FINAL DRAINAGE REPORT

Crossroads Spine Road Infrastructure
Scottsdale, Arizona

Prepared For:

Diversified Partners

Plan # 3529-13
Case # ______
Q-S # ______
[X] Accepted
[ ] Corrections
M. Rahman 10/2/13
Reviewed By Date

191235046
September 2013

Kimley»Horn

3529-13

2nd KW 9/13/13

FINAL DRAINAGE REPORT

Crossroads Spine Road Infrastructure
Scottsdale, Arizona

Prepared For:

Diversified Partners
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Suite 100A
Scottsdale, Arizona 85250

Prepared By:

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Registered Professional Engineer (Civil)
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ARIZONA U.S.A.
Expires: 9/30/17

191235046
September 2013

Section	Page No.

List of Appendices

List of Figures in Appendix E (Exhibits)

1.0 Introduction

1.1 Project Description

Diversified Partners is proposing to construct spine road infrastructure improvements on a portion of Crossroads East Planning Unit IV (Planning Unit IV) at the northeast corner of Scottsdale Road and Chauncey Lane. The project is anticipated to consist of drive aisles, parking areas, and associated infrastructure. The spine road improvements are being constructed to provide access to future apartment buildings on the northeast portion of the site.

1.2 Site Location

The proposed development encompasses approximately 12.2± net acres in a portion of the Northwest Quarter of Section 35, Township 4 North, Range 4 East of the Gila and Salt River Base and Meridian in Maricopa County, Arizona. The site is a portion of Crossroads East Planning Unit IV (138± acres), and is zoned PCD. More specifically, the parcel is bounded by Bell Lexus of North Scottsdale to the north, 73rd Place to the east, Chauncey Lane to the south, and Scottsdale Road to the west. See *Appendix A* for the site location map and legal description. See Figure 1 in *Appendix E* for a Context Aerial Map.

1.3 Purpose

This Final Drainage Report is intended to satisfy City of Scottsdale requirements and demonstrate conformance to the master drainage plan/study for Crossroads East Planning Unit IV. This report provides a description of the current storm water drainage patterns and systems and a description of the required and proposed drainage improvements.

1.4 Objectives

This report provides a drainage plan for the subject site that is intended to meet the drainage standards and guidelines of the City of Scottsdale and the Flood Control District of Maricopa County (FCDMC). In particular, this report will demonstrate the following:

1. Regional off-site storm water flows from the north are directed around the site by the recently constructed box culvert on the east side of Scottsdale Road.

2. The site drainage patterns will remain consistent with the existing hydrological divide that bisects the site.

3. Permanent drainage facilities will have a positive outfall, and any detained storm water will be disposed of within 36 hours.

4. Drainage facilities will be designed such that the 100-year post-development flows are collected and conveyed in such a manner so as to not cause damage to buildings and property.

2.0 Description of Existing Drainage Conditions and Characteristics

2.1 Existing Drainage Conditions

The site currently consists of a rough-graded pad and temporary surface detention basins. The parcel is bounded on the west by Scottsdale Road, on the north by Bell Lexus of North Scottsdale, on the east by 73rd Place, and on the south by Chauncey Lane.

The general topography of the parcel is mildly sloping terrain at approximately 2%. The rough-graded land generally slopes from the northeast to the southwest. A hydrologic divide bisects the site, directing drainage to two separate regional facilities. Storm water from areas to the west of the hydrologic divide ultimately outfall to Reach 11 (Dike 2) in the City of Phoenix. Storm water from areas to the east of the hydrologic divide ultimately outfall to the TPC Golf Course (Dike 3), in the City of Scottsdale, as outlined in the Crossroads East Planning Unit IV Drainage Report. An earthen berm exists along the hydrological divide to separate flows from the east and west.

Storm water from areas west of the hydrologic divide currently flows southwest towards a temporary detention basin near the intersection of Scottsdale Road and Chauncey Lane. From the basin, it enters the newly-constructed box culvert on the east side of Scottsdale Road and proceeds south to an earthen drainage channel that connects to an existing box culvert under Scottsdale Road at Princess Boulevard; which outfalls to Reach 11.

Storm water from areas east of the hydrologic divide flows southerly towards a temporary detention basin which ultimately discharges to "East Wash" identified on Figure 3 in *Appendix E*. "East Wash" flows south and intersects with an existing channel along the north side of Princess Boulevard, continuing on to the TPC via an existing box culvert under Princess Boulevard.

The site is primarily located west of the hydrologic divide. A portion, at the eastern boundary of the site, is east of the hydrological divide. Three surface detention basins exist along the west side of 73rd Place, on the east side of the hydrological divide. These surface basins currently detain storm water from the west half-street portion of 73rd Place. The natural hydrological divide line was modified with the off-site improvements to 73rd Place and Chauncey Lane via an equivalent land area exchange to maintain flows in accordance with the Crossroads East Planning Unit IV Drainage Report. See Figure 5 (Overall Grading and Drainage Plan for Off-Site Infrastructure) in *Appendix E* for the off-site surface basins and adjusted hydrologic divide to reflect 73rd Place and Chauncey Lane roadway designs.

2.2 Existing Off-Site Drainage Conditions

Two box culverts under the Loop 101 exist north of the site (See Figure 3 in *Appendix E*). These box culverts connect to arch culverts underneath Mayo Boulevard. A newly constructed 8'x3' double-barrel box culvert connects to the arch culverts and routes storm water around the site along the east side of Scottsdale Road. South of Chauncey Lane, the box culverts discharge to an earthen channel that connects to an existing 8'x3' double-barrel box culvert located under Scottsdale Road. No additional off-site storm water is anticipated to impact the site. See Figure 3 (Existing Conditions Topographic Map) in *Appendix E* for off-site drainage paths.

2.3 Context Relative to Adjacent Projects and Improvements

The site is located south of the Mayo Boulevard and Bell Lexus of North Scottsdale, east of Scottsdale Road, north of Chauncey Lane, and west of 73rd Place. See Figure 1 in *Appendix E* for Context Aerial of the site.

2.4 FEMA Flood Hazard Areas

The site is located in Flood Zone "AO" according to the Flood Insurance Rate Map 04013C1245H, dated September 30, 2005. Zone "AO" is designated by FEMA as "areas of flood depths of 1 foot (usually sheet flow on sloping terrain) average depths determined for areas of alluvial fan flooding, velocities also determined." Refer to *Appendix B* for the FEMA FIRMette map for the site. No buildings are proposed with these improvements.

3.0 Proposed Drainage Plan

3.1 General Description

In the analysis of the proposed drainage conditions the following items are considered:

- Area Types (pavement, building, and desert landscaping)
- Magnitude of areas
- Slopes
- Storm Drain
- Detention Basins

3.2 Proposed Site Conditions

The site proposes a combination of previously approved in-kind contribution and detention for the 100-year, 2-hour storm event. The previously approved in-kind contribution, in the form of a regional drainage channel along Scottsdale Road, will be used to convey off-site flows around the parcel and for direct drainage of site-generated storm water west of the hydrologic divide. Detention will be used for site-generated storm water east of the hydrologic divide.

West of Hydrologic Divide

Site-generated storm water from areas west of the hydrologic divide is proposed to be captured in a regional drainage channel and box culvert along Scottsdale Road via multiple storm drain lateral connections. No permanent site surface or underground retention is required or proposed for this area due to the in-kind contribution agreement and the recent construction of a regional drainage channel and box culvert along Scottsdale Road.

East of Hydrologic Divide

Site-generated storm water from areas east of the hydrologic divide will be detained in a surface detention basin near the intersection of 73rd Place and Chauncey Lane. Storm water from this surface basin will be routed south under Chauncey Lane, and will ultimately outfall to "East Wash", in accordance with current drainage patterns.

Storm water from the west side of 73rd Place and the north side of Chauncey Lane is currently detained in three existing surface detention basins on the west side of 73rd Place. Storm water from these basins is routed to the south, through the existing culvert under Chauncey Lane, and ultimately to "East Wash".

As part of the spine road improvements, the northern surface detention basin will be modified and the middle surface detention basin will be eliminated to accommodate the future apartment improvements. The southern basin (Basin C) will be enlarged as part of the spine road improvements to accommodate the displaced storm water. An underground storm drain will be installed from the northern surface detention basin to Basin C. The existing scupper that currently outfalls to the middle surface detention basin will be replaced with a catch basin that connects to the underground storm drain pipe and outfalls to Basin C. The enlarged Basin C will be entirely located to the east of the hydrological divide and will continue to outfall to "East Wash", in accordance with the current drainage patterns.

Per the Crossroads East Planning Unit IV Master Drainage Report, the east side of 73rd Place and the south side of Chauncey Lane will drain to roadside swales, discharging to "East Wash" as an interim condition. Flows in "East Wash" will continue on their current path to the box culvert that crosses south under Princess Boulevard and outfalls into the TPC golf course. See Figure 4 (*Appendix E*) for Site Basin Delineation Map Exhibit.

Future development along the east side of 73rd Place and south side of Chauncey Lane will be responsible for detaining the 100-year, 2-hour storm for their adjacent half streets.

3.3 Proposed Off-Site Conditions

Off-site storm water runoff from north of the Loop 101 onto Planning Unit IV is proposed to be handled in accordance with the Crossroads East Planning Unit IV Master Drainage Report.

The two box culverts that convey storm water from north of the Loop 101 onto Planning Unit IV are being routed around the site with the recently constructed box culvert infrastructure. South of Chauncey Lane, along the east side of Scottsdale Road, off-site storm water from the recently constructed box culvert is conveyed in an interim trapezoidal open channel with grade control structures to the existing box culvert under Scottsdale Road that connects to the Reach 11 (Dike 2). The flows in the box culvert and the interim open channel have been sized to accommodate the future fully-developed portions west of the hydrologic divide as outlined in the Crossroads East Planning Unit IV Drainage Report.

3.4 Future Conditions

It is anticipated that the future apartment development on the northeast portion of the site will occur simultaneously or shortly after the proposed spine road improvements. The apartment development storm drain system will connect to the spine road storm drain system; which has been designed to accommodate its additional flow. Refer to Figure 7 in *Appendix E* for the Conceptual Drainage Area Map for the future apartment development, and to *Appendix C* for the Hydraulic Calculations for the future apartment development.

Future developments for other undeveloped areas of the Crossroads development will also connect to the proposed spine roads storm drain system. Those portions of the spine roads storm drain system have been designed to accommodate flows from the future development areas.

3.5 Storm Water Storage Requirements

As previously stated, the northern surface detention basin along 73rd Place will be modified and the middle surface detention basin will be eliminated as part of the spine road improvements. Basin C will be enlarged to provide detention volume for the displaced storm water volume. Basin C will continue to discharge to an existing culvert under Chauncey Lane and ultimately to "East Wash". The off-site contributing areas to these basins will not be modified with the on-site spine road improvements.

Five temporary surface basins are proposed to be constructed with the on-site spine road improvements. These basins will retain storm water from undeveloped portions of the site, will be one foot deep or less, and will drain via natural percolation. It is anticipated that these basins will be removed with the subsequent development of these areas. Table 1 below summarizes the contributing area, runoff coefficient for the contributing area, and the required and provided retention volumes.

Table 1: Retention Volume Required

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-1	Landscaping	0.45	41,134	3,532		
	Pavement	0.95	0	0		
			41,134	3,532	3,664	132

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-2	Landscaping	0.45	33,123	2,930		
	Pavement	0.95	0	0		
			33,123	2,930	2,960	30

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-3	Landscaping	0.45	91,089	7,822		
	Pavement	0.95	0	0		
			91,089	7,822	7,913	91

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-4	Landscaping	0.45	134,558	11,555		
	Pavement	0.95	0	0		
			134,558	11,555	12,113	558

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-5	Landscaping	0.45	30,157	2,590		
	Pavement	0.95	0	0		
			30,157	2,590	2,806	216

As previously mentioned, Basin C will be enlarged to accommodate both the displaced storm water from the surface basins along 73rd Place, and the additional storm water that is anticipated following the future apartment improvements. Until the future apartment improvements occur, Basin C will have excess storm water storage volume. Table 2 below summarizes the contributing area, runoff coefficient for the contributing area, and the required and provided detention volume for the areas contributing to Basin C.

Table 2: Detention Volume Required

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin C	Landscaping	0.45	48,280	4,146		
	Pavement	0.95	42,104	7,633		
	Displaced Volume	--	--	661		
			90,384	12,440	24,455	12,015

No permanent storm water storage will be provided for areas west of the hydrologic divide due to the approved in-kind contribution in the form of the regional drainage channel along the east side of Scottsdale Road. Three connections to the box culvert are proposed to accommodate the site-generated storm water from the 100-year peak flow associated with the spine road improvements and the future built-out conditions. A Kri-Star Dual-Vortex Hydrodynamic Separator is proposed at each connection to provide storm water quality treatment before discharging into the existing 8'x3' box culvert along Scottsdale Road. See *Appendix C* for information regarding the Kri-Star storm water quality units and Figure 2 in *Appendix E* for the Grading and Drainage Plan.

3.6 Pre- and Post-Development Runoff Characteristics at Concentration Points

The existing site consists of a vacant rough-graded pad. Current topography shows the site draining from northeast to southwest. Upon site development, the site-generated storm water from areas west of the hydrologic divide will sheet flow to catch basins and then be conveyed through underground storm drain to the box culvert along the east side Scottsdale Road. Storm water from areas east of the hydrologic divide will sheet flow to Basin C or temporary retention basin T-5. Storm water from Basin C will outfall to an existing culvert under Chauncey Lane, and ultimately to "East Wash". Upon entering "East Wash", the storm water will flow south to the existing channel along the north side of Princess Boulevard, consistent with the current drainage patterns and the Crossroads East Planning Unit IV Master Drainage Report. Storm water from temporary retention basin T-5 will be disposed of via natural percolation.

3.7 Proposed Drainage Structures or Special Drainage Facilities

Three on-site storm drain connections to the newly constructed box culvert are proposed with the spine road improvements. Each connection to the box culvert will include a Kri-Star Dual-Vortex Hydrodynamic Separator located immediately upstream of the connection.

3.8 ADEQ AZPDES requirements

An executed Notice of Intent (NOI) has been submitted to Arizona Department of Environmental Quality (ADEQ) in conformance with the Arizona Pollution Discharge Elimination System Permit (AZPDES) permit. The NOI and associated storm water management best management practices will remain active on the site until construction is complete and a Notice of Termination is filed with ADEQ in conformance with AZPDES permit. The AZCON number for this project is 77923.

3.9 Project Phasing

This project will be constructed in a single phase.

4.0 Special Conditions

4.1 404 Discussion

Per correspondence with the U.S. Army Corp of Engineers 404 jurisdictional washes are impacted by the proposed Regional Channel improvements, roadway improvements, and temporary drainage basins. A Nationwide permit with the Corp of Engineers has been obtained for the disturbance of the existing 404 jurisdictional wash on-site. See *Appendix D* for Corp of Engineers Letter of Compliance for Nationwide Permit No. 39.

5.0 Data Analysis Methods

5.1 Hydrologic Procedures, Parameter Selection, and Assumptions

Hydrologic calculations for the site were performed using the rational equation in the FCDMC Drainage Design Manual Volume I, which is limited to drainage areas of up to 160 acres. A weighted runoff coefficient was used for the site based upon the large amount of landscaping located adjacent to perimeters of the proposed site.

For analysis of the proposed improvements, the site was sub-divided into 20 sub-basins consisting of paved areas or landscaped areas. For each sub-basin, the Rational equation was used to calculate the peak flow at each concentration point for each basin. The results of the Rational equation are located in *Appendix C*. Figure 4, which identifies the drainage sub-basin and concentration points, is located in *Appendix E*.

5.2 Hydraulic Procedures, Methods, Parameter Selection, and Assumptions

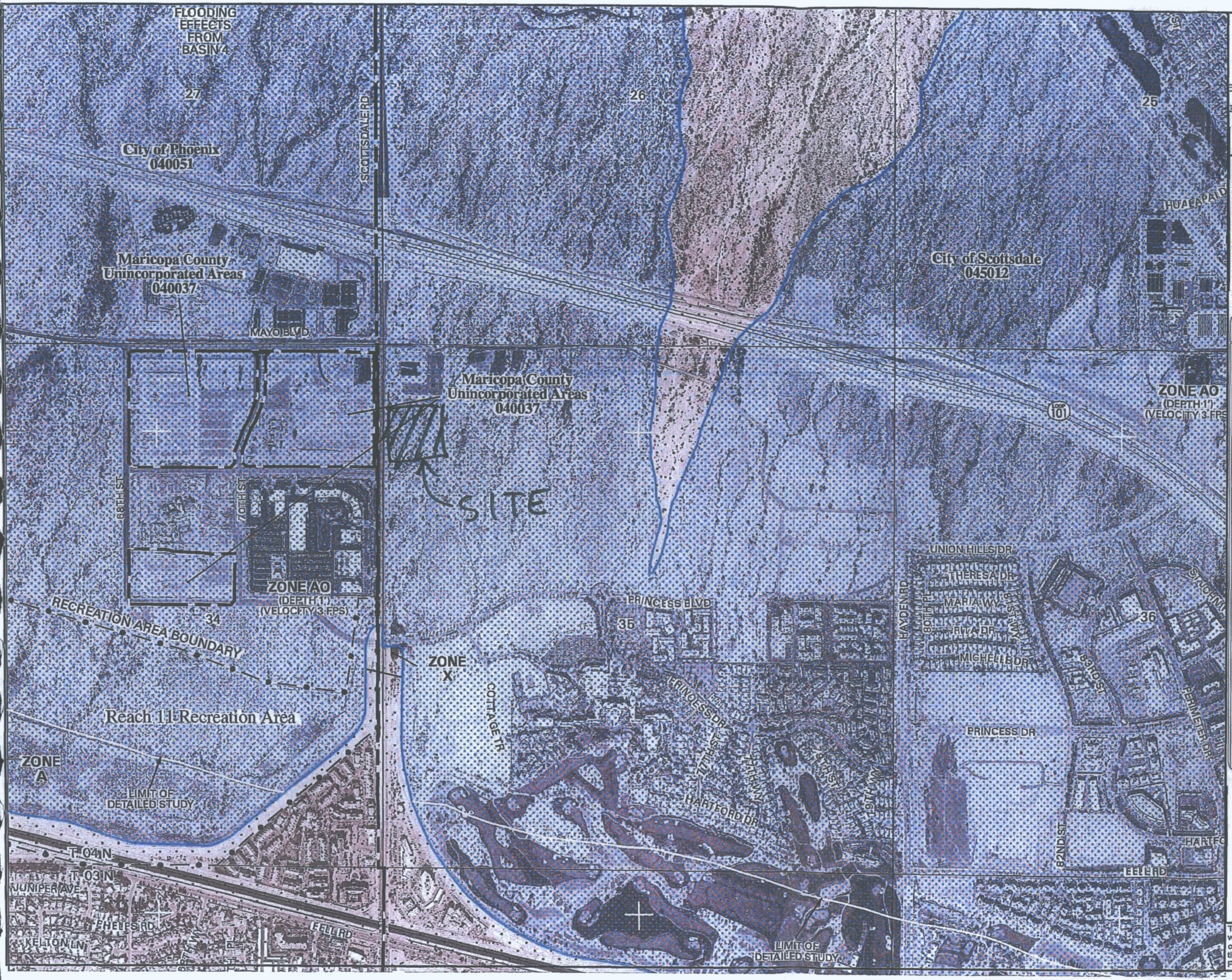
The site is divided into 20 sub-basins that drain into multiple storm drain systems. See Figure 4 in *Appendix E* for sub-basin boundaries and concentration points associated with each drainage basin.

All flows for proposed conditions were determined using the rational method as outlined by the Drainage Design Manual by Maricopa County Flood Control District. Due to the small nature of the watersheds for the individual sub-basins, a minimum time of concentration of five minutes was assumed. All of the drainage basins assume a runoff coefficients of 0.95 (100-year) and 0.85 (10-year) with the exception of the landscape sub-basins. Due to the relatively large amount of landscaping in these areas, a runoff coefficient of 0.45 was used per the City of Scottsdale Design Standards and Policy Manual.

For future development areas, a runoff coefficient of 0.85 (100-year) was used to estimate the future contributing storm water flows for pipe sizing. Therefore, the proposed storm drain system is anticipated to provide sufficient capacity for the built-out Crossroads development. The temporary retention basins located on the future development areas were sized based on a runoff coefficient of 0.45. The peak flows at the sub-basin concentration points were calculated using the Rational equation (see *Appendix C* for hydraulic results).

The following criteria were used to size the proposed pipes for on-site storm water conveyance:

- A maximum allowable 100-year ponding depth of six inches above the catch basin grate.
- The tailwater condition for the 100-year event will be assumed to be the hydraulic grade line at the pipe connection location.
- The 10-year tailwater condition will be assumed to be the pipe crown.



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1245H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 1245 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1245	H
PHOENIX, CITY OF	040051	1245	H
SCOTTSDALE, CITY OF	045012	1245	H

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C1245H

MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix C

Hydrologic/Hydraulic Calculations

Overall Retention Summary - Spine Roads								
Drainage Area	Land Use	Area [A]		Runoff Coefficient [C]	Precipitation Depth [P]	Required Storage (V_{REQ} = CPA/12)		Retention Basin
		sf	ac		in	cf	ac-ft	
5	Landscaping	8,020	0.184	0.45	2.29	689	0.016	Culvert
10	Pavement	8,717	0.200	0.95	2.29	1,580	0.036	Culvert
15	Landscaping	20,355	0.467	0.45	2.29	1,748	0.040	T-1
17	Landscaping	20,779	0.477	0.45	2.29	1,784	0.041	T-1
20	Pavement	11,766	0.270	0.95	2.29	2,133	0.049	Culvert
25	Pavement	13,421	0.308	0.95	2.29	2,433	0.056	Culvert
30	Pavement	8,741	0.201	0.95	2.29	1,585	0.036	Culvert
35	Pavement	10,161	0.233	0.95	2.29	1,842	0.042	Culvert
40	Pavement	9,131	0.210	0.95	2.29	1,655	0.038	Culvert
42	Landscaping	13,978	0.321	0.45	2.29	1,200	0.028	T-2
45	Landscaping	20,145	0.462	0.45	2.29	1,730	0.040	T-2
50	Pavement	12,483	0.287	0.95	2.29	2,263	0.052	Culvert
55	Landscaping	91,089	2.091	0.45	2.29	7,822	0.180	T-3
60	Pavement	7,121	0.163	0.95	2.29	1,291	0.030	Culvert
62	Pavement	9,063	0.208	0.95	2.29	1,643	0.038	Culvert
65	Pavement	14,149	0.325	0.95	2.29	2,565	0.059	Culvert
70	Landscaping	48,280	1.108	0.45	2.29	4,146	0.095	Basin C
75	Pavement	5,487	0.126	0.95	2.29	995	0.023	Basin C
80	Landscaping	134,558	3.089	0.45	2.29	11,555	0.266	T-4
85	Landscaping	30,157	0.692	0.45	2.29	2,590	0.059	T-5
OS 15	Pavement	10,184	0.234	0.95	2.29	1,846	0.042	Basin C
OS 25	Pavement	9,018	0.207	0.95	2.29	1,635	0.038	Basin C
OS 27	Pavement	7,235	0.166	0.95	2.29	1,312	0.030	Basin C
OS 40	Pavement	10,180	0.234	0.95	2.29	1,846	0.042	Basin C
TOTAL	-	**467,444**	**10.731**	-	-	**50,660**	**1.163**	-

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-1	Landscaping	0.45	41,134	3,532		
	Pavement	0.95	0	0		
			41,134	3,532	3,664	132

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-2	Landscaping	0.45	34,123	2,930		
	Pavement	0.95	0	0		
			34,123	2,930	2,960	30

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-3	Landscaping	0.45	91,089	7,822		
	Pavement	0.95	0	0		
			91,089	7,822	7,913	91

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-4	Landscaping	0.45	134,558	11,555		
	Pavement	0.95	0	0		
			134,558	11,555	12,113	558

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
T-5	Landscaping	0.45	30,157	2,590		
	Pavement	0.95	0	0		
			30,157	2,590	2,806	216

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin C	Landscaping	0.45	48,280	4,146		
	Pavement	0.95	42,104	7,633		
	Basin A Volume	–	–	661		
			90,384	12,440	24,455	12,015

Note: Existing surface Basin A is to be modified with these improvements, which will result in a loss of 661 CF of storm water storage volume in Basin A. This volume will be provided in Basin C

Peak Flow Calculations Using The Rational Method

Project:	Chauncey Lane Spine Roads
Proj #:	191235046
Date:	9/5/13
Prep by:	CGF
Check by:	TMJ

Base Sheet Prepared By GA, Version 2

Source of Rainfall Data --->NOAA Atlas 14

Rainfall Depth-Duration-Frequency (D-D-F), (inch)					
Storm Fequency	Time				
	5 min	10 min	15 min	30 min	60 min
10-Yr	0.41	0.63	0.78	1.05	1.29
100-Yr	0.65	0.98	1.22	1.64	2.03
Derived Rainfall Intensity-Duration-Frequency (I-D-F), (in/hr)					
10-Yr	4.92	3.78	3.12	2.10	1.29
100-Yr	7.80	5.88	4.88	3.28	2.03

Attach source and supporting data for rainfall depths

AF for Cw per $Cw_{10\text{-}Yr}$		
Freq.	Typical	Applic.
2-Yr	1.00	1.00
5-Yr	1.00	1.00
10-Yr	1.00	1.00
25-Yr	1.10	1.10
50-Yr	1.20	1.20
100-Yr	1.25	1.25

AF=Frequency Adjustment Factor

Drainage Area ID: -----

Tc,calc method: 1=Papadakis and Kazan, 2=Avg Veloc. — 1 — Tc,calc=11.4*L^0.5*Kb^0.52*S^-0.31*i^-0.38

Cw for each frequency is adjusted as a function of the 100-year value per the table above

													10-Yr					100-Yr				
													Minim allowed Tc,tot =			5.0	Q	Minim allowed Tc,tot =			5.0	Q
Concent. Point #	Contributing Sub-basins	Total Area (ac)	Base Cw (2-10 yr)	Flow Path, L (ft)	Approx High pt (ft)	Approx Low pt (ft)	Average Slope ft/ft	K_b Class A-->D	m	b	K_b	Initial/lot Tc (min)	Cw AF=1.00	Tc,calc (min)	Tc,tot (min)	i (in/hr)	10-Yr (cfs)	Cw AF=1.25	Tc,calc (min)	Tc,tot (min)	i (in/hr)	100-Yr (cfs)
5		0.184	0.45	290	83.7	79.0	0.0163	A	-0.00625	0.04	0.0446	0	0.45	4.4	5.0	4.92	0.4	0.56	3.7	5.0	7.80	0.8
10		0.200	0.95	252	82.2	78.1	0.0166	A	-0.00625	0.04	0.0444	0	0.95	4.0	5.0	4.92	0.9	0.95	3.4	5.0	7.80	1.5
15		0.467	0.85	208	81.3	78.3	0.0144	A	-0.00625	0.04	0.0421	0	0.85	3.7	5.0	4.92	2.0	0.95	3.1	5.0	7.80	3.5
17		0.477	0.85	109	85.3	75.5	0.0899	A	-0.00625	0.04	0.0420	0	0.85	1.5	5.0	4.92	2.0	0.95	1.3	5.0	7.80	3.5
20		0.270	0.95	130	81.3	80.1	0.0092	A	-0.00625	0.04	0.0436	0	0.95	3.4	5.0	4.92	1.3	0.95	2.9	5.0	7.80	2.0
25		0.308	0.95	146	83.4	81.3	0.0144	A	-0.00625	0.04	0.0432	0	0.95	3.2	5.0	4.92	1.4	0.95	2.7	5.0	7.80	2.3
30		0.201	0.95	89	80.9	79.7	0.0135	A	-0.00625	0.04	0.0444	0	0.95	2.6	5.0	4.92	0.9	0.95	2.1	5.0	7.80	1.5
35		0.233	0.95	118	82.9	81.1	0.0153	A	-0.00625	0.04	0.0440	0	0.95	2.8	5.0	4.92	1.1	0.95	2.4	5.0	7.80	1.7
40		0.210	0.95	208	80.1	74.1	0.0288	A	-0.00625	0.04	0.0442	0	0.95	3.1	5.0	4.92	1.0	0.95	2.6	5.0	7.80	1.6
42		0.321	0.85	157	79.6	73.9	0.0363	A	-0.00625	0.04	0.0431	0	0.85	2.5	5.0	4.92	1.3	0.95	2.1	5.0	7.80	2.4
45		0.462	0.85	123	77.6	73.0	0.0374	A	-0.00625	0.04	0.0421	0	0.85	2.1	5.0	4.92	1.9	0.95	1.8	5.0	7.80	3.4
50		0.287	0.95	229	79.9	72.1	0.0341	A	-0.00625	0.04	0.0434	0	0.95	3.0	5.0	4.92	1.3	0.95	2.6	5.0	7.80	2.1
55		2.091	0.85	318	80.5	73.5	0.0220	A	-0.00625	0.04	0.0380	0	0.85	3.8	5.0	4.92	8.7	0.95	3.2	5.0	7.80	15.5
60		0.163	0.95	97	83.1	81.0	0.0216	A	-0.00625	0.04	0.0449	0	0.95	2.3	5.0	4.92	0.8	0.95	1.9	5.0	7.80	1.2
62		0.208	0.95	115	83.4	80.1	0.0287	A	-0.00625	0.04	0.0443	0	0.95	2.3	5.0	4.92	1.0	0.95	1.9	5.0	7.80	1.5
65		0.325	0.95	134	82.9	80.6	0.0172	A	-0.00625	0.04	0.0431	0	0.95	2.9	5.0	4.92	1.5	0.95	2.4	5.0	7.80	2.4
70		1.108	0.85	137	81.1	71.7	0.0686	A	-0.00625	0.04	0.0397	0	0.85	1.8	5.0	4.92	4.6	0.95	1.5	5.0	7.80	8.2

Conceptual Overall Retention Summary - Future Apartments Development								
Drainage Area	Land Use	Area [A]		Runoff Coefficient [C]	Precipitation Depth [P]	Required Storage (V_{REQ} = CPA/12)		Retention Basin
		sf	ac		in	cf	ac-ft	
5	Building	1,783	0.041	0.95	2.29	323	0.007	Culvert
10	Landscaping	1,124	0.026	0.45	2.29	97	0.002	Culvert
15	Pavement	6,941	0.159	0.95	2.29	1,258	0.029	Culvert
20	Building	1,783	0.041	0.95	2.29	323	0.007	Culvert
25	Landscaping	418	0.010	0.45	2.29	36	0.001	Culvert
30	Building	615	0.014	0.95	2.29	111	0.003	Culvert
35	Building	1,164	0.027	0.95	2.29	211	0.005	Culvert
40	Pavement	10,005	0.230	0.95	2.29	1,814	0.042	Culvert
45	Landscaping	734	0.017	0.45	2.29	63	0.001	Culvert
50	Pavement	9,189	0.211	0.95	2.29	1,666	0.038	Culvert
55	Building	882	0.020	0.95	2.29	160	0.004	Culvert
60	Building	902	0.021	0.95	2.29	164	0.004	Culvert
65	Landscaping	1,126	0.026	0.45	2.29	97	0.002	Basin C
70	Landscaping	3,596	0.083	0.45	2.29	309	0.007	Basin C
75	Pavement	30,563	0.702	0.95	2.29	5,541	0.127	Basin C
80	Building	7,288	0.167	0.95	2.29	1,321	0.030	Culvert
85	Pavement	3,267	0.075	0.95	2.29	592	0.014	Culvert
90	Pavement	3,999	0.092	0.95	2.29	725	0.017	Culvert
95	Pavement	11,312	0.260	0.95	2.29	2,051	0.047	Culvert
100	Building	10,296	0.236	0.95	2.29	1,867	0.043	Culvert
105	Pavement	7,209	0.165	0.95	2.29	1,307	0.030	Basin C
110	Pavement	12,278	0.282	0.95	2.29	2,226	0.051	Basin C
115	Landscaping	3,438	0.079	0.45	2.29	295	0.007	Basin C
120	Building	7,075	0.162	0.95	2.29	1,283	0.029	Culvert
125	Building	8,861	0.203	0.95	2.29	1,606	0.037	Culvert
130	Building	18,860	0.433	0.95	2.29	3,419	0.078	Culvert
135	Pavement	5,487	0.126	0.95	2.29	995	0.023	Basin C
OS5	Pavement	11,890	0.273	0.95	2.29	2,156	0.049	Basin A*
OS15	Pavement	10,184	0.234	0.95	2.29	1,846	0.042	Basin C
OS25	Pavement	9,018	0.207	0.95	2.29	1,635	0.038	Basin C
OS27	Pavement	7,235	0.166	0.95	2.29	1,312	0.030	Basin C
OS40	Pavement	10,180	0.234	0.95	2.29	1,846	0.042	Basin C
OS70	Landscaping	3,703	0.085	0.45	2.29	318	0.007	Basin C
OS81	Landscaping	52,073	1.195	0.45	2.29	4,472	0.103	Basin C
TOTAL	-	**274,478**	**6.301**	-	-	**43,443**	**0.997**	-

Basin	Land Use	Runoff Coefficient	Drainage Area (ft^2)	Required Volume (ft^3)	Provided Volume (ft^3)	Surplus (ft^3)
Basin C	Landscaping	0.45	63,936	5,491		
	Building	0.95	0	0		
	Pavement	0.95	92,154	16,707		
	Basin A Volume	–	–	661		
			156,090	22,858	24,455	1,597

*Note: As part of the spine roads improvements, Basin A will be modified and this will result in a loss of 661 CF of storm water volume in Basin A. This storm water volume will be provided in Basin C.

Peak Flow Calculations Using The Rational Method

Project:	Conceptual Future Apartments Development
Proj #:	191316002
Date:	9/5/13
Prep by:	CGF
Check by:	TMJ

Base Sheet Prepared By GA, Version 2

Source of Rainfall Data --->NOAA Atlas 14

Rainfall Depth-Duration-Frequency (D-D-F), (inch)					
Storm Fequency	Time 5 min	10 min	15 min	30 min	60 min
10-Yr	0.41	0.63	0.78	1.05	1.29
100-Yr	0.65	0.98	1.22	1.64	2.03
Derived Rainfall Intensity-Duration-Frequency (I-D-F), (in/hr)					
10-Yr	4.92	3.78	3.12	2.10	1.29
100-Yr	7.80	5.88	4.88	3.28	2.03

Attach source and supporting data for rainfall depths

AF for Cw per $Cw_{10\text{-}Yr}$		
Freq.	Typical	Applic.
2-Yr	1.00	1.00
5-Yr	1.00	1.00
10-Yr	1.00	1.00
25-Yr	1.10	1.10
50-Yr	1.20	1.20
100-Yr	1.25	1.25

AF=Frequency Adjustment Factor

Drainage Area ID: -----

Tc,calc method: 1=Papadakis and Kazan, 2=Avg Veloc. — 1 — Tc,calc=11.4*L^0.5*Kb^0.52*S^-0.31*i^-0.38

Cw for each frequency is adjusted as a function of the 100-year value per the table above

Concent. Point #	Contributing Sub-basins	Total Area (ac)	Base Cw (2-10 yr)	Flow Path, L (ft)	Approx High pt (ft)	Approx Low pt (ft)	Average Slope ft/ft	K_b Class A-->D	m	b	K_b	Initial/lot Tc (min)	10-Yr (Minim allowed Tc,tot = 5.0) Cw AF=1.00	Tc,calc (min)	Tc,tot (min)	i (in/hr)	Q 10-Yr (cfs)	100-Yr (Minim allowed Tc,tot = 5.0) Cw AF=1.25	Tc,calc (min)	Tc,tot (min)	i (in/hr)	Q 100-Yr (cfs)
5		0.04	0.95	76	84.6	83.6	0.0132	A	-0.00625	0.04	0.0487	0	0.95	2.5	5.0	4.92	0.2	0.95	2.1	5.0	7.80	0.3
10		0.03	0.45	86	89.15	84.3	0.0564	A	-0.00625	0.04	0.0499	0	0.45	1.7	5.0	4.92	0.1	0.56	1.4	5.0	7.80	0.1
15		0.16	0.95	72	84.1	83.1	0.0139	A	-0.00625	0.04	0.0450	0	0.95	2.3	5.0	4.92	0.7	0.95	1.9	5.0	7.80	1.2
20		0.04	0.95	76	85.1	84.1	0.0132	A	-0.00625	0.04	0.0487	0	0.95	2.5	5.0	4.92	0.2	0.95	2.1	5.0	7.80	0.3
25		0.01	0.45	30	89.1	84.2	0.1633	A	-0.00625	0.04	0.0526	0	0.45	0.7	5.0	4.92	0.02	0.56	0.6	5.0	7.80	0.04
30		0.01	0.95	34	85.2	84.2	0.0294	A	-0.00625	0.04	0.0516	0	0.95	1.3	5.0	4.92	0.1	0.95	1.1	5.0	7.80	0.1
35		0.03	0.95	54	85.2	84.2	0.0185	A	-0.00625	0.04	0.0498	0	0.95	1.9	5.0	4.92	0.1	0.95	1.6	5.0	7.80	0.2
40		0.23	0.95	92	84.2	82.9	0.0141	A	-0.00625	0.04	0.0440	0	0.95	2.6	5.0	4.92	1.1	0.95	2.1	5.0	7.80	1.7
45		0.02	0.45	62	89.1	84.6	0.0726	A	-0.00625	0.04	0.0511	0	0.45	1.4	5.0	4.92	0.04	0.56	1.1	5.0	7.80	0.1
50		0.21	0.95	81	84.5	83	0.0185	A	-0.00625	0.04	0.0442	0	0.95	2.2	5.0	4.92	1.0	0.95	1.9	5.0	7.80	1.6
55		0.02	0.95	42	85.6	84.6	0.0238	A	-0.00625	0.04	0.0506	0	0.95	1.6	5.0	4.92	0.1	0.95	1.3	5.0	7.80	0.2
60		0.02	0.95	42	85.6	84.6	0.0238	A	-0.00625	0.04	0.0505	0	0.95	1.6	5.0	4.92	0.1	0.95	1.3	5.0	7.80	0.2
65		0.03	0.45	65	89	84.8	0.0646	A	-0.00625	0.04	0.0499	0	0.45	1.4	5.0	4.92	0.1	0.56	1.2	5.0	7.80	0.1
70		0.08	0.45	192	84	81.8	0.0115	A	-0.00625	0.04	0.0468	0	0.45	4.1	5.0	4.92	0.2	0.56	3.4	5.0	7.80	0.4
75		0.70	0.95	203	84.5	81.8	0.0133	A	-0.00625	0.04	0.0410	0	0.95	3.7	5.0	4.92	3.3	0.95	3.1	5.0	7.80	5.2
80		0.17	0.95	85	84.7	83.7	0.0118	A	-0.00625	0.04	0.0449	0	0.95	2.6	5.0	4.92	0.8	0.95	2.2	5.0	7.80	1.2
85		0.08	0.95	59	83.4	82.3	0.0186	A	-0.00625	0.04	0.0470	0	0.95	1.9	5.0	4.92	0.4	0.95	1.6	5.0	7.80	0.6
90		0.09	0.95	82	83.4	82.9	0.0061	A	-0.00625	0.04	0.0465	0	0.95	3.2	5.0	4.92	0.4	0.95	2.7	5.0	7.80	0.7
95		0.26	0.95	96	83.7	82.5	0.0125	A	-0.00625	0.04	0.0437	0	0.95	2.7	5.0	4.92	1.2	0.95	2.3	5.0	7.80	1.9
100		0.24	0.95	125	83.7	82.7	0.0080	A	-0.00625	0.04	0.0439	0	0.95	3.5	5.0	4.92	1.1	0.95	3.0	5.0	7.80	1.8
105		0.17	0.95	59	83.4	82.5	0.0153	A	-0.00625	0.04	0.0449	0	0.95	2.0	5.0	4.92	0.8	0.95	1.7	5.0	7.80	1.2
110		0.28	0.95	137	82.9	80.8	0.0153	A	-0.00625	0.04	0.0434	0	0.95	3.0	5.0	4.92	1.3	0.95	2.5	5.0	7.80	2.1
115		0.08	0.45	111	82.4	80.8	0.0144	A	-0.00625	0.04	0.0469	0	0.45	2.9	5.0	4.92	0.2	0.56	2.4	5.0	7.80	0.3

Peak Flow Calculations Using The Rational Method

Project:	Conceptual Future Apartments Development
Proj #:	191316002
Date:	9/5/13
Prep by:	CGF
Check by:	TMJ

Base Sheet Prepared By GA, Version 2

Source of Rainfall Data --->NOAA Atlas 14

Rainfall Depth-Duration-Frequency (D-D-F), (inch)					
Storm Fequency	Time				
	5 min	10 min	15 min	30 min	60 min
10-Yr	0.41	0.63	0.78	1.05	1.29
100-Yr	0.65	0.98	1.22	1.64	2.03
Derived Rainfall Intensity-Duration-Frequency (I-D-F), (in/hr)					
10-Yr	4.92	3.78	3.12	2.10	1.29
100-Yr	7.80	5.88	4.88	3.28	2.03

Attach source and supporting data for rainfall depths

AF for Cw per $Cw_{10\text{-}Yr}$		
Freq.	Typical	Applic.
2-Yr	1.00	1.00
5-Yr	1.00	1.00
10-Yr	1.00	1.00
25-Yr	1.10	1.10
50-Yr	1.20	1.20
100-Yr	1.25	1.25

AF=Frequency Adjustment Factor

Drainage Area ID: -----

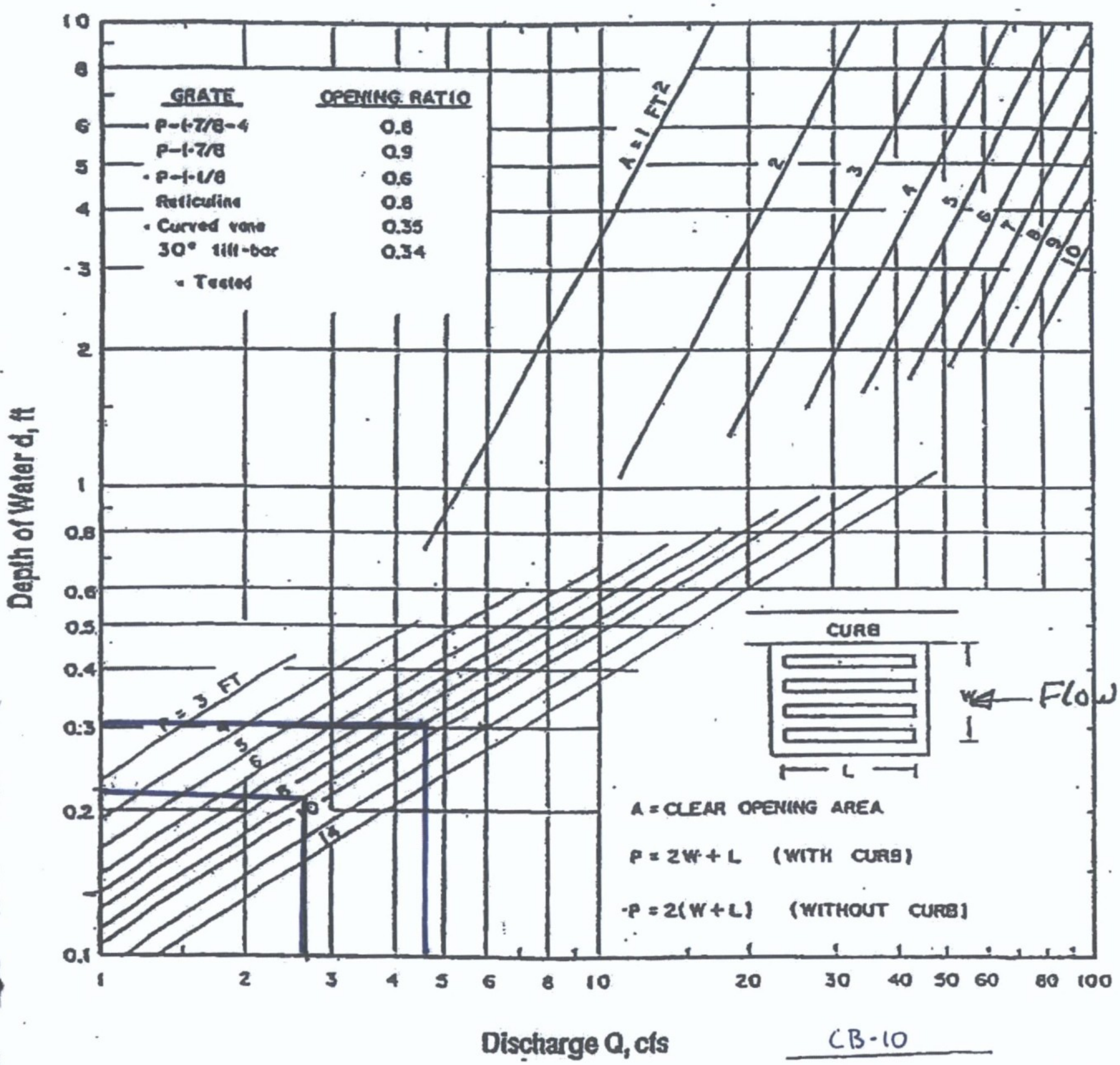
Tc,calc method: 1=Papadakis and Kazan, 2=Avg Veloc.

1 Tc,calc=11.4*L^0.5*Kb^0.52*S^-0.31*i^-0.38

Cw for each frequency is adjusted as a function of the 100-year value per the table above

Concent. Point #	Contributing Sub-basins	Total Area (ac)	Base Cw (2-10 yr)	Flow Path, L (ft)	Approx High pt (ft)	Approx Low pt (ft)	Average Slope ft/ft	K_b Class A-->D	m	b	K_b	Initial/lot Tc (min)	10-Yr (Minim allowed Tc,tot = 5.0) Cw AF=1.00	Tc,calc (min)	Tc,tot (min)	i (in/hr)	Q 10-Yr (cfs)	100-Yr (Minim allowed Tc,tot = 5.0) Cw AF=1.25	Tc,calc (min)	Tc,tot (min)	i (in/hr)	Q 100-Yr (cfs)
120		0.16	0.95	77	84.4	83.4	0.0130	A	-0.00625	0.04	0.0449	0	0.95	2.4	5.0	4.92	0.8	0.95	2.0	5.0	7.80	1.2
125		0.20	0.95	122	84.4	83.4	0.0082	A	-0.00625	0.04	0.0443	0	0.95	3.5	5.0	4.92	1.0	0.95	2.9	5.0	7.80	1.5
130		0.43	0.95	189	84.4	83.4	0.0053	A	-0.00625	0.04	0.0423	0	0.95	4.9	5.0	4.92	2.0	0.95	4.1	5.0	7.80	3.2
135		0.13	0.95	116	82.6	78.72	0.0334	A	-0.00625	0.04	0.0456	0	0.95	2.2	5.0	4.92	0.6	0.95	1.9	5.0	7.80	0.9
OS5		0.27	0.95	380	90.26	85.3	0.0131	A	-0.00625	0.04	0.0435	0	0.95	5.3	5.3	4.92	1.3	0.95	4.4	5.0	7.80	2.0
OS15		0.23	0.95	334	85.5	81	0.0135	A	-0.00625	0.04	0.0439	0	0.95	4.9	5.0	4.92	1.1	0.95	4.1	5.0	7.80	1.7
OS25		0.21	0.95	285	81	77.2	0.0133	A	-0.00625	0.04	0.0443	0	0.95	4.6	5.0	4.92	1.0	0.95	3.8	5.0	7.80	1.5
OS27		0.17	0.95	142	77.3	76.7	0.0042	A	-0.00625	0.04	0.0449	0	0.95	4.7	5.0	4.92	0.8	0.95	3.9	5.0	7.80	1.2
OS40		0.23	0.95	261	77.2	74	0.0123	A	-0.00625	0.04	0.0439	0	0.95	4.5	5.0	4.92	1.1	0.95	3.8	5.0	7.80	1.7
OS70		0.09	0.45	129	85.6	82	0.0279	A	-0.00625	0.04	0.0467	0	0.45	2.5	5.0	4.92	0.2	0.56	2.1	5.0	7.80	0.4
OS81		1.20	0.45	117	79.6	72	0.0650	A	-0.00625	0.04	0.0395	0	0.45	1.7	5.0	4.92	2.6	0.56	1.4	5.0	7.80	5.2

Inlet Nomographs



CB-10

STD DETAIL MAG 534

Q_{10} = 2.6 cfs Ponding Depth = 0.23 ft

Q_{100} = 4.6 cfs Ponding Depth = 0.31 ft

50% Clogging factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)

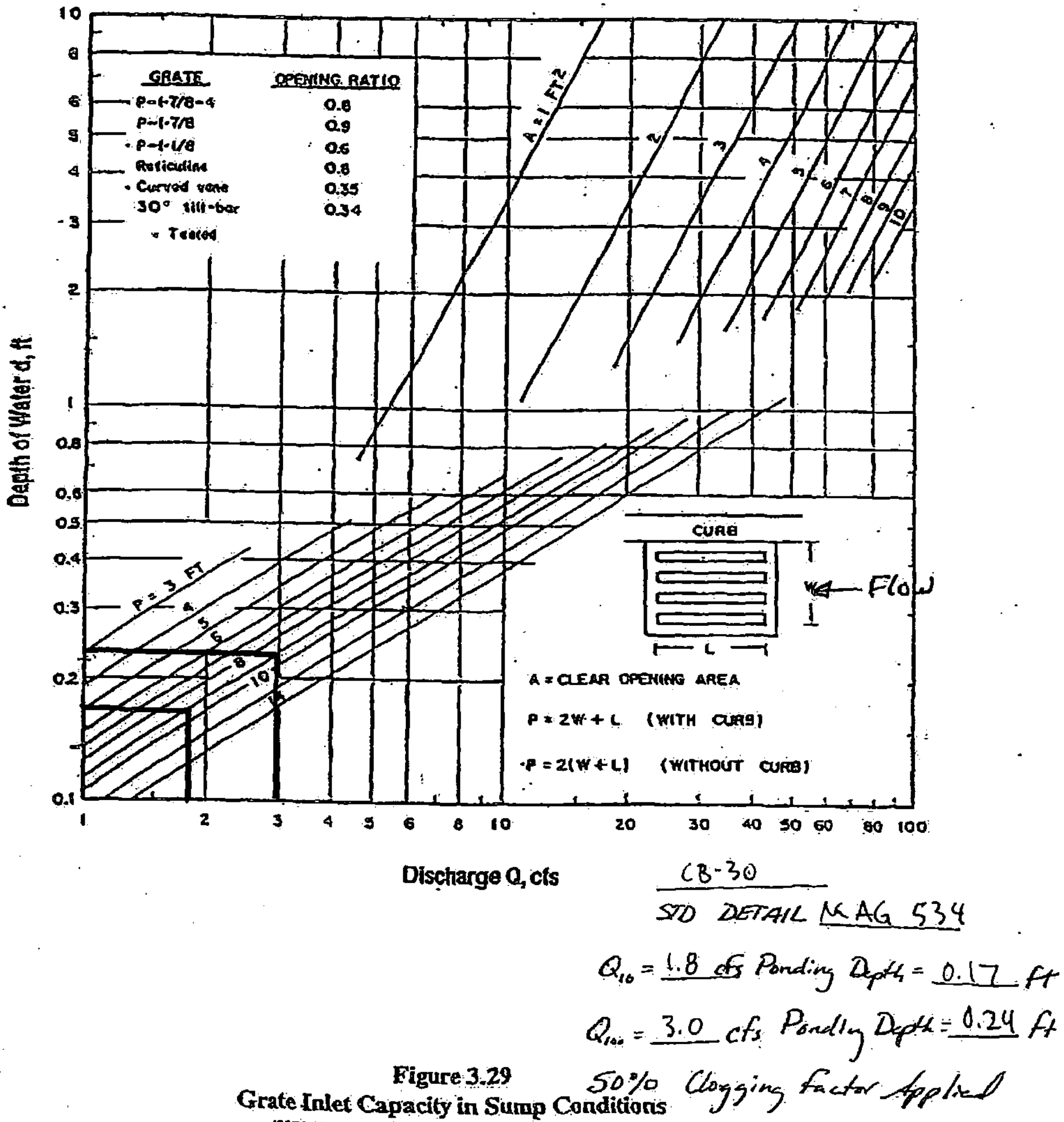
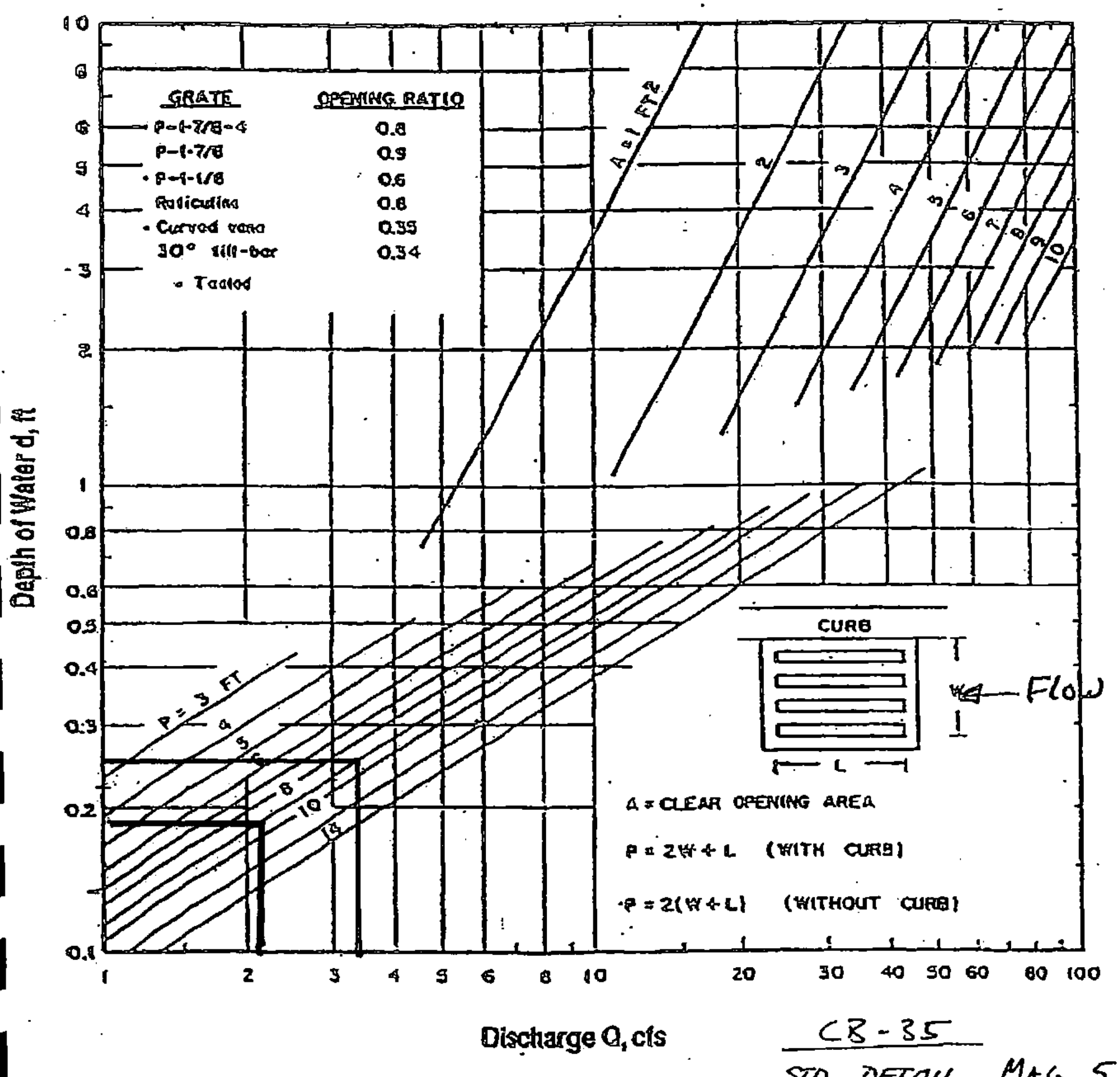


Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



CB-35

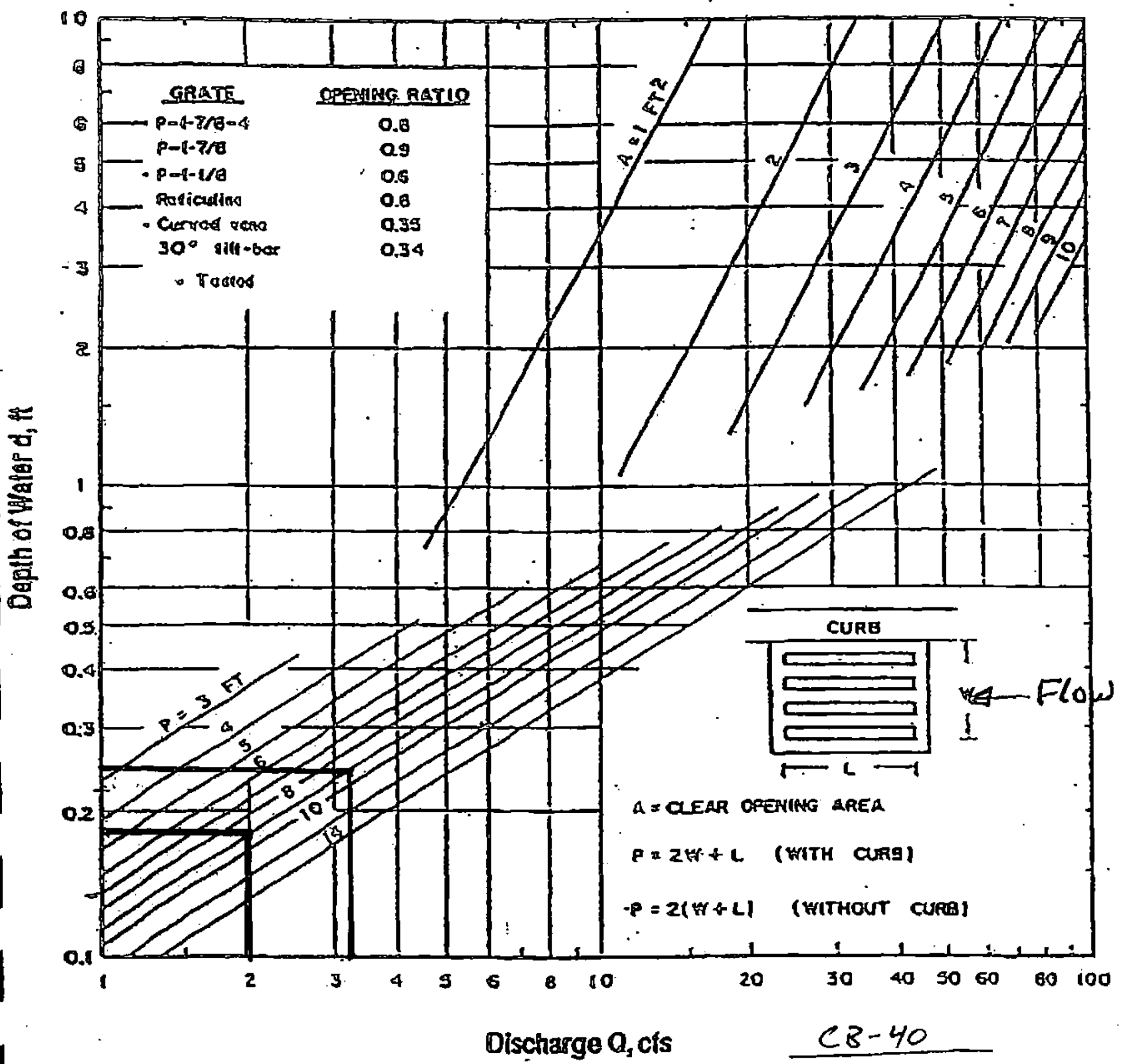
STD DETAIL MAG 534

Q_{10} = 2.2 cfs Ponding Depth = 0.19 ft

Q_{100} = 3.4 cfs Ponding Depth = 0.25 ft

50% Clogging Factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



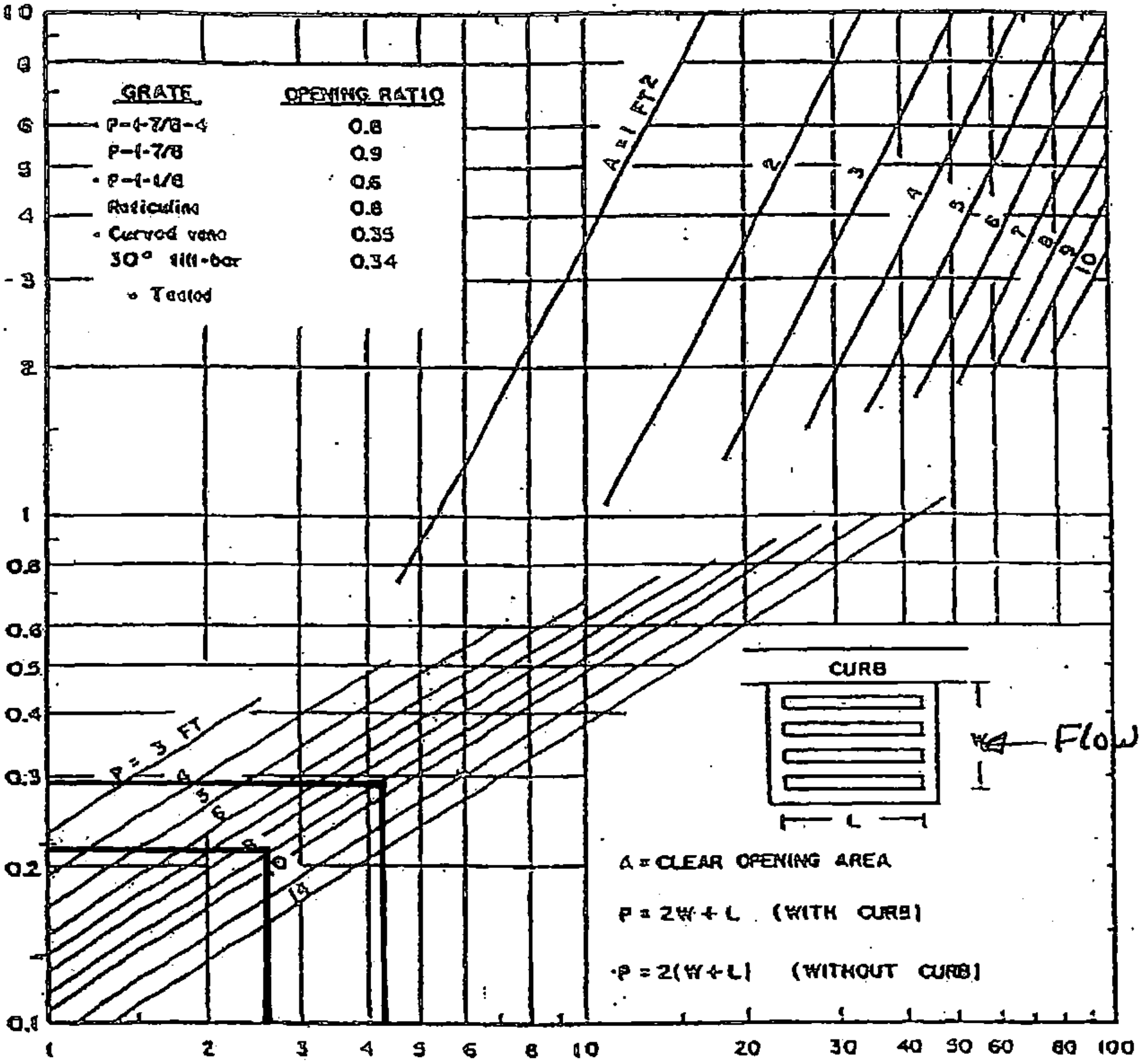
CB-40
STD DETAIL MAG 534

Q_{10} = 2.0 cfs Ponding Depth = 0.18 ft

Q_{100} = 3.2 cfs Ponding Depth = 0.24 ft

50% Clogging Factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



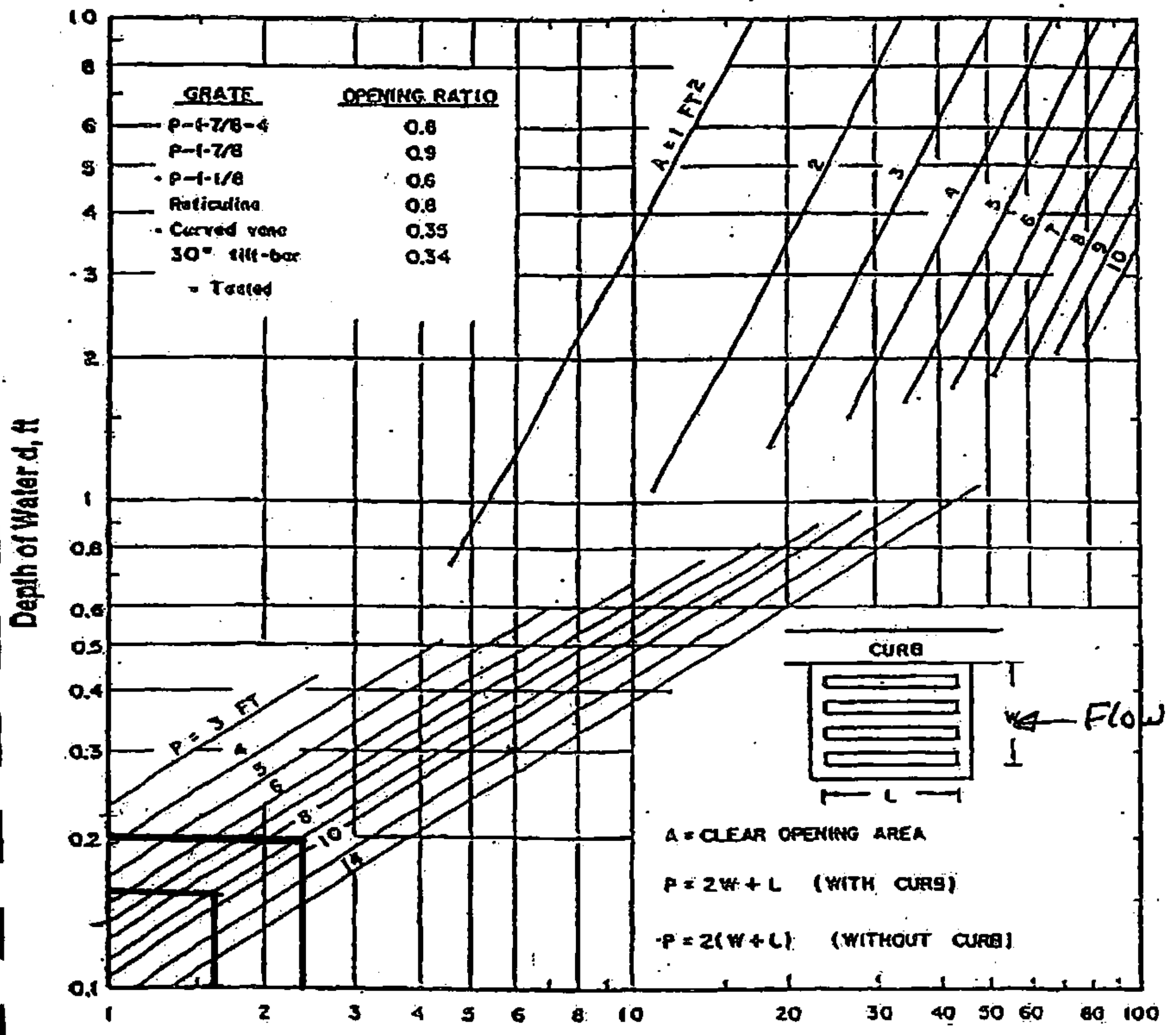
CB-50
STD DETAIL MAG 534

Q_{10} = 2.6 cfs Ponding Depth = 0.22 ft

Q_{100} = 4.2 cfs Ponding Depth = 0.29 ft

50% Clogging factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



CB-60
STD DETAIL MAG 534
Q_{10} = 1.6 cfs Ponding Depth = 0.16 ft
Q_{100} = 2.4 cfs Ponding Depth = 0.20 ft
50% Clogging Factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)

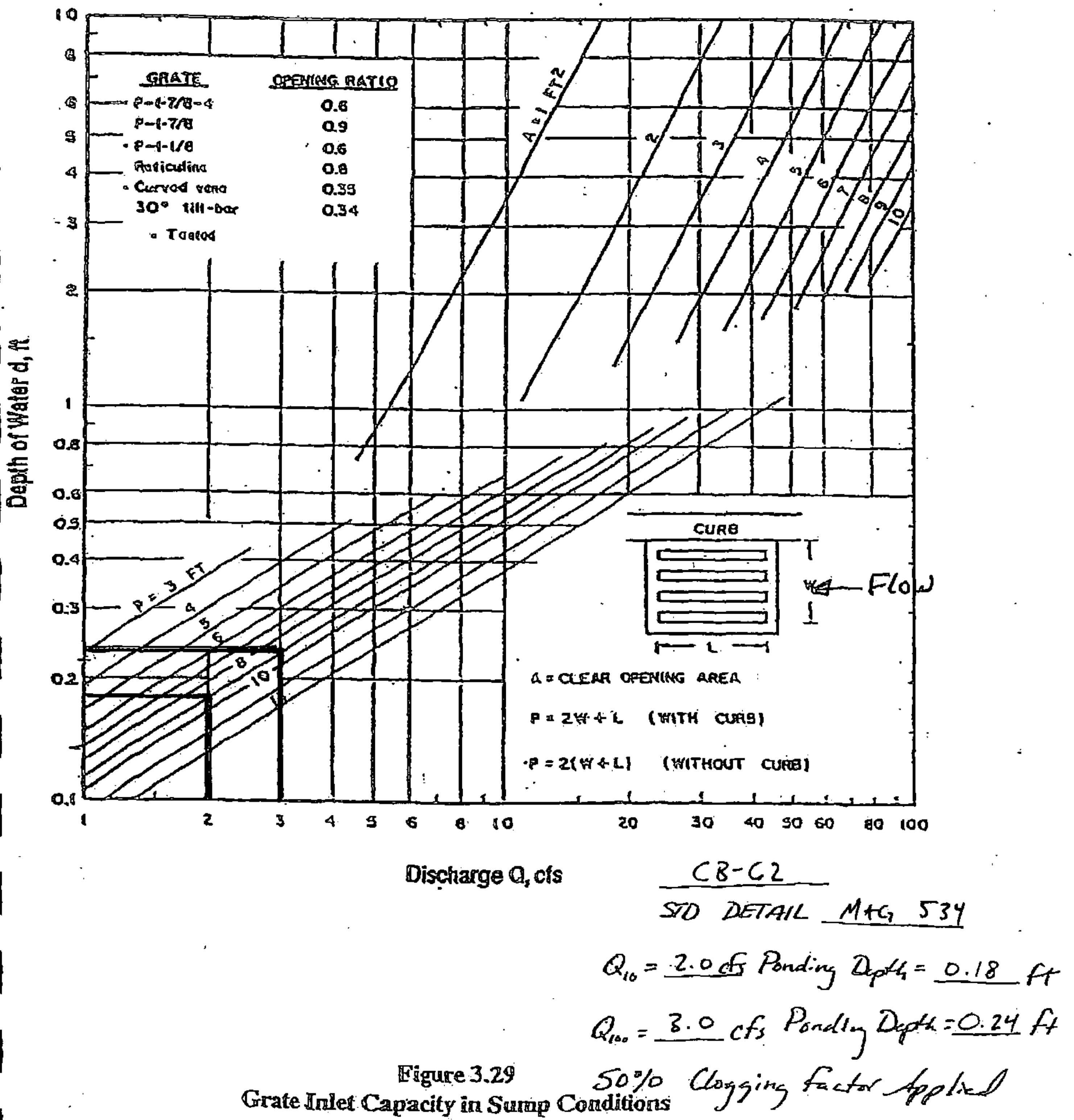
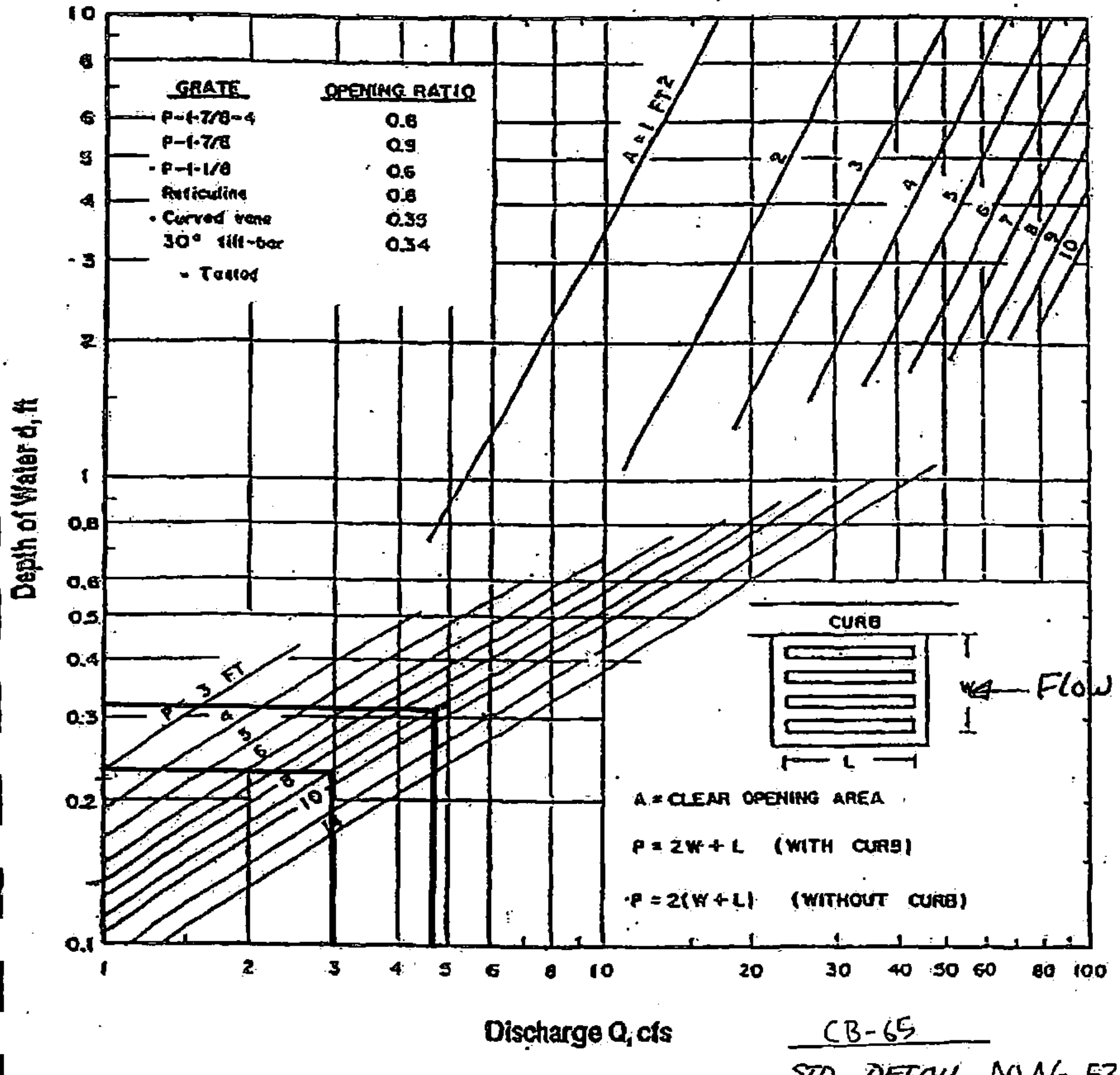


Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



CB-65

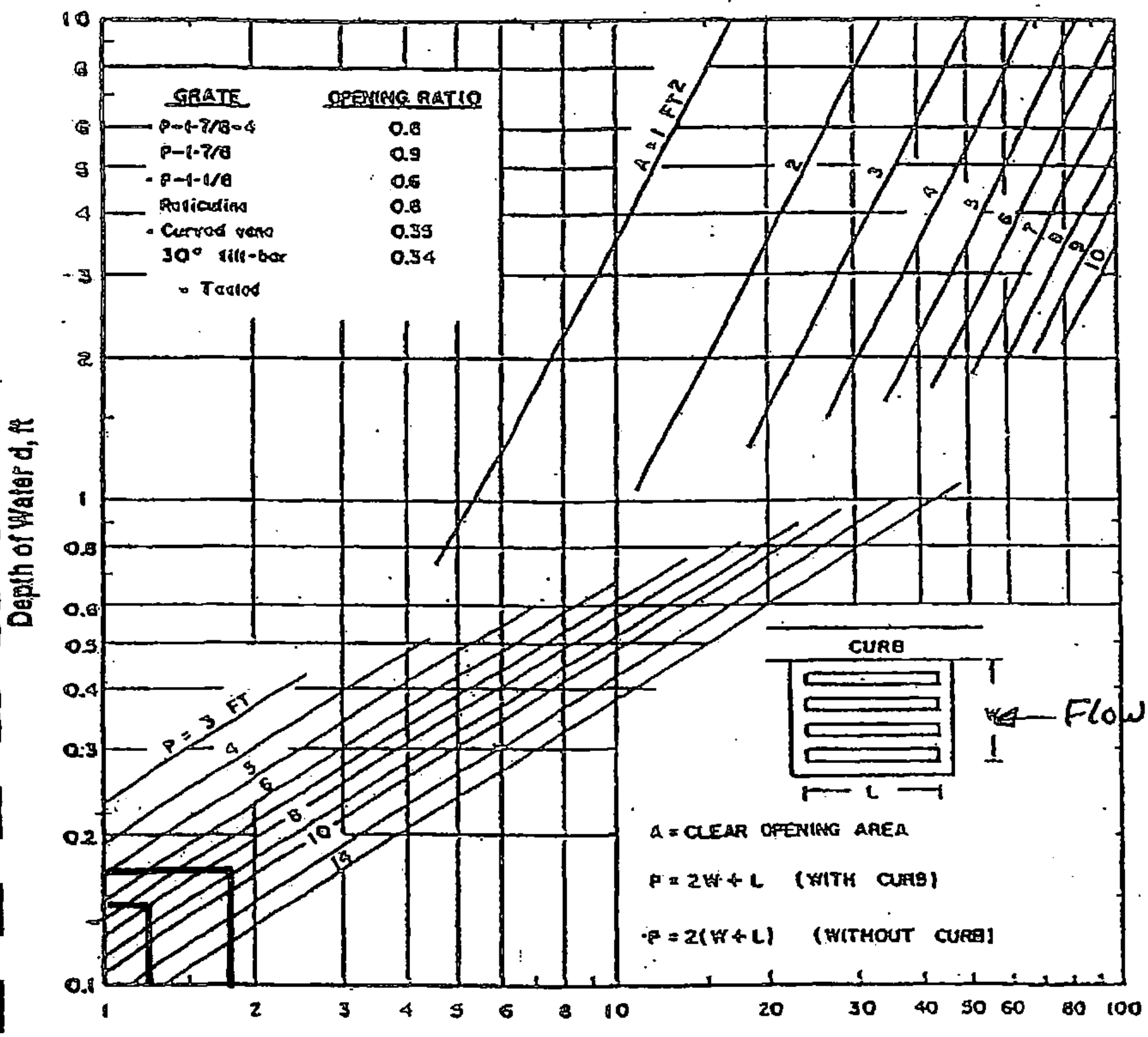
STD DETAIL MAG 534

Q_{10} = 3.0 cfs Ponding Depth = 0.24 ft

Q_{100} = 4.8 cfs Ponding Depth = 0.32 ft

50% Clogging factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)



CB-75

STD DETAIL MAG 534

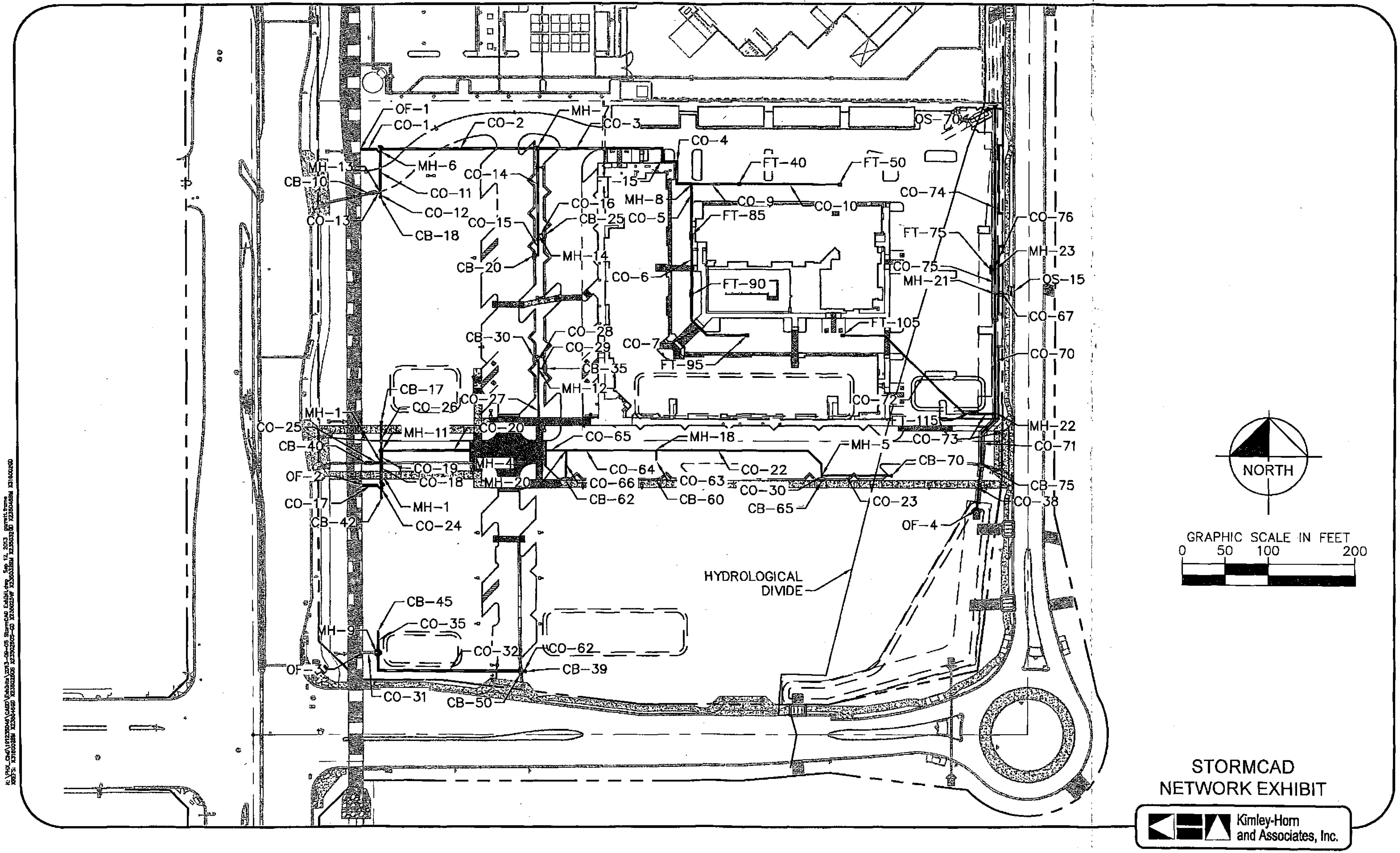
Q_{10} = 1.2 cfs Ponding Depth = 0.15 ft

Q_{100} = 1.8 cfs Ponding Depth = 0.175 ft

50% Clogging factor Applied

Figure 3.29
Grate Inlet Capacity in Sump Conditions
(USDOT, FHWA, 1984, HEC-12, Chart 11)

10-Year StormCAD Model



OF-1
CO-1
CO-2
MH-7
CO-3
CO-4
OS-70
FT-40
FT-50
MH-13
MH-6
CB-10
CO-14
FT-15
CO-11
MH-8
CO-9
CO-10
CO-74
CO-12
CO-16
CO-13
CO-15
CB-25
CO-5
FT-85
CO-76
CB-18
FT-75
MH-23
MH-14
CB-20
CO-75
CO-6
MH-21
OS-15
FT-90
CO-67
FT-105
CO-28
CB-30
CO-29
CO-7
CO-70
CB-35
FT-95
MH-12
CB-17
CO-27
CO-72
CO-26
MH-1
FT-115
CO-25
MH-11
CO-20
CO-65
MH-18
MH-22
CO-73
CB-40
MH-5
CO-71
CB-70
CO-19
MH-4
CO-64
CO-22
OF-2
CO-18
MH-20
CO-66
CO-63
CB-75
CO-30
CO-17
CB-62
CB-60
CO-23
CO-38
MH-1
CB-65
CB-42
OF-4
CO-24
HYDROLOGICAL
DIVIDE
CB-45
CO-35
MH-9
CO-32
CO-62
OF-3
CB-39
CO-31
CB-50
NORTH
GRAPHIC SCALE IN FEET
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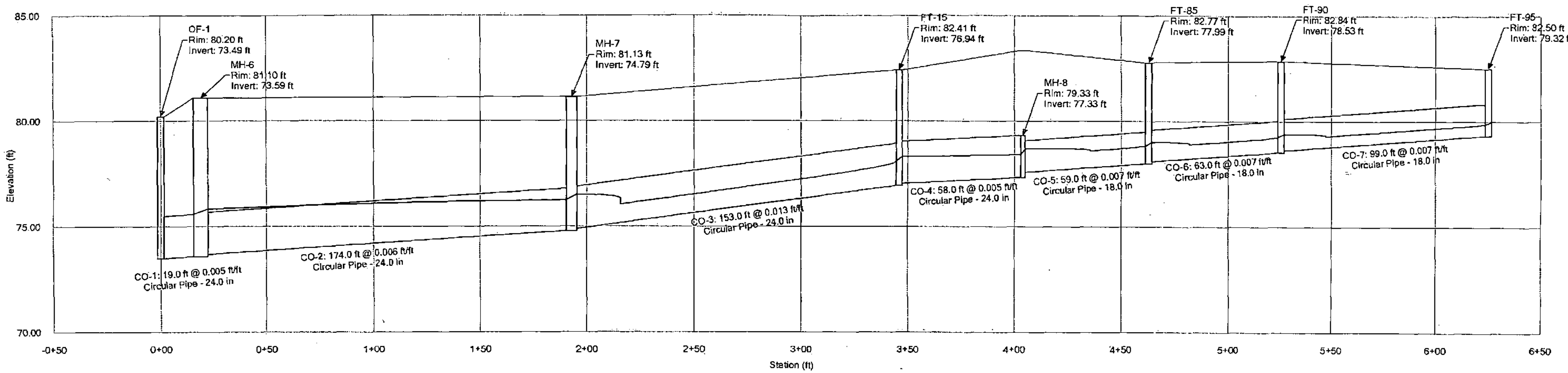
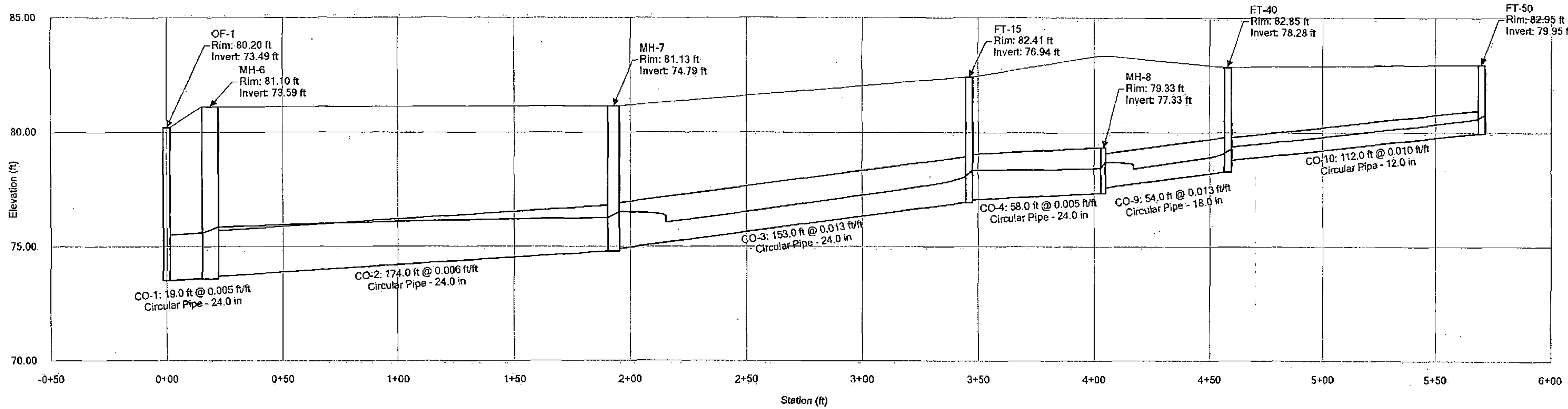
50
100
200
STORMCAD
NETWORK EXHIBIT
Kimley-Horn
and Associates, Inc.

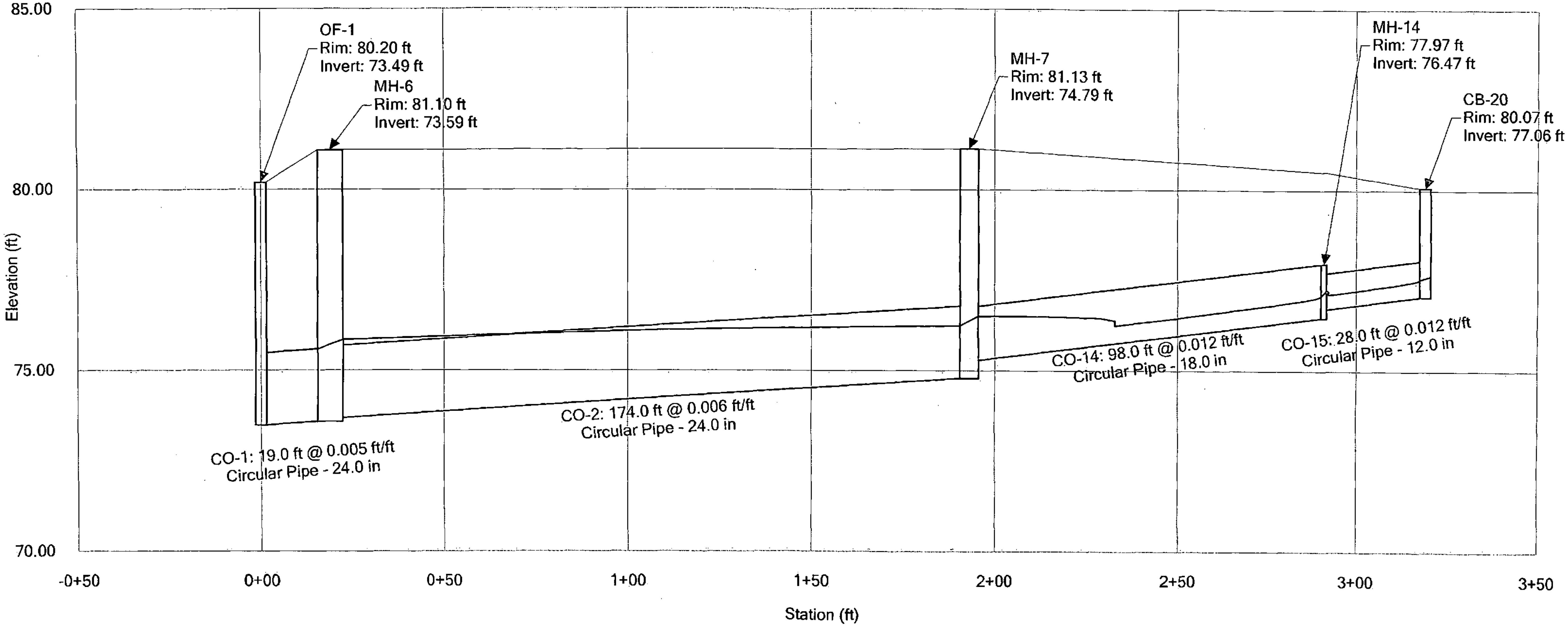
10 Year Profile - North System - Future South Inlet



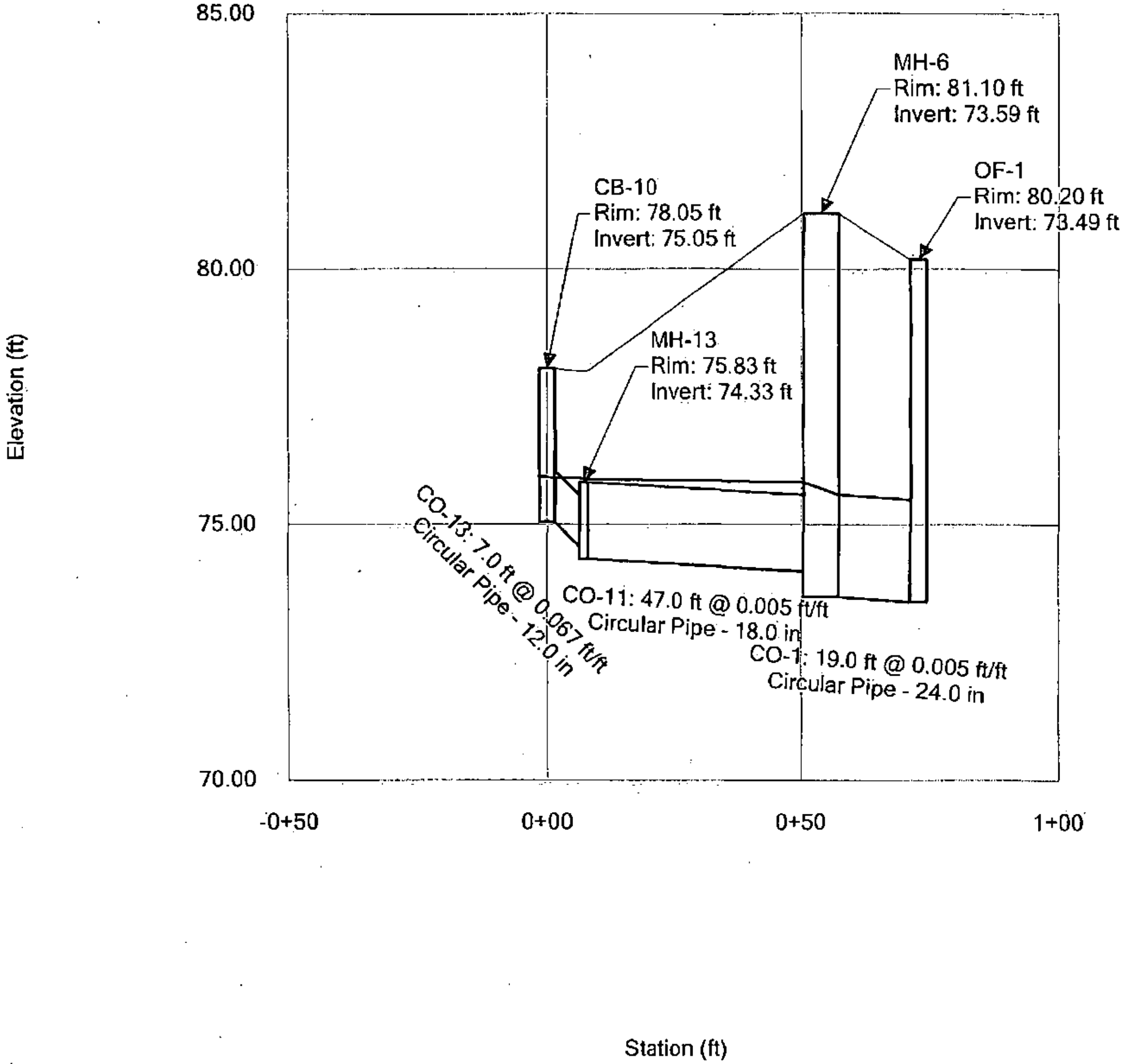
10 Year Profile - North System - Future North Inlet



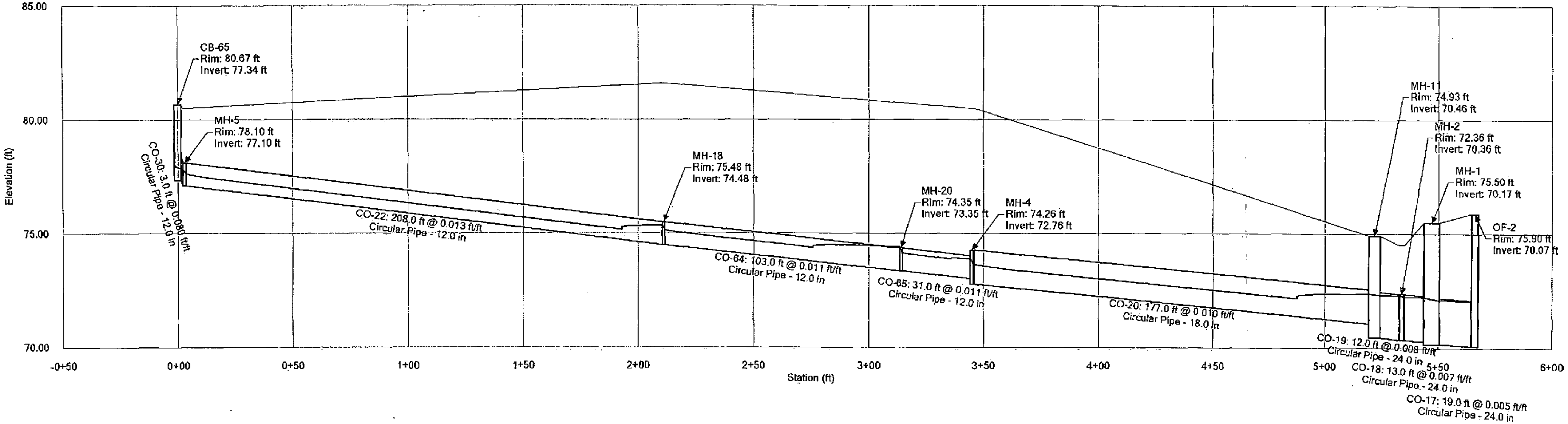
10 Year Profile - North System -Island Inlet



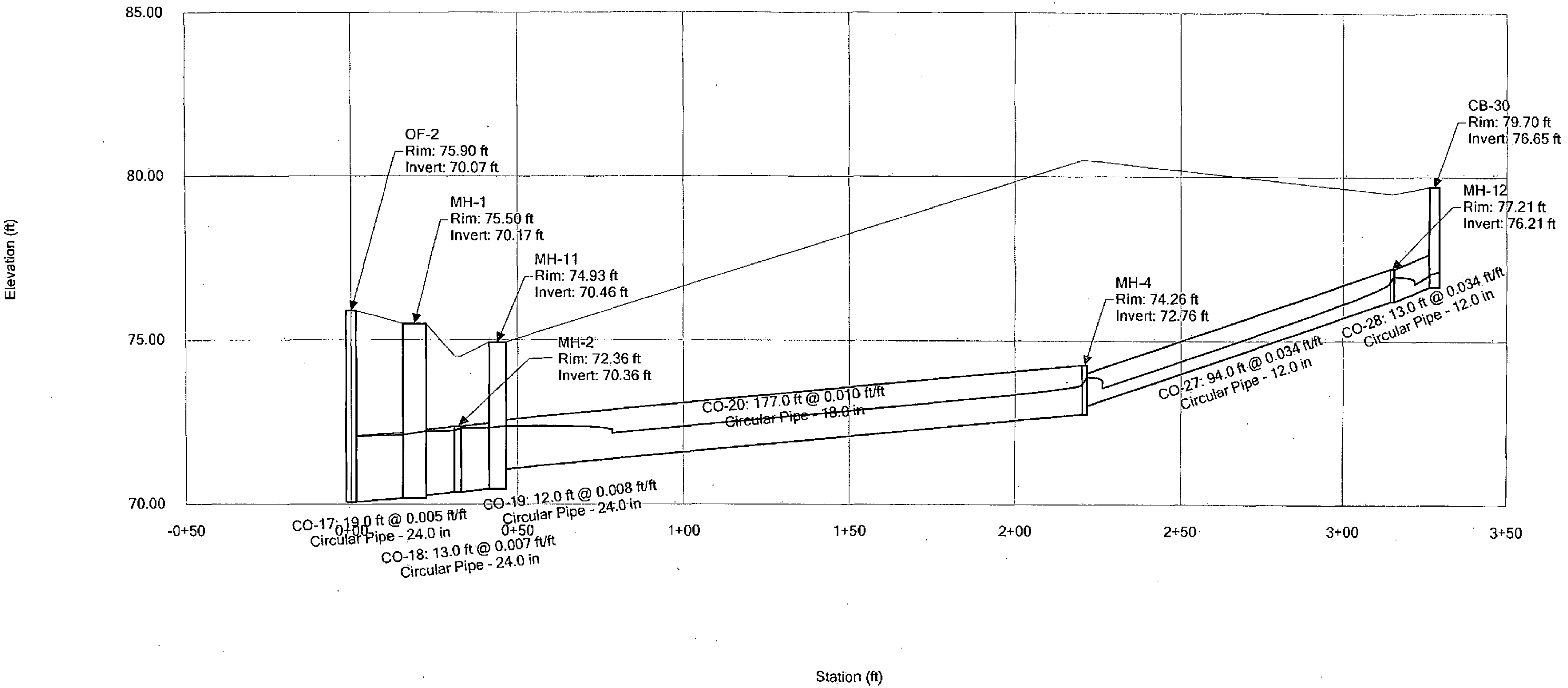
10 Year Profile - North System - Driveway Inlet

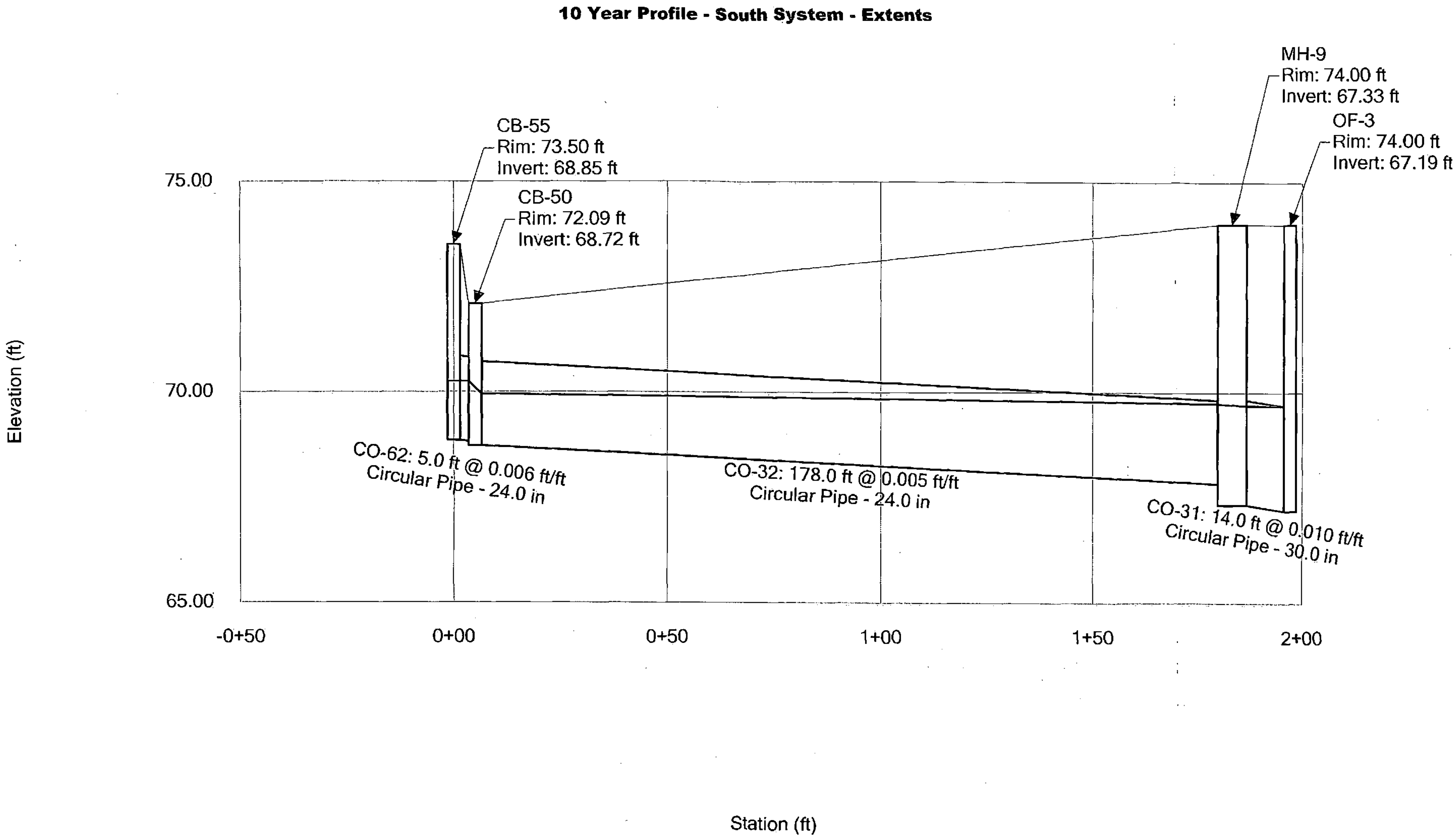


10 Year Profile - Middle System - East Inlet

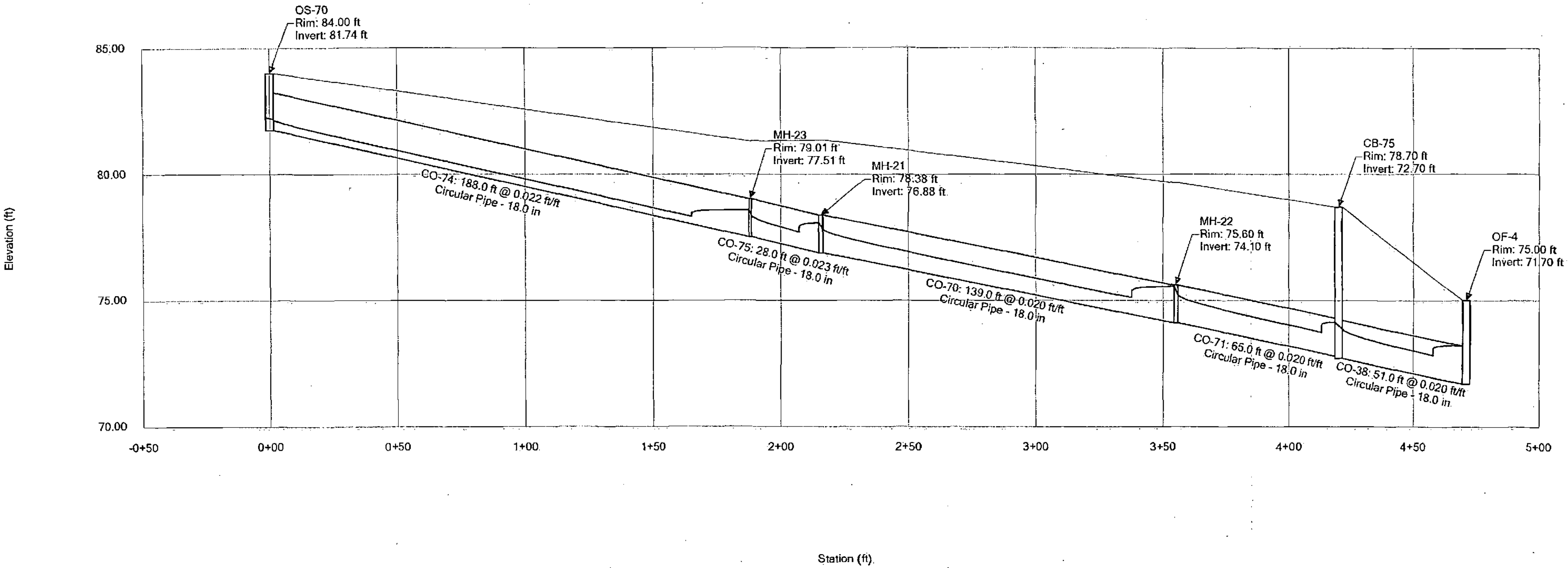


10 Year Profile - Middle System - Island Inlet

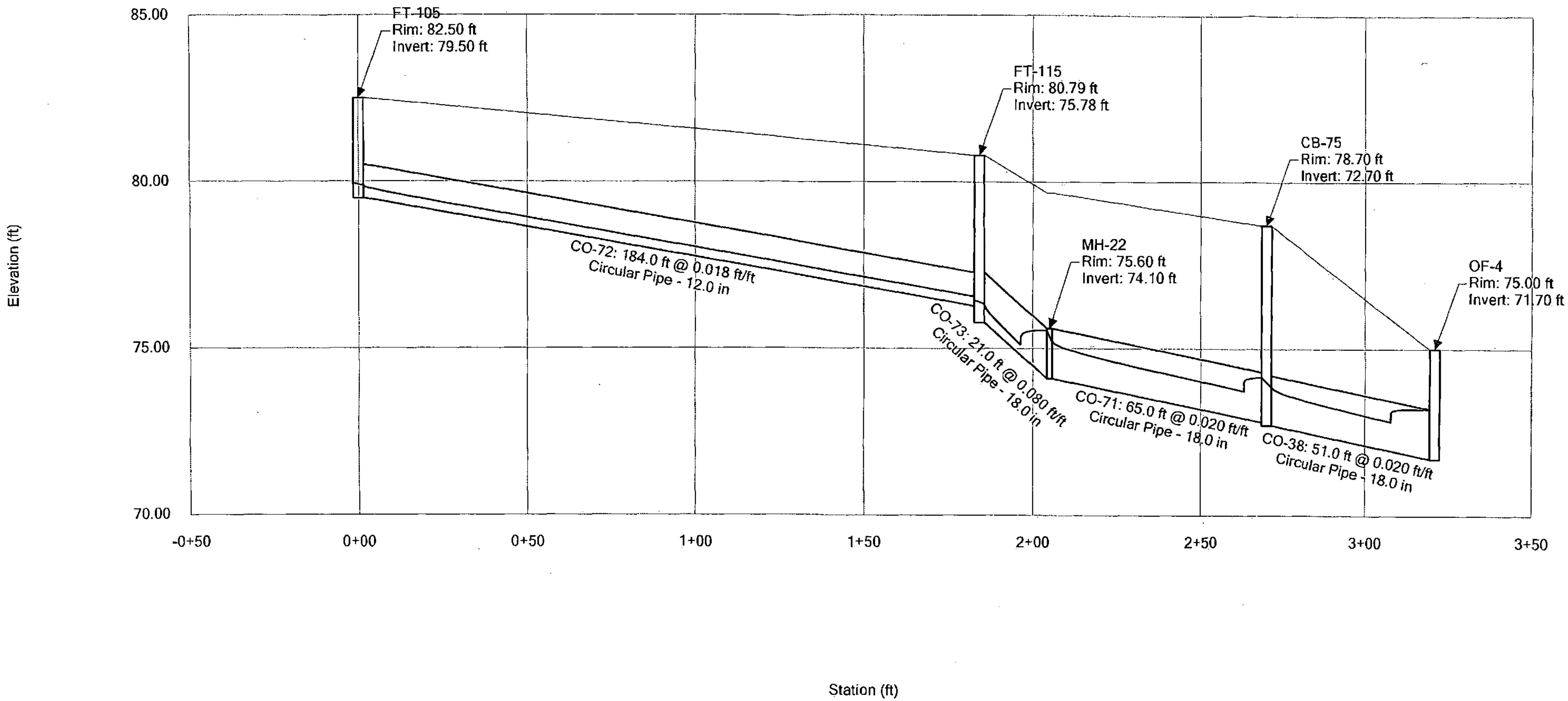



10 Year Profile - South System - Extents
MH-9
Rim: 74.00 ft
Invert: 67.33 ft
OF-3
Rim: 74.00 ft
Invert: 67.19 ft
CB-55
Rim: 73.50 ft
Invert: 68.85 ft
CB-50
Rim: 72.09 ft
Invert: 68.72 ft
75.00
70.00
65.00
Elevation (ft)
CO-62: 5.0 ft @ 0.006 ft/ft
Circular Pipe - 24.0 in
CO-32: 178.0 ft @ 0.005 ft/ft
Circular Pipe - 24.0 in
CO-31: 14.0 ft @ 0.010 ft/ft
Circular Pipe - 30.0 in
-0+50
0+00
0+50
1+00
1+50
2+00
Station (ft)

10 Year Profile - East System - North Offsite Inlet



10 Year Profile - East System - Future Area Inlet



10 Year Inlet Report

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Location	Flow (Additional) (ft^3/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Is Flooded?
CB-10	78.05	75.05	In Sag	1.30	75.95	75.92	False
CB-15	77.50	74.36	In Sag	2.00	75.93	75.92	False
CB-17	74.50	71.25	In Sag	2.00	72.38	72.37	False
CB-20	80.07	77.06	In Sag	1.30	77.64	77.54	False
CB-25	81.25	77.20	In Sag	1.40	77.80	77.70	False
CB-30	79.70	76.65	In Sag	0.90	77.12	77.05	False
CB-35	81.11	76.69	In Sag	1.10	77.22	77.13	False
CB-40	74.08	71.06	In Sag	1.00	72.33	72.32	False
CB-42	73.50	70.64	In Sag	1.30	72.23	72.22	False
CB-45	74.50	68.38	In Sag	1.90	69.76	69.75	False
CB-50	72.09	68.72	In Sag	1.30	70.25	69.95	False
CB-55	73.50	68.85	In Sag	8.70	70.25	70.25	False
CB-60	81.03	77.04	In Sag	0.80	77.48	77.41	False
CB-62	79.96	74.28	In Sag	1.00	74.78	74.70	False
CB-65	80.67	77.34	In Sag	1.50	77.96	77.86	False
CB-70	80.50	77.51	In Sag	0.20	77.80	77.79	False
CB-75	78.70	72.70	In Sag	0.60	74.15	73.86	False
FT-15	82.41	76.94	In Sag	1.00	78.33	78.09	False
FT-40	82.85	78.28	In Sag	2.22	79.27	79.10	False
FT-50	82.95	79.95	In Sag	2.34	80.75	80.60	False
FT-75	81.29	78.00	In Sag	3.60	79.03	78.81	False
FT-85	82.77	77.99	In Sag	1.20	79.00	78.83	False
FT-90	82.84	78.53	In Sag	1.40	79.40	79.25	False
FT-95	82.50	79.32	In Sag	2.20	79.98	79.88	False
FT-105	82.50	79.50	In Sag	0.80	79.94	79.87	False
FT-115	80.79	75.78	In Sag	1.50	76.46	76.35	False
OS-15	80.21	77.21	In Sag	1.10	78.11	78.09	False
OS-70	84.00	81.74	In Sag	1.40	82.26	82.18	False

10 Year Pipe Report

Label	Start Node	Stop Node	Length (Unified) (ft)	Slope (ft/ft)	Flow (Link) (ft³/s)	Capacity (Full Flow) (ft³/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Cover (Start) (ft)	Cover (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (Average) (ft/s)
CO-1	MH-6	OF-1	19.0	0.005	16.36	16.41	73.59	73.49	81.10	80.20	5.51	4.71	75.59	75.49	5.95
CO-2	MH-7	MH-6	174.0	0.006	13.06	17.99	74.79	73.69	81.13	81.10	4.34	5.41	76.24	75.84	6.24
CO-3	FT-15	MH-7	153.0	0.013	10.36	26.18	76.94	74.89	82.41	81.13	3.47	4.24	78.09	76.51	7.85
CO-4	MH-8	FT-15	58.0	0.005	9.36	16.00	77.33	77.04	83.35	82.41	4.02	3.37	78.43	78.33	5.29
CO-5	FT-85	MH-8	59.0	0.007	4.80	8.76	77.99	77.58	82.77	83.35	3.28	4.27	78.83	78.69	5.07
CO-6	FT-90	FT-85	63.0	0.007	3.60	8.78	78.53	78.09	82.84	82.77	2.81	3.18	79.25	79.00	4.72
CO-7	FT-95	FT-90	99.0	0.007	2.20	8.77	79.32	78.63	82.50	82.84	1.68	2.71	79.88	79.40	4.13
CO-9	FT-40	MH-8	54.0	0.013	4.56	11.96	78.28	77.58	82.85	83.35	3.07	4.27	79.10	78.69	6.31
CO-10	FT-50	FT-40	112.0	0.010	2.34	3.64	79.95	78.78	82.95	82.85	2.00	3.07	80.60	79.36	4.92
CO-11	MH-13	MH-6	47.0	0.005	3.30	7.51	74.33	74.09	78.00	81.10	2.17	5.51	75.89	75.84	1.87
CO-12	CB-15	MH-13	6.0	0.005	2.00	7.43	74.36	74.33	77.50	78.00	1.64	2.17	75.92	75.92	1.13
CO-13	CB-10	MH-13	7.0	0.067	1.30	9.23	75.05	74.58	78.05	78.00	2.00	2.42	75.92	75.92	8.30
CO-14	MH-14	MH-7	98.0	0.012	2.70	11.53	76.47	75.29	80.50	81.13	2.53	4.34	77.09	76.51	5.33
CO-15	CB-20	MH-14	28.0	0.012	1.30	3.93	77.06	76.72	80.07	80.50	2.01	2.78	77.54	77.23	4.49
CO-16	CB-25	MH-14	6.0	0.080	1.40	10.08	77.20	76.72	81.25	80.50	3.05	2.78	77.70	77.23	9.03
CO-17	MH-1	OF-2	19.0	0.005	9.80	16.41	70.17	70.07	75.50	75.90	3.33	3.83	72.10	72.07	5.45
CO-18	MH-2	MH-1	13.0	0.007	8.50	18.82	70.36	70.27	74.50	75.50	2.14	3.23	72.24	72.22	5.84
CO-19	MH-11	MH-2	12.0	0.008	7.50	20.65	70.46	70.36	74.93	74.50	2.47	2.14	72.31	72.31	6.05
CO-20	MH-4	MH-11	177.0	0.010	5.50	10.29	72.76	71.06	80.50	74.93	6.24	2.37	73.66	72.37	5.92
CO-22	MH-5	MH-18	208.0	0.013	1.70	4.00	77.10	74.48	80.50	81.58	2.40	6.10	77.65	75.34	4.89
CO-23	CB-70	MH-5	81.0	0.005	0.20	2.53	77.51	77.10	80.50	80.50	1.99	2.40	77.79	77.79	1.93
CO-24	CB-42	MH-1	5.0	0.010	1.30	10.50	70.64	70.59	73.50	75.50	1.36	3.41	72.22	72.22	0.74
CO-25	CB-40	MH-2	12.0	0.017	1.00	4.60	71.06	70.86	74.08	74.50	2.02	2.64	72.32	72.31	1.27
CO-26	CB-17	MH-11	17.0	0.011	2.00	11.10	71.25	71.06	74.50	74.93	1.75	2.37	72.37	72.37	4.76
CO-27	MH-12	MH-4	94.0	0.034	2.00	6.57	76.21	73.01	79.50	80.50	2.29	6.49	76.81	73.89	7.35
CO-28	CB-30	MH-12	13.0	0.034	0.90	6.55	76.65	76.21	79.70	79.50	2.05	2.29	77.05	76.97	5.85
CO-29	CB-35	MH-12	6.0	0.080	1.10	10.08	76.69	76.21	81.11	79.50	3.42	2.29	77.13	76.97	8.42
CO-30	CB-65	MH-5	3.0	0.080	1.50	10.08	77.34	77.10	80.67	80.50	2.33	2.40	77.86	77.79	9.21
CO-31	MH-9	OF-3	14.0	0.010	11.90	41.01	67.33	67.19	74.00	74.00	4.17	4.31	69.70	69.69	7.24
CO-32	CB-50	MH-9	178.0	0.005	10.00	16.00	68.72	67.83	72.09	74.00	1.37	4.17	69.95	69.74	5.37
CO-35	CB-45	MH-9	5.0	0.010	1.90	10.50	68.38	68.33	74.50	74.00	4.62	4.17	69.75	69.74	4.51
CO-38	CB-75	OF-4	51.0	0.020	9.00	14.71	72.70	71.70	78.70	75.00	4.50	1.80	73.86	73.20	8.74
CO-62	CB-55	CB-50	5.0	0.006	8.70	17.52	68.85	68.82	73.50	72.09	2.65	1.27	70.25	70.25	5.57
CO-63	CB-60	MH-18	32.0	0.080	0.80	10.08	77.04	74.48	81.03	81.58	2.99	6.10	77.41	75.34	7.65
CO-64	MH-18	MH-20	103.0	0.011	2.50	3.73	74.48	73.35	81.58	80.74	6.10	6.38	75.16	74.40	5.09
CO-65	MH-20	MH-4	31.0	0.011	3.50	3.74	73.35	73.01	80.74	80.50	6.38	6.49	74.15	73.89	5.41
CO-66	CB-62	MH-20	34.0	0.027	1.00	5.89	74.28	73.35	79.96	80.74	4.68	6.38	74.70	74.40	5.59
CO-67	OS-15	MH-21	16.0	0.005	1.10	2.52	77.21	77.13	80.21	81.35	2.00	3.22	78.09	78.08	3.10
CO-70	MH-21	MH-22	139.0	0.020	6.10	14.85	76.88	74.10	81.35	79.67	2.97	4.07	77.83	75.55	7.99
CO-71	MH-22	CB-75	65.0	0.020	8.40	14.85	74.10	72.80	79.67	78.70	4.07	4.40	75.22	74.15	8.66
CO-72	FT-105	FT-115	184.0	0.018	0.80	4.71	79.50	76.28	82.50	80.79	2.00	3.51	79.87	76.56	4.48
CO-73	FT-115	MH-22	21.0	0.080	2.30	29.71	75.78	74.10	80.79	79.67	3.51	4.07	76.35	75.55	9.98
CO-74	OS-70	MH-23	188.0	0.022	1.40	15.76	81.74	77.51	84.00	81.30	0.76	2.29	82.18	78.58	5.51
CO-75	MH-23	MH-21	28.0	0.023	5.00	15.76	77.51	76.88	81.30	81.35	2.29	2.97	78.37	78.08	7.91
CO-76	FT-75	MH-23	3.0	0.080	3.60	10.08	78.00	77.76	81.29	81.30	2.29	2.54	78.81	78.58	11.77

Worksheet for OS-15 - 10 YR (Catch Basin)

Project Description

Solve For	Efficiency

Input Data

Discharge	1.10	ft³/s
Slope	0.02060	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	9.00	ft
Local Depression	2.00	in
Local Depression Width	1.50	ft

Results

Efficiency	99.90	%
Intercepted Flow	1.10	ft³/s
Bypass Flow	0.00	ft³/s
Spread	5.38	ft
Depth	0.17	ft
Flow Area	0.33	ft²
Gutter Depression	0.06	ft
Total Depression	0.23	ft
Velocity	3.29	ft/s
Equivalent Cross Slope	0.12478	ft/ft
Length Factor	0.98	
Total Interception Length	9.20	ft

Worksheet for OS-15 - 10 YR (Scupper)

Project Description

Solve For	Efficiency

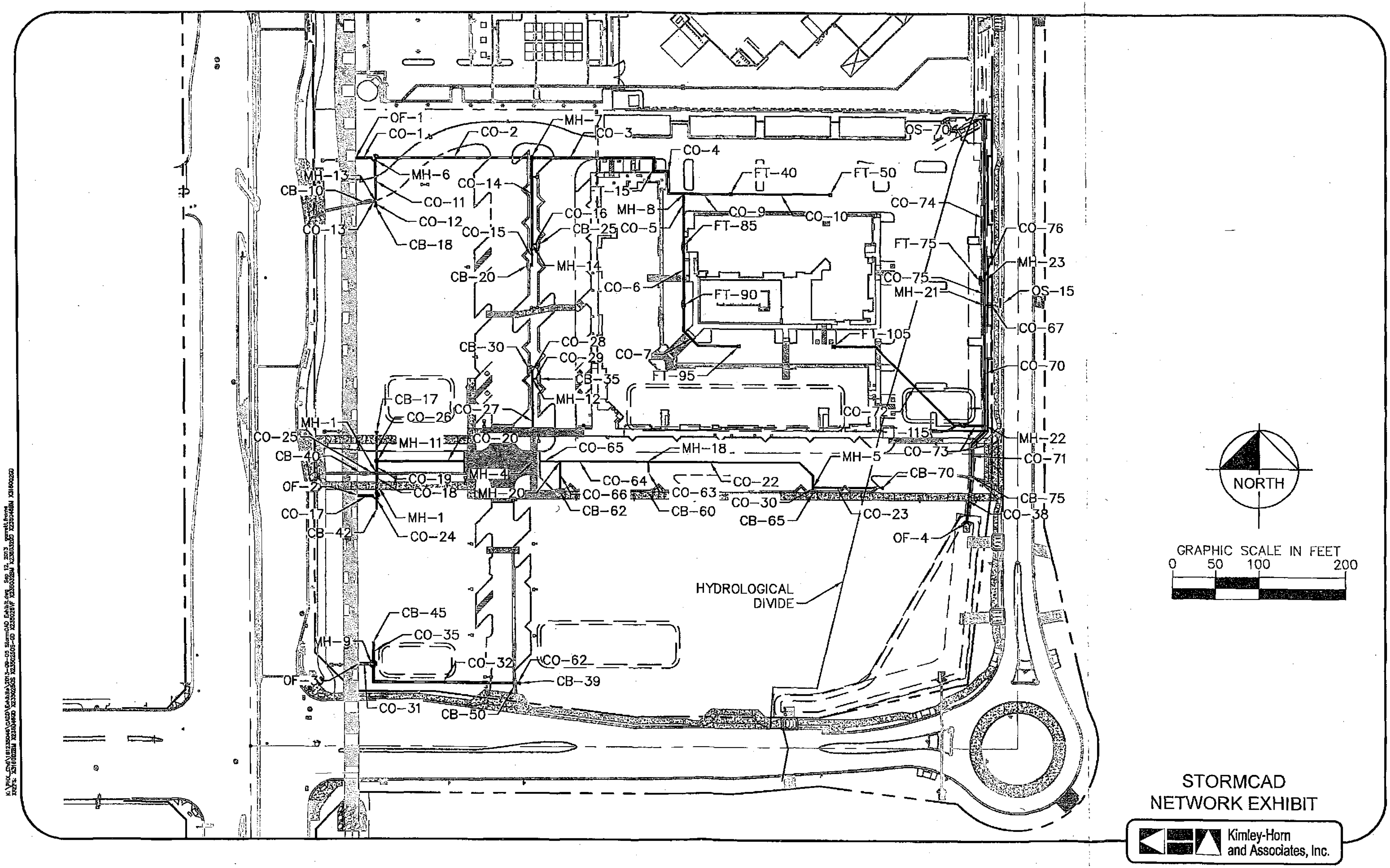
Input Data

Discharge	1.10	ft³/s
Slope	0.02060	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	1.50	ft

Results

Efficiency	97.45	%
Intercepted Flow	1.07	ft³/s
Bypass Flow	0.03	ft³/s
Spread	5.38	ft
Depth	0.17	ft
Flow Area	0.33	ft²
Gutter Depression	0.06	ft
Total Depression	0.23	ft
Velocity	3.29	ft/s
Equivalent Cross Slope	0.12478	ft/ft
Length Factor	0.87	
Total Interception Length	9.20	ft

100-Year StormCAD Model



OF-1
CO-1
CO-2
MH-7
CO-3
OS-70
CO-4
MH-13
MH-6
CO-14
FT-15
FT-40
FT-50
CB-10
CO-11
MH-8
CO-9
CO-10
CO-74
CO-12
CO-16
CO-5
CO-13
CO-15
CB-25
FT-85
CO-76
CB-18
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MH-23
CB-20
MH-14
CO-75
MH-21
CO-6
FT-90
OS-15
CO-67
FT-105
CO-28
CB-30
CO-29
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FT-95
CB-35
CO-70
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CO-26
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MH-1
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FT-115
MH-22
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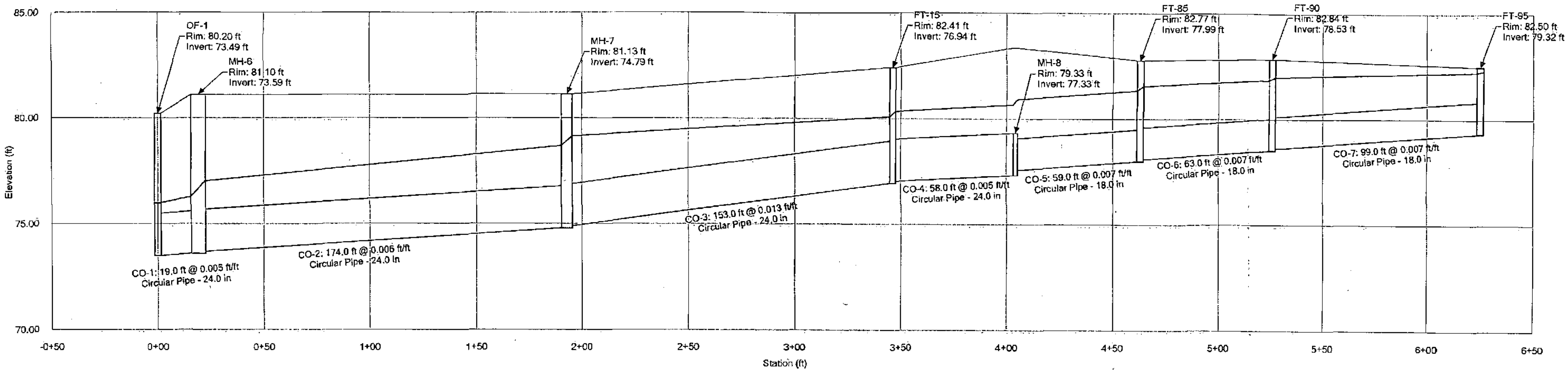
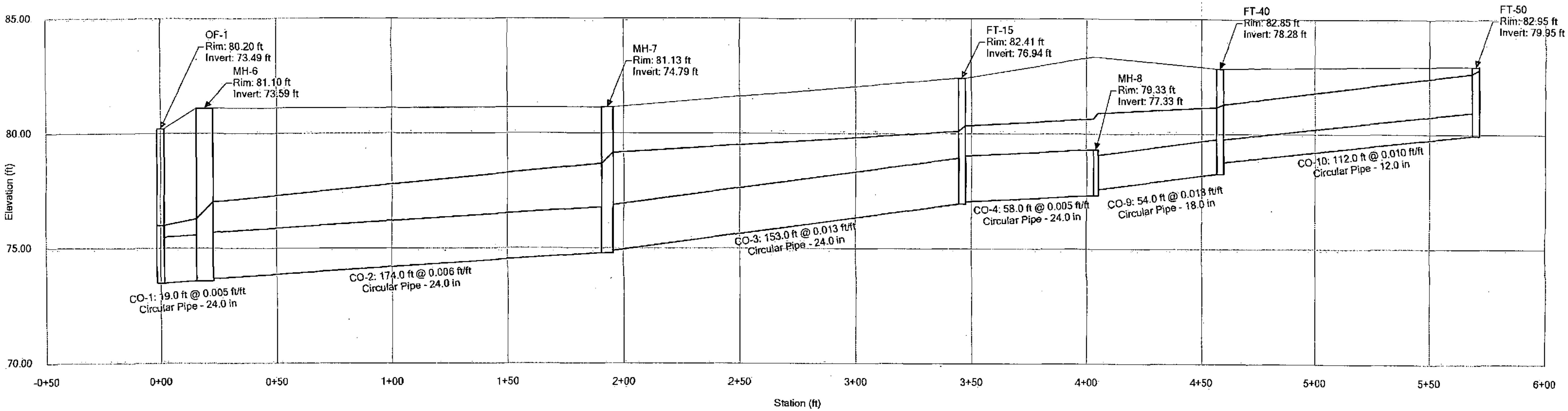
CB-75
CO-17
MH-1
CB-62
CB-60
CB-65
CO-23
CO-38
CB-42
CO-24
OF-4
HYDROLOGICAL DIVIDE
CB-45
CO-35
MH-9
CO-32
CO-62
OF-3
CB-39
CO-31
CB-50
NORTH
GRAPHIC SCALE IN FEET
0 50 100 200
STORMCAD NETWORK EXHIBIT
Kimley-Horn and Associates, Inc.

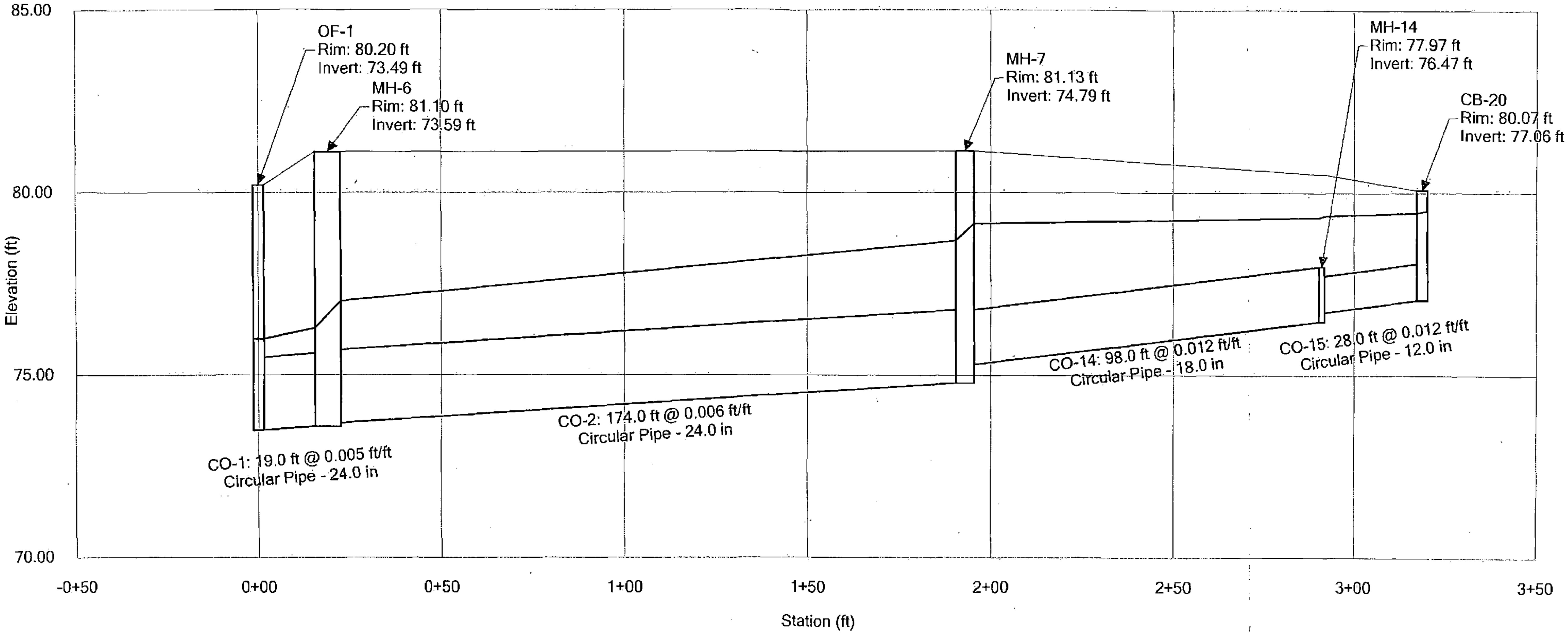
100 Year Profile - North System - Future South Inlet



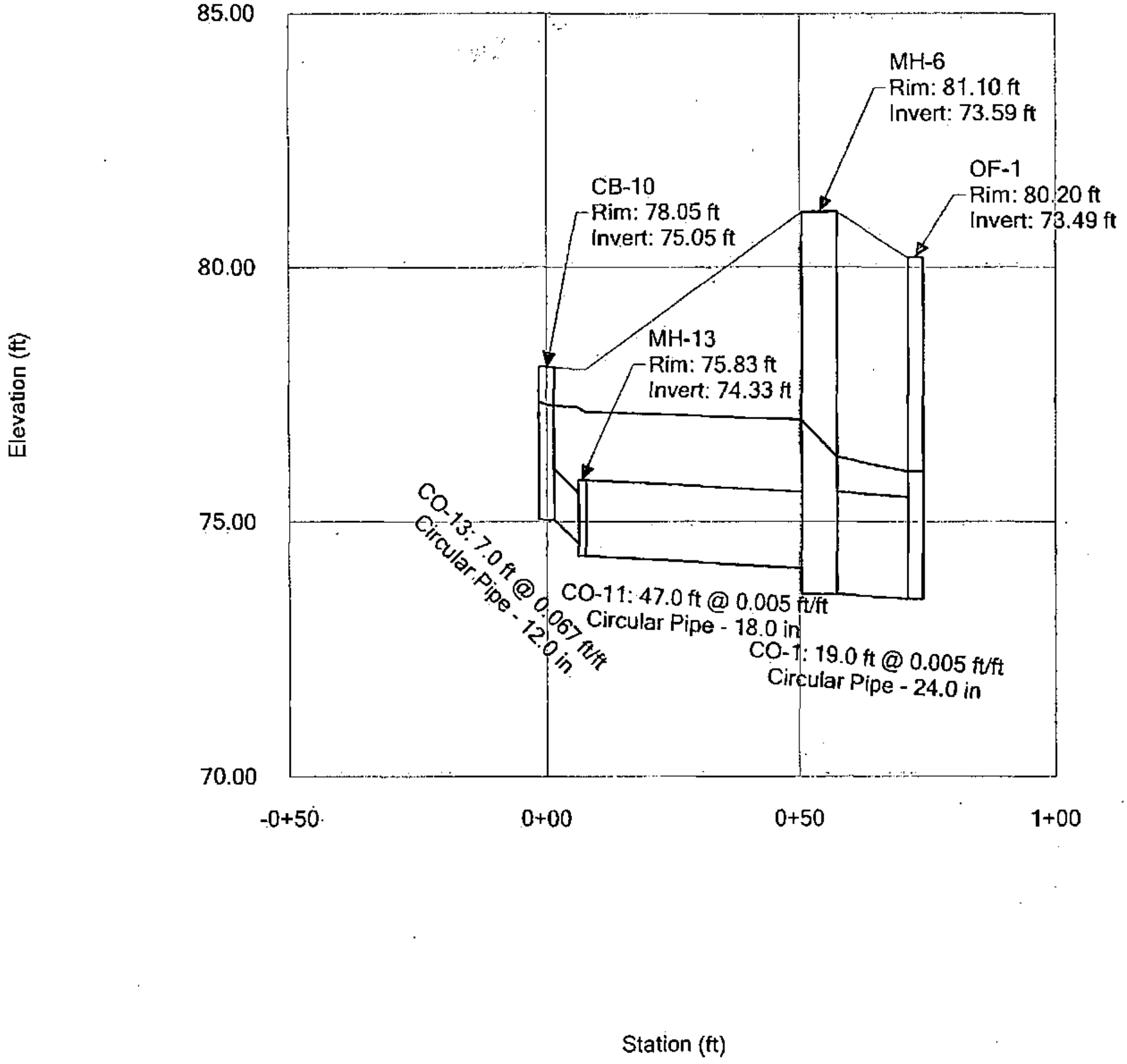
100 Year Profile - North System - Future North Inlet



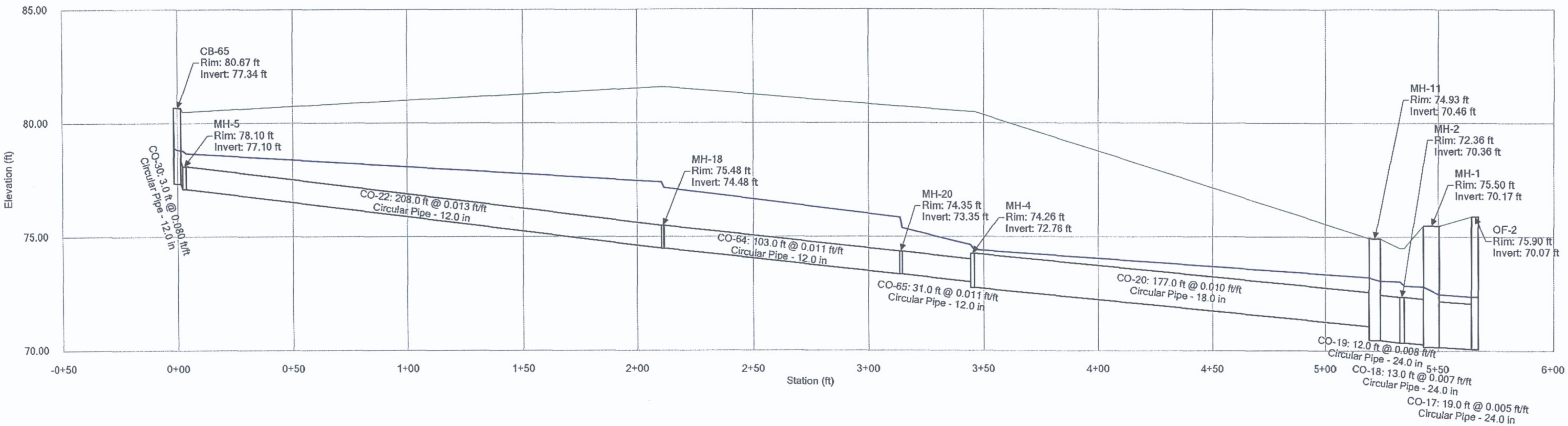
100 Year Profile - North System -Island Inlet



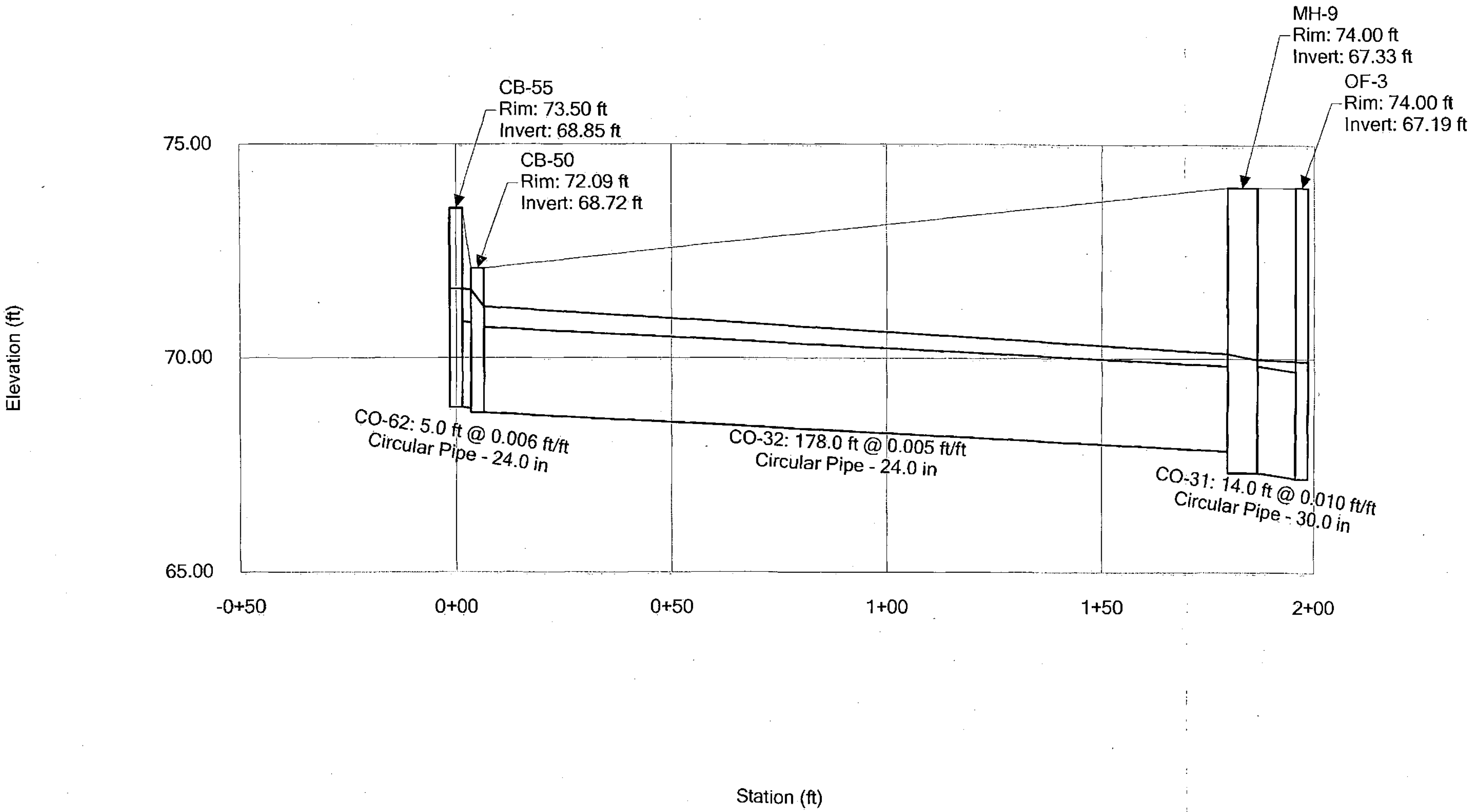
100 Year Profile - North System - Driveway Inlet



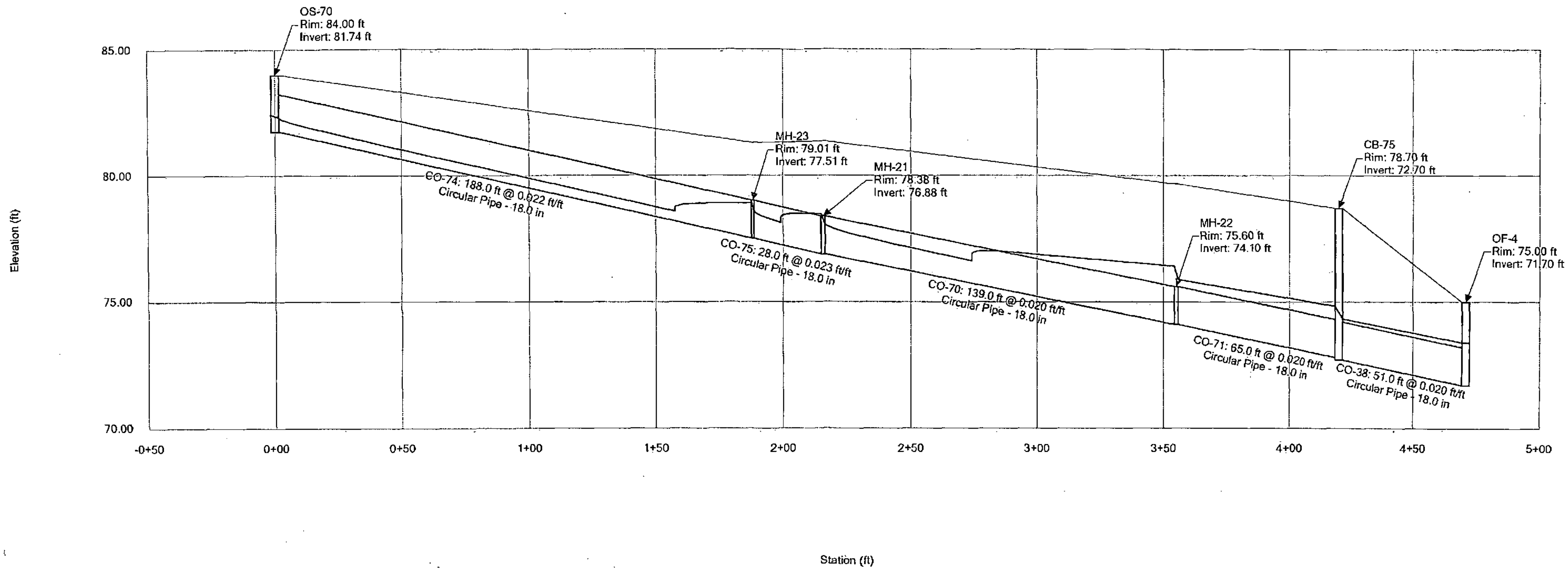
100 Year Profile - Middle System - East Inlet



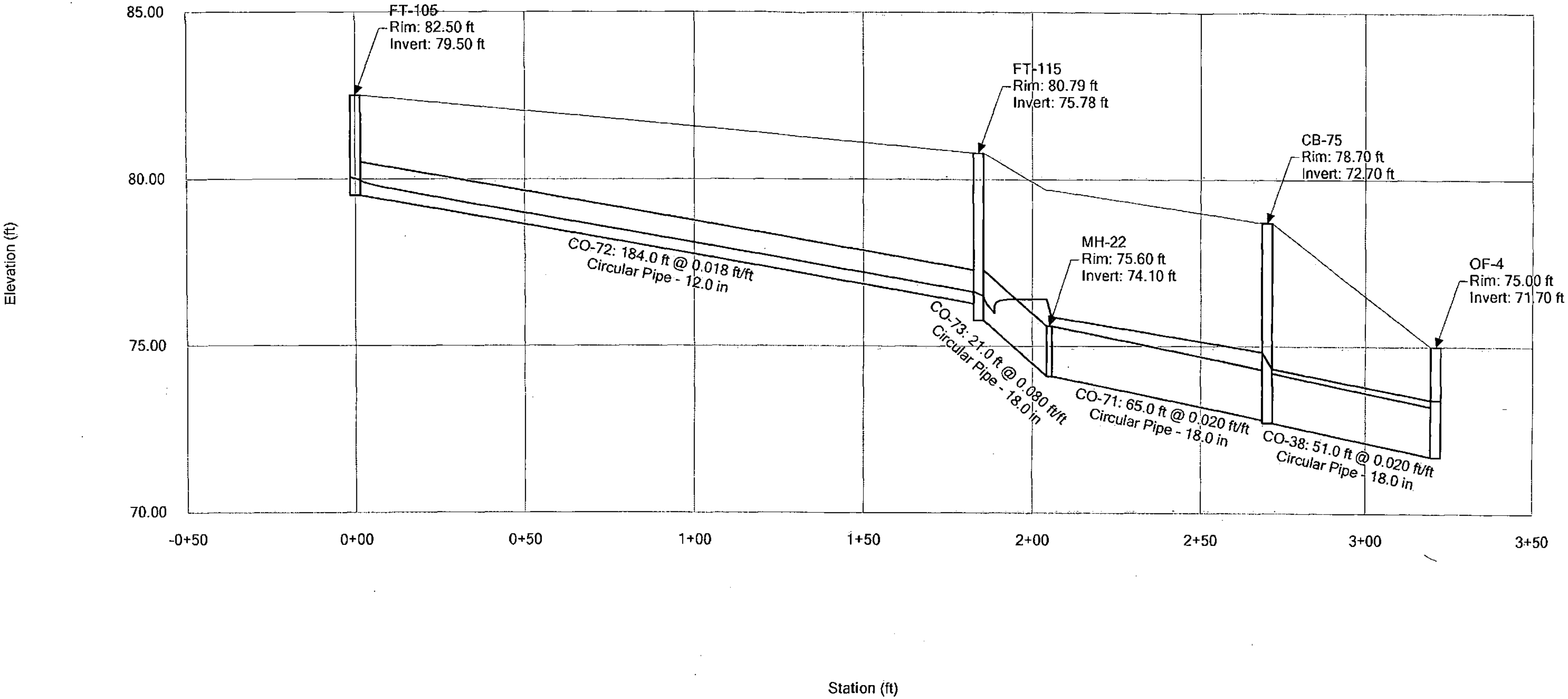
100 Year Profile - South System - Extents



100 Year Profile - East System - North Offsite Inlet



100 Year Profile - East System - Future Area Inlet



100 Year Inlet Report

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Location	Flow (Additional) (ft^3/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Is Flooded?
CB-10	78.05	75.05	In Sag	2.30	77.36	77.29	False
CB-15	77.50	74.36	In Sag	3.50	77.30	77.27	False
CB-17	74.50	71.25	In Sag	3.50	73.26	73.23	False
CB-20	80.07	77.06	In Sag	2.00	79.51	79.45	False
CB-25	81.25	77.20	In Sag	2.30	79.46	79.39	False
CB-30	79.70	76.65	In Sag	1.50	77.27	77.17	False
CB-35	81.11	76.69	In Sag	1.70	77.36	77.24	False
CB-40	74.08	71.06	In Sag	1.60	73.09	73.06	False
CB-42	73.50	70.64	In Sag	2.40	72.82	72.81	False
CB-45	74.50	68.38	In Sag	3.40	70.15	70.12	False
CB-50	72.09	68.72	In Sag	2.10	71.59	71.20	False
CB-55	73.50	68.85	In Sag	15.50	71.61	71.61	False
CB-60	81.03	77.04	In Sag	1.20	77.59	77.50	False
CB-62	79.96	74.28	In Sag	1.50	75.94	75.91	False
CB-65	80.67	77.34	In Sag	2.40	78.88	78.81	False
CB-70	80.50	77.51	In Sag	0.40	78.80	78.80	False
CB-75	78.70	72.70	In Sag	0.90	74.83	74.33	False
FT-15	82.41	76.94	In Sag	1.50	80.35	80.10	False
FT-40	82.85	78.28	In Sag	3.34	81.29	81.16	False
FT-50	82.95	79.95	In Sag	3.90	82.83	82.63	False
FT-75	81.29	78.00	In Sag	5.70	79.40	78.99	False
FT-85	82.77	77.99	In Sag	1.80	81.55	81.35	False
FT-90	82.84	78.53	In Sag	2.20	81.99	81.86	False
FT-95	82.50	79.32	In Sag	5.10	82.29	82.22	False
FT-105	82.50	79.50	In Sag	1.20	80.05	79.96	False
FT-115	80.79	75.78	In Sag	2.40	76.65	76.50	False
OS-15	80.21	77.21	In Sag	1.70	78.54	78.50	False
OS-70	84.00	81.74	In Sag	2.30	82.42	82.31	False

100 Year Pipe Report

Label	Start Node	Stop Node	Length (Unified) (ft)	Slope (ft/ft)	Flow (Link) (ft³/s)	Capacity (Full Flow) (ft³/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Cover (Start) (ft)	Cover (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (Average) (ft/s)
CO-1	MH-6	OF-1	19.0	0.005	27.94	16.41	73.59	73.49	81.10	80.20	5.51	4.71	76.28	75.99	8.89
CO-2	MH-7	MH-6	174.0	0.006	22.14	17.99	74.79	73.69	81.13	81.10	4.34	5.41	78.68	77.02	7.05
CO-3	FT-15	MH-7	153.0	0.013	17.84	26.18	76.94	74.89	82.41	81.13	3.47	4.24	80.10	79.15	5.68
CO-4	MH-8	FT-15	58.0	0.005	16.34	16.00	77.33	77.04	83.35	82.41	4.02	3.37	80.65	80.35	5.20
CO-5	FT-85	MH-8	59.0	0.007	9.10	8.76	77.99	77.58	82.77	83.35	3.28	4.27	81.35	80.90	5.15
CO-6	FT-90	FT-85	63.0	0.007	7.30	8.78	78.53	78.09	82.84	82.77	2.81	3.18	81.86	81.55	4.13
CO-7	FT-95	FT-90	99.0	0.007	5.10	8.77	79.32	78.63	82.50	82.84	1.68	2.71	82.22	81.99	2.89
CO-9	FT-40	MH-8	54.0	0.013	7.24	11.96	78.28	77.58	82.85	83.35	3.07	4.27	81.16	80.90	4.10
CO-10	FT-50	FT-40	112.0	0.010	3.90	3.64	79.95	78.78	82.95	82.85	2.00	3.07	82.63	81.29	4.97
CO-11	MH-13	MH-6	47.0	0.005	5.80	7.51	74.33	74.09	78.00	81.10	2.17	5.51	77.16	77.02	3.28
CO-12	CB-15	MH-13	6.0	0.005	3.50	7.43	74.36	74.33	77.50	78.00	1.64	2.17	77.27	77.26	1.98
CO-13	CB-10	MH-13	7.0	0.067	2.30	9.23	75.05	74.58	78.05	78.00	2.00	2.42	77.29	77.26	2.93
CO-14	MH-14	MH-7	98.0	0.012	4.30	11.53	76.47	75.29	80.50	81.13	2.53	4.34	79.31	79.15	2.43
CO-15	CB-20	MH-14	28.0	0.012	2.00	3.93	77.06	76.72	80.07	80.50	2.01	2.78	79.45	79.37	2.55
CO-16	CB-25	MH-14	6.0	0.080	2.30	10.08	77.20	76.72	81.25	80.50	3.05	2.78	79.39	79.37	2.93
CO-17	MH-1	OF-2	19.0	0.005	16.20	16.41	70.17	70.07	75.50	75.90	3.33	3.83	72.48	72.38	5.16
CO-18	MH-2	MH-1	13.0	0.007	13.80	18.82	70.36	70.27	74.50	75.50	2.14	3.23	72.86	72.81	4.39
CO-19	MH-11	MH-2	12.0	0.008	12.20	20.65	70.46	70.36	74.93	74.50	2.47	2.14	73.07	73.04	3.88
CO-20	MH-4	MH-11	177.0	0.010	8.70	10.29	72.76	71.06	80.50	74.93	6.24	2.37	74.43	73.21	4.92
CO-22	MH-5	MH-18	208.0	0.013	2.80	4.00	77.10	74.48	80.50	81.58	2.40	6.10	78.67	77.39	3.57
CO-23	CB-70	MH-5	81.0	0.005	0.40	2.53	77.51	77.10	80.50	80.50	1.99	2.40	78.80	78.79	0.51
CO-24	CB-42	MH-1	5.0	0.010	2.40	10.50	70.64	70.59	73.50	75.50	1.36	3.41	72.81	72.81	1.36
CO-25	CB-40	MH-2	12.0	0.017	1.60	4.60	71.06	70.86	74.08	74.50	2.02	2.64	73.06	73.04	2.04
CO-26	CB-17	MH-11	17.0	0.011	3.50	11.10	71.25	71.06	74.50	74.93	1.75	2.37	73.23	73.21	1.98
CO-27	MH-12	MH-4	94.0	0.034	3.20	6.57	76.21	73.01	79.50	80.50	2.29	6.49	76.98	74.65	8.32
CO-28	CB-30	MH-12	13.0	0.034	1.50	6.55	76.65	76.21	79.70	79.50	2.05	2.29	77.17	77.21	6.77
CO-29	CB-35	MH-12	6.0	0.080	1.70	10.08	76.69	76.21	81.11	79.50	3.42	2.29	77.24	77.21	9.56
CO-30	CB-65	MH-5	3.0	0.080	2.40	10.08	77.34	77.10	80.67	80.50	2.33	2.40	78.81	78.79	3.06
CO-31	MH-9	OF-3	14.0	0.010	21.00	41.01	67.33	67.19	74.00	74.00	4.17	4.31	69.98	69.94	4.28
CO-32	CB-50	MH-9	178.0	0.005	17.60	16.00	68.72	67.83	72.09	74.00	1.37	4.17	71.20	70.12	5.60
CO-35	CB-45	MH-9	5.0	0.010	3.40	10.50	68.38	68.33	74.50	74.00	4.62	4.17	70.12	70.12	1.92
CO-38	CB-75	OF-4	51.0	0.020	14.20	14.71	72.70	71.70	78.70	75.00	4.50	1.80	74.33	73.40	8.04
CO-62	CB-55	CB-50	5.0	0.006	15.50	17.52	68.85	68.82	73.50	72.09	2.65	1.27	71.61	71.59	4.93
CO-63	CB-60	MH-18	32.0	0.080	1.20	10.08	77.04	74.48	81.03	81.58	2.99	6.10	77.50	77.39	8.64
CO-64	MH-18	MH-20	103.0	0.011	4.00	3.73	74.48	73.35	81.58	80.74	6.10	6.38	77.15	75.85	5.09
CO-65	MH-20	MH-4	31.0	0.011	5.50	3.74	73.35	73.01	80.74	80.50	6.38	6.49	75.39	74.65	7.00
CO-66	CB-62	MH-20	34.0	0.027	1.50	5.89	74.28	73.35	79.96	80.74	4.68	6.38	75.91	75.85	1.91
CO-67	OS-15	MH-21	16.0	0.005	1.70	2.52	77.21	77.13	80.21	81.35	2.00	3.22	78.50	78.46	2.16
CO-70	MH-21	MH-22	139.0	0.020	9.70	14.85	76.88	74.10	81.35	79.67	2.97	4.07	78.08	76.40	8.96
CO-71	MH-22	CB-75	65.0	0.020	13.30	14.85	74.10	72.80	79.67	78.70	4.07	4.40	75.88	74.83	7.53
CO-72	FT-105	FT-115	184.0	0.018	1.20	4.71	79.50	76.28	82.50	80.79	2.00	3.51	79.96	76.62	5.01
CO-73	FT-115	MH-22	21.0	0.080	3.60	29.71	75.78	74.10	80.79	79.67	3.51	4.07	76.50	76.40	11.37
CO-74	OS-70	MH-23	188.0	0.022	2.30	15.76	81.74	77.51	84.00	81.30	0.76	2.29	82.31	78.92	6.36
CO-75	MH-23	MH-21	28.0	0.023	8.00	15.76	77.51	76.88	81.30	81.35	2.29	2.97	78.61	78.46	8.95
CO-76	FT-75	MH-23	3.0	0.080	5.70	10.08	78.00	77.76	81.29	81.30	2.29	2.54	78.99	78.92	13.23

Worksheet for OS-15 - 100 YR (Scupper)

Project Description

Solve For	Efficiency

Input Data

Discharge	1.70	ft³/s
Slope	0.02060	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.013	
Curb Opening Length	8.00	ft
Local Depression	2.00	in
Local Depression Width	1.50	ft

Results

Efficiency	86.61	%
Intercepted Flow	1.47	ft³/s
Bypass Flow	0.23	ft³/s
Spread	6.56	ft
Depth	0.19	ft
Flow Area	0.48	ft²
Gutter Depression	0.06	ft
Total Depression	0.23	ft
Velocity	3.57	ft/s
Equivalent Cross Slope	0.11027	ft/ft
Length Factor	0.67	
Total Interception Length	11.89	ft

Storm Water Quality Unit Calculations and Cut Sheet

FloGard® Dual-Vortex Hydrodynamic Separator

Characteristics and Capacities (English)

Model	ID	Depth Below Invert	Treated Flow Capacity[1]			Total Flow Capacity[3]	Max. Pipe Size	Sediment Storage	Oil/ Floatable Storage
	ft	*ft*	*67 µm cfs*	*110 µm cfs*	*Peak[2] cfs*	*cfs*	*in*	*yd^3*	*gal*
DVS-36	3	3.75	0.12	0.35	0.50	4	12	0.3	18
DVS-48	4	5.00	0.25	0.75	1.25	9	18	0.7	43
DVS-60	5	6.25	0.45	1.30	2.50	16	24	1.3	83
DVS-72	6	8.25	0.70	2.00	4.25	27	36	2.2	141
DVS-84[4]	7	9.50	1.00	3.00	6.50	40	42	3.5	294
DVS-96	8	10.75	1.40	4.20	9.50	57	48	5.3	337
DVS-120[4]	10	13.50	2.50	7.30	16.80	99	48	9.7	917
DVS-144[4]	12	16.00	3.90	11.60	26.40	154	60	15.5	1825

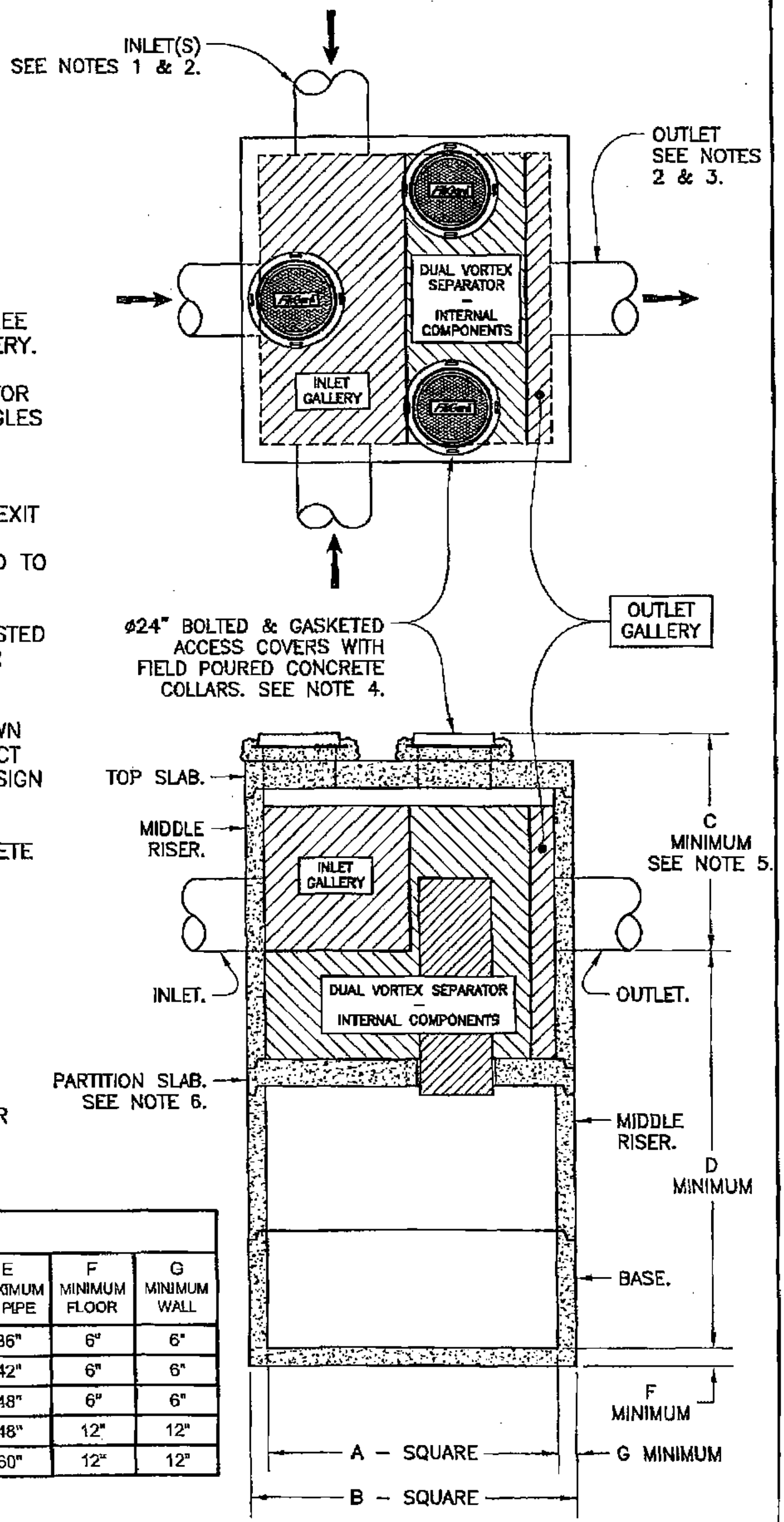
Characteristics and Capacities (Metric)

Model	ID	Depth Below Invert	Treated Flow Capacity[1]			Total Flow Capacity[3]	Max. Pipe Size	Sediment Storage	Oil/ Floatable Storage
	m	*m*	*67 µm L/s*	*110 µm L/s*	*Peak[2] L/s*	*L/s*	*mm*	*m^3*	*L*
DVS-36	0.9	1.14	3.5	10	14	113	300	0.23	68
DVS-48	1.2	1.52	7	21	35	255	450	0.54	163
DVS-60	1.5	1.91	13	37	71	453	600	1.00	314
DVS-72	1.8	2.51	20	57	120	765	900	1.70	534
DVS-84[4]	2.1	2.90	30	85	184	1133	1050	2.70	1113
DVS-96	2.4	3.28	40	120	269	1614	1200	4.00	1276
DVS-120[4]	3.0	4.11	70	205	475	2800	1200	7.40	3471
DVS-144[4]	3.7	4.88	110	330	750	4360	1500	11.90	6908

[1]Treated Flow Capacity is based on 80% removal of suspended sediment with the approximate mean particle size shown. The appropriate flow capacity should be selected based on expected site sediment characteristics.
[2] Maximum flow prior to bypass. Correlates approximately to 80% removal of suspended sediment with a 250 µm particle size mean.
[3] Total design flow to the system should not exceed the Peak Flow Capacity.
[4]Call Kristar representative for availability in your area.

Notes: Systems may be sized based on a water quality flow (i.e. 1-inch design storm) or on net annual sediment load removal depending on local regulatory requirements.
Contact Kristar for the most accurate and cost effective sizing for your project location.

When sizing system based on a water quality flow, the required flow to be treated must be less than or equal to the Treated Flow Capacity for the selected unit.



NOTES:

1. INLET PIPES MAY ENTER SEPARATOR ON THREE SIDES. POSITION RESTRICTED TO INLET GALLERY.

2. INLET AND OUTLET PIPES MAY JOIN SEPARATOR AT OBLIQUE ANGLES. SPECIFIC MAXIMUM ANGLES & PIPE SIZES APPLY. CONTACT KRISTAR ENTERPRISES FOR ENGINEERING DETAILS.

3. STANDARD OUTLET PIPE CONFIGURATION TO EXIT SEPARATOR AT THE CENTER LINE. CUSTOM ANGLED OUTLET CONFIGURATIONS RESTRICTED TO FACE OF UNIT OPPOSITE INLET GALLERY.

4. BOLTED & GASKETED ACCESS COVERS ADJUSTED TO GRADE, USING GRADE RINGS FIELD POUR CONCRETE COLLAR AS REQUIRED.

5. FOR DEPTHS LESS THAN THE MINIMUM SHOWN AS DIMENSION C IN THE TABULATION CONTACT KRISTAR ENTERPRISES FOR ENGINEERING DESIGN ASSISTANCE.

6. PARTITION SLAB MAY BE MADE AS A CONCRETE SLAB AS SHOWN, OR FROM ALTERNATIVE MATERIALS: e.g. FIBERGLASS COMPOSITE, STAINLESS STEEL, ETC.

7. CONCRETE COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM DESIGNATION C858.

8. REMOVABLE INTERNAL COMPONENTS MAY BE AVAILABLE TO FACILITATE MAINTENANCE. SEE DRAWING DVS-R-0001 OR CONTACT KRISTAR ENTERPRISES FOR DETAILS.

TABULATION

MODEL	A ID (SQUARE)	B OD (SQUARE)	C MINIMUM SEE NOTE 5	D MINIMUM SUMP	E MAXIMUM Ø PIPE	F MINIMUM FLOOR	G MINIMUM WALL
DVS-72S	6' [72"]	7' [84"]	4.5' [54"]	8.25' [99"]	36"	6"	6"
DVS-84S	7' [84"]	8' [96"]	5.0' [60"]	9.50 [114"]	42"	6"	6"
DVS-96S	8' [96"]	9' [108"]	5.5' [66"]	10.75' [129"]	48"	6"	6"
DVS-120S	10' [120"]	12' [144"]	7.0' [84"]	13.50' [162"]	48"	12"	12"
DVS-144S	12' [144"]	14' [168"]	8.0' [96"]	16.00' [192"]	60"	12"	12"

* FOR SMALLER SYSTEMS (DVS-36S, DVS-48S & DVS-60S) SEE DRAWING DVS-S-0001.

TITLE

FloGard® DUAL-VORTEX
HYDRODYNAMIC SEPARATOR
SQUARE STRUCTURES
DVS-72S, DVS-84S, DVS-96S, DVS-120S, DVS-144S

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DRAWING NO.	REV	ECO	DATE	
DVS-S-0002	D	0074 JPR 9/16/09	JPR 12/20/07	SHEET 1 OF 1

From Section 6.8.3 of City of Phoenix Storm Water Policies and Standards

$Q_{OFF} = CIA$ where $C = 1.0$ for First Flush

A = Area in Acres

$$I = \frac{0.5\ \text{in/hr} \times 60\ \text{min/hr}}{T_c}$$

North Storm Drain Connection:

Contributing Area = 3.64 Ac

$T_c = 5.0$ (Overland Flow, Assumed for Fut. Dev.)
$T_c = 6.7$ (Pipe Flow from Storm CAD output)

$T_c = 11.7$ minutes

$$I = \frac{(0.5)(60)}{(11.7)} = 2.6\ \text{in/hr}$$

$$Q = (1.0)(3.64)(2.6) = 9.5\ \text{CFS}$$

Middle Storm Drain Connection:

Contributing Area = 2.14 Ac

$T_c = 5.0$ (Overland Flow, Assumed for Fut. Dev.)
$T_c = 9.7$ (Pipe Flow, From Storm CAD output)

$T_c = 14.7$ minutes

$$I = \frac{(0.5)(60)}{(14.7)} = 2.0\ \text{in/hr}$$

$$Q = (1.0)(2.14)(2.0) = 4.3\ \text{CFS}$$

South Storm Drain Connection:

Contributing Area = 2.84 AC

$T_c = 5.0$ (Overland Flow, Assumed for Fut. Dev.)
$T_c = 5.0$ (Pipe Flow, From Storm CAD output)

$T_c = 10.0$ minutes

$$I = \frac{(0.5)(60)}{(10.0)} = 3.0\ \text{in/hr}$$

$$Q = (1.0)(2.84)(3.0) = 8.5\ \text{CFS}$$

Appendix D

Corp of Engineers Letter of Compliance for Nationwide Permit No. 39

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH
DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: SPL-2011-375-AP

Date of Issuance: April 16, 2012

Name of Permittee: Maria Baier
Arizona State Land Department
1616 W. Adams Street
Phoenix, Arizona 85007

Upon completion of the activity authorized by this permit, sign this certification and return it with an original signature to the following address:

U.S. Army Corps of Engineers
ATTENTION: Regulatory Division (SPL-2011-375-AP)
3636 North Central Avenue, Suite 900
Phoenix, Arizona 85012-1939

Please note that your permitted activity is subject to a compliance inspection by a Corps of Engineers' representative. If you fail to comply with this Nationwide Permit you may be subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced Nationwide Permit has been completed in accordance with the terms and conditions of said permit.

[signature] 5-18-12

Signature of Permittee Date

Enclosure 2

Appendix E

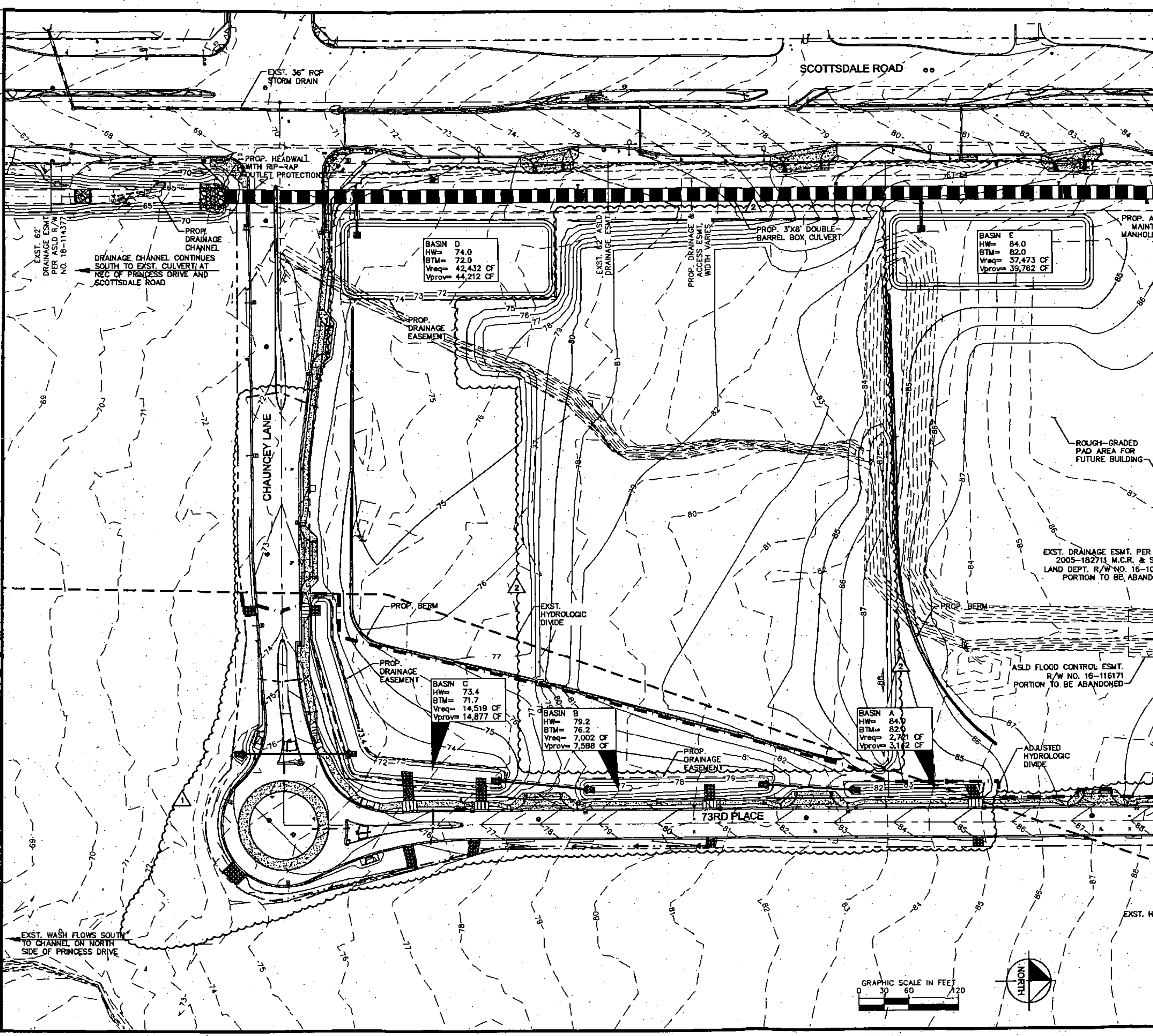
Exhibits

Kimley-Horn and Associate

7878 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

FIGURE 1. CONTEXT

FIGURE 3:EXISTING CONDITIONS TOPOGRAPHIC MAP



REV	DESCRIPTION	BY	DATE	APPR
1	INSTALL STORM DRAIN PIPE. ADJUST BASIN DIMENSIONS. UPDATE STORM DRAIN INVERT AND LENGTH.			
2	GRADING REVISIONS			

Kimley-Horn and Associates, Inc.
© 2013 KIMLEY-HORN AND ASSOCIATES, INC.
7740 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500

DIVERSIFIED PARTNERS
Nationwide Real Estate Services

SEC SCOTTSDALE ROAD AND MAYO BLVD

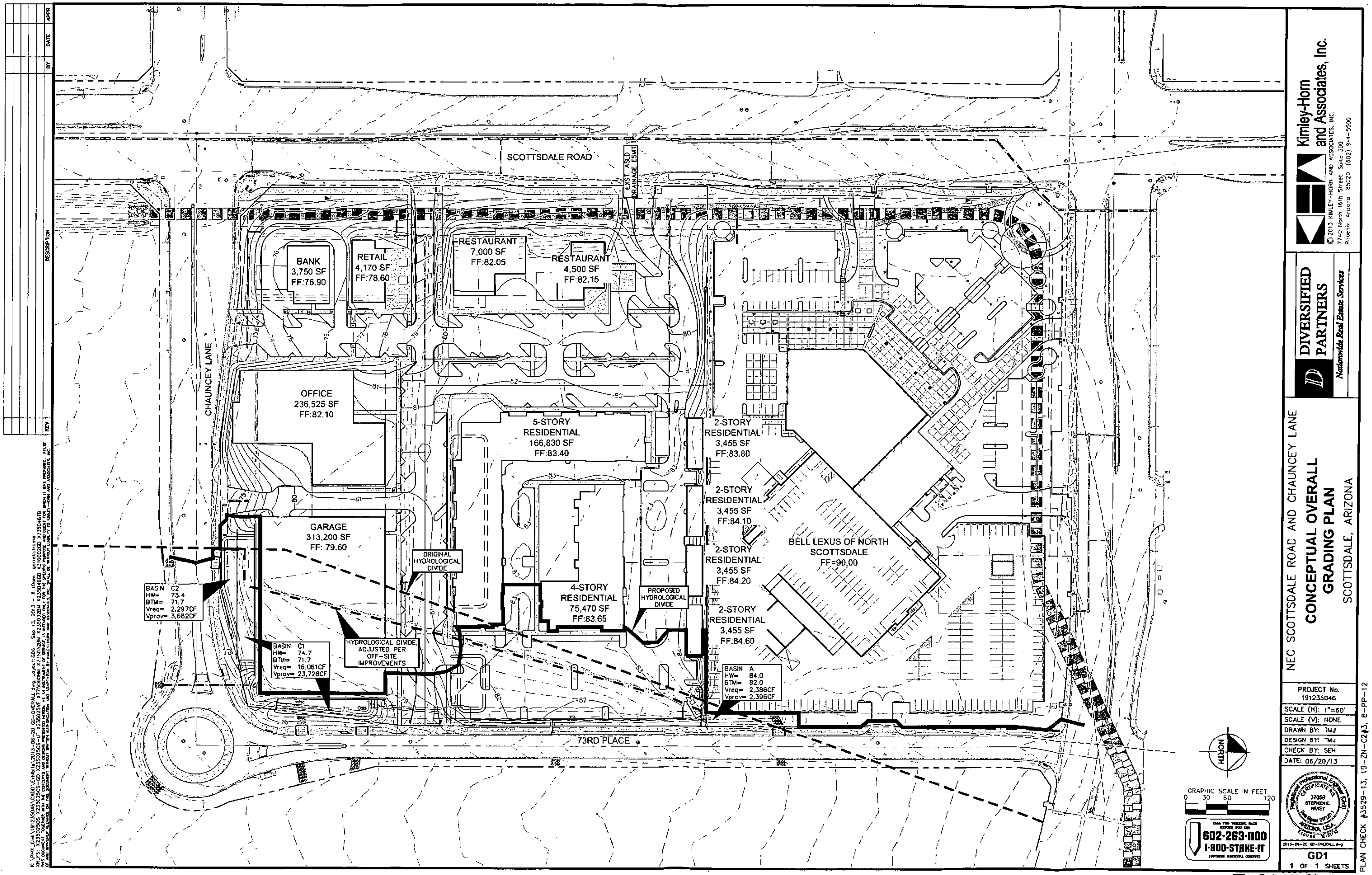
OVERALL GRADING AND DRAINAGE PLAN

SCOTTSDALE, ARIZONA

PROJECT No. 191235025
SCALE (H): 1"=60'
SCALE (V): NONE
DRAWN BY: TMJ
DESIGN BY: TMJ
CHECK BY: SEH
DATE: 04/30/13

GD1
34 OF 55 SHEETS

Q.S. 39-45, 28-DR-2012, 2519-12-1



SCOTTSDALE ROAD
EXST. ASLD DRAINAGE ESMT
CHAUNCEY LANE
73RD PLACE
BANK 3,750 SF FF:76.90
RETAIL 4,170 SF FF:78.60
RESTAURANT 7,000 SF FF:82.05
RESTAURANT 4,500 SF FF:82.15
OFFICE 236,525 SF FF:82.10
5-STORY RESIDENTIAL 166,830 SF FF:83.40
GARAGE 313,200 SF FF: 79.60
4-STORY RESIDENTIAL 75,470 SF FF:83.65
2-STORY RESIDENTIAL 3,455 SF FF:83.80
2-STORY RESIDENTIAL 3,455 SF FF:84.10
2-STORY RESIDENTIAL 3,455 SF FF:84.20
2-STORY RESIDENTIAL 3,455 SF FF:84.60
BELL LEXUS OF NORTH SCOTTSDALE FF:90.00
ORIGINAL HYDROLOGICAL DIVIDE
PROPOSED HYDROLOGICAL DIVIDE
HYDROLOGICAL DIVIDE, ADJUSTED PER OFF-SITE IMPROVEMENTS
BASIN C2 HW= 73.4 BTM= 71.7 Vreq= 2,297CF Vprov= 3,682CF
BASIN C1 HW= 74.7 BTM= 71.7 Vreq= 16,061CF Vprov= 23,728CF
BASIN A HW= 84.0 BTM= 82.0 Vreq= 2,386CF Vprov= 2,396CF
NORTH
GRAPHIC SCALE IN FEET
0 30 60 120
602-263-1100
1-800-STAKE-IT
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7740 North 16th Street, Suite 300
Phoenix, Arizona 85020 (602) 944-5500
DIVERSIFIED PARTNERS
Nationwide Real Estate Services
NEC SCOTTSDALE ROAD AND CHAUNCEY LANE
CONCEPTUAL OVERALL GRADING PLAN
SCOTTSDALE, ARIZONA
PROJECT No. 191235046
SCALE (H): 1"=60'
SCALE (V): NONE
DRAWN BY: TMJ
DESIGN BY: TMJ
CHECK BY: SEH
DATE: 06/20/13
GD1
1 OF 1 SHEETS
PLAN CHECK #3529-13, 19-ZN-C2#3, 8-PP-12
REV
DESCRIPTION
BY
DATE
APPR

FIGURE 6

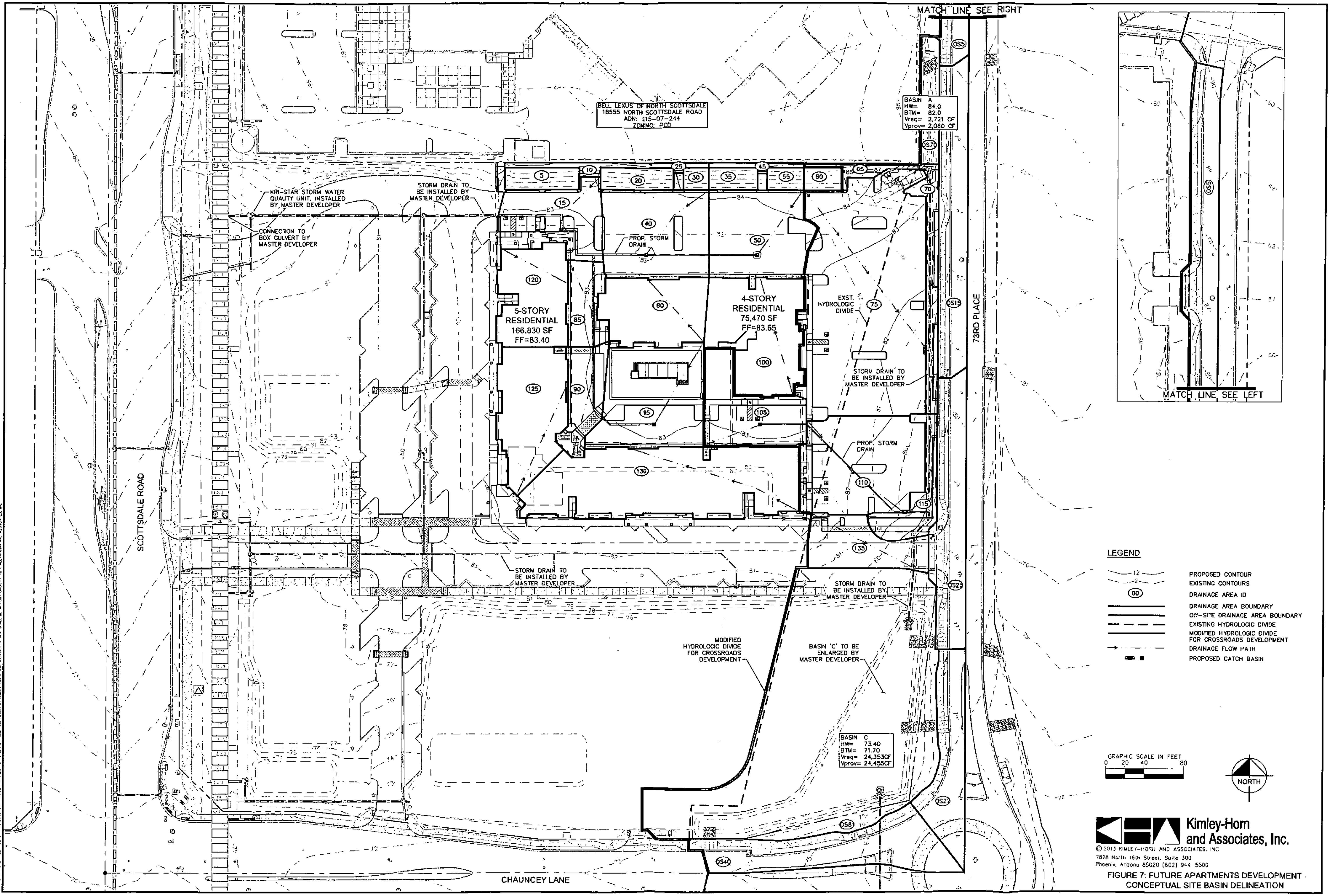
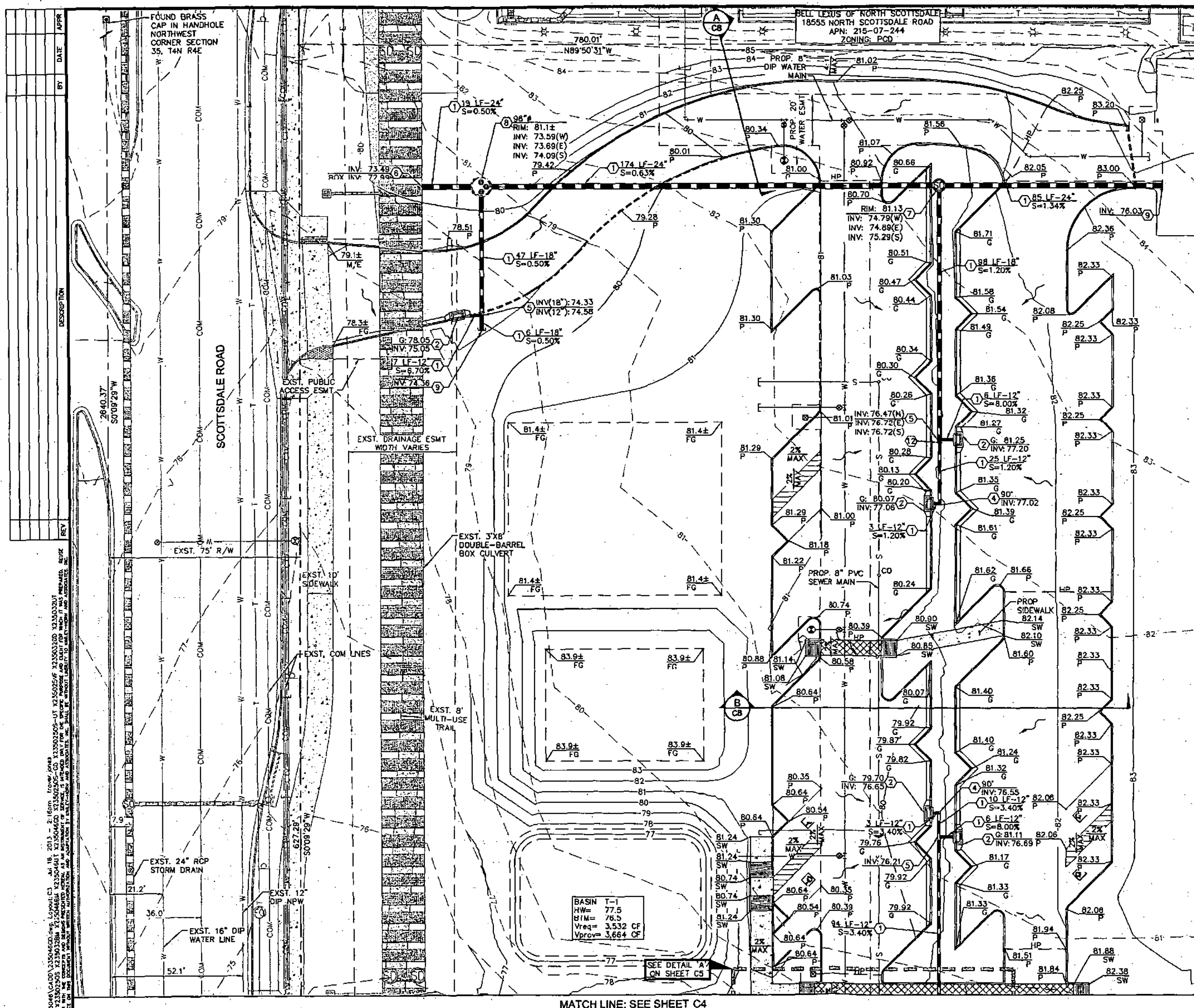


FIGURE 7: FUTURE APARTMENTS DEVELOPMENT CONCEPTUAL SITE BASIN DELINEATION



STORM DRAIN CONSTRUCTION NOTES:

(1) INSTALL HDPE STORM DRAIN PIPE. LENGTH, SIZE, AND SLOPE PER PLAN. BEDDING AND BACKFILL PER DETAIL ON SHEET C5.

(2) INSTALL TYPE 'E' CATCH BASIN PER MAG STD DET 534. RIM AND INVERT ELEVATIONS PER PLAN. GRATE SHALL BE SECURED WITH CHAIN.

(4) INSTALL HDPE STORM DRAIN PIPE BEND, SIZE TO MATCH ADJOINING PIPES. INVERT AND ANGLE PER PLAN.

(5) INSTALL HDPE STORM DRAIN TEE, SIZES TO MATCH ADJOINING PIPES. INVERTS PER PLAN.

(6) CONNECT TO EXISTING BOX CULVERT PER DETAIL ON SHEET C9, INVERT PER PLAN.

(7) INSTALL 48" STORM DRAIN MANHOLE PER MAG STD DET 520 AND 522. RIM AND INVERT ELEVATIONS PER PLAN.

(8) INSTALL KRI-STAR DUAL-VORTEX HYDRODYNAMIC SEPARATOR, INSIDE DIAMETER AND INVERT ELEVATIONS PER PLAN. SEE DETAIL ON SHEET C9.

(9) STUB AND PLUG HDPE STORM DRAIN PIPE FOR FUTURE CONNECTION PER MAG STD DET 427, INVERT PER PLAN.

(12) INSTALL 18" X 12" REDUCER.

NOTES

1. ADD 1500' TO ALL ELEVATIONS.
2. ADD 0.5' TO PAVEMENT (P) ELEVATIONS FOR TOP OF CURB ELEVATIONS FOR VERTICAL CURBS.
3. ALL SPOT ELEVATIONS ARE FINISHED GRADE PAVEMENT (P), GUTTER/GRATE (G), OR SIDEWALK (SW) ELEVATIONS UNLESS OTHERWISE NOTED.
4. CONTRACTOR SHALL USE SPOT ELEVATIONS, PROPOSED CONTOURS, AND SLOPES TO ESTABLISH GRADES.
5. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% AND LONGITUDINAL SLOPE SHALL NOT EXCEED 5%.
6. REFER TO LANDSCAPE PLANS FOR SLOPE TREATMENT.
7. REFER TO SHEET C2 FOR LEGEND AND ABBREVIATIONS.
8. ALL FILL SLOPES SHALL BE COMPACTED TO 95% RELATIVE DENSITY.

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DIVERSIFIED PARTNERS
Nationwide Real Estate Services

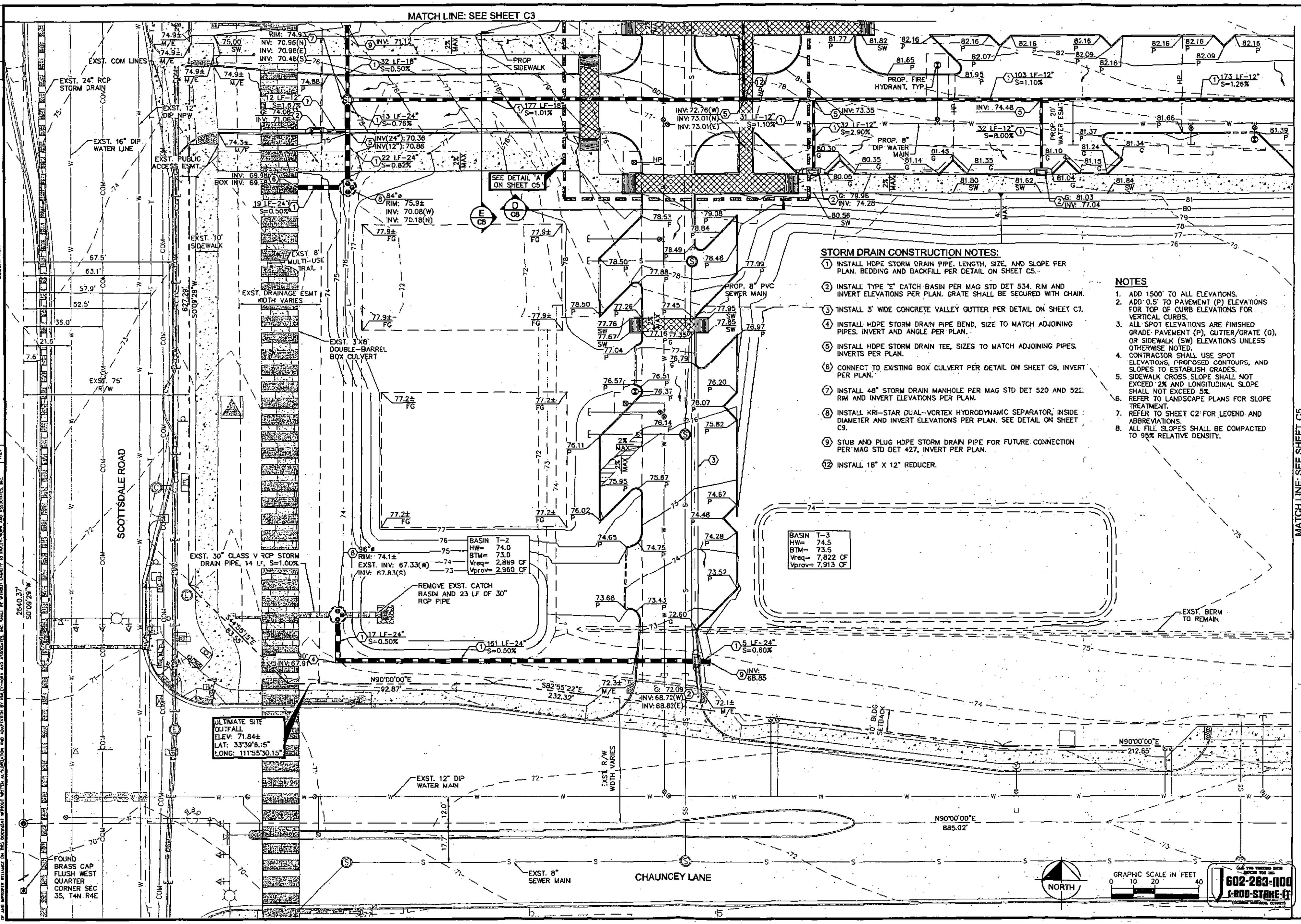
NEC SCOTTSDALE ROAD AND CHAUNCEY LANE

GRADING AND DRAINAGE PLAN

SCOTTSDALE, ARIZONA

PROJECT No. 191235046
SCALE (H): 1"=20'
SCALE (V): NONE
DRAWN BY: CGF
DESIGN BY: TMJ
CHECK BY: SEH
DATE: 07/16/13

37059 STEPHEN E. HANEY ARIZONA, USA



STORM DRAIN CONSTRUCTION NOTES:

1. INSTALL HDPE STORM DRAIN PIPE. LENGTH, SIZE, AND SLOPE PER PLAN. BEDDING AND BACKFILL PER DETAIL ON SHEET C5.
2. INSTALL TYPE 'E' CATCH BASIN PER MAG STD DET 534. RIM AND INVERT ELEVATIONS PER PLAN. GRATE SHALL BE SECURED WITH CHAIN.
3. INSTALL 3' WIDE CONCRETE VALLEY GUTTER PER DETAIL ON SHEET C7.
4. INSTALL HDPE STORM DRAIN PIPE BEND, SIZE TO MATCH ADJOINING PIPES. INVERT AND ANGLE PER PLAN.
5. INSTALL HDPE STORM DRAIN TEE, SIZES TO MATCH ADJOINING PIPES. INVERTS PER PLAN.
6. CONNECT TO EXISTING BOX CULVERT PER DETAIL ON SHEET C9, INVERT PER PLAN.
7. INSTALL 48" STORM DRAIN MANHOLE PER MAG STD DET 520 AND 522. RIM AND INVERT ELEVATIONS PER PLAN.
8. INSTALL KRI-STAR DUAL-VORTEX HYDRODYNAMIC SEPARATOR, INSIDE DIAMETER AND INVERT ELEVATIONS PER PLAN. SEE DETAIL ON SHEET C9.
9. STUB AND PLUG HDPE STORM DRAIN PIPE FOR FUTURE CONNECTION PER MAG STD DET 427, INVERT PER PLAN.
12. INSTALL 18" X 12" REDUCER.

NOTES

1. ADD 1500' TO ALL ELEVATIONS.
2. ADD 0.5' TO PAVEMENT (P) ELEVATIONS FOR TOP OF CURB ELEVATIONS FOR VERTICAL CURBS.
3. ALL SPOT ELEVATIONS ARE FINISHED GRADE PAVEMENT (P), GUTTER/GRATE (G), OR SIDEWALK (SW) ELEVATIONS UNLESS OTHERWISE NOTED.
4. CONTRACTOR SHALL USE SPOT ELEVATIONS, PROPOSED CONTOURS, AND SLOPES TO ESTABLISH GRADES.
5. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% AND LONGITUDINAL SLOPE SHALL NOT EXCEED 5%.
6. REFER TO LANDSCAPE PLANS FOR SLOPE TREATMENT.
7. REFER TO SHEET C2 FOR LEGEND AND ABBREVIATIONS.
8. ALL FILL SLOPES SHALL BE COMPACTED TO 95% RELATIVE DENSITY.

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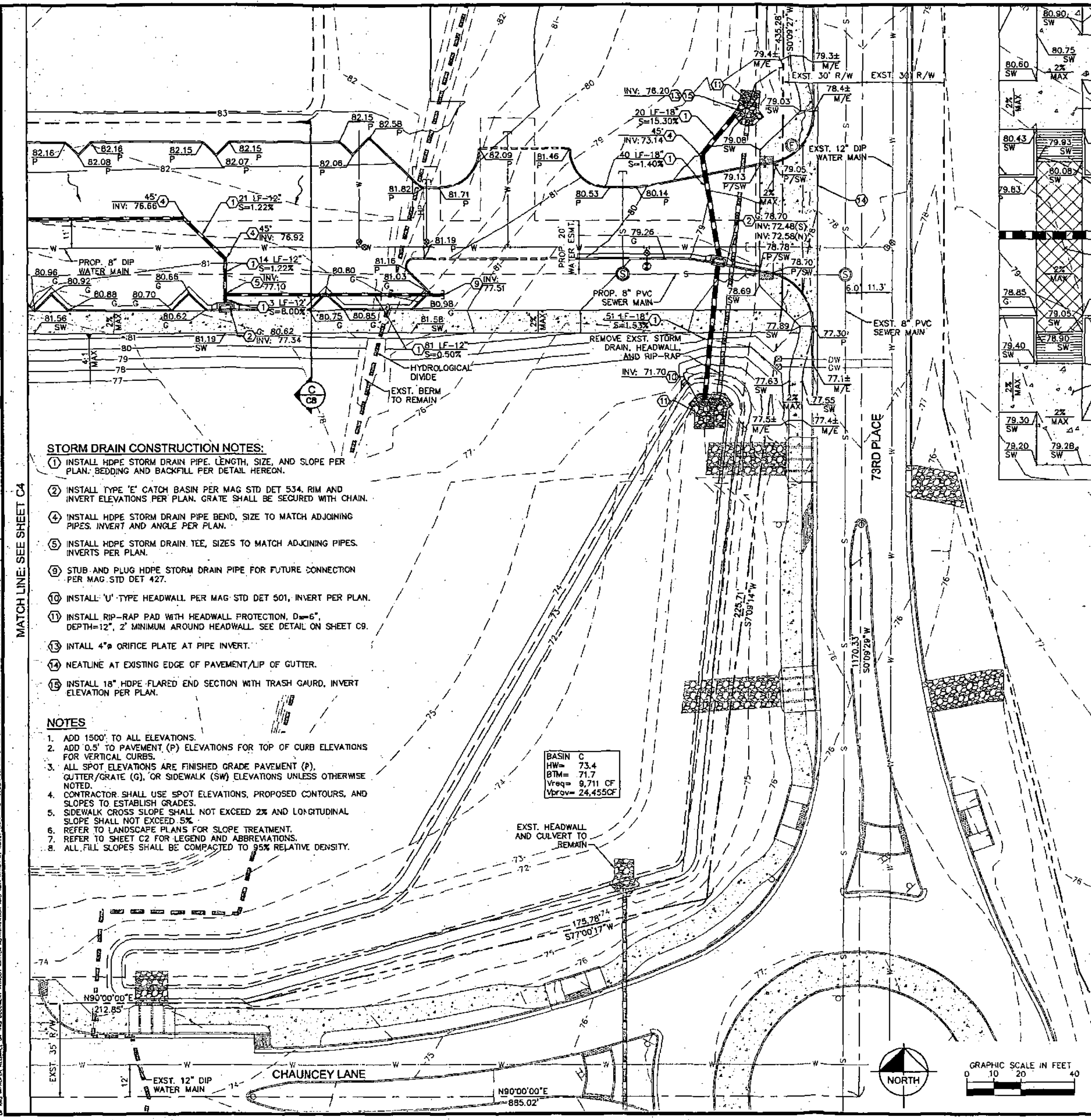
NEC SCOTTSDALE ROAD AND CHAUNCEY LANE

GRADING AND DRAINAGE PLAN

SCOTTSDALE, ARIZONA

PROJECT No. 191235046
SCALE (H): 1"=20'
SCALE (V): NONE
DRAWN BY: CGF
DESIGN BY: TMJ
CHECK BY: SEH
DATE: 07/16/13

Registered Professional Engineer — CERTIFICATE NO. 37059 — STEPHEN E. HANEY — ARIZONA, U.S.A. — Expires 12/31/13



STORM DRAIN CONSTRUCTION NOTES:

(1) INSTALL HDPE STORM DRAIN PIPE. LENGTH, SIZE, AND SLOPE PER PLAN. BEDDING AND BACKFILL PER DETAIL HEREON.

(2) INSTALL TYPE 'E' CATCH BASIN PER MAG STD DET 534. RIM AND INVERT ELEVATIONS PER PLAN. GRATE SHALL BE SECURED WITH CHAIN.

(4) INSTALL HDPE STORM DRAIN PIPE BEND, SIZE TO MATCH ADJOINING PIPES. INVERT AND ANGLE PER PLAN.

(5) INSTALL HDPE STORM DRAIN TEE, SIZES TO MATCH ADJOINING PIPES. INVERTS PER PLAN.

(9) STUB AND PLUG HDPE STORM DRAIN PIPE FOR FUTURE CONNECTION PER MAG STD DET 427.

(10) INSTALL 'U' TYPE HEADWALL PER MAG STD DET 501, INVERT PER PLAN.

(11) INSTALL RIP-RAP PAD WITH HEADWALL PROTECTION, D=6", DEPTH=12", 2' MINIMUM AROUND HEADWALL. SEE DETAIL ON SHEET C9.

(13) INTALL 4"ø ORIFICE PLATE AT PIPE INVERT.

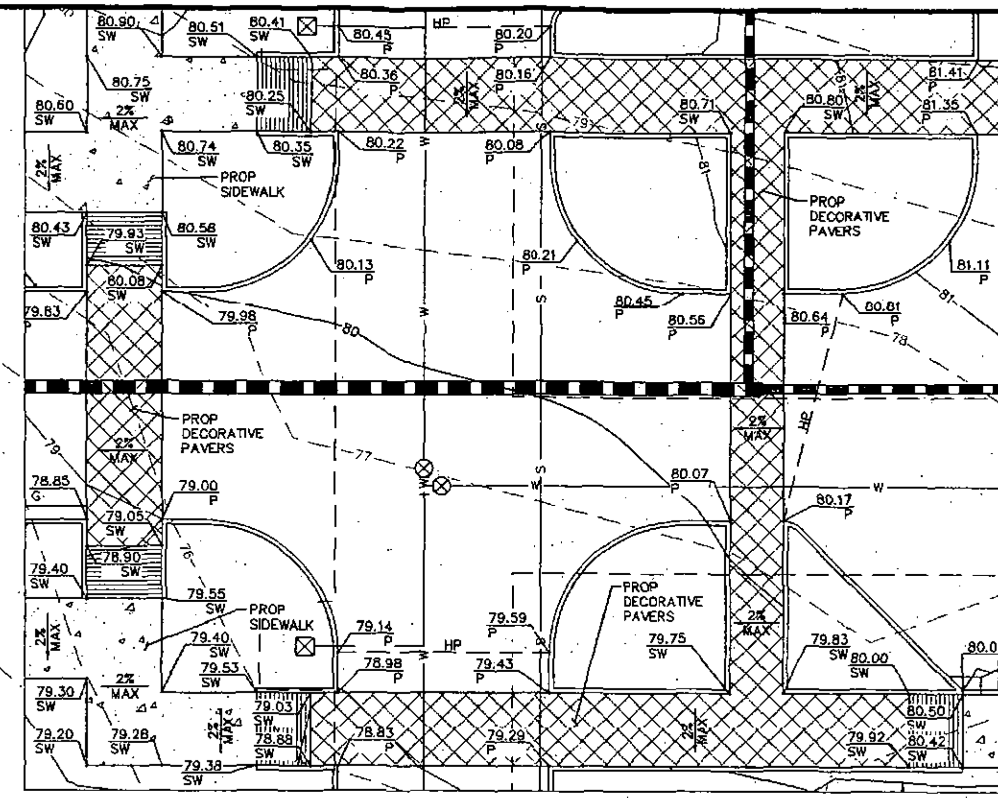
(14) NEATLINE AT EXISTING EDGE OF PAVEMENT/LIP OF GUTTER.

(15) INSTALL 18" HDPE FLARED END SECTION WITH TRASH GAURD, INVERT ELEVATION PER PLAN.

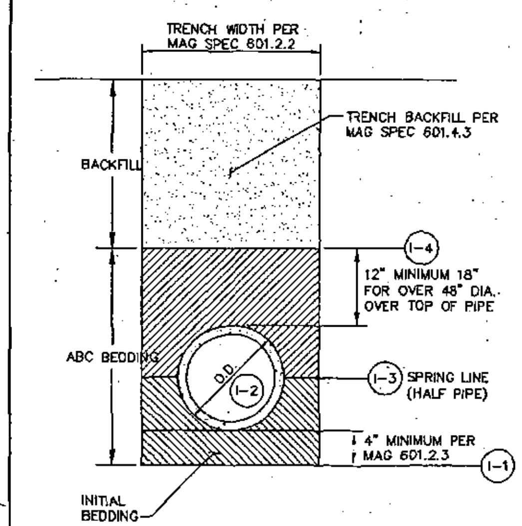
NOTES

1. ADD 1500' TO ALL ELEVATIONS.
2. ADD 0.5' TO PAVEMENT (P) ELEVATIONS FOR TOP OF CURB ELEVATIONS FOR VERTICAL CURBS.
3. ALL SPOT ELEVATIONS ARE FINISHED GRADE PAVEMENT (P), GUTTER/GRATE (G), OR SIDEWALK (SW) ELEVATIONS UNLESS OTHERWISE NOTED.
4. CONTRACTOR SHALL USE SPOT ELEVATIONS, PROPOSED CONTOURS, AND SLOPES TO ESTABLISH GRADES.
5. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2% AND LONGITUDINAL SLOPE SHALL NOT EXCEED 5%
6. REFER TO LANDSCAPE PLANS FOR SLOPE TREATMENT.
7. REFER TO SHEET C2 FOR LEGEND AND ABBREVIATIONS.
8. ALL FILL SLOPES SHALL BE COMPACTED TO 95% RELATIVE DENSITY.

BASIN	C
HW=	73.4
BTM=	71.7
Vreq=	9,711 CF
Vprov=	24,455CF



DETAIL 'A'
SCALE: 1"=10'



HDPE STORM DRAIN PIPE BEDDING AND BACKFILL DETAIL — N.T.S.

NOTES:

1. FOR USE WITH CORRUGATED HDPE PIPE WHICH SHALL CONFORM WITH MAG 738 AND SHALL BE INSTALLED PER MAG 603.

2. BEDDING TO 12" OVER PIPE SHALL BE ABC. HDPE PIPES LARGER THAN 48" REQUIRE 18" OF COVER.

3. NO BEDDING IS TO BE CONSIDERED A PART OF THE ROADWAY STRUCTURAL SECTION.

4. ALL COMPACTION DENSITIES SHALL BE PER MAG 601.4.4.

5. CONTRACTOR SHALL TAKE PRECAUTIONS TO AVOID PIPE MOVEMENT WHEN PLACING BACKFILL.

6. THIS DETAIL IS NOT TO SUPERSEDE MORE STRINGENT MANUFACTURER REQUIREMENTS.

INSPECTIONS: (I-X)

I-1. THE TRENCH SHALL BE INSPECTED PRIOR TO PLACEMENT OF BEDDING.

I-2. THE PIPE AND INITIAL BEDDING SHALL BE INSPECTED PRIOR TO ANY ADDITIONAL BEDDING.

I-3. THE PIPE SHALL BE INSPECTED AND COMPACTION TESTS SHALL BE COMPLETED AT SPRING LINE PRIOR TO BACKFILLING THE TRENCH.

I-4. THE BEDDING SHALL BE INSPECTED AND COMPACTION TESTS SHALL BE COMPLETED PRIOR TO BACKFILLING THE TRENCH.

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Phoenix, Arizona 85020 (602) 944-5500

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NEC SCOTTSDALE ROAD AND CHAUNCEY LANE

GRADING AND DRAINAGE PLAN

SCOTTSDALE, ARIZONA

PROJECT No.	191235048
SCALE (H):	1"=20'
SCALE (V):	NONE
DRAWN BY:	CGF
DESIGN BY:	TMJ
CHECK BY:	SEH
DATE:	07/16/13

37059 STEPHEN E. HANEY ARIZONA, U.S.A.