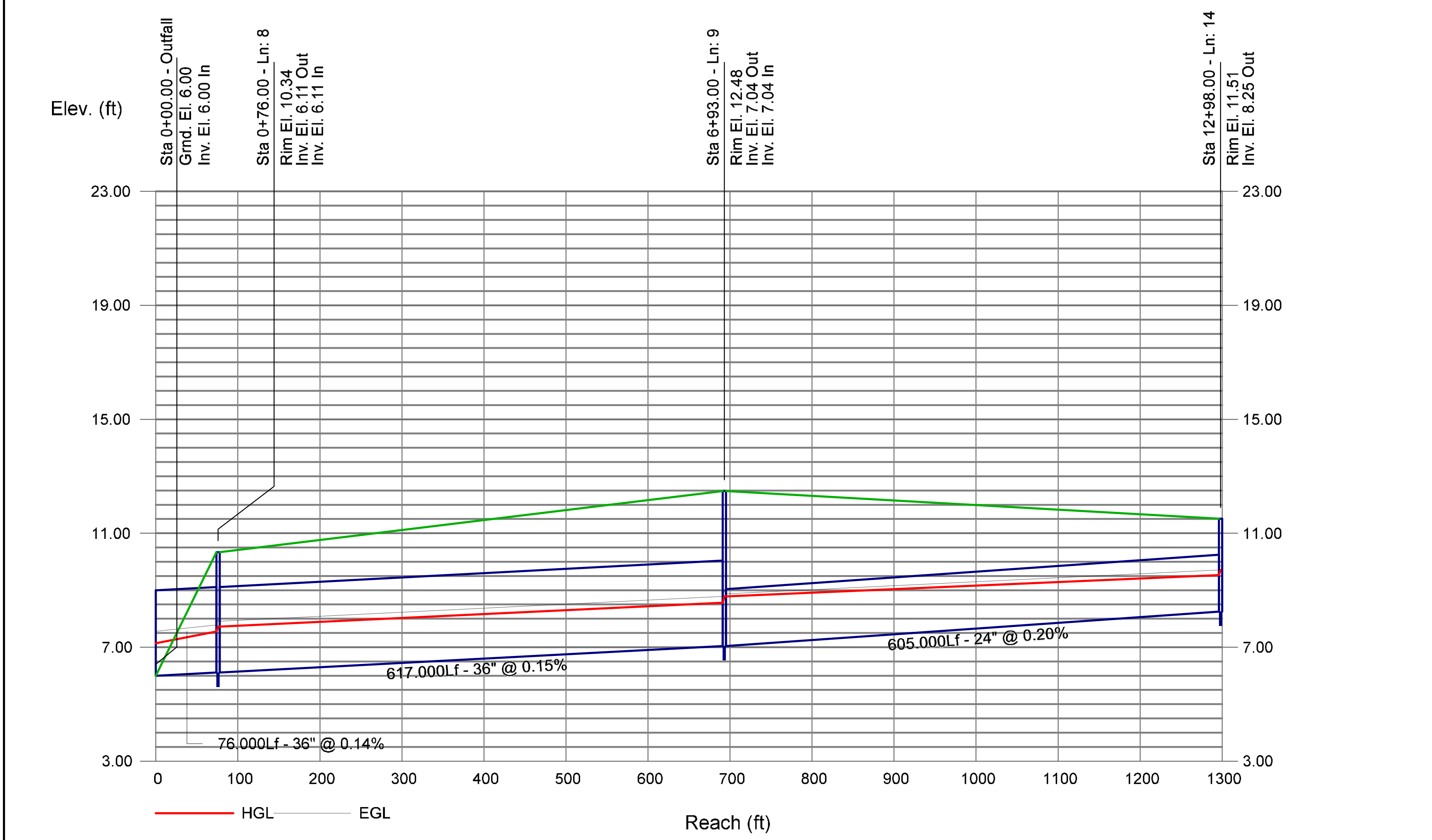


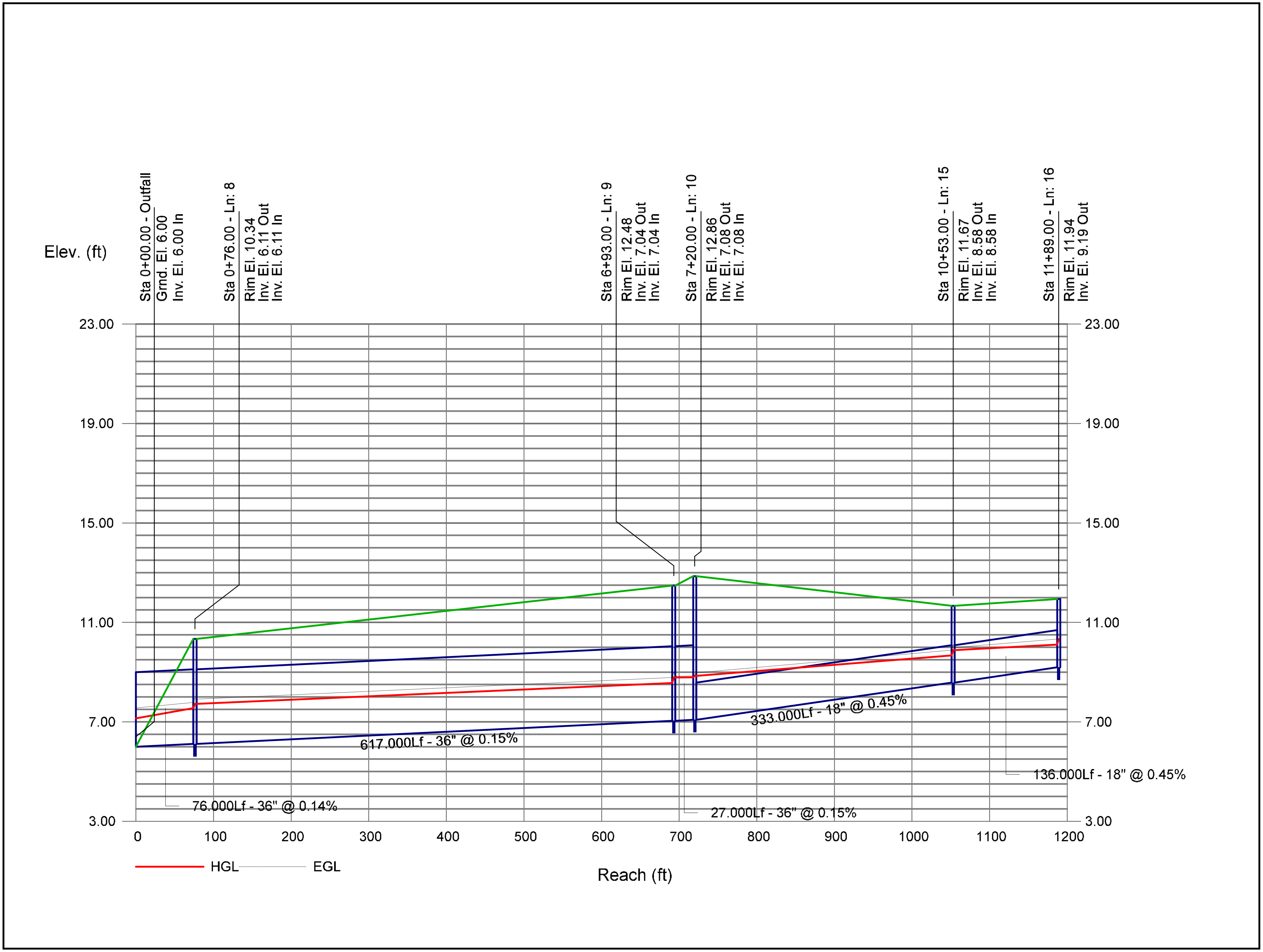
Storm Sewer Profile

Proj. file: pipe networks.stm



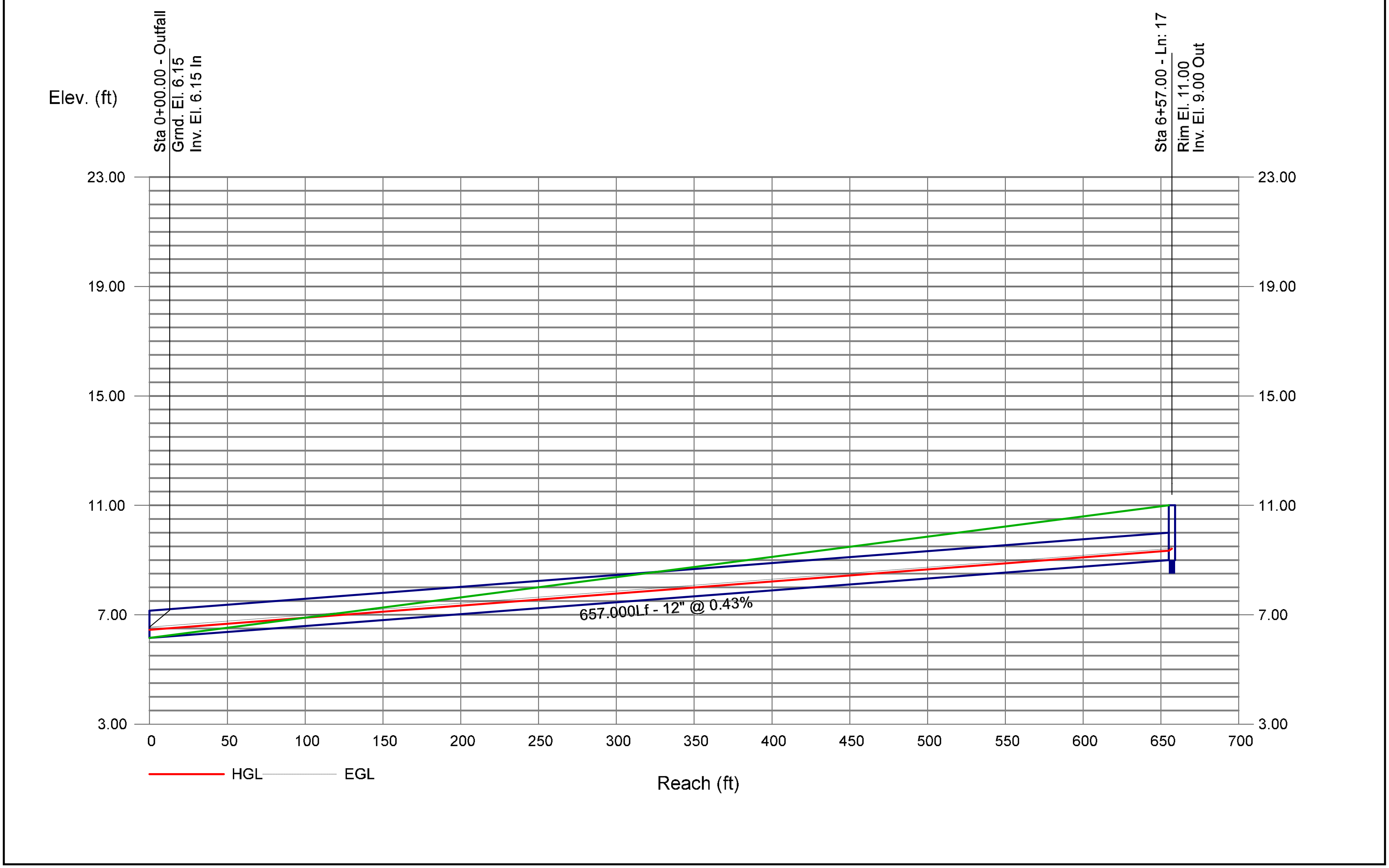
Storm Sewer Profile

Proj. file: pipe networks.stm



Storm Sewer Profile

Proj. file: pipe networks.stm



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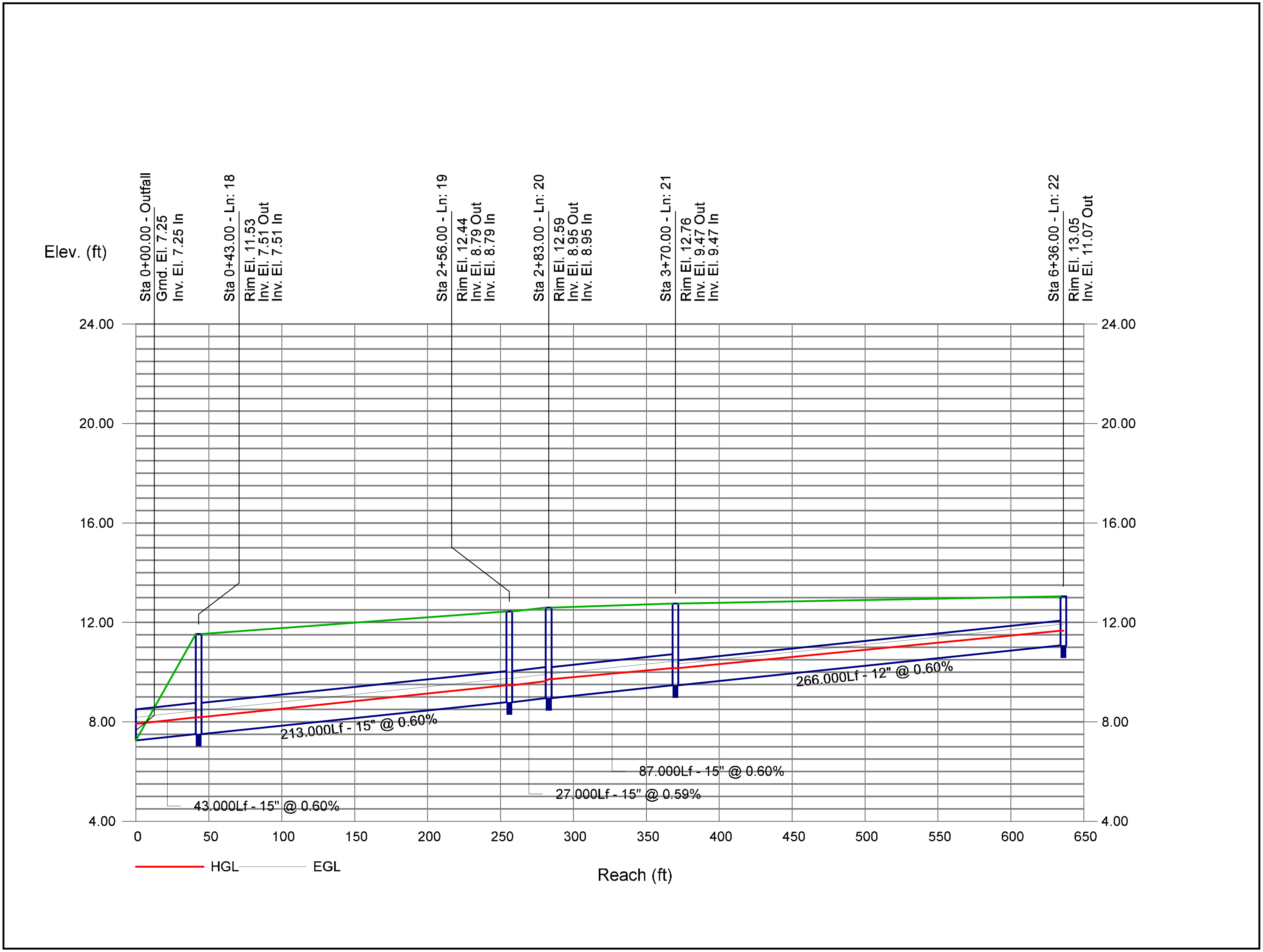
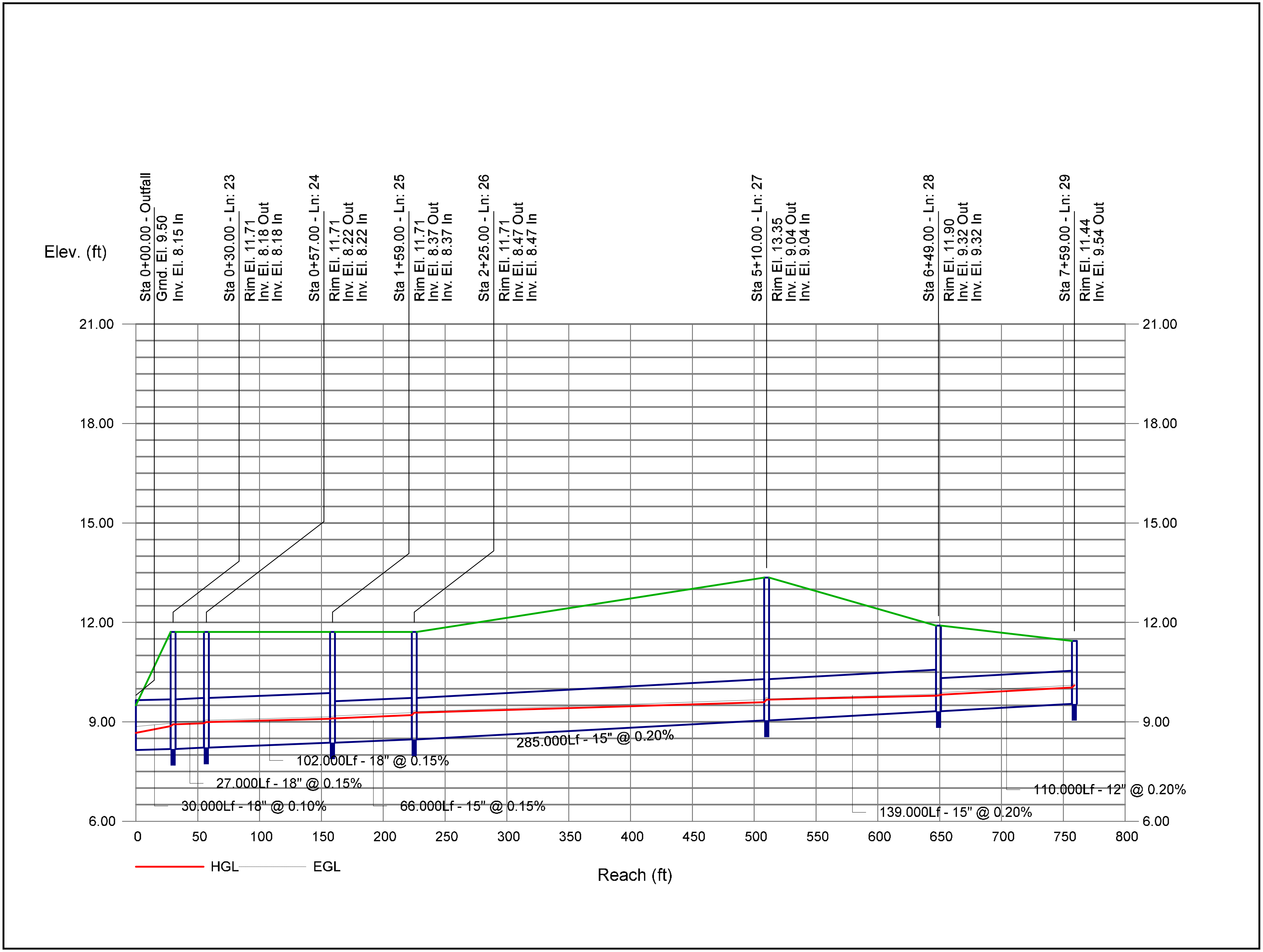


Storm Sewer Profile

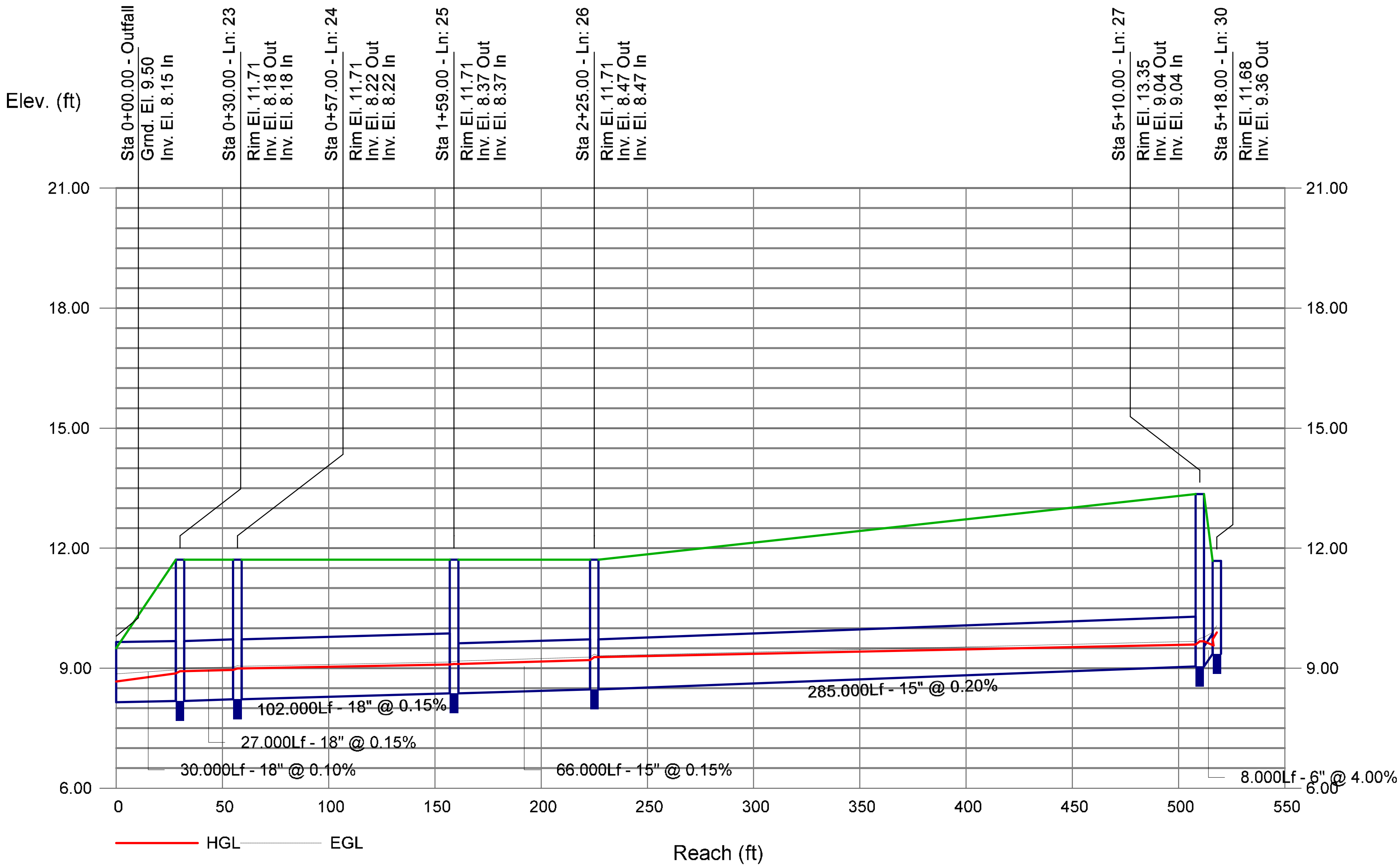
Proj. file: pipe networks.stm



Storm Sewers

Storm Sewer Profile

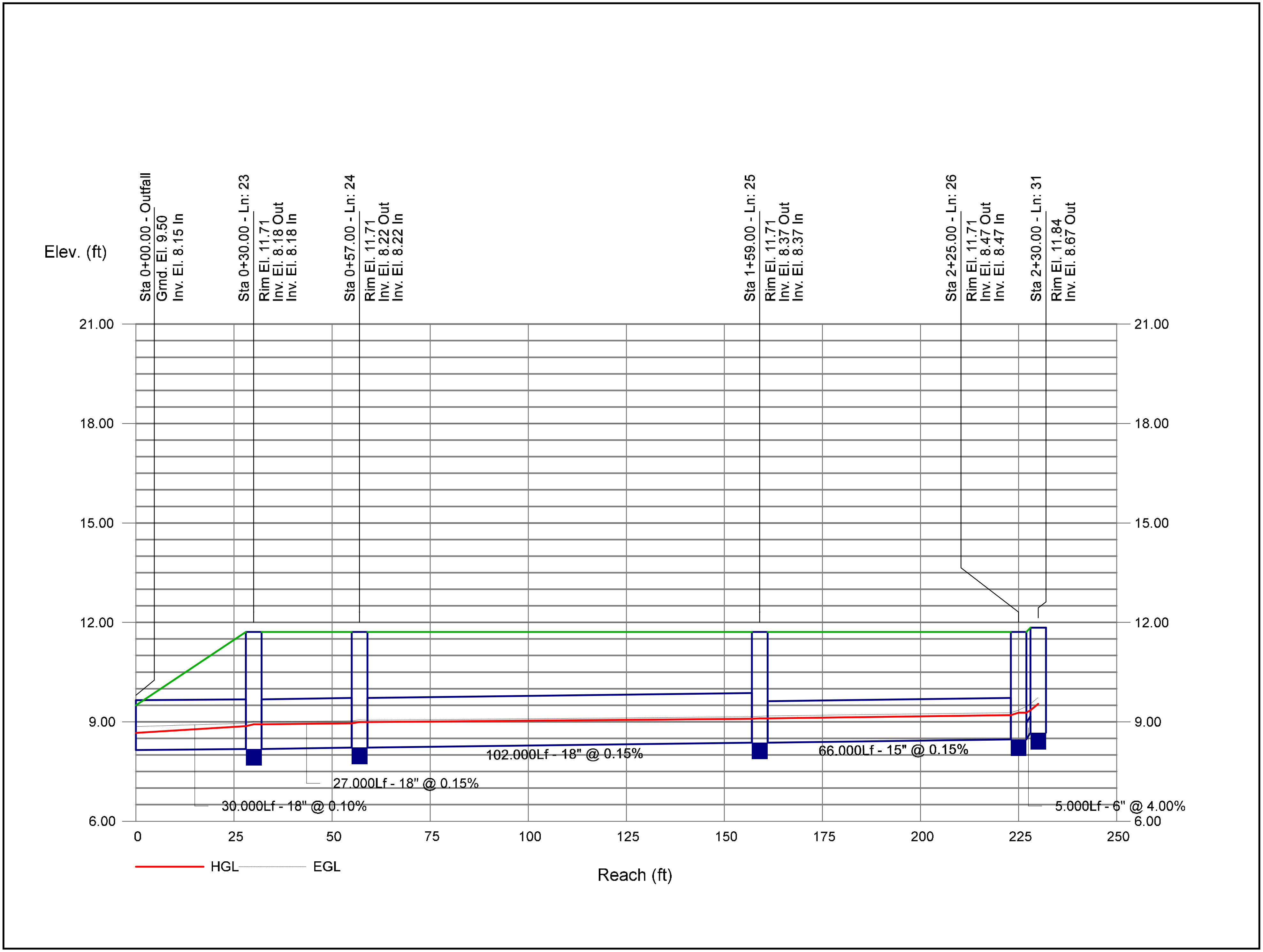
Proj. file: pipe networks.stm



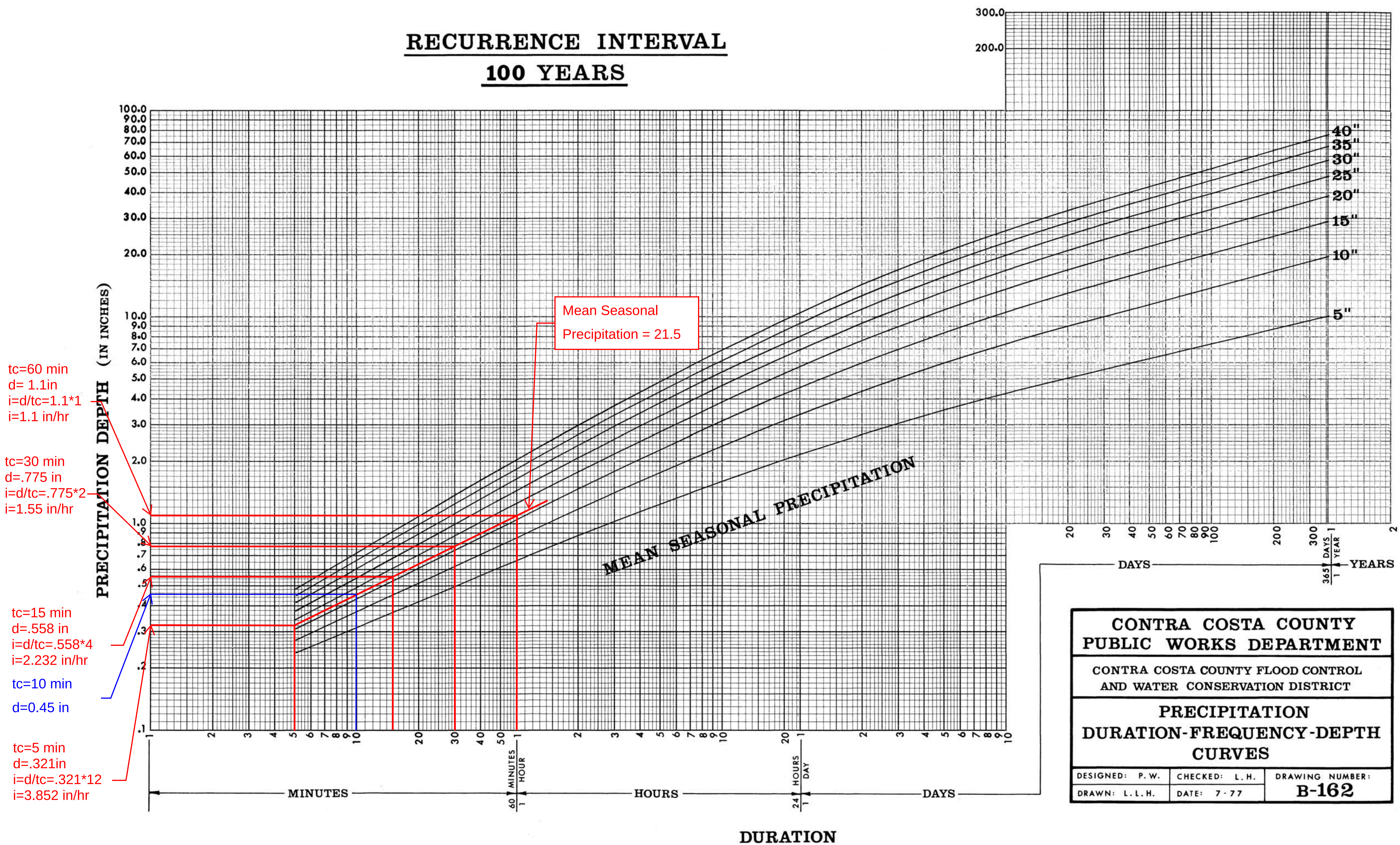
Storm Sewers

Storm Sewer Profile

Proj. file: pipe networks.stm

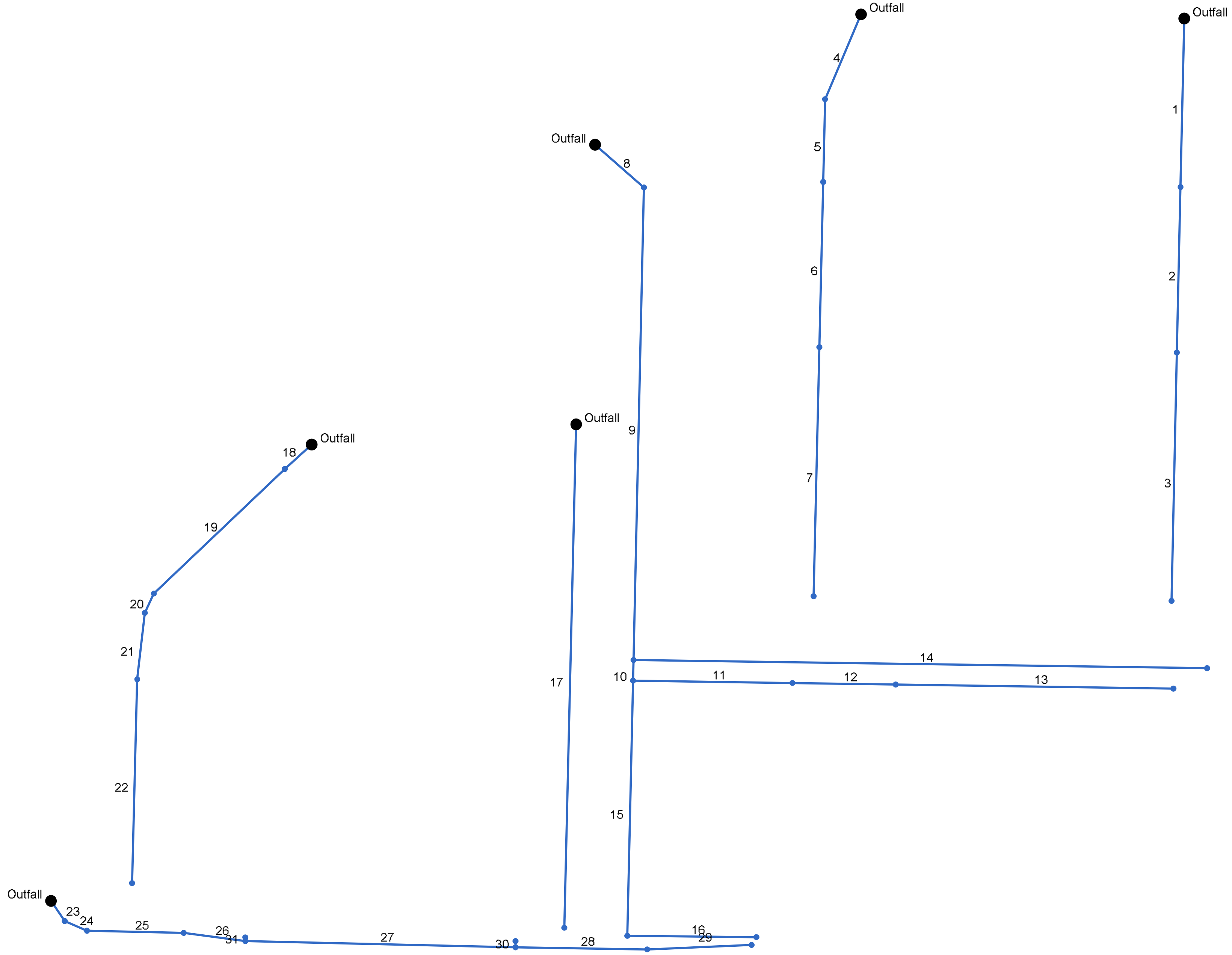


100-Year Storm Event



RECURRENCE INTERVAL
100 YEARS
PRECIPITATION DEPTH (IN INCHES)
MEAN SEASONAL PRECIPITATION
40"
35"
30"
25"
20"
15"
10"
5"
Mean Seasonal
Precipitation = 21.5
tc=60 min
d= 1.1in
i=d/tc=1.1*1
i=1.1 in/hr
tc=30 min
d=.775 in
i=d/tc=.775*2
i=1.55 in/hr
tc=15 min
d=.558 in
i=d/tc=.558*4
i=2.232 in/hr
tc=10 min
d=0.45 in
tc=5 min
d=.321in
i=d/tc=.321*12
i=3.852 in/hr
MINUTES
60 MINUTES 1 HOUR
HOURS
24 HOURS 1 DAY
DAYS
365 DAYS 1 YEAR
YEARS
DURATION
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
PRECIPITATION
DURATION-FREQUENCY-DEPTH
CURVES
DESIGNED: P. W.
CHECKED: L. H.
DRAWING NUMBER:
DRAWN: L. L. H.
DATE: 7-77
B-162

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: pipe networks 100 yrs.stm	Number of lines: 31	Date: 3/4/2021

Storm Sewers v12.00

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	220.000	0.55	2.36	0.99	0.54	2.34	8.0	12.5	2.4	5.59	6.64	4.34	18	0.40	5.16	6.04	6.07	7.24	7.75	9.53	Area 1
2	1	216.000	0.72	1.81	0.99	0.71	1.79	8.0	11.5	2.5	4.46	4.07	3.64	15	0.40	6.04	6.90	7.29	8.32	9.53	9.68	Area 2
3	2	324.000	1.09	1.09	0.99	1.08	1.08	10.0	10.0	2.7	2.87	2.52	3.66	12	0.50	6.90	8.52	8.35	10.46	9.68	9.90	Area 3
4	End	117.000	0.00	2.36	0.00	0.00	2.34	0.0	13.9	2.3	5.30	5.23	4.08	18	0.25	5.58	5.87	6.47	7.15	7.75	9.17	
5	4	108.000	0.55	2.36	0.99	0.54	2.34	8.0	13.3	2.3	5.40	5.25	3.26	18	0.25	5.87	6.14	7.21	7.46	9.17	9.18	Area 5
6	5	216.000	0.72	1.81	0.99	0.71	1.79	8.0	12.3	2.4	4.31	3.54	3.51	15	0.30	6.14	6.79	7.49	8.45	9.18	9.23	Area 6
7	6	325.000	1.09	1.09	0.99	1.08	1.08	10.0	10.0	2.7	2.87	3.55	2.34	15	0.30	6.79	7.77	8.48	9.12	9.23	9.55	Area 7
8	End	76.000	0.00	14.38	0.00	0.00	12.12	0.0	30.4	1.5	18.67	25.37	5.13	36	0.14	6.00	6.11	7.38	7.84	6.00	10.34	
9	8	617.000	0.00	14.38	0.00	0.00	12.12	0.0	27.8	1.6	19.50	25.89	4.01	36	0.15	6.11	7.04	8.07	8.98	10.34	12.48	
10	9	27.000	0.00	5.56	0.00	0.00	5.50	0.0	19.7	1.9	10.50	25.67	1.91	36	0.15	7.04	7.08	9.23	9.24	12.48	12.86	
11	10	168.000	0.68	2.94	0.99	0.67	2.91	10.0	18.2	2.0	5.77	7.19	1.84	24	0.10	7.08	7.25	9.30	9.41	12.86	10.83	Area 11
12	11	109.000	1.44	2.26	0.99	1.43	2.24	10.0	17.0	2.1	4.60	7.19	1.46	24	0.10	7.25	7.36	9.42	9.46	10.83	10.83	Area 12
13	12	293.000	0.82	0.82	0.99	0.81	0.81	10.0	10.0	2.7	2.16	7.12	0.70	24	0.10	7.36	7.65	9.47	9.49	10.83	11.08	Area 13
14	9	605.000	8.82	8.82	0.75	6.62	6.62	25.0	25.0	1.7	11.22	10.11	3.57	24	0.20	7.04	8.25	9.23	10.72	12.48	11.51	Swale 1
15	10	333.000	0.51	2.62	0.99	0.50	2.59	10.0	10.7	2.6	6.68	7.05	3.78	18	0.45	7.08	8.58	9.30	10.65	12.86	11.67	Area 15
16	15	136.000	2.11	2.11	0.99	2.09	2.09	10.0	10.0	2.7	5.56	7.03	3.15	18	0.45	8.58	9.19	10.87	11.25	11.67	11.94	Area 16
17	End	657.000	0.25	0.25	0.99	0.25	0.25	10.0	10.0	2.7	0.66	2.35	2.54	12	0.43	6.15	9.00	6.49	9.40	6.15	11.00	Area 17
18	End	43.000	0.00	1.53	0.00	0.00	1.51	0.0	12.4	2.4	3.63	5.02	4.48	15	0.60	7.25	7.51	8.02	8.31	7.25	11.53	
19	18	213.000	0.00	1.53	0.00	0.00	1.51	0.0	11.6	2.5	3.75	5.01	4.43	15	0.60	7.51	8.79	8.36	9.58	11.53	12.44	
20	19	27.000	0.00	1.53	0.00	0.00	1.51	0.0	11.5	2.5	3.77	4.97	4.12	15	0.59	8.79	8.95	9.71	9.78	12.44	12.59	
21	20	87.000	0.56	1.53	0.99	0.55	1.51	10.0	11.1	2.5	3.83	4.99	4.29	15	0.60	8.95	9.47	9.88	10.26	12.59	12.76	Area 21
22	21	266.000	0.97	0.97	0.99	0.96	0.96	10.0	10.0	2.7	2.56	2.76	3.91	12	0.60	9.47	11.07	10.31	11.79	12.76	13.05	Area 22
23	End	30.000	0.04	1.20	0.99	0.04	1.19	10.0	16.4	2.1	2.48	3.32	3.22	18	0.10	8.15	8.18	8.75	8.97	9.50	11.71	Area 23
24	23	27.000	0.11	1.16	0.99	0.11	1.15	10.0	16.2	2.1	2.41	4.04	2.33	18	0.15	8.18	8.22	9.03	9.07	11.71	11.71	Area 24
25	24	102.000	0.07	1.05	0.99	0.07	1.04	10.0	15.4	2.2	2.24	4.03	2.11	18	0.15	8.22	8.37	9.11	9.22	11.71	11.71	Area 25
26	25	66.000	0.00	0.98	0.00	0.00	0.97	0.0	14.9	2.2	2.12	2.51	2.30	15	0.15	8.37	8.47	9.25	9.35	11.71	11.71	

Project File: pipe networks 100 yrs.stm | Number of lines: 31 | Run Date: 3/4/2021

NOTES:Intensity = 8.39 / (Inlet time + 0.10) ^ 0.50; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
27	26	285.000	0.00	0.64	0.00	0.00	0.63	0.0	12.4	2.4	1.52	2.89	1.86	15	0.20	8.47	9.04	9.43	9.72	11.71	13.35	
28	27	139.000	0.00	0.39	0.00	0.00	0.39	0.0	10.9	2.6	0.99	2.90	1.53	15	0.20	9.04	9.32	9.80	9.90	13.35	11.90	
29	28	110.000	0.39	0.39	0.99	0.39	0.39	10.0	10.0	2.7	1.03	1.59	2.15	12	0.20	9.32	9.54	9.90	10.13	11.90	11.44	Area 29
30	27	8.000	0.25	0.25	0.99	0.25	0.25	10.0	10.0	2.7	0.66	1.12	3.36	6	4.00	9.04	9.36	9.80	9.86	13.35	11.68	Area 30
31	26	5.000	0.34	0.34	0.99	0.34	0.34	10.0	10.0	2.7	0.90	1.12	4.57	6	4.00	8.47	8.67	9.43	9.56	11.71	11.84	Area 31

Sample Total Flow Calculation:

Total A = 0.25 ac; C=0.99; MSP= 21.5
d100 = 0.45 in
i100 = (0.45in)(1/10min)(60min/1hr) = 2.7 in/hr

Q100 = (0.99)(2.7in/hr)(0.25 ac) = 0.66 cfs

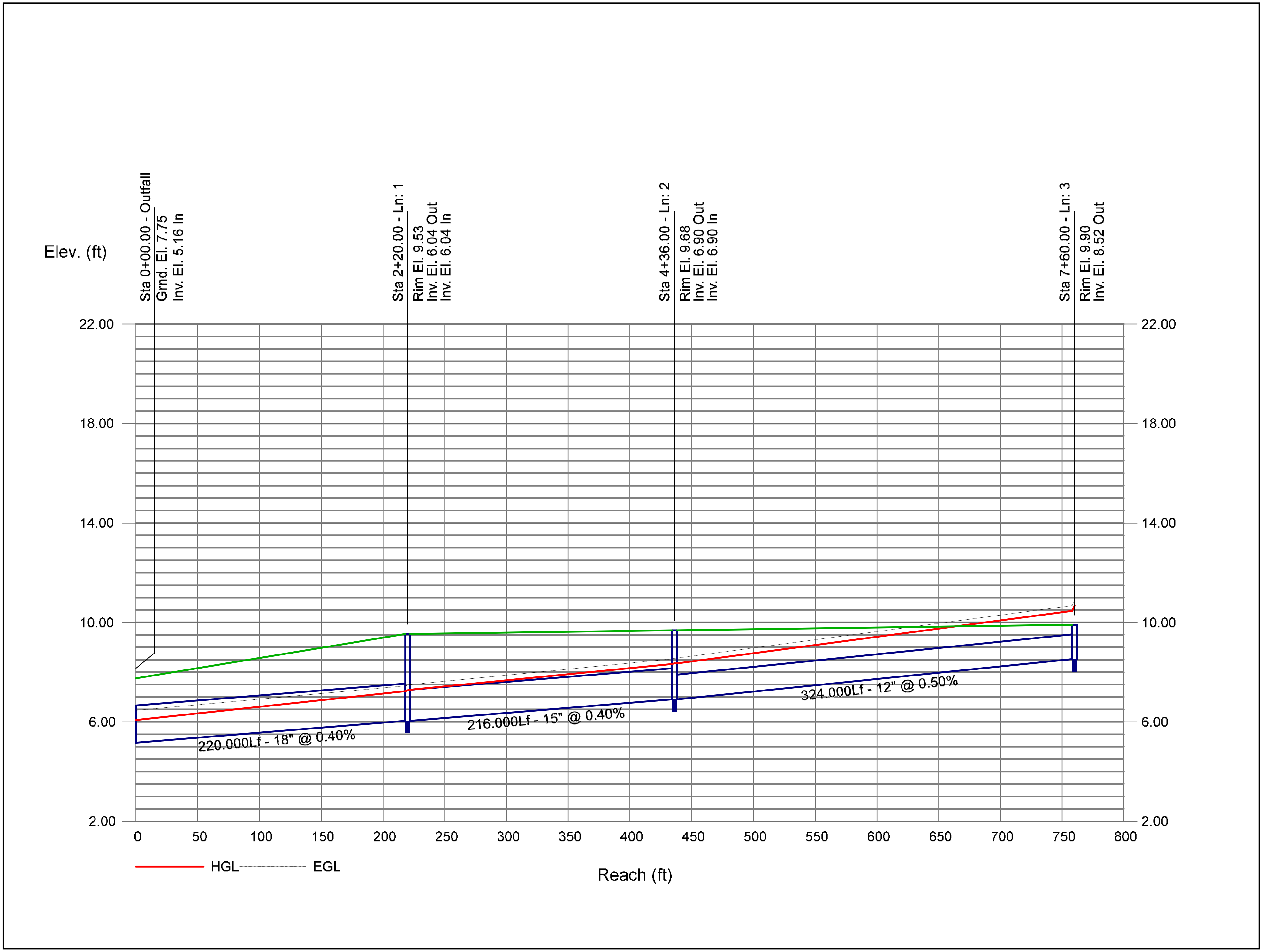
Project File: pipe networks 100 yrs.stm | Number of lines: 31 | Run Date: 3/4/2021

NOTES:Intensity = 8.39 / (Inlet time + 0.10) ^ 0.50; Return period =Yrs. 100 ; c = cir e = ellip b = box

100-Year Storm Event - Profiles

Storm Sewer Profile

Proj. file: pipe networks 100 yrs.stm



Storm Sewer Profile

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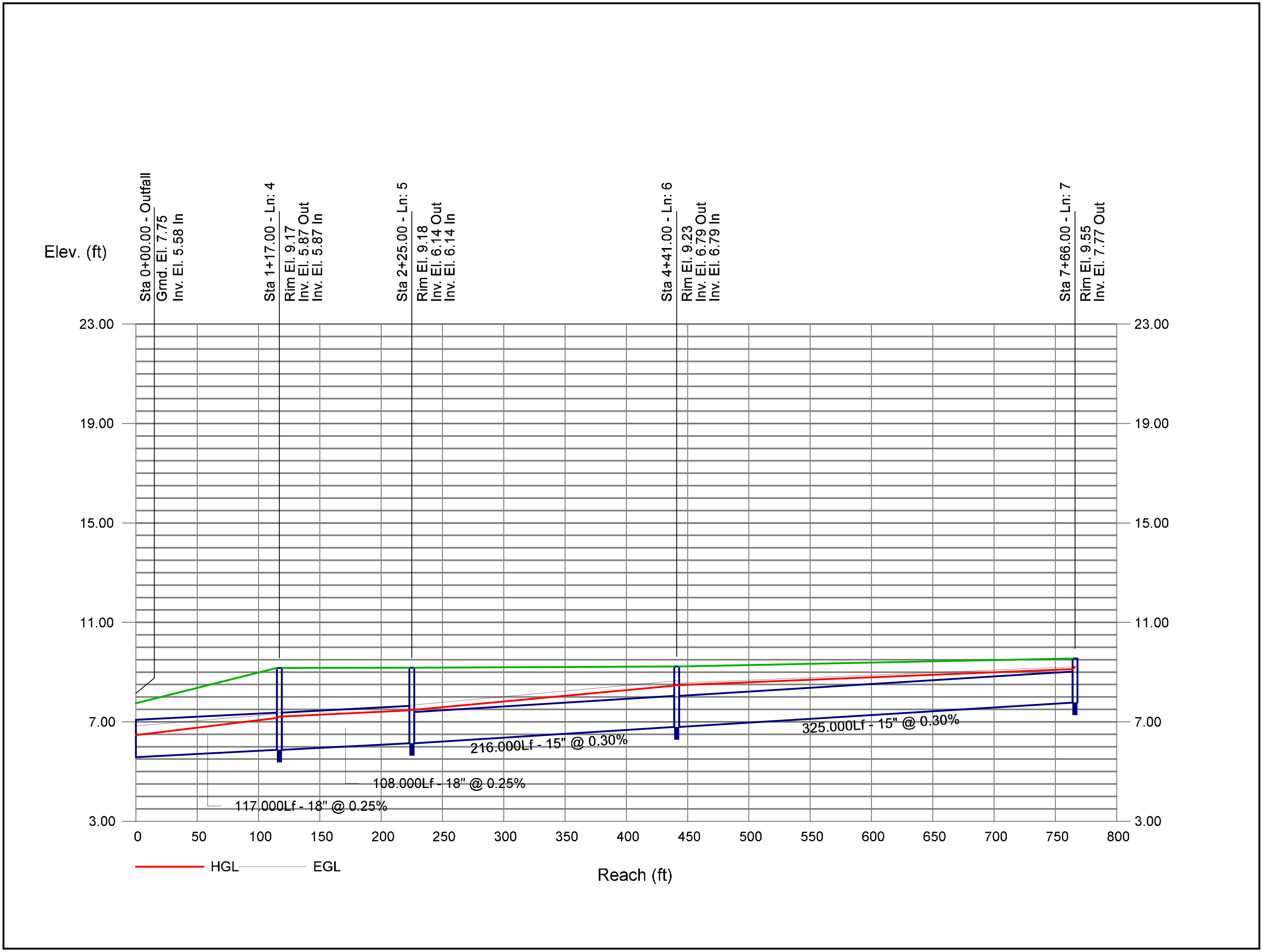

Storm Sewer Profile

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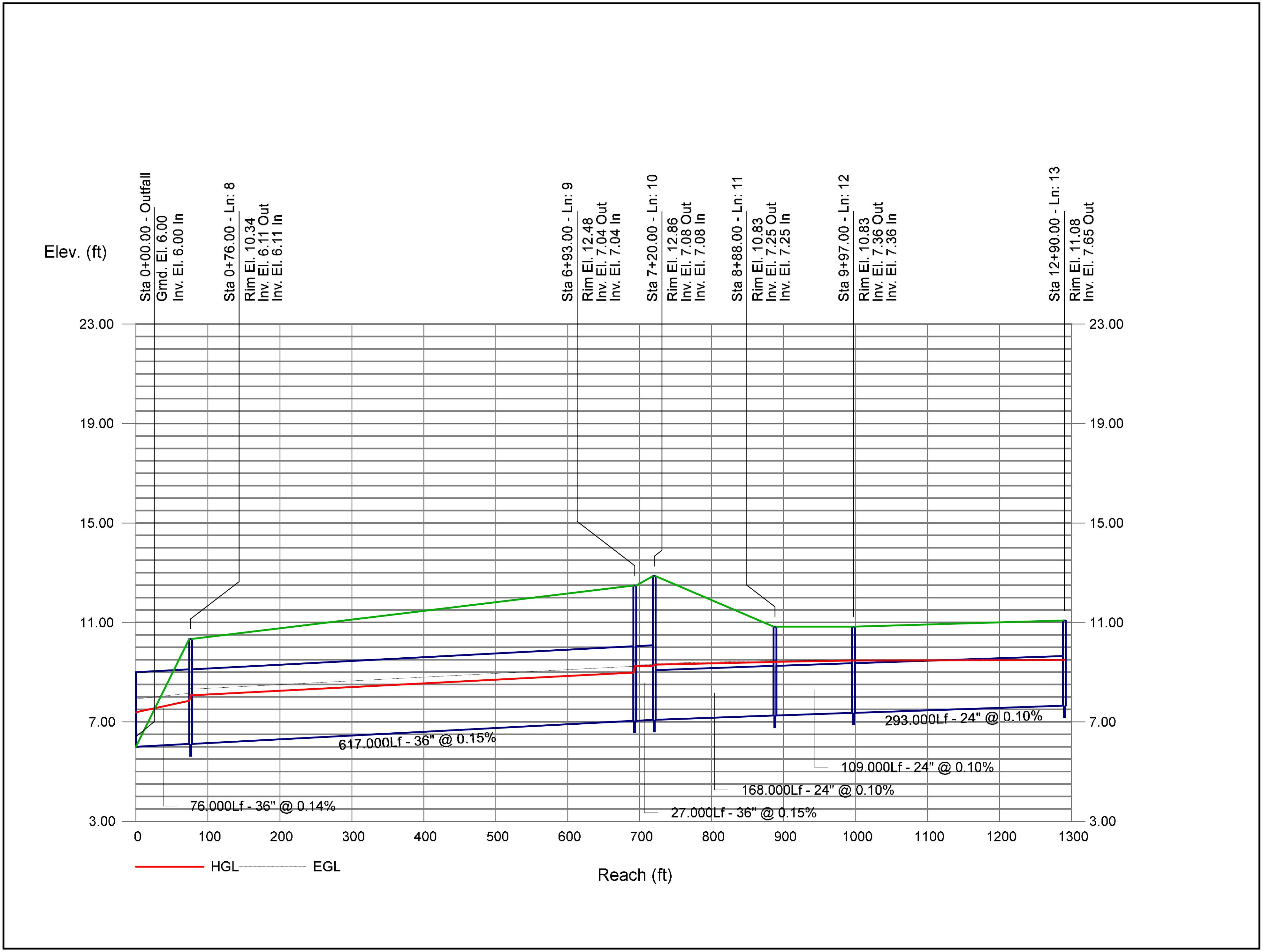

Storm Sewers

Storm Sewer Profile

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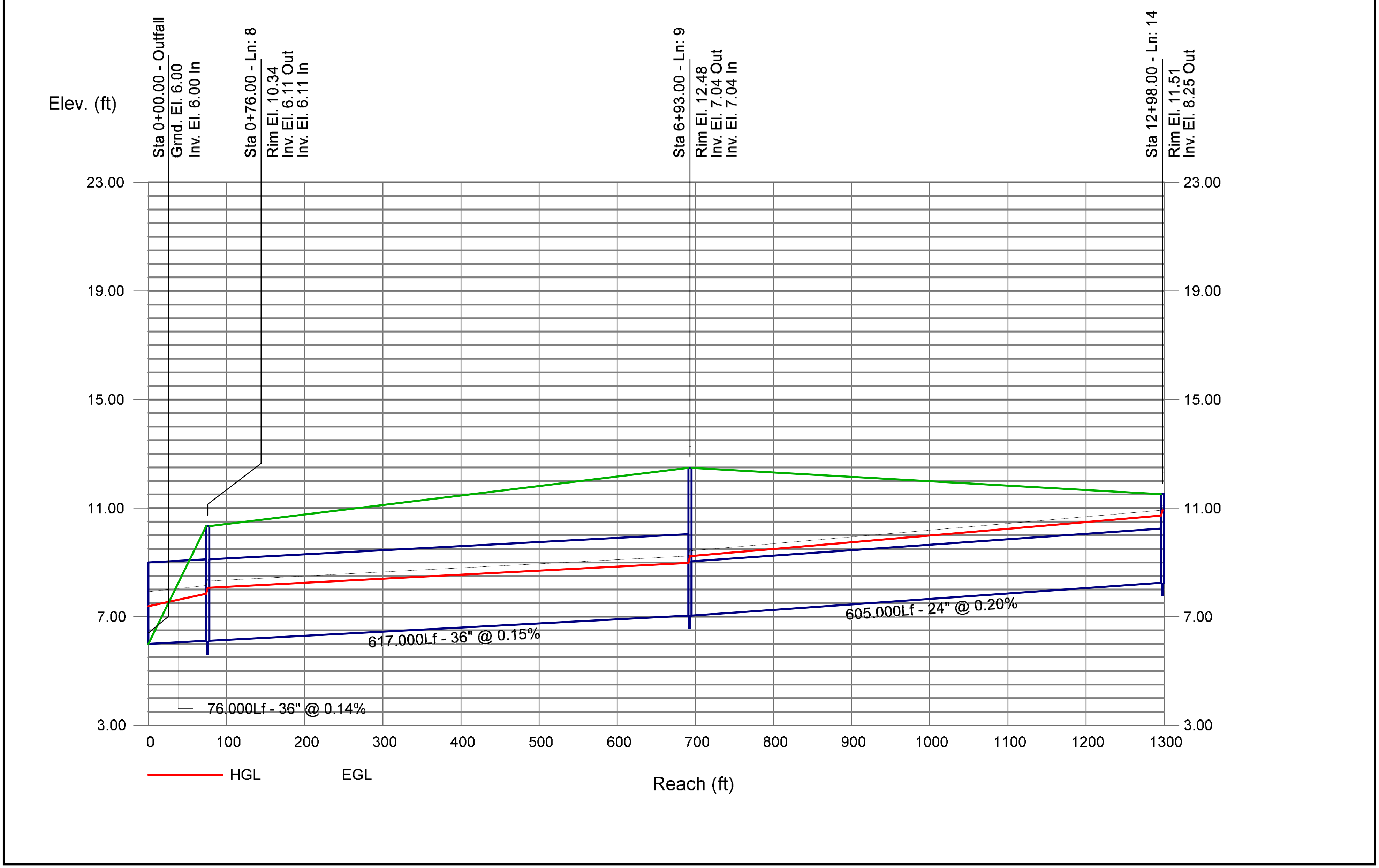

Storm Sewer Profile

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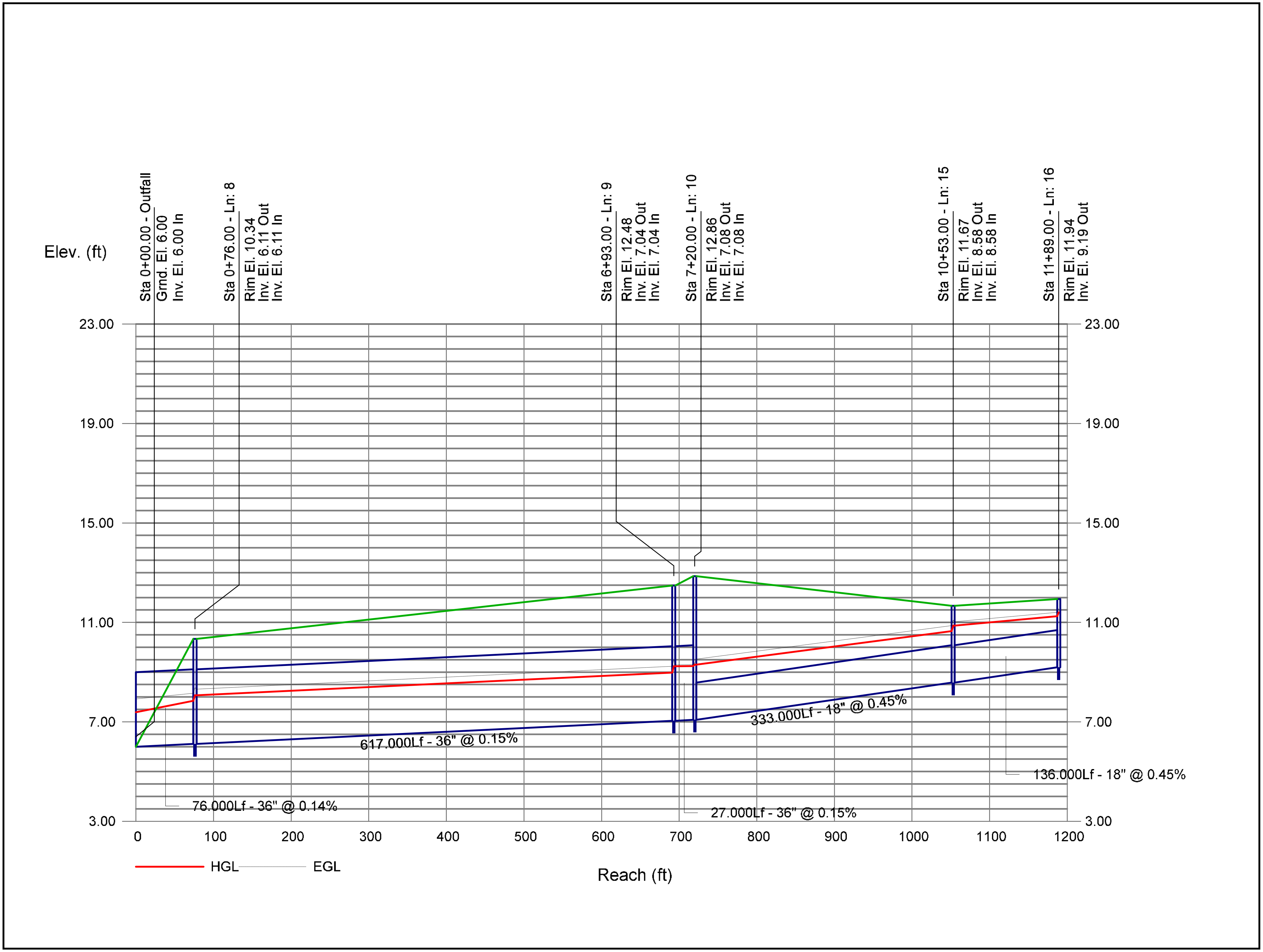

Storm Sewer Profile

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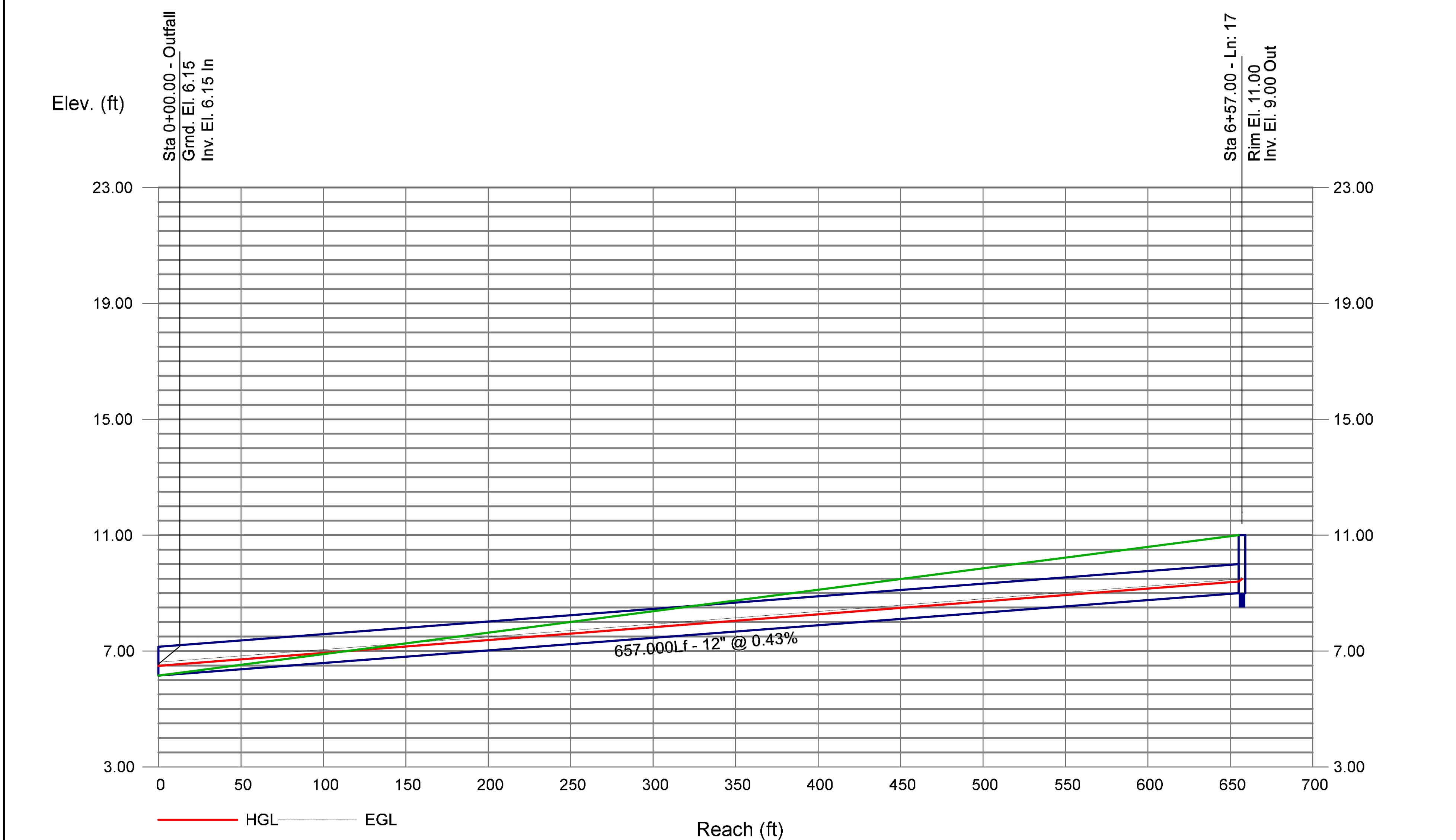
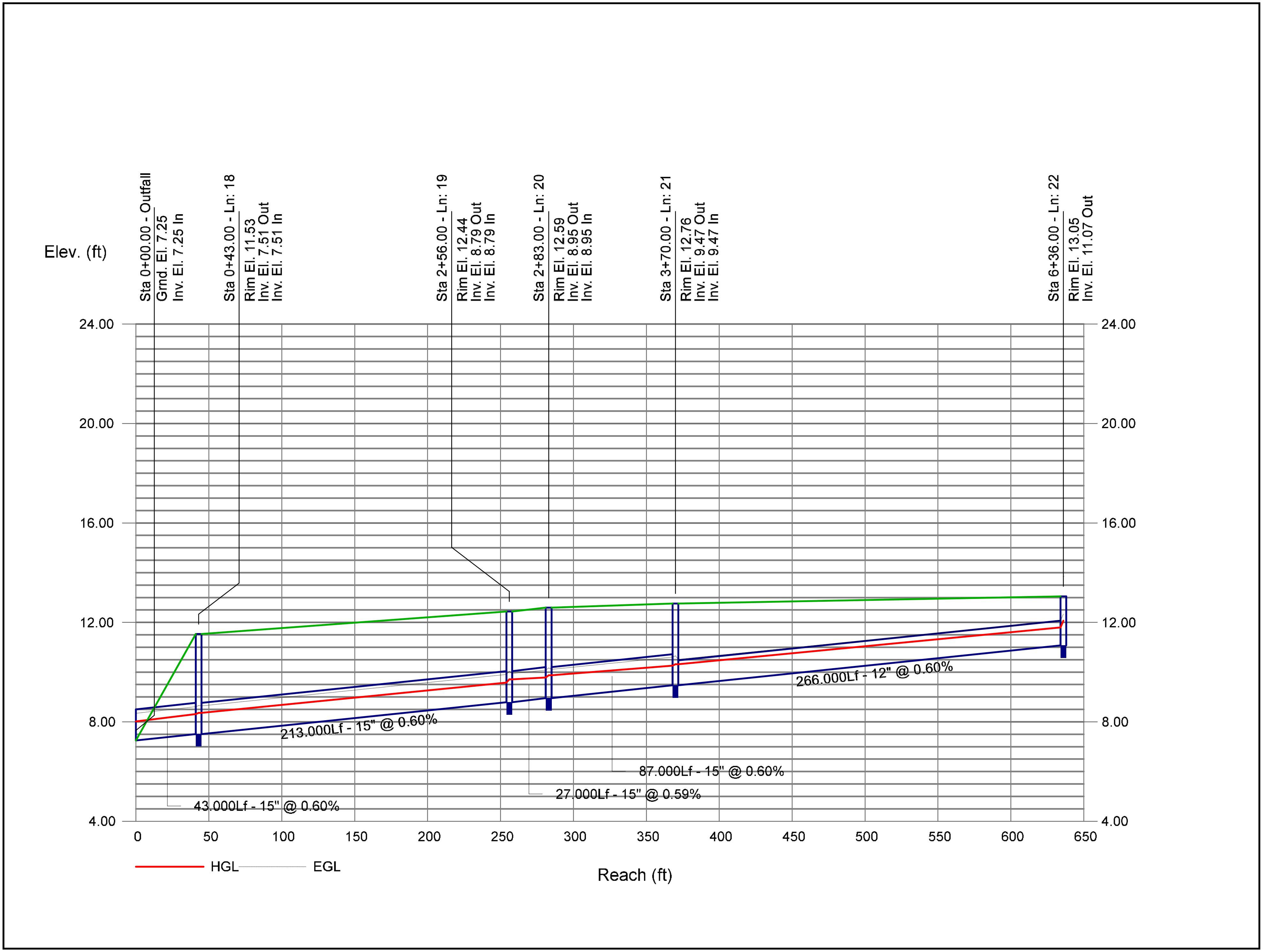


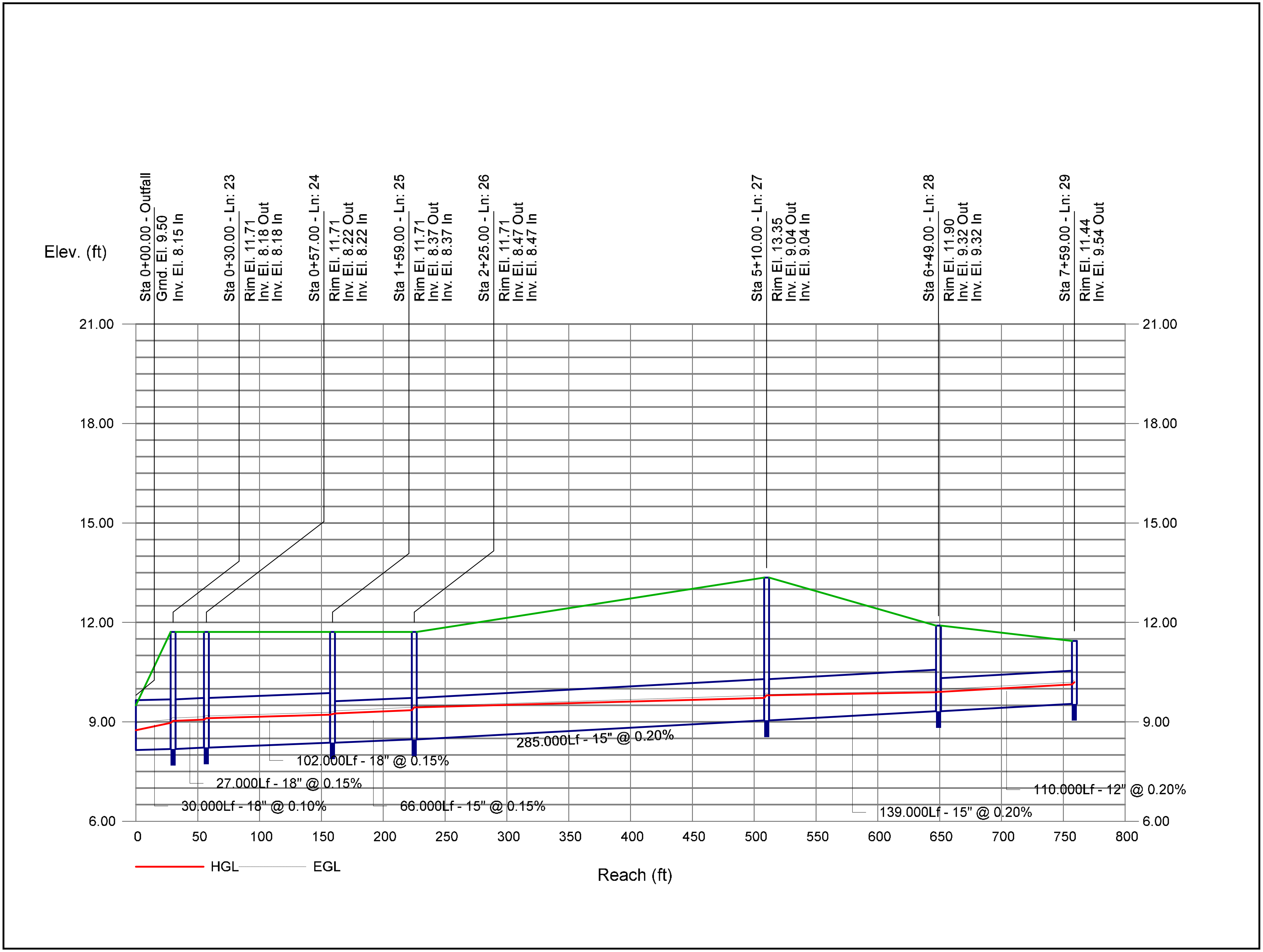
Storm Sewer Profile

Proj. file: pipe networks 100 yrs.stm



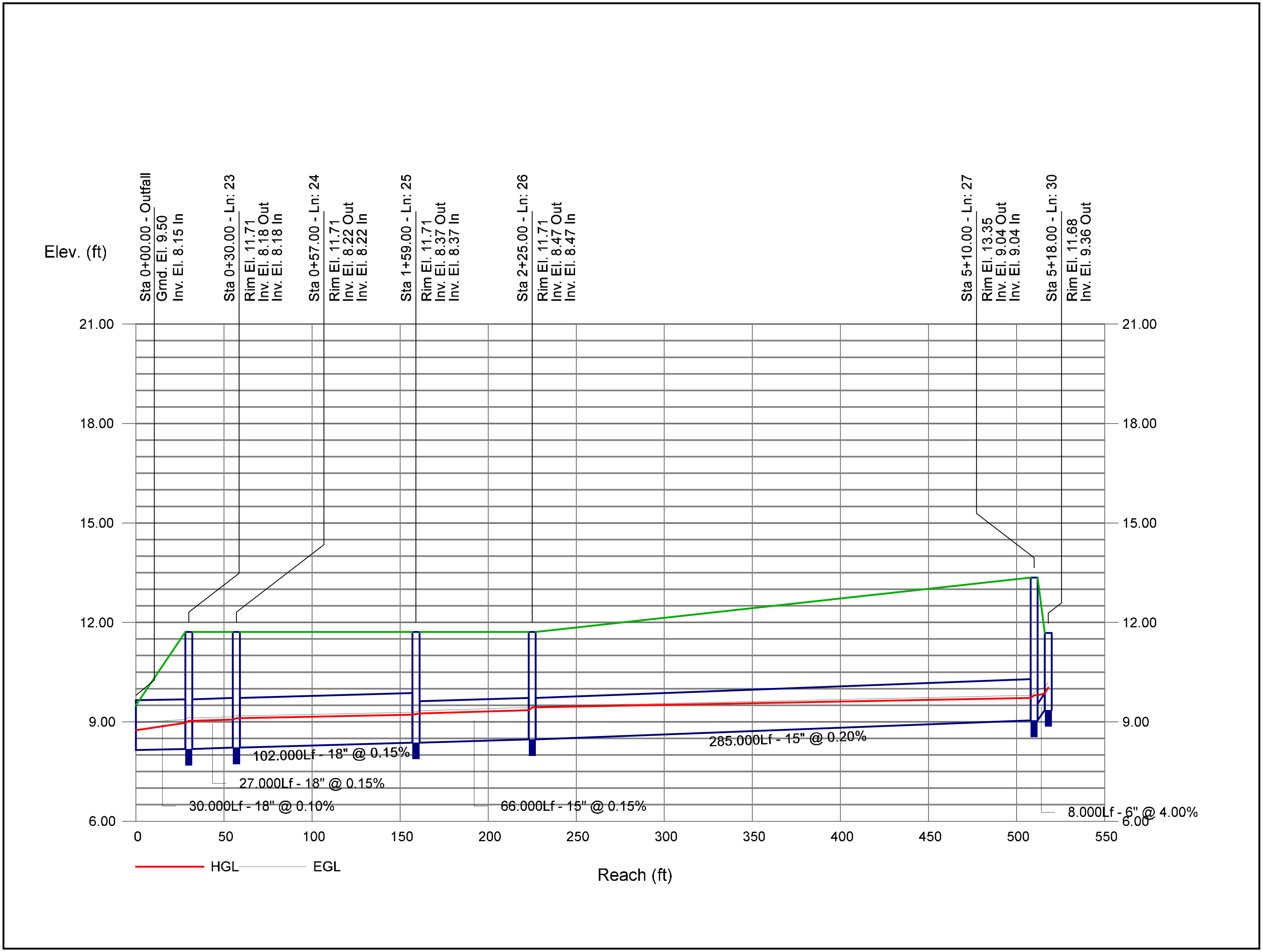
Storm Sewer Profile

Proj. file: pipe networks 100 yrs.stm



Storm Sewer Profile

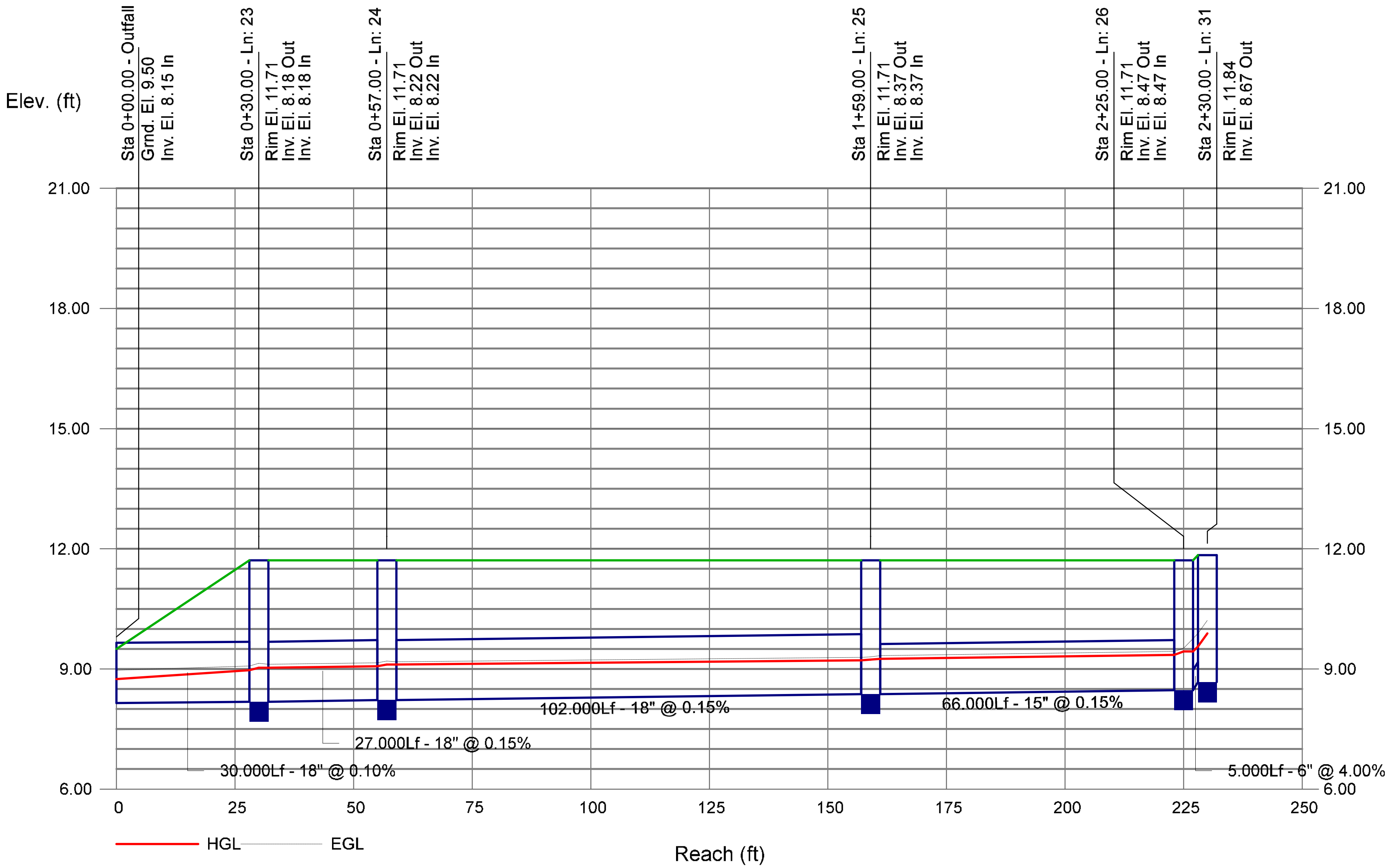
Proj. file: pipe networks 100 yrs.stm



Storm Sewers

Storm Sewer Profile

Proj. file: pipe networks 100 yrs.stm



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G.2 - Stormwater Control Plan

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STORMWATER CONTROL PLAN

for

PARR BLVD & RICHMOND PKWY (DP17-3045)

January 26, 2018

Revised: June 15, 2018

Revised: August 30, 2018

Revised: June 07, 2019

Revised: February 03, 2021

Revised: March 04, 2021

Scannell Properties
Todd Berryhill
8801 River Crossing Blvd. #300
Indianapolis, IN 46240

prepared by:

Julia Harberson
CSW/Stuber-Stroeh Engineering Group, Inc.
45 Leveroni Court
Novato, CA 94949

TABLE OF CONTENTS

Tables

Figures

Attachments

Appendix

This Stormwater Control Plan was prepared using the template dated February 2018.

I. PROJECT DATA

Table 1. Project Data

Project Name/Number	Parr Blvd & Richmond Parkway/DP17-3045
Application Submittal Date	January 26, 2018
Project Location	Parr Blvd and Richmond Parkway (APN 408-130-038-8, 408-130-039-6, 408-130-037-0, 408-090-044-4, 408-090-040-2)
Name of Developer	Scannell Properties
Project Phase No.	"NA"
Project Type and Description	Two (2) Industrial warehouses with offices
Project Watershed	San Pablo Bay
Total Project Site Area (acres)	Total 30.63 acres <[On-site 29.4 acres {8.65 acres (Lot 1), 20.75 acres (Lot 2)}], [Off-site 1.23 acres]>
Total Area of Land Disturbed (acres)	Total 30.63 acres {(On-site 29.4 acres), (Off-site 1.23 acres)}
Total New Impervious Surface Area (sq. ft.)	Total 905,694 sq. ft. {(On-site 877,517 sq. ft.), (Off-site 28,177 sq. ft.)}
Total Replaced Impervious Surface Area	Total 116,787 sq. ft. {(On-site 96,657 sq. ft.), (Off-site 20,130 sq. ft.)}
Total Pre-Project Impervious Surface Area	Total 155,517 sq. ft. {(On-site 134,814 sq. ft.), (Off-site 20,703 sq. ft.)}
Total Post-Project Impervious Surface Area	Total 1,022,481 sq. ft. {(On-site 974,174 sq. ft.), (Off-site 48,307 sq. ft.)}
50% Rule[*]	Applies
Project Density	FAR=0.32 (Lot 1); FAR=0.23 (Lot 2)
Applicable Special Project Categories [Complete even if all treatment is LID]	"NA"
Percent LID and non-LID treatment	100% LID
HM Compliance [†]	Applies

[*50% rule applies if:
Total Replaced Impervious Surface Area > 0.5 x Pre-Project Impervious Surface Area]

[†HM required (unless project meets one of the exemptions on *Guidebook* p. 9) if:
(Total New Impervious Surface Area + Total Replaced Impervious Surface Area) ≥ 1 acre]

II. SETTING

II.A. Project Location and Description

The Parr Boulevard project site is located in Contra Costa County, in Unincorporated Richmond. The site is bounded to the west and north by Richmond Boulevard, to the south by Parr Boulevard and to the east by existing commercial/industrial development. Access to the site is from Parr Boulevard.

The project proposes to split the site into two (2) lots. On each lot construction of a building (warehouse and offices), a parking lot, truck docks and access, stormwater treatment facilities, and wetland mitigation is proposed.

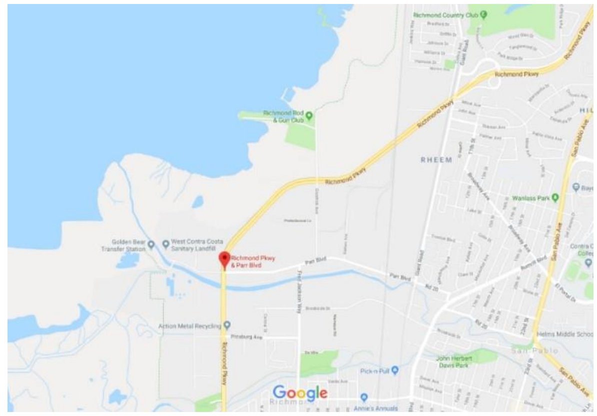


Figure 1. Location of Parr Boulevard Project, Richmond, CA

The off-site improvements proposed in the project include the construction of sidewalk, curb and gutter, and stormwater treatment facilities, and widening of Parr Boulevard.

II.B. Existing Site Features and Conditions

The existing site consists of six (6) parcels totaling 29.86 acres of area. The existing site consists of undeveloped grassy areas and industrial structures with concrete pads used for storage. The project site soil is identified as hydrologic soil group "C". There are two locations where culverts drain the site. The culverts consist of two (2) 36-inch culverts and one (1) 36-inch culvert that run beneath Richmond Parkway and discharge to the bay. The culverts are located at two locations along the west property line.

Figure 2. Existing Site Conditions

II.C. Opportunities and Constraints for Stormwater Control

The existing site is predominantly between elevations 9.0 and 10.0. The existing culvert below Richmond Parkway is at elevation 6.0. As a result there is little hydraulic head to discharge the proposed storm drain system and bioretention areas to.

III. LOW IMPACT DEVELOPMENT DESIGN STRATEGIES

III.A. Optimization of Site Layout

III.A.1. Limitation of development envelope

The development envelope has been limited to protect the integrity of the existing drainage swale between the property line and Richmond Parkway.

III.A.2. Preservation of natural drainage features

The proposed project is bounded by an existing drainage swale between the property line and Richmond Parkway. The existing swale will be preserved and the proposed development will discharge into the swale mirroring the existing condition drainage pattern.

III.A.3. Setbacks from creeks, wetlands, and riparian habitats

There are no creeks, wetlands or riparian habitats within the project site.

III.A.4. Minimization of imperviousness

The project proposes the minimum amount of passenger vehicle parking for the proposed manufacturing use to minimize the size and imperiousness of the parking lot.

III.A.5. Use of drainage as a design element

Bioretention areas surround the perimeter of the proposed project and are utilized for drainage conveyance, stormwater treatment and planter buffering.

III.B. Use of Permeable Pavements

10% of the proposed parking lot consists of permeable concrete.

III.C. Dispersal of Runoff to Pervious Areas

Landscape areas dispersed throughout the site are too small for dispersal of runoff. The larger landscape area is being considered as pavement as it may be paved for parking in the future. Runoff from the site discharges to bioretention areas via overland flow or pipe discharge.

III.D. Bioretention or other Integrated Management Practices

Six (6) bioretention areas are proposed throughout the site to address stormwater treatment.

The bioretention areas are designed in accordance with the Contra Costa County C.3 Guidebook, 7th Edition. Bioretention areas were located, such that, when possible, in level areas and flow in and out of the facilities is via gravity flow. Tributaries of the bioretention areas largely consist of impervious roofs and pavement. Overflow inlets are placed between 8” and 12” above adjacent grade and discharge into wetland mitigation areas and existing drainage swales. Emergency overflow weirs are provided at bioretention areas adjacent to wetland mitigation areas to protect the separating berm. Bioretention areas are all located adjacent to paved and future paved areas for easy accessibility.

IV. DOCUMENTATION OF DRAINAGE DESIGN

IV.A. Descriptions of each Drainage Management Area

IV.A.1. Table of Drainage Management Areas

Table 2. Drainage Management Areas

DMA Name	*Area (SF)*	*Surface Type/Description*	*DMA Type/Drains to*
BLDG 1	*205,900*	*Conventional Roof*	*Bio 1*
PVMT 1	*314,322*	*Concrete or Asphalt*	*Bio 1*
PVMT 2	*91,580*	*Concrete or Asphalt*	*Bio 2*
PERM 2	*7,378*	*Pervious Concrete*	*Bio 2*
LA 2	*34,364*	*Landscape*	*Bio 2*
PVMT 3	*64,874*	*Concrete or Asphalt*	*Bio 3*
PERM 3	*29,836*	*Pervious Concrete*	*Bio 3*
LA 3	*23,754*	*Landscape*	*Bio 3*
PERM 4	*7,508*	*Pervious Concrete*	*Bio 4*
LA 4	*3,778*	*Landscape*	*Bio 4*
BLDG 5	*121,307*	*Conventional Roof*	*Bio 5*
PVMT 5	*125,566*	*Concrete or Asphalt*	*Bio 5*
PERM 5	*5,511*	*Pervious Concrete*	*Bio 5*
LA 5	*4,905*	*Landscape*	*Bio 5*
PVMT 6	*49,069*	*Concrete or Asphalt*	*Bio 6*
DMA 7	*130,460*	*Landscape/Wetland Mitigation*	*Self - Treating*

IV.A.2. Drainage Management Area Descriptions

BLDG 1 and PVMT 1, totaling 502,222 square feet, drains Building 2 via storm drain and associated pavement and future pavement via overland flow. BLDG 1 and PVMT 1 drain to Bioretention Area 1 which discharges to wetland mitigation via storm drain with a bubble-up (note all bubble-ups have backflow prevention device).

PVMT 2, PERM 2 and LA 2, totaling 133,222 square feet, drains permeable pavement and asphalt pavement parking area south of Building 2 via overland flow and associated landscape via overland flow. PVMT 2, PERM 2 and LA 2 drain to Bioretention Area 2 which discharges to existing drainage channel adjacent to Richmond Parkway via storm drain.

PVMT 3, PERM 3 and LA 3, totaling 118,464 square feet, drains permeable pavement, asphalt pavement, and future pavement parking area south of Building 2 via overland flow and associated landscape via overland flow. PVMT 3, PERM 3 and LA 3 drain to Bioretention Area 3 which discharges to wetland mitigation via storm drain with a bubble-up.

PERM 4 and LA 4, totaling 11,286 square feet, drains permeable pavement and asphalt pavement parking area east of Building 1 via overland flow and associated landscape via overland flow. PERM 4 and LA 4 drain to Bioretention Area 4 which discharges to wetland mitigation via storm drain with a bubble-up.

BLDG 5, PVMT 5, PERM 5 and LA 5, totaling 257,289 square feet, drains Building 1 via roof leaders and associated pavement, permeable pavement and landscape via overland flow. BLDG 5, PVMT 5, PERM 5 and LA 5 drains to Bioretention Area 5 which discharges to wetland mitigation with a bubble-up.

PVMT 6, totaling 49,069 square feet, drains adjacent pavement from Parr Boulevard via overland flow and proposed sidewalk via overland flow. PVMT 6 drain to Bioretention Area 6 which discharges to existing drainage channel adjacent to Richmond Parkway via storm drain.

DMA 7, totaling 130,460 square feet, drains wetland mitigation areas and is a self-treating area.

IV.B. Integrated Management Practice Descriptions

Runoff from impervious areas on the site, including roofs and paved areas, will be routed to six bioretention facilities (see Attachment A).

Each of the facilities will be designed and constructed to the criteria in the *Stormwater C.3 Guidebook, 7th Edition*, including the following features:

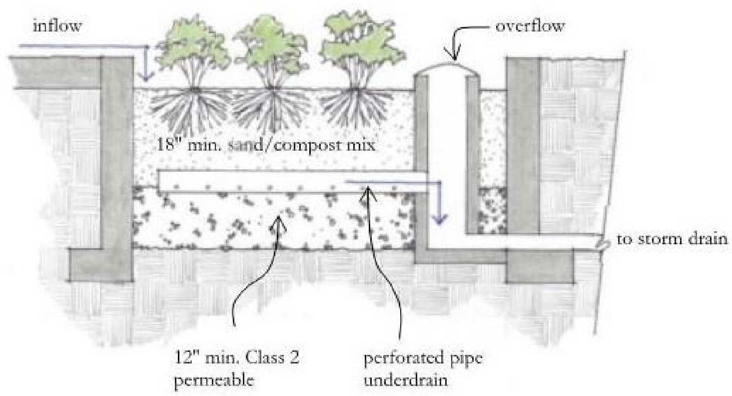


Figure 1. Bioretention Facility Illustrative Cross-section

- Surrounded by a concrete curb. Where adjacent to pavement, curbs will be thickened and an impermeable vertical cutoff wall will be included.
- Each layer built flat, level, and to the elevations specified in the plans:
  - Bottom of Gravel Layer (BGL)
  - Top of Gravel Layer (TGL)
  - Top of Soil Layer (TSL)
  - Overflow Grate
  - Facility Rim
- Minimum 12 inches Class 2 permeable, Caltrans specification 68-2.02F(3).
- Minimum 18 inches sand/compost mix meeting the specifications approved by the Regional Water Quality Control Board in April 2016.

- 4 in. dia. PVC SDR 35 perforated pipe underdrain, installed with the invert at the top of the Class 2 permeable layer with holes facing down, and connected to the overflow structure at that same elevation
- 6-inch-deep reservoir between top of soil elevation and overflow grate elevation inflow overflow 12" min. Class 2 permeable sand/compost mix perforated pipe underdrain 18" min. to storm drain
- Concrete drop inlet with frame overflow structure, with grate set to specified elevation, connected to storm drain in Main Street
- Vertical cutoff walls to protect adjacent pavement
- Plantings selected for suitability to climate and location, bioretention soil media (well-drained, low-fertility), and for water conservation
- Irrigation system on a separate zone, with drip emitters and "smart" irrigation controllers.

Bioretention Facility #1 will be located near the northeast corner of the site adjacent to the parking area north of Building 2, and adjacent to the existing wetland swale and proposed wetland mitigation area in the northeast corner of the site. This facility discharges to wetland mitigation area via storm drain with a bubble-up, and it will have an emergency overflow weir protect the berm separating the facility from the adjacent wetland mitigation area.

Bioretention Facility #2 is separated into three (3) sections connected via storm drain. Section 1 is located near the southeast corner of Building 2 adjacent to the drive aisle surrounding Building 2, the eastern property line and the parking area south of Building 2. Section 2 is located near the southwest corner of Building 2 adjacent to the walkway connecting the parking lot south of Building 2 to Building 2 and the parking area south of Building 2. Section 3 is located near the southwest corner of Building 2 adjacent to the walkway connecting the parking lot south of Building 2 to Building 2 and the main drive aisle to Building 2. This facility discharges to existing drainage channel adjacent to Richmond Parkway via storm drains.

Bioretention Facility #3 is separated into two (2) sections connected via storm drain. Section 1 is located adjacent to the proposed southern property line and the separated parking lot south of Building 2. Section 2 is located adjacent to the proposed lot line separating lot 1 and lot 2 and the drive aisle entrance to lot 2. This facility discharges to the existing drainage channel adjacent to Richmond Parkway at the corner of Richmond parkway and Parr Boulevard via storm drains.

Bioretention Facility #4 is located adjacent to the proposed southern property line and the parking lot area to the southeast of Building 1. This facility discharges to the existing drainage channel adjacent to Richmond Parkway at the corner of Richmond parkway and Parr Boulevard via storm drains.

Bioretention Facility #5 is located adjacent to drive aisle north of Building 1, and the existing drainage channel to remain. This facility discharges to the adjacent existing drainage channel via storm drains.

Bioretention Facility #6 is separated into three (3) sections connected via storm drain. Section 1 located off-site adjacent to the proposed sidewalk and landscape area south of Building 1. Section 2 is located off-site adjacent to Bioretention Facility #3 and #4 along the southern property line. Section 3 is located off-site adjacent to Bioretention Facility #3 along the southern property line. This facility discharges to the existing drainage channel adjacent to Richmond Parkway via storm drains.

IV.C. Tabulation and Sizing Calculations

See Attachment B, "Output from the IMP Sizing Calculator"

V. SOURCE CONTROL MEASURES

V.A. Site activities and potential sources of pollutants

The proposed uses for the site assume use of semi-trucks for deliveries. These vehicles will produce hydrocarbons and petroleum based pollutants.

V.B. Source Control Table

Table 3. Source Controls

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*
On-site storm drain inlets	Mark all inlets with the words "No Dumping! Flows to Bay"	Maintain and periodically repaint or replace inlet markings.
Landscape/ Outdoor Pesticide Use	Use pest-resistant plants, especially adjacent to hardscape.	Maintain landscaping using minimum or no pesticides.
Loading Docks		Move loaded and unloaded items indoors as soon as possible.
Fire Sprinkler Test Water	Provide a means to drain fire sprinkler test water to the sanitary sewer.	
Sidewalks, and parking lots		Sweep sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

VI. STORMWATER FACILITY MAINTENANCE

VI.A. Ownership and Responsibility for Maintenance in Perpetuity

The owner is committed to execute any necessary agreements and/or annex into a fee mechanism, per local requirements.

The owner accepts responsibility for operation and maintenance of facilities until that responsibility is formally transferred.

VI.B. Summary of Maintenance Requirements for Each Stormwater Facility

The three bioretention facilities will be maintained on the following schedule at a minimum. Details of maintenance responsibilities and procedures will be included in a Stormwater Facility Operation and Maintenance Plan to be submitted for approval as required in the conditions of approval.

At no time will synthetic pesticides or fertilizers be applied, nor will any soil amendments, other than aged compost mulch or sand/compost mix, be introduced.

Daily: The facilities will be examined for visible trash during regular policing of the site, and trash will be removed.

After Significant Rain Events: A significant rain event is one that produces approximately a half-inch or more rainfall in a 24-hour period. Within 24 hours after each such event, the following will be conducted:

The surface of the facility will be observed to confirm there is no ponding.

- Inlets will be inspected, and any accumulations of trash or debris will be removed.
- The surface of the mulch layer will be inspected for movement of material. Mulch will be replaced and raked smooth if needed.

Prior to the Start of the Rainy Season: In September or each year, the facility will be inspected to confirm there is no accumulation of debris that would block flow, and that growth and spread of plantings does not block inlets or the movement of runoff across the surface of the facility.

Annual Landscape Maintenance: In December – February of each year, vegetation will be cut back as needed, debris removed, and plants and mulch replaced as needed. The concrete work will be inspected for damage. The elevation of the top of soil and mulch layer will be confirmed to be consistent with the 6-inch reservoir depth.

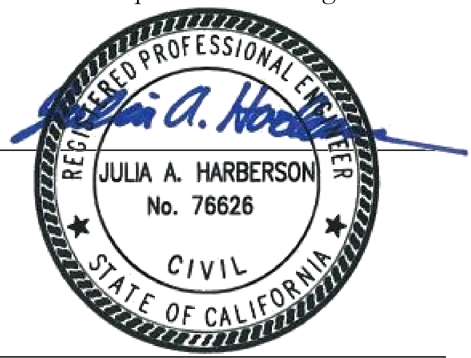
VII. CONSTRUCTION PLAN C.3 CHECKLIST

Table 4. Construction Plan C.3 Checklist

Stormwater Control Plan Page #	*BMP Description*	*See Plan Sheet #s*
C5.1	BLDG 1 and PVMT 1 drains to Bioretention Area 1 (Bio 1); facility designed as specified	
C5.1	PVMT 1, PERM 1, and LA 2 drains to Bioretention Area 2 (Bio 2); facility designed as specified	
C5.1	PVMT 3, PERM 3, and LA 3 drains to Bioretention Area 3 (Bio 3); facility designed as specified	
C5.1	PERM 4, and LA 4 drains to Bioretention Area 4 (Bio 4); facility designed as specified	
C5.1	BLDG 5, PVMT 5, and LA 5 drains to Bioretention Area 5 (Bio 5); facility designed as specified	
C5.1	PVMT 6, PERM 6, and LA 6 drains to Bioretention Area 6 (Bio 6); facility designed as specified	
C5.1	DMA 7 is Self-Treating	

VIII. CERTIFICATIONS

The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R2-2015-0049.



By

Julia Harberson

EXISTING CONDITION AREA TABULATION

TOTAL SITE AREA (SF)	TOTAL SITE AREA (AC)	EXISTING IMPERVIOUS SURFACE (SF)	EXISTING IMPERVIOUS SURFACE (AC)	EXISTING PERVIOUS SURFACE (SF)	EXISTING PERVIOUS SURFACE (AC)
1,300,745	29.86	134,814	3.09	1,165,931	26.77

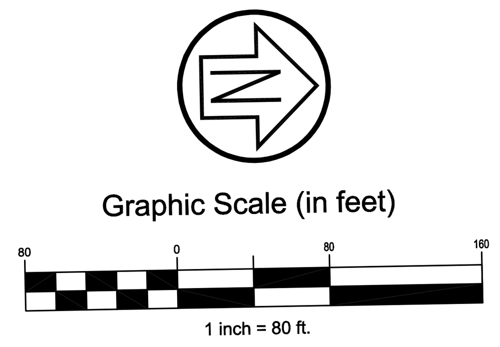
PROPOSED CONDITION AREA TABULATION

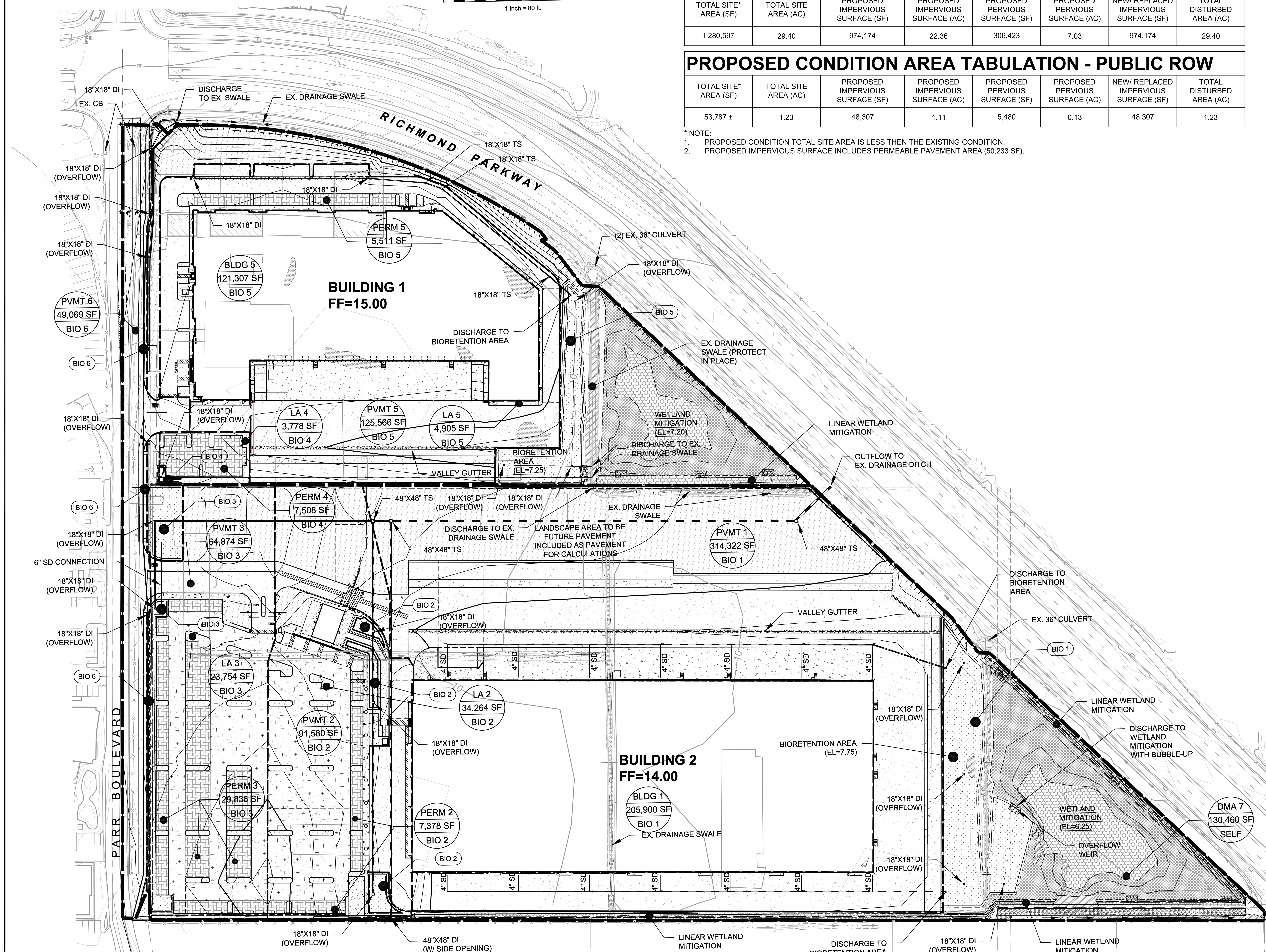
TOTAL SITE* AREA (SF)	TOTAL SITE AREA (AC)	PROPOSED IMPERVIOUS SURFACE (SF)	PROPOSED IMPERVIOUS SURFACE (AC)	PROPOSED PERVIOUS SURFACE (SF)	PROPOSED PERVIOUS SURFACE (AC)	NEW/ REPLACED IMPERVIOUS SURFACE (SF)	TOTAL DISTURBED AREA (AC)
1,280,597	29.40	974,174	22.36	306,423	7.03	974,174	29.40

PROPOSED CONDITION AREA TABULATION - PUBLIC ROW

TOTAL SITE* AREA (SF)	TOTAL SITE AREA (AC)	PROPOSED IMPERVIOUS SURFACE (SF)	PROPOSED IMPERVIOUS SURFACE (AC)	PROPOSED PERVIOUS SURFACE (SF)	PROPOSED PERVIOUS SURFACE (AC)	NEW/ REPLACED IMPERVIOUS SURFACE (SF)	TOTAL DISTURBED AREA (AC)
53,787 ±	1.23	48,307	1.11	5,480	0.13	48,307	1.23

* NOTE:
1. PROPOSED CONDITION TOTAL SITE AREA IS LESS THEN THE EXISTING CONDITION.
2. PROPOSED IMPERVIOUS SURFACE INCLUDES PERMEABLE PAVEMENT AREA (50,233 SF).





LINETYPES

EXISTING		PROPOSED
	CONTOUR - MAJOR	
	CONTOUR - MINOR	
	FENCE	
	PROPERTY / LOT LINE	
	STORM DRAIN (PERFORATED SUBDRAIN)	

SYMBOLS

EXISTING		PROPOSED
	STORM DRAINAGE - CURB INLET	
	STORM DRAINAGE - DROP INLET	
SD	STORM DRAINAGE - MANHOLE	SD
	ASPHALT CONCRETE	
	ASPHALT CONCRETE-TYPE II	
	CONCRETE	
	LANDSCAPE AREA	
	PERMEABLE CONCRETE	
	WETLAND MITIGATION	

LEGEND

DMA X	DRAINAGE MANAGMENT AREA (DMA) I.D.
XXX	DMA AREA IN SQUARE FEET
BIO X	INTEGRATED MANAGEMENT PRACTICE (IMP) TREATING DMA
	PROJECT BOUNDARY
	DMA BOUNDARY
	BIORETENTION AREA (IMP), SEE DETAIL 1, SHEET C7.2

NOTE:
1. SEE SHEET C7.2-STORMWATER CONTROL DETAILS FOR IMP SIZING CALCULATIONS.
2. INSTALL TRASH CAPTURE DEVICE ADS FLEXSTORM CONNECTOR PIPE SCREEN OR APPROVED EQUIVALENT

CSW | ST2
CSW/Stuber-Stroeh Engineering Group, Inc.
45 Leveroni Court, Novato, CA 94949
tel: 415.883.9850 fax: 415.883.9835
Civil & Structural Engineers
Surveying & Mapping
Environmental Planning
Land Planning
Construction Management
http://www.cswst2.com

Rev	Date	Description	Designed	Drawn	Checked
-	03/04/21	100% CONSTRUCTION DOCUMENTS	JAH	MTM	JAH
-	05/13/20	100% CONSTRUCTION DOCUMENTS	JAH	MTM	JAH
-	03/10/20	75% CONSTRUCTION DOCUMENTS	JAH	FAV	JAH
-	01/31/20	50% CONSTRUCTION DOCUMENTS	JAH	MTM	JAH

PARR BLVD. RICHMOND PKWY.
STORMWATER CONTROL PLAN
SCANNELL PROPERTIES

City Of

County Of Contra Costa

State Of California

Prepared Under the Direction of:

REGISTERED PROFESSIONAL ENGINEER JULIA A. HARBERSON No. 76626 CIVIL STATE OF CALIFORNIA

Sheet
C7.0

Scale: 1" = 80'
Date: 03/04/2021
Project Number: 5.1431.03
Plan File: D-XXXX-XX

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SELF TREATING AREA	
DMA 7	130,460 SF

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
BLDG 1	205,900	CONVENTIONAL ROOF	1.0	205,900
PVMT 1	314,322	CONCRETE OR ASPHALT	1.0	314,322
			TOTAL >	520,222

SOIL TYPE	IMP NAME			
C	BIO 1			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	29,725	33,593	IMP AREA
0.050	0.952	24,771	26,112	V1
0.066	0.952	32,686	35,672	V2
			ORIFICE SIZE:	5.78"

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
PVMT 2	91,580	CONCRETE OR ASPHALT	1.0	91,580
PERM 2	7,378	PERVIOUS CONCRETE	0.1	738
LA 2	34,364	LANDSCAPE	0.5	17,182
			TOTAL >	109,500

SOIL TYPE	IMP NAME			
C	BIO 2			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	6,257	6,797	IMP AREA
0.050	0.952	5,214	5,956	V1
0.066	0.952	6,883	7,245	V2
			ORIFICE SIZE:	2.93"

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
PVMT 3	64,874	CONCRETE OR ASPHALT	1.0	64,874
PERM 3	29,836	PERVIOUS CONCRETE	0.1	2,984
LA 3	23,754	LANDSCAPE	0.5	11,877
			TOTAL >	79,735

SOIL TYPE	IMP NAME			
C	BIO 3			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	4,556	10,510	IMP AREA
0.050	0.952	3,797	5,197	V1
0.066	0.952	5,012	5,803	V2
			ORIFICE SIZE:	2.76"

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
PERM 4	7,508	PERVIOUS CONCRETE	0.1	751
LA 4	3,778	LANDSCAPE	0.5	1,889
			TOTAL >	2,640

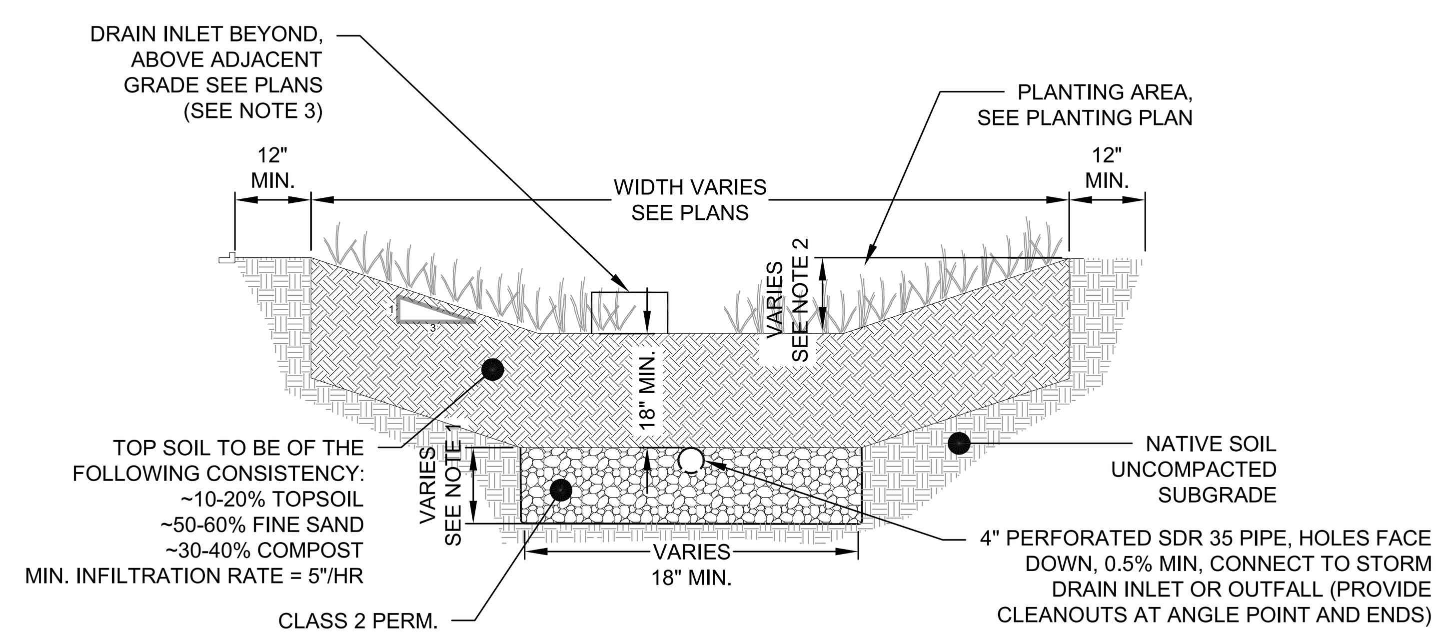
SOIL TYPE	IMP NAME			
C	BIO 4			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	151	562	IMP AREA
0.050	0.952	126	143	V1
0.066	0.952	166	180	V2
			ORIFICE SIZE:	0.85"

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
BLDG 5	121,307	CONVENTIONAL ROOF	1.0	121,307
PVMT 5	125,566	CONCRETE OR ASPHALT	1.0	125,566
PERM 5	5,511	PERVIOUS CONCRETE	0.1	551
LA 5	4,905	LANDSCAPE	0.5	2,453
			TOTAL >	249,877

SOIL TYPE	IMP NAME			
C	BIO 5			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	14,278	16,711	IMP AREA
0.050	0.952	11,898	13,225	V1
0.066	0.952	15,706	16,723	V2
			ORIFICE SIZE:	4.07"

DMA NAME	DMA AREA (SF)	POST- PROJECT SURFACE TYPE	DMA RUNOFF FACTOR	DMA AREA X RUNOFF FACTOR
PVMT 6	49,069	CONCRETE OR ASPHALT	1.0	49,069
			TOTAL >	49,069

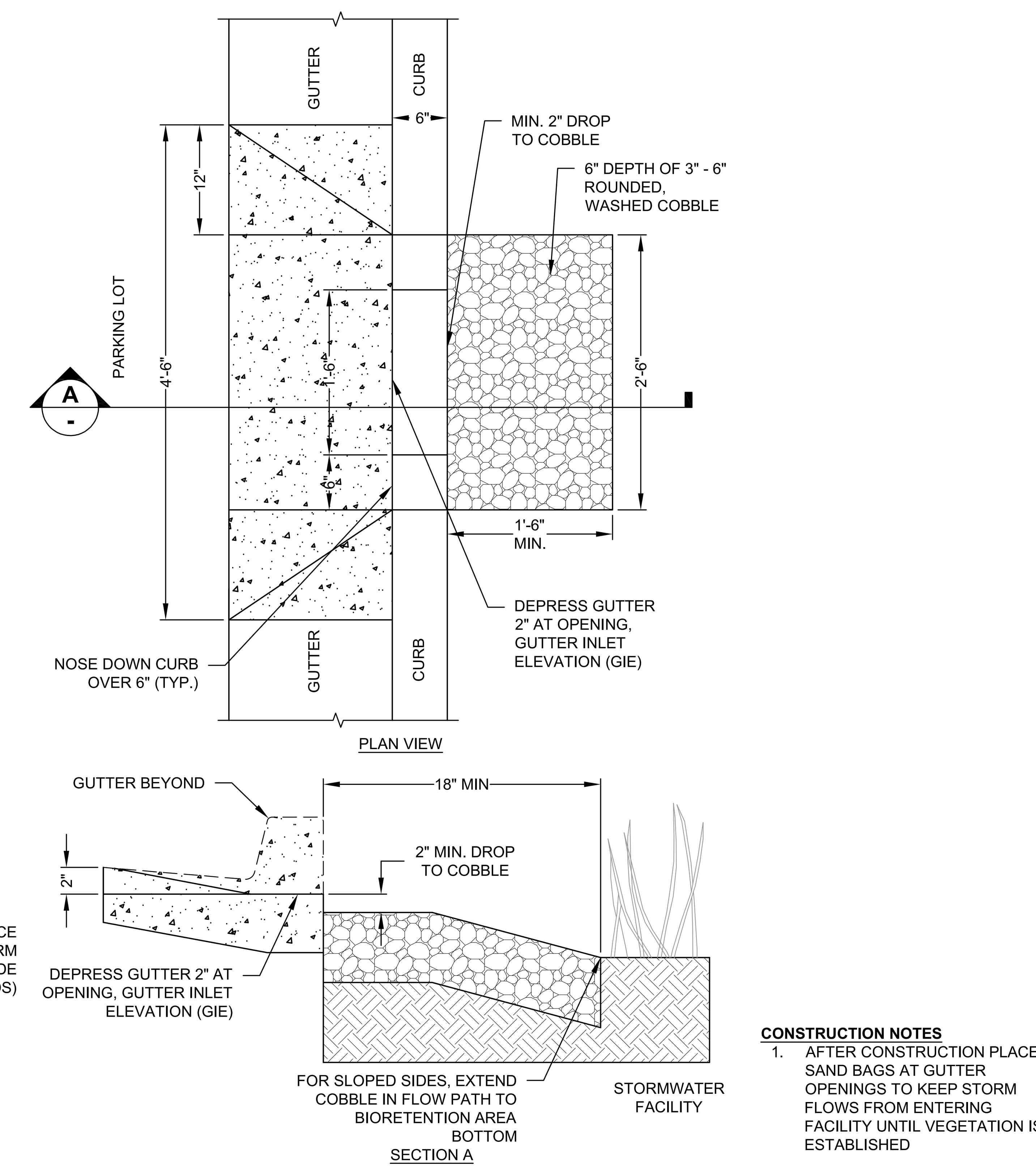
SOIL TYPE	IMP NAME			
C	BIO 6			
IMP SIZING FACTOR	RAIN ADJUSTMENT FACTOR	MINIMUM AREA OR VOLUME	PROPOSED AREA OR VOLUME	
0.060	0.952	2,804	5,480	IMP AREA
0.050	0.952	2,337	2,340	V1
0.066	0.952	3,084	3,192	V2
			ORIFICE SIZE:	1.78"



CONSTRUCTION NOTES

1. DEPTH OF GRAVEL LAYER SHALL BE 3' FOR BIO 1, 4.75' FOR BIO 2, 2.25' FOR BIO 3, 2.25' FOR BIO 4, 3.5' FOR BIO 5, AND 3.25' FOR BIO 6.
2. DEPTH OF BASIN IS 12" MINIMUM FOR BIO 1, BIO 2, BIO 3, BIO 4, BIO 5, BIO 6, AND BIO 8.
3. OVERFLOW INLET IS 10" ABOVE BOTTOM OF THE BASIN FOR BIO 1, 14" FOR BIO 2, 8" FOR BIO 3, 6" FOR BIO 4, 12" FOR BIO 5, AND 8" FOR BIO 6.

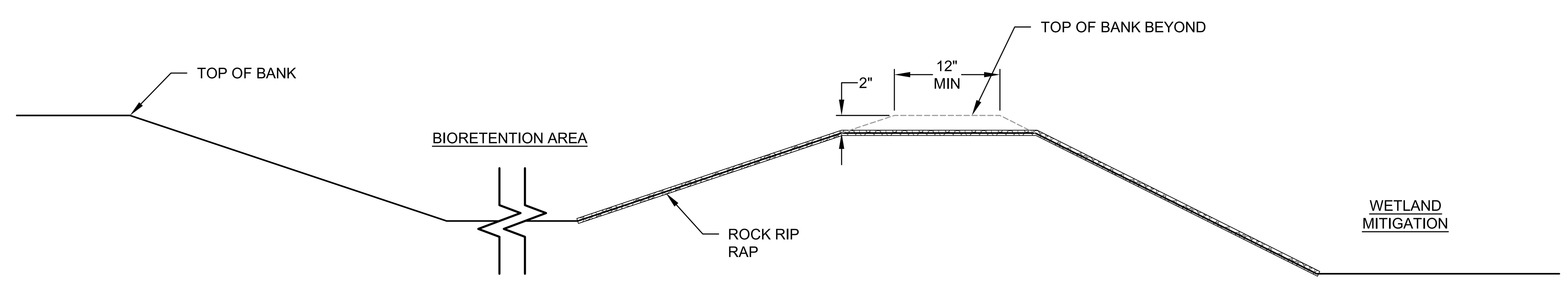
1 TYPICAL BIORETENTION AREA DETAIL
SCALE: N.T.S.



CONSTRUCTION NOTES

1. AFTER CONSTRUCTION PLACE SAND BAGS AT GUTTER OPENINGS TO KEEP STORM FLOWS FROM ENTERING FACILITY UNTIL VEGETATION IS ESTABLISHED

2 CURB OPENING INLET WITH GRAVEL ENERGY DISSIPATION
SCALE: 1" = 1'



3 OVERFLOW WEIR
SCALE: 1" = 1'

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CSW/Stuber-Stroeh Engineering Group, Inc.
45 Leveroni Court Novato, CA 94949 tel: 415.883.9850 fax: 415.883.9835
Civil & Structural Engineers
Surveying & Mapping
Environmental Planning
Land Planning
Construction Management
http://www.cswst2.com

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-	01/31/20	50% CONSTRUCTION DOCUMENTS	JAH	MTM	JAH

PARR BLVD. RICHMOND PKWY.
STORMWATER CONTROL DETAILS
SCANNELL PROPERTIES

City Of

County Of
Contra Costa

State Of
California

Prepared Under the Direction of:

REGISTERED PROFESSIONAL ENGINEER
JULIA A. HARBERSON
No. 76626
CIVIL
STATE OF CALIFORNIA

Sheet
C7.1

Scale:	AS SHOWN
Date:	03/04/2021
Project Number:	5.1431.03
Plan File:	D-XXXX-XX

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Project Name: Parr Blvd
Project Type: Treatment and Flow Control
APN:
Drainage Area: 1,329,960
Mean Annual Precipitation: 21.5

Self-Treating DMAs

DMA Name	Area (sq ft)
DMA 7	130,460.0

IV. Areas Draining to IMPs

IMP Name: BIO 1
IMP Type: Bioretention Facility
Soil Group: BIO 1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
BLDG 1	205,900	Conventional Roof	1.00	205,900
PVMT 1	314,322	Concrete or Asphalt	1.00	314,322
			Total	520,222

IMP Sizing

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	29,725	33,593
Surface Volume	0.050	0.952	24,771	26,112
Subsurface Volume	0.066	0.952	32,698	35,672
			Maximum Underdrain Flow (cfs)	0.80
			Orifice Diameter (in)	5.78

IMP Name: BIO 2
IMP Type: Bioretention Facility
Soil Group: BIO 2

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
PVMT 2	91,580	Concrete or Asphalt	1.00	91,580
PERM 2	7,378	Pervious Concrete	0.10	738
LA 2	34,364	Landscape	0.50	17,182
			Total	109,500

IMP Sizing

IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	6,257	6,797
Surface Volume	0.050	0.952	5,214	5,956
Subsurface Volume	0.066	0.952	6,883	7,245
			Maximum Underdrain Flow (cfs)	0.21
			Orifice Diameter (in)	2.93

IMP Name: BIO 3
IMP Type: Bioretention Facility
Soil Group: BIO 3

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
PVMT 3	64,874	Concrete or Asphalt	1.00	64,874
PERM 3	29,836	Pervious Concrete	0.10	2,984
LA 3	23,754	Landscape	0.50	11,877
			Total	79,735

IMP Sizing

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	4,556	10,510
Surface Volume	0.050	0.952	3,797	5,197
Subsurface Volume	0.066	0.952	5,012	5,803
			Maximum Underdrain Flow (cfs)	0.18
			Orifice Diameter (in)	2.76

IMP Name: BIO 4
IMP Type: Bioretention Facility
Soil Group: BIO 4

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
PERM 4	7,508	Pervious Concrete	0.10	751
LA 4	3,778	Landscape	0.50	1,889
			Total	2,640

IMP Sizing

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	151	562
Surface Volume	0.050	0.952	126	143
Subsurface Volume	0.066	0.952	166	180
			Maximum Underdrain	0.02

Flow (cfs)	
Orifice Diameter (in)	0.85

IMP Name: BIO 5
IMP Type: Bioretention Facility
Soil Group: BIO 5

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
BLDG 5	121,307	Conventional Roof	1.00	121,307
PVMT 5	125,566	Concrete or Asphalt	1.00	125,566
PERM 5	5,511	Pervious Concrete	0.10	551
LA 5	4,905	Landscape	0.50	2,453
			Total	249,877

IMP Sizing

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	14,278	16,711
Surface Volume	0.050	0.952	11,898	13,225
Subsurface Volume	0.066	0.952	15,706	16,723

Maximum Underdrain Flow (cfs)	0.40
Orifice Diameter (in)	4.07

IMP Name: BIO 6
IMP Type: Bioretention Facility
Soil Group: BIO 6

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
PVMT 6	49,069	Concrete or Asphalt	1.00	49,069
			Total	49,069

IMP Sizing

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.060	0.952	2,804	5,480
Surface Volume	0.050	0.952	2,337	2,340
Subsurface Volume	0.066	0.952	3,084	3,192

Maximum Underdrain Flow (cfs)	0.08
Orifice Diameter (in)	1.78

Report generated on 3/5/2021 12:00:00 AM by the Contra Costa Clean Water Program IMP Sizing Tool software (version 1.3.1.0).

G.3 - Supplemental Culvert Calculations Memorandum

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45 Leveroni Court
Novato, CA 94949
www.cswst2.com

415.883.9850
Fax: 415.883.9835

Berkeley
Dublin
Novato
Petaluma
Redwood City
Sacramento

CSW | ST2
CSW/Stuber-Stroeh Engineering Group, Inc.

Engineers | Land Planners | Surveyors

MEMORANDUM

DATE: June 17, 2021 **FILE:** 5.1431.03

TO: Lawrence Gossett
Contra Costa County Public Works Department
Engineering Services Division

FROM: Julia Harberson, CSW|ST2

RE: **PARR BOULEVARD – SUPPLEMENTAL CULVERT CALCULATIONS**

The purpose of this memorandum is to provide supplemental calculations to the March 4, 2021 Drainage Study, confirming that the existing culverts under Richmond Parkway are sufficiently sized per Contra Costa County Ordinance (914-2.010) which states "minor drainage facilities (i.e. those serving a watershed area less than one square mile) shall have adequate capacity to contain with sufficient freeboard a ten-year frequency of average recurrence interval runoff." The Parr Boulevard project discharges stormwater runoff to San Pablo Bay via existing culverts under Richmond Parkway. The project site discharges at two (2) locations, Discharge Point A and Discharge Point B (see Appendix 7.1 – Maps in the Drainage Study dated March 04, 2021.

Hydrologic Calculations (See Drainage Study dated March 04, 2021)
Per the Drainage Study dated March 04, 2021, the 10-year peak discharge rates for the 6- and 12- hour storm events are shown in Table 6.1 and 6.3 below. The peak discharge rates were determined using the unit hydrograph methodology utilizing the County's HEC-HMS template and model as directed by Contra Costa County.

Table 6.1: 10-Year Rain Event – Discharge Point A

Condition	10-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	10-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	39.8	42.2
Proposed	24.1	25.2

Table 6.3: 10-Year Rain Event – Discharge Point B

Condition	10-Year, 6-Hour - Recurrence Peak Discharge Rate (cfs)	10-Year, 12-Hour - Recurrence Peak Discharge Rate (cfs)
Existing	28.1	29.7
Proposed	25.3	26.5

Existing Culverts (See Parr Boulevard SLR Analysis dated December 18, 2018)
There are two (2) discharge points where water leaves the project site through culverts running below Richmond Parkway. The culverts discharge into drainage swales west of Richmond Parkway and ultimately discharge into San Pablo Bay. As-built information on the existing culverts

discharging from the Parr Boulevard site are attached (Attachment A). The as-built information is noted in a different datum (NGVD29) than the topographic field survey (NAVD88) performed by CSW|ST2. Table 2 depicts the existing condition of the culverts in NAVD88.

Table 2: Existing Outfall Data

Outfall	Invert Up	Invert Down	Length
(2)-36" Culverts	6.06	5.75	56 LF
(1)-36" Culvert	6.69	6.29	68 LF

We assumed the tailwater elevation to be equivalent to the Mean High High Water elevation which was determined from the National Oceanic and Atmospheric Administration (NOAA) tides and water levels. Table 3 depicts the tidal data for Station 9415056, Pinole Point, San Pablo Bay, CA.

Table 3: NOAA Tidal Data

Tidal Data	Mean High High Water (MHHW)	Mean Sea Level (MSL)	Mean Low Water (MLW)
	6.18	3.26	1.02

For the capacity analysis of the existing culverts, AutoCAD Civil 3D Hydraflow Express Extensions was utilized.

Results

The results of the existing culverts capacity analysis are shown in the table below, and the AutoCAD Civil 3d Hydraflow Express Extensions Channel reports are attached.

Table 1: Culvert Capacity Results

Dicharge Point	Outfall	Slope (%)	Length (ft)	Min. Flow Rate Qmin (10yr-6hr) (cfs)	Max. Flow Rate Qmin (1-yr-12hr) (cfs)	Pipe Flow Rate (cfs)	Flow Rate Overtop (cfs)	Hw Elev. (ft)	Hw/D (ft)
A	(2)-36" Culverts	0.55	56	24.1	25.2	24.10	0.00	7.59	0.51
B	(1)-36" Culvert	0.16	68	25.3	26.5	26.30	0.00	8.86	0.82

Conclusion

In conclusion, the existing culverts at Discharge Point A and Discharge Point B have sufficient capacity to convey the 10-year storm event.

Attachments

- Attachment A: Project Plans for Construction of Richmond Parkway – Section 4A, September 1994 (As-Builts)
- Attachment B: NOAA Tidal Data – Pinole Point, San Pablo Bay, CA
- Attachment C: Culvert Analysis Results

ATTACHMENTS

Attachment A: Project Plans for Construction of Richmond Parkway – Section 4A, September 1994 (As-Builts)

RP4ATITL.DGN

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9 - 21.9	1	124

INDEX OF SHEETS

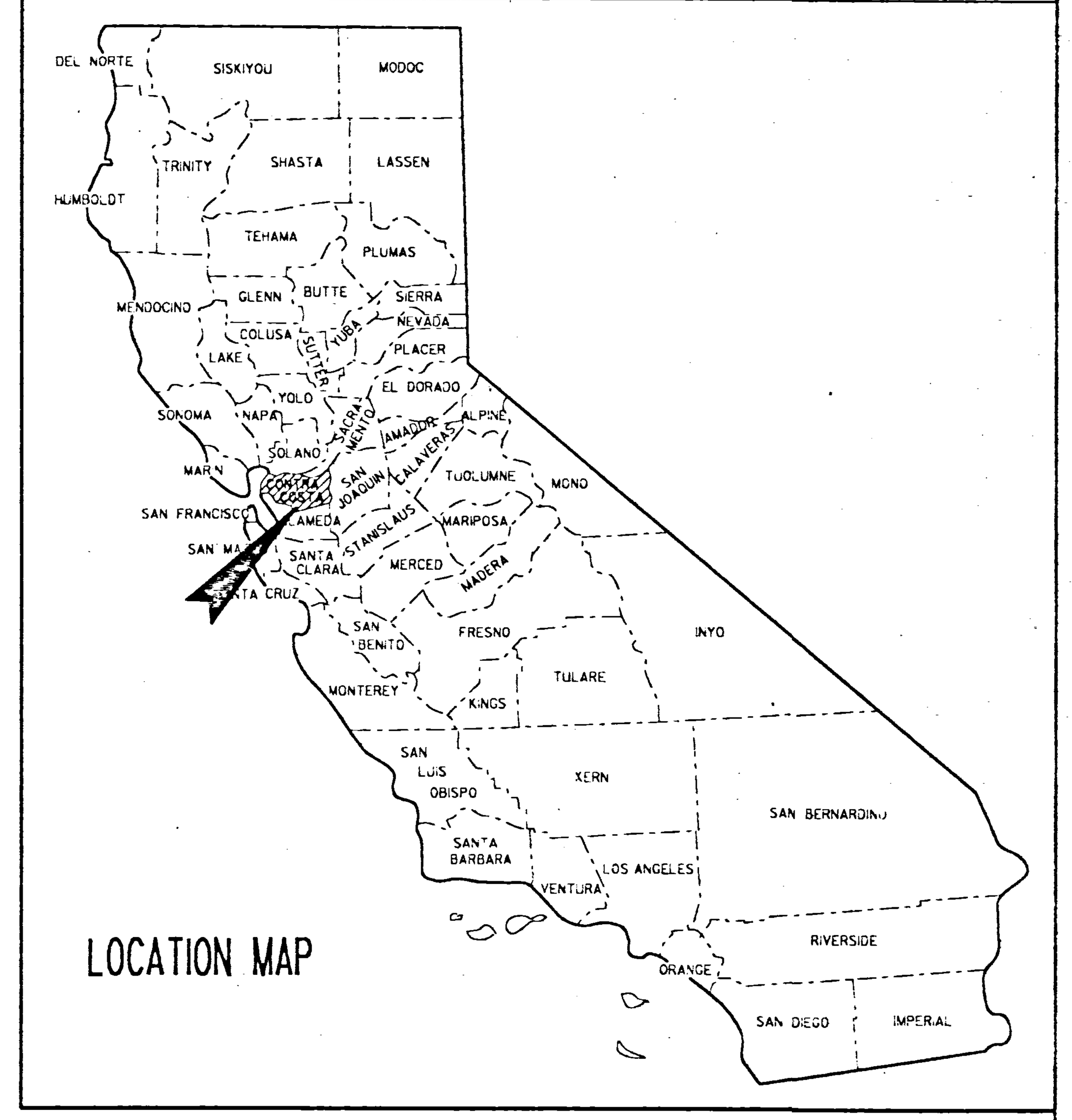
SHEET No.	DESCRIPTION
1	Title Sheet
2-5	Typical Cross Section
6-7	Standard Plans List
8	Key Map and Line Index
9	Construction Staking Survey Control Data
10-17	Layout, Profile, and Superelevation
18-20	Removal and Demolition Plan
21-27	Construction Details
28-50	Drainage Plan, Profiles, Details, and Quantities
51-54	Sanitary Sewer Plan, Profiles, Details, and Quantities
55-58	Utilities Plans
59-61	Stage Construction
62-63	Detour
64-69	Pavement Delineation Plan, Details, and Quantities
70-71	Summary of Quantities
72-79	Sign Plan, Details, and Quantities
80-105	Highway Planting Plans
106-116	Lightng and Signal Plans
117-124	Structure Plans

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS

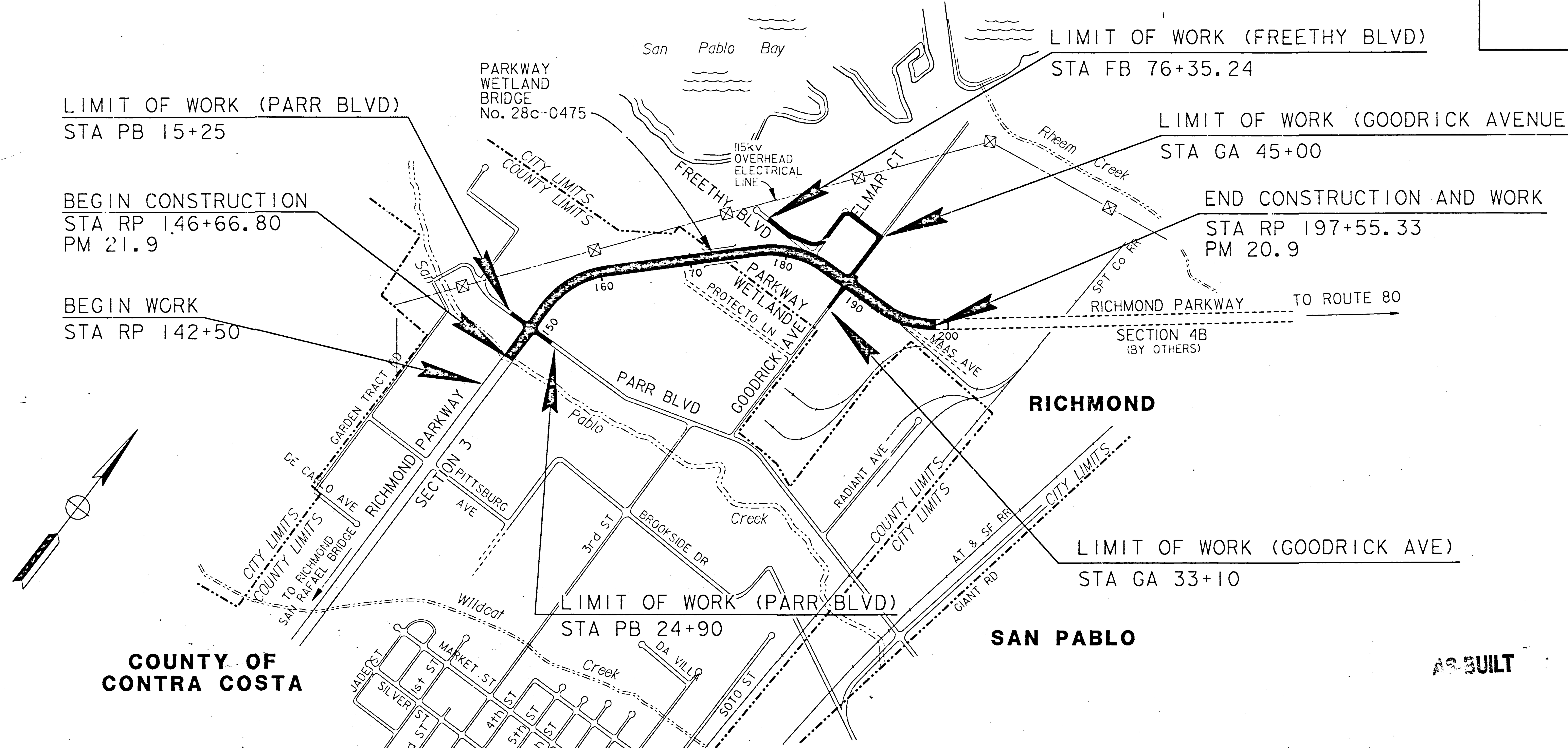
PROJECT PLANS FOR CONSTRUCTION OF
RICHMOND PARKWAY - SECTION 4A

IN CONTRA COSTA COUNTY
IN CITY OF RICHMOND
FROM 0.1 MILES SOUTH OF PARR BOULEVARD
TO 0.2 MILES EAST OF GOODRICK AVENUE

To be supplemented by Caltrans Standard Plans dated July 1992



LOCATION MAP



NO SCALE

Lawrence H. Loder, City of Richmond
Department of Public Works

Project Manager
Registered Civil Engineer

REGISTERED PROFESSIONAL ENGINEER
MELVIN SEARS
No. 47821
Exp. 2-31-95
CIVIL
STATE OF CALIFORNIA

AS BUILT

Plans Approval Date

ISSUED FOR CONSTRUCTION
SEPTEMBER 1994

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
2600 BARRETT AVENUE
RICHMOND, CALIFORNIA 94804

CH2M HILL
1111 BROADWAY, SUITE 1200
OAKLAND, CALIFORNIA 94607

5-D-1689 Contract No.

The Contractor shall possess the Class (or Classes) of license as specified in the "Notice to Contractors".

PROJECT ENGINEER	DATE	DESIGN ENGINEER	DATE	APPROVAL RECOMMENDED BY	DATE
28-Sep-1994					

FORM DC-DE-93-F REV 3/83

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU

EA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	28	124

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — DS PATENIA — No. 45288 — Exp. 9/30/94 — CIVIL — STATE OF CALIFORNIA

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
2600 BARRETT AVENUE
RICHMOND, CALIFORNIA 94804

CALSAE, INC.
3065 RICHMOND PARKWAY, SUITE 105
RICHMOND, CALIFORNIA 94806

NOTES:

1. THERE ARE EXISTING HIGH AND LOW RISK UNDERGROUND FACILITIES WITHIN THE CITY RIGHT-OF-WAY.
2. CONTRACTOR SHALL COORDINATE WITH THE ENGINEER FOR REMOVAL OF ABANDONED FACILITIES INDICATED OR/AND NOT INDICATED ON PLANS IN CONFLICT WITH PLANNED WORK.
3. SEE QUANTITY SHEETS FOR COMPLETE DESCRIPTIONS OF ALL DRAINAGE SYSTEMS.
4. SEE ROADWAY TYPICAL X-SECTION FOR ATPB LAYER WITH EDGE DRAIN TRENCH FOR THICKNESS AND DIMENSIONS.
5. STRUCTURAL SECTION DRAINAGE SYSTEM (EDGE DRAIN) SHALL BE TYPE 5. SEE STD PLAN D99A FOR DETAILS.
6. LOCATIONS OF VENTS, CLEANOUTS AND OUTLETS AS SHOWN ARE APPROXIMATE. FINAL LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.
7. SEE STD PLANS D99B AND D99C FOR EDGE DRAIN DETAILS.
8. FOR EDGE DRAIN QUANTITIES, SEE SUMMARY OF QUANTITIES.

ABBREVIATIONS:

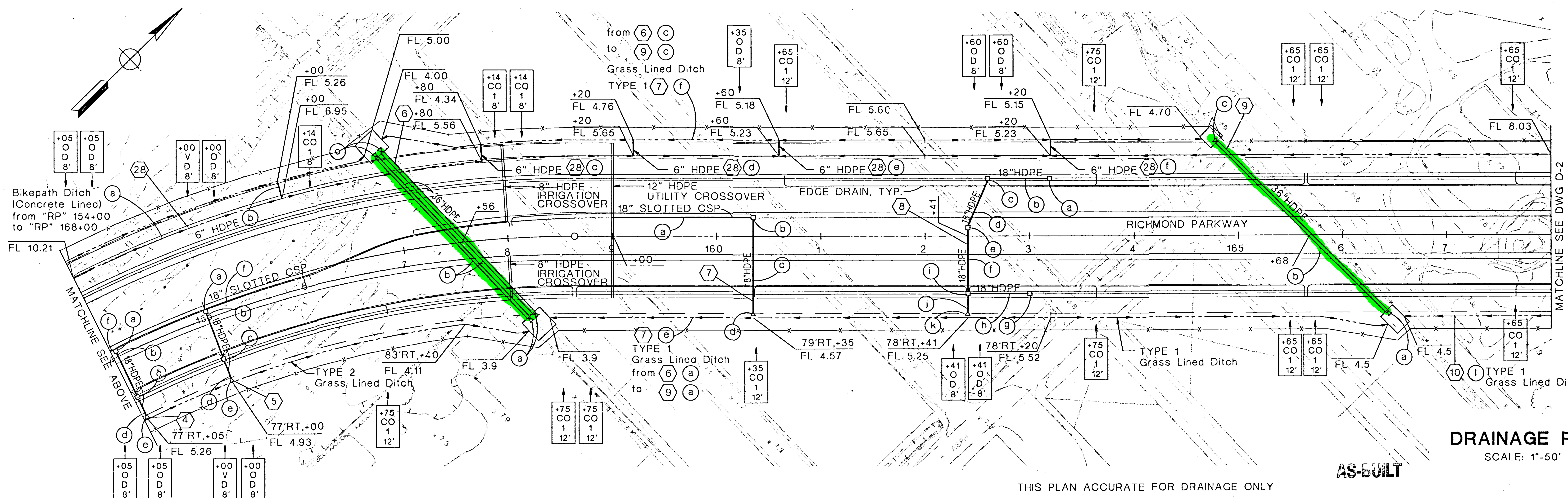
SO	SIDE OPENING
W/	WITH
HDPE	HIGH DENSITY POLYETHELENE PIPE

DRAINAGE LEGEND:

- □ INLET
- ○ MANHOLE
- ◯ DRAINAGE UNIT
- ⬡ DRAINAGE SYSTEM NUMBER

EDGE DRAIN LEGEND:

+10	PLUS STATION
CO	(V) VENT, (O) OUTLET OR (CO) CLEANOUT
1	TYPE (SEE STD PLANS OR DRAINAGE DETAILS)
8'	LENGTH OF UNSLOTTED PLASTIC PIPE



THIS PLAN ACCURATE FOR DRAINAGE ONLY

AS-BUILT

DRAINAGE PLAN

SCALE: 1"=50'

D-1

DATE	REVISED BY / DATE REVISED
CALCULATED/DESIGNED BY	CHECKED BY
PROJECT ENGINEER	JOHN PARIS

CITY OF RICHMOND - DEPARTMENT OF PUBLIC WORKS

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

FORM DC-OE-90-PF (REV. 3/88)

CU

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	33	124

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
DS PATENIA
No. 45288
Exp. 9/30/94
CIVIL
STATE OF CALIFORNIA

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DEPARTMENT OF PUBLIC WORKS
2600 BARRETT AVENUE
RICHMOND, CALIFORNIA 94804

CALSAE, INC.
3065 RICHMOND PARKWAY, SUITE 105
RICHMOND, CALIFORNIA 94806

DATE | REVISEDBY | DATEREVISED

CALCULATED/DESIGNEDBY | CHECKEDBY

PROJECT ENGINEER

CITY OF RICHMOND - DEPARTMENT OF PUBLIC WORKS

DRAINAGE PROFILES

SCALE: HORIZ. 1"=10'
VERT. 1"=10'

D-6

FORM DC-OE-90-PF (REV. 3/88)

FOR REDUCED PLANS
ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU

EA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	34	124

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
DS PATENIA
No. 45288
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STATE OF CALIFORNIA

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2600 BARRETT AVENUE
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CALSAE, INC.
3065 RICHMOND PARKWAY, SUITE 105
RICHMOND, CALIFORNIA 94806

DATE	REVISED BY	DATE REVISED
CALCULATED/DESIGNED BY	CHECKED BY	
PROJECT ENGINEER	JOHN PARIS	

CITY OF RICHMOND DEPARTMENT OF PUBLIC WORKS

AS BUILT

DRAINAGE PROFILES

SCALE: HORIZ. 1"=10'
VERT. 1"=10'

D-7

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	42	124

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
DS PATENIA
No. 45288
Exp. 9/30/94
CIVIL
STATE OF CALIFORNIA

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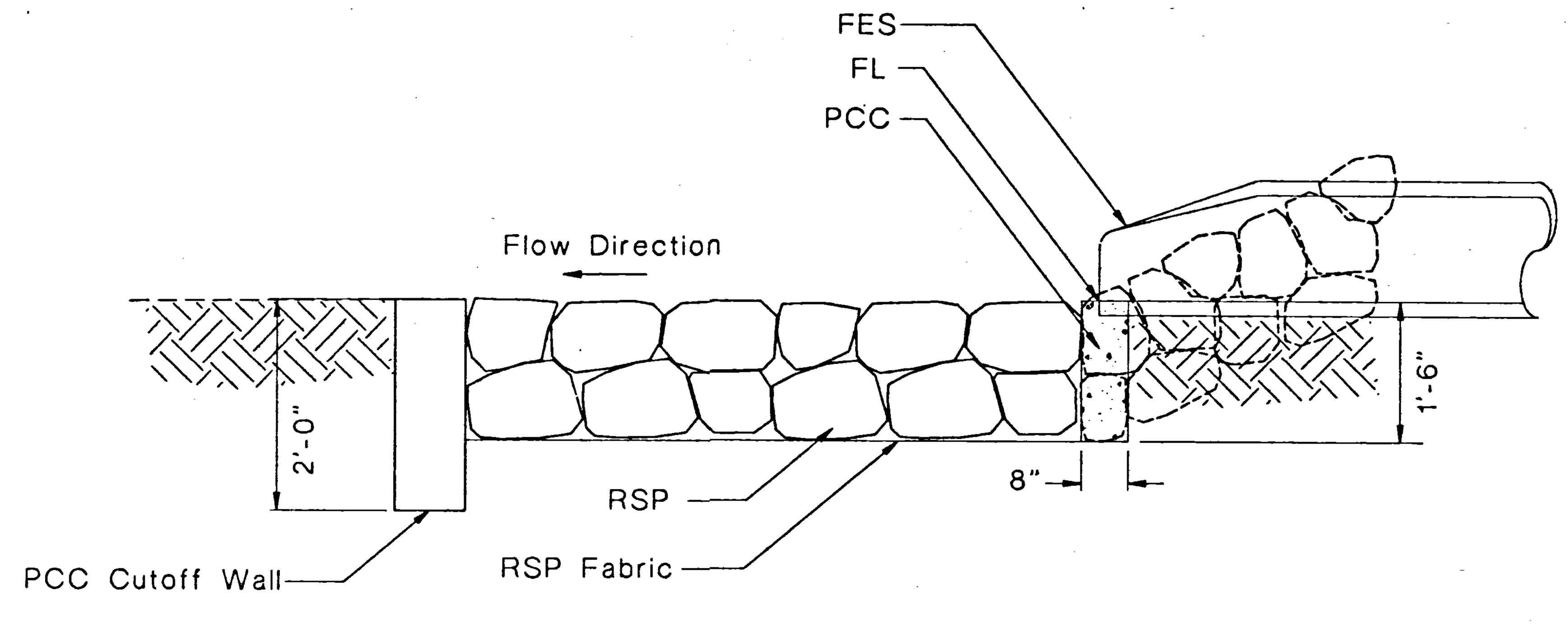
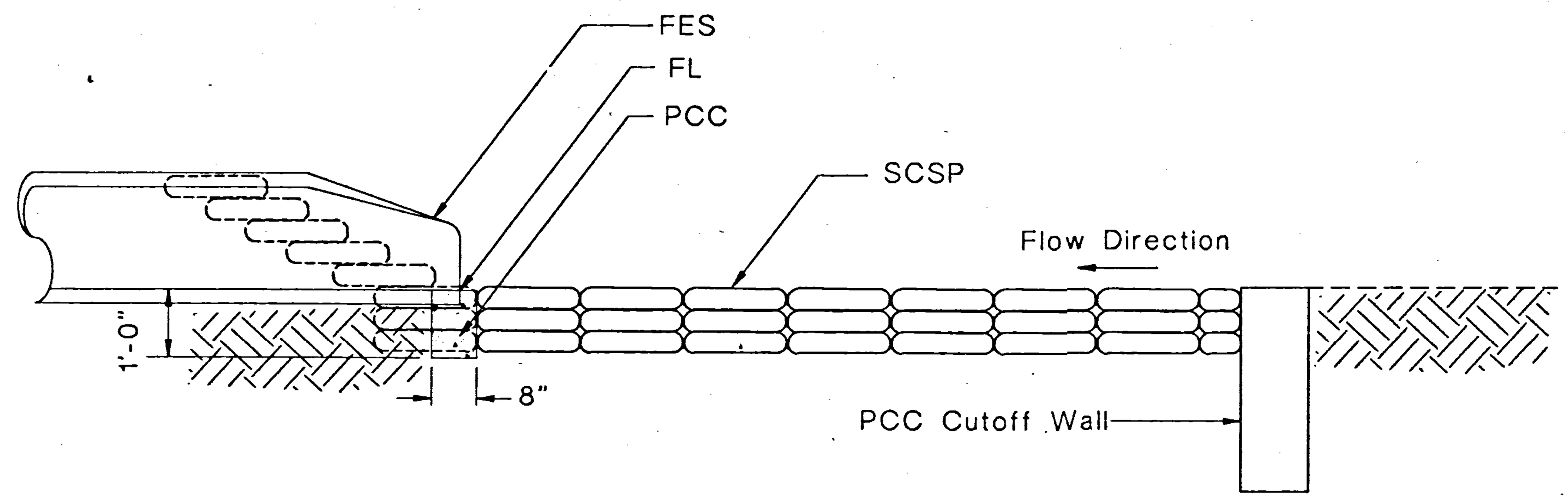


SECTION A-A



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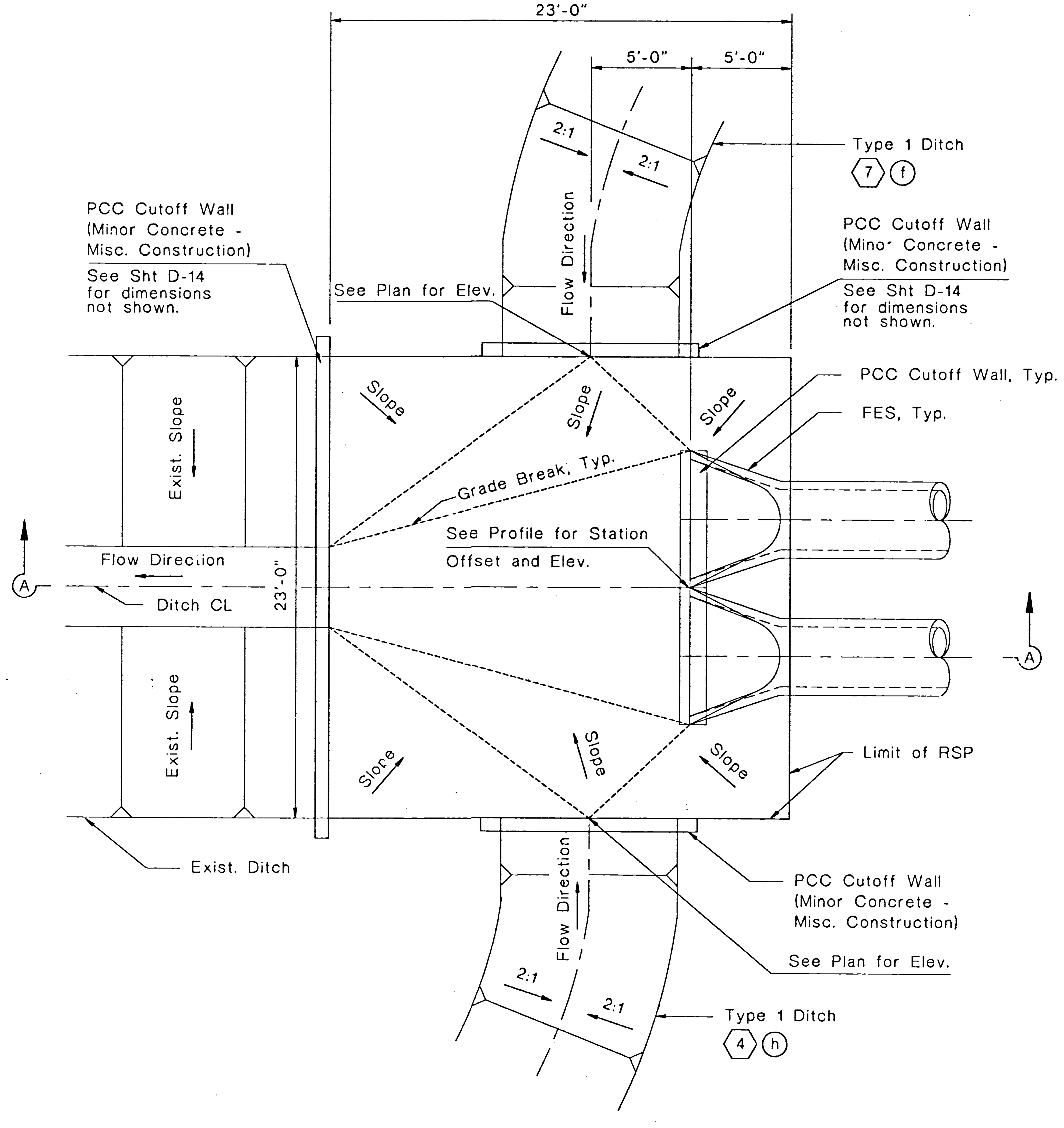
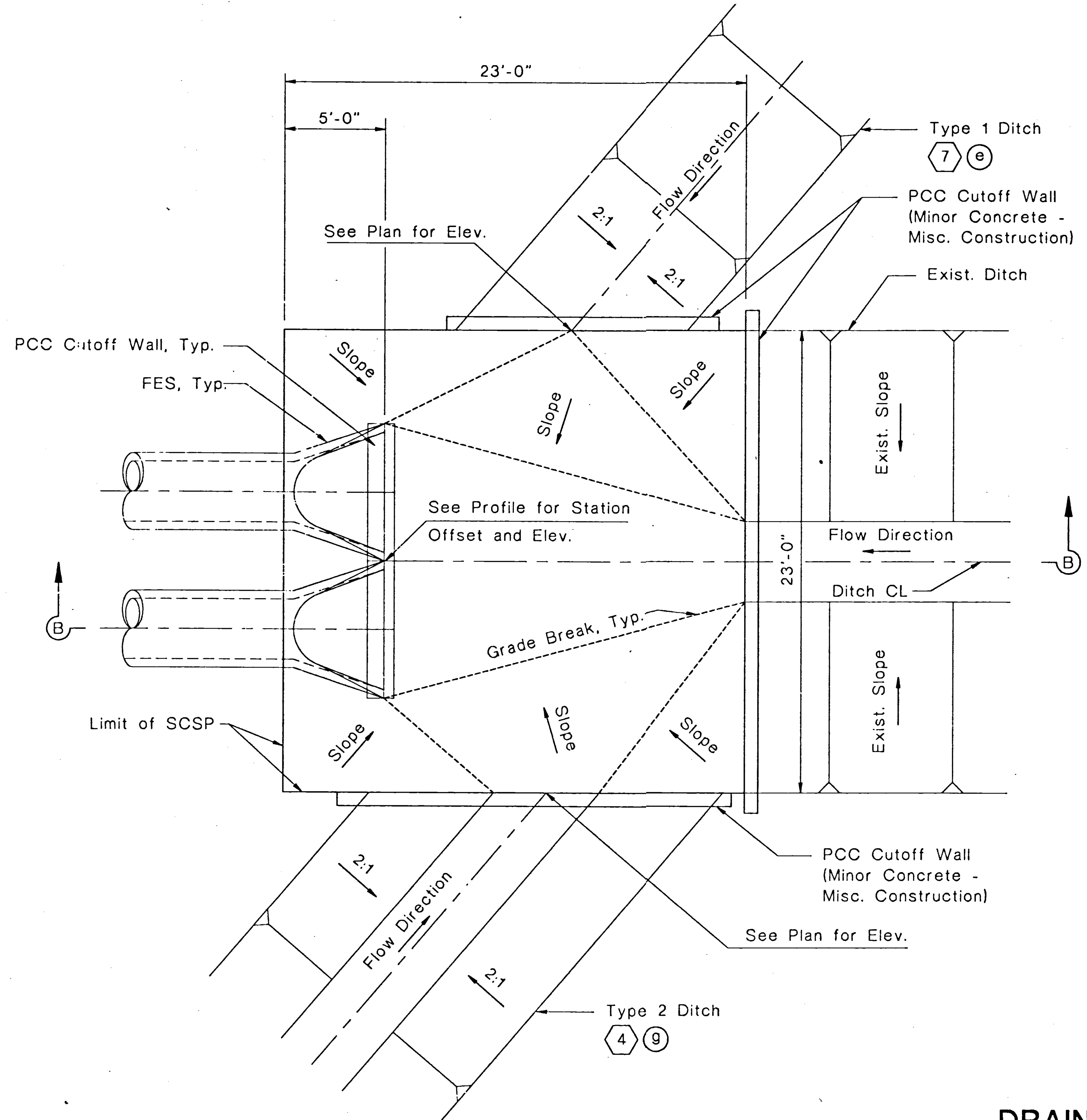


FES W/ RSP

6 c



FES W/ SCSP

6 a

AS-BUILT

DRAINAGE DETAILS

NO SCALE

D-15

CITY OF RICHMOND - DEPARTMENT OF PUBLIC WORKS

PROJECT ENGINEER: JOHN PARIS

CALCULATED/DESIGNED BY | CHECKED BY | DATE REVISED | REVISED BY

41

FORM DC-OE-90-PF (REV. 3/88)

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	43	124

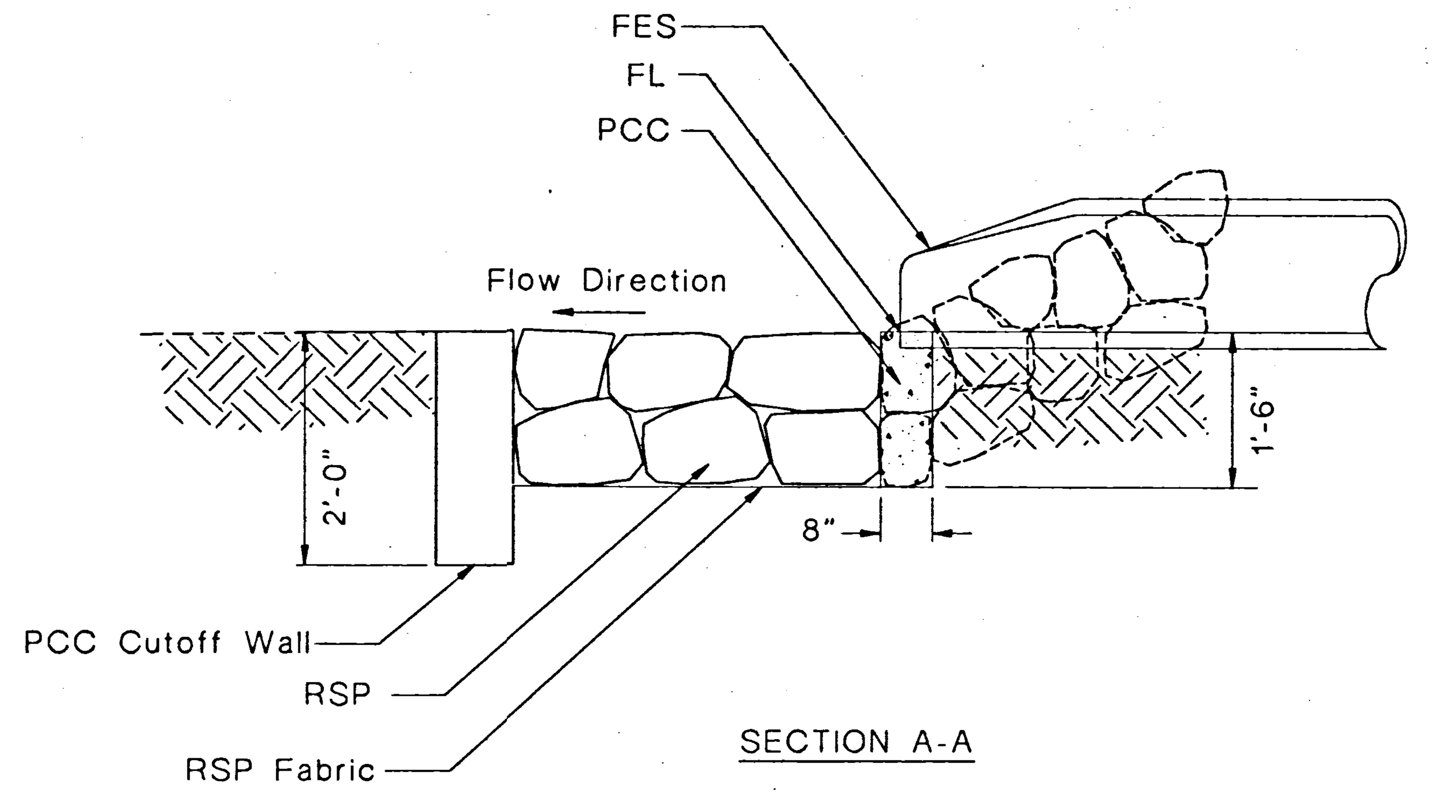
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — DS PATENIA — No. 45288 — Exp. 9/30/94 — CIVIL — STATE OF CALIFORNIA

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
2600 BARRETT AVENUE
RICHMOND, CALIFORNIA 94804

CALSAE, INC.
3065 RICHMOND PARKWAY, SUITE 105
RICHMOND, CALIFORNIA 94806



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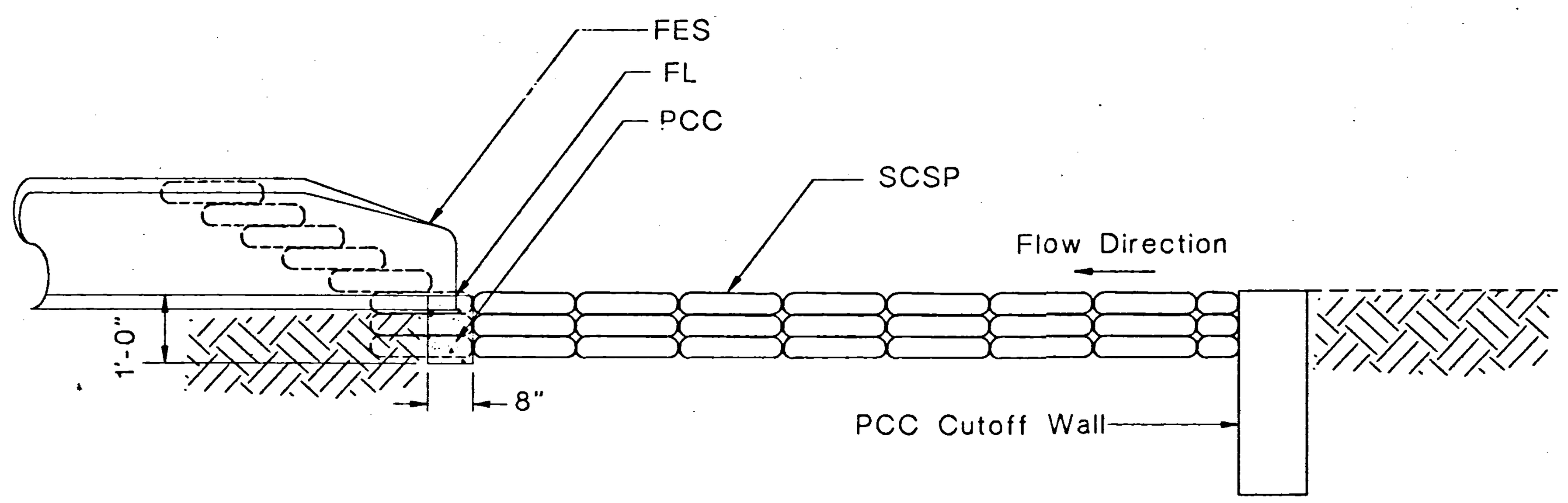

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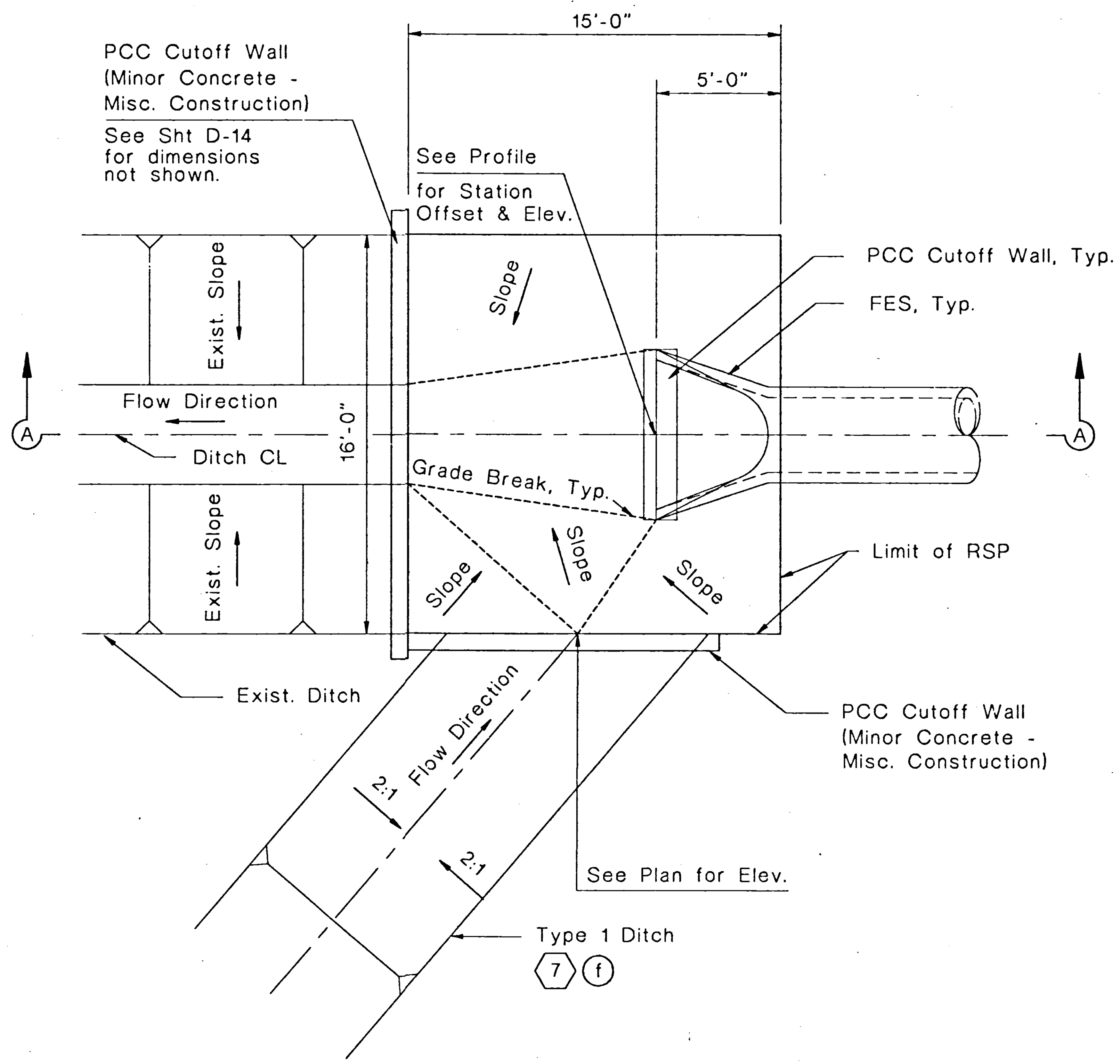
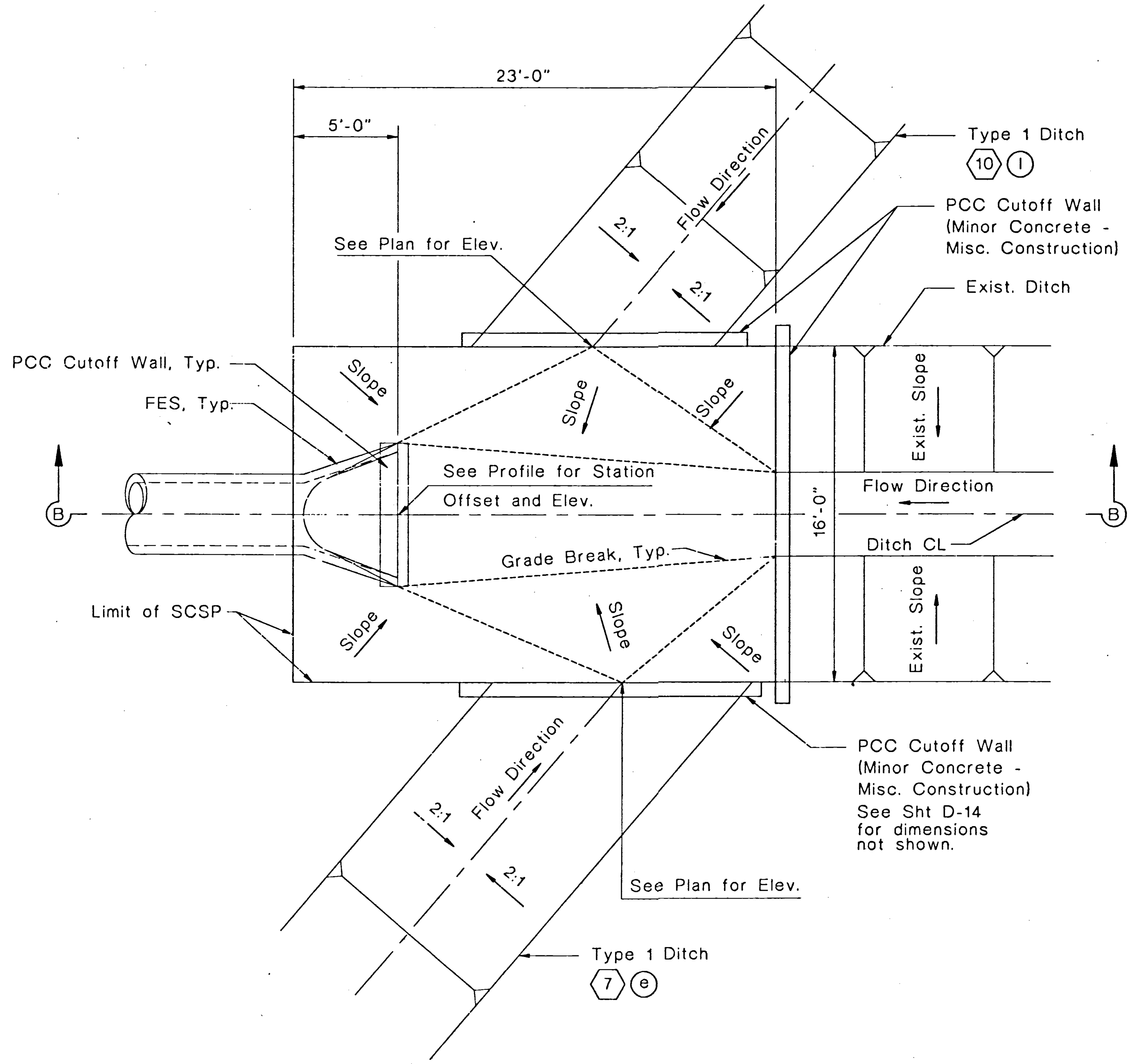


FES W/ RSP

9 c



FES W/ SCSP

9 a

AS-BUILT

DRAINAGE DETAILS

NO SCALE

D-16

REVISED BY	DATE REVISED
DATE	

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CITY OF RICHMOND — DEPARTMENT OF PUBLIC WORKS

42

FORM DC-OE-90-PF (REV. 3/88)

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU

EA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	CC	RICHMOND PARKWAY	20.9-21.9	46	124

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER DS PATENIA No. 45288 Exp. 9/30/94 CIVIL STATE OF CALIFORNIA

CITY OF RICHMOND
DEPARTMENT OF PUBLIC WORKS
2600 BARRETT AVENUE
RICHMOND, CALIFORNIA 94804

CALSAE, INC.
3065 RICHMOND PARKWAY, SUITE 105
RICHMOND, CALIFORNIA 94806

DRAINAGE QUANTITIES

DRAINAGE SYSTEM NO.	ITEM NO.	ABANDON CULVERT	ABANDON INLET	SAND BACKFILL	STORM DRAIN MANHOLE	DITCH EXCAVATION	18" HDPE FLARED END SECTION	24" HDPE FLARED END SECTION	30" HDPE FLARED END SECTION	36" HDPE FLARED END SECTION	HDPE 6"	HDPE 18"	HDPE 24"	HDPE 30"	HDPE 36"	30" RCP	18" SLOTTED CSP (.079" THICK)	SCSP	RSP (FACING, METHOD B)	RSP FABRIC	MINOR CONCRETE BACKFILL	MINOR CONCRETE DITCH LINING	MINOR CONCRETE MINOR STRUCTURE	MINOR CONCRETE MISC CONSTRUCTION	MISCELLANEOUS IRON & STEEL	FRAMES, GRATES & COVERS (N) 1/4" CHECKER PLATE	24-12x	24-12	HEIGHT OF INLET "H" (N)	MAXIMUM COVER (N)	CULVERT SKEW (DEGREES)RIGHT/LEFT	DESCRIPTION	STATION	DRAINAGE PLAN SHT NO.	DRAINAGE SYSTEM NO.	ITEM NO.
		EA	EA	CY	EA	CY	EA	EA	EA	EA	LF	LF	LF	LF	LF	LF	LF	CY	CY	SY	CY	CY	CY	CY	LB	EA	EA	EA	FT	FT						
5	a																						2.20		170	1			4.0			OL-7 (Modified) Inlet	RP 155+00 (6' Rt.)	D-1	5	a
	b											46									8.0									2.4		18" HDPE	RP 155+00			b
	c																						1.40	1.14	239		1		3.3			GOM Inlet / 0.10' SGD	RP 155+00 (54.5' Rt.)			c
	d											22																		1.8		18" HDPE	RP 155+00			d
	e						1												7.4	24				2.07								18" HDPE FES / RSP	RP 155+00 (75' Rt.)			e
	f																50															18" SLOTTED CSP	RP 155+00 to RP 155+50			f
6	a									2								20.0						6.60								2 - 36" HDPE FES / SCSP	RP 158+22 (78' Rt.)	D-1	6	a
	b														432																	2 - 36" HDPE	RP 157+56			b
	c									2									29.4	80				5.70								2 - 36" HDPE FES / RSP	RP 156+90 (98' Lt.)			c
7	a																134															18" SLOTTED CSP	RP 159+00 to RP 160+35	D-1	7	a
	b																						2.26	1.14	239		1		6.7			GOM Inlet / 0.10' SGD	RP 160+35 (18.5' Lt.)			b
	c											92																		2.9		18" HDPE	RP 160+35			c
	d						1												6.3	21				2.08								18" HDPE FES / RSP	RP 160+35 (79' Rt.)			d
	e					286																										TYPE 1 Grass Lined Ditch	RP 158+22 to RP 166+46			e
	f					247																										TYPE 1 Grass Lined Ditch	RP 156+90 to RP 164+77			f
8	a																						1.32	1.14	239		1		2.9			GOM Inlet / 0.10' SGD	RP 163+19 (54.5' Lt.)	D-1	8	a
	b											56									9.7									1.9		18" HDPE	RP 163+19			b
	c																						2.38	1.53	239		1		3.2			GOM Inlet / 0.10' SGD	RP 162+60 (54.5' Lt.)			c
	d											44									6.4									3.0		18" HDPE	RP 162+60			d
	e																						1.58		239		1		4.3			G2 Inlet	RP 162+41 (8' Lt.)			e
	f											60									6.4									1.7		18" HDPE	RP 162+41			f
	g																						1.43	1.14	239		1		3.4			GOM Inlet / 0.10' SGD	RP 163+00 (54.5' Rt.)			g
	h											56									9.7									2.5		18" HDPE	RP 163+00			h
	i																						2.03	1.53	239		1		3.7			GOM Inlet / 0.10' SGD	RP 162+41 (54.5' Rt.)			i
	j											20																		2.6		18" HDPE	RP 162+41			j
	k						1												5.7	19				1.83								18" HDPE FES / RSP	RP 162+41 (78' Rt.)			k
9	a									1								14.0						5.50								36" HDPE FES / SCSP	RP 166+46 (76' Rt.)	D-1	9	a
	b														238																	36" HDPE	RP 166+68			b
	c									1									13.3	40				3.70								36" HDPE FES / RSP	RP 164+77 (91' Lt.)			c
SHEET TOTAL						533	3			6		396			670		184	34.0	62.1	184	40.20		14.60	27.48	1843	1	7						SHEET TOTAL			

GRAND TOTAL See Sht. D-23

AS-BUILT

DRAINAGE QUANTITIES

AS-BUILT

D-19

CITY OF RICHMOND DEPARTMENT OF PUBLIC WORKS

PROJECT ENGINEER JOHN PARIS

CALCULATED/DESIGNED BY CHECKED BY

REVISED BY DATE REVISED

FORM DC-OE-90-PF (REV. 3/88)

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

CU

EA

Attachment B: NOAA Tidal Data – Pinole Point, San Pablo Bay, CA

Datums for 9415056, Pinole Point, San Pablo Bay CA

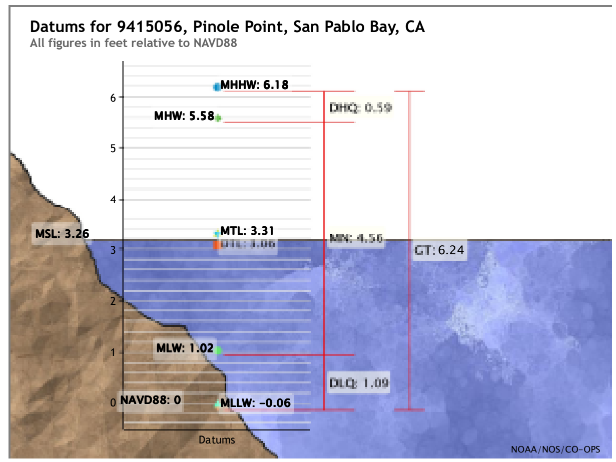
NOTICE: All data values are relative to the NAVD88.

Elevations on NAVD88

Station: 9415056, Pinole Point, San Pablo Bay, CA
Status: Accepted (Jun 27 2014)
Units: Feet
Control Station: 9414863 Richmond, CA

T.M.: 120
Epoch: (/datum_options.html#NTDE) 1983-2001
Datum: NAVD88

Datum	Value	Description
MHHW (/datum_options.html#MHHW)	6.18	Mean Higher-High Water
MHW (/datum_options.html#MHW)	5.58	Mean High Water
MTL (/datum_options.html#MTL)	3.31	Mean Tide Level
MSL (/datum_options.html#MSL)	3.26	Mean Sea Level
DTL (/datum_options.html#DTL)	3.06	Mean Diurnal Tide Level
MLW (/datum_options.html#MLW)	1.02	Mean Low Water
MLLW (/datum_options.html#MLLW)	-0.06	Mean Lower-Low Water
NAVD88 (/datum_options.html)	0.00	North American Vertical Datum of 1988
STND (/datum_options.html#STND)	-8.04	Station Datum
GT (/datum_options.html#GT)	6.24	Great Diurnal Range
MN (/datum_options.html#MN)	4.56	Mean Range of Tide
DHQ (/datum_options.html#DHQ)	0.59	Mean Diurnal High Water Inequality
DLQ (/datum_options.html#DLQ)	1.09	Mean Diurnal Low Water Inequality
HWI (/datum_options.html#HWI)	8.55	Greenwich High Water Interval (in hours)
LWI (/datum_options.html#LWI)	2.18	Greenwich Low Water Interval (in hours)
Max Tide (/datum_options.html#MAXTIDE)		Highest Observed Tide
Max Tide Date & Time (/datum_options.html#MAXTIDEDT)		Highest Observed Tide Date & Time
Min Tide (/datum_options.html#MINTIDE)		Lowest Observed Tide
Min Tide Date & Time (/datum_options.html#MINTIDEDT)		Lowest Observed Tide Date & Time
HAT (/datum_options.html#HAT)	7.64	Highest Astronomical Tide
HAT Date & Time	12/31/1986 19:36	HAT Date and Time
LAT (/datum_options.html#LAT)	-2.37	Lowest Astronomical Tide



Showing datums for

9415056 Pinole Point, San P...

Datum

NAVD88

Data Units ◉ Feet ○ Meters

Epoch ◉ Present (1983-2001) ○ Superseded (1960-1978)

Submit

Datum	Value	Description
LAT Date & Time	05/25/1990 15:06	LAT Date and Time

Tidal Datum Analysis Periods
12/01/2010 - 02/28/2011

Show nearby stations

Products available at 9415056 Pinole Point, San Pablo Bay, CA

TIDES/WATER LEVELS

Water Levels
NOAA Tide Predictions (/noaatidepredictions.html?id=9415056)
Harmonic Constituents (/harcon.html?id=9415056)
Sea Level Trends
Datums (/datums.html?id=9415056)
Bench Mark Sheets (/benchmarks.html?id=9415056)
Extreme Water Levels
Reports (/reports.html?id=9415056)

METEOROLOGICAL/OTHER

Meteorological Observations
Water Temp/Conductivity

PORTS®

This station is not a member of PORTS®

OPERATIONAL FORECAST SYSTEMS

San Francisco Bay (/ofs/sfbofs/sfbofs.html)
OFS product page for Pinole Point, San Pablo Bay (/ofs/ofs_station.shtml?stname=Point Pinole&ofs=sfb&stnid=9415056&subdomain=la)

INFORMATION

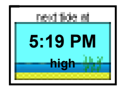
Station Home Page (/stationhome.html?id=9415056)
Data Inventory (/inventory.html?id=9415056)
Measurement Specifications (/measure.html)

Pinole Point, San Pablo Bay, CA - Station ID: 9415056

Station Info Today's Tides Photos Sensor Information Observations Directions and Map Available Products

Established:	Sep 17, 1976
Time Meridian:	120° W
Present Installation:	Nov 18, 2010
Date Removed:	2011-05-07
Water Level Max (ref MHHW):	N/A
Water Level Min (ref MLLW):	N/A
Mean Range:	4.56 ft.
Diurnal Range:	6.24 ft.
Latitude	38° 0.9' N
Longitude	122° 21.8' W
NOAA Chart#:	18654 (http://www.charts.noaa.gov/OnLineViewer/18654.shtml)
Met Site Elevation:	ft. above

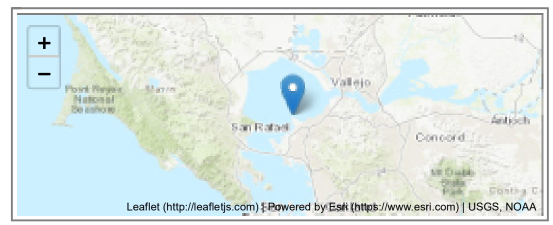
Today's Tides (LST/LDT)



6:20 AM	high	4.9 ft.
11:29 AM	low	3.0 ft.
5:19 PM	**high**	**5.8** ft.

No photos are available for this station. (stationphotos.html?id=9415056)

How to reach: To reach the tidal bench marks from Berkeley, proceed north on Highway 80 to El Cerrito, then proceed west on Cutting Boulevard to 23rd Street, then turn right and proceed north on 23rd Street/San Pablo Avenue for 8.9 km (5.5 mi) to Richmond Parkway, then turn left and proceed west on Richmond Parkway for 400 m (1300 ft), then turn right and proceed NW on Atlas Road to the Point Pinole Regional Park, and continue to the paved road in the park to where there is a fishing pier and ruins of the Atlas Powder Company pier. The bench marks are located in the park, along the road leading to the pier. The tide gage and staff were located 137 m (450 ft) from the shore on a piling among the ruins of the powder company pier.



Show nearby stations

Products available at 9415056 Pinole Point, San Pablo Bay, CA

TIDES/WATER LEVELS

Water Levels

NOAA Tide Predictions (/noaatidepredictions.html?id=9415056)

Harmonic Constituents (/harcon.html?id=9415056)

Sea Level Trends

Datums (/datums.html?id=9415056)

METEOROLOGICAL/OTHER

Meteorological Observations

Water Temp/Conductivity

PORTS®

This station is not a member of PORTS®

OPERATIONAL FORECAST SYSTEMS

San Francisco Bay (/ofs/sfbofs/sfbofs.html)

OFS product page for Pinole Point, San Pablo Bay (/ofs/ofs_station.shtml?stname=Point Pinole&ofs=sfb&stnid=9415056&subdomain=la)

INFORMATION

Attachment C: Culvert Analysis Results

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 17 2021

Pro. Cond. - Discharge Pt. A - Ex. (2)-36inch Culvert

Invert Elev Dn (ft)	= 5.75
Pipe Length (ft)	= 56.00
Slope (%)	= 0.55
Invert Elev Up (ft)	= 6.06
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 2
n-Value	= 0.014
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

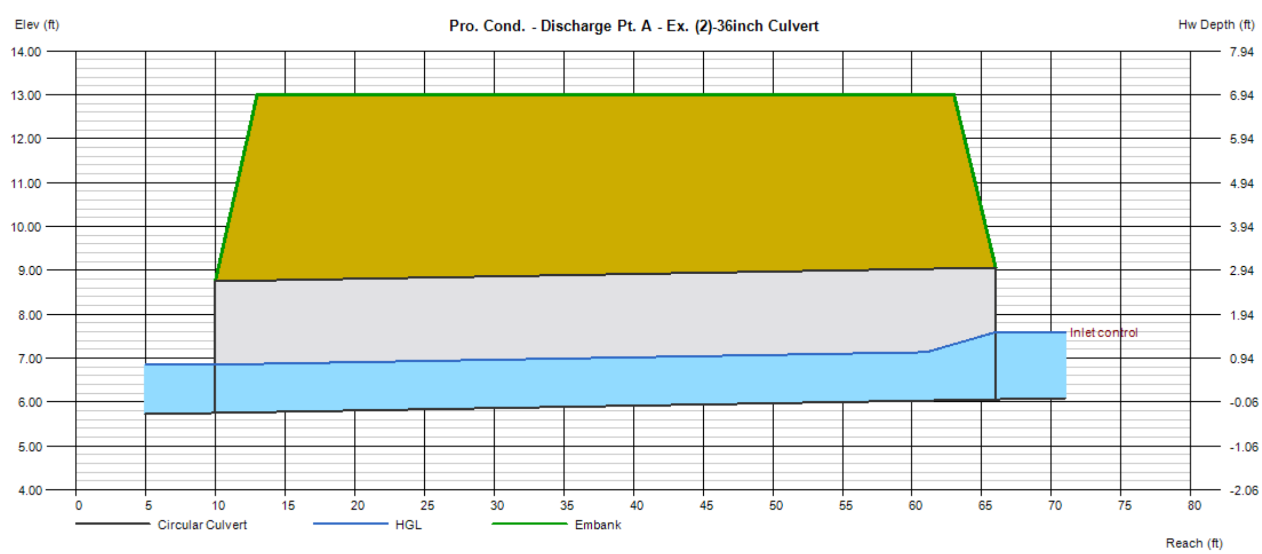
Top Elevation (ft)	= 13.00
Top Width (ft)	= 50.00
Crest Width (ft)	= 1000.00

Calculations

Qmin (cfs)	= 24.10
Qmax (cfs)	= 25.20
Tailwater Elev (ft)	= 6.18

Highlighted

Qtotal (cfs)	= 24.10
Qpipe (cfs)	= 24.10
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 5.12
Veloc Up (ft/s)	= 5.12
HGL Dn (ft)	= 6.85
HGL Up (ft)	= 7.16
Hw Elev (ft)	= 7.59
Hw/D (ft)	= 0.51
Flow Regime	= Inlet Control



Culvert Report

Pro. Cond. - Discharge Pt. B - Ex. (1)-36inch Culvert

Invert Elev Dn (ft)	= 6.29
Pipe Length (ft)	= 68.00
Slope (%)	= 0.16
Invert Elev Up (ft)	= 6.40
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.014
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	= 13.00
Top Width (ft)	= 50.00
Crest Width (ft)	= 1000.00

Calculations

Qmin (cfs)	= 25.30
Qmax (cfs)	= 26.50
Tailwater Elev (ft)	= 6.18

Highlighted

Qtotal (cfs)	= 26.30
Qpipe (cfs)	= 26.30
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.58
Veloc Up (ft/s)	= 6.58
HGL Dn (ft)	= 7.95
HGL Up (ft)	= 8.06
Hw Elev (ft)	= 8.86
Hw/D (ft)	= 0.82
Flow Regime	= Inlet Control