DRAINAGE REPORT
FOR

TRACT 10
OF
RENAISSANCE CENTER

FEDERAL EXPRESS

Prepared by:

Received 5-28-97
CAH

Tierra West Development Management Services
4421 McLeod Rd., NE, Suite D
Albuquerque, New Mexico 87109

February 14, 1997
(Revised February 28, 1997)
(Revised May 22, 1997)

I certify that this report was prepared under my supervision, and I am a registered professional engineer in the state of New Mexico in good standing.

RONALD RAY BOHANNAN
NEW MEXICO
7868
REGISTERED PROFESSIONAL ENGINEER

Ronald R. Bohannan
PE NO. 7868

Job No 960057

Location

Tract 10 of the Renaissance Center is a 15.36 acre site which is located at the southwest corner of Renaissance Boulevard and Century Drive. See attached Zone Atlas page number F-16 for location. We are proposing to build a 110,827 sf FEDEX Distribution Center as part of Phase I. This portion of Tract 10 contains 7.60 acres. A preliminarily layout for the remaining portions of Tract 9 and 10 has been included as part of the master layout for these two tracts and are preliminarily only, therefore the drainage analysis is not shown.

Purpose

The purpose of this drainage report is to present a grading and drainage solution for the FEDEX building site. We are requesting grading, building permit, site development for subdivision, site development for building permit, and preliminary plat approval (Tract 10).

Existing Drainage Conditions

The existing conditions for Tracts 9 and 10 were originally analyzed under drainage report number F-16/D5I (Tract 9 of Renaissance Center). See enclosed existing basin layout. The site falls within the Renaissance Drainage Master Plan, and it is currently undeveloped. The existing undeveloped runoff partially drains (Basin 1) east to Chappell Drive at a flow

rate of 3.00 cfs. The majority portion of Tract 9 (Basin 2) drains west and south to an existing desilting pond on the southwest corner of the tract and from there it drains to Renaissance Boulevard at a flow rate of 30.38 cfs. Basin 3 flows west and south to a desilting pond at the southwest corner of the Tract 10 at flow rate of 12.21 cfs. Basin 4 flows west to a desilting pond along the southerly property line.

FEMA Map and Soil Condition

The site is located on FEMA Map section 350002 panel 16 as shown on the attached excerpt. The map shows that the site does not lie within any 100 year flood plains.

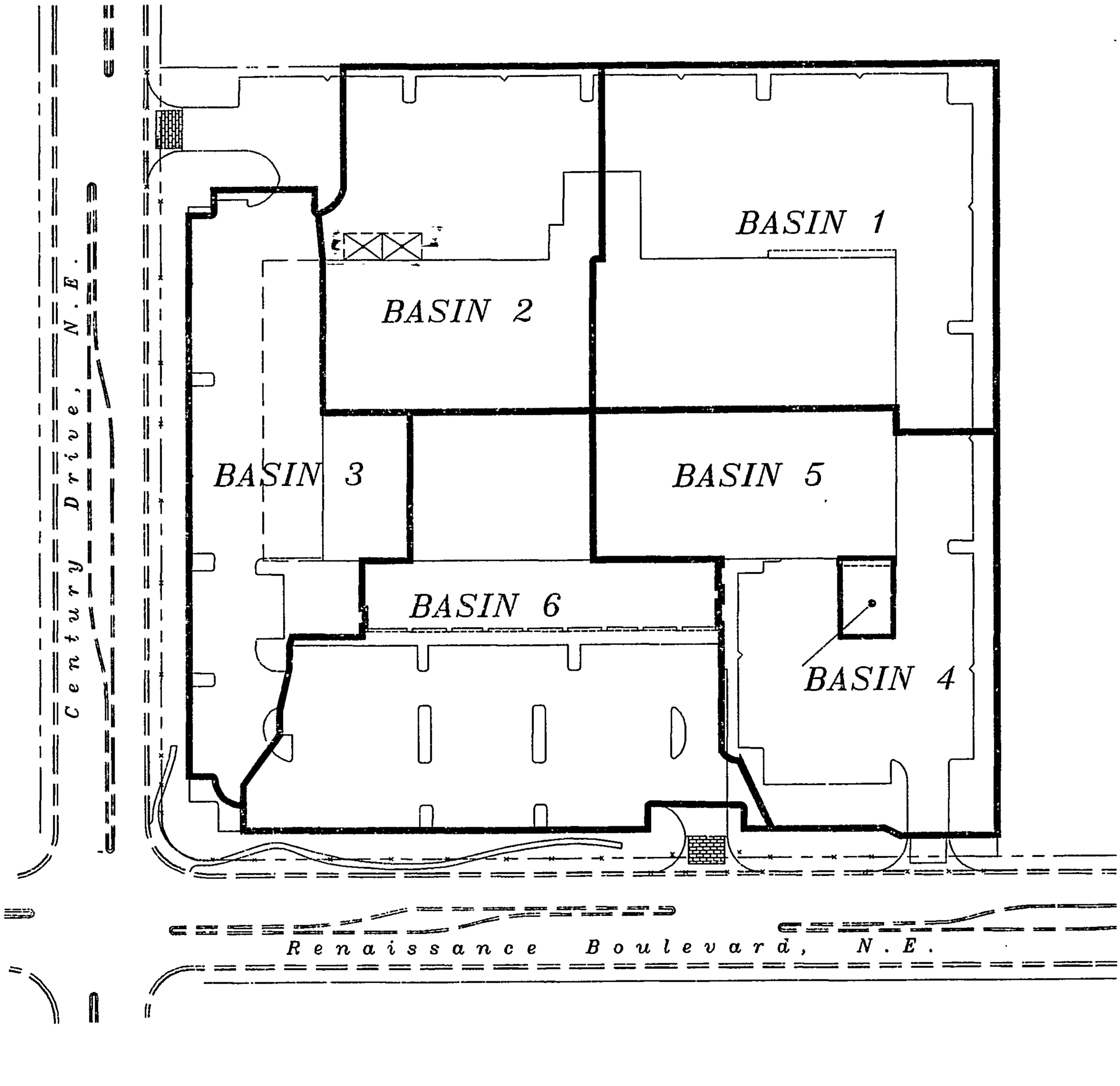
The site contains one soil type as indicated on the Soil Map from the Soil Conservation Service Survey of Bernalillo County. This soil type is Bluepoint-Kokan association. The Bluepoint-Kokan association is a Bluepoint loamy fine sand that has slow runoff, rapid permeability, and moderate to severe hazard of water erosion.

Proposed Conditions and On-Site Drainage Management Plan

This site will develop portion of the Tract 10. All the offsite flows will drain to existing or proposed desilting ponds.

On-Site Drainage Management

Per Renaissance Master Drainage Plan 0.1 cfs/acre can be discharged from the site.

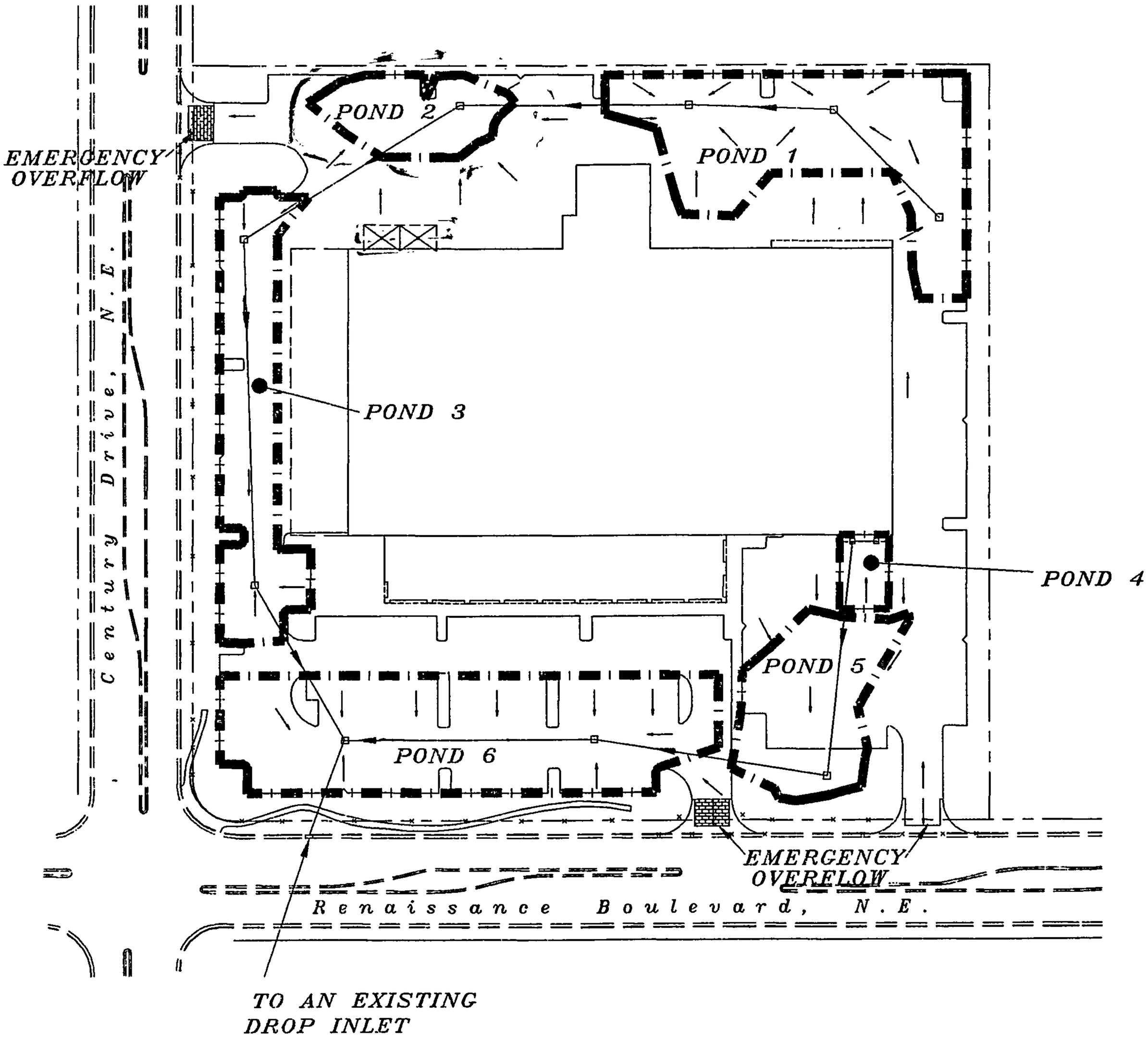


ON-SITE BASIN LAYOUT

Therefore the allowable discharge rate for the FEDEX site (7.60 acres) is 0.76. The site is divided into several subbasins. The runoff from this phase is collected through a series of storm sewer inlets and then drained to Renaissance Boulevard (via a 12" RCP) to an existing drop inlet at a flow rate of 0.56 cfs (lees than the allowable discharge by 0.20 cfs). See attached AHYMO runs for flow numbers and routing.

The following is a tabulation of the routing used to collect all of the flows:

- Basin 1 (7.02 cfs) collects all the runoff through three inlets in ponding area 1 and discharges the runoff to Basin 2 at a confined flow rate of 0.23 cfs.
- Basin 2 (4.62 cfs) along with the runoff from Basin 1 collects the runoff through one inlet and discharges the runoff to Basin 3 at a confined flow rate of 1.03 cfs.
- Basin 3 (4.43 cfs) along with the runoff from Basin 2 collects the runoff through two inlets and discharges the runoff to Basin 6 at a confined flow rate of 0.68 cfs.
- Basin 4 (0.22 cfs), the loading area, will collect the runoff through two inlets and drain the flow to Basin 5 at flow rate of 0.22 cfs.
- Basin 5 (6.60 cfs), along with Basin 4, drains to an inlet in ponding area 4, and then drains to Basin 6 at a confined flow rate of 0.56 cfs.
- Basin 6 (7.13 cfs), along with the runoff from Basins 3 and 5, drains the runoff to an inlet in ponding area 6 and then drains the runoff to an existing inlet on Renaissance Boulevard at a confined flow rate of 0.56 cfs.



ON-SITE PONDING & ROUTING LAYOUT

Offsite Drainage Management

Offsite drainage flow is managed through two Basins, A and B. See enclosed Offsite Basin Layout. Basin A (27.74 cfs) will drain to a proposed temporary pond. Basin B (15.93 cfs) drains west to an existing desilting pond along the westerly boundary of Tract 10.

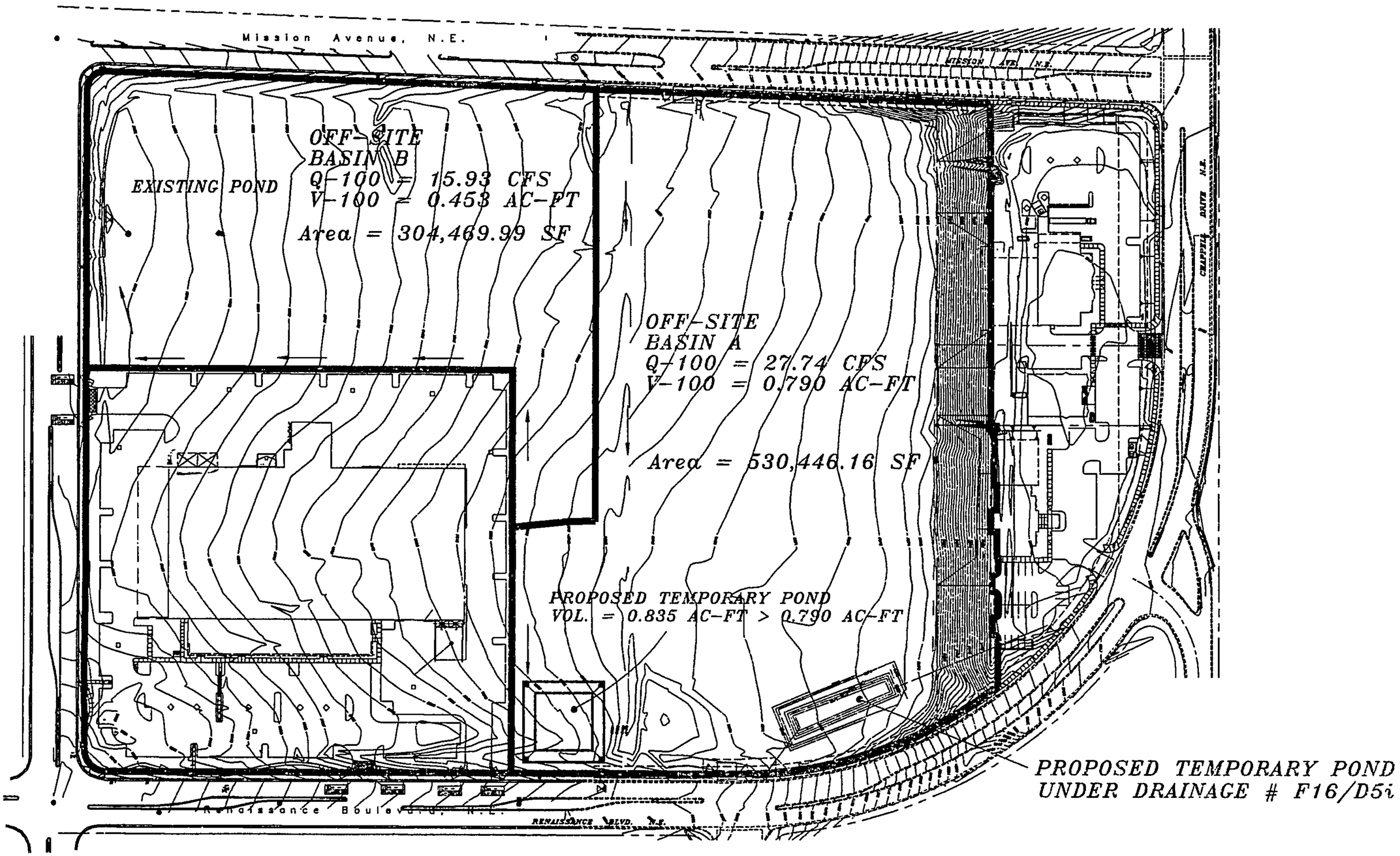
Emergency Conditions

On-Site Drainage Management

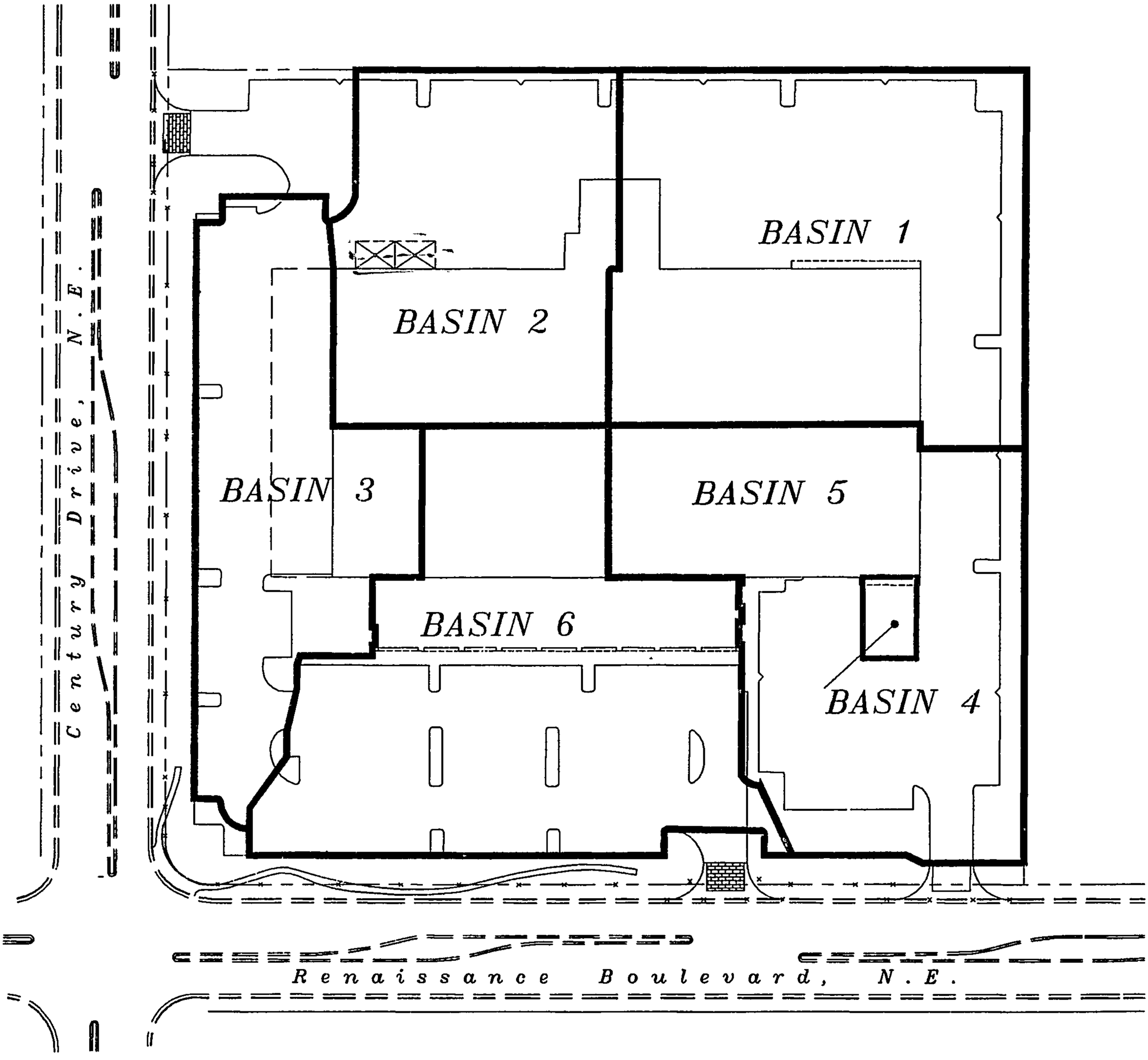
In case of an emergency the runoff will overflow through the entrances to Century Boulevard and Renaissance Boulevard.

Offsite Drainage Management

In case of an event larger than the 100-year storm the runoff will overflow from the ponds over to Century Boulevard and Renaissance Boulevard.



OFF-SITE BASIN LAYOUT



ON-SITE BASIN LAYOUT

RUNOFF CALCULATIONS

The site is @ Zone 2

LAND TREATMENT

Proposed
D = 86.19 %
B = 13.81 %

Existing
B = 100 %

DEPTH (INCHES) @ 100-YEAR STORM

P_{60} = 2.01 inches

P_{360} = 2.35 inches

P_{1440} = 2.75 inches

DEPTH (INCHES) @ 10-YEAR STORM

P_{60} = 2.01 x 0.667
= 1.34 inches

P_{360} = 1.57

P_{1440} = 1.83

See the summary output from AHYMO calculations.

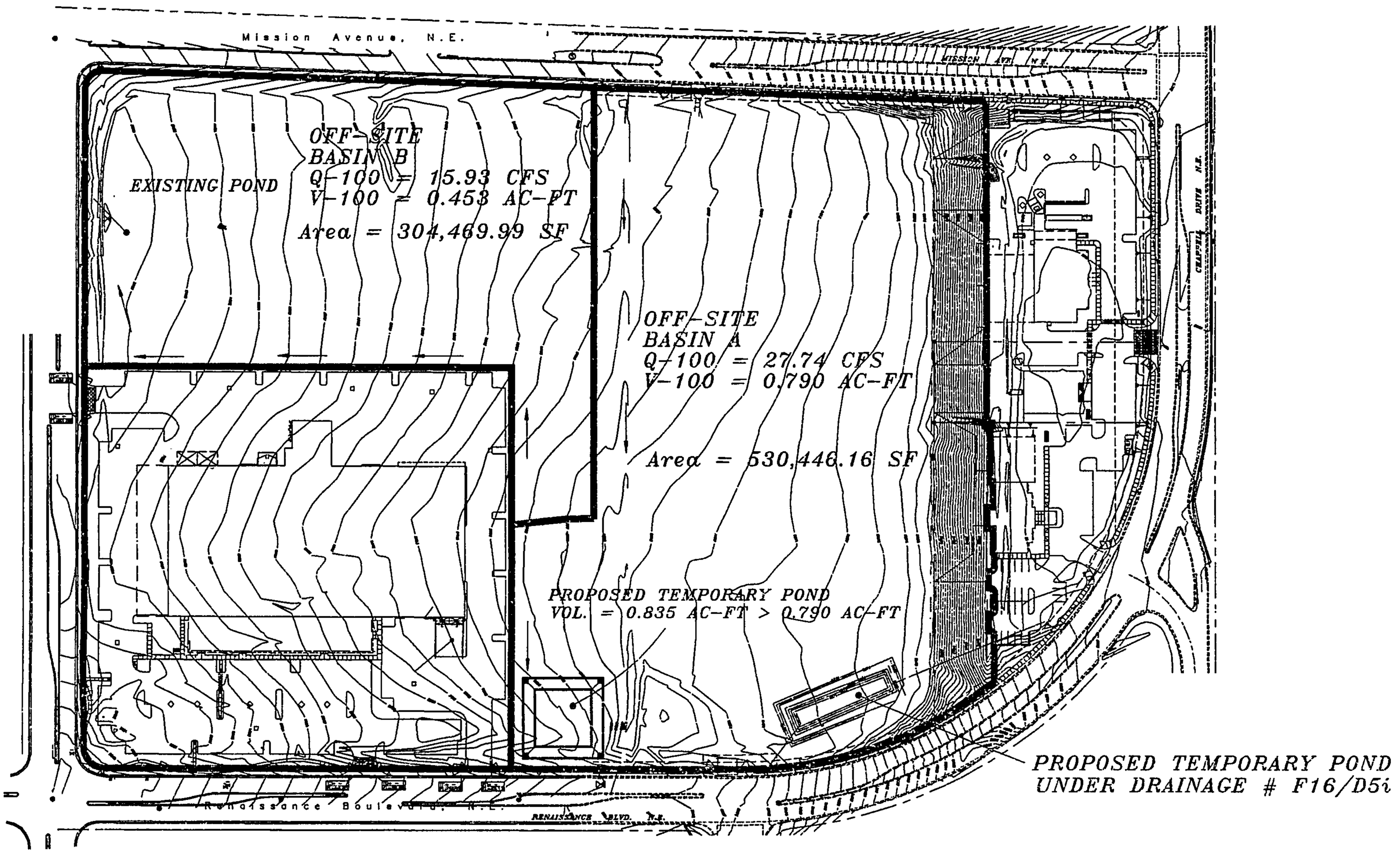
Also see the following summary tables.

RUNOFF SUMMARY TABLE
PROPOSED
DRAINAGE BASINS

SUB-BASIN	AREA (SF)	AREA (AC)	AREA (MI^2)
1	69,895.54	1.6046	0.002507
2	45,946.65	1.0548	0.001648
3	44,084.55	1.0120	0.001581
4	2,062.34	0.0473	0.000074
5	63,526.04	1.4584	0.002279
6	71,029.11	1.6306	0.002548

BASINS RUNOFF CALCULATION RESULTS
UNDER PROPOSED CONDITIONS

BASIN	Q-100 CFS	V-100 AC-FT	Q-10 CFS	V-10 AC-FT
1	7.02	0.296	4.51	0.184
2	4.62	0.195	2.97	0.121
3	4.43	0.187	2.84	0.116
4	0.22	0.009	0.14	0.005
5	6.38	0.269	4.10	0.167
6	7.13	0.301	4.58	0.187



OFF-SITE BASIN LAYOUT

RUNOFF SUMMARY TABLE

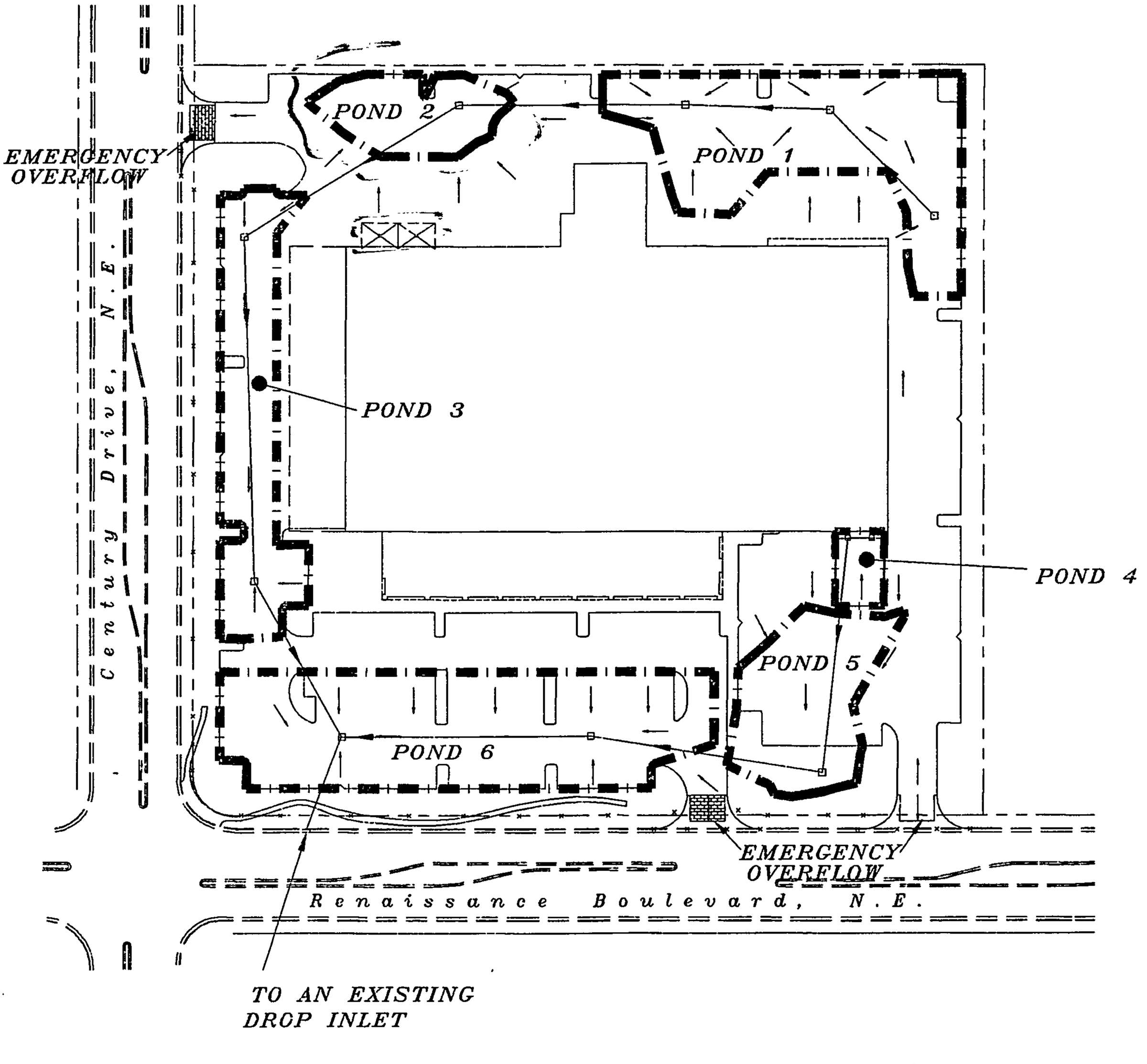
OFF-SITE

DRAINAGE BASINS

SUB-BASIN	AREA (SF)	AREA (AC)	AREA (MI^2)
A	530446.16	12.1774	0.019027
B	304469.99	6.9897	0.010921

BASINS RUNOFF CALCULATION RESULTS
UNDER EXISTING CONDITIONS

BASIN	Q-100 CFS	VOLUME AC-FT	Q-10 CFS	VOLUME AC-FT
A	27.74	0.790	11.38	0.282
B	15.93	0.453	6.54	0.162



ON-SITE PONDING & ROUTING LAYOUT

POND VOLUME CALCULATIONS

POND #1

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =3.73'

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF	
At =	23,922.95	SF	
Dt =	1.20	FT	(Ponding depth from top of the inlet to maximum ponding depth
Dia =	2	IN	
Radius =	1	IN	
C =	19930.01	FT / LF-DEPTH	

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5053.29
3.73	3.73	0.00059	0.20	5057.02
3.93	0.20	0.00978	0.21	5057.22
4.13	0.40	0.03726	0.21	5057.42
4.33	0.60	0.08305	0.22	5057.62
4.53	0.80	0.14713	0.22	5057.82
4.73	1.00	0.22952	0.23	5058.02
4.93	1.20	0.33021	0.23	5058.22

$Q = CA\sqrt{2gH}$
C = 0.60
$A = \P r^2$
g = 32.2
H = water depht, measured from the center of the orifice plate

POND #2

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =2.60

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF	
At =	6,469.24	SF	
Dt =	1.31	FT	(Ponding depth from top of the inlet to maximum ponding depth)
Dia =	4.5	IN	
Radius =	2.25	IN	
C =	4933.05	FT / LF-DEPTH	

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5051.85
2.60	2.60	0.00041	0.83	5054.45
2.80	0.20	0.00271	0.86	5054.65
3.00	0.40	0.00954	0.89	5054.85
3.20	0.60	0.02089	0.92	5055.05
3.40	0.80	0.03678	0.95	5055.25
3.60	1.00	0.05720	0.98	5055.45
3.80	1.20	0.08214	1.01	5055.65
3.91	1.31	0.09779	1.03	5055.76

POND #3

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =7.06'

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF
At =	15,508.98	SF
Dt =	1.76	FT
Dia =	3	IN
Radius =	1.5	IN
C =	8807.98	FT / LF-DEPTH

(Ponding depth from top of the inlet to maximum ponding depth)

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5048.98
7.06	7.06	0.00112	0.62	5056.04
7.26	0.20	0.00520	0.63	5056.24
7.46	0.40	0.01736	0.64	5056.44
7.66	0.60	0.03762	0.65	5056.64
7.86	0.80	0.06596	0.66	5056.84
8.06	1.00	0.10239	0.67	5057.04
8.26	1.20	0.14690	0.67	5057.24
8.46	1.40	0.19951	0.68	5057.44
8.66	1.60	0.26020	0.69	5057.64
8.82	1.76	0.31458	0.70	5057.80

POND #4

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =2.71'

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF	
At =	2,062.34	SF	
Dt =	2.25	FT	(Ponding depth from top of the inlet to maximum ponding depth)
Dia =	8	IN	
Radius =	4	IN	
C =	913.51	FT / LF-DEPTH	

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5051.79
2.71	2.71	0.00043	2.59	5054.50
3.01	0.30	0.00142	2.75	5054.80
3.31	0.60	0.00430	2.90	5055.10
3.61	0.90	0.00907	3.04	5055.40
3.91	1.20	0.01572	3.18	5055.70
4.21	1.50	0.02426	3.31	5056.00
4.51	1.80	0.03469	3.43	5056.30
4.81	2.10	0.04701	3.56	5056.60
4.96	2.25	0.05387	3.62	5056.75

POND #5

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =4.11

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF	
At =	12,029.64	SF	
Dt =	1.85	FT	(Ponding depth from top of the inlet to maximum ponding depth)
Dia =	3	IN	
Radius =	1.5	IN	
C =	6498.76	FT / LF-DEPTH	

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5050.64
4.11	4.11	0.00065	0.47	5054.75
4.31	0.20	0.00367	0.48	5054.95
4.51	0.40	0.01265	0.49	5055.15
4.71	0.60	0.02760	0.51	5055.35
4.91	0.80	0.04852	0.52	5055.55
5.11	1.00	0.07541	0.53	5055.75
5.31	1.20	0.10826	0.54	5055.95
5.51	1.40	0.14708	0.55	5056.15
5.71	1.60	0.19187	0.56	5056.35
5.96	1.85	0.25625	0.57	5056.60

POND #6

Volume = 6.94 * D (from bottom of the inlet to the top of inlet)

Inlet Depth =6.37'

Ab - Bottom Of The Pond Surface Area (Top of the inlet)
At - Top Of The Pond Surface Area
D - Water Depth (From top of inlet)
Dt - Total Pond Depth (From top of inlet to maximum water detph)
C - Change In Surface Area / Water Depth

Volume = $Ab * D + 0.5 * C * D^2$

C = (At - Ab) / Dt

Ab =	6.94	SF	
At =	30,506.86	SF	
Dt =	2.00	FT	(Ponding depth from top of the inlet to maximum ponding depth)
Dia =	2.75	IN	
Radius =	1.375	IN	
C =	15249.96	FT / LF-DEPTH	

H (FT)	D (FT)	VOLUME (AC-FT)	Q (CFS)	FULL ELEV.
0.00	0.00	0.00000	0.00	5048.08
6.37	6.37	0.00101	0.50	5054.45
6.57	0.20	0.00805	0.50	5054.65
6.77	0.40	0.02909	0.51	5054.85
6.97	0.60	0.06413	0.52	5055.05
7.17	0.80	0.11317	0.53	5055.25
7.37	1.00	0.17622	0.53	5055.45
7.57	1.20	0.25327	0.54	5055.65
7.77	1.40	0.34433	0.55	5055.85
7.97	1.60	0.44939	0.56	5056.05
8.17	1.80	0.56845	0.56	5056.25
8.37	2.00	0.70152	0.57	5056.45

AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994 RUN DATE (MON/DAY/YR) =05/22/1997

INPUT FILE = ona USER NO.= R_BOHANN.I01

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION	
START										TIME=	.00
RAINFALL TYPE= 2										RAIN24=	2.750
COMPUTE NM HYD	101.00	-	1	.00251	7.02	.296	2.21575	1.500	4.375	PER IMP=	86.19
ROUTE RESERVOIR	501.00	1	2	.00251	.23	.296	2.21521	2.500	.142	AC-FT=	.218
COMPUTE NM HYD	102.00	-	1	.00165	4.62	.195	2.21576	1.500	4.381	PER IMP=	86.19
ADD HYD	102.10	1& 2	3	.00416	4.84	.491	2.21543	1.500	1.819		
ROUTE RESERVOIR	502.10	3	1	.00416	1.03	.491	2.21534	2.100	.386	AC-FT=	.095
COMPUTE NM HYD	103.00	-	2	.00158	4.43	.187	2.21576	1.500	4.382	PER IMP=	86.19
ADD HYD	103.10	1& 2	3	.00574	5.38	.678	2.21545	1.500	1.465		
ROUTE RESERVOIR	503.10	3	4	.00574	.68	.678	2.21512	3.933	.186	AC-FT=	.222
COMPUTE NM HYD	104.00	-	1	.00007	.22	.009	2.21612	1.500	4.601	PER IMP=	86.19
ROUTE RESERVOIR	504.10	1	2	.00007	.22	.008	2.07773	1.500	4.593	AC-FT=	.000
COMPUTE NM HYD	105.00	-	1	.00228	6.38	.269	2.21575	1.500	4.377	PER IMP=	86.19
ADD HYD	105.10	1& 2	3	.00235	6.60	.278	2.21141	1.500	4.384		
ROUTE RESERVOIR	505.10	3	1	.00235	.56	.277	2.21116	2.200	.369	AC-FT=	.176
COMPUTE NM HYD	106.00	-	2	.00255	7.13	.301	2.21575	1.500	4.375	PER IMP=	86.19
ADD HYD	106.10	1& 2	3	.00490	7.66	.579	2.21355	1.500	2.441		
ADD HYD	106.20	3& 4	1	.01064	8.31	1.256	2.21440	1.500	1.221		
ROUTE RESERVOIR	506.00	1	2	.01064	.56	.866	1.52581	10.832	.083	AC-FT=	.623
FINISH											

AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994 RUN DATE (MON/DAY/YR) =02/27/1997

INPUT FILE = ON100 USER NO.= R_BOHANN.I01

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION	
START										TIME=	.00
RAINFALL TYPE= 2										RAIN24=	2.750
COMPUTE NM HYD	101.00	-	1	.00251	7.02	.296	2.21575	1.500	4.375	PER IMP=	86.19
COMPUTE NM HYD	102.00	-	1	.00165	4.62	.195	2.21576	1.500	4.381	PER IMP=	86.19
COMPUTE NM HYD	103.00	-	2	.00158	4.43	.187	2.21576	1.500	4.382	PER IMP=	86.19
COMPUTE NM HYD	104.00	-	1	.00007	.22	.009	2.21612	1.500	4.601	PER IMP=	86.19
COMPUTE NM HYD	105.00	-	1	.00228	6.38	.269	2.21575	1.500	4.377	PER IMP=	86.19
COMPUTE NM HYD	106.00	-	2	.00255	7.13	.301	2.21575	1.500	4.375	PER IMP=	86.19
START										TIME=	.00
RAINFALL TYPE= 2										RAIN24=	1.830
COMPUTE NM HYD	101.00	-	1	.00251	4.51	.184	1.37655	1.500	2.808	PER IMP=	86.19
COMPUTE NM HYD	102.00	-	1	.00165	2.97	.121	1.37656	1.500	2.811	PER IMP=	86.19
COMPUTE NM HYD	103.00	-	2	.00158	2.84	.116	1.37656	1.500	2.812	PER IMP=	86.19
COMPUTE NM HYD	104.00	-	1	.00007	.14	.005	1.37679	1.500	2.946	PER IMP=	86.19
COMPUTE NM HYD	105.00	-	1	.00228	4.10	.167	1.37655	1.500	2.809	PER IMP=	86.19
COMPUTE NM HYD	106.00	-	2	.00255	4.58	.187	1.37655	1.500	2.808	PER IMP=	86.19
FINISH											

CITY OF
Albuquerque

March 4,1998

Ronald R. Bohannan
Tierra West LLC
4421 Mcleod Rd. Suite D
Albuquerque, New Mexico 87109

RE: REVISED DRAINAGE PLAN FOR MASTER DRAINAGE FOR TRACT 5
RENAISSANCE CENTER & ECONO LUBE N TUNE (F16-D5H) ENGINEER'S
STAMP DATED 2/13/98

Dear Mr. Bohannan:

Based on the information provided on your February 13,1998 submittal, the above referenced Master Plan is approved for Preliminary & Final Plat, Site Development for Subdivision and Building,Grading, and Building Permit for Econo Lube & Tune.

Please attach a copy of the approved plan for Econo Lube & Tune to the construction sets prior to sign-off by Hydrology.

Also, prior to Certificate of Occupancy release, Engineer Certification per the DPM checklist will be required.

If I can be of further assistance, please feel free to contact me at 924-3986.

C: Andrew Garcia
File

Sincerely

Bernie J. Montoya CE
Associate Engineer

DRAINAGE REPORT

for

RENAISSANCE CENTER

Revised
February 22, 1985

RECEIVED
MAR 07 1985
HYDROLOGY SECTION

Andrews, Asbury & Robert, Inc.
Consulting Engineers
Albuquerque, New Mexico

I. INTRODUCTION

This report, with the enclosed maps, provides a Drainage Plan for Renaissance Center. This project is located in the Northeast Quandrant of the Albuquerque Metropolitan Area, west of the North Diversion Channel and lies northwest of the Montano Road-Interstate 25 Interchange. [See enclosed Location Map (Map A); Zone Atlas Map F-16.]

The lands on which this project lie have previously been mined of gravel; however, all mining activities have been completed and the lands have been regraded and restored to a usable condition except for the grading that will be required by the development of the project.

Renaissance Center lies within the area covered by the Master Plan of Drainage for Albuquerque Gravel Products Company; Montbel, Inc.; and Montano Venture. This master plan of drainage is on file in the City Engineer's office and was approved in February, 1982.

This plan and report is generally consistent with the Master Plan and enclosed for reference herewith is Map No. 2, Proposed Developed Conditions, of the Master Plan.

Since, however, the Master Plan was developed, the City of Albuquerque has issued its Development Process Manual (DPM). The hydrological calculations in this report have utilized the design criteria published in the DPM. This has resulted in somewhat lower off site flows than those in the Master Plan of Drainage.

II. EXISTING CONDITIONS

The underlying contours shown on the Drainage Plan included herein depict the existing topographic conditions of the site.

As mentioned previously, this area has formerly been mined of its gravel resources. The mining of the gravel in the area has been completed and the surface of the lands has been restored and graded to provide a relatively smooth terrain having a slope of approximately one percent to two percent (1% to 2%) to the west.

Major off site flows reaching the project site originate from the south side of Montano Road. Drainage from Off Site Area A-1 presently flows under Montano Road at the Railroad Spur Bridge. Drainage from Off Site Areas A-2 and A-3 flows under Montano Road in Alexander Boulevard.

The major portion of the east side of the area is bounded by the North Diversion Channel and off site drainage reaching subject lands from the easterly direction is limited to an area adjacent to the southeast corner.

The off site drainage area at the southeast corner, Off Site Area H-1, consists of Interstate right-of-way and a partially developed area lying east of the Interstate. Flow from this area is discharged to subject property by culverts under the Interstate. A retention area, at the outlet of the culverts, draining Off Site Area H-1, has been constructed to confine the off site flow.

The north side of the site is bounded by a large earth dike, therefore runoff flows from the north are not allowed to reach the property.

Runoff flows from the major portion of the site is collected and retained in an excavated area lying north and west of the north end of Alexander Boulevard.

Flows generated by Montano Road, a public street, are collected by a series of inlets, pipes, and rundowns that are directed to the north side of Montano Road.

An agreement between the City of Albuquerque and Albuquerque Gravel Products Company, made at the time Montano Road was constructed, states that these waters

would be allowed to be discharged onto private lands for a five year period after construction of Montano Road. This period of time has since expired and the City of Albuquerque is presently in default of the agreement. The developers of Renaissance Center request that the City participate in the disposal of these waters.

III. PROPOSED DEVELOPED CONDITIONS

The drainage plan for proposed developed conditions is shown on Map B enclosed herein.

This plan of drainage is to establish the major drainage facilities to be constructed at the time the infrastructure for the project is constructed. Also, this plan is to provide a guide for use in the preparation of future drainage plans on an individual basis when actual development of various parcels of land occurs.

Off Site areas contributing runoff to the subject site will remain basically the same under Developed Conditions as under Existing Conditions. Limits of the off site drainage areas are shown on Map No. 2 of the Master Plan of Drainage. Values for rates of runoff from the off site areas were recomputed for use in this plan in order to correspond with current criteria established by the City's Development Process Manual.

As shown on Map B, a portion of Renaissance Center drains

to the north and a portion of the area drains to the west.

The northerly portion of the area will drain towards Mission Avenue and then be carried by Mission Avenue to a point approximately 500 feet east of the Mission School where the runoff will be discharged to the north. The property owner to the north of Renaissance Center, Albuquerque Gravel Products Company, has agreed to receive and retain these waters.

The remaining on site area along with off site areas contributing storm water runoff to the site, will be collected by a combination of streets and storm drains and directed to a detention area at the southwest corner of the site, all as shown on Map B enclosed. This detention area is sized to accommodate the 100 year frequency storm runoff from the lands under undeveloped conditions. However, the detention area is sized to accommodate the increased volume created by the paving of the streets within the Renaissance Center site.

Overflows and draining of this detention area are to be directed to Montano Road and to a storm sewer to be constructed by the City in Montano Road.

All increases in flow rates and volumes of runoff created by the placement of impervious surfaces by the development of individual sites will be required to be detained and discharged at a controlled rate. Drainage plans for each specific development will be required.

The areas within Subbasins A-1 through A-6 will be limited to a discharge rate of 1.04 cfs per acre. (Q = CIA = (0.34) (3.06)[1] (1) = 1.04 cfs/Acre). The temporary detention basin north of the site will be of sufficient size to contain 6.70[2] acre feet, the volume of the entire 100 year developed runoff from Subbasins A-1 through A-6.

Areas B-1 through B-19 will be limited to a peak discharge runoff rate from the developed site of 0.99 cfs per acre. (Q = CIA = (0.34) (2.92)[3] (1) = 0.99 cfs/Acre). Increased runoff volume due to development must be detained on site to prevent the overflow of the detention basin at the southwest corner of the site.

Combined discharge rates from the individual site detention areas must not be more than the capacity of the proposed future storm drain in Montano Road nor the capacity of the

[1] I = 3.06 - from sheet 8 of 9 of the computations

[2] 6.70 Ac. Ft. - from sheet 9 of 9 of the computations

[3] Z = 2.92 - from sheet 7 of 9 of the computations analysis point 23.

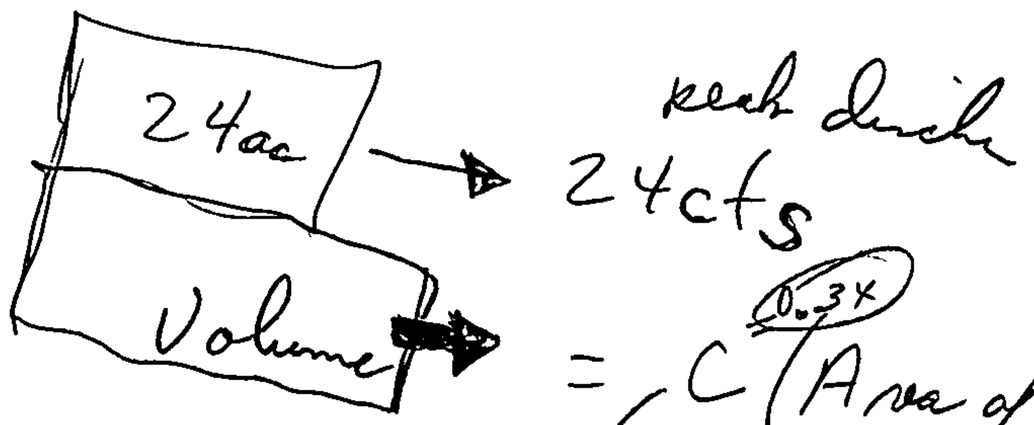
excess developed runoff volumes over undeveloped volumes using "C" = 0.34, must be detained and released @ max of 0.09 cfs/AC with any uncontrolled flows existing site at 0.99 cfs/AC.

outlet works from the detention basin at the southwest corner of the site.

It is recommended that the storm drain in Montano Road be sized to accommodate a flow from the detention basin of 24.3 cfs. This will allow each individual site detention area to discharge at a rate of 0.09 cfs per acre.

.1 cfs per Acre

.99 cfs/acre. designed for ~~existing~~



assume developed C = .64

(.64 - .34) (Area) × 2.2/12 = rate at .1 cfs

IV. PROPOSED FACILITIES

1. Drainage Area A (Sub-Areas A-1 thru A-6)

Drainage will be collected and conveyed by surface methods on Mission Avenue and directed to the north as shown on Map B enclosed.

2. Drainage Area B (Sub-Areas B-1 thru B-19) and Off Site Areas

Drainage will be collected and conveyed by surface methods and storm drains as shown on Map B enclosed. Inlets will be provided as required to relieve street flows and all flows from Sub-Areas B-1 thru B-14, and all flows including off site areas, will be collected by the storm drain at the intersection of Alexander Boulevard and Renaissance Boulevard. The storm drain will convey all flows from this intersection to the Detention Pond. This storm drain, as it extends west, will also intercept and convey the flows from Sub-Areas B-15 thru B-18 to the detention pond. Sub-Area B-19 will be conveyed to the detention pond by surface means.

The detention pond located at the southwest corner of the Renaissance Center site will be constructed with earth dikes having a 12' wide berm, 2-1/2 to 1 side slopes on the outside, and 3 to 1 side slopes on the water side. The depth of water in the pond to accommodate a 100 year frequency storm will be 8.5' in depth. A free board of 3' above the 100 year high waterline will be provided. A 100' wide emergency spillway will be constructed of concrete on the south side of the pond towards Montano Road and sized to provide overflow at least equivalent to the capacity of the storm drain feeding the detention pond plus any suface flows draining directly to the pond under PMP conditions. (See Computations.)

When the City installs the storm drain in Montano Road, such storm drain should be sized to drain the pond at a peak rate of 24.3 cfs, the peak capacity of the outlet works, this will allow individual developments to drain their detention pond to the system at a rate of 0.09 cfs per acre.

A temporary sedimentation basin will be constructed immediately north of the existing railroad spur bridge.

on Montano Road to collect flows from off site area A-1.

Upon development of the area south of Montano Road, developers must extend a storm sewer beneath the bridge to pick up the controlled developed flow. At the time this development occurs, the temporary sedimentation basin is to be removed.

TEMPORARY CONDITIONS

The existing storm drain facilities in Montano Road downstream of the Renaissance Center have limited capacity. (2.7 cfs - See Computations.) Therefore, under temporary conditions, until the City of Albuquerque constructs the new storm drain in Montano Road, which is anticipated to be constructed in 1986, the outlet works will be provided with a valve in the line. This valve will be normally closed.

When rains occur, and after the existing storm drain has disposed of the downstream drainage, this valve will be opened to drain the Ranaissance Detention Pond. The rate of discharge is adjustable by the valve and will be set at the capacity of the existing downstream drainage facilities.

There is a much smaller existing detention pond on the south side of Montano Road that drains to the same existing system at a rate ranging from 0.9 cfs when full to 0.0 cfs when empty.

It is anticipated that after opening the valve, the Renaissance Detention Pond will be drained at an average rate of 2.0 cfs. Therefore, the total time to drain the pond in the event of a 100 year frequency storm is 120 hours.

The time required for the existing storm drain facilities to dispose of downstream waters should not exceed 12 hours and under most rains a much shorter time.

Assuming the valve on the Renaissance Detention Pond outlet works remains closed 12 hours prior to opening to drain the pond, the total time to evacuate the pond will be 120 + 12 = 132 hours.

Upon the City completing construction of the new storm drain in Montano Road, the valve will remain open and the total time to evacuate the pond will be 55 hours. (See Computations.)

V. EROSION CONTROL

The contractor for the project will be responsible for soil migration during the construction phase. This can be accomplished by sedimentation basins and windrows.

After development of the individual tracts, erosion will be controlled by landscaping of all areas not covered by buildings or pavement.

VI. DRAINAGE ANALYSES

Following are the Drainage Analyses (computations) made for the drainage areas affecting subject lands in the proposed developed conditions.

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Project RENAISSANCE CENTER Sheet 1 of 9
Job No. 356
By JA Chk'd — Date 10-5-84

DRAINAGE ANALYSIS

CRITERIA

Development Process Manual
Volume 2 - Section 22

DESIGN PARAMETERS

Peak runoff rate - Rational Formula, $Q = CIA$

Runoff coefficients - from Plate 22.2, C-1-OPM

Soils are SCS Soil Group B

Assume street Pavement in Place.
therefore, percent Imperuion = 13%

USE $C = 0.40$

$$I_{100} = (2.2)\, 6.84 \times t_e^{-0.51}$$

$$I_{10} = 0.657 \times I_{100}$$

Travel time determined from Plates

22.2 B-1 & 22.2 B-2.

TABLE -1- DEVELOPED CONDITIONS- PEAK RATES

Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (Ac.)	LENGTH OF TRAVEL (Ft.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (Mins.)	C	I_{10} (IN/Hr)	I_{100} (IN./Hr.)	Q_{10} (CFS)	Q_{100} (CFS)
(1)	B-1	8.79	310' o 80' o 170' o	1.61 33 1.176	0.75 — 0.80	6.89 -o- 3.54 } 10.43	0.40	2.98	4.54	10.48	15.96
(2)	B-2	5.15	400 o 350 st. 150 st	1.50 7.5 1.00 -	1.60 8.0 2.70	4.17 0.73 0.92 } 5.82 use 10	0.40	3.05	4.65	6.29	9.58
	B-3	9.94	600 o 200 o	1.66 1.0	1.70 1.35	5.88 2.47 } 8.35 use 10	0.40	3.05	4.65	12.15	18.49
	Street Flow		450' st	2.0	3.8	1.97					
(3)	B-1 thru B-3	23.88	—	—	—	10.43 1.97 } 12.4	0.40	2.74	4.17	26.17	39.83
	B-4	3.84	300' 400' 100'	2.0 o 2.32 st. 2.0 st.	1.9 4.1 3.8	2.63 1.63 0.44 } 4.7 use 10	0.40	3.05	4.65	4.69	7.14
(4)	B-1 thru B-4	27.72	—	—	—	12.40 1.63 0.44 } 14.47	0.40	2.53	3.85	28.05	42.69
(5)	B-5	1.43				use 10	0.40	3.05	4.65	1.75	2.66
(6)	H-1 Offsite	20.68	900' o 300' calv.	0.80 culvert	1.25 6	12.07 0.83 } 12.83	0.63	2.69	4.10	35.10	53.42
	B-6	9.57	250' o 980' st.	2.0 0.50	1.9 2.1	2.19 7.77 } 9.97 use 10	0.40	3.05	4.65	11.69	17.80
	Storm Drain		300' 780'	2.0 0.5	11.0 6.4	0.45 2.03 } 2.48					
(7)	H-1 & B-6	30.25	—	—	—	12.83 2.48 } 15.31	0.57	2.46	3.74	42.37	64.49

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By JA Chk'd — Date 10-1-84
Job No. 356

TABLE-1 DEVELOPED CONDITIONS - PEAK RATES

Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (AC.)	LENGTH OF TRAVEL (FT.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (MINS.)	C	I_{10} (IN/Hr)	I_{100} (IN./HR.)	Q_{10} (CFS)	Q_{100} (CFS)
	B-7	7.59	750' ○	2.2 ○	2.0	6.25 use 10	0.40	3.05	4.65	9.28	14.12
	— Storm Drain		770'	steep	13	1.0					
(8)	H-1, B-6 & B-7	37.84	—	—	—	15.31 / 1.0 } 16.31	0.53	2.38	3.62	47.70	72.60
	B-8	6.01	600' ○	0.50	1.95	5.13 use 10	0.40	3.05	4.65	7.35	11.18
	— Storm Drain		500'	1.8	12.	0.69					
(9)	H-1 & B-1 thru B-8	73.0	—	—	—	16.31 / 0.69 } 17.0	0.47	2.33	3.55	80.02	121.80
	B-9	11.83									
	— Storm Drain		250'	1.7	12-	0.35					
(10)	H-1, B-1 thru B-9	84.83	—	—	—	17.0 / 0.35 } 17.35	0.45	2.31	3.51	88.03	133.99
	B-10	14.28									
	— Storm Drain		820'	0.8	10.5	1.30					
(11)	H-1, B-1 thru B-10	99.11	—	—	—	17.35 / 1.30 } 18.65	0.44	2.22	3.38	96.84	147.40

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Project RENAISSANCE CENTER Sheet 3 of 9
By JA Chk'd Job No. 356
Date 10-1-84

TABLE-1 - DEVELOPED CONDITIONS - PEAK RATES

Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (Ac.)	LENGTH OF TRAVEL (Ft.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (Mins.)	C	I_{10} (IN/Hr)	I_{100} (IN./Hr.)	Q_{10} (CFS)	Q_{100} (CFS)
	H-2	5.81	1150'	0.80	1.10	19.17	0.40	2.19	3.34	5.12	7.80
	D-1	2.25	650'	1.0	1.05	10.32	0.40	3.00	4.57	2.70	4.11
	D-2	1.28	530'	2.6	4.3 st.	2.05. use 10	0.71	3.05	4.65	2.78	4.23
	D-3	0.90	400'	2.0	3.8 st.	1.75 use 10	0.71	3.05	4.65	1.95	2.97
	D-4	0.76	350'	2.8	4.5 st.	1.30 use 10	0.71	3.05	4.65	1.65	2.51
	C-1	3.25	550'	1.8	1.8	5.09 use 10	0.40	3.05	4.65	3.97	6.04
	Storm	Drain	700'	3+	12	0.97					
(12)	H-2, C-1 D-1 thru D-3	13.49	—	—	—	19.17 / 1.02 / 0.97 } 21.16	0.47	2.08	3.17	13.21	20.10

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Project RENAISSANCE CENTER Sheet 4 of 9
By LA Chk'd Job No. 356
Date 10-2-84

TABLE-1 DEVELOPED CONDITIONS- PEAK RATES

Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (Ac.)	LENGTH OF TRAVEL (Ft.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (Mins.)	C	I_{10} (IN/Hr)	I_{100} (IN./Hr.)	Q_{10} (CFS)	Q_{100} (CFS)
(13)	A-2 & A-3 Offsite	15.69	500'	0.8 o	1.2	6.94	0.40	2.63	4.08	18.51	28.17
			1000'	1.1 st.	2.8	5.95 } 12.89					
	B-11	12.04	400' o	1.70	1.8	3.70 } 7.65	0.40	3.05	4.65	14.71	22.39
			450' st.	0.50	1.9	3.95 } use 10					
	B-12	6.53	450' o	0.80	1.2	6.25 } 11.07	0.40	2.90	4.42	7.59	11.55
			550' st.	0.50	1.9	4.82					
(14)	A-1 offsite	46.95	2400'	0.60	2.1	19.05	0.40	2.20	3.35	41.33	62.91
ENTER STORM SEWER											
			250'	1.0	9.5	0.44					
			400'	1.0	10.5	0.63 } 2.49					
			300'	0.5	8.2	0.61					
			400'	0.5	8.2	0.81					
	A-1 - A-3	62.64									
	B-11 & B-12	18.57									
(15)	H-2, D-1 thru D-4 & C-1	14.25 } 95.46	—	—	—	19.05 } 21.54	0.41	2.06	3.14	80.75	122.90
						2.49					

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Project RENAISSANCE CENTER Sheet 5 of 9
By JA Chk'd Job No. 356
Date 10-3-84

TABLE 1 - DEVELOPED CONDITIONS - PEAK RATES
Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (Ac.)	LENGTH OF TRAVEL (Ft.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (Mins.)	C	I_{10} (IN/Hr)	I_{100} (IN./Hr.)	Q_{10} (CFS)	Q_{100} (CFS)
(16)	B-13	13.80	850'-0 400'-st.	1.1 1.0	1.4 2.7	10.12 2.47 } 12.59	0.40	2.71	4.13	14.98	22.80
	B-14	6.41	500'-0 250'-st.	1.6 1.0	1.7 2.7	4.90 1.54 } 6.44 use 10	0.40	3.05	4.65	7.83	11.92
	B-1-B-14 H-2-C-1 D-1-D-4	99.15 95.46 20.21									
(17)	& offsite	214.82	—	—	—	21.54	0.41	2.06	3.14	181.70	276.56
(18)	B-15	13.13	800'-0 350'-st.	1.75 0.50	1.8 1.9	7.47 3.07 } 10.47	0.40	2.98	4.54	15.66	23.84
	— Storm Drain-		600'	0.50	10.4	0.96					
(19)		227.95				21.54 0.96 } 22.5	0.41	2.02	3.07	188.51	286.92
	B-16	8.24	600'-0	0.70	1.25	8.0 use 10	0.40	3.05	4.65	10.07	15.33
	D-5	1.40	1200'-st	2.5	4.2	4.8 use 10	0.71	3.05	4.65	3.03	4.62
	— Storm Drain		380'	0.50	10.5	0.6					
(20)	—	237.59	—	—	—	0.6 22.5 } 23.10	0.41	1.99	3.03	193.85	295.16

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Project RENAISSANCE CENTER Sheet 6 of 9
By [illegible] Chk'd Job No. 356
Date 10-3-84

REVISED - 2-15-85

TABLE: 1- DEVELOPED CONDITIONS- PEAK RATES
Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (AC.)	LENGTH OF TRAVEL (FT.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (MINS.)	C	I10 (IN/HR)	I100 (IN./HR.)	Q10 (CFS)	Q100 (CFS)
	B-17	10.60	1050'	0.60	1.05	16.67	0.40	2.35	3.58	9.97	15,18
—	Storm Drain		700'	0.50	10.5	1.11					
(21)		248.19	—	—	—	1.11 / 23.10 } 24.21	0.41	1.94	2.96	197.41	301.20
	B-18	3.16	800'	0.80	1.2	11.11	0.40	2.90	4.41	3.66	5.57
—	Storm Drain		380'	0.50	10.7	0.59	—				
(22)	—	251.35	—	—	—	24.21 / 0.59 } 24.8	0.41	1.93	2.93	198.89	301.95
—	Storm Drain		100'	0.50	10.7	0.16					
(23)		251.35	—	—	—	24.80 / 0.16 } 24.96	0.41	1.92	2.92	197.86	300.92
(24)	B-19	8.33	850'	2.0	1.9	9.44 use 10	0.40	3.05	4.65	10.18	15.49

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Project RENAISSANCE CENTER Sheet 7 of 9
By JA Chk'd Job No. 356
Date 10-4-84

REVISED - 2-15-85

TABLE-1 DEVELOPED CONDITIONS - PEAK RATES

Refer to Map B for location of Drainage Areas & Analysis Points

ANALYSIS POINT	DRAINAGE AREA DESIGNATION	AREA (Ac.)	LENGTH OF TRAVEL (Ft.)	SLOPE (%)	VELOCITY (FPS)	TRAVEL TIME (Tc) (Mins.)	C	I_{10} (IN/Hr)	I_{100} (IN./Hr.)	Q_{10} (CFS)	Q_{100} (CFS)
(25)	A-1	18.25	550' 450'	1.4 o 1.0 o	1.6 1.35	5.73 5.56 } 11.29	0.40	2.87	4.37	20.96	31.90
	A-2	8.26	900'	1.5 o	1.65	9.09 use 10	0.40	3.05	4.65	10.09	15.36
	Street Flow		750'	1.47	3.3	3.79					
(26)	A-1 & A-2	26.51	—	—	—	11.29 3.79 } 15.08	0.40	2.48	3.77	26.27	39.98
	A-3	9.89	800' o 400' st.	2.1 0.50	1.95 1.9	6.84 3.51 } 10.35	0.40	3.00	4.57	11.88	18.08
	A-4	7.76	550' 400'	0.90 0.50	1.3 1.0	7.05 6.67 } 13.72	0.40	2.60	3.96	8.07	12.29
	Street Flow		500'	0.80	2.4	3.47					
(27)	A-1 thru A-4	44.16	—	—	—	15.08 3.47 } 18.55	0.40	2.23	3.39	39.34	59.88
	A-5	5.63	650'	0.50	0.95	11.40	0.40	2.86	4.35	6.44	9.80
	Street Flow		500'	0.55	2.0	4.17					
(28)	A-1 thru A-5	49.79	—	—	—	18.55 4.17 } 22.72	0.40	2.01	3.06	40.03	60.94
(29)	A-6	2.38	450 st.	1.3	3.1	7.40 use 10	0.40	3.05	4.65	2.91	4.43
(30)	A-1 thru A-6	52.17	—	—	—	22.72	0.40	2.01	3.06	41.96	63.86

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By JA Job No. 356
Chkd Date 10-3-84

REVISED 2-17-85

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Project RENAISSANCE CENTER Sheet 9 of 9
Job No. 356
By JA Chk'd _____ Date 10-5-84

RUNOFF VOLUME

Drainage Area A - Sub-basins A-1 thru A-6

Area = 52.17 Acres

Volume-Undeveloped $= (52.17)\left(\frac{2.2}{12}\right)(.40) =$ 3.83 Acre Feet.

Volume-Developed $= (52.17)\left(\frac{2.2}{12}\right)(.70) =$ 6.70 Acre Feet.

DRAINAGE AREA B - Sub-basins - B-1 thru B-19 & Offsite Areas

Area = 251.35 + 8.33 + 3.86 (Pond) = 263.54 Acres

$Volume_{100yr} = (263.54)\left(\frac{2.2}{12}\right)(0.41) =$ 19.81 Acre Feet

$Volume_{10yr} = 19.81 \times 0.657 =$ 13.02 Acre Feet.

Size of Detention Pond @ Southwest Corner of property = 19.81 Acre Feet.

Average Discharge Rate to drain in 96 hrs

$100yr = \frac{(19.81)(43,560)}{60 \times 60 \times 96} = 2.50$ cfs

$10yr = (2.50)(0.657) = 1.64$ cfs

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Project RENAISSANCE CENTER Sheet 1A of 11
Job No. 356
By DS Chk'd JA Date 10-26-84

RENAISSANCE DETENTION POND

PMF COMPUTATIONS

The maximum flows reaching the Renaissance Detention Pond are determined by the probable maximum flood (PMF) from the portion of the watershed area draining by surface means to the detention pond plus the maximum capacity of the 84" storm drain directed to the pond.

The maximum water surface elevation at the intersection of Renaissance Boulevard and Alexander Boulevard is 5135.5. Any water buildup above this elevation will flow south under Montano Road and to the west away from the detention pond.

The direct surface flow is from Drainage Area B-17, B-18, B-19, and the pond itself. (See Map.) The Renaissance storm drainage system collects flows from the remaining watershed east of the direct inflow areas.

The PMF for the direct inflow area was computed as follows:

1. 1-hour rainfall was obtained from Hydrometeorological Report No. 55.

   (A 1-hour rainfall PMF storm was used as this storm produces a larger runoff than the 6-hour storm due to the extremely small drainage area.)

2. The 1-hour amount was subdivided into 2:1 ratios for even time intervals and plotted.

3. The time of concentration (Tc) was computed for the basin assuming an average sheet flow depth of 4" on urban topography.

4. The rainfall amount for a duration equal to the Tc was selected and an hourly intensity computed.

5. A runoff coefficient of C = 0.8 was computed.

6. The PMF flow was computed using the rational formula Q = CIA.

Probably maximum precipitation estimate for Albuquerque, New Mexico.

Albuquerque lies outside the 1-hour, 1-sq. mi. "Local" storm area shown in figure 12.15 of Hydrometeorological Report 55, dated March, 1984. Therefore, the "general" storm method applies. Since the watershed area is very small, only 1-hour PMP will be necessary for analysis.

Stepwise Prodedure; General Storm (P216-217, HM 55)

Steps 1 & 2 From Plate Ic, the 1-hour 10-sq. mi. PMP is 8 inches.

Steps 3, 4 & 5. Since area is below 10 sq. mi. there is no areal reduction factor.

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Steps 6, 7 & 8. No applicable.

Temporal Distribution of PMP.

For time distribution of the PMP, the rainfall was broken down into 2:1 ratios for even time intervals as follows:

TIME	RAINFALL
60 minutes	8"
30 minutes	5.33"
15 minutes	3.56"
7-1/2 minutes	2.37"
3-3/4 minutes	1.58"

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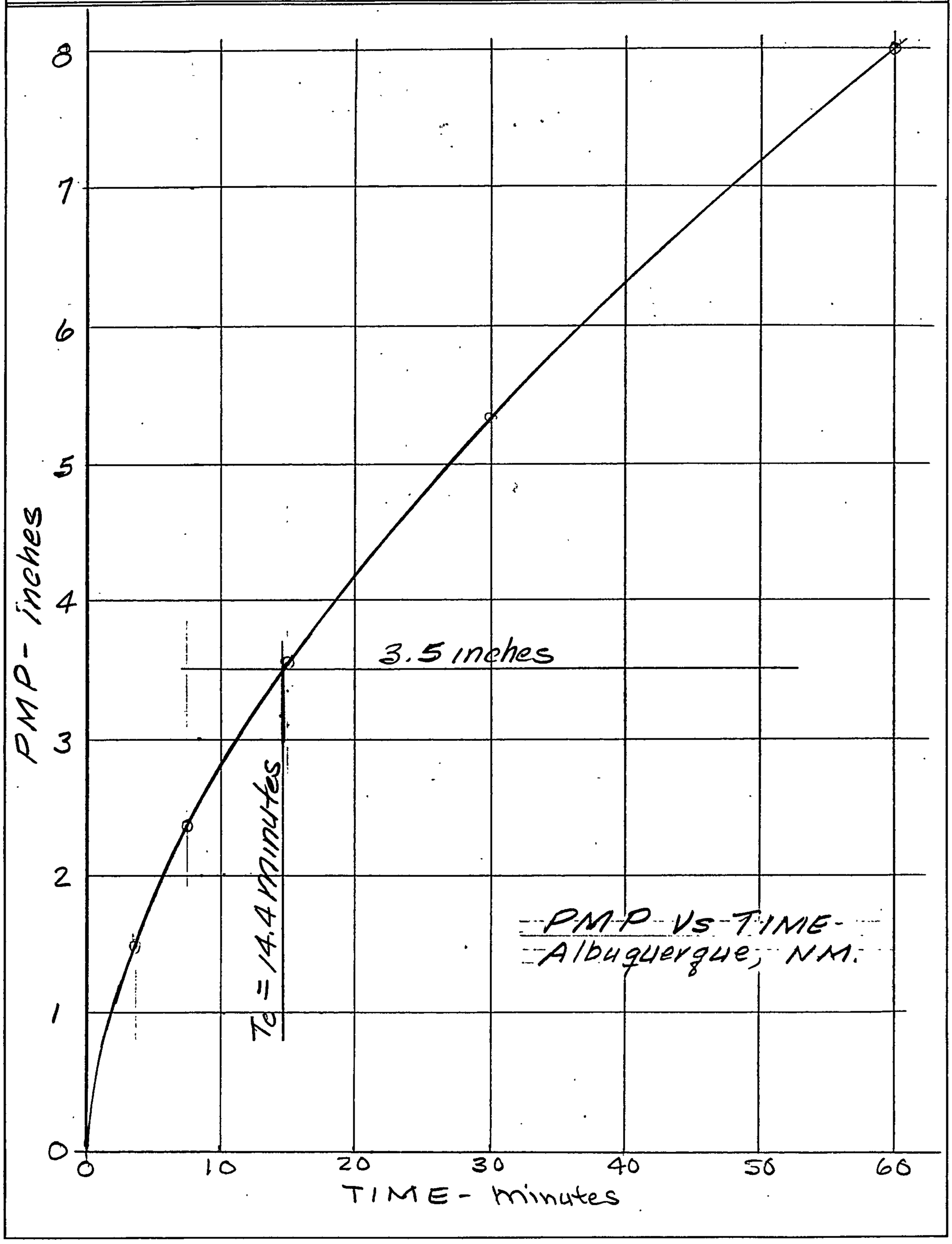
Project RENAISSANCE CENTER Sheet 3A of 11

Job No. 356

By DS Chk'd JA Date 10-26-84



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Project RENAISSANCE CENTER Sheet 4A of 11
Job No. 356
By DS Chk'd JA Date 10-27-84

PMF COMPUTATION

The watershed area is very small, so the rational method may be used $Q = CIA$

A_{TOTAL} = 3.86 Ac (Detention Pond) + 8.33 (B-19)
+ 3.16 (B-18) + 10.6 (B-17) = 25.95 Acres

Rainfall intensity is a function of Time of Concentration.

Tc Computation – Length of Area = 2340'

From Plan, Slope = 0.58%

Runoff would be in form of sheet flow through future parking lots and around buildings. Assume average depth of 4" for PMF

For unit width of sheet flow.

Area = 0.33 ft²
P = 1.0 ft. $R = \frac{A}{P} = 0.33$

Assume $n = 0.02$

$$V = \frac{1.486}{.02}(0.33)^{2/3}(.0058)^{1/2} = 2.7 \text{ fps.}$$

$$Tc = \frac{2340'}{2.7} = 867 \text{ Sec} = 14.4 \text{ minutes}$$

From PMP vs Time graph - for T = 14.4 min.
PMP = 3.5"

Average rainfall intensity =

$$I_{in/hr} = \frac{3.5}{14.4}\left(\frac{60 \text{ min}}{\text{hr.}}\right) = 14.6 \text{ in./hr.}$$

Use $C = 0.8$

$$Q = CIA = (0.8)(14.6)(25.95) = \underline{303 \text{ CFS}}$$

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Project RENAISSANCE CENTER Sheet 5A of 11
Job No. 356
By JEM Chk'd JA Date 11-23-84

Maximum Flow from Storm Drain into Detention Pond during PMF

Water Surface in Pond = 5013.0

Water Surface at Renaissance & Alexander Blvd. Intersection = 5035.5

Available Head = 35.5 - 13.0 = 22.5 ft.

Length of 84" Pipe = 2117.33'

$$\text{Slope} = \frac{22.5}{2117.33} = 0.0104$$

$$R = \frac{A}{P} = \frac{38.485}{21.99} = 1.75$$

$$Q = AV = 38.485\left(\frac{1.486}{.013}\right)(1.75)^{2/3}(.0104)^{1/2}$$

$$= \underline{651.4 \text{ cfs.}}$$

TOTAL FLOW TO DETENTION POND.

Storm Drain flow Plus PMF

951 + 303 = 1254 CFS

Since - the volume of pond is small, no routing of the PMF is neeessay. and the emergency spillway will be designed to pass the inlet flow of-1254 CFS

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Project RENAISSANCE CENTER Sheet 6A of 11

Job No. 356

By JA Chk'd ✓ Date 2-12-85

DETENTION POND STORAGE VOLUME

ELEV.	AREA (Acres)	AVG AREA	DEPTH (Ft.)	ACRE FEET	ACCUM. AC. FT.
5101.5	0				0
		0.8572	0.50	0.4286	
5102	1.7143				0.4286
		1.7602	1.0	1.7602	
5103	1.8061				2.1888
		1.8520	1.0	1.8520	
5104	1.8980				4.0408
		1.9210	0.5	0.9605	
5104.5	1.9439				5.0013
5104.5	2.1694				
		2.1956	0.5	1.0978	
5105	2.2217				6.0991
		2.2740	1.0	2.2740	
5106	2.3262				8.3731
		2.3785	1.0	2.3785	
5107	2.4308				10.7516
		2.4830	1.0	2.4830	
5108	2.5353				13.2346
		2.5876	1.0	2.5876	
5109	2.6399				15.8222
		2.6922	1.0	2.6922	
5110	2.7444				18.5144
		2.7706	0.5	1.3853	
5110.5	2.7967				19.8997
		2.8490	1.0	2.8490	
5111.5	2.9012				22.7487
		2.9535	1.0	2.9535	
5112.5	3.0058				25.7022
		3.0581	1.0	3.0581	
5113.5	3.1104				28.7603

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Project RENAISSANCE CENTER Sheet 7A of 11
Job No. 356
By JA Chk'd ✓ Date 2-17-85

RENAISSANCE DETENTION POND
EMERGENCY SPILLWAY CAPACITY

Spillway width - L = 100', C = 2.63

ELEV.	H (ft)	Discharge - $Q = CLH^{3/2}$ (cfs)	
5110.5	0	0	
5111.0	0.5	93.0	
5111.5	1.0	263.0	
5112.0	1.5	483.2	
5112.5	2.0	743.9	
5112.86	2.36	953.5	- Design Flow -
5113.0	2.5	1039.6	
5113.5	3.0	1366.6	- max. capacity.

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Project RENAISSANCE CENTER Sheet 8A of 11
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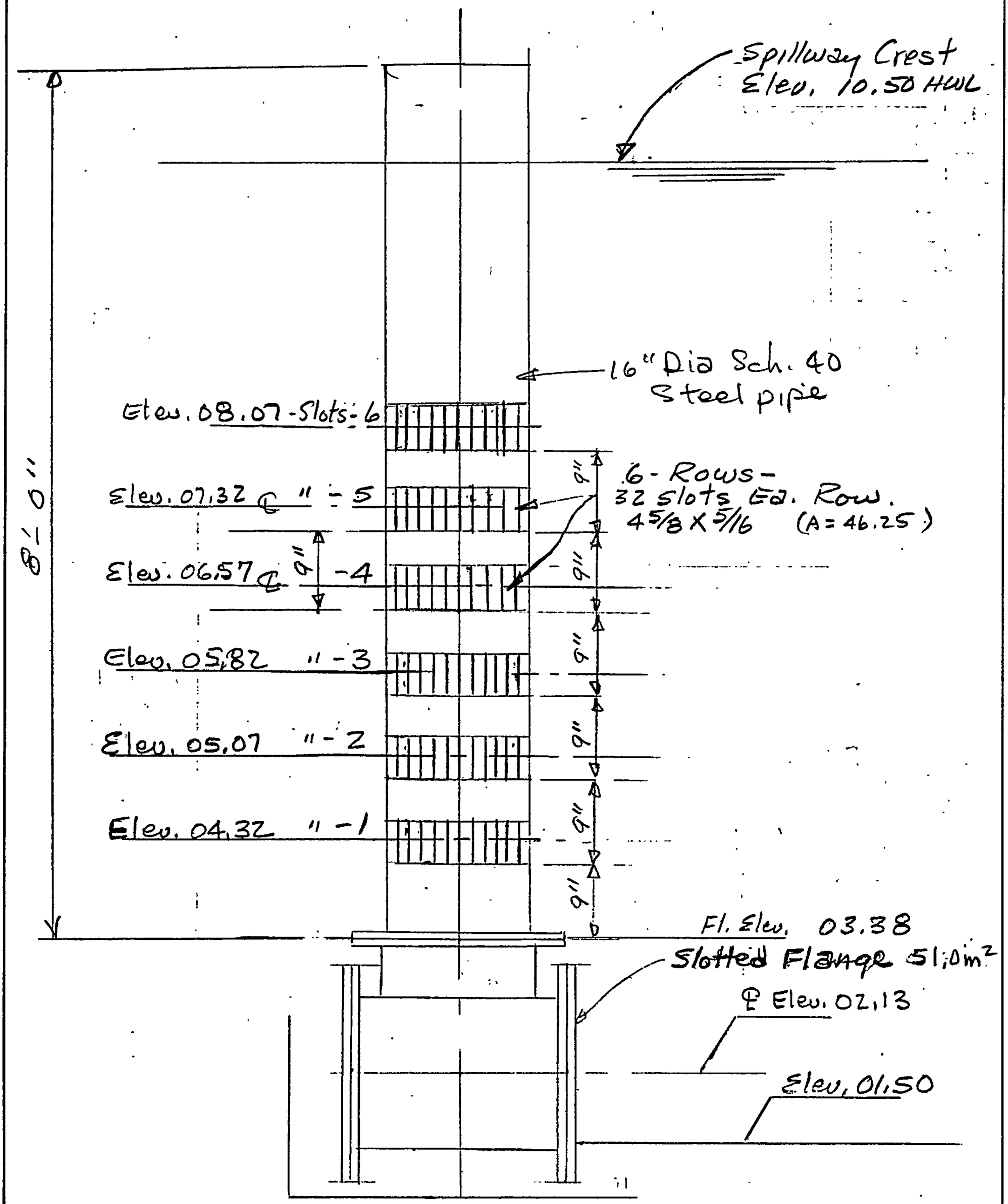
By JA Chk'd ✓ Date 2-12-85



DETAIL OF INLET TO OUTLET WORKS.

DETENTION POND - Discharge - Outlet Works - $Q = Ca\sqrt{2gh}$.

	BL. Flg.		Slots-1		Slots-2		Slots 3		Slots-4		Slots-5		Slots-6		
Water Elev.	H_1	Q_1	H_2	Q_2	H_3	Q_3	H_4	Q_4	H_5	Q_5	H_6	Q_6	H_7	Q_7	Total Q-CFS
		1.737	d=46.25	1.57		1.57		1.57		1.57		1.57		1.57	
5101.5	0	0													0
5102.0	0.22	0.32													0.32
5103.0	0.87	1.62													1.62
5104.0	1.87	2.37													2.37
5104.5	2.37	2.67	0.18	0.67											3.34
5105.0	2.87	2.94	0.68	1.29	—										4.23
5106.0	3.87	3.40	1.68	2.03	0.93	1.51	0.18	0.67							7.61
5107.0	4.87	3.82	2.68	2.57	1.93	2.18	1.18	1.71	0.43	1.03					11.31
5108.0	5.87	4.19	3.68	3.01	2.93	2.69	2.18	2.32	1.43	1.88	0.68	1.29			15.38
5109.0	6.87	4.53	4.68	3.40	3.93	3.11	3.18	2.80	2.43	2.45	1.68	2.03	0.93	1.51	19.83
5110.0	7.87	4.85	5.68	3.74	4.93	3.49	4.18	3.21	3.43	2.91	2.68	2.57	1.93	2.18	22.95
5110.5	8.37	5.01	6.18	3.90	5.43	3.66	4.68	3.40	3.93	3.11	3.18	2.80	2.43	2.45	24.33
5111.5	9.37	5.30	7.18	4.21	6.43	3.98	5.68	3.74	4.93	3.49	4.18	3.21	3.43	2.91	26.84
5112.5	10.37	5.57	8.18	4.49	7.43	4.28	6.68	4.06	5.93	3.82	5.18	3.57	4.43	3.30	29.09
5113.5	11.37	5.83	9.18	4.76	8.43	4.56	7.68	4.35	6.93	4.13	6.18	3.90	5.43	3.66	31.19

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Project RENAISSANCE CENTER Sheet 9A of 11
By LA Chk'd ____ Job No. 356
Date 2-12-85

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Project RENAISSANCE CENTER Sheet 10A of 11
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By _____ Chk'd _____ Date 2-12-85

DETENTION POND

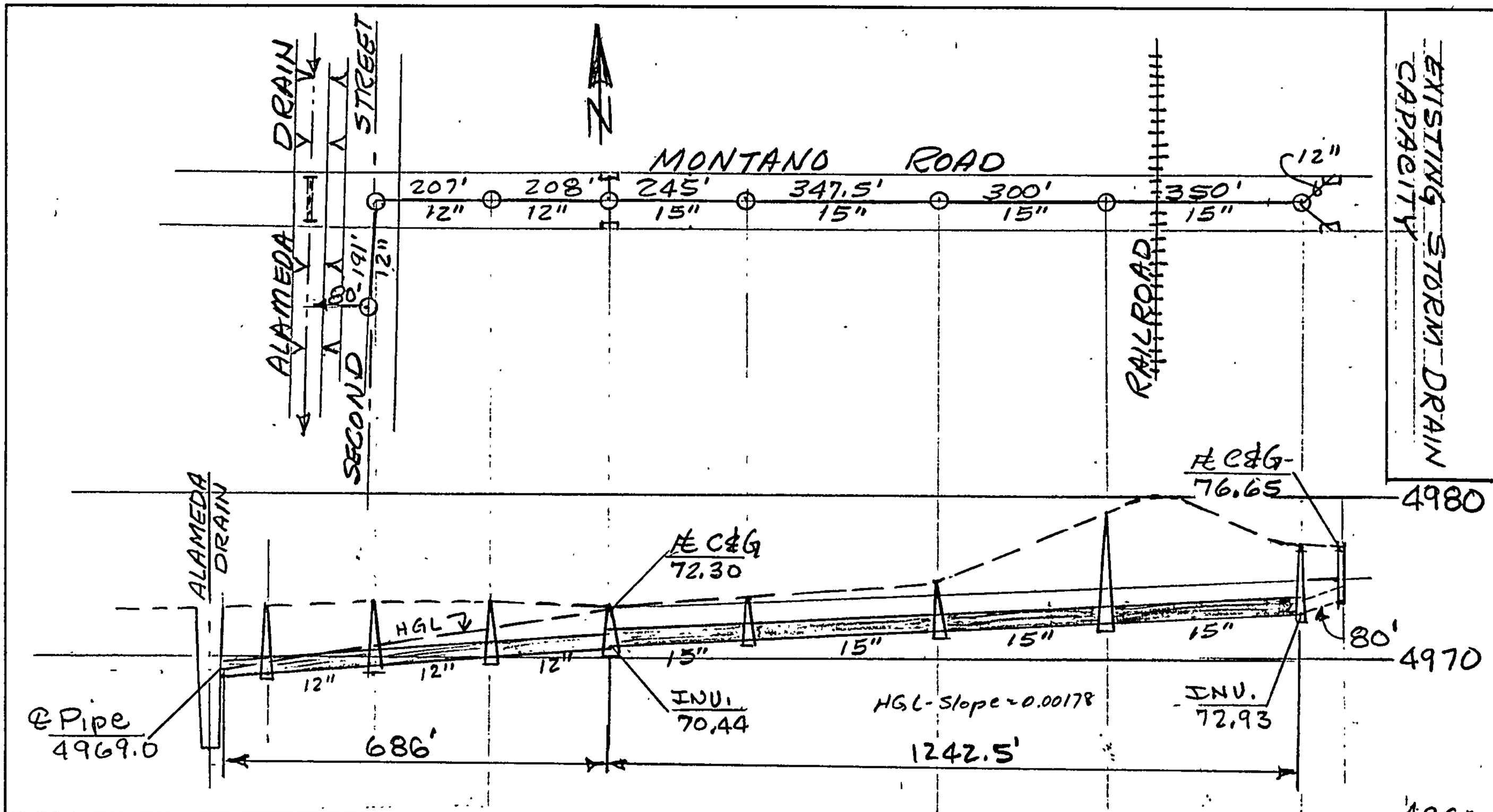
EVACUATION TIME THROUGH OUTLET WORKS

ELEV.	Increment Storage AF	Outflow CFS	Avg. Outflow CFS	TIME (HOURS)	
5101.5		0			
	0.43		0.16	32.52	This time Disregarded Considered Sediment Pool. Elev. 01.5 to Elev. 02.0
5102.0		0.32			
	1.76		0.97	21.95	
5103		1.62			
	1.85		2.00	11.19	
5104		2.37			
	0.96		2.86	4.06	
5104.5		3.34			
	1.10		3.78	3.49	
5105		4.23			
	2.27		5.92	4.64	
5106		7.61			
	2.38		9.46	3.04	
5107		11.31			
	2.48		13.34	2.25	
5108		15.38			
	2.59		17.60	1.78	
5109		19.83			
	2.69		21.39	1.52	
5110		22.95			
	1.39		23.64	0.71	
5110.5		24.33			
			TOTAL TIME	54.63 Hrs.	Not including Sediment Pool.

NOTE Under interim conditions, until the City installs storm sewer in Montano Road - Pond will be drained at the rate of 2 cfs.

$$\text{Evacuation Time} = \frac{(19.9)(43,560)}{(2)(3600)} = 120 \text{ hrs.}$$

Flow rate Controlled by throttling Butterfly Valve in outlet line.



$$\frac{\text{Capacity - 12" Line -}}{\text{HGL - Slope}} = \frac{72.30-69.0}{686'} = 0.0048'/_{1}$$

$$Q = VA = (0.785)\frac{1.486}{0.013}(0,25)^{2/3}(.0048)^{1/2}$$

$$= 2.69 \text{ CFS}$$

$$\frac{\text{Capacity - 15" Line -}}{\text{Slope}} = \frac{76.65-72.30}{1322.5} = 0.0033'/_{1}$$

$$Q = VA = 1.227\left(\frac{1.486}{0.013}\right)(0.307)^{2/3}(.0033)^{1/2}$$

$$= 3.166 \text{ CFS}$$

STORM SEWER CAPACITY = 2.69 CFS.

114.3 6455 0574

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Project RENAISSANCE CENTER Sheet 11A of 11
By JA Chk'd Job No. 356
Date 2-13-85

VII. CATCH BASIN CALCULATIONS

Following are the computations made for locating the catch basins required to intercept the flows calculated in Part VI, Drainage Analysis.

These catch basins were sized from plates 22.3D-5 and 22.3D-6 of the Development Process Manual.

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Project Renaissance Center Sheet 1 of 6
Catch Basins Job No. 356
By EM Chk'd Date 11.27.84

Compute Catch Basin Requirements in Renaissance Blvd East of Culture Dr.
Q = 42.69 cfs
Slope of Street = 2.5 %
75% of Flow = 34.3 cfs S side 25% = 8.4 cfs N side

Compute S. Side
Depth (Fig D-4) = 0.57'
Type A cap = 10.5 cfs - Flow remaining = 23.8 cfs
Depth = 0.52'
Type A cap = 9.2 cfs - Flow remaining = 14.6 cfs
Depth = 0.44'
Type A cap = 7 cfs - Flow remaining = 7.6 cfs
Depth = 0.37'
Type A cap = 4.8 cfs - Flow remaing = 2.8 cfs - 1ct pass

Compute N. Side

Depth 0.38'
Type A capacity = 5 cfs Flow remaining = 3.4 cfs
Depth = 0.29'
Type A cap = 3 cfs Flow remaing = 0.4 cfs - 1ct pass

4 Catch Basins S. Side, 2 Catch Basins N Side

Compute Catch Basin Requirements in Renaissance Blvd @ AP-9
Q100 (B-8) = 11.18 cfs 75% N Side
N Side = 8.4 cfs
+Pass from Above 0.4 cfs
TOTAL 8.8 cfs
Slope = 1.5%
N side Depth = 0.41'
Type A cap = 5 cfs Flow remaing = 3.8 cfs - 1ct pass

S Side 2.8 cfs
2.8 cfs
5.6 cfs

S side Depth = 0.36'
Type A cap = 3.8 cfs Flow remaing = 2.8 cfs - 1ct Pass

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Project Renaissance Center Sheet 2 of 6
Catch Basins Job No. 356
By JEM Chk'd Date 11.27.84

Compute Catch Basin Requirements @ AP-10 Street Slope = 0.98%
Q_{100} (B-9) = 20.2 cfs 90% S side

	South side	North side
Q =	18.2 cfs	2.0 cfs
+ Pass from above	2.8 cfs	3.8 cfs
Total	21.0 cfs	5.8 cfs

Compute S side
Depth: 0.58' Type A cap: 9.2 cfs
Flow remaining 11.8 cfs – Let Pass

Compute N. side
Depth - 0.38'
Type A cap: 4.3 cfs
Flow remaining: 1.5 cfs – Let Pass

Catch Basin Requirements @ Renaissance – 500' E of Alexander
will intercept 50% of B-10 Q: ½ × 23.76 = 11.88 cfs
75% N side

	N side	S side
	8.9 cfs	3.0 cfs
+ Pass from Above	1.5 cfs	11.8 cfs
Total	10.4 cfs	14.8 cfs

Compute N side
Depth: 0.47'
Type A Cap: 6.5 cfs
Flow remaining: 3.9 cfs – Let Pass

Compute S. Side
Depth = 0.51
Type A cap: 7.8 cfs
Flow remaining = 7 cfs – Let Pass

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Project Renaissance Center Sheet 3 of 6
Catch Basins Job No. 356
By EM Chk'd Date 11.27.84

Compute Catch Basins @ AP-11
remainder of Flow from B-10 · 11.88 cfs
·75% N Side

	N Side	S Side
	8.9 cfs	3.0 cfs
+ Pass from above	3.9 cfs	7.0 cfs
TOTAL	12.8 cfs	10.0 cfs

Slope = 0.80%

Compute N. Side
Depth = 0.51'
Type A cap · 6.6 cfs
Flow Remaing = 6.2 cfs — 1ct Pass

Compute S. Side
Depth: 0.48
Type A cap · 6.2 cfs
~~Flow~~ Remaining = 4.8 cfs — 1ct Pass

Compute @ Manhole Sta 14+70 S=0.72%
Plow 1/3 of Flow from B-6
Q = 17.80 ÷ 3 = 5.93 cfs (all S. Side)

Depth = 0.40'
Type C capacity = 4 cfs
Flow Remaining = 1.93 cfs - 1ct pass

Compute @ A.P- 7 - Low Point catch Basin
Q = (2/3 × 17.80) + 1.93 = 13.8 cfs

Type Double "C" will intercept 100%

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Project Renaissance Center Sheet 4 of 6
Catch Basins Job No. 356
By JAM Chk'd Date 11.27.84

Compute Requirements @ SP 8

Q_{100} (from B-7) = 14.12 cfs (100% on E side) Slope = 1.73%

Depth = 0.47'
Type A Cap = 7 cfs
Remaining = 7.12 cfs
Depth = 0.38'
Type C cap = 4.6 cfs
Remaining = 2.5 cfs Let Pass

Compute Requirements @ Mercantile / Montano
Collects Discharge from Area C-1 Q = 6.04 cfs
w/ no crown & cross slope all Flow on NW side
Slope = 3%
Depth = 0.33'
Type A cap = 4 cfs
Remaining = 2.04 cfs - let pass

Compute Inlet from Sedimentation Basin Area A-1
Q = 62.91 cfs

4'ϕ weir inlet C = 3.0

$62.91 = 3 \times \pi \times 4 \times H^{3/2}$
H = 1.41 ft Set overflow @ el. 34.0
Max WS = 35.41 - Set embankment @ 37.0

Compute @ Alexander Blvd Sta 15+35 Area A-2, A-3, & 20% of B-11 & 40% B-12
$Q = 28.17 + 0.2 \times 22.39 + 0.4 \times 11.55 = 37.27$ cfs
approx 1/2 to each side of street Q = 18.63 cfs
Slope = 0.50%
Depth = 0.63 ft
Type A cap = 10. cfs - Passing 8.63 cfs to each side.

Compute @ AD # 15

West side
$Q = (.6 \times 11.55) + 8.63 = 15.56$ cfs

E side
$Q = (0.8 \times 22.39) + 8.63 = 26.54$ cfs

Use Type Double "C" @ Low Point

Net open area of Grating = 7.125 ft^2 Neglecting throat

W side $15.56 = 0.61 \times 7.125 \times \sqrt{64.4h}$
$h = 0.20$ ft

E side $26.54 = .61 \times 7.125 \times \sqrt{64.4h}$
$h = 0.57'$

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Project Renaissance Center Sheet 5 of 6
Catch Basins Job No. 356
By JEM Chk'd Date 11.27.84

Compute @ AP #16 : Area B-13
Q = Q = 22.80 cfs Slope = 0.75% E 1.60% W
Flow 75% E = 17.1 cfs 25% W = 5.7 cfs
Eastside
Depth 0.54'
Type A Cap = 8 cfs
Flow Remaining = 9.1 cfs - Ict Pass

Westside
Depth = 0.35'
Type A Cap = 3.5 cfs
Flow Remaining = 2.2 cfs Ict Pass

Compute @ Renaissance Blvd sta 6+90 Area D-16 & E
Q = 15.33 cfs
Low Pt Double "C" on E side

$15.33 = 0.61 \times 7.125 \sqrt{64.4}\, h$
$h = 0.19'$

Compute @ A-P 18 Area B-15 Q, 23.84 cfs
90% on west = 21.5 cfs East = 2.3 cfs
Slope = 0.29% Slope = 1.68%
west side
Depth = 0.60 ft
Type A Cap = 8.5 cfs
Flow Remaining = 13 cfs
Depth = 0.50'
Type A Cap = 6.5 cfs
Flow Remaining = 6.5 cfs
Depth = 0.42'
Type A Cap = 4.5 cfs
Flow Remaining = 2 cfs - Ict Pass

East Side
Depth = 0.27'
Type A Cap = 1.6 cfs
Flow Remaining = 0.7 cfs Ict Pass

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Project Renaissance Center Sheet 6 of 6
Catch Basins Job No. 356
By JEM Chk'd _____ Date 11.27.84

Compute L.P Catch Basins @ Renaissance Blvd Sta 15+45

B-14 Flow = 16.92 cfs

	65% W Side	35% S Side
	7.7 cfs	4.2 cfs
Flow Passing from above	0.7 cfs	4.8 cfs
	2.0 cfs	
	9.1 cfs	
	3.5 cfs	
	6.2 cfs	
TOTAL	29.2 cfs	9.0 cfs

$29.2 = 0.61 \times 7.125 \times \sqrt{64.4h}$
$h = 0.70'$

$9.0 = 0.61 \times 7.125 \times \sqrt{64.4h}$
$h = 0.07'$

VIII. HYDRAULIC GRADIENT CALCULATIONS

Following are the computations made for the hydraulic gradient in the proposed storm sewers. Critical areas were evaluated in detail. Areas which could not possibly impede flow from catch basins were less stringently investigated.

In almost all instances the proposed storm sewers are several feet below the proposed catch basins, flowing only partially full and incapable of obstructing the catch basins by backwater.

Substantial reserve capacity was supplied in the storm sewer system due to the potentially deep flooding at the Renaissance Boulevard, Alexander Boulevard intersection in the event of storms of greater than 100 year frequency.

SUMMARY OF HYDRAULIC CALCULATIONS

CLOSED CONDUIT

BY: JEM
DATE: 02/18/85
SHEET: 1 OF: 4

PROJECT: Renaissance Center
LINE: Merchandise Mart Collector Dr.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATION	STRUCT	D	Q	A	V	K	S_f	L	Δ	JUNCTION		LOSSES							E.G.	h_v	H.G.
										D	θ	h_f	h_b	h_j	h_{mh}	h_f	h_{misc}	Σ			
18+64		30	53.42	3.73	14.32		.0238	265.91	—	—	—	7.04						7.04	94.91	3.18	91.73
15+68.09		30	53.42	3.73	14.32		.0238	0	63-01				0.53					0.53	87.27	3.18	84.69
15+68.09		36	53.42	3.53	15.11		.026	43.09				1.10						1.10	87.49	3.55	83.94
15+25		36	53.42	4.24	12.59		.0159	50'				0.80						0.80	86.24	2.46	83.74
14+75		36	53.42	4.49	11.90		.014	241				0.34						0.34	85.45	2.20	83.31
14+51		36	53.42	4.93	10.84		—	0											85.11	1.83	83.32
14+51		36	57.11	6.11	9.34		.0096	626.29				6.01						6.01	85.02	1.35	83.67
8+24.71		36	57.11	2.07	8.08		-	0	45				0.24					0.24	79.07	1.01	78.00
8+24.71	18+54.99	36	57.11	6.10	9.36		.0075	1499				0.11						0.11	78.77	1.36	77.41
18+40		36	57.11	4.49	12.72		.016	12				0.19						0.19	78.52	2.51	75.92
18+28		36	57.11	3.85	14.82		.0235	11				0.26						0.26	78.33	3.41	75.00
18+17		36	57.11	3.64	15.69				45				0.53					0.53	78.07	3.87	74.25
18+17		36	64.49	4.70	13.72														77.54	2.92	74.62
	Obviously Flow will approach Normal by Sta 11											to 03.21									
11+03.21		36	64.49	3.22	20.05		—	0		24	45			0.31				0.31	41.36	6.24	35.12
11+03.21		36	72.60	3.75	19.38		.041	13.50				0.55						0.55	41.05	5.83	35.30
10+89.71		36	72.6	3.75	19.38			0					0.29					0.29	40.50	5.83	34.63
10+89.71		36	72.6	3.85	18.86		.038	28.28				1.07						1.07	40.21	5.52	34.66
10+61.43		36	72.6																39.14	5.83	33.22
	Most Energy Dissipated Open End by 48'																				

REMARKS:

MANNING'S n: 0.013

SUMMARY OF HYDRAULIC CALCULATIONS

CLOSED CONDUIT

BY: JEM
DATE: 02/18/85
SHEET: 2 OF: 4

PROJECT: Renaissance Center
LINE: Renaissance Blvd/Trac IB-IC

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATION	STRUCT	D	Q	A	V	K	S_f	L	Δ	JUNCTION D	JUNCTION θ	LOSSES h_f	h_b	h_j	h_{mh}	h_f	$h_{misc.}$	Σ	E.G.	h_v	H.G.
32+05.12		48"	121.8	8.61	14.15		0.013	505.18				6.58						6.57	36.83	3.11	33.72
27+00		48"	121.8	8.61	14.15												0.07	0.07	30.25	3.11	27.14
27+00		54"	121.8	7.63	15.96		0.017	19				0.33						0.33	30.18	3.95	26.24
26+81		54"	124.8	7.95	15.32		0.016	28											29.85	3.64	26.19
26+53		54"	124.8	8.64	14.45														29.40	3.241	26.12
26+53		54"	133.99	9.46	14.16		.009	250				2.15						2.15	29.40	3.11	26.30
24+03		54"	133.99	15.63	8.57														27.25	1.14	26.13
24+03		54"	147.4	13.32	11.06		.0074	753				5.55						5.55	27.25	1.90	25.35
16+50		54"	147.4	12.326	11.96												0.60	0.60	24.70	2.22	19.48
16+50		84"	147.4	33.29	4.43		.0005	20.82				0.01							21.10	0.29	20.75
16+29.18		84"	147.4	34.06	4.33														21.09	0.29	20.74
16+29.18		84"	276.76	23.67	11.69		.0041	569				2.57						2.57	21.09	2.12	18.97
10+60.18		84"	276.76	30.40	9.10			0											18.77	1.29	17.44
10+60.18		84"	293.42	24.63	11.91		.0045	148.60											18.77	2.20	16.57
9+00		84"	293.42	24.63	11.91			0									.03	.03	18.10	2.20	15.90
9+00		84"	293.42	29.06	10.10		.0026	100				0.29						0.29	18.09	1.58	16.56
8+00		84"	293.42	30.40	9.65		.0025	50				0.12						0.12	17.81	1.45	16.32
7+50		84"	293.42	31.21	9.40		.002	67.25				0.14						0.14	17.69	1.37	16.23
6+82.75		84"	293.42	33.29	8.81			105	66-46				0.47					0.47	17.55	1.21	16.28
6+82.75	12+71.48	84"	293.42	26.86	10.92		.0043	171.48				0.73						0.73	17.08	1.85	15.23
11+00		84"	299.24	25.09	11.93														16.40	2.21	14.14
11+00		54"	299.24	29.06	10.30		.0026	71.24				0.19						0.17	16.40	1.65	14.75
10+28.76		84"	299.24	30.4	9.65			"					0.22					0.22	16.21	1.45	14.70
10+28.76		84"	299.24	27.42	10.91		.0045	328.76				1.48						1.48	15.99	1.85	14.14
																			14.51	1.93	12.58

REMARKS:

MANNING'S n: 0.013

SUMMARY OF HYDRAULIC CALCULATIONS

CLOSED CONDUIT

BY: JEM
DATE: 02.18.25
SHEET: 3 OF: 4

PROJECT: Renaissance Center
LINE: Pen Blvd / Trac 18-1C

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATION	STRUCT	D	Q	A	V	K	S_f	L	Δ	JUNCTION D	JUNCTION θ	LOSSES h_f	h_b	h_j	h_{mh}	h_t	h_{misc}	Σ	E.G.	h_v	H.G.
7+00		84"	299.24	25.09	11.93														14.51	1.93	12.48
7+00		84"	299.24	29.06	10.30		.0029	75				.22						.22	14.51	1.58	12.93
6+25		84"	299.24	29.06	10.10		.0026	65				.16						.16	14.29	1.58	12.67
5+60		84"	299.24	31.21	9.59		.0023	60				.14						.14	14,13	1.43	12.73
5+00		84"	299.24	33.29	8.99		.0022	65.99				.14						.14	13.89	1.25	12.81
4+34.01		84"	299.24	34.06	8.79				61-54				0.46					0.46	13.85	1.20	12.65
4+34.01		84"	299.24	26.86	11.14		.0037	34.01				.13						.13	13.39	1.93	11.46
4+00		84"	299.24	22.90	13.07		.0056	50				.28						.28	13.20	2.65	10.59
3+50		84"	299.24	20.90	14.32		.0071	50				.35						.35	12.98	3.18	9.85
3+00		84"	299.24	20.01	14.95		.0079	53				.42						.42	12.63	3.47	9.25
2+47		84"	299.24	20.01	14.95								0.46					0.46	12.21	3.47	8.74
2+47		84"	299.24	24.36	12.28		.0043	103				.44						.44	11.75	2.34	9.41
1+43		84"	299.24	19.54	15.31														11.31	3.64	7.67
	Hydraulic Jump will Take place approximately in this Area (Depending upon exact ws in 2nd)																				

REMARKS:

MANNING'S n: .013

SUMMARY OF HYDRAULIC CALCULATIONS

CLOSED CONDUIT

BY: JEM
DATE: 02/18/85
SHEET: 4 OF 4

PROJECT: Renaissance Blvd
LINE: Alexander/Montana

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
STATION	STRUCT	D	Q	A	V	K	S_f	L	Δ	JUNCTION D	JUNCTION θ	LOSSES h_f	h_b	h_j	h_{mh}	h_t	h_{misc}	Σ	E.G.	h_v	H.G.
11+19.92	Junction w/84"	54"	122.90							84"	45°			0.53					21.09	0.29	20.74
11+19.92		54"	122.9	15.90	7.73		.0039	41.78	45°			.16		0.10			.22	.48	21.62	0.93	20.69
11+61.70		54"	122.90	15.90	7.73														22.10	0.92	21.18
11+61.70		54"	103.98	15.90	6.54		.0028	29.1				0.82						.82	22.10	0.66	21.44
14+52.7		54"	103.98	15.9	6.54		.003	47.3				0.14						0.14	22.92	0.66	22.26
15+00.01		54"	103.98	15.78	6.59		.0023	38.99				0.07	.02					0.09	23.06	0.67	22.36
15+39		54"	103.98	15.65	6.64			0									.08	.08	23.15	.69	22.46
15+39		48"	103.98	12.43	6.75		.003	65.74				.10	.03					.23	23.23	.71	22.52
16+04.74		48"	103.98	12.16	6.91		.003	64.87				.19						.19	23.45	.74	22.68
16+50		48"	103.98	11.79	7.12		.003	68.74				0.20						.20	23.64	.79	22.84
17+18.74		48"	103.98	11.22	7.48		.003	48'				015	.34					.49	23.84	.87	22.97
17+66.74		48"	103.98	12.21	6.88		.003	48'				.14	.28					.42	24.33	.73	23.60
18+14.74		48"	103.98	12.57	6.68														24.25	.69	24.11

REMARKS:

MANNING'S n: .13

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Project Renaissance Center — Hydraulic Gradient — Sheet 1 of 18
By JM — Chk'd — Job No. 356 — Date 12/3/84

Compute "Normal" Flow in Conduit & determine whether Sub or Super Critical

1. Tracts 1B-1C storm Drain Sta 1+17.00 - Sta 4+34.01
48" ϕ C. 0.92% Q = 299.24 cfs
A_{48} = 38.485 ft² R = 1.75'
Compute Capacity
V = $\frac{1.486}{.013} \times 1.75^{2/3} \times .0092^{1/2}$ = 15.92 fps Cap = 15.92 x 38.485 = 612.75 cfs
Compute "Normal" Depth
Q/Cap = 299.24 ÷ 612.75 = 0.488
∴ D/DF = 0.49 ∴ Depth = 3.43'
∴ A/AF = 0.495 ∴ A = 19.55 ft² V = 15.306 fps
WS width = $2\sqrt{3.50^2 - 0.07^2}$ = 7.00'
y_h = 19.55 ÷ 7 = 2.793'

Fr = $\frac{15.306}{\sqrt{32.2 \times 2.793}}$ = 1.61 ∴ Flow is supercritical

2. Tracts 1B-1C Storm Drain Sta 4+34.01 - Sta 5+60
48" ϕ @ 0.45% Q = 299.24 cfs
Compute Capacity
V = 11.14 fps Cap = 428.53 cfs
Q/Cap = 0.70
∴ D/DF = 0.612 ∴ Depth = 4.28'
∴ A/AF = 0.652 ∴ Area = 25.092 ft² ∴ V = 11.926 fps

WS width = $2\sqrt{3.50^2 - 0.78^2}$ = 6.824' y_h = 3.677'
Fr = $\frac{11.926}{\sqrt{32.2 \times 3.677}}$ = 1.096 Flow is slightly supercritical

3 Tracts 1B-1C Storm Drain Sta 5+60 - Sta 12+71.48
48" @ 0.45% Q = 299.24
same as 2 - Slightly Supercritical

4 Renaissance Blvd Sta 6+42.75 - 10+64.68 Q = 293.42 cfs
Capacity = 428.53 cfs
Q/Cap = 0.685 ∴ D/DF = 0.605 ∴ D = 4.24'
A/AF = 0.640 ∴ A = 24.63 ft² ∴ V = 11.913 fps
WS width = $2\sqrt{3.50^2 - 0.74^2}$ = 6.842'
y_h = 3.60'

Fr = $\frac{11.913}{\sqrt{32.2 \times 3.60}}$ = 1.106 Supercritical

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Project Renaissance Center Sheet 2 of 18
Hydraulic Gradient Job No. 356
By EM Chk'd Date 12/3/84

Renaissance Blvd sta 10+64.68 — 16+29.18 Q = 276.56 cfs
Cap = 428.53 cfs

Q/Cap = 0.645 ∴ D/DF = 0.581 ∴ D = 4.067'
A/AF = 0.615 ∴ A = 23.668 ft² V = 11.685 fps

WS width = $2\sqrt{3.50^2 - 0.567^2}$ = 6.91'

y_n = 3.426

Fr = 1.112 Supercritical

5. Renaissance Blvd 16+57.18 — 24+31 Q = 147.4 cfs
54" RCP @ 0.75%
A_{54} = 15.904 ft² R = 1.125 ft
Compute Capacity
V = 10.708 Cap = 170.30 cfs
Q/Cap = 0.866
D/DF = 0.715 ∴ Depth = 3.22'
A/AF = 0.775 ∴ A = 12.325 V = 11.96 fps
WS width = $2\times\sqrt{2.25^2 - 0.97^2}$ = 4.06'
y_h = 3.036'

Fr = $\frac{11.96}{\sqrt{32.2\times3.036}}$ = 1.21 Supercritical

6. Renaissance Blvd Sta 24+31 - 27+00 Q = 133.99 cfs
capacity = 170.30 cfs
Q/Cap = 0.787
D/DF = 0.665 ∴ Depth = 2.993'
A/AF = 0.715 ∴ A = 11.371 ft² ∴ V = 11.783
WS width = $2\times\sqrt{2.25^2 - 0.743^2}$ = 4.248'
y_h = 2.77'
Fr = 1.27 Supercritical

7 Renaissance Blvd Sta 27+00 — Sta 32+05 Q = 121.80 cfs
48" RCP @ 1.30%
A_{48} 12.96 ft² R = 1
compute Capacity
V = 13.03 Cap = 163.77 cfs
Q/Cap = 0.744 ∴ D/DF = 0.64 ∴ D = 2.56
A/AF 0.685 ∴ A = 8.608 ∴ V = 14.13 fps
WS width = 3.84' y_h = 2.242'
Fr = 1.67 Supercritical

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Project Renaissance Center — Sheet 3 of 18
Hydraulic Gradient — Job No. 356
By JEM — Chk'd — Date 12/3/84

8 Culture Drive Sta 11+03.23 - 14+50 Q = 64.49 cfs
36" @ 4.98%
A_{36} = 7.069
Compute Capacity
V = 21.057 Cap = 148.85 cfs
Q/Cap = 0.433 ∴ D/DF = 0.46 ∴ D = 1.38'
A/AF = 0.455 ∴ A = 3.216 ∴ V = 20.05 fps
ws width = $2\sqrt{1.5^2 - .12^2}$ = 2.99'
y_h = 1.075'
Fr = 3.41 supercritical

9 Culture Drive Sta 14+50 — sta 18+17.00 Q = 64.49
36" @ 5.93%
Compute Capacity
V = 22.978 Cap = 162.43 cfs
Q/Cap = 0.397 ∴ D/DF = 0.438 D = 1.314
A/Af = 0.425 ∴ A = 3.004 ∴ V = 21.466
ws width = $2\sqrt{1.5^2 - .186^2}$ = 2.977
y_h = 1.009
Fr = 3.77 supercritical

10 Mercantile Ave Sta 8+24.71 - 14+51.00 Q = 57.11 cfs
36" RCPE 1.00%
V = 9.43 Cap = 66.704 cfs
Q/Cap = 0.856 ∴ D/DF = 0.71 ∴ depth = 2.13'
A/Af = 0.765 ∴ A = 5.405 ∴ V = 10.561
ws width = 2.723
y_h = 1.98
Fr = 1.32 supercritical

11 Mercantile Ave Sta 15+68.09 - 18+64.00 Q = 53.42 cfs
30" RCPE 2.38%
A_{30} = 4.909 R_{30} = 0.625
V = 12.89 Cap = 63.28 cfs
Q/Cap = 0.844 ∴ D/DF = 0.701 ∴ D = 1.753'
A/AF = 0.76 ∴ A = 3.731 ∴ V = 14.32 fps
ws width = 2.289
y_h = 1.473
Fr = 2.08 supercritical

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Project Renaissance Center Sheet 4 of 18
Hydraulic Gradient Job No. 356
By JEM Chk'd _____ Date 12/3/84

12 Alcp Blvd Sta 11+19.92 - Sta 15+35.00 Q = 103.98 cfs

54" @ 0.486%
A_{54} - 15.904 R = 1.125
V = 8.62 fps cap - 137.09
Q/Cap = 0.758 ∴ D/D_F = 0.649 ∴ D = 2.911'
A/A_F = 0.693 ∴ A = 11.021 ft² ∴ V = 9.434 fps

widthews = 4.30'
y_n = 2.562

Fr = 1.04 supercritical - Slightly - Normal

13 Alcp Blvd Sta 15+35 - Montano Sta 87+32.67 Q = 83.98 cfs
48" RCPE 0.486%
A_{48} - 12.56 ft² R = 1
V = 7.97 Cap = 100.136 cfs
Q/Cap = 0.839 ∴ D/D_F = 0.698 ∴ D = 2.792 ft
A/A_F = 0.752 ∴ A = 9.45 V = 8.887 fps

width - 3.623
y_n = 2.573

Fr = 0.976 sub critical - Slightly - Normal

14 Montano Sta 87+32.67 - 87+00 Q = 83.98
48" RCPE 0.50%
V = 8.083 Cap = 101.568 cfs
Q/cap = 0.827 ∴ D/D_F = 0.69 ∴ D = 2.76 ft
A/A_F = 0.743 ∴ A = 9.337 V = 8.995
widthews = 3.70'
y_n = 2.524

Fr = 0.998 - Critical

15 Montano Sta 89+00 - 90+69.00 Q = 82.77 cfs
Q/Cap = 0.815 ∴ D/D_F = 0.682 ∴ D = 2.728'
A/A_F = 0.735 ∴ A = 9.236 V = 8.962
widthews = 3.726'
y_h = 2.479

Fr = 1.003 - Critical

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Project Renaissance Center Sheet 5 of 18
Hydraulic Gradient Job No. 356
By FEM Chk'd Date 12.3.84

16 Montano Sta 90+65 - 92+80 Q = 20.10 cfs
24" RCP @ 8.45%
$A_{24} = 3.142\ ft^2$ R = 0.50
V = 20.932 Cap = 65.76 cfs
Q/cap = 0.306 ∴ D/D = 0.38 ∴ D = 0.76'
A/Af = 0.35 ∴ A = 1.10 ft^2 V = 18.28 fps
width ws = 1.942'
y_h = 0.567'

Fr = 4.28 Supercritical

17 Montano Sta 92+80 - 95+00 Q = 17.69 cfs
24" RCP @ 9.09%
V = 21.71 cfs Cap = 68.209 cfs
Q/cap = 0.259 ∴ D/Df = 0.347 ∴ D = 0.694
A/Af = 0.31 ∴ A = 0.974 ∴ V = 18.16 fps
width ws = 1.904'
y_h = 0.512
Fr = 4.47

18 Montano Sta 95+00 - 97+03.42 Q = 17.69 cfs
24" @ 4.60%
V = 15.44 Cap = 48.52 cfs
Q/cap = 0.365 ∴ D/Df = 0.418 ∴ D = 0.836'
A/Af = 0.40 ∴ A = 1.257 ∴ V = 14.077
width ws = 1.973'
y_h = 0.637

Fr = 3.11

Flow through Main Line all supercritical (Upstream Control)
∴ Begin @ Mercantile Sta 18+64 Q = 53.42 cfs AE = 89.98
Normal Depth = 1.75' HGL = 91.73
V = 14.32 fps ∴ hv = 3.18' EGL = 94.91
This head is available so assume normal flow
to 15+68.09 - AE = 82.94
HGL = 84.69
EGL = 87.87
At Sta 15+68.09 △ = C3-01-37
$h_b = K_b\ h_v$ K_b = 0.167 ∴ h_b = 0.53

∴ EGL out = 87.34

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Project Renaissance Center Sheet 6 of 18
Hydraulic Gradient Job No. 356
By JEM Chk'd Date 12·3·84

Sta 14+51 - 15+68.09 5342 cfs in 36" RCP FE = 82.44

Trial & Error to match EGL = 87.34

Depth/D	Depth	A/AF	A	V	hv	EGL	
1.00	3.00	1.00	7.069	7.557	0.89	86.33	
0.95	2.85	0.985	6.963	7.672	0.91	86.20	
0.60	1.80	0.635	4.489	11.90	2.20	86.44	
0.40	1.20	0.375	2.651	20.15	6.30	89.95	
0.50	1.50	0.50	3.53	15.11	3.55	87.49	(w.th 0.05 ∴ use)

HGL = 1.50 + 82.44 = 83.94

Compute loss in Increments
1st Increment to 15+25 L = 43.09' Invert = 82.01

R/RF = 1.00 ∴ R = 0.75
$15.11 = \frac{1.486}{.013} \times 0.75^{2/3} \times S^{1/2}$

S = 0.026 HF = 1.10 EGL = 86.34

Trial & Error to Match EGL

Depth/D	Depth	A/AF	A	V	hv	EGL
0.60	1.80	0.635	4.489	11.90	2.20	86.01
0.55	1.65	0.57	4.029	13.26	2.73	86.39
0.575	1.725	0.60	4.24	12.59	2.463	86.20

with 0.04 ∴ use

HGL = 82.01 + 1.73 = 83.74

Compute to 14+75 L = 50' Invert = 81.50

R/RF = 1.085 R = 0.814
$11.57 = \frac{1.486}{.013} \times .814^{2/3} \times S^{1/2}$
S = 0.0159 HF = 0.80 EGL = 85.45

Depth/D	Depth	A/AF	A	V	hv	EGL
0.60	1.80	.635	4.489	11.90	2.20	85.51 (within 0.06 - use)

HGL = 83.31

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Project Renaissance Center Sheet 7 of 18
Hydraulic Gradient Job No. 353
By JEM Chk'd Date 12-3-84

Compute to 14+51 (24') Invert = 81.27

A/A_F = 1.11 R = 0.833

S: 0.014 EGL = 85.11

Depth/D	Depth	A/A_F	A	V	hv	EGL	
0.65	1.95	.697	4.93	10.84	1.83	85.05	USE

HGL = 83.22

Below 14+51 Q = 57.11 cfs (Normal Depth = 2.13')

Depth/D	Depth	A/A_F	A	V	hv	EGL	
0.80	2.40	0.865	6.11	9.34	1.35	85.02	USE

HGD = 81.27 + 2.40 = 83.67

Will Achieve Normal-Depth before 8+24.71 FE = 75.01

HGL = 77.14
EGL = 78.87

C 8+24.71 45° Bend

K_b = 0.14 h_b = 0.24

EGL out = 78.63

Depth/D	Depth	A/A_C	A	V	hv	EGL	
1.00	3.00	1.00	7.069	8.08	1.01	79.02	
0.95	2.85	.972	6.871	8.31	1.07	78.93	
0.90	2.70	.953	6.737	8.48	1.16	78.82	
0.85	2.55	.911	6.44	8.87	1.22	78.78	
0.80	2.40	.863	6.10	9.34	1.36	78.77	← Critical
0.75	2.25	.813	5.75	9.94	1.53	78.79	

Conclusion: There is about 0.14' (Energy) backwash from this bend. HGL = 77.41

Compute to 18+40 - 74.99' Invert = 74.12

R/R_E = 1.22 ∴ R = 0.15 S = .007541

EGL = 78.52

Depth/D	Depth	A/A_F	A	V	hv	EGL	
0.75	2.25	0.813	5.75	9.94	1.53	77.90	
0.70	2.10	.755	5.337	10.70	1.78	77.99	
0.60	1.80	0.635	4.489	12.72	2.51	78.43	USE
0.55	1.65	057	4.029	14.17	3.12	78.88	

HGL = 75.92

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Project Renaissance Center Sheet 8 of 18
Hydraulic Gradient Job No. 356
By EM Chk'd Date 12.4.84

Compute to 18+28 (12" HGL = 73.41)
R/R_F = 1.11 R = 0.833 S = 0.0158 EGL = 78.33

Depth/D	Depth	A/AF	A	V	hv	EGL	
0.55	1.65	0.57	4.027	14.17	3.12	78.18	
0.50	1.50	0.50	3.53	16.18	4.06	78.97	
0.53	1.59	0.545	3.85	14.82	3.41	78.41	USE
	HGL =	75.00					

Compute to 18+17 (11" R = 72.76)
R/R_F = 1.038 R = .78 S = .0235 78.07

Depth/D	Depth	A/AF	A	V	hv	EGL
0.50	1.50	0.50	3.53	16.18	4.06	78.32

Obviously flow is approaching Normal
d will be Normal by sta 11+03.21
Compute Normal - Q
30"ø 4.98% Q_D = 64.49 cfs

A_{30} = 7.069 ft² R = 0.75'

V_F = 21.05 fps Cap = 148.85 cfs

Q/Q_F = 0.433 ∴ D/D_F = 0.466 ∴ D = 1.38'
V/V = 0.965 ∴ V = 20.05 fps hv = 6.214
FE @ 11+03.21 = 3.74
∴ HGL = 35.12 EGL = 41.36

From 10+61.43 – 11+03.21 Q_D = 72.60 cfs

Q/Cap = 0.488 compute Normal Flow
D/D_F = 0.492 ∴ D = 1.48'
A/A_F = 0.495 ∴ A = 3.50 ft² V = 20.75 fps hv = 6.68'
Side flow insignificant ∴ hf = 0.05 hv = 0.05 x 20.05²/64.4 = 0.312
∴ EGL DS = 41.36 – .31 = 41.05

Depth/D	Depth	A/AF	A	V	hv	EGL	
0.55	1.65	0.57	4.027	18.03	5.05	40.44	
0.53	1.59	0.545	3.85	18.86	5.52	4085	
0.52	1.56	0.53	3.75	19.38	5.83	41.13	← USE
	HGL =	35.30					

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Hydraulic Gradient Job No. 356
By EM Chk'd Date 12.7.84

Compute to Elbow @ 10+89.71 (13.50') HE = 33.07

$R/R_F = 1.03$ ∴ $R = 0.7725$
$s = 0.041$ EGL = 40.50

D/DF	Depth	A/AF	A	V	hv	EGL
0.50	1.50	0.50	3.53	20.57	6.57	41.14
0.52	1.56	0.53	3.75	19.38	5.83	40.46 ← USE

HGL = 34.63

Loss in 45°
$K_b = 0.05$ $h_b = 0.29$ ∴ EGL Downstream = 40.21

D/DF	Depth	A/AF	A	V	hv	EGL
0.52	1.56	0.53	3.75	19.38	5.83	40.46
0.53	1.59	0.545	3.85	18.86	5.52	40.18 ← USE

HGL = 34.66

Compute to 10+61.43 (28.28') HE = 31.66

$R/R_F = 1.038$ $R = 0.7785$

$s = 0.038$ EGL = 39.141

D/DF	Depth	A/AF	A	V	hv	EGL
0.52	1.56	0.53	3.75	19.38	5.83	39.05 ← USE

HGL = 33.22

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Hydraulic Gradient Job No. 356
By JEM Chk'd Date 12.7.84

Renaissance Blvd. 27+00 – 32+05
Q = 121.80 cfs
Upstream Energy Gradient sufficient to establish Normal Supercritical Flow!! D = 2.56' V = 14.15 fps hf = 3.11 ft

∴ @ 32+05.18 HGL = 33.72
EGL = 36.83

@ 27+00 HGL = 27.14
EGL = 30.25

Downstream in 64" Normal Depth = 2.99' (Normal Q = 133.99 cfs)
Normal A = 11.371'
Velocity of 54" w/ 121.8 cfs = 10.71 fps
K_e = 0.38

$h = \frac{.38(14.15-10.71)^2}{64.4} = 0.07'$ EGL = 30.18'

D/DF	Depth	A/AF	Area	V	hv	EGL
0.625	2.81	0.665	10.58	11.52	2.06	28.95
0.55	2.48	0.570	9.07	13.44	2.80	29.36
0.50	2.25	0.50	7.95	15.32	3.64	29.97
0.48	2.16	0.48	7.63	15.96	3.95	30.19 ← USE

HGL = 26.24
Compute to 26+81 (19') A = 23.94
R/RF = 0.975 R = 1.097
S = 0.017 EGL = 29.85

D/DF	Depth	A/AF	Area	V	hv	EGL
0.50	2.25	0.50	7.95	15.32	3.64	29.83 USE

HGL = 26.19

Compute to 26+53 (28') FL = 23.73 Q = 124.8 cfs
R/RF = 1.00 R = 1.125 S = 0.016 EGL = 29.40

D/DF	Depth	A/AF	Area	V	hv	EGL
0.55	2.48	0.57	9.07	13.76	2.94	29.15
0.53	2.39	0.543	8.64	14.45	3.24	29.36 ← USE

HGL = 26.12 upstream – combine Q = 133.99 cfs

D/DF	Depth	A/AF	Area	V	hv	EGL
0.55	2.48	0.57	9.07	14.77	3.39	29.60
0.57	2.57	.595	9.46	14.16	3.11	29.41 ← USE

HGL = 26.30

Nnn

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Project Renaissance Center Sheet 11 of 12
Hydraulic Gradient Job No. 356
By JM Chk'd _____ Date 12.7.84

by Sta 24+03 Flow will approach Normal FE = 21.25
HGL = 24.84
EGL = 27.00

Downstream Q = 147.40 cfs

D/DF	Depth	A/AF	Area	V	hv	EGL
0.625	2.81	0.665	10.58	13.93	3.01	27.67
0.65	2.93	0.696	11.07	13.31	2.75	27.53
0.70	3.15	0.755	12.01	12.28	2.34	27.34
0.75	3.38	0.812	12.91	11.41	2.02	27.25
0.85	3.83	0.911	14.49	10.17	1.61	27.28

Have Passed through Critical Depth (3.5'±). ∴ There is approx 0.25' of Energy surcharge upstream - recompute Upstream Depth based upon EGL = 27.25

D/DF	Depth	A/AF	Area	V	hv	EGL	
0.70	3.15	0.755	12.01	11.16	1.93	26.93	
0.75	3.38	0.812	12.91	10.38	1.67	26.90	
0.85	3.83	0.911	14.49	9.25	1.33	27.01	
0.90	4.05	.955	15.19	8.82	1.21	27.10	
1.00	4.50	1.00	15.90	8.42	1.10	27.45	
0.95	4.28	0.983	15.63	8.57	1.14	27.27	← USE

HGL = 26.13
Jump Takes Place at approx sta 24.40
Downstream Q goes to Critical HGL = 25.35 EGL = 27.25

By 16+57.18 Flow will be Normal FE = 16.26
HGL = 19.48
EGL = 21.70

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Project Renaissance Center — Sheet 12 of 18
Hydraulic Gradient — Job No. 356
By JEM Chk'd _____ Date 12.8.84

Compute whether 54" from Alexander is under backwater conditions —

		in 84"
Normal	HGL = 19.43	HGL = 19.09
	EGL = 20.95	EGL = 21.19
Critical	HGL = 19.39	
	EGL = 20.91	

← with Losses backwater — will exist — work from downstream

Compute Junction Loss

$$h = \frac{11.69^2}{64.4} - \frac{5.46^2}{64.4} - 2\frac{15.90}{23.66} \times \frac{8.25^2}{64.4} \cos 45 = 0.53'$$

EGL = 21.72'
Q = 122.90 cfs

D/DF	Depth	A/AF	Area	V	hv	EGL
0.75	3.38	0.812	12.914	9.52	1.41	20.93
1.00	4.50	1.00	15.904	7.73	0.93	21.56

∴ HGL = 16.14 + 4.50 + 21.72 − 21.56 = 20.80

Compute to HGL 20.70 — 41.78' — AE = 16.34

hf = 0.0039 Hp = 0.16 Misc Losses (45° bend) = 0.25 hv = 0.22'

EGL = 22.10
HGL = 21.18
Upstream Q = 103.98 cfs
V = 6.54 fps hv = 0.66' ∴ HGL = 21.44
Surcharge = 0.60'

hf = .0028 ∴ Δ between Slope & hf = .00206
∴ Distance to WS breaking from Crown = 291
@ Sta 14+52.7
AE = 17.76 HGL = 22.26 EGL = 22.92

Compute to beginning of Curve Sta 15+00.01 AE = 17.99 L = 47.31
EGL = 23.06

D/DF	Depth	A/AF	Area	V	hv	EGL
0.95	4.28'	.984	15.65	6.64	0.69	22.96
0.97	4.37	.992	15.78	6.59	0.67	23.03 ← USE

HGL = 22.36

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Hydraulic Gradient Job No. 356
By EM Chk'd Date 12.11.84

Compute to Sta. 15+39.00 (38.99') R = 18.18
Misc Losses = 5 - 1°-50' bends total Loss = 0.03 hv = 0.02'
R/RF = 1.16 R = 1.305
hf = .00233 Hf = 0.07'
EGL = 23.15

D/DF	D	A/AF	Area	V	hv	EGL
0.95	4.28	0.984	15.55	6.64	0.69	23.15 ← 0.02

HGL = 22.46

Upstream 48" Q = 83.98 cfs
Increm Loss = 0.08'
EGL = 23.23

D/DF	D	A/AF	Area	V	hv	EGL
1.00	4.0	1.0	12.56	6.68	0.69	23.37
0.96	3.84	0.99	12.43	6.75	0.71	23.23 ←

HGL = 22.52

Compute to 16+04.74 65.74' R = 19.00
Misc Losses = 7 - 1°-50' bends Total Loss = 0.04 hv = 0.03'
R/RF 1.13

hf = 0.003
EGL = 23.45

D/DF	D	A/AF	Area	V	hv	EGL
0.92	3.68	.968	12.16	6.91	0.74	23.42 ← OSC

HGL = 22.68
R = 1.175
Compute to 16+50 64.87' HE = 19.32
hf = .003 EGL = 23.64

D/DF	D	A/AF	Area	V	hv	EGL
0.88	3.52	.938	11.79	7.12	0.79	23.63 ←

HGL = 22.84
Compute to End of Curve Sta 17+18.74 L = 68.74' HE = 19.65
R = 1.203
hf .003 EGL = 23.84

D/DF	D	A/AF	Area	V	hv	EGL
0.83	3.32	.893	11.22	7.48	0.87	23.84 ←

HGL = 22.97
R = 1.22

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Hydraulic Gradient Job No. 355
By EM Chk'd Date 12.11.84

Compute 1/2 way around Curve Sta 17+66.74 - 45° R= 19.88
Misc Losses - 6 - 9°-30' bends. Total Loss 0.39 hv= 0.34'
hf= 0.003 EGL= 24.33

D/DF	D	A/AF	A	V	hv	EGL
0.93	3.72	.972	12.21	6.88	0.73	24.33 ⇐

HGL = 23.60
R= 1.168
Compute to Sta 17+14.74 24" FL = 20.11
Misc Losses 6 - 9°30' bends Total Loss - 0.28'
hf= 0.003 EGL = 24.75

D/DF	D	A/AF	A	V	hv	EGL
1.00	4.00	1	12.56	6.68	0.69	24.80 ←

Obviously the remainder of this line will have its HGL below the top of the pipe & cause no backwater conditions affecting any inlet.

Compute sedimentation basin inlet @ Sta 90+72

48" Pipe turned up - perfect will act as weir
C= 3.0 L= π x 4 = 12.57' Q= 62.91 cfs

$62.91 = 3.0 \times 12.57 \times H^{3/2}$
H= 1.41'
Weir surface = 34.00 ∴ Max (100yr) WS = 35.41
Set temp berm @ 37.50 (2'+ Freeboard)

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Project Renaissance Center Sheet 15 of 18
Hydraulic Gradient Job No. 356
By EM Chk'd Date 12.11.84

In Renaissance Blvd Compute D.S from Sta 16+29.18
Q = 293.42 cfs
Flow will be under essentially Normal Conditions to Sta 6+82.75
= Sta 12+71.48 Tract 1B&1C FL = 16.68

Depth D.S = 4.24' ∴ HGL = 14.92 EGL = 17.12

Losses = Z-34°-07' Bends K_b = 0.128 ea
∴ total Loss 0.57' ∴ EGL Downstream = 16.55

D/DF	D	A/AF	A	V	hv	EGL
0.65	4.55	.698	26.86	10.92	1.85	17.08

Essentially Critical Depth ∴ Same backwater through elbow - Recompute from D.S.

EGL Upstream = $17.08 + 2 \times .128 \times \frac{10.92^2}{64.4} = 17.55$ (0.43' of Energy backwater)

D/DF	Depth	A/AF	A	V	hv	EGL
0.65	4.55	0.698	26.86	10.92	1.85	17.08
0.75	5.25	.811	31.21	9.40	1.37	17.30
0.80	5.60	.865	33.29	8.81	1.21	17.50 ← OSL

HGL = 16.28
R/RF = 1.22 R = 2.135
Compute to Sta 7+50 (67.25') FL = 10.98
hf = .002 ∴ EGL = 17.69 (Normal EGL = 17.42)

D/DF	Depth	A/AF	A	V	hv	EGL
0.75	5.25	.811	31.21	9.40	1.37	17.60 ← OSL

HGL = 16.23 R/RF = 1.21 R = 2.118
Compute to 8+00 (50.00') FE = 11.21
hf = .0025 EGL = 17.81 (Normal EGL = 17.65)

D/DF	Depth	A/AF	A	V	hv	EGL
0.70	4.90'	.755	29.06	10.10	1.58	17.69
0.73	5.11	0.79	30.40	9.65	1.45	17.76 ← OSL

HGL = 16.32 R/RF = 1.203 R = 2.105
Compute to 9+00 100' FL = 11.43
hf = .0026 EGL = 17.95 (Normal EGL = 17.87) Getting Very Close to Location of Hydraulic Jump) & Return to Normal Depth.

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Project Renaissance Center Sheet 16 of 18
Hydraulic Gradient Job No. 355
By JEM Chk'd Date 12-11-84

Elbow @ Sta 10+28.76, Δ = 31.00° will produce critical Depth
Downstream FE = 9.59
Downstream HGL = 14.14 EGL = 15.99

K_b = 0.117 ∴ Loss = 0.22'

EGL upstream = 16.21

D/D_F	D	A/A_F	A	V	hv	EGL
0.73	5.11	0.79	30.40	9.65	1.45	16.15 ← USE

HGL = 14.700 R/R_F = 1.203 R = 2.105

Compute to 11+00 = 7.24' FE = 9.91
hf = .0025 EGL = 16.40 Normal EGL = 16.35
Approx location of Hydraulic Jump & Return to Normal Flow

By 5+60.00 Flow will be normal
FE = 7.48 HGL = 11.72 EGL = 13.92

Downstream Q = 299.24 cfs

@ 4+34.01 2-31° Bends
K_b = 0.12 ea total = 0.24

Flow will be critical Depth Downstream of bends FE = 06.91
Depth = 4.55' V = 11.14 FPS hv = 1.93'
D.S HGL = 11.46 EGL = 13.39
Loss = .24 x 1.93 = 0.46'
EGL upstream = 13.85

D/D_F	D	A/A_F	A	V	hv	EGL
0.75	5.25	.811	31.21	9.59	1.43	13.52
0.80	5.60	.865	33.29	8.99	1.25	13.76
0.82	5.74	.885	34.06	8.79	1.20	13.85 ← USE

HGL = 12.65 R/R_F = 1.22 R = 2.135
This will Create a backwater past 5+60

6.7f

Compute to 5+00 - 6599' FE = 7.21
hf = .0022 EGL = 13.99

D/D_F	D	A/A_F	A	V	hv	EGL
0.80	5.60	0.865	33.29	8.99	1.25	14.06 ← USE

HGL = 12.81 R/R_F = 1.22 R = 2.135

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Hydraulic Gradient Job No. 356
By JAM Chk'd _____ Date 12.11.84

Compute to 12+60 (60') FE = 7.48
hf = .0023 ∴ EGL = 14.13

6.45

D/Df	D	A/Af	A	V	hv	EGL
0.75	5.25	.811	31.21	9.59	1.43	14.16 ← USE

HGL = 12.73 R/Rf = 1.21 R = 2.12

Compute to 6+25 65' R = 7.77 (Normal EGL = 14.21)

6.52 hf = .002C EGL = 14.29

D/Df	D	A/Af	A	V	hv	EGL
0.70	4.90	.755	29.06	10.10	1.58	14.25 ← USE

HGL = 12.67 R/Rf = 1.19 R = 2.08

Compute to 7+00 75' R = 8.11 (Normal EGL = 14.55)

hf = .0029 EGL = 14.51 ← Location of Jump to Normal Depth

Check From Pipe outlet · FE = 04.00

Max WS in Pond = 10.50

Under "Normal" flow in outlet · HGL = 07.43 EGL = 11.06

$$h_L = \frac{(6.5 - 3.43)^3}{4 \times 6.5 \times 3.43} = 0.32'$$

∴ Jump will take place @ (1+17) + $\frac{.24}{.0092}$ = Sta 1+43
FE = 04.24
HGL upstream = 7.67' EGL = 11.31

299.24

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By JM Chk'd Date 12.11.84

Compute Downstream from 4+34.01 to Sta 4+00

FL = 6.60

R/RF = 1.55 R = 2.02

hf = .0037 EGL = 13.26

D/DF	D	A/AF	A	V	hv	EGL
.60	4.20	.633	24.36	12.28	2.34	13.14
.58	4.06	0.61	23.46	12.75	2.52	13.18
0.55	3.85	0.57	21.94	13.64	2.89	13.33
0.53	3.99	.595	22.90	13.07	2.65	13.24 ←

HGL = 10.57 R/RF = 1.08 R = 1.89

Compute to 3+50 L = 50' FL = 6.14

hf = .0056 EGL = 12.98

D/DF	D	A/AF	A	V	hv	EGL
0.55	3.85	0.57	21.94	13.64	2.89	12.88
0.54	3.78	.559	21.51	13.91	3.00	12.92
0.53	3.71	.543	20.90	14.32	3.18	13.03 ←

HGL = 9.85 R/RF = 1.038 R = 1.82

Compute to 3+00 L = 50' FL = 5.68

hf = .0071 EGL = 12.63

D/DF	D	A/AF	A	V	hv	EGL
0.50	3.50	0.50	19.24	15.55	3.76	12.93
0.51	3.57	0.52	20.01	14.95	3.47	12.72 ← USE

HGL = 9.25 R/RF = .1015 R = 1.78

Compute to 2+55 L = 45' FL = 5.27

hf = .0079 EGL = 12.27

D/DF	D	A/AF	A	V	hv	EGL
0.50	3.50	0.50	19.24	15.55	3.76	12.53
0.51	3.57	0.52	2001	14.95	3.47	12.31 ←

HGL = 8.84

1-40° Bend K_B = 0.13 h_B = 0.46

EGL DS = 11.81

D/DF	D	A/AF	A	V	hv	EGL
0.60	4.20	.633	24.36	12.28	2.34	11.81

HGL = 9.47

6.54

IX. DRAINAGE AREA A OUTFALL CALCULATIONS

Following are the calculations for the required outfall line and detention basin to the north of the property.

Albuquerque Gravel Products will construct this facility.

ANDREWS, ASBURY & ROBERT, INC.
CONSULTING ENGINEERS
149 Jackson, N.E., Albuquerque, N.M. 87108
Telephone (505) 265-6631

Project Renaissance Center Sheet 1 of 1
Drainage Area A Outfall Job No. 356
By FM Chk'd _____ Date 12.12.84

Compute size of Retention Pond required under Developed Conditions.

C = 0.70 Area = 52.17 Acres

Volume = 6.70 Ac. Ft
100 year flow = 63.86 cfs
outfall Channel to Detention basin 5' Bottom width, 2:1 side slopes. w n = 0.013 depth = 1.85'

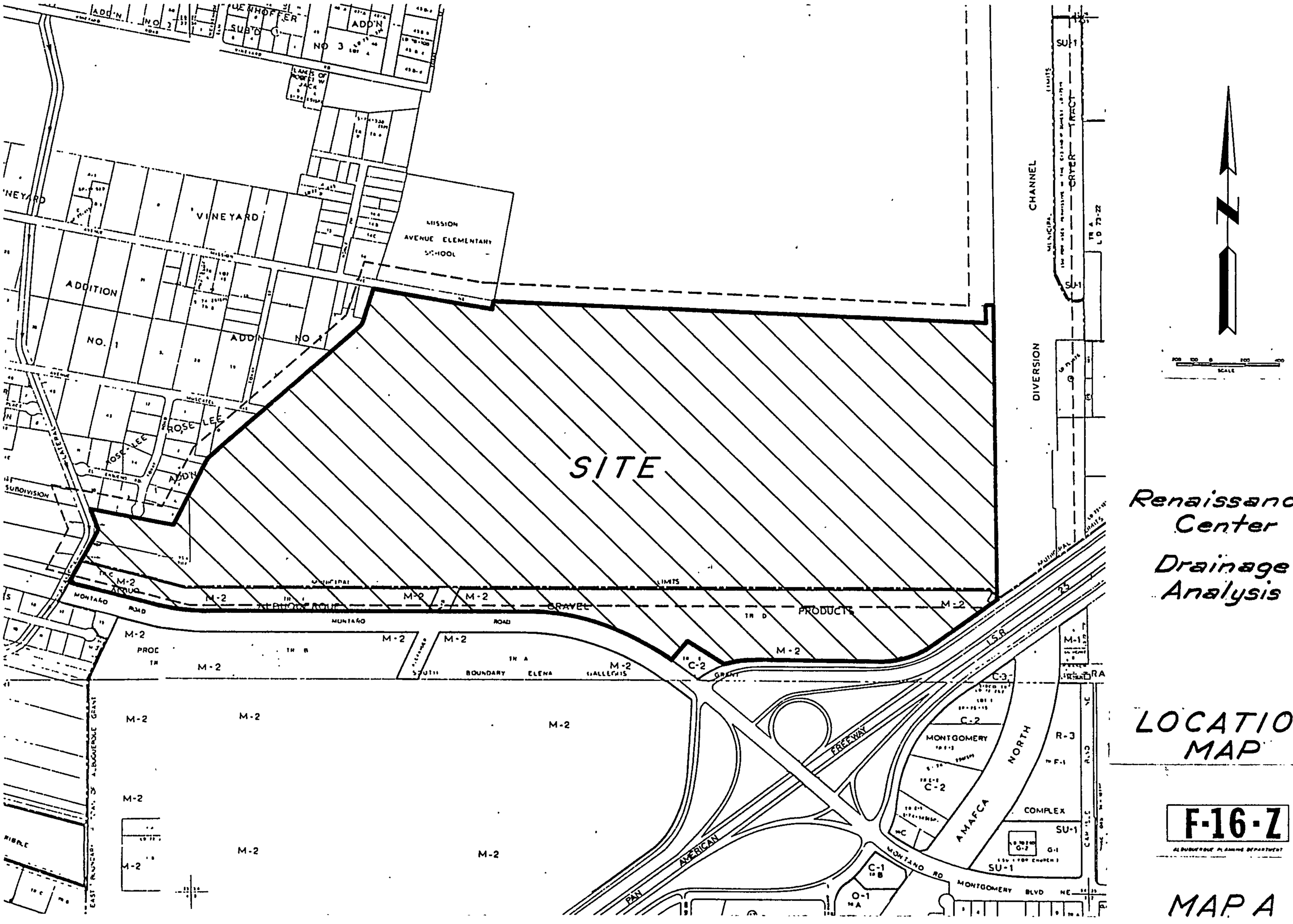
48" Pipe through levee 0.50% under Inlet control. Hec Inlet = 38.50
HW/D = 0.89
Headwater = 3.56'
HGLC Entrance = 42.06

INTERSTATE 25 STORM DRAIN INSTALLATION PROCEDURE

Two existing 30" diameter RCP culvert pipes, located north of the I-25 West Frontage Road, will be extended 20 feet to a new junction box. This extension will connect to a new 36" diameter storm sewer on the Renaissance Center property. This is necessitated in order to eliminate an existing ponding area.

The pipes will be installed by trenching. No trenching or pipelaying equipment will be operated from the paved roadway, which is approximately 10 feet south of the present north end of the culvert. Construction time will be less than one week.

Traffic control device will be in accordance with the "Manual on Uniform Traffic Control Devices for Streets and Highways".



Renaissance Center

Drainage Analysis

LOCATION MAP

F-16-Z

ALBUQUERQUE PLANNING DEPARTMENT

MAP A