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CITY OF COLORADO SPRINGS

Interstate 25
INTERQUEST PARKWAY / S.H. 83
RELOCATION

Final Hydraulic Report

(Phase II)

Prepared for: **SCHUCK HOLDINGS LLC.**

Date:
March 12, 1999
DMJM Project No. 3821.3804

DMJM

Daniel, Mann, Johnson, & Mendenhall, Inc. (DMJM)
1490 West Fillmore Street, Suite 101, Colorado Springs, Colorado 80904 - (719) 471-9866

CITY OF COLORADO SPRINGS

Interstate 25
INTERQUEST PARKWAY / S.H. 83
RELOCATION

Final Hydraulic Report
(Phase II)

This report was performed under my direct supervision and is correct to the best of my knowledge and belief.

COLORADO REGISTERED
CLYDE L. PIKKARAINEN
20450
5-5-99
PROFESSIONAL ENGINEER

Prepared for: **SCHUCK HOLDINGS LLC.**

Date:
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DMJM

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CITY OF COLORADO SPRINGS

I. INTRODUCTION

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INTERQUEST PARKWAY (FORMERLY FAIRLANE PARKWAY)
PHASE II FINAL DRAINAGE REPORT

I. INTRODUCTION

A. PURPOSE AND SCOPE

The purpose of this document is to provide a final update to previous drainage studies to facilitate the proposed construction of Phase II of Interquest Parkway. This report is based upon the Colorado Department of Transportation Drainage Criteria developed in1995 and the City of Colorado Springs Drainage criteria developed in October 1987, revised November 1991. HEC-12 was utilized as an additional reference.

This study defines the general nature of existing historic runoff conditions and the impact of the development of Phase II of Interquest Parkway on existing downstream drainage facilities. This report also determines proposed drainage facilities designed to accommodate both offsite and onsite runoff occurring in Phase II.

More specifically, this report includes determining the limits of contributory drainage basins and the major drainage facilities in Phase II. The drainage basin data was established including: delineating basins, determining basin size, determining waterway geometries, and establishing vegetation cover and land use. Based on this hydrologic analysis, structure hydraulic design, structure cross sections, and a storm water management plan were produced. In the appendix; drainage basin maps, storm sewer design, structure cross sections, project design criteria, and three channel alternatives are included.

B. PROJECT LIMITS

The proposed Interquest Parkway Phase II (formerly Fairlane Parkway Phase II) study area is located in north Colorado Springs in Sections 16, 17, 20, 21, Township12 South, Range 66, west of the Sixth Principal Meridian. The study area is displayed on Figure 1, page 3. It is bounded on the west by existing SH 83, on the north by New Life Church and Pikes Peak Community College, to the south by the proposed Interquest Parkway Phase II and to the east by the Kettle Creek Drainage Basin. Phase II begins at the intersection of present State Highway 83 (SH83) and existing Stout Allen Road ending with the future northern intersection of SH 83 and Interquest Parkway. This Hydraulic report addresses Phase II Final Design; the Final Hydraulic Phase I report was submitted dated August 26, 1998.

The proposed Phase II project disturbance area contains approximately 23.52 acres or .037 square miles. Historically, the project area receives runoff from an area of about 227 acres to the northeast of the property. This area is currently undeveloped pasture land. A small ridge line along the southerly limits of the basin prevents this runoff from reaching Kettle Creek. An extended Powers Boulevard proposed by others may alter historic drainage patterns in offsite area O-1 (See Appendix A/Design Point 1).

The current network of roadways and development has slightly affected drainage patterns:

Flows traveling southwest from the northeast offsite basin run into State Highway 83 (SH83) and are channelized north of this highway until crossing into the Pikes Peak Community College (PPCC) site in an existing 24" pipe at design point 2. The community college does not recognize this historic flow in their drainage report as flowing through their property and rather shows flow routed west in a roadside ditch where it is eventually discharged at the northeast corner of SH 83 and the existing Stout Allen Road at design point 4. The remainder of the flow from the PPCC is released from the property at historic levels from an onsite detention pond (under construction/design point 3).

The New Life Church has also constructed an onsite detention facility that releases flow at historic rates from its property to the northeast side of the Stout Allen, SH 83 Intersection.

All of the areas studied drain directly to Monument Creek to the west.

VICINITY MAP
PHASE II
INTERQUEST INTERCHANGE

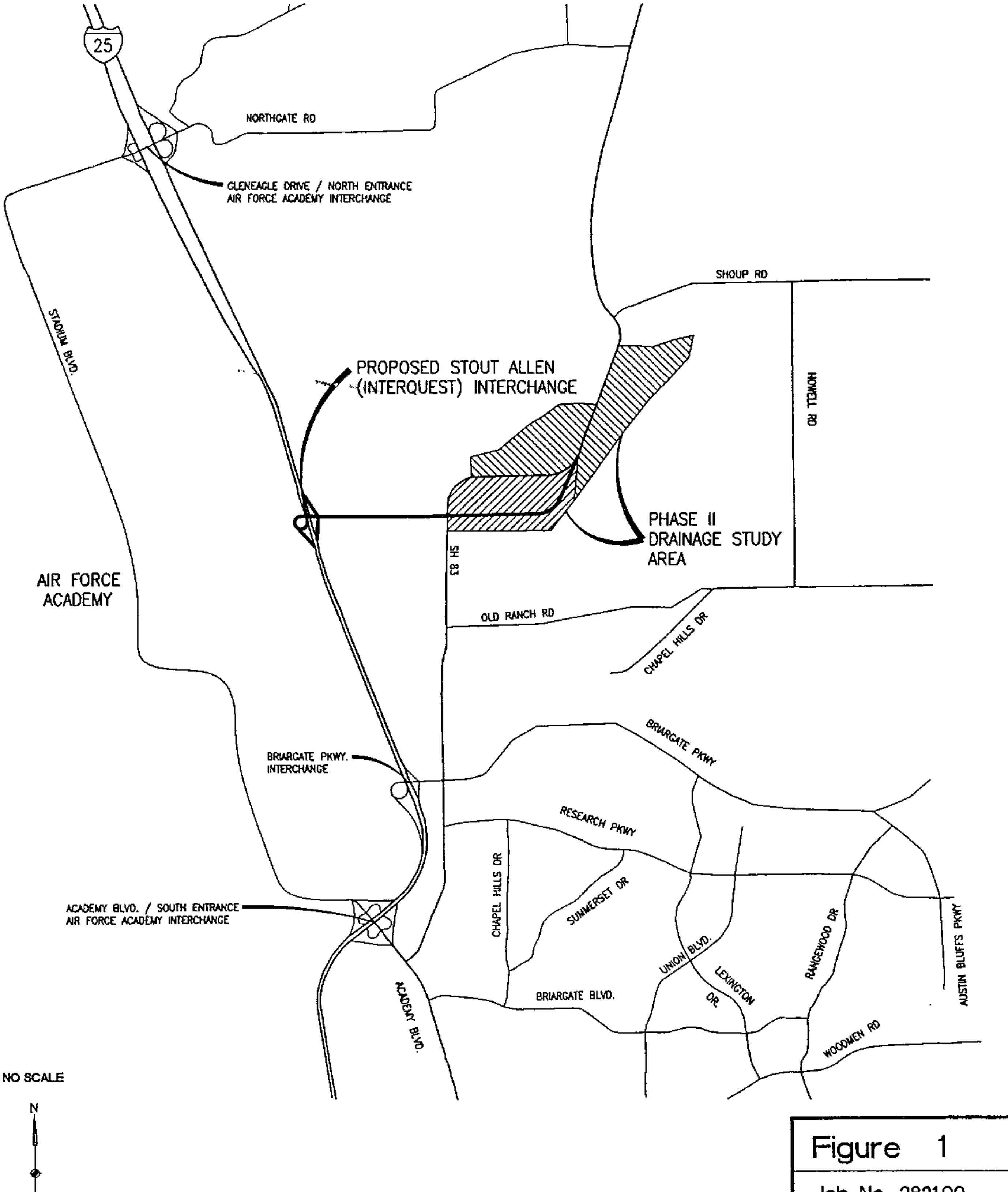

Figure 1

Job. No. 3821.00

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Date Prepared: 03/17/99

Drawing: S:3821\CADD\HYDR\REPORT\VICMAP.DWG

CITY OF COLORADO SPRINGS

II. HYDROLOGY

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II. HYDROLOGY

A. GENERAL DISCUSSION

This report includes review of the drainage limits associated with the area surrounding the proposed project. The review included previous drainage reports and plans that were available from CDOT or the City of Colorado Springs (City). These drainage reports and plans include the following:

1. "Fairlane Technology Park - Hydrology Update," Ayres Associates, November 13, 1997.

2. "Master Development Drainage Report and Plan", Fairlane Technology Park., URS Project No. 42044. October 22, 1993, Revised January 6, 1994.

3. "Preliminary and Final Drainage Report and Plan", Fairlane Technology Park Filing No. 2. URS Project No. 42044. Revised January 6, 1994.

4. "Drainage Memorandum for Pikes Peak Community College North Campus", Colorado Springs, Colorado., El Paso County. URS Project No. 67.42154, October 7, 1996

5. "New Life Church Drainage Report," KLH Engineering, INC., April, 1991.

6. "Preliminary and Final Drainage Report for International Bible Society Filing NO. 1.", URS Project NO. 48404. August, 1988.

7. "Northgate Phase 1 Drainage Plan", URS Project No. 45206, June 15, 1987, Revised August 27, 1987.

8. "Northgate Phase 1 Drainage Plan", URS Project No. 45206, June 15, 1987, Revised August 27, 1987. Addendum Date October 6, 1987.

9. "New Life Church Filing No. 2, Drainage Addendum #1," Haynes and Associates Project No. 95-105, May 20, 1996.

B. DRAINAGE AREA CHARACTERISTICS

The project is surrounded by undeveloped pasture land with parcels of recently developed light industrial and commercial land. The topography of the site consists of moderately sloping hills which slope in general from northeast to southwest at an average slope of slightly greater than 2%. Existing drainage paths within the basin are not clearly defined by channels or gullies, indicating runoff travels across the site in sheet flows. Offsite basins and on site sub-basins have been delineated and labeled on the "Drainage Basin Area" (DBA) sheets located in Appendix A.

Vegetation within the basin boundaries consists mostly of prairie grasses with some small stands of trees and scrub oak. In this study the undeveloped areas have been considered as pasture or range land. Phase II soils consist mostly of Blakeland Sandy Loam soil type 8. This soil type generally exists in slope ranges between 1-9% and is Hydrologic Soil Type A. The majority of the offsite contributory areas to the northwest are classified as Petyon Pring Complex, Pring Course Sandy Loam, Stapleton Sandy Loam or Stapleton-Bernal-Sandy-Loam. These soils have evolved from material weathered from Arkosic sedimentary rock. Arkosic sedimentary rock is considered a sandstone with granitic source for sand. The sand sized Feldspar particles are much stronger than the cementing material in the sandstone and remaining as discrete particles after loss of cementation in the rock. The result is a granular soil considered to be part of the Hydrologic Soils Group B which is easily erodible by surface water runoff.

Basin soil and land use characteristics determine the resultant level of precipitation runoff that travels over the ground or infiltrates into the soil. The U.S. Soil Conservation Service classifies soils into four hydrologic groups (A, B, C, and D) according to runoff potential. Group A soils exhibit high infiltration rates when thoroughly wetted and are considered to have low runoff potential. Group B soils exhibit moderate infiltration rates when thoroughly wetted. Group C soils exhibit slow infiltration rates when thoroughly wetted. Group D soils exhibit very slow infiltration rates when thoroughly wetted and are considered to have high runoff potential.

In the case of this study. Phase II consists primarily of soil type A with low runoff potential. As a result of current City of Colorado Springs Criteria, type A soils are not allowed in runoff analysis where any grading or fill operations have or will occur. Therefore Phase II of the project has been analyzed with soil type B.

C. DESIGN METHODS AND CRITERIA

Project design criteria were developed that incorporated critical elements of both CDOT and City of Colorado Springs criteria. The methods and criteria utilized are included in Appendix B. The design references used for this project are as follows:

1. "Drainage Design Manual, 1995 Draft", Colorado Department of Transportation, July 1995.

2. "Drainage Criteria Manual", City of Colorado Springs and El Paso County, October, 1987 including amendments in November, 1991 and October, 1994.

3. "Erosion Control and Stormwater Quality Guide", Colorado Department of Transportation, June, 1995.

4. "Soil Survey of El Paso County Area, Colorado" United States Department of Agriculture Soil Conservation Service. 1975.

5. "Design of Small Dams" United States Department of the Interior, Bureau of Reclamation. Revised Reprint, 1977.

6. "NOAA Atlas 2-Precipitation-Frequency Atlas of the Western U.S.," Volume III-Colorado. National Oceanic and Atmospheric Administration, 1973.

7. "Drainage of Highway Pavements", Hydraulic Engineering Circular No. 12, U.S. Department of Transportation/Federal Highway Administration, March 1984.

D. HYDROLOGIC CRITERIA

The design rainfall intensity for sizing of hydraulic structures is the 100 year storm intensity. The on-site calculations of this drainage study area based upon the criteria and requirements of the State Drainage Design Manual (State Manual) and the City of Colorado Springs Design Manual (City Manual). In accordance with chapter 6 of the City Manual, the Rational Method was applied to only basins less than 100 Acres. The Rational Method was used to calculate the 5 and 100 year frequency storm runoffs for any areas that were determined by hand calculations. The Rational Method is defined as follows:

$$Q=CiA$$

Q = maximum rate of runoff in cubic feet per second
C = a runoff coefficient as a ratio between the maximum rate of runoff and the average rate of rainfall intensity over a duration equal to the time of concentration
i = average intensity of rainfall in in/hr for a duration equal to the time of concentration.
A = area of basin or sub-basin in acres

The overall storm sewer system was analyzed using XPRAT storm sewer software. Results from the use of this software is attached in Appendix E.

The time of concentration is defined as the time required for water to flow from the most remote point of the area to the point being investigated. The runoff coefficients are based on the subasin's historic and proposed land use. A table for these coefficients can be found in the design criteria in Appendix C. The rainfall time/intensity/frequency curve for Zone 11A was taken from the City Manual. (Appendix C).

The time of concentration for basins under with overland flows of less than 300 feet was calculated by utilizing the formula below from the City Manual.

$$Tc = 1.87\ (1.1 - C_{10}) L^{.5} S^{-.33}$$

Where C_{10}	= adjusted runoff coefficient for 10 year flow
L	= length of overland flow in feet
S	= slope of flow path in percent; and
Tc	= travel time in minutes

For basins over 100 acres, or for basins part of a larger analysis, the HEC-1 computer program was utilized. HEC-1 output can be viewed in Appendix E. The time of concentration used for the larger basins was calculated using the formula below with adjustments made for the project location west of the 105 meridian.

$$Tc = \left(\frac{11.9\ L^3}{H}\right)^{.385}$$

Where Tc	=	time of concentration in hours
L	=	length of longest watercourse in miles
H	=	elevation difference in feet

The adjustment table for watersheds west of the 105 meridian and mountainous timber-covered watersheds east of the 105 meridian is shown below:

CN	T'c/Tc
80...	1.0
70...	1.4
60...	1.8
50...	2.2

Rainfall depths of 3.0 and 4.4 inches were obtained from the NOAA Atlas 2 isopluvials for the project area for the 5-year 24-hour, 10-year 24 hour, and the 100-year 24 hour storm events respectively. Currently no analysis has been performed for the 2-hour 10 year and 2-hour 100 year storm events.

Flow capacities for the proposed road were based on the allowable capacities for major storms according to road type, major arterial and highway respectively. Design assumptions for these systems are located in the design criteria. (Appendix C).

E. OFFSITE HYDROLOGY

The offsite basin flows were calculated using the above hydrologic computation methods and were compared to flows established in the other studied basins. The flows generated by offsite flow analysis were then used to determine culvert capacities, size proposed stormsewer, determine grading and other drainage related items.

Offsite Basin O-1

Offsite Basin O-1 was last studied in report reference #1. This basin is shown as containing 170 Acres and producing a 100 year 24 hour historic flow of 230 CFS directly onto the northeast quadrant of the project site. Reference #2 shows almost identical data of 169.1 acres and 230 CFS historic flow.

Offsite Basin O-2 (O-2A, O-2B)

Offsite Basin O-2 was last studied in report reference #1. This basin is shown as "not contributing" to the project site. This assumption may be based on the assertion that an existing 24" CMP would be removed. In fact this CMP is undersized but does transfer some flow from approximately 55 acres of OS-2 to the project site. Reference #2 shows this relationship correctly, displaying 55 acres of contributory area and 148.5 cfs 100 year flow. However, it should be noted that only approximately 35 CFS would be able to pass through the pipe in peak flow conditions before possible road overtop or cross basin flow diversion. For clarity OS-2 is broken into 2 parts in this report; OS-2B which does contribute to the project, and OS-2A which contributes to the Black Squirrel Basin.

A summary of design point flows is included below:

DESIGN POINT SUMMARY					
DS	HISTORIC 100 YEAR FLOW	DEVELOPED 100 YEAR FLOW	FLOW INCREASE + FLOW DECREASE -	FLOW CHANGE %	DESCRIPTION OF DESIGN POINT LOCATION
PT					
1	230	65*	-165	-71.74%	OFFSITE AREA O-1/POWERS EXT.
2	148.5	148.5	0	0.00%	CROSS CULVERT/O-2B TO B-9
3	173	60	-113	-65.32%	PIKES PEAK POND
4	178	34	-144	-80.90%	NEW LIFE POND
	*Preliminary Quantities-Assuming future alignment of Powers Boulevard				

CITY OF COLORADO SPRINGS

III. EXISTING STRUCTURE

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III. EXISTING STRUCTURE

A. GENERAL DISCUSSION

Their are few existing drainage structures in Phase 11 of the Interquest Parkway Project.

B. EXISTING DETENTION POND OUTFALLS

Two detention ponds exist which outfall onto the project. These ponds were designed and constructed by individual property owners.

Pikes Peak Community College Pond Outfall
Pikes Peak Community College's pond was designed in October of 1996 and completed late in 1997 (design point 3) (Reference #4). This pond discharges at a rate of 55 CFS during a 100 year storm to the southeast which is shown as a decrease of 55.6% from the historic flow of 124 CFS.

New Life Church Pond Outfall
The New Life Church's pond system was designed in April 1991 and is currently operational (design point 4). This pond system discharge at a rate of 34 CFS in a 100 year storm which is just less than the capacity of the existing 30" culvert under SH 83.

<u>OTHER FACILITIES</u>

A 24" CMP exists due north of the Pike Peak Community College at design point 2; the pipe crosses perpendicular to SH 83. As previously stated this pipe carries flow from O-2A toward the community college. The college has rerouted the historic flow in a roadside ditch created by berming around the north quadrant of their property. Flow travels toward the New Life Church's Northern Boundary. At the New Life Church flow travels through a 24" RCP (reported as a 30" RCP in other references) and then continues to flow southwest in a roadside ditch to the intersection of existing SH 83 and existing Stout Allen Road at design point 4.

A 24" H.D.P.E. stormsewer is currently in place on the northwest portion of the New Life Church property. The stormsewer initiates at the temporary sediment basin, designed to capture sediment from the construction of the World Prayer Center, and terminates at the concrete channel which outlets into the detention pond. With the relocation of the New Life Church intersection (See sheet FLHPP06), the existing 24" H.D.P.E. will be extended and the existing inlet and perforated water quality pipe riser will be removed.

CITY OF COLORADO SPRINGS

IV. DESIGN DISCUSSION

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IV. DESIGN DISCUSSION

A. GENERAL DISCUSSION

Overall, the design criteria of CDOT and the City has been established and the project design based on its guidelines. HEC-12 was also utilized during design to supplement the criteria.

B. SITE SPECIFIC CONDITIONS AND CONSTRAINTS

ROW constraints along the proposed Interquest Parkway limit some of the choices in transferring drainage through the project.

At the intersection of SH 83 and proposed Interquest Parkway a 36" water is located approximately 5' below the existing ground. As a result, a 2' X 6' RCBC is proposed to cross SH 83 and avoid alteration of this water line. Final design elevations can be found in the drawing appendix.

C. MAJOR DRAINAGE ALTERNATIVES

As pointed out in previous drainage reports and addendums, offsite area 0-1 contributes 230 CFS to the eastern edge of the project in a 100 year storm. It is predicted that the extension of Powers will cut off approximately 150 acres of this basin from contributing to this project. However, the 230 CFS must be accommodated in the Phase II projects drainage plan in the interim period between Phase II completion and the Powers Extension Project.

To accommodate the 230 CFS in the interim and the reduced 65 CFS predicted when Powers is constructed; a combination storm sewer system, temporary channel/berm system is proposed. Offsite area 0-1 flow travels southwest until is interrupted by the construction of the Phase 2 roadway. To prevent flow from overtopping the road a berm system is designed which will force drainage south. At approximately station 18+640 an existing ridge intersects the roadway which would pinch the flow off between the roadway and the berm causing road overtop. To route the flow at this pinch point, a "drainage pit" is located. In the bottom of the drainage pit, the inlet pipe to the stormsewer system and outlet culvert leading to the downstream channel are located. By making this pit facility, it is possible to lower the invert of the downstream channel and its resultant slope to provide non-erosive velocities (see Appendix D) and connect a portion of the flow into the stormsewer system. This configuration will route a maximum of 65 CFS into the stormsewer system while routing 165 CFS into a temporary channel. The stormsewer is designed in this fashion to accommodate the maximum estimated future contributing flow with Powers in place. The channel is designed to take the remainder of the flow to the historic channel downstream.

In this fashion the full 100 year storm will be accommodated; when Powers is constructed the temporary channel and berm can be graded back to their present configuration. This design provides the passage of the 100 year storm without grossly over-designing a storm sewer system to pass flows that will exist only until Powers is constructed.

D. PERMITTING REQUIREMENTS

A stormwater drainage permit will be prepared and submitted by the consultant.

A section 404 permit will not be submitted as there are no wetlands in the project limits.

A floodplain development permit will not be submitted as there are no designated flood plains within the project area.

CITY OF COLORADO SPRINGS

V. RECOMMENDED DESIGN

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V. RECOMMENDED DESIGN

A. GENERAL DISCUSSION

Appendix A-includes drainage basin area sheets.
Appendix B-maps and preliminary design drawings for the recommended system.
Appendix C- includes the criteria and calculations for the recommended design.
Appendix D- channel alternatives and interim drainage pit calculations.
Appendix E- includes hydrologic and hydraulic calculations.

B. PROPOSED HYDRAULIC DESIGN

INTERQUEST PARKWAY

Phase II systems collect flow from Pikes Peak Community College and Offsite Area O-1 in addition to the flow from the project area. Flow from Phase II travels into the Phase I trunkline.

As discussed above in Major Drainage Alternatives the flow from Offsite Area 0-1 will be divided into the stormsewer system and a temporary channel based on future predicted flows that may contribute to the project with the Powers Extension.

For specific design information see Appendices.

CITY OF COLORADO SPRINGS

APPENDIX A

DRAINAGE BASIN AREA SHEETS

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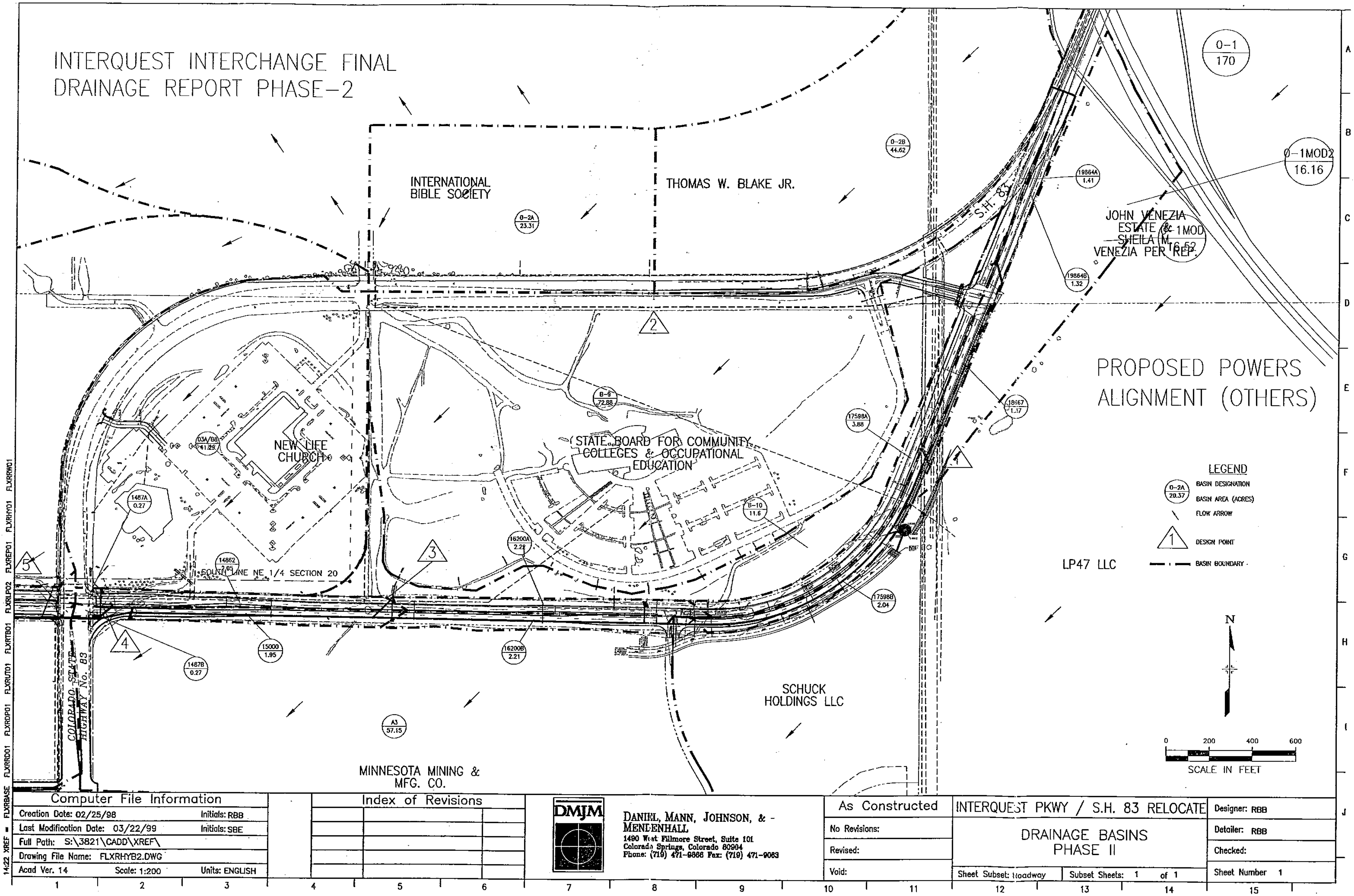

INTERQUEST INTERCHANGE FINAL
DRAINAGE REPORT PHASE-2
INTERNATIONAL BIBLE SOCIETY
THOMAS W. BLAKE JR.
JOHN VENEZIA ESTATE & SHEILA M. VENEZIA PER REP.
NEW LIFE CHURCH
STATE BOARD FOR COMMUNITY COLLEGES & OCCUPATIONAL EDUCATION
PROPOSED POWERS ALIGNMENT (OTHERS)
LP47 LLC
SCHUCK HOLDINGS LLC
MINNESOTA MINING & MFG. CO.
COLORADO STATE HIGHWAY No. 83
S.H. 83
SOUTH LINE NE 1/4 SECTION 20
0-1 170
0-1MOD2 16.16
1MOD 16.52
0-2B 44.62
0-2A 23.31
19864A 1.41
19864B 1.32
18667 1.17
B-9 72.88
17598A 3.88
03A/B8 41.29
1487A 0.27
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14862 2.05
17598B 2.04
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16200B 2.21
1487B 0.27
A3 57.15
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3
4
5
LEGEND
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FLOW ARROW
DESIGN POINT
BASIN BOUNDARY
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Index of Revisions
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As Constructed
No Revisions:
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INTERQUEST PKWY / S.H. 83 RELOCATE
DRAINAGE BASINS
PHASE II
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Subset Sheets: 1 of 1
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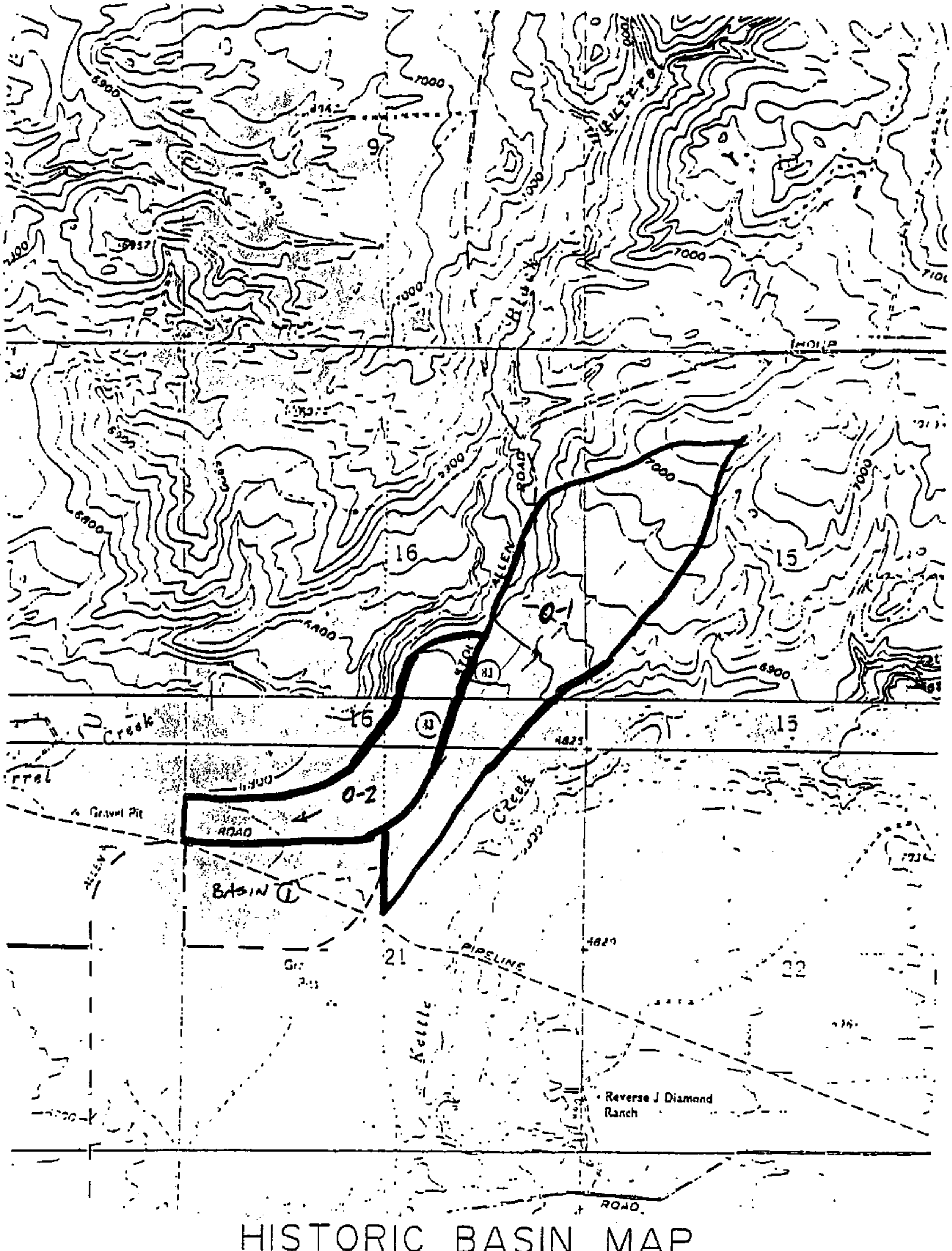

HISTORIC BASIN MAP

URS CONSULTANTS, INC.
COLORADO SPRINGS, COLORADO
PROJ NO. 67.42154

PIKES PEAK COMMMUNITY COLLEGE
NORTH CAMPUS BUILDING

FIGURE 2

CITY OF COLORADO SPRINGS

APPENDIX B

DRAINAGE PLAN SHEETS

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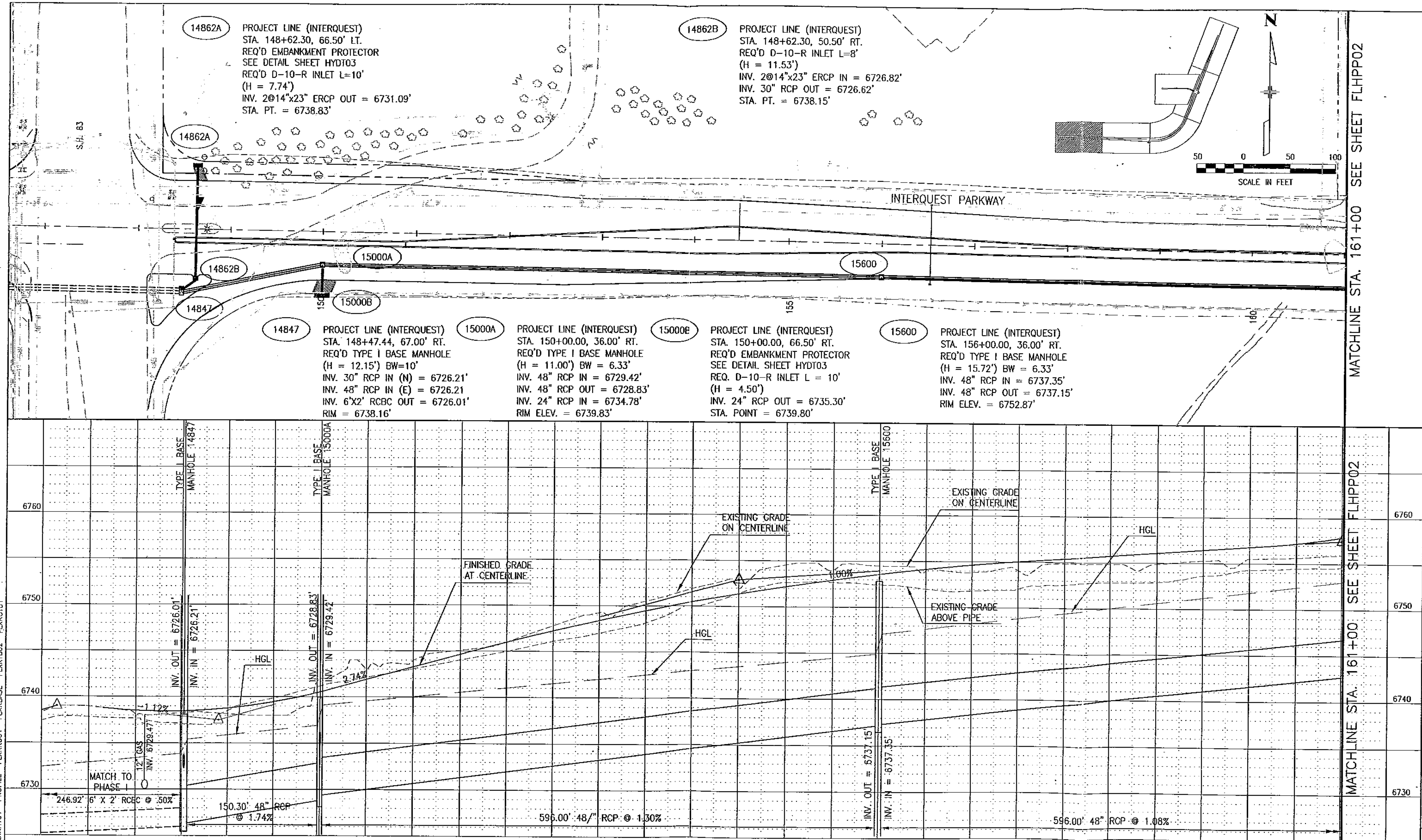

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INTERQUEST PARKWAY
DRAINAGE PLAN & PROFILE

Sheet Subset: DRAINAGE | Subset Sheets: FLHPP01 of 6

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Detailer: SBE
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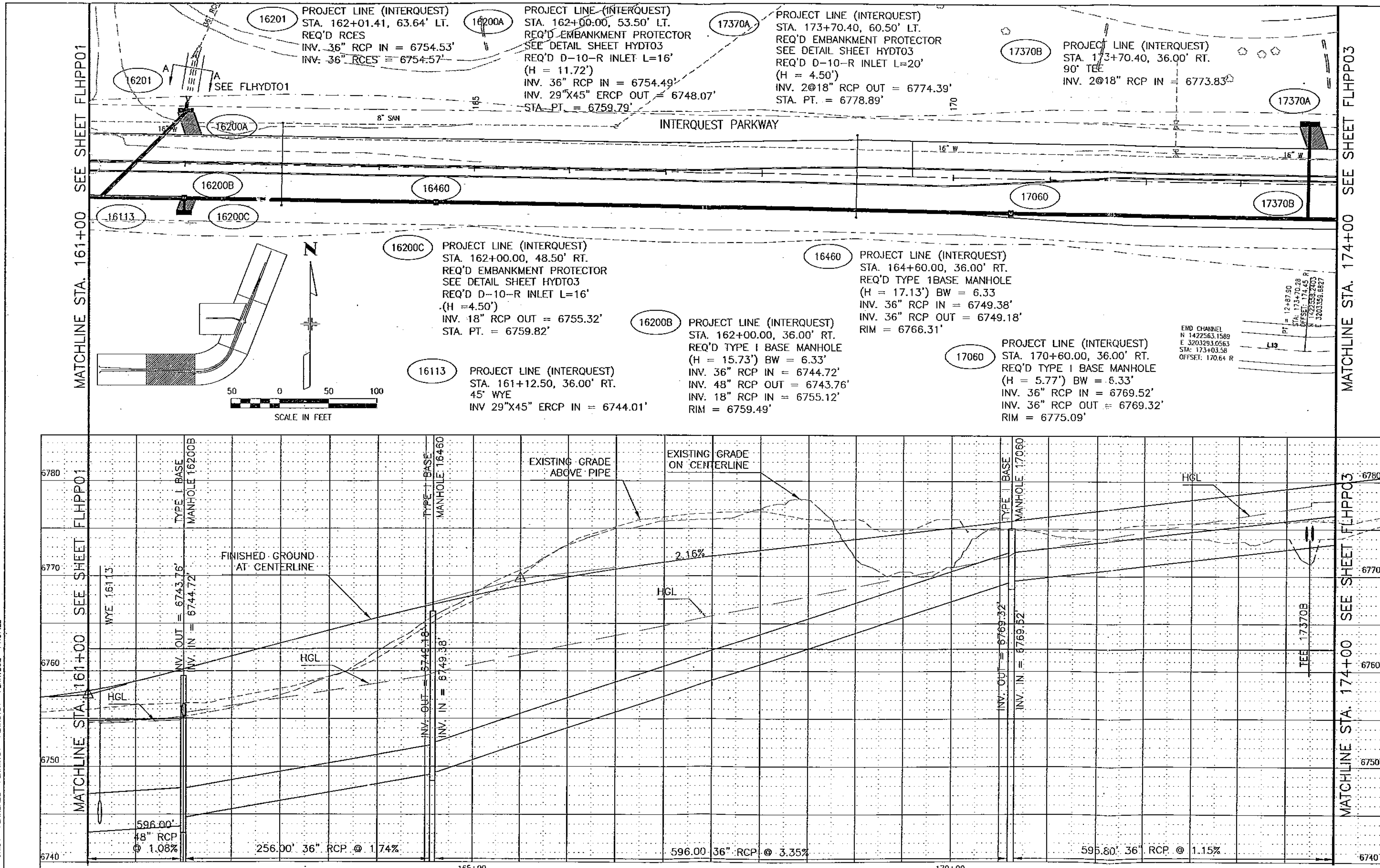

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Void:

INTERQUEST PKWY / S.H. 83 RELOCATE

INTERQUEST PARKWAY DRAINAGE PLAN & PROFILE

Sheet Subset: DRAINAGE
Subset Sheets: FLHPP02 of 6

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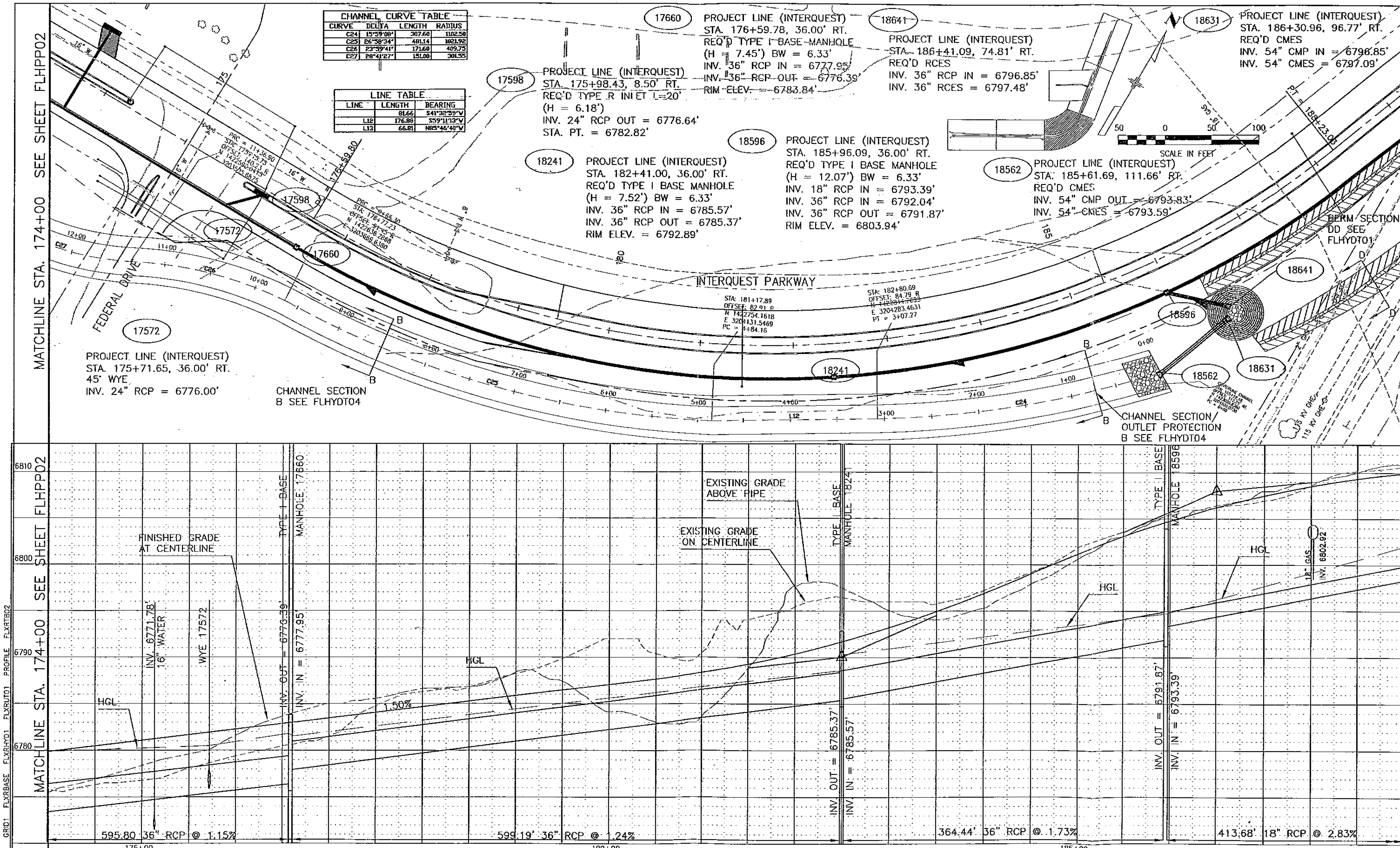

CHANNEL CURVE TABLE			
CURVE	DELTA	LENGTH	RADIUS
C24	15°59'08"	307.60	1102.50
C25	26°58'34"	481.14	1021.92
C26	23°59'41"	171.60	409.75
C27	28°41'27"	151.00	301.55

LINE TABLE		
LINE	LENGTH	BEARING
	81.66	S41°32'59"W
L12	176.88	S59°11'13"W
L13	66.81	N85°46'40"W

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Sheet Subset: DRAINAGE | Subset Sheets: FLHPP03 of 6

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Detailer: SBE
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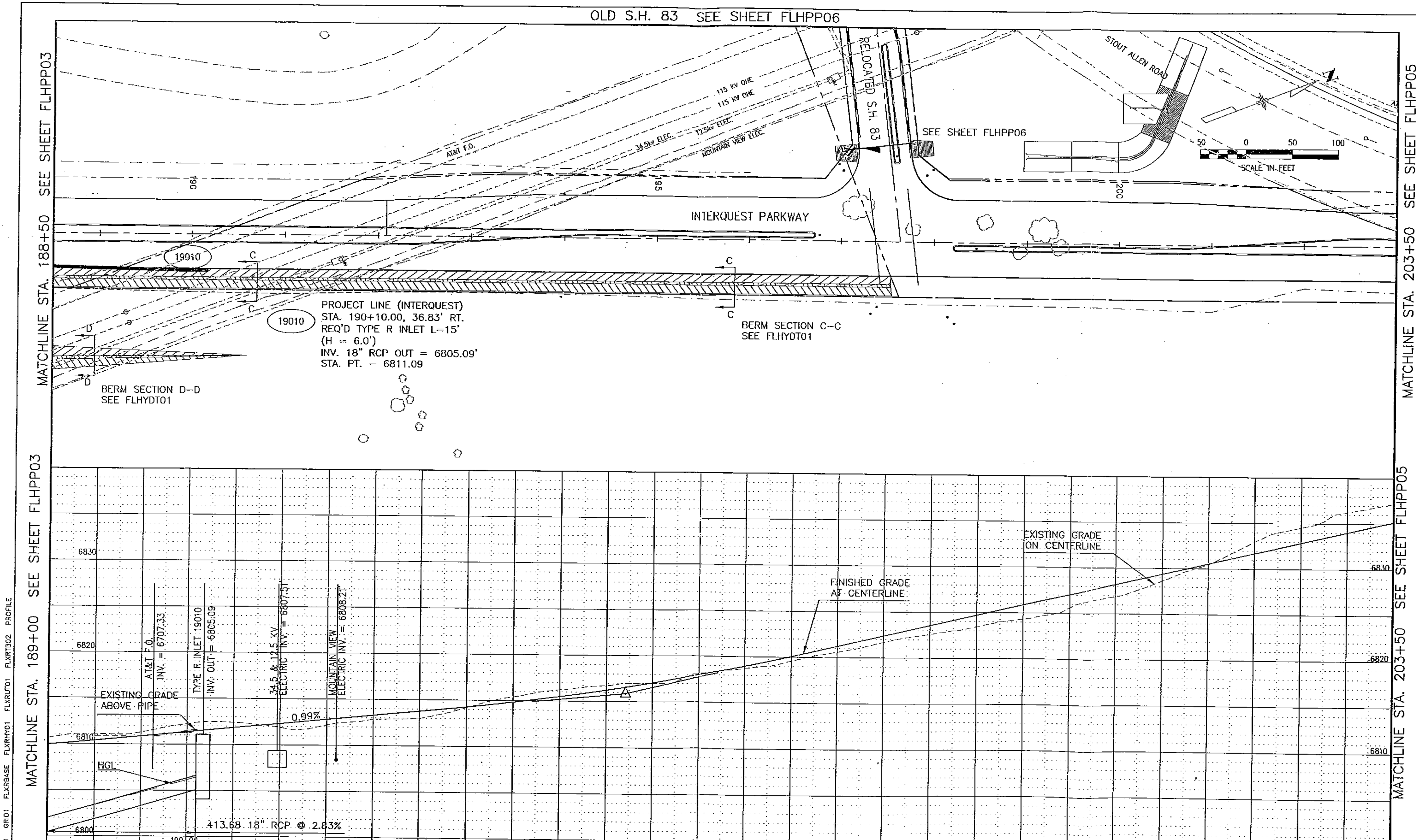

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Drawing File Name: FLHPP04.DWG	
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Colorado Springs, Colorado 80904
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INTERQUEST PKWY / S.H. 83 RELOCATE

INTERQUEST PARKWAY DRAINAGE PLAN & PROFILE

Sheet Subset: DRAINAGE | Subset Sheets: FLHPP04 of 6

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Detailer: SBE
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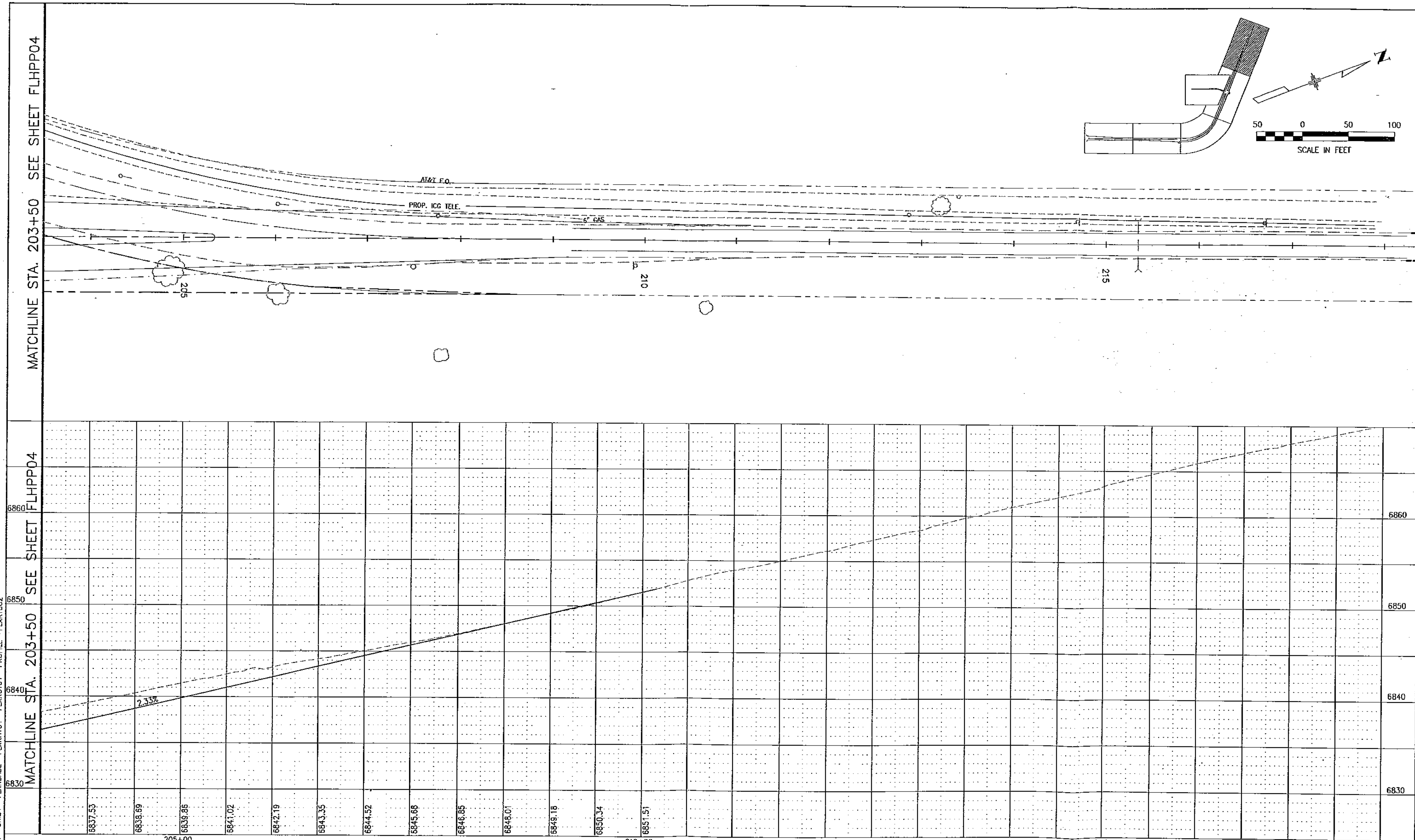

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INTERQUEST PARKWAY
DRAINAGE PLAN & PROFILE

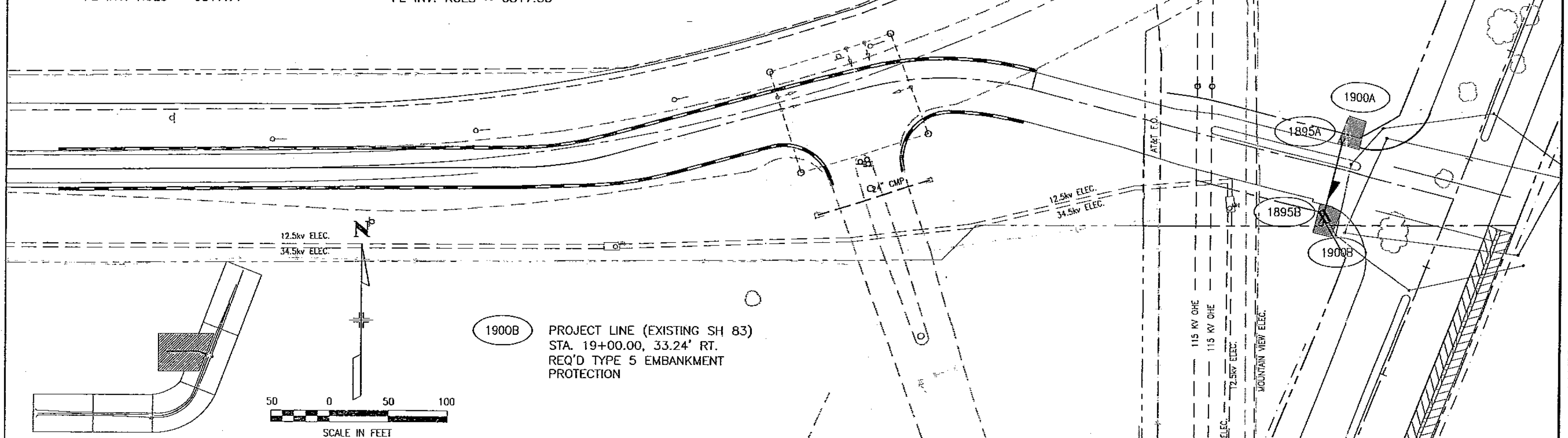
Sheet Subset: DRAINAGE | Subset Sheets: FLHPP05 of 6

Designer: CAS/RBB
Detailer: SBE
Checked: CLP
Sheet Number

1895A
PROJECT LINE (EXISTING SH 83)
STA. 18+94.80, 20.46' LT.
REQ'D RCES
FL INV. 24" RCP IN = 6817.72'
FL INV. RCES = 6817.77'

1895B
PROJECT LINE (EXISTING SH 83)
STA. 18+94.80, 43.17' RT.
REQ'D RCES
FL INV. 24" RCP OUT = 6817.40'
FL INV. RCES = 6817.35'

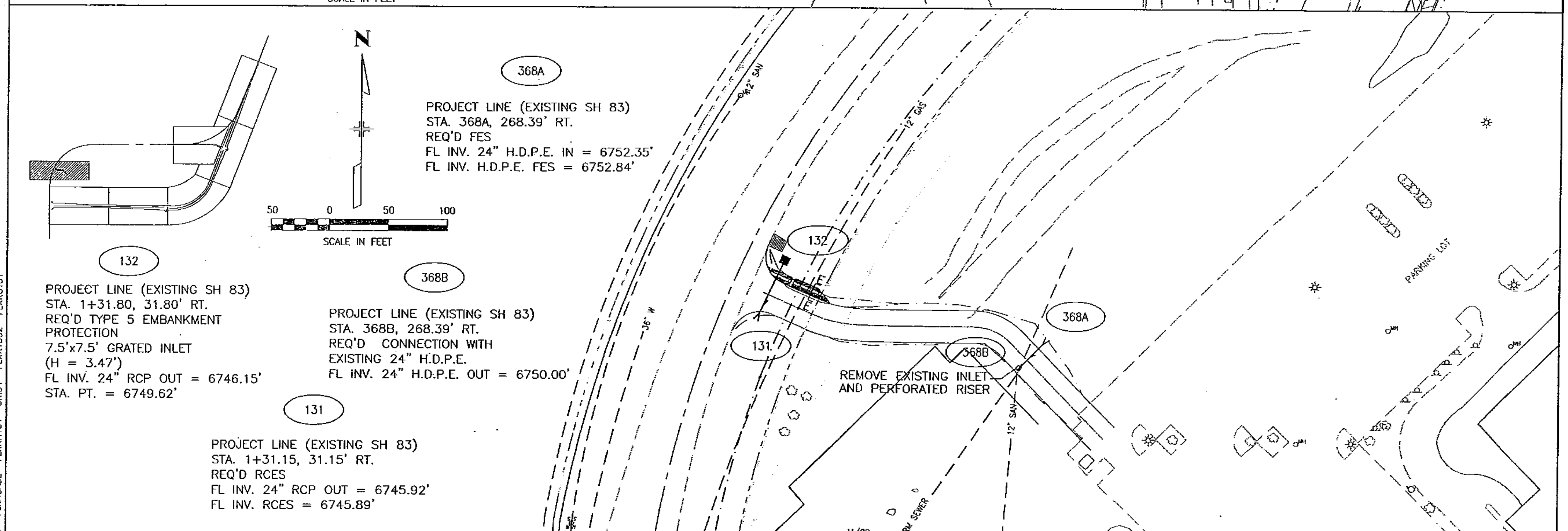
1900A
PROJECT LINE (EXISTING SH 83)
STA. 19+00.00, 20.52' LT.
REQ'D TYPE 5 EMBANKMENT PROTECTION



1900B
PROJECT LINE (EXISTING SH 83)
STA. 19+00.00, 33.24' RT.
REQ'D TYPE 5 EMBANKMENT PROTECTION

MATCHLINE SEE SHEET FLHPP04

368A
PROJECT LINE (EXISTING SH 83)
STA. 368A, 268.39' RT.
REQ'D FES
FL INV. 24" H.D.P.E. IN = 6752.35'
FL INV. H.D.P.E. FES = 6752.84'



132
PROJECT LINE (EXISTING SH 83)
STA. 1+31.80, 31.80' RT.
REQ'D TYPE 5 EMBANKMENT PROTECTION
7.5'x7.5' GRATED INLET
(H = 3.47')
FL INV. 24" RCP OUT = 6746.15'
STA. PT. = 6749.62'

368B
PROJECT LINE (EXISTING SH 83)
STA. 368B, 268.39' RT.
REQ'D CONNECTION WITH EXISTING 24" H.D.P.E.
FL INV. 24" H.D.P.E. OUT = 6750.00'

131
PROJECT LINE (EXISTING SH 83)
STA. 1+31.15, 31.15' RT.
REQ'D RCES
FL INV. 24" RCP OUT = 6745.92'
FL INV. RCES = 6745.89'

08:02 XREF = FLXRRD01 FLXRBASE FLXRHY01 GRID1 FLXRTB02 FLXRUT01

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OLD S.H. 83
DRAINAGE PLAN & PROFILE

Sheet Subset: DRAINAGE | Subset Sheets: FLHPP06 of 6

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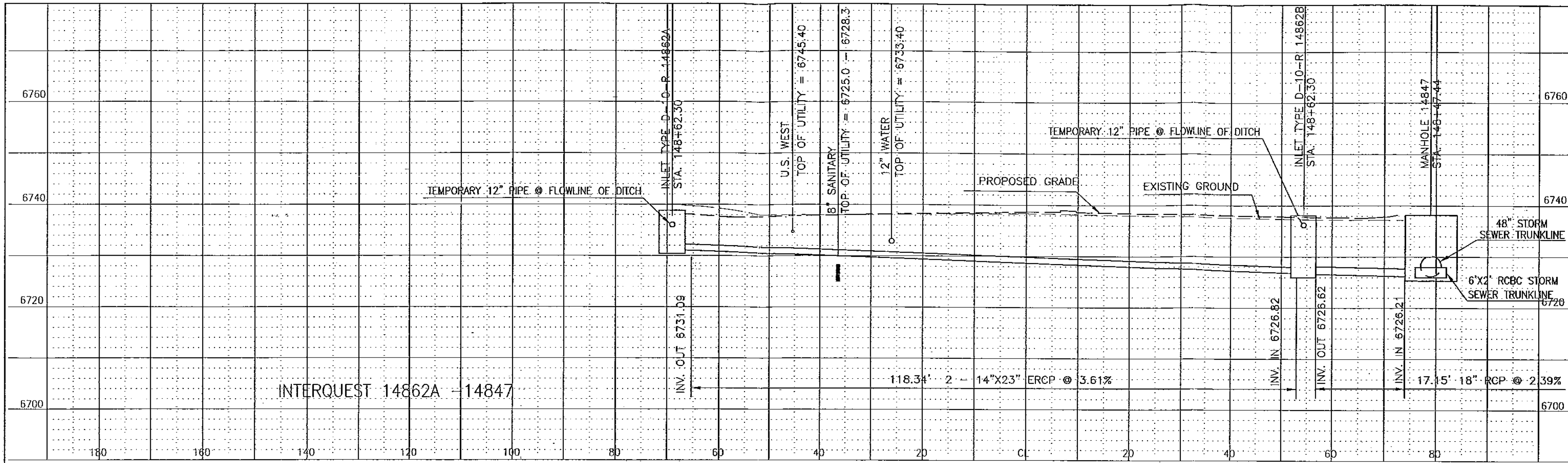

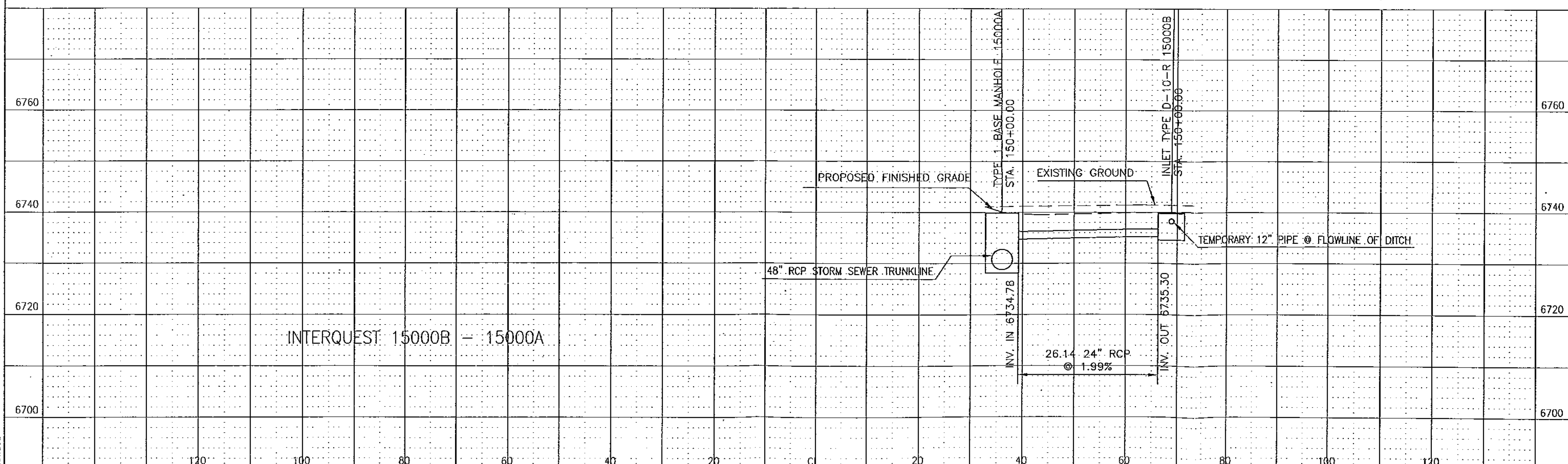

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Drawing File Name: FLXS01.DWG	
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STRUCTURE CROSS SECTIONS

Sheet Subset: Drainage | Subset Sheets: FLXS01 of 6

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Detailer: GES

Checked: CLP

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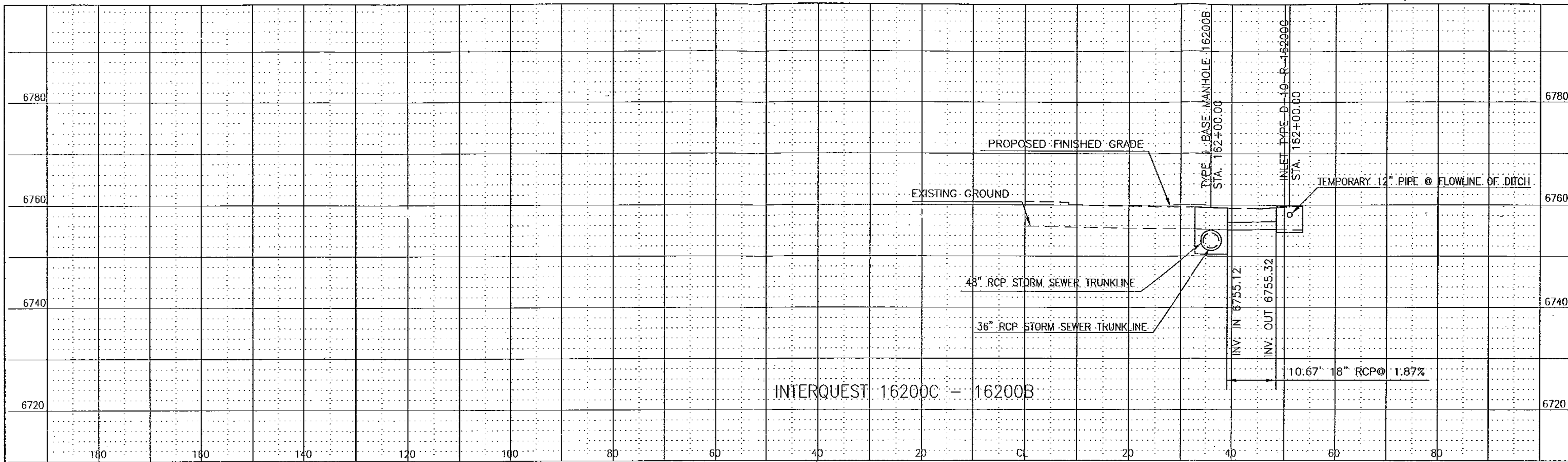

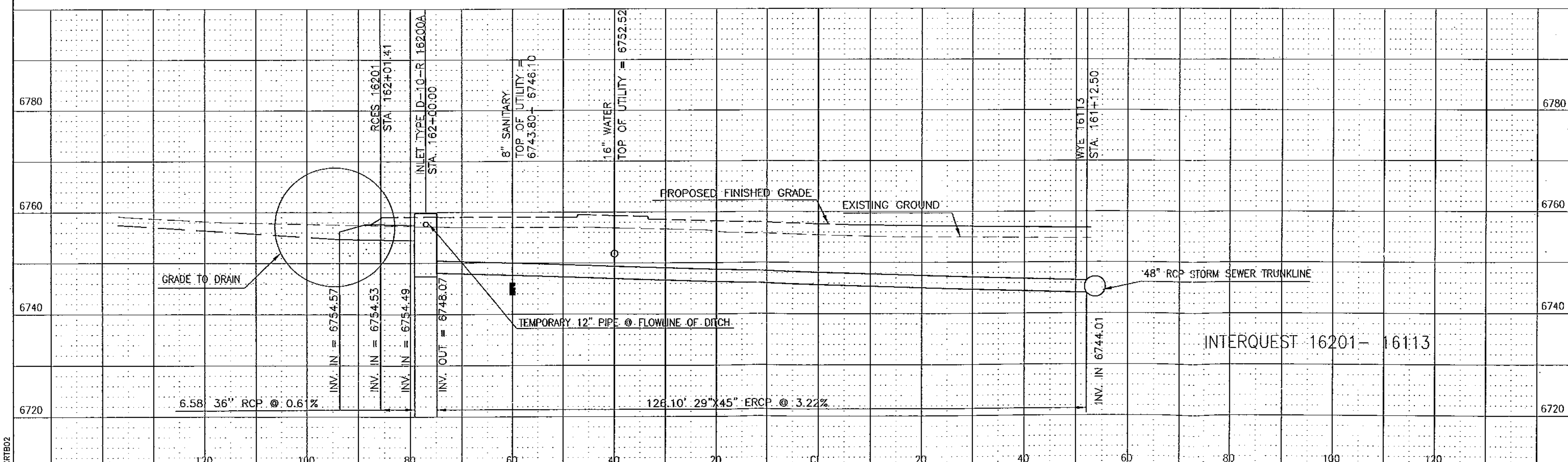

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STRUCTURE
CROSS SECTIONS

Sheet Subset: Drainage | Subset Sheets: FLXS02 of 6

Designer: CAS/RBB
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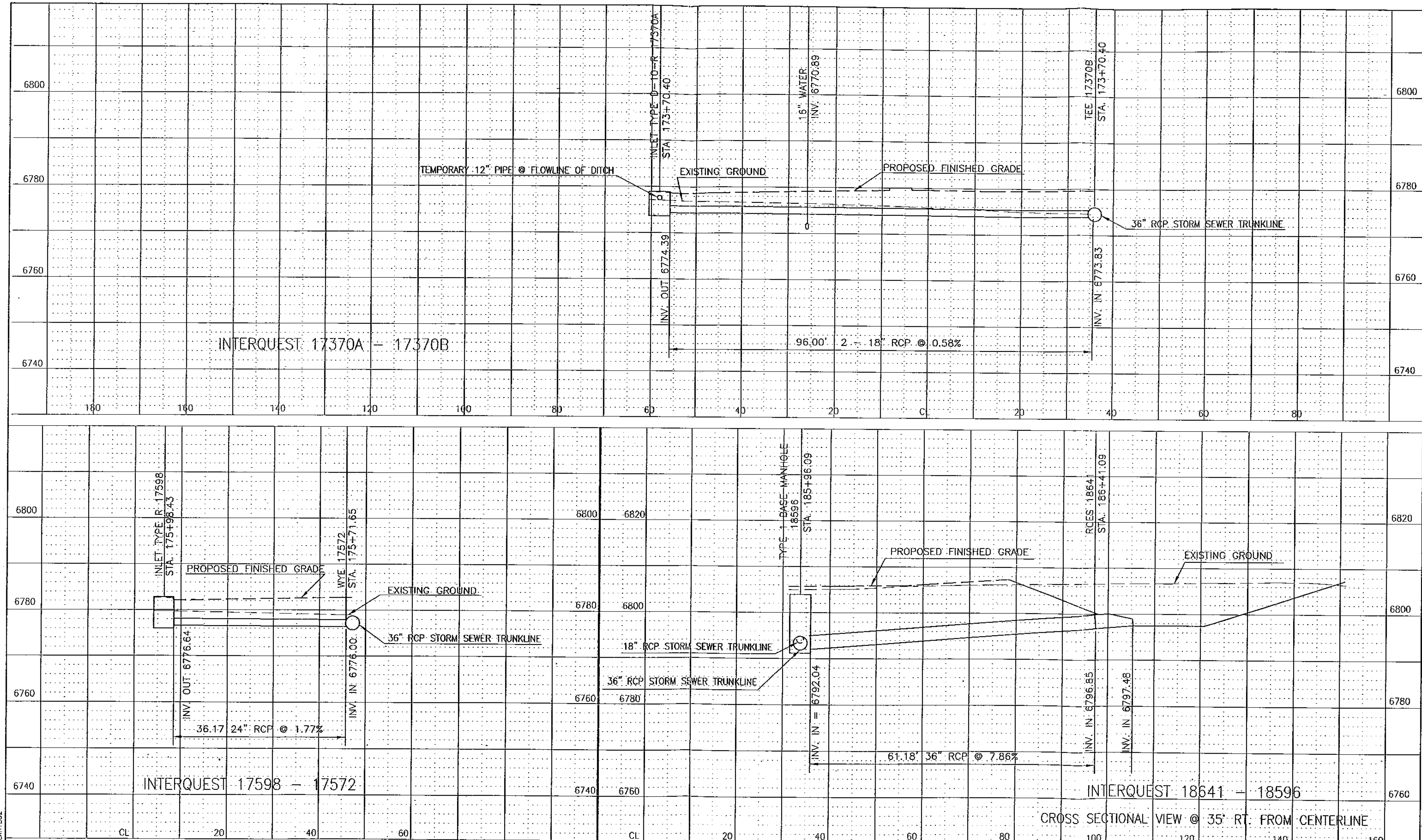

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STRUCTURE CROSS SECTIONS

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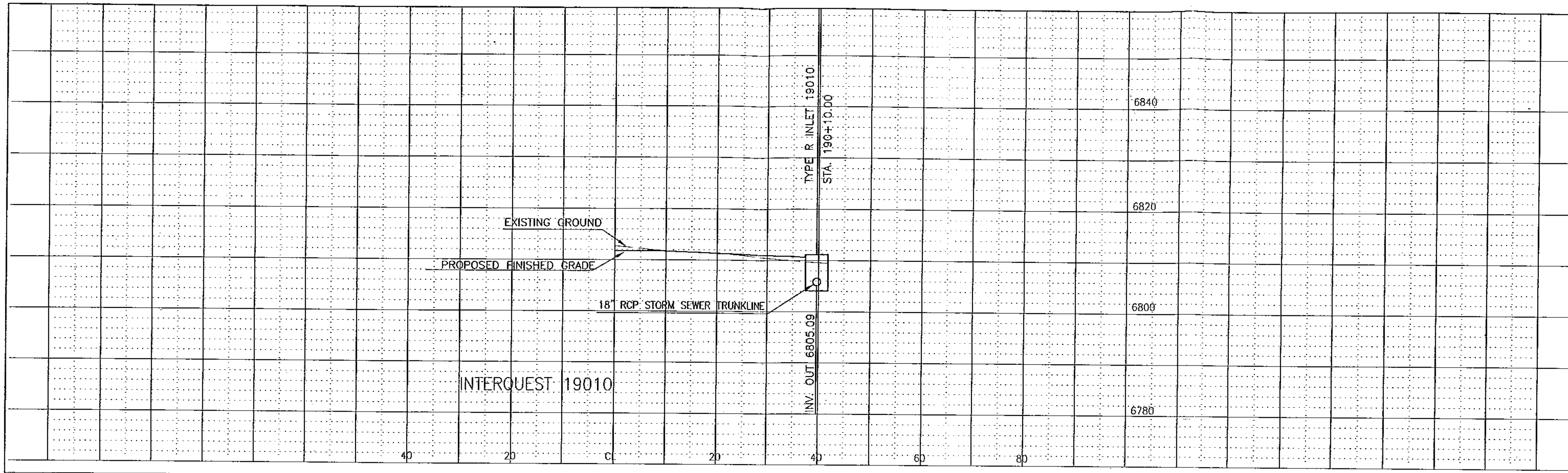

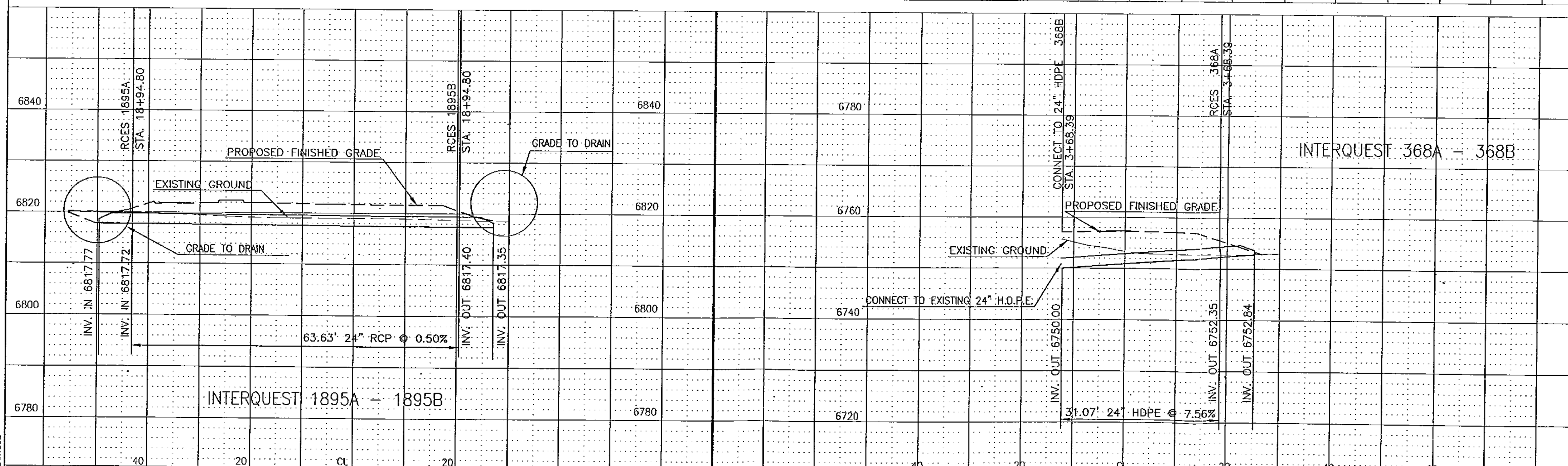

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STRUCTURE CROSS SECTIONS

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Detailer: GES
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Subset Sheets: FLXS04 of 6
Sheet Number

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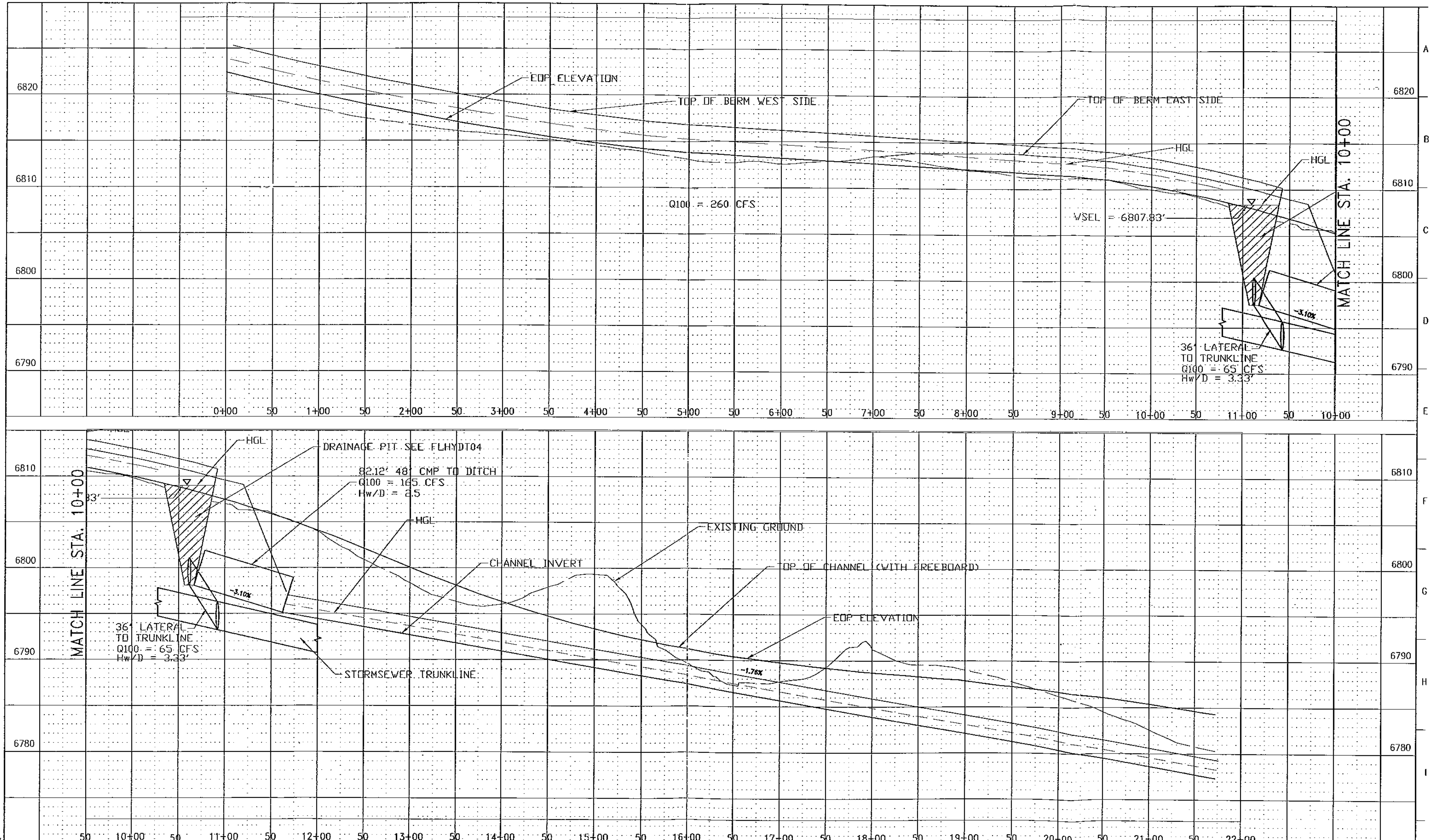

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CHANNEL AND BERM
PROFILE AT EOP

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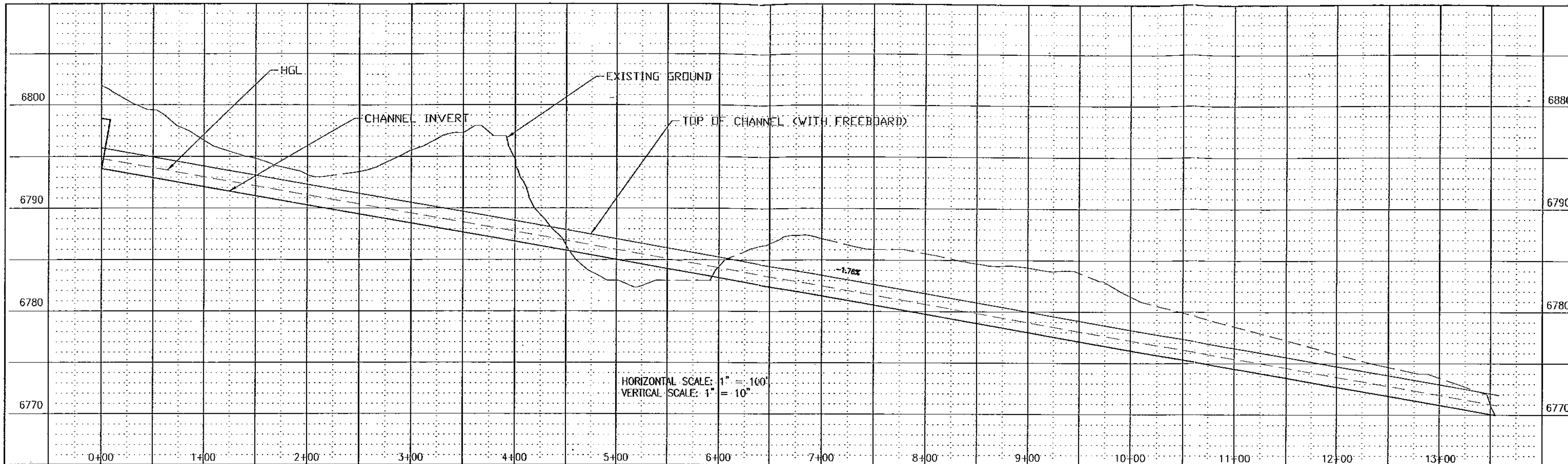

HGL
EXISTING GROUND
CHANNEL INVERT
TOP OF CHANNEL (WITH FREEBOARD)
-1.76%
HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10"
6800
6790
6780
6770
6880
6790
6780
6770
0+00
1+00
2+00
3+00
4+00
5+00
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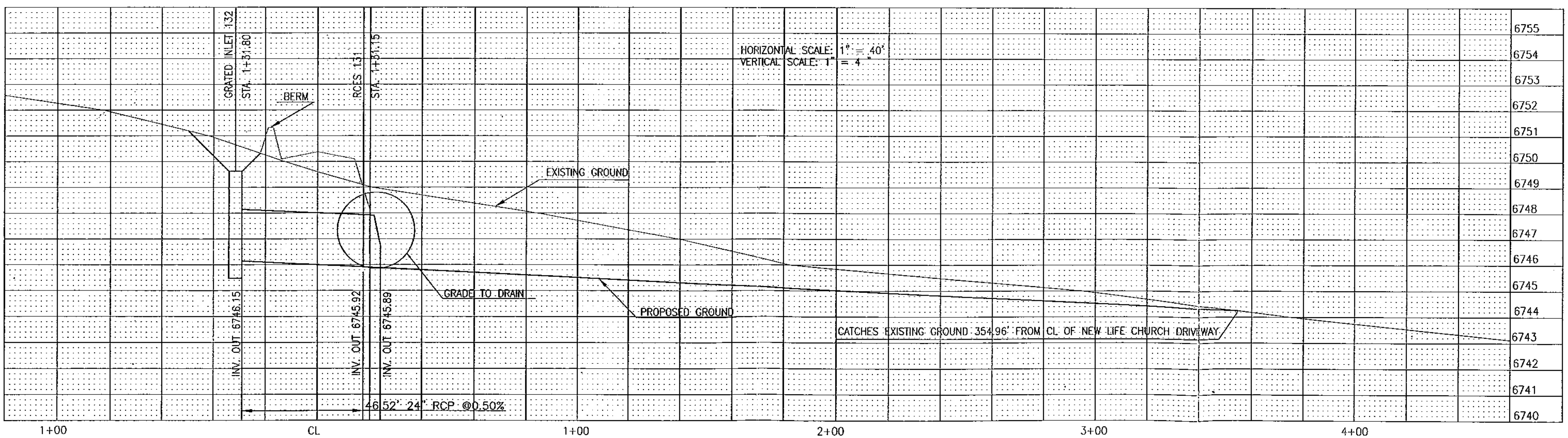
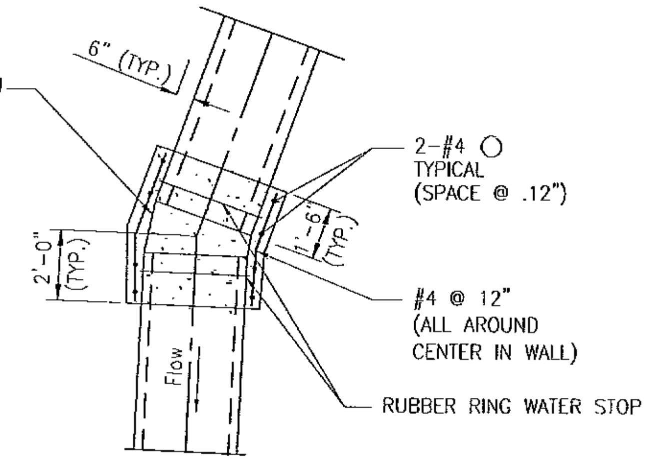
10+00
11+00
12+00
13+00



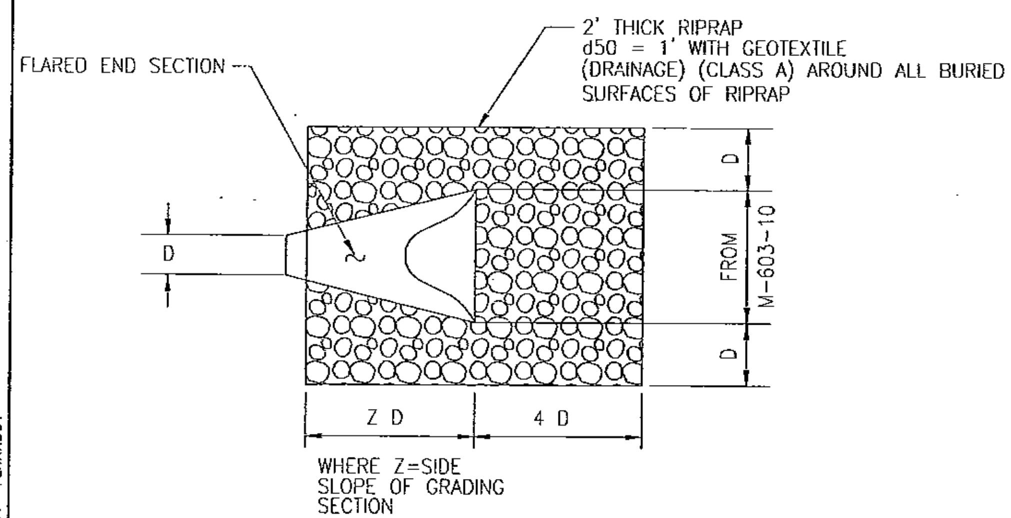
GRATED INLET 132
STA. 1+31.80
RCES 131
STA. 1+31.15
BERM
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'
EXISTING GROUND
GRADE TO DRAIN
PROPOSED GROUND
CATCHES EXISTING GROUND 354.96' FROM CL OF NEW LIFE CHURCH DRIVEWAY
INV. OUT 6746.15
INV. OUT 6745.92
INV. OUT 6745.89
46.52' 24" RCP @0.50%
6755
6754
6753
6752
6751
6750
6749
6748
6747
6746
6745
6744
6743
6742
6741
6740
1+00
CL
1+00
2+00
3+00
4+00



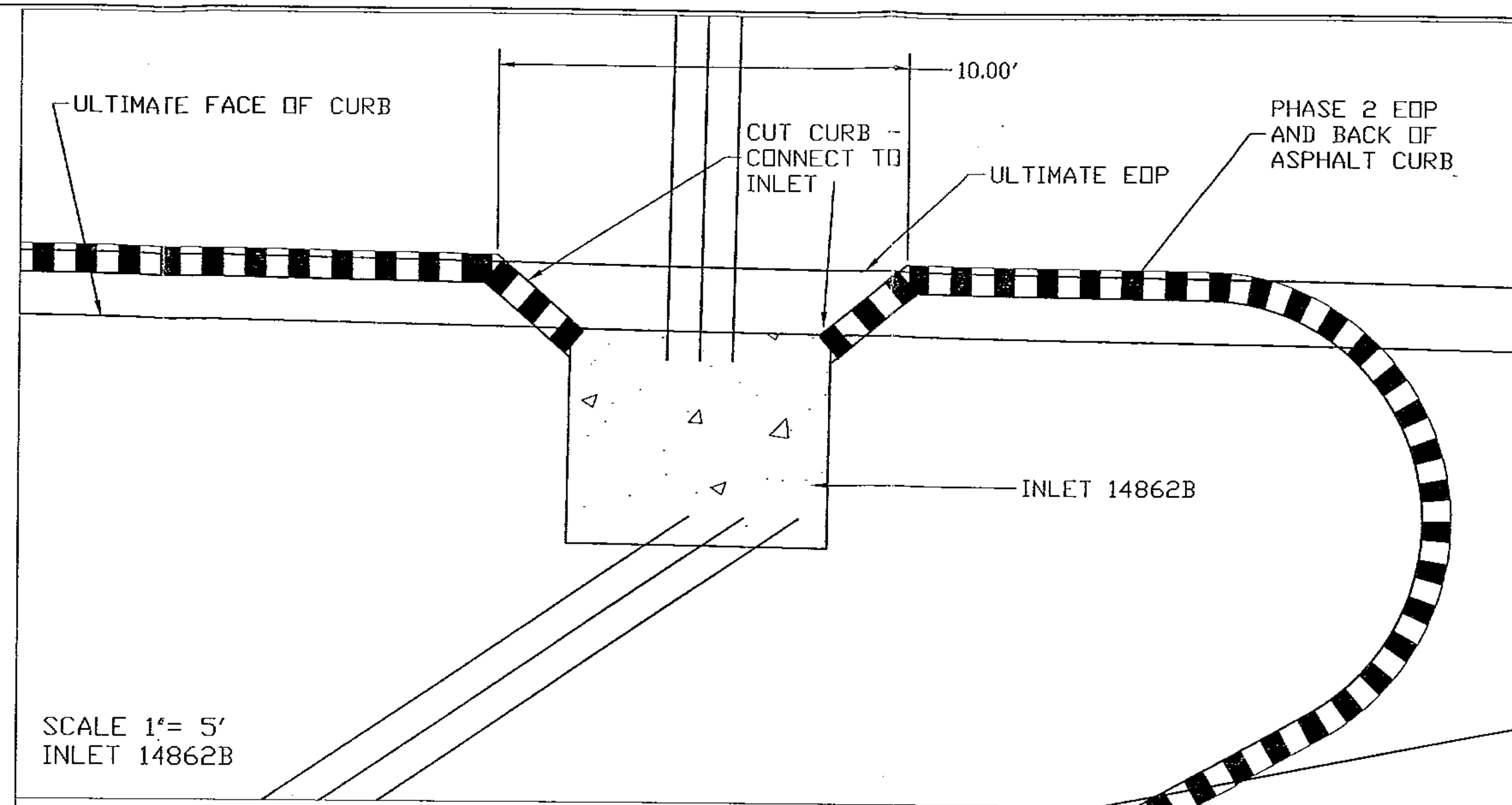
CONCRETE COLLAR DETAIL

NOTES:

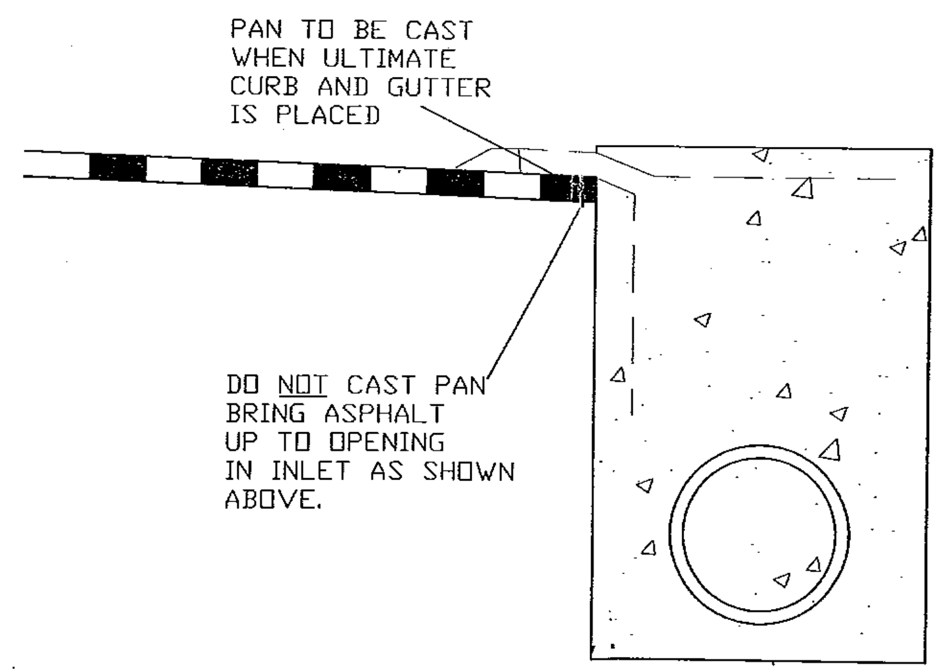
1) ALL WORK TO BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS APPLICABLE TO THE PROJECT.
2) CONCRETE FOR COLLAR SHALL BE CLASS A OR B.
3) PAYMENT FOR CONCRETE, RUBBER RING, REINFORCED STEEL, AND ALL INCIDENTAL MATERIALS WILL NOT BE MADE SEPARATELY BUT SHALL BE INCLUDED IN THE COST OF THE WORK.
4) PIPING MAY BE IN ANY DIRECTION.
5) REINFORCING SHALL HAVE fy=413,700 kPa



PIPE OUTLET EROSION PROTECTION



SCALE 1"= 5'
INLET 14862B



NTS
INLET 14862B

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MISC. HYDRAULIC DETAILS

Sheet Subset: DRAINAGE | Subset Sheets: HYDT02 of 4

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16:23 XREF = FLXRTB02 FLXRHY01 FLXRRD01

NOTES:

DETAILS OF BITUMINOUS CURBING ARE SHOWN ELSEWHERE IN THE PLANS.

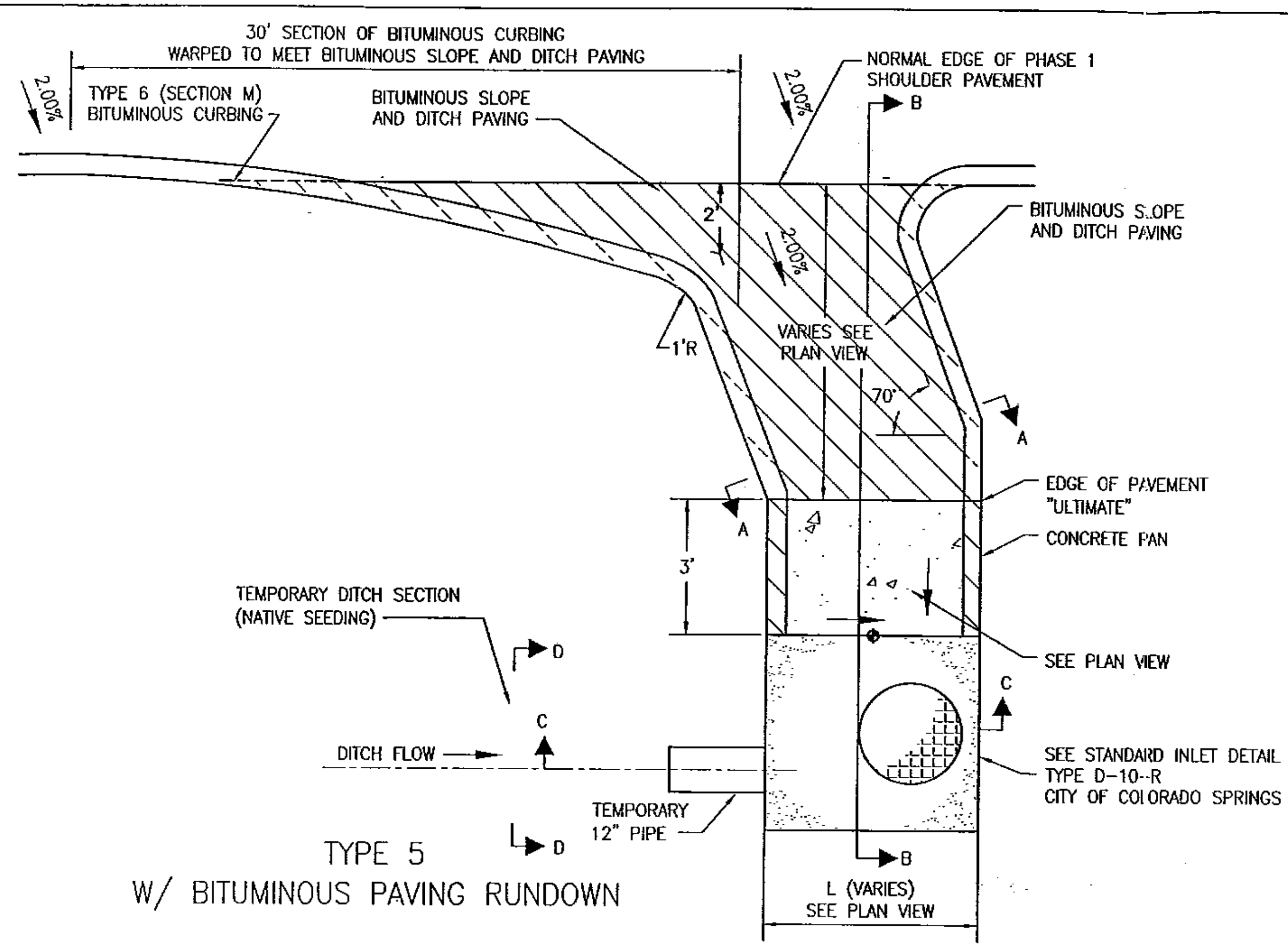
STRUCTURE BACKFILL MATERIAL SHALL NOT BE USED IN THE WORK. EMBANKMENT MATERIAL SHALL BE USED WITH CONSTRUCTION REQUIREMENTS IN ACCORDANCE WITH SECTION 203. PAYMENT FOR EMBANKMENT MATERIAL SHALL BE INCLUDED IN THE PAY ITEM FOR EMBANKMENT PROTECTOR.

PAYMENT FOR THIS WORK SHALL BE AS FOLLOWS:

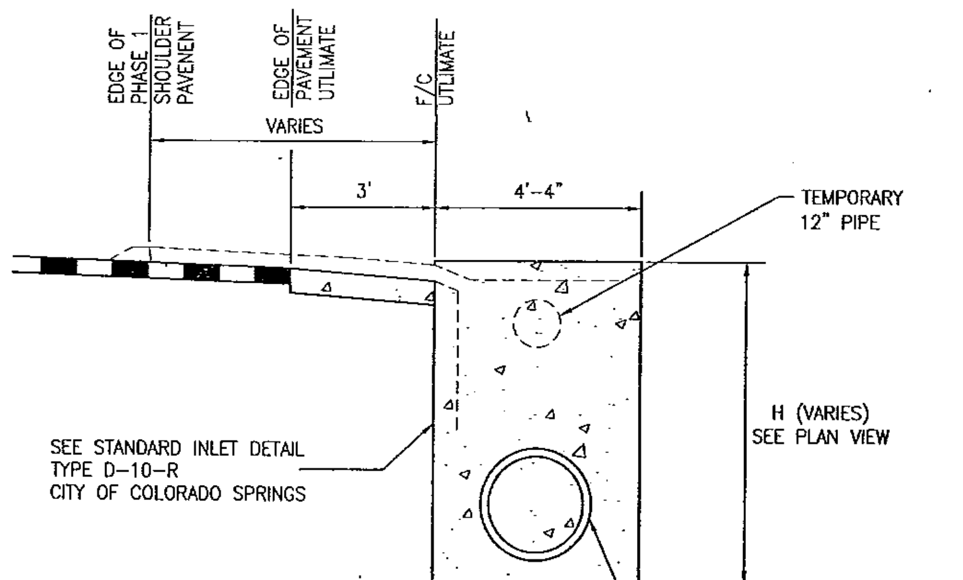
520 – BITUMINOUS SLOPE AND DITCH PAVING (ASPHALT)....................................TON

609 – CURB, TYPE 6 (SECTION M)...LINEAR FOOT

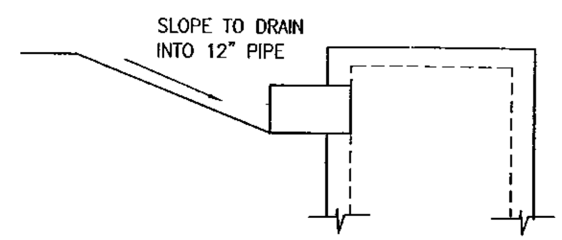
603 – 12" REINFORCED CONCRETE PIPE..LINEAR FOOT



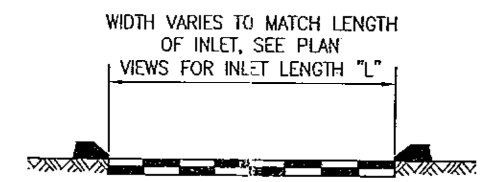
TYPE 5
W/ BITUMINOUS PAVING RUNDOWN



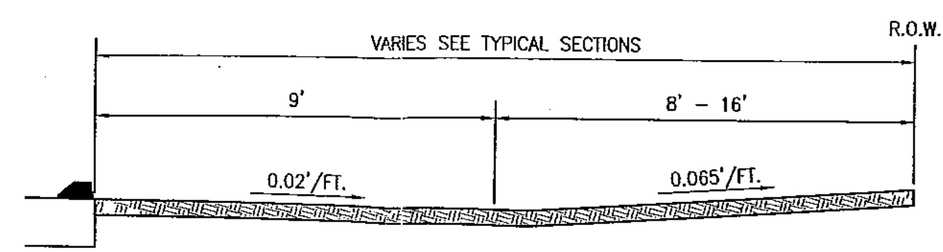
SECTION B–B
WITH 4" BITUMINOUS
SLOPE AND DITCH PAVING & CURB INLET
TYPE D–10–R



SECTION C–C
SLOPE/STUB-OUT
SECTION



SECTION A–A
W/ 4" BITUMINOUS SLOPE
AND DITCH PAVING



SECTION D–D
DITCH SECTION APPROACHING
TEMPORARY SECTION

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EMBANKMENT PROTECTOR

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Designer: RBB
Detailer: SBE
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16:23 XREF = FLXRTB02

CITY OF COLORADO SPRINGS

APPENDIX C

DESIGN CRITERIA

DMJM

Daniel, Mann, Johnson, & Mendenhall, Inc. (DMJM)
1490 West Fillmore Street, Suite 101, Colorado Springs, Colorado 80904 - (719) 471-9866

DRAINAGE - PERMITS

STORMWATER DISCHARGE PERMIT

ANY CONSTRUCTION PROJECT WHICH DISTURBS OVER 5 ACRES REQUIRES A STORMWATER DISCHARGE PERMIT FROM CDPHE. THIS PROJECT IS EXPECTED TO DISTURB OVER THIS AMOUNT. THIS WILL INVOLVE CREATING A STORM WATER MANAGEMENT PLAN FOR THE PROJECT. THE KEY ELEMENTS OF THIS ARE EROSION CONTROL MEASURES AND A LIST OF BEST MANAGEMENT PRACTICES TO BE USED DURING CONSTRUCTION OF THE PROJECT. THE PLAN WILL BE SUBMITTED BY CDOT. A COPY OF THE LIKELY GENERAL PERMIT TO BE USED ON THE PROJECT IS INCLUDED. ADDITIONAL INFORMATION IS AVAILABLE.

CDOT DRAINAGE DESIGN MANUAL
CDPHE GENERAL PERMIT FORMS

SECTION 404 PERMIT

ANY CONSTRUCTION PROJECT WHICH DISTURBS JURISDICTIONAL WETLANDS OR "WATERS OF THE U.S." REQUIRES A 404 PERMIT FROM THE CORPS OF ENGINEERS. IT IS ANTICIPATED THAT THE PROJECT WILL EITHER REQUIRE NO PERMIT OR WILL BE PERMITTED UNDER A NATIONWIDE OR REGIONAL PERMIT. THE EXISTENCE OF WETLANDS WITHIN THE PROJECT WILL BE VERIFIED BY THE EA UPDATE FOR THE PROJECT. IT APPEARS THAT THERE MAY NOT BE ANY WETLANDS AFFECTED. ADDITIONAL INFORMATION IS AVAILABLE.

CDOT DRAINAGE DESIGN MANUAL

FLOODPLAIN DEVELOPMENT PERMIT

ANY PROJECT WHICH AFFECTS AREAS DESIGNATED AS FLOODPLAINS BY THE NATIONAL FLOOD INSURANCE ACT REQUIRE A PERMIT FROM FEMA. IT IS ANTICIPATED THAT THERE ARE NO DESIGNATED FLOODPLAINS WITHIN THE PROJECT AREA. THIS WILL BE VERIFIED WITH THE REGIONAL FLOOD PLAIN ADMINISTRATOR FOR THE PIKES PEAK AREA.

CDOT DRAINAGE DESIGN MANUAL

OTHER PERMITS

IT NEEDS TO BE VERIFIED IF A FUGITIVE DUST PERMIT OR OTHER PERMITS ARE REQUIRED FOR THIS PROJECT.

DRAINAGE - DATA COLLECTION

THE FOLLOWING REPORTS HAVE BEEN OBTAIN THAT ARE RELATED TO THE PROJECT: PROJECT SPECIFIC

"INTERQUEST TECHNOLOGY PARK -HYDROLOGY UPDATE", AYRES AND ASSOCIATES, NOVEMBER 13, 1997.

"MASTER DEVELOPMENT DRAINAGE REPORT AND PLAN", INTERQUEST TECHNOLOGY PARK FILING NO.2", URS PROJECT # 42044, OCTOBER 22, 1993. REVISED JANUARY 6, 1994.

"PRELIMINARY AND FINAL DRAINAGE REPORT AND PLAN", INTERQUEST TECHNOLOGY PARK FILING NO.2", URS PROJECT # 42044, JANUARY 6, 1994.

"DRAINAGE MEMORANDUM FOR PIKES PEAK COMMUNITY COLLEGE NORTH CAMPUS", COLORADO SPRING, COLORADO., EL PASO COUNTY, URS PROJECT NO. 67.42154., OCTOBER 7, 1996

"NEW LIFE CHURCH DRAINAGE REPORT", KLH ENGINEERING, INC. APRIL, 1991.

"PRELIMINARY AND FINAL DRAINAGE REPORT FOR INTERNATIONAL BIBLE SOCIETY FILING NO. 1", URS PROJECT NO 48404, AUGUST, 1988.

"NORTHGATE PHASE 1 DRAINAGE PLAN", URS PROJECT NO. 45206, JUNE 15, 1987., REVISED AUGUST 27, 1987

"NORTHGATE PHASE 1 DRAINAGE PLAN", URS PROJECT NO. 45206, JUNE 15, 1987., REVISED AUGUST 27, 1987. ADDENDUM DATED OCTOBER 6, 1987

DRAINAGE - HYDROLOGY

INTERQUEST PARKWAY DESIGN STORMS

INTERQUEST PARKWAY CROSS CULVERTS WILL BE DESIGNED FOR THE 100 YEAR STORM — CCS DRAINAGE CRITERIA MANUAL

INTERQUEST PARKWAY PARALLEL STORM SEWER - INITIAL STORM IS THE 5 YEAR STORM WITH A MAXIMUM DEPTH OF 6" @ FLOWLINE UP TO A MAXIMUM OF 34 CFS PER SIDE.

INTERQUEST PARKWAY PARALLEL STORM SEWER - MAJOR STORM IS THE 100 YEAR STORM WITH A MAXIMUM DEPTH OF 12" @ FLOWLINE OR 4" AT CENTERLINE WHICHEVER IS MORE RESTRICTIVE.

OTHER ROADS

NO OTHER ROADS WILL NOT INCLUDE STORM SEWER UNLESS IT IS NECESSARY TO PREVENT FLOW FROM CROSSING OVER INTERSECTIONS AND THERE IS A STORM SEWER LINE NEARBY TO DISCHARGE INTO. — PROJECT SPECIFIC

ALL OTHER ROADS WITH PERMANENT ROADSIDE DITCHES WILL BE DESIGNED FOR THE 10 YEAR STORM. THE ROUTING OF THE 100 YEAR STORM NEEDS TO BE CHECKED TO ENSURE THAT FLOODING OF THE ROAD OR NEARBY STRUCTURES DOES NOT OCCUR. — CDOT DRAINAGE DESIGN MANUAL

HYDROLOGIC METHODS

THE OFFSITE DRAINAGE ANALYSIS WILL BE DEVELOPED USING THE PREVIOUS DRAINAGE STUDIES IN THE AREA. THE STANDARD USED IS THE CITY OF COLORADO SPRINGS STANDARD FOR BASINS OVER APPROXIMATELY (100 ACRES) IN TRIBUTARY AREA. THIS METHOD IS THE SCS METHOD TYPICALLY UTILIZING EITHER THE TR-20 OR HEC-1 COMPUTER PROGRAM. THE DESIGN STORM TO BE UTILIZED IS THE 100 YEAR 24 HOUR STORM WITH ANTECEDENT MOISTURE CONDITION II. — PROJECT SPECIFIC CCS DRAINAGE CRITERIA MANUAL

THE ONSITE DRAINAGE ANALYSIS WILL BE DEVELOPED FROM PROJECT TOPOGRAPHY AND PREVIOUS DRAINAGE STUDIES IN THE AREA. THE METHOD USED WILL BE THE RATIONAL METHOD WHICH IS AS FOLLOWS FOR ENGLISH UNITS: — CDOT DRAINAGE DESIGN MANUAL

$Q = C\,i\,A$

WHERE: Q = THE RUNOFF IN CUBIC FEET PER SECOND (CFS)
C = RUNOFF COEFFICIENT OF THE AREA
i = THE AVERAGE RAINFALL INTENSITY IN IN/HR
A = THE AREA IN ACRES

VALUES FOR C AND i ARE PROVIDED FROM CDOT AND THE CITY, RESPECTIVELY. THE INTENSITIES ARE BASED ON THE TIME OF CONCENTRATION FOR A BASIN. THIS IS CALCULATED BASED ON THE FOLLOWING: — CDOT DRAINAGE DESIGN MANUAL

$T_c = T_i + T_t$

WHERE: T_c = TIME OF CONCENTRATION IN MINUTES
T_i = OVERLAND FLOW TIME IN MINUTES
T_t = TRAVEL TIME IN MINUTES

$$T_i = \frac{1.8\,(1.1-C)\,D^{.5}}{S^{0.33}}$$

WHERE: C = RUNOFF COEFFICIENT FROM THE RATIONAL METHOD
D = DISTANCE OF FLOW PATH IN FEET
(500 FT. MAX. NON-URBAN AREAS)
(300 FT. MAX. URBAN AREAS)
S = AVERAGE SLOPE OF BASIN IN %

VARIOUS METHODS ARE AVAILABLE TO ESTIMATE THE TRAVEL TIME BASED ON AVERAGE VELOCITIES OR EMPIRICAL FORMULAS.

DRAINAGE - CHANNELS

DESIGN OF CHANNELS AND ROADSIDE DITCHES WILL BE DONE USING MANNING'S EQUATION. IN SIMPLE CASES THIS WILL BE DONE ASSUMING UNIFORM FLOW AND DIRECT APPLICATION OF THE MANNING EQUATION TO DETERMINE THE NORMAL DEPTH. THIS IS AS FOLLOWS:

CDOT DRAINAGE DESIGN MANUAL

$$Q = (1.49/n)\,A\,R^{2/3}\,S^{1/2}$$

WHERE: Q = DISCHARGE IN CUBIC FEET PER SECOND (CFS)
n = MANNING'S ROUGHNESS COEFFICIENT
A = CROSS SECTIONAL AREA IN SQUARE FEET
R = HYDRAULIC RADIUS IN FEET
S = CHANNEL SLOPE IN FT/FT

VALUES OF MANNING'S ROUGHNESS COEFFICIENT ARE AVAILABLE IN THE CDOT MANUAL. THE INITIAL ANALYSIS SHOULD INCLUDE A CHECK OF THE FOLLOWING PARAMETERS:

CDOT DRAINAGE DESIGN MANUAL

$$V = Q / A$$

WHERE: V = AVERAGE VELOCITY IN FEET PER SECOND (FPS)

GENERALLY, THE VELOCITY SHOULD BE WITHIN THE FOLLOWING LIMITS FOR NATURAL OR GRASS LINED CHANNELS:

PROJECT SPECIFIC

V >2 FPS WHERE POSSIBLE
V < 3 FPS FOR BARE ERODIBLE SOILS
V < 5 FPS FOR BARE NON-ERODIBLE SOILS
V < 5 FPS FOR VEGETATED ERODIBLE SOILS
V < 7 FPS FOR VEGETATED NON-ERODIBLE SOILS

ADDITIONAL DETAILED INFORMATION IS AVAILABLE FOR THIS, IF NECESSARY. THE FROUDE NUMBER SHOULD ALSO BE CALCULATED FOR EACH CASE, AS FOLLOWS: — CCS DRAINAGE CRITERIA MANUAL

$$F_r = \frac{V}{(g\,d)^{0.5}}$$

WHERE: Fr = FROUDE NUMBER
g = ACCELERATION DUE TO GRAVITY (32.2 FPS^2)
d = NORMAL DEPTH IN FEET

IT SHOULD BE NOTED THAT THE FOLLOWING GUIDELINES SHOULD BE USED WHERE POSSIBLE WHEN CHECKING THE FROUDE NUMBER: — PROJECT SPECIFIC

$F_r = 1$	CRITICAL DEPTH
$F_r < 1$	SUBCRITICAL FLOW
$F_r > 1$	SUPERCRITICAL FLOW
$F_r <0.9$ OR $F_r >1.1$	DESIRABLE RANGE OF FROUDE NUMBERS SINCE THE FLOW IS GENERALLY UNSTABLE NEAR CRITICAL DEPTH.

FOR CASES WHERE GRADUALLY VARIED FLOW IS EXPECTED, THE U.S. ARMY CORPS OF ENGINEERS' HEC-2 COMPUTER PROGRAM WILL BE UTILIZED FOR THE PROJECT. — CDOT DRAINAGE DESIGN MANUAL

DRAINAGE - CROSS CULVERTS

THE CROSS CULVERTS WILL BE ASSUMED TO BE REINFORCED CONCRETE PIPE (RCP) OR REINFORCED CONCRETE BOX CULVERTS (CBC).
HOWEVER, SEVERAL CORRUGATED STEEL PIPES MAY BE EXTENDED WITH LIKE MATERIAL.
USE A MANNING'S n VALUE OF 0.013 FOR RCP'S, 0.012 FOR CBC'S AND .026 FOR CSP'S — PROJECT SPECIFIC

CROSS CULVERTS ARE SIZED BASED ON THE "HYDRAULIC DESIGN OF HIGHWAY CULVERTS" BY FHWA. — CDOT DRAINAGE DESIGN MANUAL

DRAINAGE - STORM SEWER

AREAS THAT REQUIRE STORM SEWER WILL BE DESIGNED WITH STORM SEWER DESIGN SOFTWARE. DESIGN WILL ALSO UTILIZE SPREADSHEETS TO HELP ESTIMATE THE LOCATION AND NUMBER OF INLETS, PIPE SIZES AND KEY LOCATIONS.

INLETS

INLETS ARE REQUIRED 10 FT BEFORE THE POINT WHERE STREET CROSS SLOPE BEGINS TO SUPERELEVATE TOWARDS THE OPPOSITE SIDE TO PREVENT CROSS STREET FLOW. — CDOT DRAINAGE DESIGN MANUAL

SUMP INLETS REQUIRE FLANKING INLETS ON EACH SIDE OF THE SUMP INLET TO PROVIDE RELIEF FROM DEBRIS CLOGGING. SUMP INLETS ON I-25 SHOULD BE CHECKED TO ENSURE THAT THE 50 YEAR STORM DOES NOT CAUSE PONDING OF WATER OUTSIDE THE SHOULDER. THERE ARE NO SUMP INTLETS ON THE PROJECT AT THIS TIME. — CDOT DRAINAGE DESIGN MANUAL

THE ROAD CAPACITY IS BASED ON MANNING'S EQUATION WITH THE SIMPLIFYING ASSUMPTION THAT THE WETTED PERIMETER IS EQUAL TO THE WIDTH OF FLOW. ASSUME n=0.016. — HEC-12 FROM FHWA

THE INLETS ON INTERQUEST PARKWAY WILL BE CURB OPENING INLETS IN THE 8 INCH CURB. EMBANKMENT PROTECTORS WILL BE USED BE USED IN THE INTERIM TO CONVEY FLOW FROM THE PHASE 2 PAVED SECTION TO THE ULTIMATE LOCATION OF THE TYPE D-10-R INLETS — CCS DESIGN MANUAL M-STANDARD

DRAINAGE - DETENTION FACILITIES

NO NEW DETENTION FACILITIES ARE PLANNED IN INTERQUEST PARKWAY PHASE 2 — CDOT DRAINAGE DESIGN MANUAL

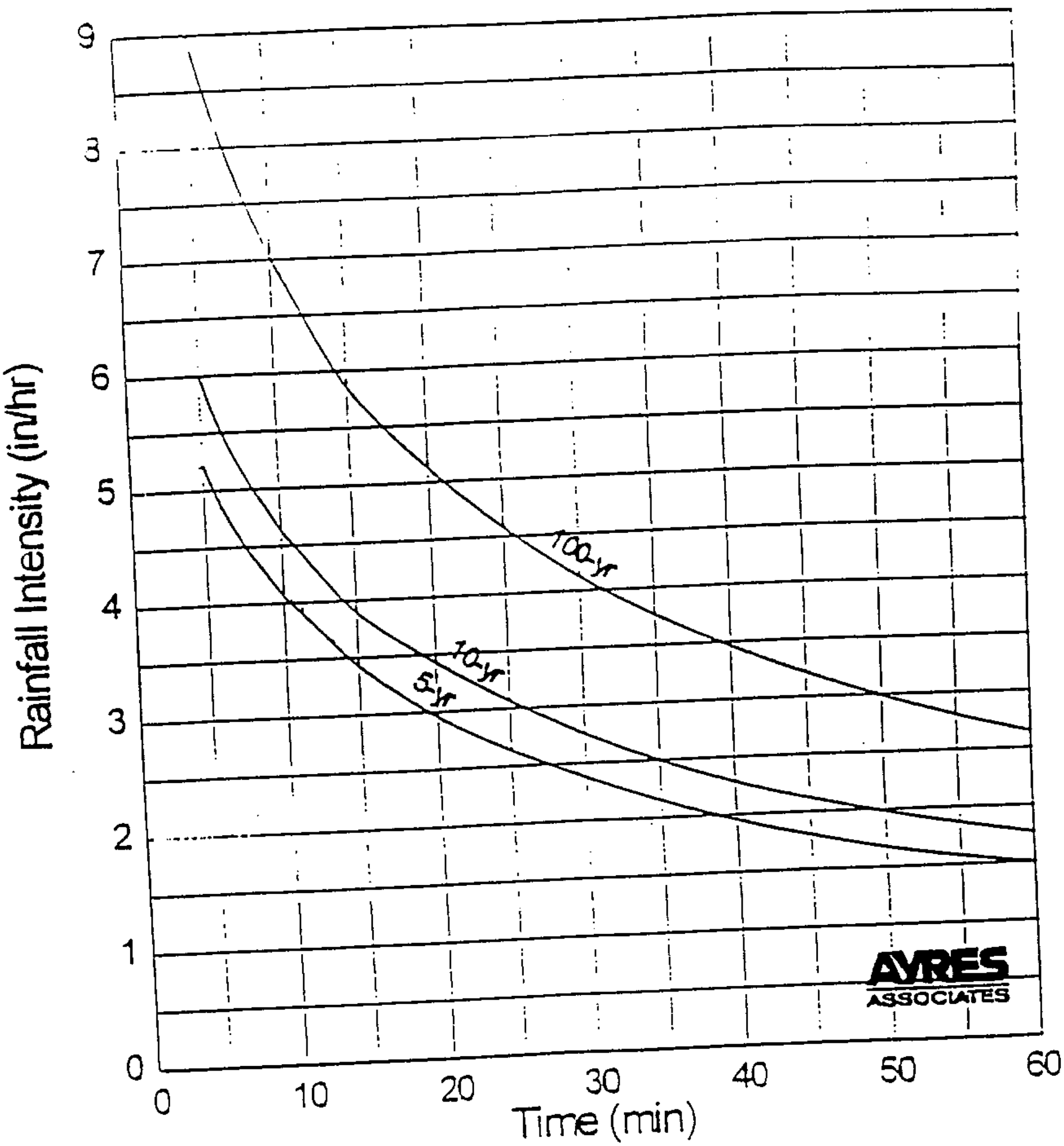
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

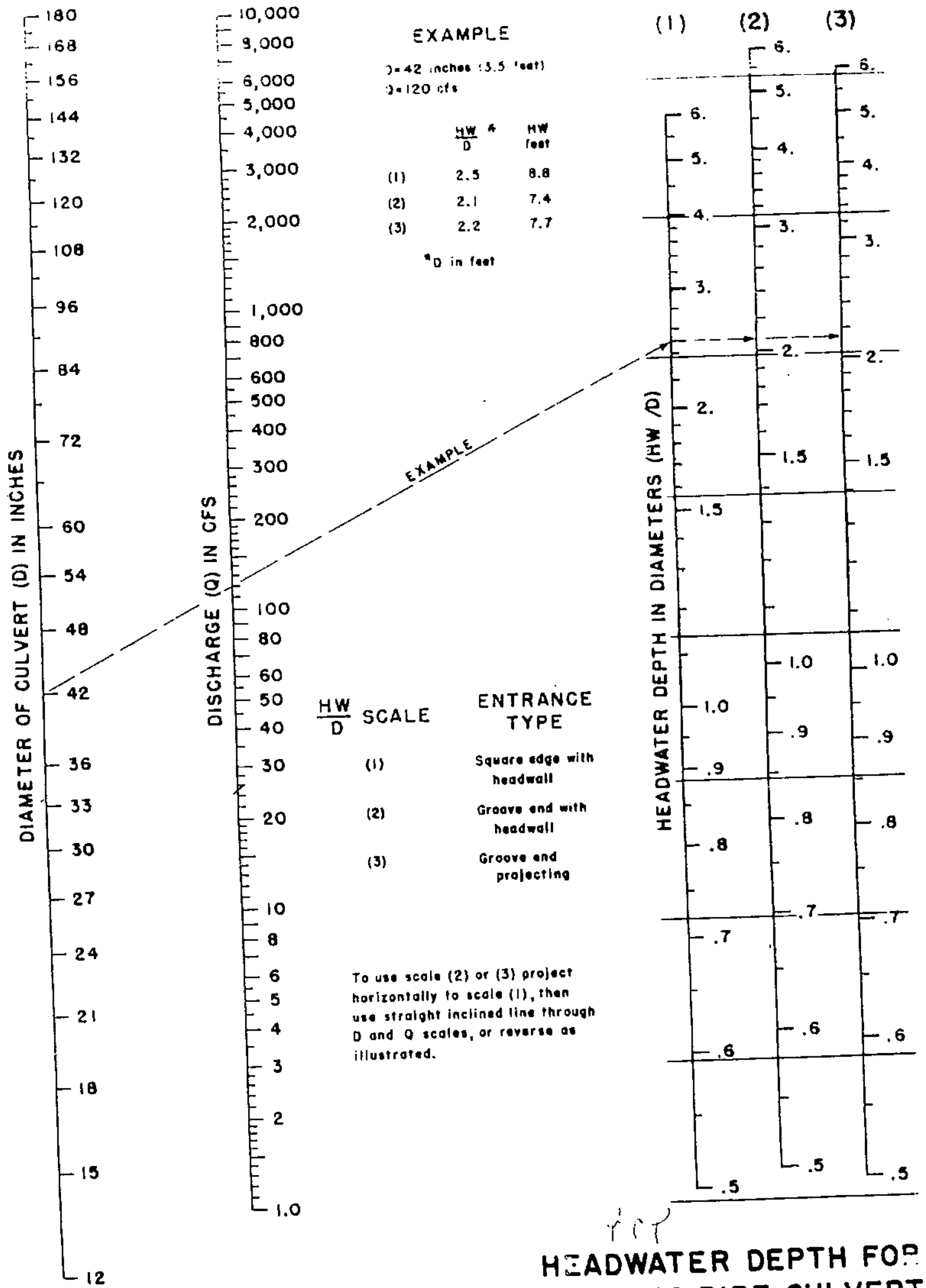
* Hydrologic Soil Group

9/30/90



Interim Release October 12, 1994 , Rainfall Intensity Curves
City Of Colorado Springs Drainage Criteria Manual

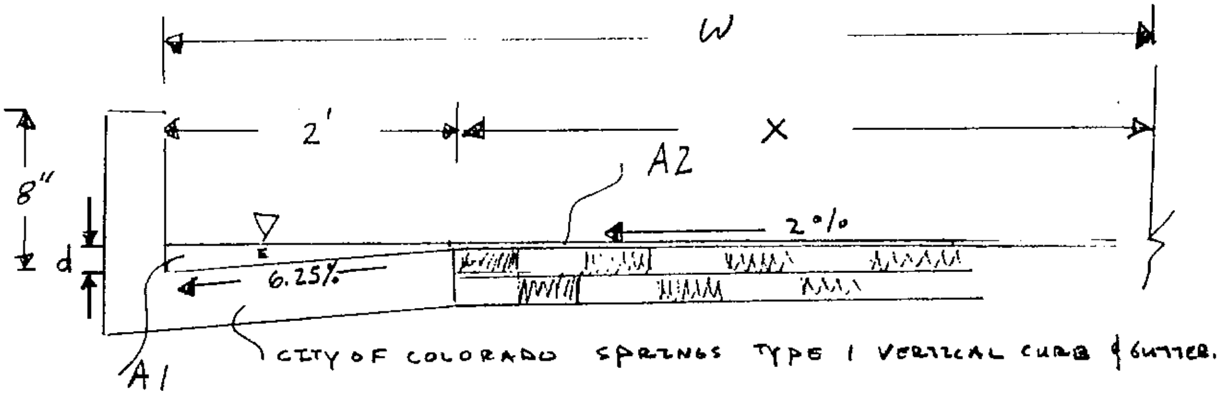
CHART 10



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



$(x)(.02) = d - .125 \qquad x = \dfrac{d - .125}{.02}$

$A_1 = \left(\dfrac{d + d - .125}{2}\right)(2') = \underline{\underline{2d - .125}}$

$A_2 = \dfrac{(d - .125)}{2}\dfrac{(d - .125)}{.02} = \dfrac{d^2 - .25d + .0156}{.04}$

$= \underline{\underline{25d^2 - 6.25d + .39}}$

$A = A_1 + A_2 = \underline{\underline{25d^2 - 4.25d + .265}}$

$P = \omega \quad \dfrac{d - .125}{.02} + 2' = 50d - 6.25 + 2 = \underline{\underline{50d - 4.25}}$

$n = .016$

$Q = \dfrac{1.49}{n}\dfrac{A^{5/3}}{P^{2/3}} S^{1/2}$ ∴ FOR 6" DEPTH AT CURB $Q = 145.15 S^{1/2}$

AT 6" DEPTH AT THE CURB $\quad Q = \dfrac{1.49}{.016}\dfrac{4.39^{5/3}}{20.75^{2/3}} S^{1/2}$

$Q = 145.15 S^{1/2}$

AT 8" DEPTH $Q = \dfrac{1.49}{.016}\dfrac{8.64^{5/3}}{29.25^{2/3}} S^{1/2}$ → $Q = 356.87 S^{1/2}$

COMPARISON OF EXISTING AND PROPOSED CRITERIA

INITIAL STORM:

STREET TYPE	OLD	NEW
Hillside Residential ramp curb	flow spread to crown, maximum 25 cfs. per side, whichever is more restrictive	flow spread to crown max. 15 cfs. per side
Hillside Residential vertical curb	flow spread to crown, maximum 25 cfs. per side, whichever is more restrictive	6" allowable depth @ flowline max. 25 cfs. per side
Residential Street ramp curb	flow spread to crown	flow spread to crown max. 20 cfs. per side
Residential Street vertical curb	flow spread to crown	6" allowable depth @ flowline max. 34 cfs. per side
Collector Street	20 foot flow spread	6" allowable depth @ flowline, max. 34 cfs. per side, no overtopping the crown
Arterial Street	flow may encroach onto one outside lane	6" allowable depth @ flowline, max. 34 cfs. per side, one ten foot lane free of water in each direction

MAJOR STORM:

STREET TYPE	OLD	NEW
Hillside Residential Residential Streets Collector Streets	12" max. depth @ flowline no adjacent flooding	NO CHANGE
Arterial Streets	8" max. depth @ flowline (no curb overtopping)	NO CHANGE

CROSS FLOWS: No changes to any street types for the initial storm.
Only change for Major Storm is the Arterial street will now allow 12" max. depth @ flowline and 4" max. depth @ crown whichever is more restrictive. Existing criteria allows no crossflow.

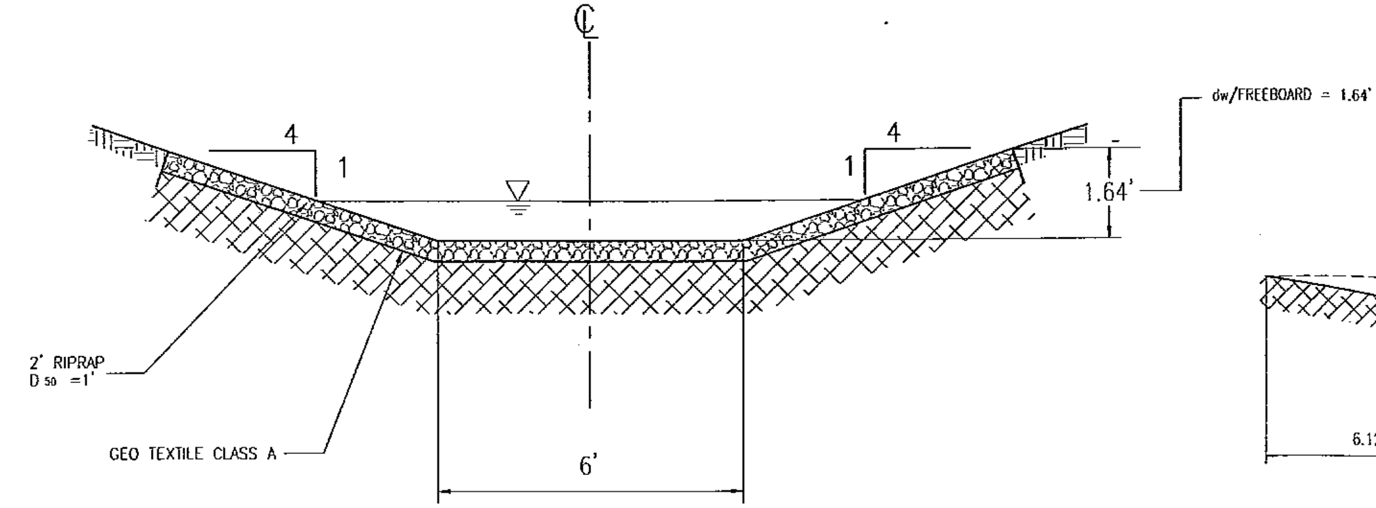
CITY OF COLORADO SPRINGS

APPENDIX D

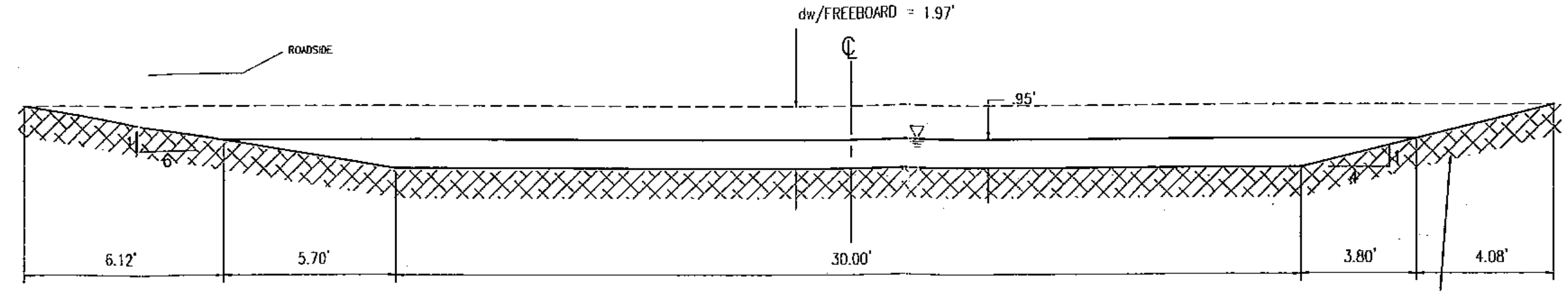
CHANNEL ALTERATIVES AND INTERIM DRAINAGE PIT

DMJM

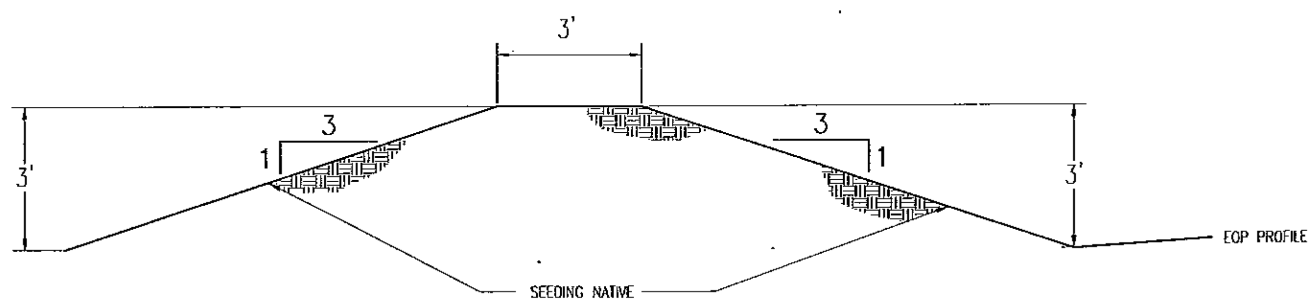
Daniel, Mann, Johnson, & Mendenhall, Inc. (DMJM)
1490 West Fillmore Street, Suite 101, Colorado Springs, Colorado 80904 - (719) 471-9866



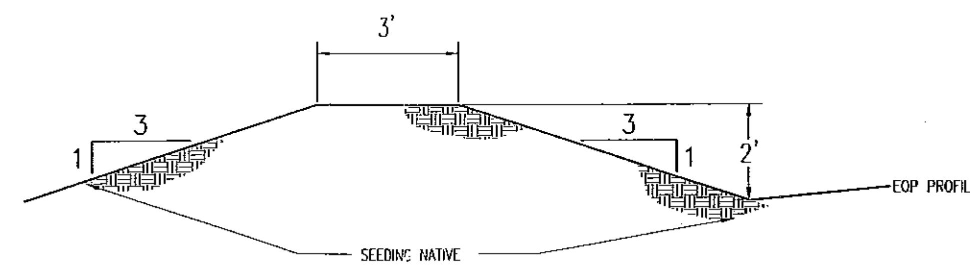
DITCH SECTION A–A
RIPRAP LINED CHANNEL



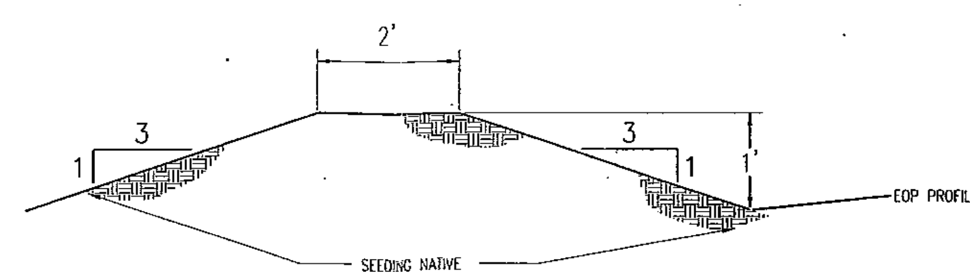
CHANNEL SECTION B–B
SCALE 1"=3'



BERM SECTION C–C



BERM SECTION D–D



BERM SECTION E–E

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Last Modification Date: 03/22/99	Initials: SBE
Full Path: S:\3821\CADD\PLANS\Phase2\Drain\details\	
Drawing File Name: Hydt01.DWG	
Acad Ver. R14	Scale: 1"= 2' / Units: ENGLISH

Index of Revisions

DMJM

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As Constructed
No Revisions:
Revised:
Void:

INTERQUEST PKWY / S.H. 83 RELOCATE

CHANNEL SECTIONS
BERM SECTIONS

Sheet Subset: DRAINAGE | Subset Sheets: HYDT01 of 4

Designer: RBB
Detailer: SBE
Checked: CLP
Sheet Number

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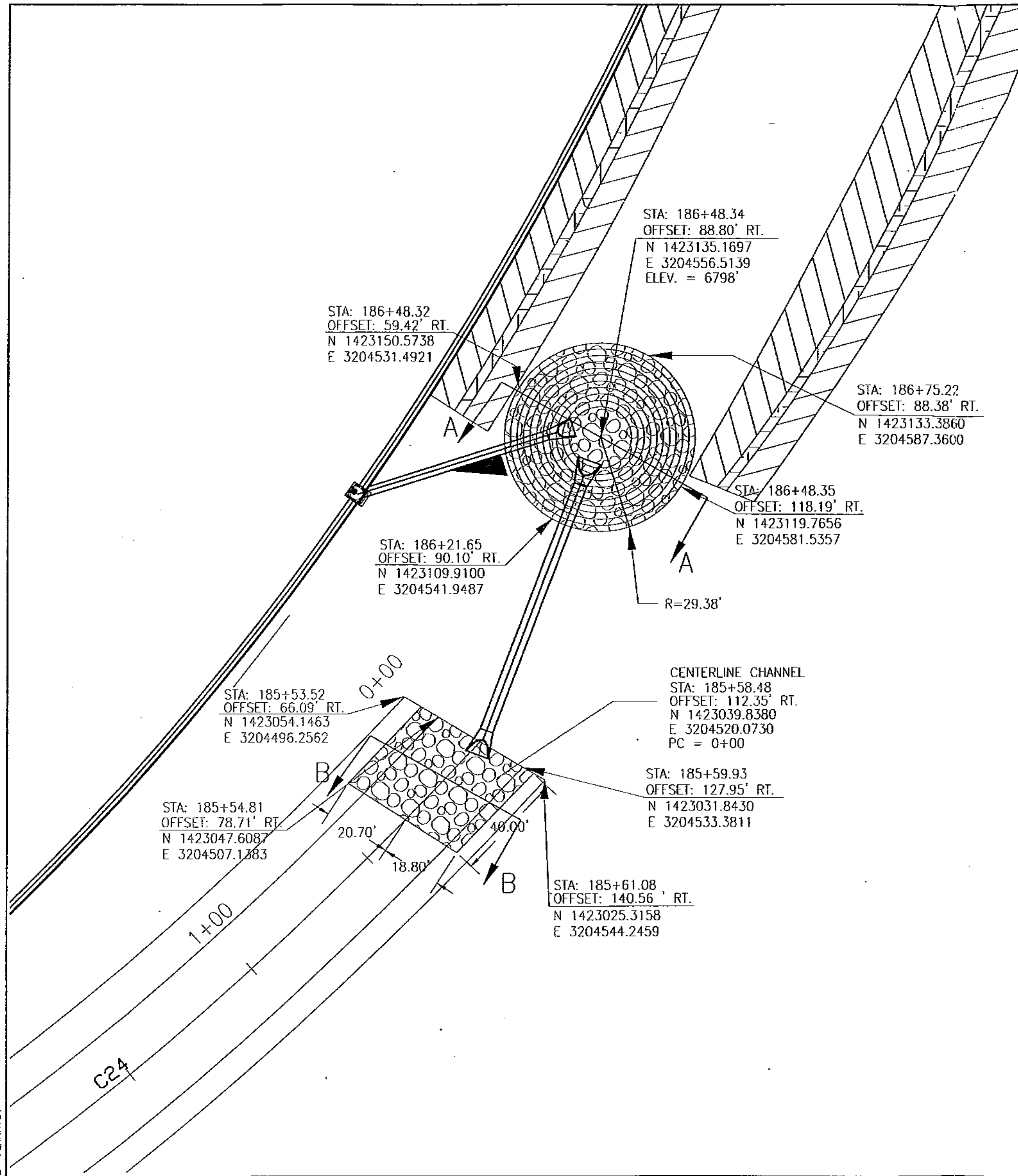
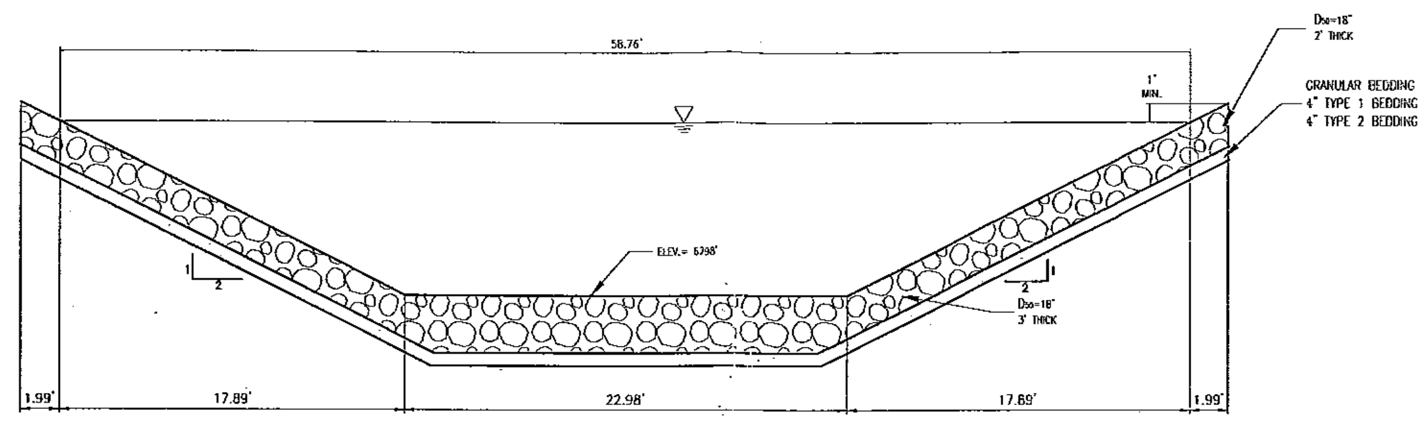
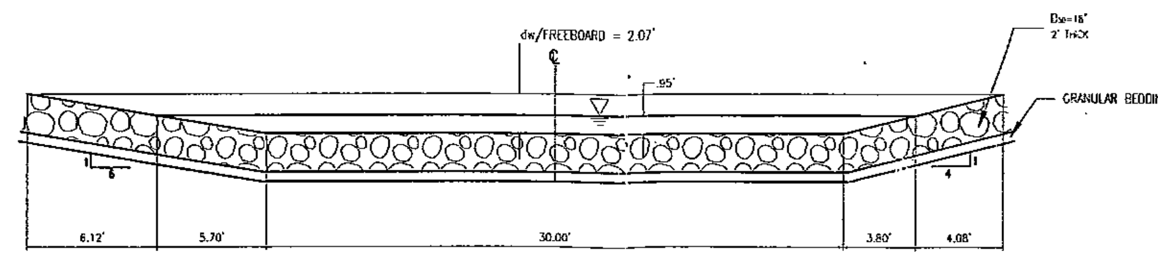




DRAINAGE PIT SECTION A–A
SCALE 1"=5'



OUTLET PROTECTION SECTION B–B
SCALE 1"=5'

Computer File Information	
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Last Modification Date: 03/22/99	Initials: SBE
Full Path: S:\3821\CADD\PLANS\Phase2\Drain\details\	
Drawing File Name: Hydt04.DWG	
Acad Ver. R14 Scale: NONE	Units: ENGLISH

Index of Revisions

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As Constructed
No Revisions:
Revised:
Void:

INTERQUEST PKWY / S.H. 83 RELOCATE

DRAINAGE PIT/
OUTLET PROTECTION DETAIL

Sheet Subset: DRAINAGE | Subset Sheets: HYDT04 of 4

Designer: RBB
Detailer: SBE
Checked: CLP
Sheet Number

16:24 XREF = FLXRTB02 FLXRHY01

DITCH AA/BB

23-Feb-99	B (FT)	d (FT)	z1 (FT)	z2 (FT)	n	A (FT^2)	P (FT)	R (FT)	S (%)	Q (FPS)	V (FPS)	F	Free Board	
BERM	20.000	1.450	3.0	18.0	0.035	51.076	50.726	1.007	1.12%	231.175	4.53	0.66	1.128	BERM/FLOW ADJACENT/UPSTREAM/BERM
														ON ONE SIDE FLOW CAN SPREAD OUT(WORSE CASE)
														WIDTH TOTAL VARIES WITH GROUND-APPROX 52'
BERM AT END	32.000	1.300	3.0	3.0	0.035	46.670	40.222	1.160	1.12%	232.175	4.97	0.77	1.136	BERM FLOW WITH BERM ON EACH SIDE
														WIDTH TOTAL = 76' INCLUDING BOTH BERMS
														AT WORSE CASE INCLUDING WHOLE BERM
DITCH FROM	20.000	1.100	6.0	4.0	0.035	28.050	31.226	0.898	1.87%	152.024	5.42	0.91	1.140	DITCH FLOW MINUS 70CFS INTO TRUNKLINE

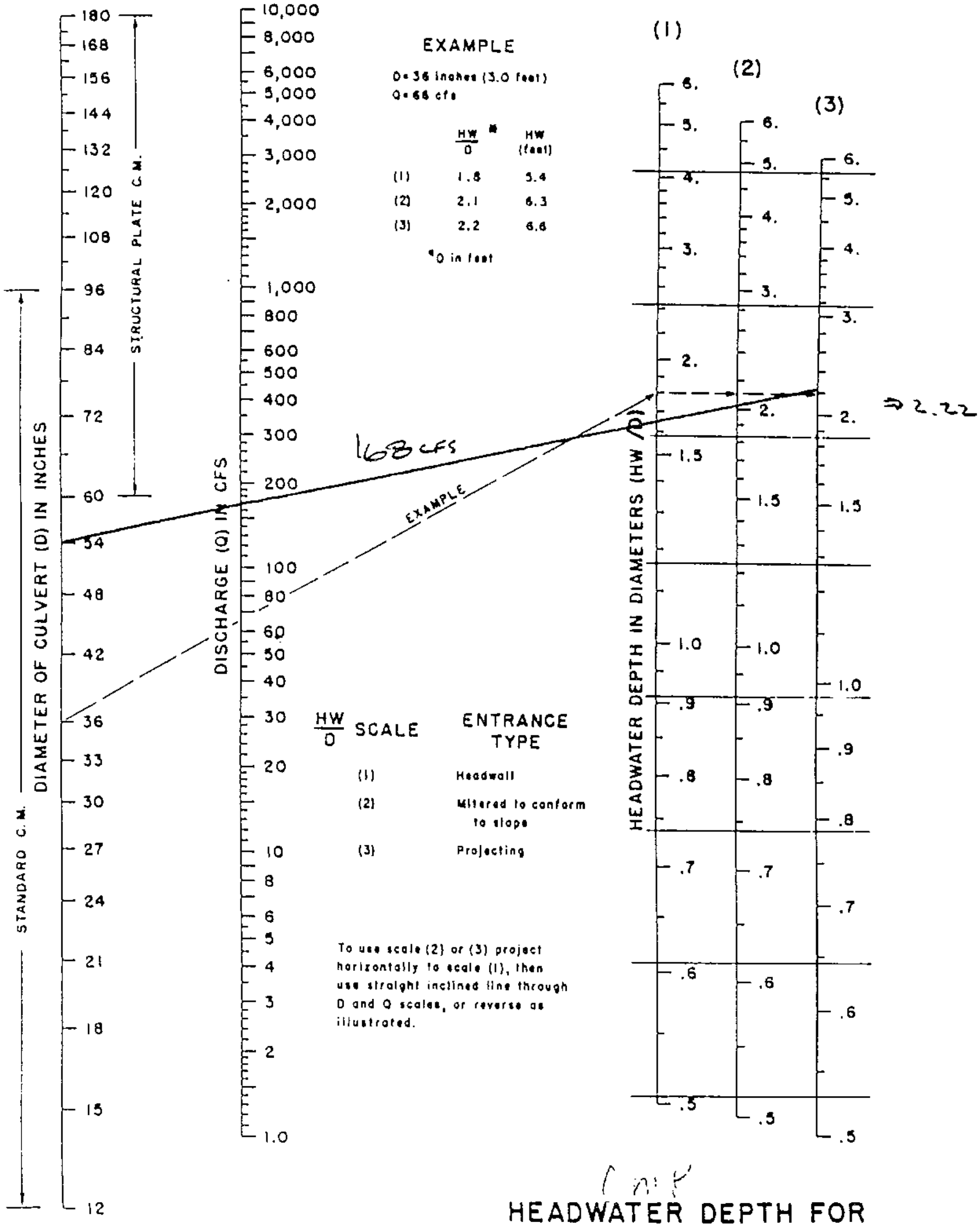
DMJM

Planning
Architecture
Engineering
Program/Construction
Management

	JOB No. 3821	SHEET No.
	DESIGNED BY CAS	DATE 1-6-99
PIT DESIGN	APPROVED	PHASE 2

DEPTH OF WATER SURFACE FT	HW/D RCP PIPE 36"	HW/D RCP PIPE 48"	RCP $Q_{36"}$ CFS	RCP $Q_{48"}$ CFS	Q_{TOTAL} CFS	$Q_{54"}$ CMP
2.0	0.67	0.5	18	24	42	
3.0	1.0	0.75	31	44	75	
4.0	1.33	1.0	50	71	121	
5.0	1.67	1.25	60	92	152	
5.5	1.83	1.38	(65)	104	169	
6.0		1.5		112	177	
6.5		1.63		120	185	
7.0		1.75		130	195	
7.5		1.88		135	200	
8.0		2.0		142	207	
8.5		2.13		149	214	
9.0		2.25		155	220	
9.5		2.38		160	225	
10.0		2.5		(165)	(230)	≈165 CFS

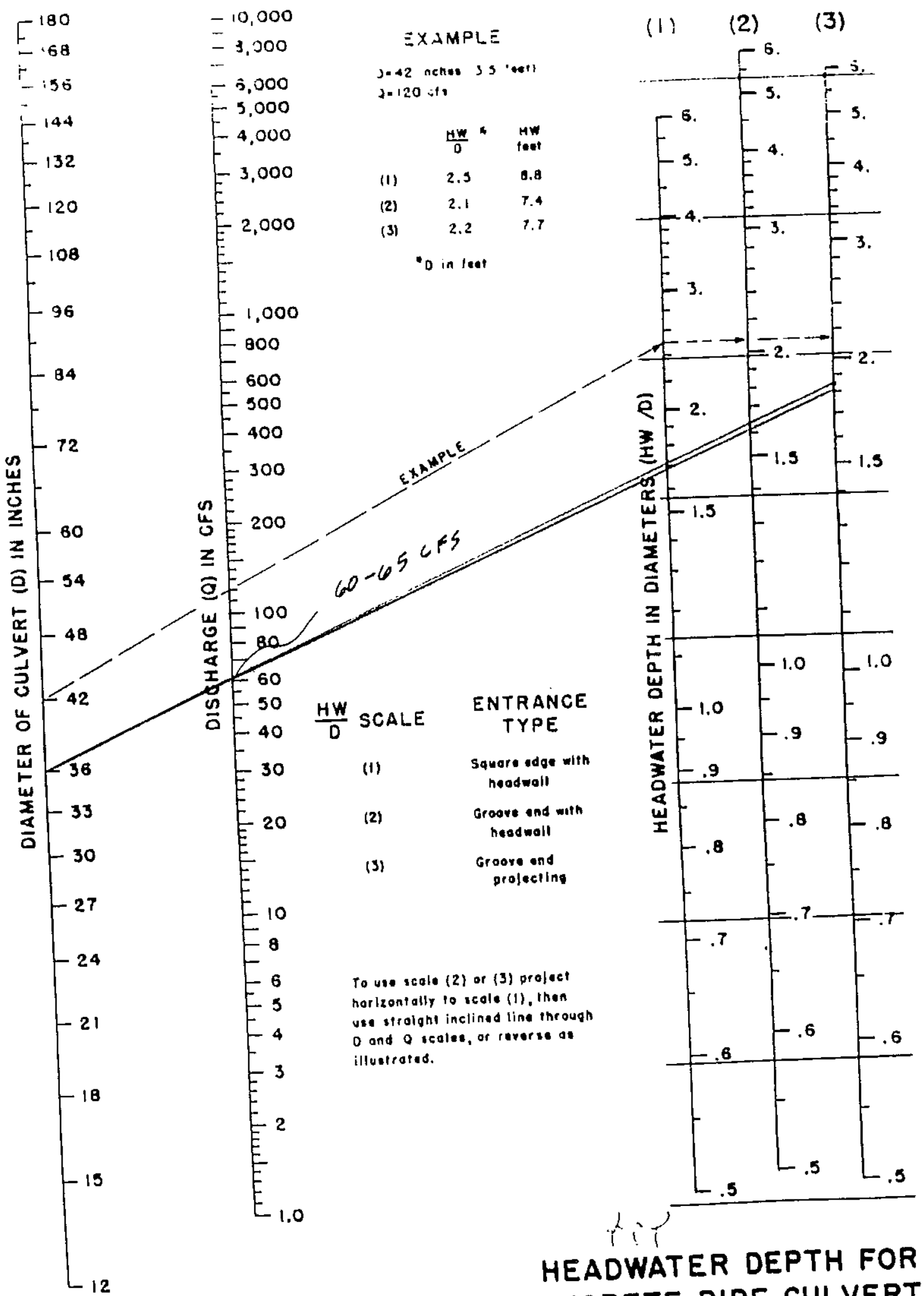
CHART 2



HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 10



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

DEPARTMENT OF TRANSPORTATION

CITY OF COLORADO SPRINGS

APPENDIX E

HYDROLOGIC / HYDRAULIC CALCULATIONS

DMJM

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1490 West Fillmore Street, Suite 101, Colorado Springs, Colorado 80904 - (719) 471-9866

STREET CAPACITY AND INLET SPACING CHART

ANY INLETS NOT INCLUDED HAVE BEEN PLACED ACCORDING TO GEOMETRIC CONTRAINTS
SUCH AS SUPER ELEVATION CHANGES, INTERSECTIONS, SUMP LOCATIONS ETC.

3/22/99 16:57

FAIRLANE INTERCHANGE

INITIAL CALCULATIONS FOR STORM SEWER IN FAIRLANE PARKWAY 3/22/99

	Initial Storm - 5 Year Storm Rational Method Hydrology					MAX STREET CAPACITY Manning's Equation for Street Flow (2% Cross Slope)						Assumed 60% capture		ACTUAL SPREAD/DEPTH Manning's Equation for Street Flow (2% Cross Slope)						ROAD WIDTH	MAXIMUM ALLOW LENGTH
BASIN	/Tc If app	A (acres)	i (in/hr)	Tc	Q (cfs)	d (FT)	W (FT)	VG S (%)	A (FT2)	Q (CFS)	V (FPS)	FLOWBY (CFS)	RATIONAL + FLOWBY	d (FT)	W (FT)	S (%)	A (FT2)	Q (CFS)	PATH	ASSUME WIDEST	LENGTH BETWEEN INLETS
1895A	0.90	2.01	4.4	7.7	7.960	0.500	20.750	2.33%	4.390	22.157	5.05	0/sump	7.960	0.364	13.950	2.33%	2.030	7.986	offsite -1895A	60	GEOMETRY
19010	0.90	2.94	3.8	12.6	10.055	0.500	20.750	1.94%	4.390	20.218	4.61	4.02	10.055	0.405	16.000	1.94%	2.644	10.330	offsite -19010	60	GEOMETRY
17598	0.90	2.04	4.3	8.5	7.895	0.500	20.750	2.14%	4.390	21.234	4.84	3.16	11.917	0.417	16.600	2.14%	2.840	11.923	19010 - 17598B	60	1481.04
17370A	0.90	4.08	3.3	16.1	12.118	0.500	20.750	1.39%	4.390	17.113	3.90	4.85	12.118	0.449	18.200	1.39%	3.397	12.180	1895A - 17370A	60	2962.08
16200A	0.90	1.73	4.8	6.4	7.474	0.500	20.750	1.26%	4.390	16.293	3.71	2.99	12.321	0.480	19.750	1.26%	3.985	14.330	17307A-16200A	60	1255.98
16200C	0.90	1.93	4.8	6.4	8.338	0.500	20.750	1.26%	4.390	16.293	3.71	3.34	11.496	0.447	18.100	1.26%	3.360	11.432	17598B - 16200B	60	1401.18
15000B	0.90	1.95	4.9	6.2	8.600	0.500	20.750	2.62%	4.390	23.495	5.35	3.44	11.935	0.403	15.900	2.62%	2.612	11.813	16200B - 15000B	60	GEOMETRY
14862A	0.90	2.05	5.2	5.0	9.594	0.500	20.750	2.30%	4.390	22.014	5.01	3.84	12.583	0.426	17.150	2.30%	3.026	13.441	16200A-14862A	60	GEOMETRY
13275A	0.90	2.50	5.2		11.700	0.500	20.750	2.82%	4.390	24.375	5.55	4.68	11.700	0.398	15.650	2.82%	2.534	11.769	SH83-13275A	60	1815.00
13275B	0.90	2.40	5.2		11.232	0.500	20.750	2.82%	4.390	24.375	5.55	4.49	11.232	0.393	15.400	2.82%	2.456	11.295	SH83-13275B	60	1742.40
CHECK					94.964																
11302A	0.90	2.80	5.2		13.104	0.500	20.750	2.82%	4.390	24.375	5.55	5.24	17.784	0.452	18.350	2.82%	3.452	17.720	13275A-11302A	60	2032.80
11302B	0.90	2.89	5.2		13.525	0.500	20.750	2.82%	4.390	24.375	5.55	5.41	13.525	0.415	16.500	2.82%	2.807	13.476	FED-11302B	60	2098.14
24811	0.90	0.37	5.2		1.732	0.500	20.750	2.82%	4.390	24.375	5.55	0.69	7.142	0.341	12.800	2.82%	1.723	7.076	11302B-24811	60	GEOMETRY
CHECK					28.361																

1. ASSUME Tc= 5 Minutes Unless otherwise noted
2. ASSUME n=0.016
3. BASED N ASSUMPTION #4, ASSUME MAXIMUM DEPTH OF FLOW @ GUTTER OF 6" OR .5 FT
4. ASSUME CITY STREET AND LEAVE ONE INSIDE 12 FT LANE (10' REQUIRED) OPEN FOR INITIAL STORM OR 6" AT FLOWLINE WHICHEVER IS MORE RESTRICTIVE

FAIRLANE INTERCHANGE

INITIAL CALCULATIONS FOR STORM SEWER IN FAIRLANE PARKWAY 3/22/99

	Major Storm - 100 Year Storm Rational Method Hydrology					MAX STREET CAPACITY Manning's Equation for Street Flow (2% Cross Slope)						Assumed 60% capture		ACTUAL SPREAD/DEPTH Manning's Equation for Street Flow (2% Cross Slope)						ROAD WIDTH	MAXIMUM ALLOW LENGTH
BASIN	C	A (acres)	i (in/hr)	Tc	Q (cfs)	d (FT)	W (FT)	VG S (%)	A (FT2)	Q (CFS)	V (FPS)	FLOWBY (CFS)	RATIONAL + FLOWBY	d (FT)	W (FT)	S (%)	A (FT2)	Q (CFS)	PATH	ASSUME WIDEST	LENGTH BETWEEN INLETS
1895A	0.95	2.01	7.7	7.7	14.703	0.670	29.250	2.33%	8.640	54.473	6.30	0/sump	14.703	0.440	17.750	2.33%	3.235	14.782	offsite -1895A	60	GEOMETRY
19010	0.95	2.94	6.8	12.6	18.853	0.670	29.250	1.94%	8.640	49.706	5.75	7.54	18.853	0.490	20.250	1.94%	4.185	18.975	offsite -19010	60	GEOMETRY
17598	0.95	2.04	7.3	8.5	14.051	0.670	29.250	2.14%	8.640	52.205	6.04	5.62	21.592	0.502	20.850	2.14%	4.432	21.502	19010 - 17598B	60	5 year/geometry dictates
17370A	0.95	4.08	5.7	16.1	22.093	0.670	29.250	1.39%	8.640	42.074	4.87	8.84	22.093	0.542	22.850	1.39%	5.306	22.006	1895A - 17370A	60	5 year/geometry dictates
16200A	0.95	1.73	8.5	6.4	13.970	0.670	29.250	1.26%	8.640	40.058	4.64	5.59	22.807	0.586	25.050	1.26%	6.359	26.653	17307A-16200A	60	5 year/geometry dictates
16200C	0.95	1.93	8.5	6.4	15.585	0.670	29.250	1.26%	8.640	40.058	4.64	6.23	21.205	0.548	23.150	1.26%	5.444	21.678	17598B - 16200B	60	5 year/geometry dictates
15000B	0.95	1.95	8.6	6.2	15.839	0.670	29.250	2.62%	8.640	57.764	6.69	6.34	22.073	0.490	20.250	2.62%	4.185	22.051	16200B - 15000B	60	5 year/geometry dictates
14862A	0.95	2.05	9.0	5.0	17.528	0.670	29.250	2.30%	8.640	54.121	6.26	7.01	23.115	0.518	21.650	2.30%	4.772	24.588	16200A-14862A	60	5 year/geometry dictates
13275B	0.95	2.50	9.0		21.375	0.670	29.250	2.82%	8.640	59.928	6.94	8.55	21.375	0.479	19.700	2.82%	3.965	21.298	SH83-13275A	60	5 year/geometry dictates
13275A	0.95	2.40	9.0		20.520	0.670	29.250	2.82%	8.640	59.928	6.94	8.21	20.520	0.472	19.350	2.82%	3.829	20.330	SH83-13275B	60	5 year/geometry dictates
CHECK					252.149																
11302A	0.95	2.80	9.0		23.940	0.670	29.250	2.82%	8.640	59.928	6.94	9.58	32.490	0.550	23.250	2.82%	5.490	32.799	13275A-11302A	60	5 year/geometry dictates
11302B	0.95	2.89	9.0		24.710	0.670	29.250	2.82%	8.640	59.928	6.94	9.88	24.710	0.500	20.750	2.82%	4.390	24.375	FED-11302B	60	5 year/geometry dictates
24811	0.95	0.37	9.0		3.164	0.670	29.250	2.82%	8.640	59.928	6.94	1.27	13.047	0.410	16.250	2.82%	2.725	12.969	11302B-24811	60	GEOMETRY
CHECK					51.813																

1. ASSUME Tc= 5 Minutes unless otherwise noted
2. ASSUME n=0.016
3. ASSUME MAXIMUM DEPTH OF FLOW @ GUTTER OF .666 FT OR 8 INCHES (CITY OF COLORADO SPRINGS)
(New critieria allows 12" max at flowline and 4" max at crown of street whichever is more restrictive. In this case 12" at FL is more restrictive, however using 8" at flowline for 100 , the 5 year still controls spacing.)

INLET LENGTH CALCULATION CHART
FROM HEC-12 - USING 5 YEAR Q VALUES

INLET #	Street Flow	*Inlet Drop*	*Gutter Width*	*Total Spread*	*Cross Slope*	*Longitudinal Slope*	Equivalent Cross Slope	*Roughness Coefficient*	Ratio of flow in a chosen width	Cross slope of gutter measured from slope of street section	Length of inlet for total interception	*Length of inlet selected*		MUST BE > OR = TO 60% Efficiency	Actual Physical length of inlet For 60%+ pickup
#	Q	a	W	T	Sx	S	Se	n	Eo	Sw'	Lt	L	L/Lt	E	L
1895A	7.96	0.333333	2	13.95	0.02	0.0233	0.076	0.016	0.34	0.17	25.96	8.00	0.31	48.5%	NO
1895A	7.96	0.333333	2	13.95	0.02	0.0233	0.076	0.016	0.34	0.17	25.96	10.00	0.39	58.3%	NO
1895A	7.96	0.333333	2	13.95	0.02	0.0233	0.076	0.016	0.34	0.17	25.96	12.00	0.46	**67.3%**	**YES**
19010	10.055	0.333333	2	16	0.02	0.0194	0.070	0.016	0.30	0.17	28.58	8.00	0.28	44.6%	NO
19010	10.055	0.333333	2	16	0.02	0.0194	0.070	0.016	0.30	0.17	28.58	10.00	0.35	53.9%	NO
19010	10.055	0.333333	2	16	0.02	0.0194	0.070	0.016	0.30	0.17	28.58	12.00	0.42	**62.5%**	**YES**
17598B	11.917	0.333333	2	16.6	0.02	0.0214	0.068	0.016	0.29	0.17	32.05	10.00	0.31	49.0%	NO
17598B	11.917	0.333333	2	16.6	0.02	0.0214	0.068	0.016	0.29	0.17	32.05	12.00	0.37	57.0%	NO
17598B	11.917	0.333333	2	16.6	0.02	0.0214	0.068	0.016	0.29	0.17	32.05	14.00	0.44	**64.4%**	**YES**
17370A	12.118	0.333333	2	18.2	0.02	0.0139	0.065	0.016	0.27	0.17	29.36	8.00	0.27	43.6%	NO
17370A	12.118	0.333333	2	18.2	0.02	0.0139	0.065	0.016	0.27	0.17	29.36	10.00	0.34	52.7%	NO
17370A	12.118	0.333333	2	18.2	0.02	0.0139	0.065	0.016	0.27	0.17	29.36	12.00	0.41	**61.2%**	**YES**
16200A	14.437	0.333333	2	19.75	0.02	0.0126	0.061	0.016	0.25	0.17	31.63	10.00	0.32	49.5%	NO
16200A	14.437	0.333333	2	19.75	0.02	0.0126	0.061	0.016	0.25	0.17	31.63	12.00	0.38	57.6%	NO
16200A	14.437	0.333333	2	19.75	0.02	0.0126	0.061	0.016	0.25	0.17	31.63	14.00	0.44	**65.1%**	**YES**
16200C	11.496	0.333333	2	18.1	0.02	0.0126	0.065	0.016	0.27	0.17	27.83	8.00	0.29	45.7%	NO
16200C	11.496	0.333333	2	18.1	0.02	0.0126	0.065	0.016	0.27	0.17	27.83	10.00	0.36	55.1%	NO
16200C	11.496	0.333333	2	18.1	0.02	0.0126	0.065	0.016	0.27	0.17	27.83	12.00	0.43	**63.8%**	**YES**
15000B	11.935	0.333333	2	15.9	0.02	0.0262	0.070	0.016	0.30	0.17	33.53	10.00	0.30	47.1%	NO
15000B	11.935	0.333333	2	15.9	0.02	0.0262	0.070	0.016	0.30	0.17	33.53	12.00	0.36	55.0%	NO
15000B	11.935	0.333333	2	15.9	0.02	0.0262	0.070	0.016	0.30	0.17	33.53	14.00	0.42	**62.2%**	**YES**
14862A															
14862A	IN SUMP USE SEPARATE METHOD TO CALCULATE CAPACITY.														
14862A															

INLET LENGTH CALCULATION CHART
FROM HEC-12 - USING 100 YEAR Q VALUES

INLET #	Street Flow	Inlet Drop	Gutter Width	Total Spread	Cross Slope	Longitudinal Slope	Equivalent Cross Slope	Roughness Coefficient	Ratio of flow in a chosen width	Cross slope of gutter measured from slope of street section	Length of inlet for total interception	Length of inlet selected		MUST BE > OR = TO 60% Efficiency	Select Length does it give 60%+ pickup?
#	Q	a	W	T	Sx	S	Se	n	Eo	Sw'	Lt	L	L/Lt	E	L
1895A	14.703	0.333333	2	17.75	0.02	0.0233	0.066	0.016	0.27	0.17	36.84	12.00	0.33	50.8%	NO
1895A	14.703	0.333333	2	17.75	0.02	0.0233	0.066	0.016	0.27	0.17	36.84	14.00	0.38	57.7%	NO
1895A	14.703	0.333333	2	17.75	0.02	0.0233	0.066	0.016	0.27	0.17	36.84	**16.00**	0.43	**64.1%**	**YES**
19010	18.853	0.333333	2	20.25	0.02	0.0194	0.060	0.016	0.24	0.17	40.65	12.00	0.30	46.7%	NO
19010	18.853	0.333333	2	20.25	0.02	0.0194	0.060	0.016	0.24	0.17	40.65	14.00	0.34	53.2%	NO
19010	18.853	0.333333	2	20.25	0.02	0.0194	0.060	0.016	0.24	0.17	40.65	**16.00**	0.39	**59.4%**	**YES**
17598B	21.592	0.333333	2	20.85	0.02	0.0214	0.059	0.016	0.24	0.17	44.79	14.00	0.31	49.1%	NO
17598B	21.592	0.333333	2	20.85	0.02	0.0214	0.059	0.016	0.24	0.17	44.79	16.00	0.36	54.9%	NO
17598B	21.592	0.333333	2	20.85	0.02	0.0214	0.059	0.016	0.24	0.17	44.79	**18.00**	0.40	**60.4%**	**YES**
17370A	22.093	0.333333	2	23	0.02	0.0139	0.056	0.016	0.22	0.17	41.17	14.00	0.34	52.7%	NO
17370A	22.093	0.333333	2	23	0.02	0.0139	0.056	0.016	0.22	0.17	41.17	16.00	0.39	58.8%	NO
17370A	22.093	0.333333	2	23	0.02	0.0139	0.056	0.016	0.22	0.17	41.17	**18.00**	0.44	**64.5%**	**YES**
16200A	26.764	0.333333	2	25.05	0.02	0.0126	0.053	0.016	0.20	0.17	44.65	14.00	0.31	49.2%	NO
16200A	26.764	0.333333	2	25.05	0.02	0.0126	0.053	0.016	0.20	0.17	44.65	16.00	0.36	55.0%	NO
16200A	26.764	0.333333	2	25.05	0.02	0.0126	0.053	0.016	0.20	0.17	44.65	**18.00**	0.40	**60.5%**	**YES**
16200C	21.205	0.333333	2	23.15	0.02	0.0126	0.056	0.016	0.21	0.17	39.38	12.00	0.30	48.0%	NO
16200C	21.205	0.333333	2	23.15	0.02	0.0126	0.056	0.016	0.21	0.17	39.38	14.00	0.36	54.7%	NO
16200C	21.205	0.333333	2	23.15	0.02	0.0126	0.056	0.016	0.21	0.17	39.38	**16.00**	0.41	**60.9%**	**YES**
15000B	22.073	0.333333	2	20.25	0.02	0.0262	0.060	0.016	0.24	0.17	47.53	16.00	0.34	52.2%	NO
15000B	22.073	0.333333	2	20.25	0.02	0.0262	0.060	0.016	0.24	0.17	47.53	18.00	0.38	57.5%	NO
15000B	22.073	0.333333	2	20.25	0.02	0.0262	0.060	0.016	0.24	0.17	47.53	**20.00**	0.42	**62.6%**	**YES**
14862A															
14862A	IN SUMP USE SEPARATE METHOD TO CALCULATE CAPACITY.														
14862A															

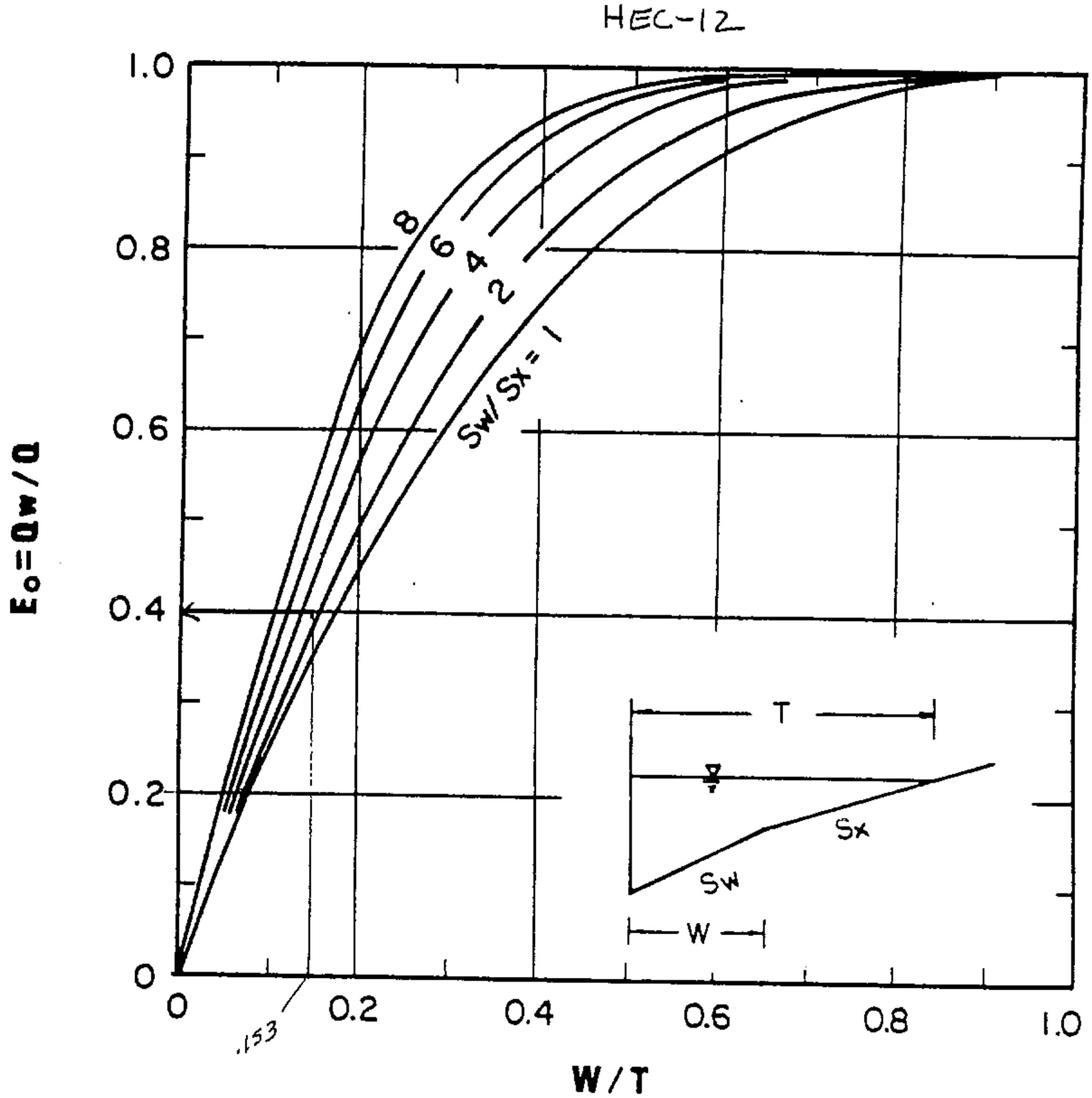
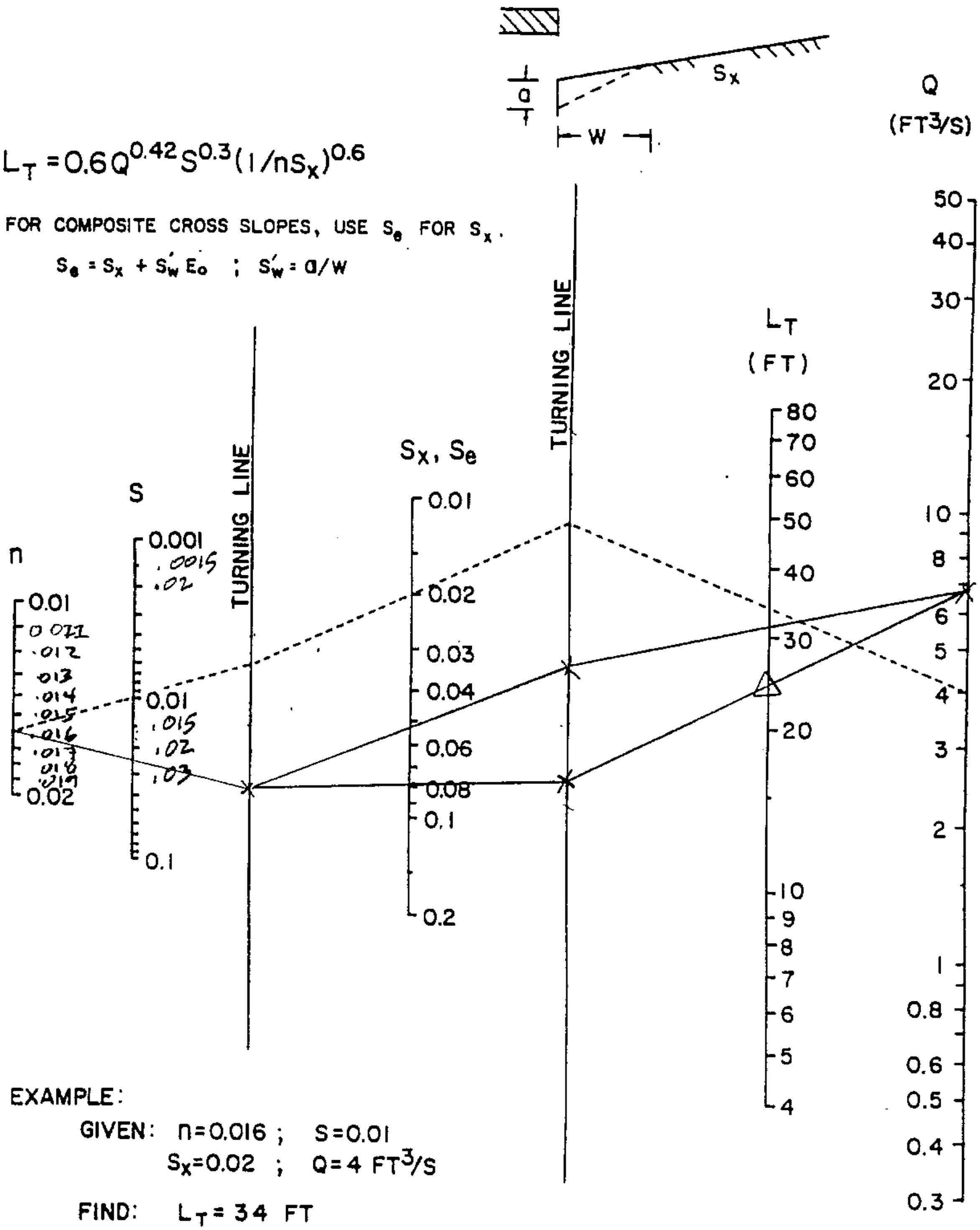


CHART 4. Ratio of frontal flow to total gutter flow.



$$L_T = 0.6 Q^{0.42} S^{0.3} (1/nS_x)^{0.6}$$

FOR COMPOSITE CROSS SLOPES, USE S_e FOR S_x.

$S_e = S_x + S'_w E_o$; $S'_w = a/W$

EXAMPLE:

GIVEN: $n = 0.016$; $S = 0.01$

$S_x = 0.02$; $Q = 4\ FT^3/S$

FIND: $L_T = 34$ FT

CHART 9. Curb-opening and slotted drain inlet length for total interception.

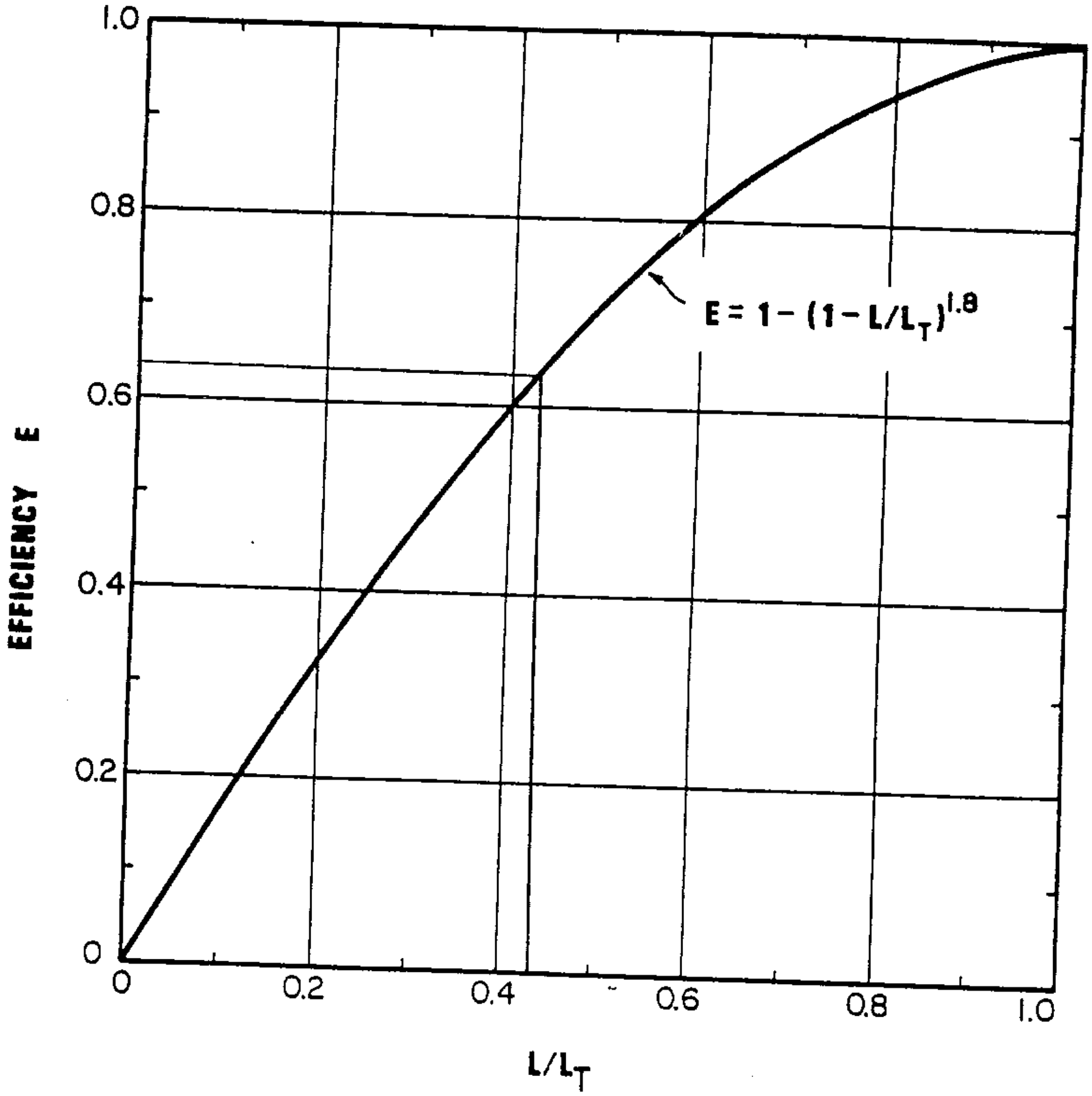


CHART 10. Curb–opening and slotted drain inlet interception efficiency.

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HEC-12	JOB No. 3821	SHEET No.
SUMP INLET	DESIGNED BY RBB	DATE 13 APR 98
	APPROVED	REFENCE

EQUATION FOR INTERCEPTION CAPACITY - OPERATING AS A WEIR.

$Q_i = C_w (L + 1.8W) d^{1.5}$

$C_w = 2.3$ L = LENGTH OF CURB OPENING

CHART 12 DEPRESSED CURB OPENING INLET CAPACITY IN SUMP LOCATIONS. — CHART 12 PAGE 77

Q FROM HYDROLOGY TO INLET = 14.904 CFS 100 YR STORM — EXCEL SPD SHT FORSTRECAP2

TRY 10' OPENING

$P = L + 1.8W = 10' + 1.8(2)' = 13.6$

$d_i = d + a = 8'' = .67'$

$P = L + 1.8W$ OFF CHART

TRY 14' INLET

P = 17.6

/ TRY 16' INLET

P = 19.6

FOR Q_{100} $d = .48'$ $d < h$

TRY DEPTH OF .5' → WHAT Q CAN 10' INLET PICKUP? 11 CFS

TRY DEPTH OF .70 → WHAT Q CAN 10' INLET PICKUP?

HEC-12

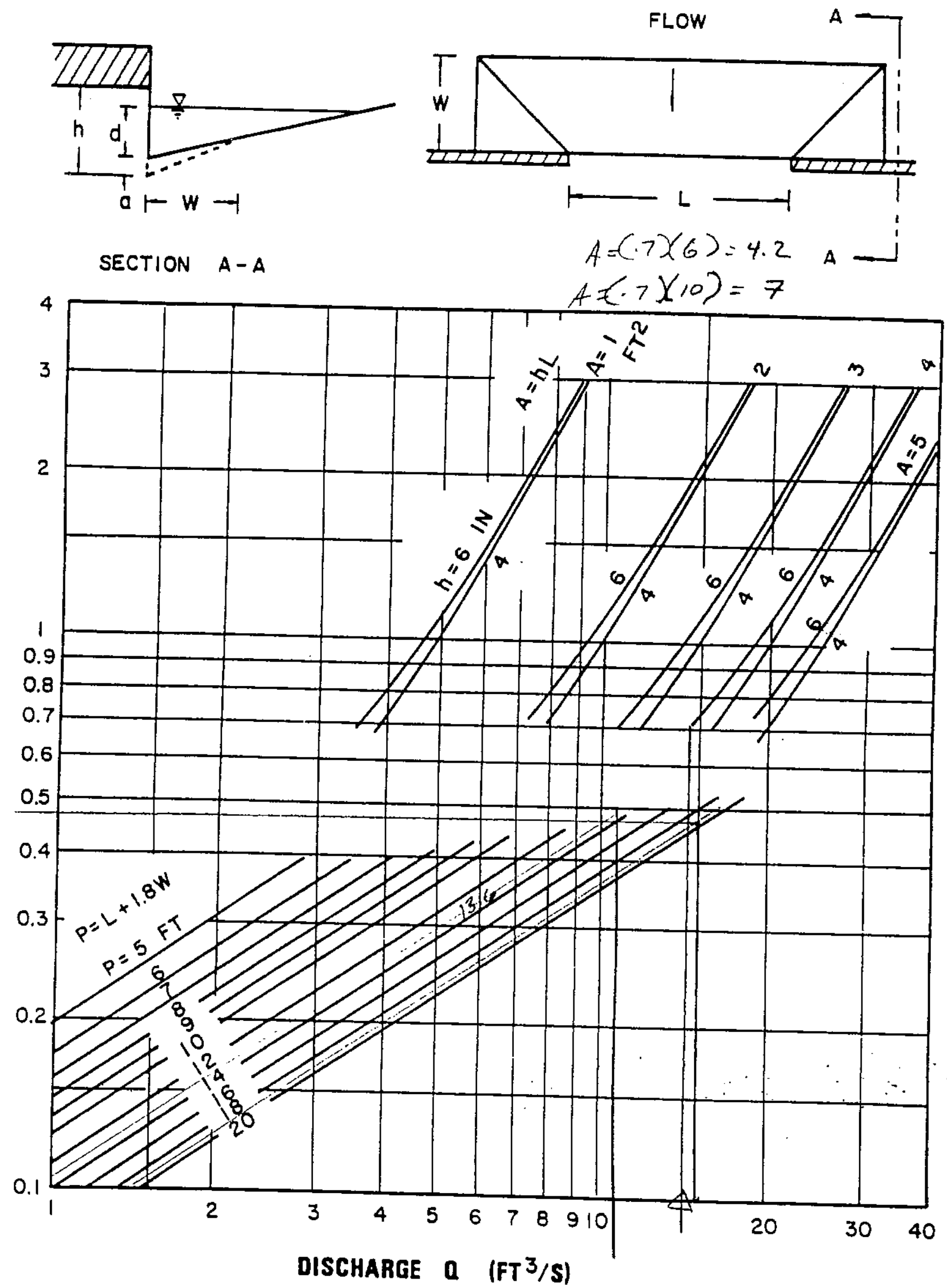

CHART 12. Depressed curb-opening inlet capacity in sump locations.

DMJM

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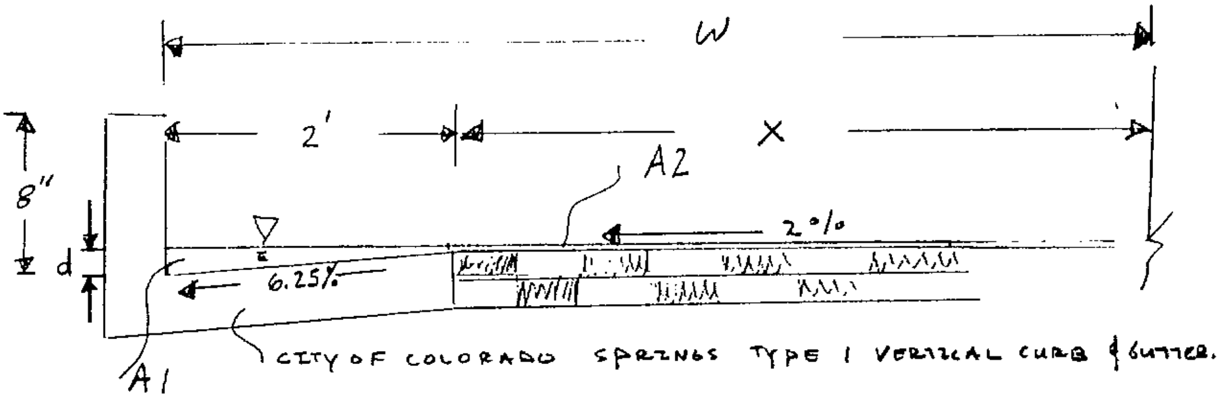
Engineering
Program/Construction
Management

STANDARD STREET CAPACITY	JOB No. 3821.02	SHEET No.
CITY STREET – TYPE 1	DESIGNED BY	DATE 27 MAR 98
	APPROVED	



$(x)(.02) = d - .125 \qquad x = \frac{d - .125}{.02}$

$A_1 = \left(\frac{d + d - .125}{2}\right)(2') = \underline{\underline{2d - .125}}$

$A_2 = \frac{(d - .125)}{2}\frac{(d - .125)}{.02} = \frac{d^2 - .25d + .0156}{.04}$

$= \underline{\underline{25d^2 - 6.25d + .39}}$

$A = A_1 + A_2 = \underline{\underline{25d^2 - 4.25d + .265}}$

$P = w \quad \frac{d - .125}{.02} + 2' = 50d - 6.25 + 2 = \underline{\underline{50d - 4.25}}$

$n = .016$

$Q = \frac{1.49}{n}\frac{A^{5/3}}{P^{2/3}} S^{1/2}$

$\therefore$ FOR 6" DEPTH AT CURB $Q = 145.15\, S^{1/2}$

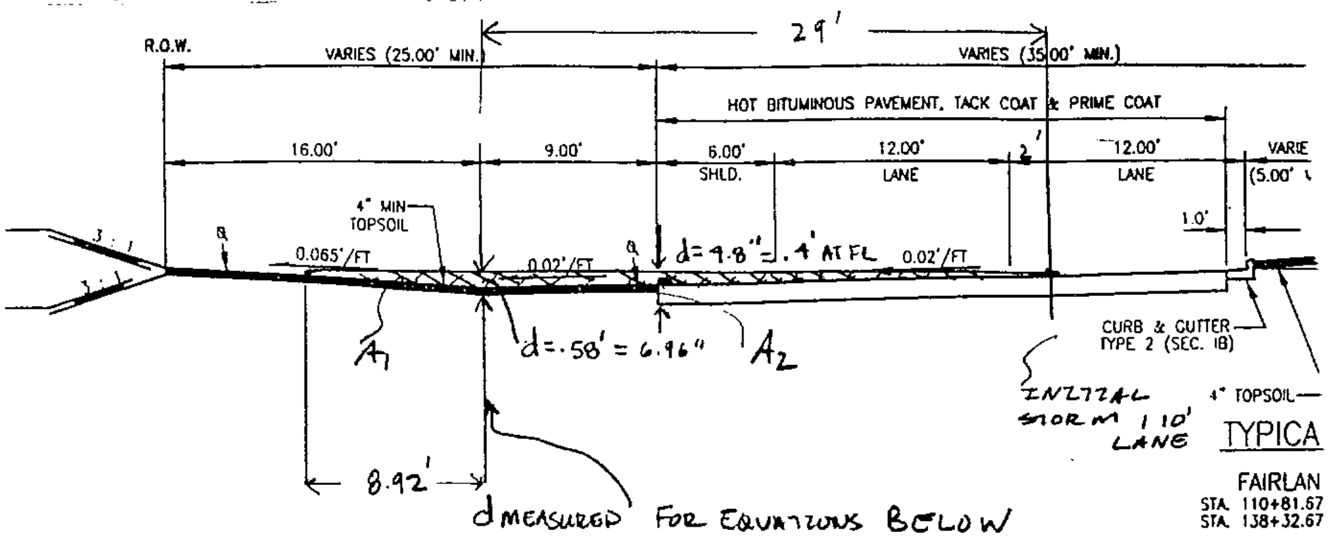
AT 6" DEPTH AT THE CURB $\qquad Q = \frac{1.49}{.016}\frac{4.39^{5/3}}{20.75^{2/3}} S^{1/2}$

$Q = 145.15\, S^{1/2}$

$Q = 178.65\, S^{1/2}$ IF $N = .013$

AT 8" DEPTH $Q = \frac{1.49}{.016}\frac{8.64^{5/3}}{29.25^{2/3}} S^{1/2}$

$Q = 356.87\, S^{1/2}$



INITIAL STORM

AREA = AREA 1 + AREA 2

$$\text{AREA 1} = \frac{1}{2}\left(\frac{d}{.065}\right)(d) = \frac{d^2}{.13}$$

For initial $d = .58$
$A_1 = 2.59$ ✓

$$\text{AREA 2} = \frac{1}{2}\left(\frac{d}{.02}\right)(d) = \frac{d^2}{.04}$$

For initial $d = .58$
$A_2 = 8.41$ ✓

$$\text{AREA} = \frac{d^2}{.13} + \frac{d^2}{.04} = 32.69 d^2$$

$$P = W = \frac{d}{.02} + \frac{d}{.065} = 50d + 15.38d = 65.38d$$

For initial $d = .58$
$P = 37.92$ ✓

$n = .016$

$$Q = \frac{1}{n}\frac{A^{5/3}}{P^{2/3}} S^{1/2}$$

∴ For initial storm leaving 10' lane open

$$Q = \frac{1}{.016}\frac{11^{5/3}}{37.92^{2/3}} S^{1/2}$$

$$Q = (62.5)(4.82) S^{1/2}$$

$$\boxed{Q = 301.27 S^{1/2}}$$

CARDER CONCRETE PRODUCTS COMPANY
5311 W CARDER CT
LITTLETON, CO 80125
(303) 791-1600 (303) 791-1710 FAX

CARDER CONCRETE PRODUCTS

DATE: PAGE of

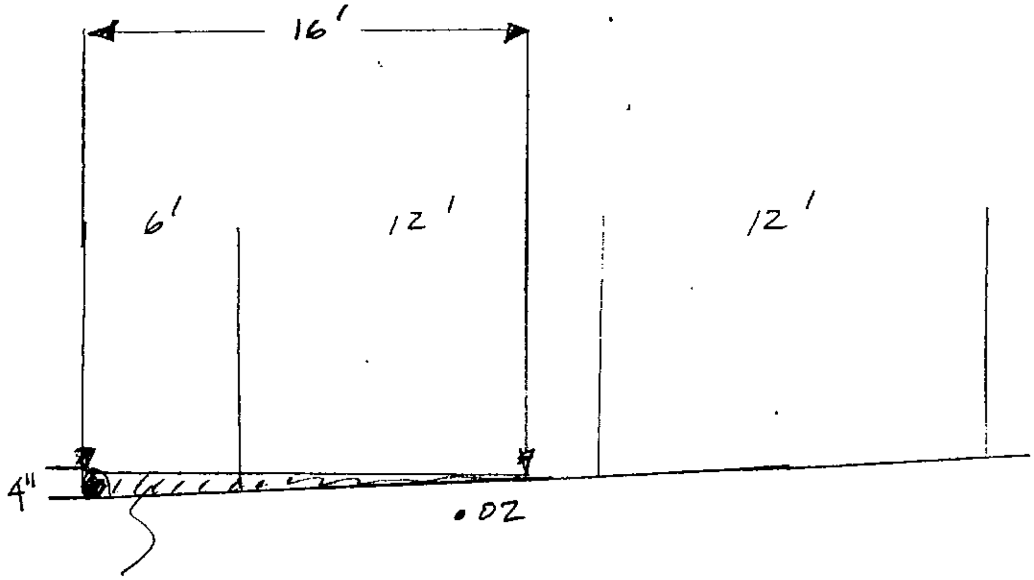
SUMMARY OF STREET CAPACITIES

5 YR ULTIMATE	$Q = 145.15\, S^{1/2}$	(6" DEPTH AT CURB) (1 INSIDE LANE OPEN)
100 YR ULTIMATE	$Q = 356.87\, S^{1/2}$	(8" DEPTH AT CURB
5 YR INTERIM	$Q = 75.40\, S^{1/2}$	(4" CURB - 16' SPREAD
5 YR INTERIM + DITCH	$Q = 301.27\, S^{1/2}$	(LEAVE 10' LANE OPEN) OVERTOP CURB
100 YR INTERIM	$Q = 1547.63\, S^{1/2}$	(USE FULL DITCH) POND TO CROWN
100 YR INTERIM + DITCH	$Q = 1547.63\, S^{1/2}$	(USE FULL DITCH) POND TO CROWN

By ____________________

CARDER CONCRETE PRODUCTS
CARDER CONCRETE PRODUCTS COMPANY
8311 W. CARDER CT
LITTLETON CO 80125
(303) 791-1600 (303) 791-1710 FAX

DATE PAGE of



$$A = \frac{\left(\frac{4}{12}\right)(16)}{2} = 2.67 \text{ FT}^2$$

$P \approx W = 16'$

$R = \frac{2.67 \text{ FT}^2}{16'} = .167$

$Q = \frac{1.49}{.016} (2.67)(.167)^{2/3} (.01)^{1/2}$

$Q = 7.5$ CFS

$Q = 75.40 (S)^{1/2}$

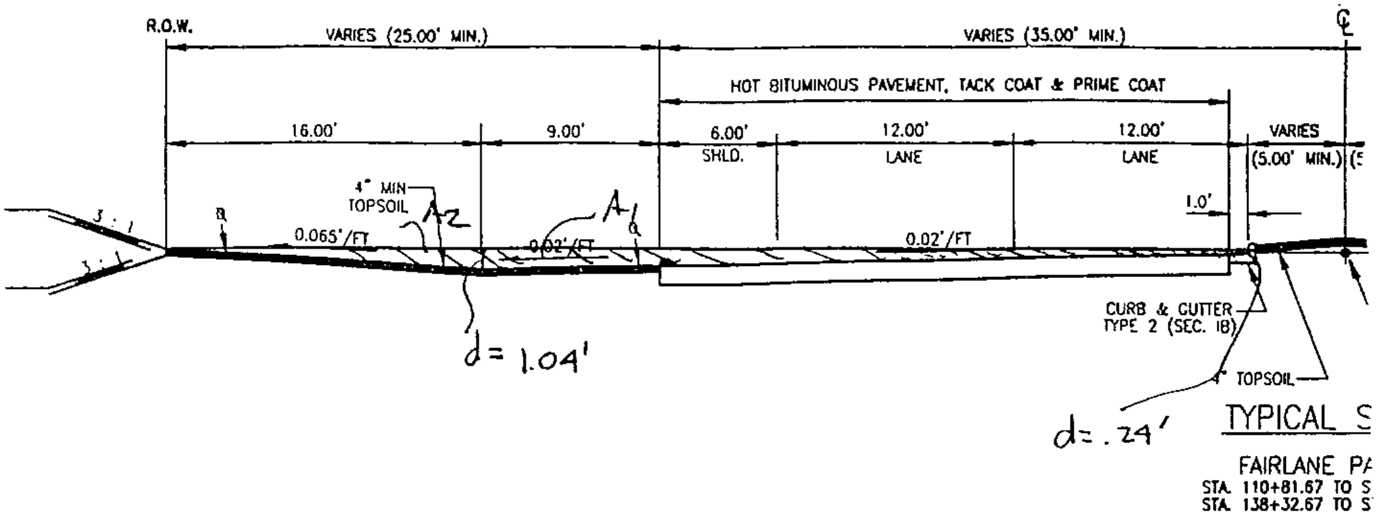
SPREAD 16', SO LEAVES 14' TRAVEL LANE FOR 4" DEPTH AT FLOWLINE 5 & 100 YR

$Q = 171.7 S^{1/2}$

FOR 6" DEPTH AT FLOWLINE ULT 5 YEAR

$Q = 356.87 S^{1/2}$

FOR 8" DEPTH AT FLOWLIN ULT 100 YEAR



MAJOR STORM — ASSUME FLOW TO EDGE OF INSIDE FL PONDS 2"

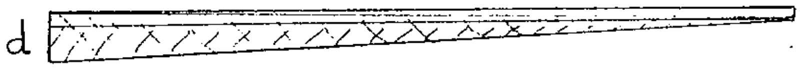
$Area = Area\,1 + Area\,2$

$Area\,1 = \frac{1}{2}\left(\frac{d}{.065}\right)(d) = \frac{d^2}{.13}$

FOR MAJOR $d = 1.04'$

$A_1 = 8.32\ FT^2$

AREA 2 =



$\frac{1}{2}\left(\frac{d}{.02}\right)(d)$ = ROUGH APPROX

.2' MORE

$= \frac{d^2}{.04}$

FOR MAJOR

$A_2 = 26$

REALITY = 25.6'

ATOTAL = 34.32

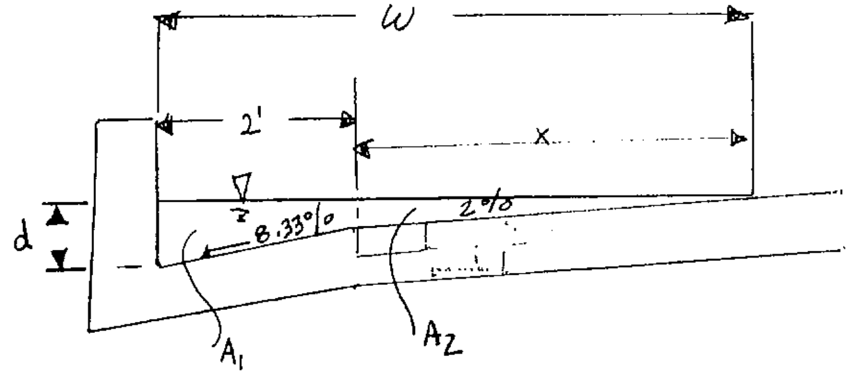
P = 56' (MIN)

$Q = \frac{1}{n}\frac{A^{5/3}}{P^{2/3}} S^{1/2} = 1547.75^{1/2}$

$Q = 1547.63\ S^{1/2}$

CARDER CONCRETE PRODUCTS COMPANY
3311 W CARDER CT
LITTLETON, CO 80125
(303) 791-1600 (303) 791-1710 FAX

FAIRLANE
SET UP EQUATIONS FOR INITIAL STORM
DATE 20 JAN 98 PAGE of
RBB



$(x)(.02) = d - .166$

$x = \frac{d - .166}{.02}$

$A_1 = \frac{(d + d - .166)}{2}(2') = 2d - .166$

$A_2 = \left(\frac{d - .166}{2}\right)\left(\frac{d - .166}{.02}\right) = \frac{d^2 - .332d + .028}{.04} = 25d^2 - 8.3d + .7$

$A = A_1 + A_2 = 25d^2 - 6.3d + .534$

$P = w = \left(\frac{d - .166}{.02}\right) + 2' = 50d - 8.3 + 2 = 50d - 6.3$

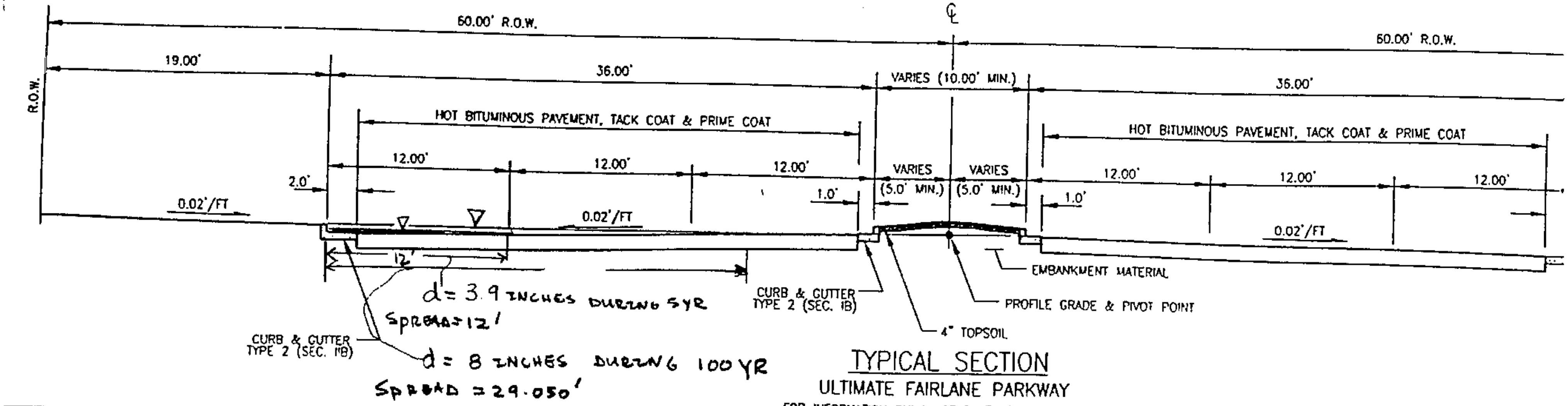
$n = .016$

$Q = \frac{1}{n} \frac{A^{5/3}}{P^{2/3}} S^{1/2}$

FOR 6" OF FLOW $Q = \frac{1}{.016} \frac{(3.634)^{5/3}}{(18.7)^{2/3}} S^{1/2}$

TYPICAL SECTION

FAIRLANE PARKWAY
STA. 110+81.67 TO STA. 127+13.93
STA. 138+32.67 TO STA. 140+73.03



TYPICAL SECTION

ULTIMATE FAIRLANE PARKWAY
FOR INFORMATION ONLY–NOT PART OF THIS PROJECT

Computer File Information

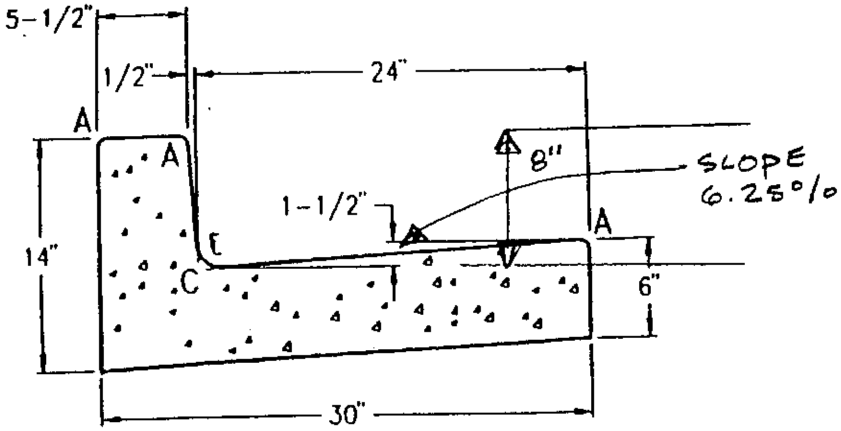
...tion Date: 11/24/97 Initials: TAH
Modification Date: 02/26/98 Initials: LLT
Path: S:\3821\CADD\PLANS\Phase1\
...ing File Name: FLCTY01.DWG
... Ver. R14 Scale: NONE Units: ENGLISH

Index of Revisions

DMJM
DANIEL, MANN, JOHNSON, & MENDENHALL
1490 West Fillmore Street, Suite 101
Colorado Springs, Colorado 80904
Phone: (719) 471-9888 Fax: (719) 471-9063

As Construct...
No Revisions: _
Revised: _
Void: _

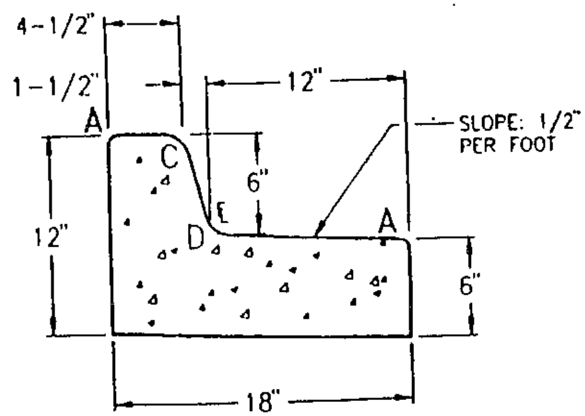
1 2 3 4 5 6 7 8 9 10 11



TYPE 1

VERTICAL CURB AND GUTTER

SCALE: 1" = 1'-0"

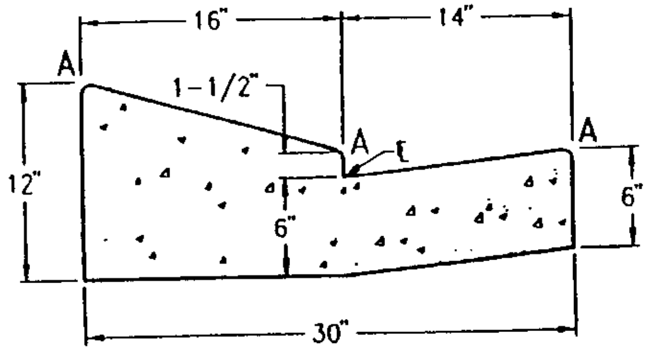


TYPE 3

STANDARD MEDIAN CURB AND GUTTER

SCALE: 1" = 1'-0"

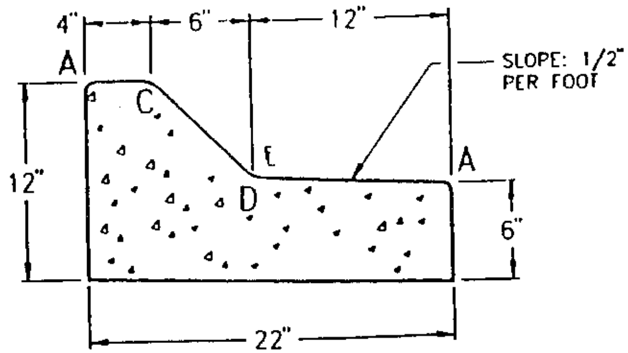
LENGTH FOR RADII
A = 1/2" C = 1-1/2" D = 1-1/2" TO 2"



TYPE 2

RAMP CURB AND GUTTER

SCALE: 1" = 1'-0"

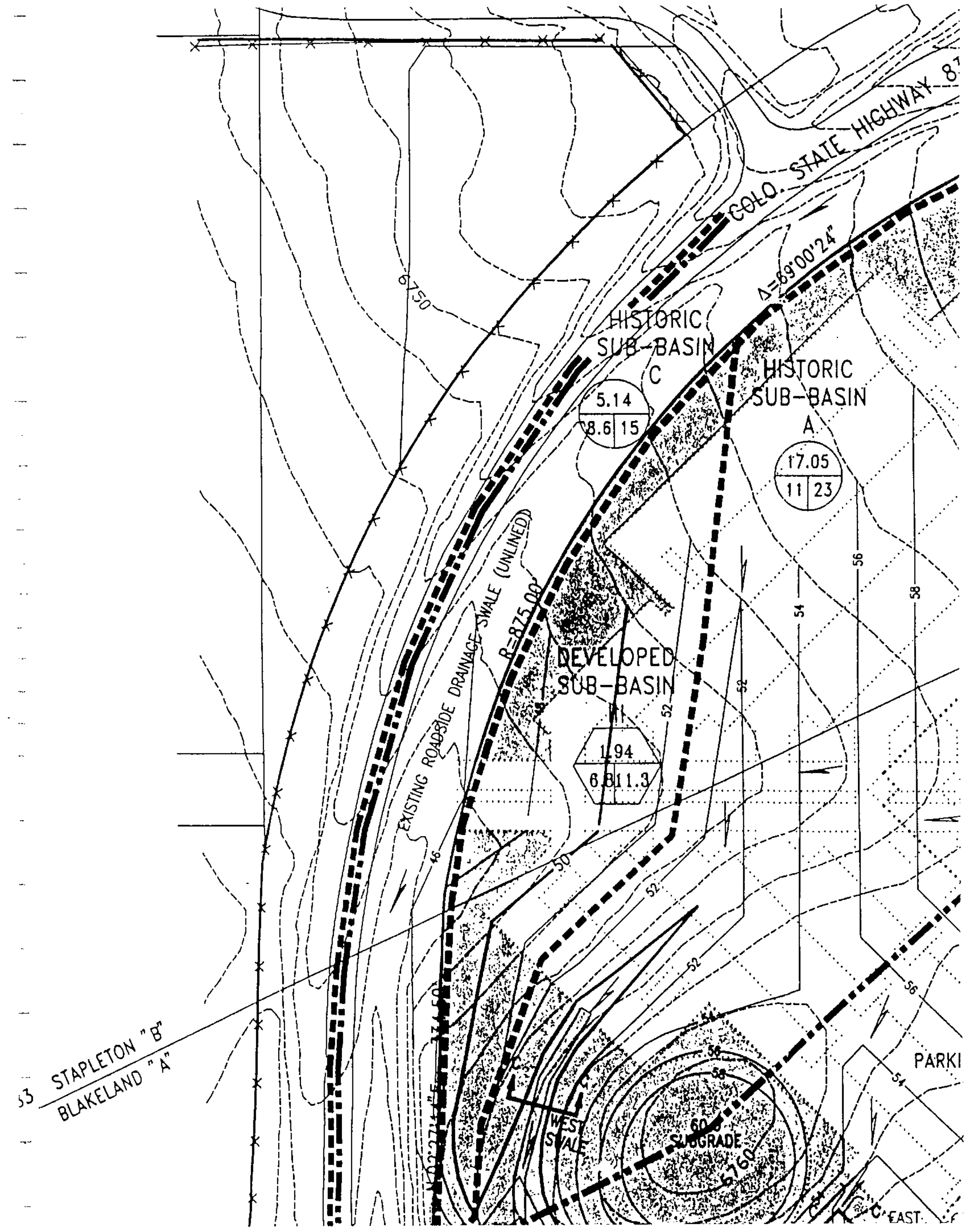


TYPE 4

MOUNTABLE MEDIAN CURB AND GUTTER

SCALE: 1" = 1'-0"

CITY OF COLORADO SPRINGS	
Standard Curb & Gutter Type 1, 2, 3, & 4	
Approved by:	City Engineer
Drawn by: KLW 07/94	STD. D-6


COLO. STATE HIGHWAY 8
Δ=69°00'24"
HISTORIC SUB-BASIN C
5.14
8.6 | 15
HISTORIC SUB-BASIN A
17.05
11 | 23
R=875.00'
EXISTING ROADSIDE DRAINAGE SWALE (UNLINED)
DEVELOPED SUB-BASIN
1.94
6.8 | 11.3
6750
54
56
58
52
50
46
STAPLETON "B"
BLAKELAND "A"
WEST SWALE
SUBGRADE
6760
PARKI
EAST

DMJM

Planning
Architecture
Engineering
Program/Construction
Management

	JOB No. 3B21-0438	SHEET No.
	DESIGNED BY CAS	DATE 3-19-99
NEW LIFE CHURCH GRATED INLET	APPROVED	

SAG LOCATION

FLOW NEEDED = 11.3 CFS (FROM HAYNES & ASSOCIATES DRAINAGE ADDENDUM #1 FOR NEW LIFE CHURCH FILING #2)

$Q_i = \frac{3.0 P d^{1.5}}{F}$, Q_i = RATE OF DISCHARGE INTO GRATE OPENING (CFS)

P = PERIMETER OF GRATE OPENING (FT)

d = DEPTH OF WATER AT GRATE (FT)

F = CLOGGING FACTOR

TRY 7.5 x 7.5 GRATED INLET ⇒ $P = 4(7.25) = 29$ FT

$P_{EFFECTIVE} = \frac{P}{2} = \frac{29}{2} = 14.5$ (50% CLOGGING)

$Q_i = (3)(14.5)(.44)^{1.5} = 12.7$ CFS

$d_{REQ} = \left[\frac{11.3}{(14.5)(3)}\right]^{2/3} = 0.41 \approx 0$ FREEBOARD

HYDROLOGICAL COMPUTATIONS
RATIONAL METHOD Q=CIA

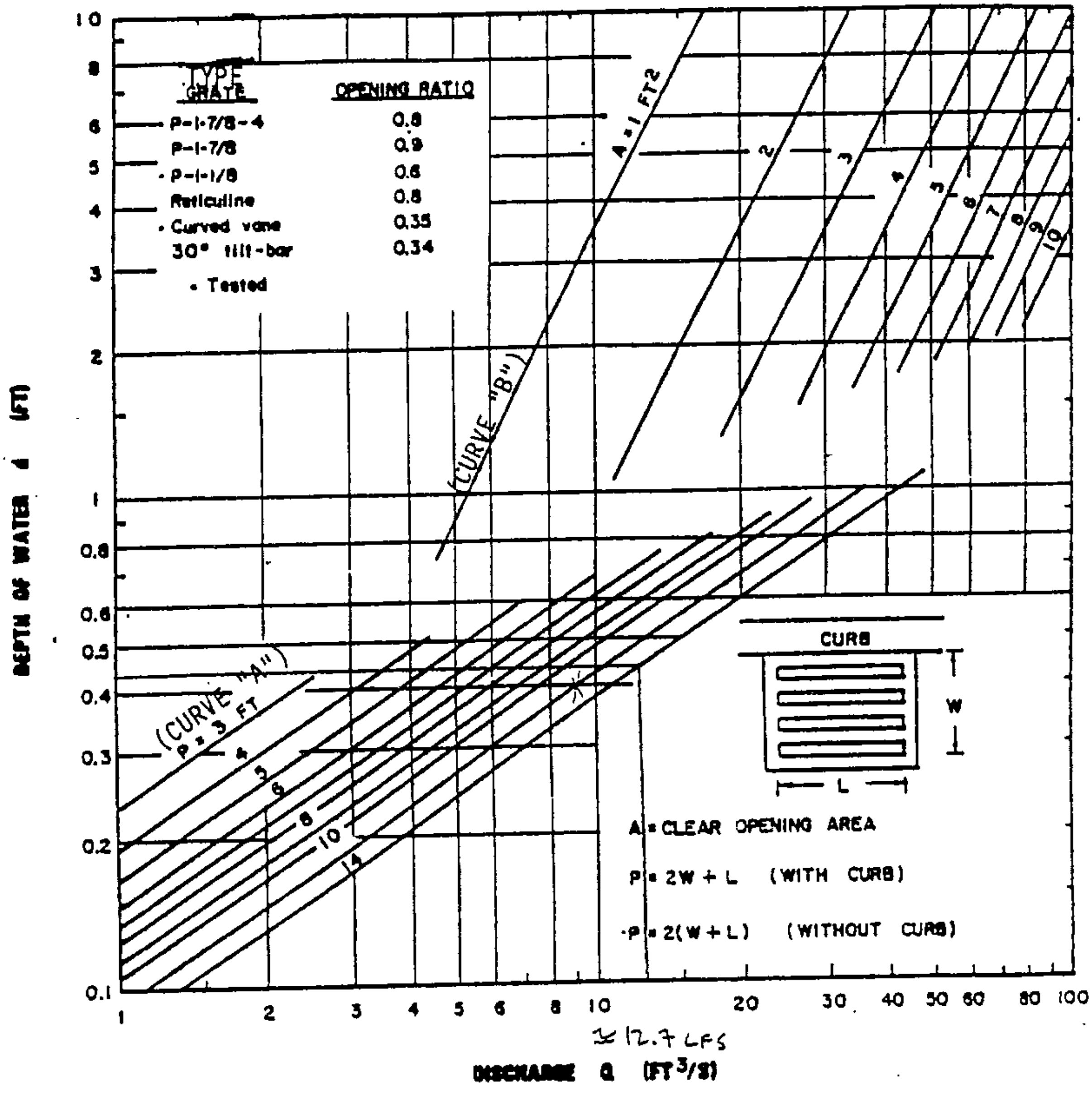
FREQ. STORM	BASIN	AREA TOTAL ACRES	BASIN LENGTH (FT)	BASIN HEIGHT (FT)	Tc (MIN.)	I	SOIL GROUP	DEVEL. TYPE	C	10/100 YEAR Q (cfs)
DEVELOPED FLOWS										
10	I	15.37	1550	40	12.7	4.2	A & B	COMM.	0.71	46.0
100						6.3			0.77	75.0
10	II	19.44	1800	40	13.8	4.1	A & B	COMM.	0.82	69.0
100						6.0			0.92	107.0
10	III	1.94	250	6	5.0	6.0	A & B	COMM.	0.58	6.8
100						9.0			0.65	11.3
POND FLOWS (in, developed)										
10	I & II	34.81	1800	40	13.8	4.1	A & B	COMM.	0.80	114.0
100						6.0			0.85	178.0
HISTORIC FLOWS										
10	A	17.05	2100	42	32.9	2.5	A & B	PASTURE/	0.25	11.0
100						3.8		MEADOW	0.35	23.0
10	B	19.35	2700	54	34.4	2.5	A & B	PASTURE/	0.25	12.0
100						3.8		MEADOW	0.35	26.0
10	C	5.14	2800	54	26.4	2.9	A & B	PASTURE/	0.25	8.6
100						4.4		MEADOW	0.35	15.0
10	A & B	36.40	2700	54	34.4	2.5	A & B	PASTURE/	0.25	23.0
100						3.8		MEADOW	0.35	48.0

NEW LIFE CHURCH — PREPARED BY: BH

FREQ. STORM - 10 AND 100 YR

CONDITION - DEVELOPED & HISTORIC — DATE: 4/2/90

FROM MASTER DRAINAGE PLAN FOR NEW LIFE CHURCH PREPARED BY KLH ENGINEERING, INC. APRIL, 1991



Reference: USDOT, March 1984
HEC NO. 12

NOTE: Use with effective P or A

9/30/90

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987

Hydraulic Capacity of Grate Inlet in Sump

Figure
7 - 6

INTERQUEST INTERCHANGE
XPRAT HYDROLOGIC DATA
100 YEAR STORM

	AREA		FLOWS						CRITICAL AREA DATA			
				SURFACE FLOWS								
						OVERFLOW						
NODE NAME	TOTAL	IMPERVIOUS	PIPE FLOW	CATCHMENT CONTRIBUTION	TOTAL GUTTER FLOW	CAPTURED FLOW	BYPASS FLOW	OVERFLOW DESTINATION	CRITICAL AREA Tc	INTENSITY	EQ. IMPERVIOUS AREA	CRITICAL PEAK FLOWS
	acre	acre	cfs	cfs	cfs	cfs	cfs		min	in/hr	acre	
PND162	1.73	0	60.235	61.343	61.343	60.500	1.108	16113	33.16	3.91	15.559	56.577
16200C	1.93	0	12.667	15.274	15.274	12.720	2.607	16200B	6.40	8.44	1.795	14.089
19010	2.94	0	11.255	17.721	17.721	11.310	6.465	17598	12.60	6.43	2.734	16.344
17598	2.04	0	12.904	14.538	22.182	12.960	9.278	17572	8.50	7.60	1.897	13.408
18641	-	-	64.997	65.000	65.000	65.000	0.003	18596	28.00	4.30	14.992	59.953
18596	-	-	72.291	0.000	0.003	0.000	0.003	18241	28.14	4.29	17.727	70.659
18241	-	-	70.906	0.000	0.002	0.000	0.003	17660	28.96	4.20	17.727	69.308
17660	-	-	69.383	0.000	0.003	0.000	0.003	17572	29.86	4.11	17.727	67.824
17572	-	-	75.707	0.000	5.004	0.000	5.356	17370B	30.05	4.10	19.624	74.772
17370A	4.08	-	13.207	21.899	21.899	13.260	8.692	17370B	16.10	5.72	3.794	20.197
17370B	-	-	84.253	0.000	11.507	0.000	11.894	17060	30.47	4.07	23.418	88.683
17060	-	-	83.164	0.000	11.797	0.000	12.199	16460	31.02	4.04	23.418	87.964
16460	0.83	0	81.456	3.094	15.100	0.000	15.495	16200B	32.08	3.98	24.19	89.424
16200B	-	-	86.359	0.000	16.599	0.000	17.012	16113	32.58	3.95	25.985	95.359
16113	-	-	144.727	0.000	18.067	0.000	18.773	15600	32.80	3.93	41.243	150.816
15600	-	-	141.783	0.000	18.483	0.000	19.191	15000A	33.82	3.87	41.243	148.476
15000B	1.93	0	13.183	15.419	15.419	13.240	2.235	15000A	6.20	8.52	1.795	14.223
15000A	-	-	144.340	0.000	19.831	0.000	20.522	14847	35.01	3.80	43.038	152.056
14862A	2.05	0	17.298	17.300	17.300	17.300	0.002	14862B	5.00	9.00	1.906	15.953
14862B	0.1	0	17.806	0.828	0.830	0.830	0.002	14847	5.42	8.83	2	16.429
14847	0.67	0	150.552	2.376	22.801	0.000	23.530	14594	35.31	3.78	45.661	160.559

INTERQUEST HYDRAULIC DATA TRUNKLINE AND LATERALS

HYDRAULIC GRADE LINE

DATA AT D/S MH				CONDUIT DATA						DATA AT U/S MH			
D/S PIT NAME	D/S REF STATION	D/S INVERT	D/S HGL	PIPE FLOW	DIAMETER OR HEIGHT	# OF PAR. CONDUITS	DISTANCE BTWN MH'S	PIPE LENGTH	CONDUIT GRADE	U/S PIT NAME	U/S REF. STATION	U/S INVERT	U/S HGL
		ft	ft	cfs	ft	#	ft	ft	%			ft	ft
16113	16113	6743.47	6754.517	60.235	36	1	126.1	126.1	3.65	PND162	PND162	6748.07	6755.546
16200B	16200B	6755.12	6756.22	12.667	18	1	10.67	10.67	1.87	16200C	16200C	6755.32	6756.417
18596	18596	6792.04	6794.776	11.255	18	1	403.2	403.2	3.26	19010	19010	6805.19	6806.447
17572	17572	6776.16	6780.582	12.904	24	1	36.17	36.17	1.33	17598B	17598B	6776.64	6780.7
18596	18596	6792.04	6794.776	64.997	36	1	62	62	7.76	18641	18641	6796.85	6799.412
18241	18241	6785.57	6790.321	72.291	36	1	372.99	372.99	1.73	18596	18596	6792.04	6794.703
17660	17660	6777.95	6781.821	70.906	36	1	599.19	599.19	1.24	18241	18241	6785.37	6788.601
17572	17572	6775.3	6780.582	69.383	36	1	88.13	88.13	1.24	17660	17660	6776.39	6781.537
17370B	17370B	6773	6777.898	75.707	36	1	201.25	201.25	1.14	17572	17572	6775.3	6780.493
17370B	17370B	6773.83	6777.898	13.207	18	2	96	96	0.5	17370A	17370A	6774.31	6778.278
17060	17060	6769.52	6772.521	84.253	36	1	310.4	310.4	1.12	17370B	17370B	6773	6777.479
16460	16460	6749.38	6759.854	83.164	36	1	596.01	596.01	3.35	17060	17060	6769.32	6772.08
16200B	16200B	6744.21	6755.64	81.456	36	1	256	256	1.94	16460	16460	6749.18	6759.462
16113	16113	6742.84	6754.517	86.359	48	1	87.5	87.5	1.05	16200B	16200B	6743.76	6754.833
15600	15600	6737.35	6747.082	144.727	48	1	508.5	508.5	1.08	16113	16113	6742.84	6752.25
15000A	15000A	6729.42	6739.092	141.783	48	1	596	596	1.3	15600	15600	6737.15	6744.905
15000A	15000A	6734.78	6739.092	13.183	24	1	26.14	26.14	1.99	15000A	15000A	6735.3	6739.181
14847	14847	6726.21	6735.4	144.34	48	1	150.3	150.3	1.74	15000A	15000A	6728.83	6736.919
14862B	14862B	6727.82	6735.452	17.298	14X23 ERCP	2	118.34	118.34	2.76	14862A	14862A	6731.09	6736.255
14847	14847	6727.21	6735.4	17.806	36	1	17.15	17.15	2.39	14862B	14862B	6727.62	6735.412
14594	14594	6724.78	6732.42	150.552	54	1	246.92	246.92	0.5	14847	14847	6726.01	6733.869

DMJM

Planning
Architecture
Engineering
Program/Construction Management

	JOB No. 3821	SHEET No.
OFFSITE AREA O-1	DESIGNED BY RBB	DATE
	APPROVED	

$Q = CiA$

$C = .65$ OFF SITE FLOW (UNDEFINED)

$A = 16.52$ ACRES

$$T_c = \left[\frac{(11.9)(.34)^3}{40'}\right]^{.385}$$

6845 - 6805

$T_c = .18$ HRS = 10.8 MINUTES ← REALLY DESIGNED FOR BASINS 100+ SO SHOULD BE HIGHER

$T_t = 1.37\ (11 - .6)\ 300^{.5}\ 2.22^{-.33}$ CHECK

= 12.4 MINUTES

1500' AT 2.22% "SWALE FLOW"

$$T_s = \frac{L_s}{60V_s} = \frac{1500'}{(60)(5\ FPS)}$$

FROM MANNING SEE CHANNEL DESIGN APPENDIX

$T_s = 5$ MIN

$T_c = T_t + T_s = 12.4 + 5$ MIN = **17.4 MIN** ← USE

$Q = CiA = (.65)(5.4)(16.52) = 58$ CFS ← APPROPRIATE PIPE TAKES 65 CFS

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3


```
ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID        FAIRLANE TECHNOLOGY PARK - URS PROJECT NO. 6742044
ID        MAJOR SYSTEM HYDROLOGY FOR THE BASIN - INPUT FILE HISA.INP
ID        USING THE 100-YEAR 24-HOUR STORM IN THE CITY/COUNTY CRITERIA
ID        ROUTED THROUGH DETENTION POND A
ID        HISTORIC CONDITIONS THROUGHOUT THE BASIN
ID        RUN DATE 4-1-1993
*DIAGRAM
IT       5 01JUL90     800     300
IO       5

KK      01
KM        RUNOFF FROM BASIN 01
BA   0.264
LS       0    67.8
UD   0.280
IN      15
PB       0
PC   0.000   0.002   0.007   0.013   0.020   0.026   0.035   0.044   0.053   0.063
PC   0.073   0.083   0.092   0.103   0.112   0.122   0.141   0.172   0.202   0.233
PC   0.264   0.330   0.440   1.760   3.080   3.190   3.300   3.366   3.432   3.476
PC   3.520   3.564   3.608   3.630   3.652   3.674   3.696   3.718   3.740   3.762
PC   3.784   3.801   3.817   3.834   3.850   3.867   3.883   3.900   3.916   3.933
PC   3.949   3.966   3.982   3.997   4.011   4.025   4.039   4.052   4.066   4.079
PC   4.092   4.103   4.114   4.125   4.136   4.147   4.158   4.169   4.180   4.191
PC   4.202   4.213   4.224   4.235   4.246   4.257   4.268   4.279   4.290   4.301
PC   4.312   4.318   4.323   4.329   4.334   4.340   4.345   4.351   4.356   4.362
PC   4.367   4.373   4.378   4.384   4.389   4.395   4.400

KK    01-1
KM        ROUTE BASIN 01 TO DES PT 1
RK    1250    0.02   0.013            CIRC     3.5

KK      02
KM        RUNOFF FROM BASIN 02
BA   0.086
LS       0    59.8
UD   0.170

KK    02-1
KM        ROUTE BASIN 02 TO DES PT 1
RK    1850    0.02   0.016            TRAP      44       3

KK      A1
KM        RUNOFF FROM BASIN A1
BA   0.064
LS       0    55.0
UD   0.100

KK       1
KM        COMBINE 01,02,A1
HC       3
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 45           KK     1-2
 46           KM             ROUTE DES PT 1 TO DES PT 2
 47           RK    1330   0.016   0.013              CIRC      3.5

 48           KK      A2
 49           KM             RUNOFF FROM BASIN A2
 50           BA   0.059
 51           LS       0    56.6
 52           UD   0.080

 53           KK       2
 54           KM             COMBINE DES PT 1, A2
 55           HC       2

 56           KK     2-4
 57           KM             ROUTE DES PT 2 TO DES PT 4
 58           RK    1940    0.02   0.013              CIRC        4

 59           KK      A3
 60           KM             RUNOFF FROM BASINS A3,A4
 61           BA   0.092
 62           LS       0    49.5
 63           UD   0.140

 64           KK       4
 65           KM             COMBINE DES PT 2, A3
 66           HC       2

 67           KK     4-5
 68           KM             ROUTE DES PT 4 TO DES PT 5
 69           RK    1740   0.018   0.013              CIRC        4

 70           KK      A5
 71           KM             RUNOFF FROM BASINS A5,A6
 72           BA   0.165
 73           LS       0    49.0
 74           UD   0.150

 75           KK       5
 76           KM             COMBINE DES PT 4, A5
 77           HC       2

 78           KK     5-7
 79           KM             ROUTE DES PT 5 TO DES PT 7
 80           RK    1100   0.005   0.015              TRAP        6       1.5


 81           KK      A7
 82           KM             RUNOFF FROM BASIN A7
 83           BA   0.068
 84           LS       0    49.0
 85           UD   0.130
```

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 86           KK       7
 87           KM             COMBINE DES PT 5, A7
 88           HC       2

 89           KK    7-12
 90           KM             ROUTE DES PT 7 TO DES PT 12
 91           RK    2200    0.02   0.015              TRAP        6       1.5

 92           KK   A8.1
 93           KM             RUNOFF FROM BASIN A8.1
 94           BA   0.030
 95           LS       0    49.0
 96           UD   0.130
```

```
 97   KK     9A
 98   KM        COMBINE DES PT 7, A8.1 CONCRETE CHANNEL DESIGN FLOW
 99   HC      2

100   KK     A9
101   KM        RUNOFF FROM BASIN A9,A10
102   BA  0.091
103   LS      0    49.0
104   UD  0.100

105   KK  A9-12
106   KM        ROUTE BASIN A9 TO DES PT 12
107   RK    650    0.02   0.013            CIRC       3

108   KK    A11
109   KM        RUNOFF FROM BASIN A8.2,A11
110   BA  0.089
111   LS      0    49.0
112   UD  0.130

113   KK   DPIN
114   KM        COMBINE ALL FLOWS INTO POND A
115   HC      3

116   KK  DPOUT
117   KM       ROUTE THROUGH DETENTION POND A
118   SV      0     0.1     1.2     5.0    10.8    19.6    30.4    40.2    54.3    63.6
119   SV   80.9    89.9    99.2
120   SE   6611    6612    6613    6614    6615    6616    6617    6618    6619    6620
121   SE 6620.9    6622    6623
122   SQ      0      10      14      19      22      24      28      75     123     162
123   SQ    188     506    1028
124   RS      1    ELEV    6611
125   ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE    (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.    (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

   9        O1
            V
            V
  26       O1-1
            .
            .
  29        .          O2
            .          V
            .          V
  34        .        O2-1
            .          .
            .          .
  37        .          .          A1
            .          .          .
            .          .          .
  42        1......................
            V
            V
  45       1-2
            .
            .
  48        .         A2
            .         .
            .         .
  53        2..........
            V
            V
  56       2-4
            .
            .
  59        .         A3
            .         .
```

```
 64          4............
             V
             V
 67        4-5
             .
             .
 70          .          A5
             .           .
             .           .
 75          5............
             V
             V
 78        5-7
             .
             .
 81          .          A7
             .           .
             .           .
 86          7............
             V
             V




 89        7-12
             .
             .
 92          .        A8.1
             .           .
             .           .
 97         9A............
             .
             .
100          .          A9
             .           V
             .           V
105          .       A9-12
             .           .
             .           .
108          .           .          A11
             .           .            .
             .           .            .
113       DPIN.........................
             V
             V
116       DPOUT

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1
```

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

FAIRLANE TECHNOLOGY PARK - URS PROJECT NO. 6742044
MAJOR SYSTEM HYDROLOGY FOR THE BASIN - INPUT FILE HISA.INP
USING THE 100-YEAR 24-HOUR STORM IN THE CITY/COUNTY CRITERIA
ROUTED THROUGH DETENTION POND A
HISTORIC CONDITIONS THROUGHOUT THE BASIN
RUN DATE 4-1-1993

```
  8 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE    1JUL90  STARTING DATE
                     ITIME       0800  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE    2JUL90  ENDING DATE
                    NDTIME       0855  ENDING TIME

                  COMPUTATION INTERVAL     .08 HOURS
```

TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	01	230.	6.17	32.	10.	10.	.26		
ROUTED TO	01-1	226.	6.17	32.	10.	10.	.26		
HYDROGRAPH AT	02	58.	6.08	6.	2.	2.	.09		
ROUTED TO	02-1	56.	6.17	7.	2.	2.	.09		
HYDROGRAPH AT	A1	33.	6.00	3.	1.	1.	.06		
3 COMBINED AT	1	298.	6.17	41.	14.	13.	.41		
ROUTED TO	1-2	294.	6.17	41.	14.	13.	.41		
HYDROGRAPH AT	A2	41.	6.00	4.	1.	1.	.06		
2 COMBINED AT	2	307.	6.17	45.	15.	14.	.47		
ROUTED TO	2-4	303.	6.17	45.	15.	14.	.47		
HYDROGRAPH AT	A3	22.	6.08	3.	1.	1.	.09		
2 COMBINED AT	4	321.	6.17	48.	16.	16.	.56		

ROUTED TO	4-5	315.	6.17	48.	16.	16.	.56		
HYDROGRAPH AT	A5	35.	6.08	5.	2.	2.	.17		
2 COMBINED AT	5	345.	6.17	52.	18.	17.	.73		
ROUTED TO	5-7	336.	6.17	53.	18.	17.	.73		
HYDROGRAPH AT	A7	16.	6.08	2.	1.	1.	.07		
2 COMBINED AT	7	348.	6.17	54.	19.	18.	.80		
ROUTED TO	7-12	339.	6.25	54.	19.	18.	.80		
HYDROGRAPH AT	A8.1	7.	6.08	1.	0.	0.	.03		
2 COMBINED AT	9A	342.	6.25	55.	19.	18.	.83		
HYDROGRAPH AT	A9	22.	6.08	3.	1.	1.	.09		
ROUTED TO	A9-12	22.	6.08	3.	1.	1.	.09		
HYDROGRAPH AT	A11	21.	6.08	3.	1.	1.	.09		
3 COMBINED AT	DPIN	365.	6.17	60.	21.	20.	1.01		
ROUTED TO	DPOUT	24.	8.67	24.	18.	17.	1.01	6616.01	8.67

*** NORMAL END OF HEC-1 ***

107	1	JUL	1650	28.36	31.78	60.57
108	1	JUL	1655	28.33	30.81	60.55
109	1	JUL	1700	28.31	30.11	60.53
110	1	JUL	1705	28.32	29.61	60.52
111	1	JUL	1710	28.33	29.24	60.52
112	1	JUL	1715	28.33	28.99	60.51
113	1	JUL	1720	28.34	28.80	60.51
114	1	JUL	1725	28.35	28.68	60.50
115	1	JUL	1730	28.36	28.58	60.50
116	1	JUL	1735	28.36	28.52	60.50
117	1	JUL	1740	28.37	28.48	60.50
118	1	JUL	1745	28.38	28.45	60.50
119	1	JUL	1750	28.39	28.43	60.50
120	1	JUL	1755	28.39	28.42	60.50
121	1	JUL	1800	28.40	28.41	60.50
122	1	JUL	1805	27.86	28.33	60.50
123	1	JUL	1810	26.52	28.01	60.49
124	1	JUL	1815	25.01	27.38	60.48
125	1	JUL	1820	23.61	26.52	60.46
126	1	JUL	1825	22.48	25.54	60.44
127	1	JUL	1830	21.73	24.58	60.42
128	1	JUL	1835	21.35	23.72	60.40
129	1	JUL	1840	21.33	23.05	60.39
130	1	JUL	1845	21.48	22.59	60.38
131	1	JUL	1850	21.58	22.29	60.37
132	1	JUL	1855	21.48	22.08	60.36
133	1	JUL	1900	21.26	21.88	60.36
134	1	JUL	1905	21.14	21.69	60.36