City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

February 11, 1999

George Nemeth,. PE
Easterling & Associates, Inc.
2600 American Rd, Suite 100
Rio Rancho, NM 87124

RE: DRAINAGE REPORT FOR SEVEN BAR TOWN CENTER (A-13/D013)
RECEIVED JAN 21, 1999 FOR SITE DEVELOPMENT PLAN
ENGINEER'S STAMPED 1-15-99

Dear Mr. Nemeth:

Based on the information included in the submittal referenced above, City Hydrology accepts the Drainage Report for Site Development Plan. Address the drainage system maintenance issue prior to the next submittal. Typically, Storm Maintenance would not maintain this facilities. Include a written commitment to maintain the drainage system in the next submittal.

If I can be of further assistance, You may contact me at 768-2727.

Sincerely,

John P. Curtin

John P. Curtin, P.E.
Project Manager, PWD/Hyd

c: Andrew Garcia

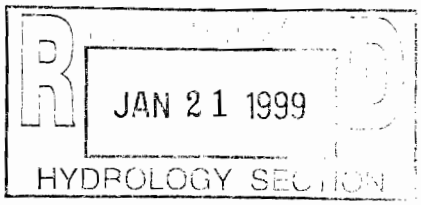
SEVEN BAR RANCH TOWN CENTER

DRAINAGE REPORT

JANUARY 1999

Prepared for:

Consensus Planning, Inc.
924 Park Avenue SW
Albuquerque, New Mexico 87102



Prepared By:

Easterling & Associates, Inc.
2600 American Road SE, Suite 100
Rio Rancho, New Mexico 87124

I, George Nemeth, P.E., do hereby certify that this document was prepared by me, or under my direct supervision, and is true and correct to the best of my knowledge and belief and that I am a duly registered Professional Engineer under the laws of the State of New Mexico.

George Nemeth, P.E.
New Mexico P.E. No. 12284

1-15-99
Date

INTRODUCTION

The project site is located at the northwest corner of Ellison Drive and the Coors Bypass in the northwest section of Albuquerque, New Mexico (see **Figure 1**). The site is within the special Assessment District (SAD) No. 223 and is designated as Tract B-9D. The tract is 7.3 acres in size, and is zoned SU-1 for Institutional Purposes / Office / Mix.

Tract B-9D is included in the analysis of the "SAD No. 223 Drainage Management Plan", dated May 1991 and revised through July 1994, prepared by Easterling & Associates, Inc. According to a table on Plate 1 of the Drainage Management Plan, the allowable stormwater release rate from the developed Tract B-9D is 4.4 cfs and is to be achieved through the implementation of on-site stormwater detention. A copy of the table on Plate 1 is included for convenience as **Figure 2**.

The proposed development of Tract B-9D includes a Park & Ride facility on the eastern portion of the site and a community center on the western portion. The community center is to include a police/fire station, a library, a senior center, and a daycare center. The ultimate, or master, site plan is included as **Figure 3**.

The site slopes from west to east at approximately a 5 percent grade. It is presently undeveloped and is covered with typical west mesa desert vegetation. The only site improvement is a temporary stormwater discharge structure at the northeast corner of the property.

DRAINAGE ANALYSIS

The SAD No. 223 Drainage Management Plan was completed using the September 1991 (9-91) version of AHYMO. The current analysis of stormwater runoff from tract B-9D presented in this report utilizes the January 1994 (1-94) version of AHYMO. The AHYMO commands used in the current analysis (using 1-94 version) are identical to the commands used in the SAD No. 223 Drainage Management Plan (using 9-91 version).

The input parameters are also the same. For example, both analyses use the 24-hour storm duration to analyze the 100-year and 10-year runoff, time increments of D=0.05 hours, and minimum time at concentration, t_c = 12 minutes.

The current drainage analysis looks at the fully developed site as a community center as shown on the Seven Bar Ranch Town Center Master Plan included in this report as Figure 3. The plan includes an estimated 0.2 acres of Land Treatment B, 2.0 acres of Land Treatment C, and 5.1 acres of Land Treatment D. Total site area is 7.3 acres.

The SAD No. 223 Drainage Management Plan constrained the project site to an allowable discharge rate of 4.4 cfs. The current AHYMO analysis (1-94 version), included as **Appendix A**, indicates that, with the proposes detention system, the peak discharge rate from the fully developed site for the 100-year/24-hour storm event does not exceed the allowable discharge rate. The proposed on-site detention system is described in the following section.

DRAINAGE BASIN DATA

Tract	Analysis Point I.D. No.	Area (Acres)	Developed Condition		Allowable Release Rate (cfs)	Property Zoning Comments
			V_{100} (AF)	Q_{100} (cfs)		
PROJECT SITE → B-9D	175	7.40	0.95	23.4	4.4	SU-1 for Institutional Purposes/Office/Mix
B-9E	124	16.90	2.43	57.2	10.7	SU-1 for R-2 uses/High Density
B-9F	120	12.90	1.85	43.7	8.5	SU-1 For R-2 Uses/High Density
B-9G (South)	108	30.60	4.84	110.5	20.6	R-T/Medium Density
B-9H (West)	101	15.00	2.37	54.2	10.1	R-T/Medium Density
B-9H (East)	116	7.00	1.11	25.3	4.7	R-T/Medium Density
B-9J	150	37.60	5.40	127.2	23.8	SU-1 for R-2 uses/Medium & High Density
B-10	174	8.30	1.19	28.1	8.1	SU-1 for R-2 uses/Medium Density
Cibola High School	133	45.67	4.87	94.9	*(1)*	High School
G-1A	224	9.29	1.61	35.7	6.7	SU-1/R3
G-2A	234	9.98	1.72	38.3	7.2	SU-1/IP
M	206	42.82	7.40	164.4	30.7	A-1 (W/Permit for SU-1 for C2 uses)
N-2A-1 (North)	139	2.0	0.32	7.4	4.6	SU-1 for R-2 uses/Medium Density
N-2A-2 (East)	135	1.02	0.14	3.3	3.3	R-T/Medium Density
N-2B (South)	188	2.46	0.44	9.7	*(1)*	Open Space/Parking Area
N-2B (North)	189	4.41	0.37	12.6	*(1)*	Open Space/Ponding
0-1A-1 & 0-2A-1	238	59.30	9.82	197.2	40.8	SU-1 for IP uses/Office Mix
SR 528 & Adjacent Area	240	60.10	(2) 5.15	(2) 114.66		Area outside of S.A.D. 223 Partially Undeveloped/Mixed Uses
Sky View Acres	244	74.11	(3) 7.22	(3) 177.80		Area Outside of S.A.D. 223 Residential

(1) Free discharge into regional detention pond allowed. Total allowable discharge from regional pond = 11.6 cfs.

(2) Peak flow rate and volume reflect the existing condition of the area with no credit given for on-site ponding. The 1984 Conceptual Grading and Drainage Plan for this area indicates on-site ponding ranging from 20% to 100% of the 100 year developed runoff volume is required on the individual tracts.

(3) Previous drainage plans indicate that this portion of Skyview Acres is to have free discharge to the Cabezon Channel.

FIGURE 2

SEVEN BAR TOWN CENTER

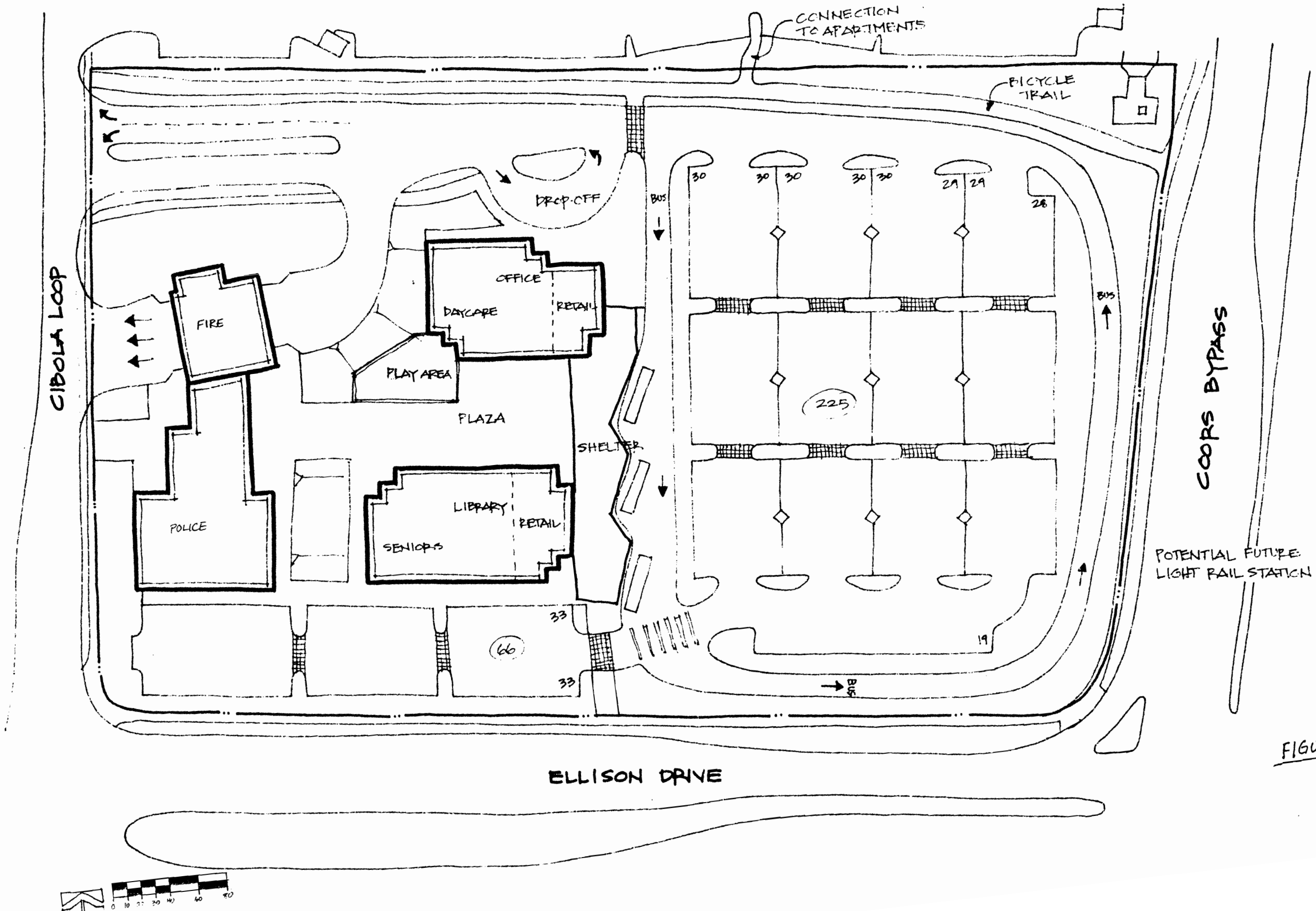


FIGURE 3

ON-SITE DETENTION

Initially, the on-site stormwater detention facility was envisioned as a conventional surface pond with a controlled discharge. However, the amount of property required for a surface pond to achieve the discharge constraints of the SAD No. 223 Drainage Management Plan is estimated at 0.5 acres. This would have reduced the available parking to service the Park & Ride facility by 15%. This was deemed to be unacceptable by the City.

A combination surface and subsurface stormwater detention facility was then investigated. For the purpose of this Drainage Report, a system of buried 90" pipes, totaling approximately 550 lineal feet, can provide approximately 80 percent of the 100-year/24-hour stormwater runoff. The remainder of the storage will be accounted for on the parking lot surface and in a small landscaped area. Storage within the storm inlets, stormceptor manholes, and the connecting 18" pipes is not included in the analysis. Exclusion of these elements will provide a factor of safety in both the available storage volume and the actual discharge through the 7" orifice.

The AHYMO analysis shows the maximum storage volume is 0.6878 AC-PT, the maximum discharge is 4.25 cfs, and the maximum water surface elevation is 5057.54. Exhibit 1 shows the proposed grading and drainage system for the project site as well as the maximum extent of ponding on the surface during the 100-year 24-hour storm event. No surface ponding will occur during the 50-year storm event, because the maximum surface elevation is 5055.46 and finish grade is approximately 5057.00.

Discharge is controlled by an 7" diameter outlet orifice, and the peak was computed to be approximately 4.25 cfs. This discharge is less than the allowable of 4.4 cfs determined by the SAD No. 223 Drainage Management Plan. However, since final design of the system has not been completed at the time this Drainage Report was written, discharge may increase up to the allowable of 4.4 cfs upon completion of final design. **Appendix B** includes the discharge computation through the 7" orifice.

The invert of the 90" buried pipe detention system is to be set at elevation 5047.0, and will discharge to the existing on-site storm sewer inlet which has an invert elevation of 5046.47. This inlet will be converted to a standard City manhole and the surrounding concrete and riprap will be removed and disposed of. Discharge is to the north and then to the east into the existing city 36" storm sewer in the Coors Blvd. Bypass Road. **Exhibit 1** in the back pocket of this plan shows the proposed and existing components graphically.

Two different ways of completely draining the buried pipe have been considered. One way is slope the pipe slightly toward the discharge orifice so eventually all stormwater discharges into the City system. The second way is to set the invert level and to perforate the invert of the pipe corrugations so infiltration occurs. Since the discharge orifice and the 90" pipe inverts will be the same, only water trapped in the pipe corrugations will need to infiltrate into the ground. The preferred alternative is a combination of the two. That is to set the 90" pipe at a very gentle slops toward the discharge orifice and to perforate the bottom of the pipe corrugations to allow infiltration into the ground.

SITE GRADING

The existing west-to-east downhill slope of the site is to be maintained. However, site grading will be performed to accommodate the proposed future buildings and Park & Ride facilities. All four sides of the property are developed and thus matching grade elevations are fixed around the site. A rough proposed grading plan is included in the back pocket of this plan as **Exhibit 1**.

The top of the 90" pipe will be at elevation 5047.0 plus 7.5 feet or 5054.5 feet. This leaves about 2 feet of cover at a minimum. If a detailed design analysis indicates, a concrete cap can be placed over the pipe to distribute loads. It is proposed to use corrugated metal pipe (CMP) for the buried detention system. This pipe allows a minimum of one foot of cover.

STORM WATER QUALITY

Storm water quality, as it runs-off from the proposed 225-car parking area, is a concern. An oil/water separator will be located so as to run the 10-year storm peak flow rate (18.44cfs) through the separator to remove oils and sediment prior to discharging to the City storm sewer or to the ground through infiltration. **Appendix C** is an example of the type of oil/water separator system intended for use on this project.

EROSION CONTROL

Steep slopes (greater than 1:10) will be stabilized with landscaping stone on filler cloth or with turf. The grading plan shown on **Exhibit 1** indicates very few areas with slopes greater than 1:10.

References

Easterling & Associates, Inc., May 1991, "SAD No. 223 Drainage Management Plan," revised through July 1994

AMAFCA, January 1994, "AHYMO Computer Program Users Manual"

American Concrete Pipe Association, October 1987, "Concrete Pipe Design Manual"

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    AHYMO PROGRAM (AHYMO194) - AMAFCA Hydrologic Model - January, 1994
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         START TIME (HR:MIN:SEC) = 08:45:15     USER NO.= EASTERNM.I01
         INPUT FILE = t:\projects\4570\eng\devcon99.hmi

*** SEVEN BAR RANCH TOWN CENTER - DRAINAGE REPORT

**********************************************************************
**This data set computes the developed condition runoff from     **
**the proposed ultimate development plan for the entire 7.3 ac   **
**site and routes it through a subsurface detention pond.        **
**Date: 12/28/98 *  * filename= devcon99.hmi                     **
**  **
**********************************************************************
*
**********************************************************************
** DESIGN STORM IS THE 100 YEAR - 24 HOUR STORM
**
** COA DPM TYPE 2, 24 HR STORM WITH PEAK INTENSITY AT 1.4 HRS
**********************************************************************

START                TIME=0

RAINFALL             TYPE = 2
                     RAIN QUARTER = 0.00   INCHES
                     RAIN ONE     = 1.87
                     RAIN SIX     = 2.20
                     RAIN DAY     = 2.66
                     DT = 0.05  HOURS


                COMPUTED 24-HOUR RAINFALL DISTRIBUTION BASED ON NOAA ATLAS 2 - PEAK AT 1.40 HR.
                DT =     .050000 HOURS        END TIME =    24.000000 HOURS
                   .0000   .0025   .0050   .0076   .0103   .0131   .0160
                   .0190   .0222   .0254   .0289   .0324   .0362   .0401
                   .0443   .0487   .0534   .0584   .0637   .0695   .0758
                   .0837   .0924   .1176   .1773   .2798   .4384   .6668
                   .9790  1.2253  1.3366  1.4295  1.5109  1.5836  1.6495
                  1.7096  1.7648  1.8156  1.8624  1.9057  1.9458  1.9548
                  1.9631  1.9708  1.9780  1.9848  1.9912  1.9973  2.0031
                  2.0087  2.0140  2.0191  2.0240  2.0287  2.0333  2.0377
                  2.0420  2.0462  2.0502  2.0542  2.0580  2.0617  2.0653
                  2.0689  2.0724  2.0757  2.0791  2.0823  2.0855  2.0886
                  2.0916  2.0946  2.0976  2.1005  2.1033  2.1061  2.1088
                  2.1115  2.1142  2.1168  2.1193  2.1219  2.1244  2.1268
                  2.1293  2.1316  2.1340  2.1363  2.1386  2.1409  2.1431
                  2.1453  2.1475  2.1497  2.1518  2.1539  2.1560  2.1580
                  2.1601  2.1621  2.1641  2.1660  2.1680  2.1699  2.1718
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                  2.1864  2.1882  2.1899  2.1916  2.1933  2.1950  2.1967
                  2.1984  2.2000  2.2020  2.2039  2.2059  2.2078  2.2097
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                  2.2870  2.2887  2.2903  2.2920  2.2937  2.2953  2.2970
                  2.2986  2.3002  2.3019  2.3035  2.3051  2.3068  2.3084
                  2.3100  2.3116  2.3132  2.3148  2.3164  2.3180  2.3196
                  2.3212  2.3227  2.3243  2.3259  2.3274  2.3290  2.3305
                  2.3321  2.3336  2.3352  2.3367  2.3383  2.3398  2.3413
                  2.3428  2.3444  2.3459  2.3474  2.3489  2.3504  2.3519
                  2.3534  2.3549  2.3563  2.3578  2.3593  2.3608  2.3622
                  2.3637  2.3652  2.3666  2.3681  2.3695  2.3710  2.3724
                  2.3739  2.3753  2.3767  2.3782  2.3796  2.3810  2.3824
                  2.3839  2.3853  2.3867  2.3881  2.3895  2.3909  2.3923
                  2.3937  2.3951  2.3965  2.3978  2.3992  2.4006  2.4020
                  2.4033  2.4047  2.4061  2.4074  2.4088  2.4101  2.4115
                  2.4128  2.4142  2.4155  2.4168  2.4182  2.4195  2.4208
                  2.4222  2.4235  2.4248  2.4261  2.4274  2.4287  2.4300
                  2.4314  2.4327  2.4340  2.4352  2.4365  2.4378  2.4391
                  2.4404  2.4417  2.4430  2.4442  2.4455  2.4468  2.4480
                  2.4493  2.4506  2.4518  2.4531  2.4543  2.4556  2.4568
                  2.4581  2.4593  2.4606  2.4618  2.4630  2.4643  2.4655
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2.4753  2.4765  2.4777  2.4789  2.4801  2.4813  2.4825
2.4837  2.4849  2.4860  2.4872  2.4884  2.4896  2.4908
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2.5082  2.5093  2.5105  2.5116  2.5127  2.5139  2.5150
2.5161  2.5172  2.5184  2.5195  2.5206  2.5217  2.5229
2.5240  2.5251  2.5262  2.5273  2.5284  2.5295  2.5306
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2.5762  2.5772  2.5782  2.5792  2.5803  2.5813  2.5823
2.5833  2.5843  2.5853  2.5863  2.5873  2.5883  2.5893
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2.5973  2.5982  2.5992  2.6002  2.6012  2.6022  2.6031
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2.6564  2.6573  2.6582  2.6591  2.6600
```

```
**************************************************************
** DEVELOPED CONDITION RUNOFF
**************************************************************

COMPUTE NM HYD       ID=10   HYDNO=100   DA=0.0114   SQ MI
                     PERCENT A=0   B=2.7   C=27.4   D=69.9
                     TP=0.111 HOURS    MASSRAIN=-1


    K =   .060495HR    TP =   .111000HR    K/TP RATIO =   .545000     SHAPE CONSTANT, N =  7.106420
    UNIT PEAK =   37.781    CFS   UNIT VOLUME =    1.000       B =   526.28      P60 = 1.8700
    AREA =      .007969 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


    K =   .090033HR    TP =   .111000HR    K/TP RATIO =   .811107     SHAPE CONSTANT, N =  4.409559
    UNIT PEAK =   11.797    CFS   UNIT VOLUME =    1.001       B =   381.61      P60 = 1.8700
    AREA =      .003431 SQ MI    IA =    .36346 INCHES    INF =    .86767 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD            ID=10   CODE=1

                                PARTIAL HYDROGRAPH   100.00


    RUNOFF VOLUME =     1.98495 INCHES     =       1.2068 ACRE-FEET
    PEAK DISCHARGE RATE =      29.18 CFS  AT   1.500 HOURS   BASIN AREA =   .0114 SQ. MI.



**THE FOLLOWING TABLE IS FOR 90" DIAMETER PIPE WITH 7" OUTFLOW ORIFICE.**

ROUTE RESERVOIR      ID=20   HYD=PIPE.90   INFLOW ID=10   CODE=5
                      OUTFLOW (CFS)  STORAGE (AC FT)  ELEV (FT)
                          0.0            0.0           5047.0
                          1.00           0.0160        5047.5
                          1.12           0.0442        5048.0
                          1.47           0.0794        5048.5
                          1.74           0.1194        5049.0
                          1.98           0.1628        5049.5
                          2.19           0.2084        5050.0
                          2.39           0.2552        5050.5
                          2.56           0.3026        5051.0
                          2.72           0.3494        5051.5
                          2.88           0.3950        5052.0
                          3.03           0.4384        5052.5
                          3.19           0.4784        5053.0
```

3.32	0.5136	5053.5
3.45	0.5418	5054.0
3.58	0.5578	5054.5
4.28	0.6936	5057.67

* * * * * * * * * * * * * * * *

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
.00	.00	5047.00	.000	.00
.25	.00	5047.00	.000	.00
.50	.00	5047.00	.000	.00
.75	.00	5047.00	.000	.00
1.00	.00	5047.00	.000	.00
1.25	3.40	5047.31	.010	.63
1.50	29.18	5051.30	.330	2.66
1.75	10.06	5055.73	.610	3.85
2.00	5.66	5057.44	.684	4.23
2.25	1.39	5056.92	.662	4.12
2.50	.64	5055.47	.599	3.79
2.75	.36	5053.87	.535	3.42
3.00	.24	5052.93	.473	3.17
3.25	.18	5052.22	.414	2.95
3.50	.15	5051.60	.359	2.75
3.75	.14	5051.04	.307	2.57
4.00	.13	5050.53	.258	2.40
4.25	.13	5050.05	.213	2.21
4.50	.13	5049.60	.172	2.02
4.75	.13	5049.18	.135	1.83
5.00	.14	5048.78	.102	1.62
5.25	.14	5048.42	.074	1.41
5.50	.15	5048.08	.050	1.18
5.75	.16	5047.75	.030	1.06
6.00	.17	5047.40	.013	.81
6.25	.20	5047.18	.006	.36
6.50	.20	5047.12	.004	.24
6.75	.19	5047.10	.003	.21
7.00	.19	5047.10	.003	.20
7.25	.19	5047.10	.003	.19
7.50	.18	5047.09	.003	.19
7.75	.18	5047.09	.003	.18
8.00	.18	5047.09	.003	.18
8.25	.18	5047.09	.003	.18
8.50	.17	5047.09	.003	.18
8.75	.17	5047.09	.003	.17
9.00	.17	5047.08	.003	.17
9.25	.17	5047.08	.003	.17
9.50	.16	5047.08	.003	.17
9.75	.16	5047.08	.003	.16
10.00	.16	5047.08	.003	.16
10.25	.16	5047.08	.003	.16
10.50	.15	5047.08	.003	.16
10.75	.15	5047.08	.002	.15
11.00	.15	5047.08	.002	.15
11.25	.15	5047.08	.002	.15
11.50	.15	5047.07	.002	.15
11.75	.14	5047.07	.002	.15
12.00	.14	5047.07	.002	.14
12.25	.14	5047.07	.002	.14
12.50	.14	5047.07	.002	.14
12.75	.14	5047.07	.002	.14
13.00	.14	5047.07	.002	.14
13.25	.13	5047.07	.002	.14
13.50	.13	5047.07	.002	.14
13.75	.13	5047.07	.002	.13

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
14.00	.13	5047.07	.002	.13
14.25	.13	5047.06	.002	.13
14.50	.13	5047.06	.002	.13
14.75	.13	5047.06	.002	.13
15.00	.12	5047.06	.002	.13

15.25	.12	5047.06	.002	.13
15.50	.12	5047.06	.002	.12
15.75	.12	5047.06	.002	.12
16.00	.12	5047.06	.002	.12
16.25	.12	5047.06	.002	.12
16.50	.12	5047.06	.002	.12
16.75	.12	5047.06	.002	.12
17.00	.12	5047.06	.002	.12
17.25	.11	5047.06	.002	.12
17.50	.11	5047.06	.002	.11
17.75	.11	5047.06	.002	.11
18.00	.11	5047.06	.002	.11
18.25	.11	5047.06	.002	.11
18.50	.11	5047.06	.002	.11
18.75	.11	5047.05	.002	.11
19.00	.11	5047.05	.002	.11
19.25	.11	5047.05	.002	.11
19.50	.10	5047.05	.002	.11
19.75	.10	5047.05	.002	.11
20.00	.10	5047.05	.002	.10
20.25	.10	5047.05	.002	.10
20.50	.10	5047.05	.002	.10
20.75	.10	5047.05	.002	.10
21.00	.10	5047.05	.002	.10
21.25	.10	5047.05	.002	.10
21.50	.10	5047.05	.002	.10
21.75	.10	5047.05	.002	.10
22.00	.10	5047.05	.002	.10
22.25	.10	5047.05	.002	.10
22.50	.10	5047.05	.002	.10
22.75	.09	5047.05	.002	.10
23.00	.09	5047.05	.002	.10
23.25	.09	5047.05	.002	.09
23.50	.09	5047.05	.001	.09
23.75	.09	5047.05	.001	.09
24.00	.09	5047.05	.001	.09
24.25	.01	5047.03	.001	.05
24.50	.00	5047.01	.000	.02
24.75	.00	5047.00	.000	.01
25.00	.00	5047.00	.000	.00

PEAK DISCHARGE = 4.250 CFS - PEAK OCCURS AT HOUR 2.05
MAXIMUM WATER SURFACE ELEVATION = 5057.536
MAXIMUM STORAGE = .6878 AC-FT INCREMENTAL TIME= .050000HRS

****

FINISH

NORMAL PROGRAM FINISH END TIME (HR:MIN:SEC) = 08:45:16

```
    AHYMO PROGRAM (AHYMO194) - AMAFCA Hydrologic Model - January, 1994
         RUN DATE (MON/DAY/YR) = 01/14/1999
         START TIME (HR:MIN:SEC) = 10:54:44     USER NO.= EASTERNM.I01
         INPUT FILE = t:\projects\4570\eng\devcon50.hmi

*** SEVEN BAR RANCH TOWN CENTER - DRAINAGE REPORT

**********************************************************************
**This data set computes the developed condition runoff from     **
**the proposed ultimate development plan for the entire 7.3 ac   **
**site and routes it through a subsurface detention pond.        **
**Date: 01/15/99 *  * filename= devcon50.hmi                     **
**  **
**********************************************************************
*
**********************************************************************
** DESIGN STORM IS THE 50 YEAR - 24 HOUR STORM
**
** COA DPM TYPE 2, 24 HR STORM WITH PEAK INTENSITY AT 1.4 HRS
**********************************************************************

START                TIME=0

RAINFALL             TYPE = 2
                     RAIN QUARTER = 0.00   INCHES
                     RAIN ONE     = 1.68
                     RAIN SIX     = 1.98
                     RAIN DAY     = 2.39
                     DT = 0.05  HOURS


               COMPUTED 24-HOUR RAINFALL DISTRIBUTION BASED ON NOAA ATLAS 2 - PEAK AT 1.40 HR.
               DT =     .050000 HOURS       END TIME =    24.000000 HOURS
                  .0000   .0023   .0046   .0070   .0095   .0120   .0147
                  .0175   .0204   .0234   .0265   .0298   .0333   .0369
                  .0407   .0448   .0491   .0536   .0586   .0639   .0696
                  .0767   .0846   .1072   .1608   .2529   .3954   .6006
                  .8811  1.1024  1.2023  1.2858  1.3589  1.4243  1.4835
                 1.5375  1.5870  1.6327  1.6748  1.7137  1.7496  1.7578
                 1.7653  1.7722  1.7787  1.7849  1.7907  1.7962  1.8014
                 1.8065  1.8113  1.8159  1.8203  1.8246  1.8288  1.8328
                 1.8367  1.8404  1.8441  1.8476  1.8511  1.8545  1.8578
                 1.8610  1.8641  1.8672  1.8702  1.8731  1.8760  1.8789
                 1.8816  1.8843  1.8870  1.8896  1.8922  1.8947  1.8972
                 1.8996  1.9020  1.9044  1.9067  1.9090  1.9113  1.9135
                 1.9157  1.9179  1.9200  1.9222  1.9242  1.9263  1.9283
                 1.9303  1.9323  1.9343  1.9362  1.9381  1.9400  1.9419
                 1.9437  1.9455  1.9473  1.9491  1.9509  1.9527  1.9544
                 1.9561  1.9578  1.9595  1.9611  1.9628  1.9644  1.9661
                 1.9677  1.9692  1.9708  1.9724  1.9739  1.9755  1.9770
                 1.9785  1.9800  1.9817  1.9835  1.9852  1.9870  1.9887
                 1.9904  1.9921  1.9938  1.9955  1.9972  1.9989  2.0006
                 2.0022  2.0039  2.0056  2.0072  2.0089  2.0105  2.0122
                 2.0138  2.0154  2.0171  2.0187  2.0203  2.0219  2.0235
                 2.0251  2.0267  2.0283  2.0299  2.0315  2.0330  2.0346
                 2.0362  2.0377  2.0393  2.0408  2.0424  2.0439  2.0455
                 2.0470  2.0485  2.0500  2.0515  2.0531  2.0546  2.0561
                 2.0576  2.0591  2.0606  2.0620  2.0635  2.0650  2.0665
                 2.0679  2.0694  2.0709  2.0723  2.0738  2.0752  2.0766
                 2.0781  2.0795  2.0809  2.0824  2.0838  2.0852  2.0866
                 2.0880  2.0894  2.0908  2.0922  2.0936  2.0950  2.0964
                 2.0978  2.0992  2.1005  2.1019  2.1033  2.1046  2.1060
                 2.1074  2.1087  2.1101  2.1114  2.1127  2.1141  2.1154
                 2.1167  2.1181  2.1194  2.1207  2.1220  2.1234  2.1247
                 2.1260  2.1273  2.1286  2.1299  2.1312  2.1325  2.1337
                 2.1350  2.1363  2.1376  2.1389  2.1401  2.1414  2.1427
                 2.1439  2.1452  2.1464  2.1477  2.1490  2.1502  2.1514
                 2.1527  2.1539  2.1552  2.1564  2.1576  2.1588  2.1601
                 2.1613  2.1625  2.1637  2.1649  2.1661  2.1673  2.1685
                 2.1697  2.1709  2.1721  2.1733  2.1745  2.1757  2.1769
                 2.1781  2.1792  2.1804  2.1816  2.1828  2.1839  2.1851
                 2.1863  2.1874  2.1886  2.1897  2.1909  2.1920  2.1932
                 2.1943  2.1955  2.1966  2.1977  2.1989  2.2000  2.2011
                 2.2023  2.2034  2.2045  2.2056  2.2068  2.2079  2.2090
                 2.2101  2.2112  2.2123  2.2134  2.2145  2.2156  2.2167
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2.2178  2.2189  2.2200  2.2211  2.2222  2.2232  2.2243
2.2254  2.2265  2.2275  2.2286  2.2297  2.2308  2.2318
2.2329  2.2339  2.2350  2.2361  2.2371  2.2382  2.2392
2.2403  2.2413  2.2424  2.2434  2.2444  2.2455  2.2465
2.2475  2.2486  2.2496  2.2506  2.2517  2.2527  2.2537
2.2547  2.2557  2.2568  2.2578  2.2588  2.2598  2.2608
2.2618  2.2628  2.2638  2.2648  2.2658  2.2668  2.2678
2.2688  2.2698  2.2708  2.2718  2.2728  2.2737  2.2747
2.2757  2.2767  2.2777  2.2786  2.2796  2.2806  2.2815
2.2825  2.2835  2.2844  2.2854  2.2864  2.2873  2.2883
2.2892  2.2902  2.2911  2.2921  2.2930  2.2940  2.2949
2.2959  2.2968  2.2978  2.2987  2.2996  2.3006  2.3015
2.3024  2.3034  2.3043  2.3052  2.3062  2.3071  2.3080
2.3089  2.3098  2.3108  2.3117  2.3126  2.3135  2.3144
2.3153  2.3162  2.3171  2.3181  2.3190  2.3199  2.3208
2.3217  2.3226  2.3235  2.3244  2.3252  2.3261  2.3270
2.3279  2.3288  2.3297  2.3306  2.3315  2.3323  2.3332
2.3341  2.3350  2.3359  2.3367  2.3376  2.3385  2.3394
2.3402  2.3411  2.3420  2.3428  2.3437  2.3445  2.3454
2.3463  2.3471  2.3480  2.3488  2.3497  2.3505  2.3514
2.3522  2.3531  2.3539  2.3548  2.3556  2.3565  2.3573
2.3582  2.3590  2.3598  2.3607  2.3615  2.3623  2.3632
2.3640  2.3648  2.3657  2.3665  2.3673  2.3682  2.3690
2.3698  2.3706  2.3714  2.3723  2.3731  2.3739  2.3747
2.3755  2.3763  2.3772  2.3780  2.3788  2.3796  2.3804
2.3812  2.3820  2.3828  2.3836  2.3844  2.3852  2.3860
2.3868  2.3876  2.3884  2.3892  2.3900
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**************************************************************
** DEVELOPED CONDITION RUNOFF
**************************************************************

COMPUTE NM HYD       ID=10   HYDNO=10   DA=0.0114   SQ MI
                     PERCENT A=0   B=2.7   C=27.4   D=69.9
                     TP=0.111 HOURS    MASSRAIN=-1


    K =   .060495HR    TP =   .111000HR    K/TP RATIO =   .545000     SHAPE CONSTANT, N =  7.106420
    UNIT PEAK =   37.781    CFS   UNIT VOLUME =    1.000       B =   526.28      P60 = 1.6800
    AREA =      .007969 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


    K =   .088658HR    TP =   .111000HR    K/TP RATIO =   .798721     SHAPE CONSTANT, N =  4.486234
    UNIT PEAK =   11.944    CFS   UNIT VOLUME =    1.002       B =   386.37      P60 = 1.6800
    AREA =      .003431 SQ MI    IA =    .36346 INCHES    INF =    .86767 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD            ID=10   CODE=1

                                   OUTFLOW HYDROGRAPH REACH    10.00


    RUNOFF VOLUME =     1.74392 INCHES     =       1.0603 ACRE-FEET
    PEAK DISCHARGE RATE =      25.99 CFS  AT   1.500 HOURS   BASIN AREA =   .0114 SQ. MI.



**THE FOLLOWING TABLE IS FOR 90" DIAMETER PIPE WITH 7" OUTFLOW ORIFICE.**

ROUTE RESERVOIR      ID=20   HYD=PIPE.90   INFLOW ID=10   CODE=5
                      OUTFLOW (CFS)  STORAGE (AC FT)  ELEV (FT)
                          0.0            0.0           5047.0
                          1.00           0.0160        5047.5
                          1.12           0.0442        5048.0
                          1.47           0.0794        5048.5
                          1.74           0.1194        5049.0
                          1.98           0.1628        5049.5
                          2.19           0.2084        5050.0
                          2.39           0.2552        5050.5
                          2.56           0.3026        5051.0
                          2.72           0.3494        5051.5
                          2.88           0.3950        5052.0
                          3.03           0.4384        5052.5
                          3.19           0.4784        5053.0
```

3.32	0.5136	5053.5
3.45	0.5418	5054.0
3.58	0.5578	5054.5
4.28	0.6936	5057.67

* * * * * * * * * * * * * * * *

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
.00	.00	5047.00	.000	.00
.25	.00	5047.00	.000	.00
.50	.00	5047.00	.000	.00
.75	.00	5047.00	.000	.00
1.00	.00	5047.00	.000	.00
1.25	2.82	5047.23	.007	.47
1.50	25.99	5050.85	.288	2.51
1.75	8.82	5053.85	.533	3.41
2.00	4.95	5055.38	.596	3.77
2.25	1.20	5054.90	.575	3.67
2.50	.55	5053.60	.519	3.35
2.75	.30	5052.78	.461	3.12
3.00	.19	5052.10	.404	2.91
3.25	.14	5051.50	.349	2.72
3.50	.13	5050.95	.297	2.54
3.75	.11	5050.44	.249	2.36
4.00	.11	5049.96	.205	2.17
4.25	.11	5049.51	.164	1.98
4.50	.11	5049.09	.127	1.78
4.75	.11	5048.69	.095	1.57
5.00	.12	5048.32	.067	1.34
5.25	.13	5048.00	.044	1.12
5.50	.13	5047.65	.024	1.04
5.75	.14	5047.28	.009	.57
6.00	.15	5047.13	.004	.26
6.25	.18	5047.10	.003	.19
6.50	.17	5047.09	.003	.18
6.75	.17	5047.09	.003	.17
7.00	.17	5047.09	.003	.17
7.25	.17	5047.08	.003	.17
7.50	.16	5047.08	.003	.17
7.75	.16	5047.08	.003	.16
8.00	.16	5047.08	.003	.16
8.25	.16	5047.08	.003	.16
8.50	.15	5047.08	.003	.16
8.75	.15	5047.08	.002	.15
9.00	.15	5047.08	.002	.15
9.25	.15	5047.07	.002	.15
9.50	.14	5047.07	.002	.15
9.75	.14	5047.07	.002	.14
10.00	.14	5047.07	.002	.14
10.25	.14	5047.07	.002	.14
10.50	.14	5047.07	.002	.14
10.75	.14	5047.07	.002	.14
11.00	.13	5047.07	.002	.14
11.25	.13	5047.07	.002	.13
11.50	.13	5047.07	.002	.13
11.75	.13	5047.06	.002	.13
12.00	.13	5047.06	.002	.13
12.25	.13	5047.06	.002	.13
12.50	.12	5047.06	.002	.13
12.75	.12	5047.06	.002	.12
13.00	.12	5047.06	.002	.12
13.25	.12	5047.06	.002	.12
13.50	.12	5047.06	.002	.12
13.75	.12	5047.06	.002	.12

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
14.00	.12	5047.06	.002	.12
14.25	.12	5047.06	.002	.12
14.50	.11	5047.06	.002	.11
14.75	.11	5047.06	.002	.11
15.00	.11	5047.06	.002	.11

```
    15.25        .11   5047.06       .002       .11
    15.50        .11   5047.06       .002       .11
    15.75        .11   5047.05       .002       .11
    16.00        .11   5047.05       .002       .11
    16.25        .11   5047.05       .002       .11
    16.50        .10   5047.05       .002       .11
    16.75        .10   5047.05       .002       .11
    17.00        .10   5047.05       .002       .10
    17.25        .10   5047.05       .002       .10
    17.50        .10   5047.05       .002       .10
    17.75        .10   5047.05       .002       .10
    18.00        .10   5047.05       .002       .10
    18.25        .10   5047.05       .002       .10
    18.50        .10   5047.05       .002       .10
    18.75        .10   5047.05       .002       .10
    19.00        .10   5047.05       .002       .10
    19.25        .09   5047.05       .002       .10
    19.50        .09   5047.05       .002       .10
    19.75        .09   5047.05       .001       .09
    20.00        .09   5047.05       .002       .09
    20.25        .09   5047.05       .001       .09
    20.50        .09   5047.05       .001       .09
    20.75        .09   5047.05       .001       .09
    21.00        .09   5047.05       .001       .09
    21.25        .09   5047.04       .001       .09
    21.50        .09   5047.04       .001       .09
    21.75        .09   5047.04       .001       .09
    22.00        .09   5047.04       .001       .09
    22.25        .09   5047.04       .001       .09
    22.50        .08   5047.04       .001       .09
    22.75        .09   5047.04       .001       .09
    23.00        .09   5047.04       .001       .08
    23.25        .09   5047.04       .001       .08
    23.50        .08   5047.04       .001       .08
    23.75        .08   5047.04       .001       .08
    24.00        .08   5047.04       .001       .08
    24.25        .01   5047.02       .001       .05
    24.50        .00   5047.01       .000       .02
    24.75        .00   5047.00       .000       .01
    25.00        .00   5047.00       .000       .00
 PEAK DISCHARGE =        3.792 CFS - PEAK OCCURS AT HOUR    2.05
 MAXIMUM WATER SURFACE ELEVATION =     5055.461
 MAXIMUM STORAGE =          .5990 AC-FT      INCREMENTAL TIME=     .050000HRS

**********************************************************************

FINISH

    NORMAL PROGRAM FINISH          END TIME (HR:MIN:SEC) = 10:54:44
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    AHYMO PROGRAM (AHYMO194) - AMAFCA Hydrologic Model - January, 1994
         RUN DATE (MON/DAY/YR) = 01/14/1999
         START TIME (HR:MIN:SEC) = 10:45:16     USER NO.= EASTERNM.I01
         INPUT FILE = T:\PROJECTS\4570\ENG\DEVCON10.HMI

*** SEVEN BAR RANCH TOWN CENTER - DRAINAGE REPORT

**********************************************************************
**This data set computes the developed condition runoff from     **
**the proposed ultimate development plan for the entire 7.3 ac   **
**site and routes it through a subsurface detention pond.        **
**Date: 01/15/99 *  * filename= devcon10.hmi                     **
**  **
**********************************************************************
*
**********************************************************************
** DESIGN STORM IS THE 10 YEAR - 24 HOUR STORM
**
** COA DPM TYPE 2, 24 HR STORM WITH PEAK INTENSITY AT 1.4 HRS
**********************************************************************

START                TIME=0

RAINFALL             TYPE = 2
                     RAIN QUARTER = 0.00   INCHES
                     RAIN ONE     = 1.25
                     RAIN SIX     = 1.47
                     RAIN DAY     = 1.77
                     DT = 0.05  HOURS


               COMPUTED 24-HOUR RAINFALL DISTRIBUTION BASED ON NOAA ATLAS 2 - PEAK AT 1.40 HR.
               DT =     .050000 HOURS       END TIME =    24.000000 HOURS
                  .0000   .0016   .0033   .0051   .0069   .0087   .0106
                  .0127   .0147   .0169   .0192   .0216   .0241   .0267
                  .0295   .0324   .0355   .0388   .0424   .0462   .0504
                  .0557   .0615   .0784   .1182   .1868   .2928   .4454
                  .6542   .8188   .8932   .9553  1.0097  1.0583  1.1024
                 1.1426  1.1794  1.2134  1.2447  1.2736  1.3004  1.3064
                 1.3119  1.3171  1.3219  1.3264  1.3307  1.3348  1.3387
                 1.3424  1.3459  1.3493  1.3526  1.3558  1.3588  1.3618
                 1.3646  1.3674  1.3701  1.3727  1.3753  1.3778  1.3802
                 1.3826  1.3849  1.3871  1.3893  1.3915  1.3936  1.3957
                 1.3977  1.3997  1.4017  1.4036  1.4055  1.4074  1.4092
                 1.4110  1.4128  1.4145  1.4162  1.4179  1.4196  1.4212
                 1.4228  1.4244  1.4260  1.4275  1.4291  1.4306  1.4321
                 1.4335  1.4350  1.4364  1.4379  1.4393  1.4406  1.4420
                 1.4434  1.4447  1.4460  1.4474  1.4486  1.4499  1.4512
                 1.4525  1.4537  1.4549  1.4562  1.4574  1.4586  1.4598
                 1.4609  1.4621  1.4633  1.4644  1.4656  1.4667  1.4678
                 1.4689  1.4700  1.4713  1.4726  1.4738  1.4751  1.4764
                 1.4776  1.4789  1.4801  1.4814  1.4826  1.4838  1.4851
                 1.4863  1.4875  1.4887  1.4899  1.4912  1.4924  1.4936
                 1.4948  1.4960  1.4971  1.4983  1.4995  1.5007  1.5019
                 1.5030  1.5042  1.5054  1.5065  1.5077  1.5088  1.5100
                 1.5111  1.5123  1.5134  1.5145  1.5157  1.5168  1.5179
                 1.5190  1.5202  1.5213  1.5224  1.5235  1.5246  1.5257
                 1.5268  1.5279  1.5290  1.5301  1.5311  1.5322  1.5333
                 1.5344  1.5355  1.5365  1.5376  1.5386  1.5397  1.5408
                 1.5418  1.5429  1.5439  1.5449  1.5460  1.5470  1.5481
                 1.5491  1.5501  1.5511  1.5522  1.5532  1.5542  1.5552
                 1.5562  1.5572  1.5583  1.5593  1.5603  1.5613  1.5622
                 1.5632  1.5642  1.5652  1.5662  1.5672  1.5682  1.5691
                 1.5701  1.5711  1.5721  1.5730  1.5740  1.5750  1.5759
                 1.5769  1.5778  1.5788  1.5797  1.5807  1.5816  1.5826
                 1.5835  1.5844  1.5854  1.5863  1.5872  1.5882  1.5891
                 1.5900  1.5909  1.5919  1.5928  1.5937  1.5946  1.5955
                 1.5964  1.5973  1.5982  1.5991  1.6000  1.6009  1.6018
                 1.6027  1.6036  1.6045  1.6054  1.6063  1.6071  1.6080
                 1.6089  1.6098  1.6106  1.6115  1.6124  1.6133  1.6141
                 1.6150  1.6159  1.6167  1.6176  1.6184  1.6193  1.6201
                 1.6210  1.6218  1.6227  1.6235  1.6244  1.6252  1.6260
                 1.6269  1.6277  1.6286  1.6294  1.6302  1.6310  1.6319
                 1.6327  1.6335  1.6343  1.6352  1.6360  1.6368  1.6376
                 1.6384  1.6392  1.6400  1.6408  1.6417  1.6425  1.6433
```

```
1.6441  1.6449  1.6457  1.6464  1.6472  1.6480  1.6488
1.6496  1.6504  1.6512  1.6520  1.6528  1.6535  1.6543
1.6551  1.6559  1.6566  1.6574  1.6582  1.6590  1.6597
1.6605  1.6613  1.6620  1.6628  1.6635  1.6643  1.6651
1.6658  1.6666  1.6673  1.6681  1.6688  1.6696  1.6703
1.6711  1.6718  1.6726  1.6733  1.6740  1.6748  1.6755
1.6763  1.6770  1.6777  1.6785  1.6792  1.6799  1.6806
1.6814  1.6821  1.6828  1.6835  1.6843  1.6850  1.6857
1.6864  1.6871  1.6878  1.6886  1.6893  1.6900  1.6907
1.6914  1.6921  1.6928  1.6935  1.6942  1.6949  1.6956
1.6963  1.6970  1.6977  1.6984  1.6991  1.6998  1.7005
1.7012  1.7019  1.7026  1.7032  1.7039  1.7046  1.7053
1.7060  1.7067  1.7073  1.7080  1.7087  1.7094  1.7100
1.7107  1.7114  1.7121  1.7127  1.7134  1.7141  1.7147
1.7154  1.7161  1.7167  1.7174  1.7181  1.7187  1.7194
1.7200  1.7207  1.7213  1.7220  1.7227  1.7233  1.7240
1.7246  1.7253  1.7259  1.7266  1.7272  1.7278  1.7285
1.7291  1.7298  1.7304  1.7311  1.7317  1.7323  1.7330
1.7336  1.7342  1.7349  1.7355  1.7361  1.7368  1.7374
1.7380  1.7387  1.7393  1.7399  1.7405  1.7412  1.7418
1.7424  1.7430  1.7436  1.7443  1.7449  1.7455  1.7461
1.7467  1.7473  1.7479  1.7486  1.7492  1.7498  1.7504
1.7510  1.7516  1.7522  1.7528  1.7534  1.7540  1.7546
1.7552  1.7558  1.7564  1.7570  1.7576  1.7582  1.7588
1.7594  1.7600  1.7606  1.7612  1.7618  1.7624  1.7630
1.7636  1.7642  1.7647  1.7653  1.7659  1.7665  1.7671
1.7677  1.7683  1.7688  1.7694  1.7700
```

```
**************************************************************
** DEVELOPED CONDITION RUNOFF
**************************************************************

COMPUTE NM HYD       ID=10   HYDNO=10   DA=0.0114   SQ MI
                     PERCENT A=0   B=2.7   C=27.4   D=69.9
                     TP=0.111 HOURS    MASSRAIN=-1


    K =   .060495HR    TP =   .111000HR    K/TP RATIO =   .545000     SHAPE CONSTANT, N =  7.106420
    UNIT PEAK =   37.781    CFS   UNIT VOLUME =    1.000       B =   526.28      P60 = 1.2500
    AREA =      .007969 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


    K =   .092477HR    TP =   .111000HR    K/TP RATIO =   .833122     SHAPE CONSTANT, N =  4.280814
    UNIT PEAK =   11.546    CFS   UNIT VOLUME =    1.002       B =   373.48      P60 = 1.2500
    AREA =      .003431 SQ MI    IA =    .36346 INCHES    INF =    .86767 INCHES PER HOUR
    RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD            ID=10   CODE=1

                                    OUTFLOW HYDROGRAPH REACH    10.00


    RUNOFF VOLUME =     1.20027 INCHES     =        .7298 ACRE-FEET
    PEAK DISCHARGE RATE =      18.44 CFS  AT   1.500 HOURS   BASIN AREA =   .0114 SQ. MI.



**THE FOLLOWING TABLE IS FOR 90" DIAMETER PIPE WITH 7" OUTFLOW ORIFICE.**

ROUTE RESERVOIR      ID=20   HYD=PIPE.90   INFLOW ID=10   CODE=5
                      OUTFLOW (CFS)  STORAGE (AC FT)  ELEV (FT)
                          0.0            0.0           5047.0
                          1.00           0.0160        5047.5
                          1.12           0.0442        5048.0
                          1.47           0.0794        5048.5
                          1.74           0.1194        5049.0
                          1.98           0.1628        5049.5
                          2.19           0.2084        5050.0
                          2.39           0.2552        5050.5
                          2.56           0.3026        5051.0
                          2.72           0.3494        5051.5
                          2.88           0.3950        5052.0
                          3.03           0.4384        5052.5
                          3.19           0.4784        5053.0
```

3.32	0.5136	5053.5
3.45	0.5418	5054.0
3.58	0.5578	5054.5
4.28	0.6936	5057.67

* * * * * * * * * * * * * * * *

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
.00	.00	5047.00	.000	.00
.25	.00	5047.00	.000	.00
.50	.00	5047.00	.000	.00
.75	.00	5047.00	.000	.00
1.00	.00	5047.00	.000	.00
1.25	1.19	5047.08	.003	.16
1.50	18.44	5049.80	.190	2.11
1.75	6.03	5051.56	.355	2.74
2.00	3.52	5051.96	.391	2.87
2.25	.81	5051.75	.373	2.80
2.50	.34	5051.26	.327	2.64
2.75	.16	5050.75	.279	2.48
3.00	.09	5050.26	.232	2.29
3.25	.06	5049.78	.189	2.10
3.50	.05	5049.33	.148	1.90
3.75	.04	5048.91	.112	1.69
4.00	.04	5048.51	.080	1.48
4.25	.04	5048.13	.053	1.21
4.50	.05	5047.77	.031	1.06
4.75	.06	5047.37	.012	.74
5.00	.07	5047.12	.004	.25
5.25	.08	5047.06	.002	.12
5.50	.09	5047.05	.001	.09
5.75	.10	5047.05	.001	.09
6.00	.11	5047.05	.002	.10
6.25	.13	5047.06	.002	.12
6.50	.13	5047.06	.002	.13
6.75	.12	5047.06	.002	.13
7.00	.12	5047.06	.002	.13
7.25	.12	5047.06	.002	.12
7.50	.12	5047.06	.002	.12
7.75	.12	5047.06	.002	.12
8.00	.12	5047.06	.002	.12
8.25	.11	5047.06	.002	.12
8.50	.11	5047.06	.002	.11
8.75	.11	5047.06	.002	.11
9.00	.11	5047.06	.002	.11
9.25	.11	5047.05	.002	.11
9.50	.11	5047.05	.002	.11
9.75	.10	5047.05	.002	.11
10.00	.11	5047.05	.002	.11
10.25	.10	5047.05	.002	.10
10.50	.10	5047.05	.002	.10
10.75	.10	5047.05	.002	.10
11.00	.10	5047.05	.002	.10
11.25	.10	5047.05	.002	.10
11.50	.10	5047.05	.002	.10
11.75	.10	5047.05	.002	.10
12.00	.09	5047.05	.002	.09
12.25	.09	5047.05	.001	.09
12.50	.09	5047.05	.001	.09
12.75	.09	5047.05	.001	.09
13.00	.09	5047.04	.001	.09
13.25	.09	5047.04	.001	.09
13.50	.09	5047.04	.001	.09
13.75	.09	5047.04	.001	.09

TIME (HRS)	INFLOW (CFS)	ELEV (FEET)	VOLUME (AC-FT)	OUTFLOW (CFS)
14.00	.09	5047.04	.001	.09
14.25	.09	5047.04	.001	.09
14.50	.08	5047.04	.001	.08
14.75	.08	5047.04	.001	.08
15.00	.08	5047.04	.001	.08

15.25	.08	5047.04	.001	.08
15.50	.08	5047.04	.001	.08
15.75	.08	5047.04	.001	.08
16.00	.08	5047.04	.001	.08
16.25	.08	5047.04	.001	.08
16.50	.08	5047.04	.001	.08
16.75	.08	5047.04	.001	.08
17.00	.08	5047.04	.001	.08
17.25	.08	5047.04	.001	.08
17.50	.07	5047.04	.001	.07
17.75	.07	5047.04	.001	.07
18.00	.07	5047.04	.001	.07
18.25	.07	5047.04	.001	.07
18.50	.07	5047.04	.001	.07
18.75	.07	5047.04	.001	.07
19.00	.07	5047.04	.001	.07
19.25	.07	5047.04	.001	.07
19.50	.07	5047.03	.001	.07
19.75	.07	5047.03	.001	.07
20.00	.07	5047.03	.001	.07
20.25	.07	5047.03	.001	.07
20.50	.07	5047.03	.001	.07
20.75	.07	5047.03	.001	.07
21.00	.07	5047.03	.001	.07
21.25	.06	5047.03	.001	.07
21.50	.06	5047.03	.001	.07
21.75	.06	5047.03	.001	.06
22.00	.06	5047.03	.001	.06
22.25	.07	5047.03	.001	.06
22.50	.06	5047.03	.001	.06
22.75	.06	5047.03	.001	.06
23.00	.06	5047.03	.001	.06
23.25	.06	5047.03	.001	.06
23.50	.06	5047.03	.001	.06
23.75	.06	5047.03	.001	.06
24.00	.06	5047.03	.001	.06
24.25	.01	5047.02	.001	.03
24.50	.00	5047.01	.000	.01
24.75	.00	5047.00	.000	.00

PEAK DISCHARGE = 2.874 CFS - PEAK OCCURS AT HOUR 2.05
MAXIMUM WATER SURFACE ELEVATION = 5051.980
MAXIMUM STORAGE = .3932 AC-FT INCREMENTAL TIME= .050000HRS

****

FINISH

NORMAL PROGRAM FINISH END TIME (HR:MIN:SEC) = 10:45:16

SEVEN BAR TOWN CENTER EAI No. 4570

THIS SPREADSHEET COMPUTES THE STORAGE VOLUME IN A CIRCULAR PIPE (SHEET 1).
ORIFICE DISCHARGE RATES ARE COMPUTED ON SHEET 2 OF THIS SPREADSHEET.
AN APPLICATION MAY BE TO COMPUTE DISCHARGES AND STORED VOLUMES IN A
BURIED PIPE STORAGE FACILITY. DO NOT USE FOR PIPES LARGER THAN 120" DIAMETER.
THE USER OF THIS SPREADSHEET SHOULD CHANGE ONLY CELLS SHOWN IN **RED**.

filename t:\projects\4570\eng\circ pipe_vol.xls CREATED 12-23-98

PIPE DIAMETER (INCHES) = **90.00** RADIUS (IN) = 45.00

LENGTH OF PIPE (FEET) = **550.00**

COMPUTATION DATE = 01-15-99

STORAGE COMPUTATION

WATER DEPTH IN PIPE (INCHES)	ANGLE A (DEGREES)	ARC LENGTH (INCHES)	CHORD (INCHES)	CROSS-SECT AREA (FT^2)	VOLUME (FT^3)	VOLUME (AC FT)
2	34.29	26.93	26.53	0.25	135.69	0.0031
4	48.68	38.23	37.09	0.69	381.25	0.0088
6	59.85	47.01	44.90	1.26	695.60	0.0160
8	69.38	54.49	51.22	1.93	1063.48	0.0244
10	77.88	61.17	56.57	2.68	1475.70	0.0339
12	85.67	67.28	61.19	3.50	1925.87	0.0442
14	92.92	72.97	65.24	4.38	2409.06	0.0553
16	99.75	78.34	68.82	5.31	2921.35	0.0671
18	106.26	83.46	72.00	6.29	3459.43	0.0794
20	112.50	88.36	74.83	7.31	4020.45	0.0923
22	118.52	93.09	77.36	8.37	4601.91	0.1056
24	124.36	97.67	79.60	9.46	5201.56	0.1194
26	130.05	102.14	81.58	10.58	5817.34	0.1335
28	135.61	106.50	83.33	11.72	6447.36	0.1480
30	141.06	110.78	84.85	12.89	7089.86	0.1628
32	146.42	114.99	86.16	14.08	7743.17	0.1778
34	151.70	119.14	87.27	15.28	8405.71	0.1930
36	156.93	123.25	88.18	16.50	9075.95	0.2084
38	162.10	127.31	88.90	17.73	9752.43	0.2239
40	167.24	131.35	89.44	18.97	10433.73	0.2395
42	172.35	135.36	89.80	20.22	11118.45	0.2552
44	177.45	139.37	89.98	21.46	11805.21	0.2710
46	182.55	143.37	89.98	22.71	12492.64	0.2868
48	187.65	147.37	89.80	23.96	13179.40	0.3026
50	192.76	151.39	89.44	25.21	13864.12	0.3183
52	197.90	155.43	88.90	26.45	14545.41	0.3339
54	203.07	159.49	88.18	27.68	15221.90	0.3494
56	208.30	163.59	87.27	28.89	15892.14	0.3648
58	213.58	167.74	86.16	30.10	16554.68	0.3800
60	218.94	171.95	84.85	31.29	17207.99	0.3950
63	227.16	178.41	82.49	33.03	18167.17	0.4171
66	235.64	185.07	79.60	34.72	19096.29	0.4384
69	244.46	192.00	76.13	36.34	19989.08	0.4589
72	253.74	199.28	72.00	37.89	20838.42	0.4784
75	263.62	207.04	67.08	39.34	21636.06	0.4967
78	274.33	215.46	61.19	40.68	22371.98	0.5136
81	286.26	224.82	54.00	41.88	23033.36	0.5288
84	300.15	235.73	44.90	42.91	23602.25	0.5418
87	317.92	249.69	32.31	43.73	24049.39	0.5521

WATER DEPTH IN PIPE (INCHES)	ANGLE A (DEGREES)	ARC LENGTH (INCHES)	CHORD (INCHES)	CROSS-SECT AREA (FT^2)	VOLUME (FT^3)	VOLUME (AC FT)
90	360.00	282.74	0.00	44.18	24297.85	0.5578
93	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
96	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
99	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
102	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
105	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
108	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
111	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
114	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
117	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

DISCHARGE COMPUTATION

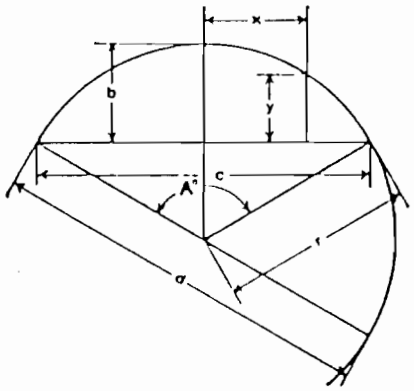
THE TABLE BELOW CALCULATES THE DISCHARGE, Q, THROUGH AN ORIFICE. C = **0.62** and $Q = CA\ (2gh)^{0.5}$

PIPE DIAMETER (IN) = 90
ORIFICE DIAM. (IN) = **7**
CREATED ON 12-23-98

HEAD ON ORIFICE (INCHES)	DISCHARGE (CFS)	HEAD ON ORIFICE (INCHES)	DISCHARGE (CFS)
2	0.54	52	2.77
4	0.77	54	2.82
6	0.94	56	2.87
8	1.09	58	2.92
10	1.21	60	2.97
12	1.33	63	3.05
14	1.44	66	3.12
16	1.54	69	3.19
18	1.63	72	3.26
20	1.72	75	3.32
22	1.80	78	3.39
24	1.88	81	3.45
26	1.96	84	3.52
28	2.03	87	3.58
30	2.10	90	3.64
32	2.17	93	0
34	2.24	96	0
36	2.30	99	0
38	2.37	102	0
40	2.43	105	0
42	2.49	108	0
44	2.55	111	0
46	2.60	115	0
48	2.66	118	0
50	2.71	120	0

TABLE A-13

PROPERTIES OF THE CIRCLE



Circumference = 6.28318 r = 3.14159 d
Diameter = 0.31831 circumference
Area = 3.14159 r^2

Arc $a = \frac{\pi r A^\circ}{180^\circ} = 0.017453\, r A^\circ$

Angle $A^\circ = \frac{180^\circ a}{\pi r} = 57.29578 \frac{a}{r}$

Radius $r = \frac{4b^2 + c^2}{8b}$

Chord $c = 2\sqrt{2br - b^2} = 2r \sin \frac{A}{2}$

Rise $b = r - \frac{1}{2}\sqrt{4r^2 - c^2} = \frac{c}{2} \tan \frac{A}{4}$

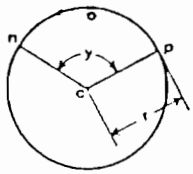
$= 2r \sin^2 \frac{A}{4} = r + y - \sqrt{r^2 - x^2}$

$y = b - r + \sqrt{r^2 - x^2}$

$x = \sqrt{r^2 - (r + y - b)^2}$

Diameter of circle of equal periphery as square = 1.27324 side of square
Side of square of equal periphery as circle = 0.78540 diameter of circle
Diameter of circle circumscribed about square = 1.41421 side of square
Side of square inscribed in circle = 0.70711 diameter of circle

CIRCULAR SECTOR



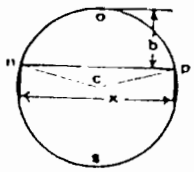
r = radius of circle y = angle ncp in degrees

Area of Sector ncpo = ½ (length of arc nop × r)

= Area of Circle × $\frac{y}{360}$

= 0.0087266 × r^2 × y

CIRCULAR SEGMENT



r = radius of circle x = chord b = rise

Area of Segment nop = Area of Sector ncpo — Area of triangle ncp

$= \frac{(\text{Length of arc nop} \times r) - x(r - b)}{2}$

Area of Segment nap = Area of Circle — Area of Segment nop

1. Overview of Stormceptor

The **Storm***ceptor* is a pollution prevention device that efficiently removes oil and sediment from stormwater. The **Storm***ceptor* replaces a conventional manhole in the storm sewer system.

The key advantage of **Storm***ceptor* compared to other water quality controls in a storm sewer is the patented by-pass which prevents the resuspension and scour of settled material during subsequent storm events. Accordingly, **Storm***ceptor* will not release pollutants between servicing, even during infrequent events (i.e. 5 year or 10 year storm).

Storm*ceptor* follows the philosophy of treating pollution at its source. Treating pollution at the source is the preferred methodology for water quality control since the dilution of pollutants in stormwater becomes problematic in terms of effective treatment as the drainage area increases. A recent study in Wisconsin (Bannerman et al., 1993) indicated that the application of stormwater quality controls to 14% of the residential land and 40% of the industrial lands could reduce a region's total contaminant loading by 75%, indicating that cost-effective water quality control can be implemented by targeting certain "hot spots". In the Wisconsin study, streets were critical in all land uses, and parking lots were critical for industrial and commercial land uses.

1.1 Stormceptor Applications

Storm*ceptor* is applicable in a variety of development situations including:

- stormwater quality retrofits for existing developments
- industrial and commercial parking lots
- automobile service stations
- power/utility stations
- areas susceptible to spills (of materials lighter than water) such as bus depots, transfer stations, airports and train stations
- new residential developments (as part of a treatment train)
- re-development in the urban core

Existing Development Retrofits

Existing development can comprise up to 80% of a watershed's tributary drainage area (eg. The Don River Watershed, Greater Toronto Area). These areas are often overlooked since the large area of uncontrolled runoff is overwhelming. By targeting "hot spot" areas however, cost-effective water quality control can be implemented for existing developed areas.

Existing developed areas generally provide numerous constraints to the implementation of water quality enhancement. Surrounding properties define the grading of the property (or else berms and expensive retaining walls are required) and existing sewer inverts and locations define the minor system drainage route. These constraints generally limit the number and type of options available to the stormwater management professional with respect to water quality enhancement. In these situations, the **Storm***ceptor* is an attractive solution due to its size, low cost, ease of installation and maintenance, and compatibility with the existing drainage system.

Potential Spill Areas

Gas stations, parking lots, streets, and industrial areas where there is a high volume of traffic and/or transfer of deleterious materials are potential spill areas. Generally, the area of land draining to the storm sewers in these instances is small.

Storm*ceptor* is recommended for these types of land use regardless of whether other water quality control techniques are proposed. The spills protection provided by **Storm***ceptor* prevents creeks from damaging spills which have toxic effects on the instream aquatic resources.

Redevelopment

Redevelopment can be classified as new construction on an existing developed area. This can be an addition to an existing development, or the replacement of the entire development with a similar or new type of land use.

In these situations surface treatment techniques are generally not feasible, meaning that any treatment system must conform to the existing sewer system. The implementation of large underground systems (such as tanks, underground sand filters, etc.) is also generally problematic due to the proximity of other underground utilities and the configuration of the existing sewer system.

Most redevelopment situations are small in size. Surface stormwater quality techniques for these areas would result in a loss of developable land which could jeopardize the economic feasibility of small urban areas. In these situations the **Storm***ceptor* is sometimes the only feasible solution.

New Residential Subdivisions

The **Storm***ceptor* is not intended to replace natural stormwater management system solutions (wet ponds, wetlands) for large residential subdivisions.

Storm*ceptor* can be used, however, as part of the treatment train approach in these subdivisions. For small subdivisions, in which ponds or wetlands are not feasible (i.e. < 12 ac), and for subdivisions (< 25 ac) that would result in numerous small ponds within a tributary area, the use of the **Storm***ceptor* as part of the treatment train approach (i.e. in conjunction with down spouts, grading, rear yard controls, etc.) is a cost-effective solution which will lessen the maintenance burden of municipalities who will have the ultimate responsibility for stormwater quality systems.

The use of **Storm***ceptor* for street drainage helps to mitigate long term maintenance costs if catch-basin sumps are not implemented. In these situations, maintenance is centralized at **Storm***ceptor* locations reducing the time and cost of storm sewer maintenance.

1.2 Stormceptor Design and Operation

The **Storm***ceptor* can be divided into two components :

- treatment chamber
- by-pass chamber

Stormwater flows into the by-pass chamber via the storm sewer pipe. Low to normal flows are diverted into the treatment chamber by a weir and drop pipe arrangement (Figure 1). The drop pipe is configured to discharge water tangentially along the treatment chamber wall. Water flows through the treatment chamber to the outlet pipe which is submerged similar to the drop inlet pipe. Water flows up through the outlet pipe based on the head at the inlet weir, and is discharged back into the by-pass chamber downstream of the weir. The downstream section of the by-pass chamber is connected to the outlet sewer pipe.

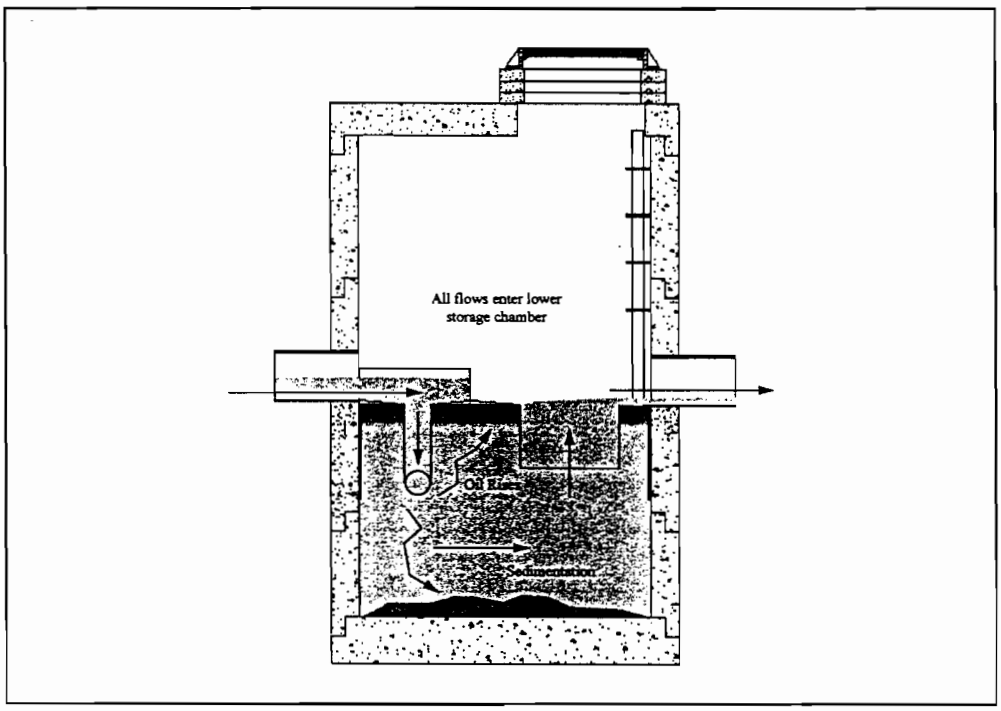


Figure 1. **Storm***ceptor* Operation During Normal Flow Conditions

Oil and other liquids with a specific gravity less than water will rise in the treatment chamber and become trapped since the outlet pipe is submerged. Sediment will settle to the bottom of the chamber by gravity.

During high flow conditions, stormwater in the by-pass chamber will overtop the weir and be conveyed to the outlet sewer directly (Figure 2). Water which overflows the weir creates a backwater effect on the outlet pipe (head stabilization between the inlet drop pipe and outlet riser pipe) ensuring that excessive flow will not be forced into the treatment chamber which could scour or resuspend the settled material. The by-pass is an integral part of the **Storm***ceptor* since other types of oil/grit interceptors have been noted to scour during high flow conditions (Schueler and Shepp, 1993).

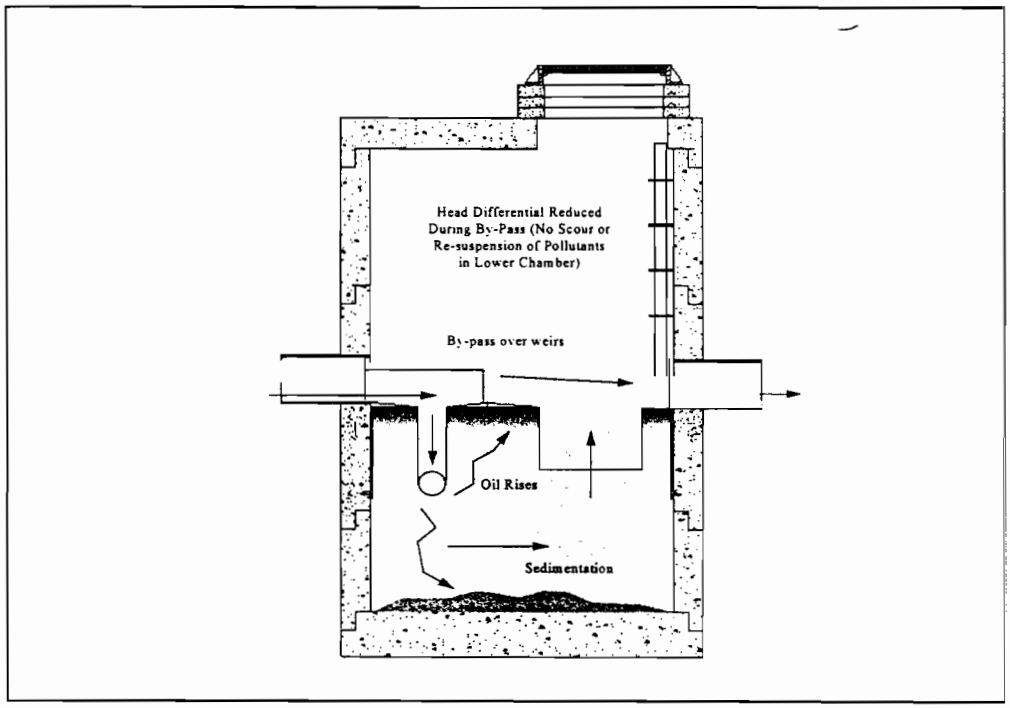


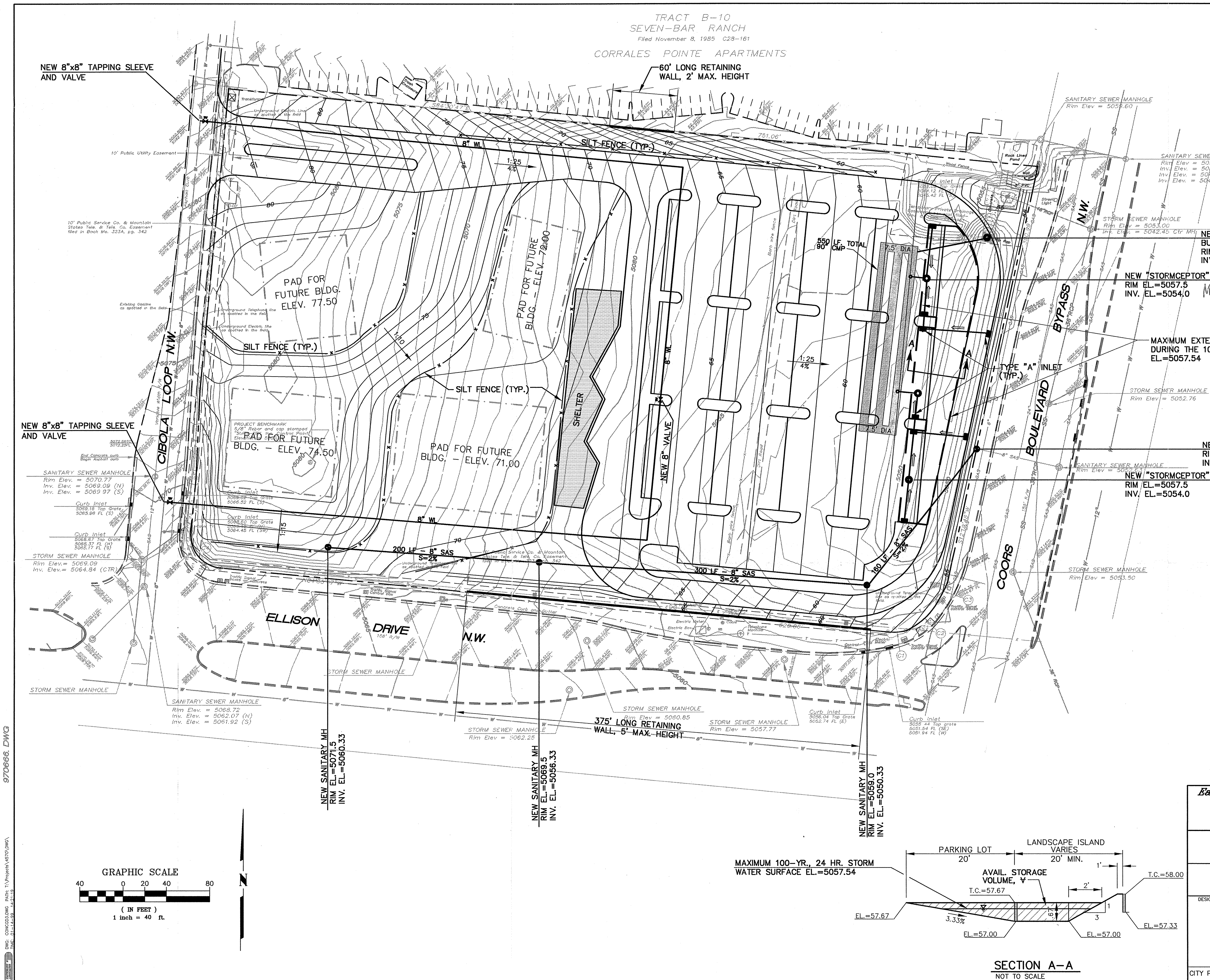
Figure 2. **Storm***ceptor* Operation During High Flow Conditions

Since the Storm*ceptor* operates on the head differential between the inlet and outlet pipes it cannot be used as an inlet (catch-basin).

The **Storm***ceptor* comes complete to the jobsite with its own frame and cover. The cover has the name **Storm***ceptor* clearly embossed on it to allow easy identification of the unit in the field for maintenance. There are pick holes in the cover that vent the interceptor, allow removal of the cover, and provide sampling ports for air quality monitoring before the cover is removed.

1.3 Construction Materials

CSR Hydro Conduit manufactures and markets the precast concrete **Storm***ceptor* in the U.S. under license of **Storm***ceptor* Corporation. Current interceptor sizes being manufactured range from 108 ft.^{3} to 1000 ft.^{3} (900 gal. to 7,200 gal. **Storm***ceptor* units).



RECEIVED JAN 21 1999 HYDROLOGY SECTION

AS BUILT INFORMATION
CONTRACTOR
WORK STAKED BY — DATE
INSPECTOR'S ACCEPTANCE BY — DATE
FIELD VERIFICATION BY — DATE
DRAWINGS CORRECTED BY — DATE

MICRO-FILM INFORMATION
RECORDED BY — DATE
NO.

BENCH MARKS

SURVEY INFORMATION
FIELD NOTES
NO. BY DATE

ENGINEER'S SEAL
GEORGE NEMETH, NEW MEXICO, 12284, REGISTERED PROFESSIONAL ENGINEER

NO. DATE BY REMARKS
REVISIONS
DESIGN

DESIGNED BY GN DATE 01/11/99
DRAWN BY PMT DATE 01/11/99
CHECKED BY RPB DATE 01/11/99

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