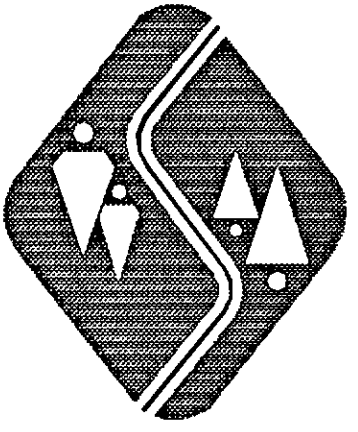
Phase III Drainage Report
Willow Spring Open Space Park

Prepared for

South Suburban
Park and Recreation District



6631 South University Boulevard
Littleton, Colorado

MWE
Denver, Colorado

September 1993

PHASE III DRAINAGE REPORT

WILLOW SPRING OPEN SPACE PARK

PREPARED FOR

SOUTH SUBURBAN PARK AND RECREATION DISTRICT
6631 SOUTH UNIVERSITY BOULEVARD
LITTLETON, COLORADO

PREPARED BY:

MCLAUGHLIN WATER ENGINEERS, Ltd.
2420 Alcott Street
Denver, Colorado 80211

September, 1993

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ENGINEER'S STATEMENT

I hereby affirm that this Phase III Drainage Report for the Willow Spring Open Space Park was prepared by me (or under my direct supervision) in accordance with the provisions of Arapahoe County Drainage Design and Technical Criteria for the owners thereof. I understand that Arapahoe County does not and will not assume liability for drainage facilities designed by others.

John M. Pflaum, P.E.
Registered Professional Engineer
State of Colorado №14526

OWNERS CERTIFICATION

The South Suburban Park and Recreation District hereby certifies that the drainage facilities for Willow Spring Open Space Park shall be constructed according to the design presented in this report. I understand that Arapahoe County does not and will not assume liability for the drainage facilities designed and/or certified by my engineer. I understand that Arapahoe County reviews drainage plans pursuant to Colorado Revised Statutes Title 30, Article 28; but cannot, on behalf of South Suburban Park and Recreation District, guarantee that final drainage design review will absolve and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat and/or Final Development Plan does not imply approval of my engineer's drainage design.

South Suburban Park and Recreation District

Senior Park Planner

82-065.040P

PHASE III DRAINAGE REPORT

WILLOW SPRING OPEN SPACE PARK

I. GENERAL LOCATION AND DESCRIPTION

A. Location

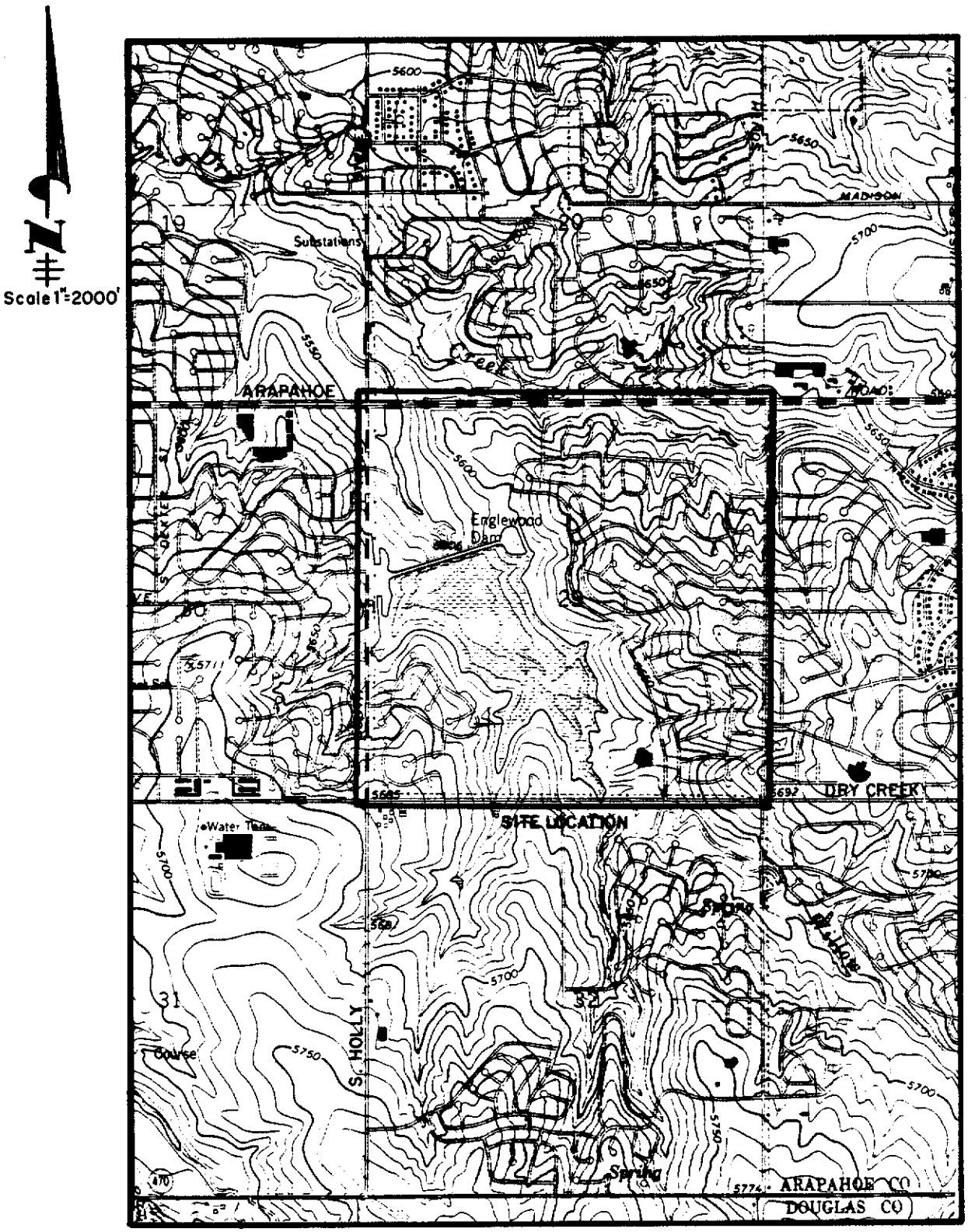
The Willow Creek Open Space is a 121 acre site immediately upstream of the Englewood Dam embankment. It is located in Section 29, Township 5 South, Range 67 West in unincorporated Arapahoe County, Colorado (Figure 1). The site was purchased in 1987 by the South Suburban Park and Recreation District for the purpose of preserving the area as an open space park.

While normally dry, the major potion of the site lies within the flood pool of Willow Creek impounded by Englewood Dam during extreme flood events. The dam embankment and spillways are owned and maintained by the Urban Drainage and Flood Control District (UDFCD). Multiple use of the 100-year floodplain for recreation, open space and riparian habitat is supported by the UDFCD.

The property is bounded on the west by South Holly Street and the Homestead in The Willows subdivision; on the south by Dry Creek Road, the future Homestead multi-family housing development and Homestead Elementary School; on the east by the Homestead at Willows End Subdivision; and on the north by the Homestead in the Willows Subdivision and Homestead Office Park.

The South Suburban Park and Recreation District proposes to preserve the site as an open space park and make the following improvements, which are shown on the Preliminary Master Plan (Drawing Nº 1 in Pocket).

1. An improved (crusher fines surface) main trail will be installed generally along the west side of the park, with connections to various points of entry at key locations shown. The trail will follow from Dry Creek Road to South Holly Street and then eastward along the downstream toe of Englewood Dam to a point of entry and parking area at South Homestead Parkway. This trail is one of the final links in the development of a continuous trail along Willow Creek from the Highline Canal to the C-470 trail.



WILLOW SPRING OPEN SPACE PARK
SOUTH SUBURBAN PARK AND RECREATION DISTRICT

Figure 1
Vicinity Map

2. An unimproved (stabilized earth) minor trail will be installed along the east side of the park, following a route from Homestead Elementary School northward to the dam and westward across the crest of the dam to South Holly Street.

3. A future improved trail extension is proposed to follow along the west side of Willow Creek from the downstream side of the dam northward to Arapahoe Road. The major portion of the trail will be crusher fines, and the remainder will be concrete path.

4. The Park District's maintenance facility will be improved. Located on a 4-acre site along South Holly Street and just upstream of the west side of Englewood Dam, the existing facility consists of a fenced yard, several large corrugated metal buildings and open storage and parking. A new service center facility is proposed to include a new maintenance operations office building, a new storage building, a pipe and chemical storage building, and various facilities for trees, landscaping materials and other materials used in the District's maintenance operations.

   A small picnic area and a public parking lot will be located outside the fenced maintenance yard. The District plans to establish a nature center and interpretive display at the office building for use by Homestead Elementary School and the general public.

B. Description

The site is comprised of 121 acres through which Willow Creek meanders within a wide floodplain area. The zone immediately adjacent to the stream is heavily vegetated with wetland species, shrubs and some large cottonwoods. Native grasses dominate the rolling, open terrain surrounding the drainageway. The site provides a textbook example of a riparian stream environment and the variety of habitat that it supports. Soils in the area are the Renohill and Fondis series of loams that are characterized by slow permeability, high shrink-swell potential and moderate natural fertility.

Willow Creek is the major drainageway that meanders through the site area. Englewood Dam, originally constructed at the site in 1936, was acquired and improved by the Urban Drainage and Flood Control District between 1973 and 1975. Englewood Dam is a key flood control structure that provides flood protection for downstream areas for major storms that occur on the 9.5 square mile upstream urbanized watershed. Figure 2 illustrates the location of the Englewood

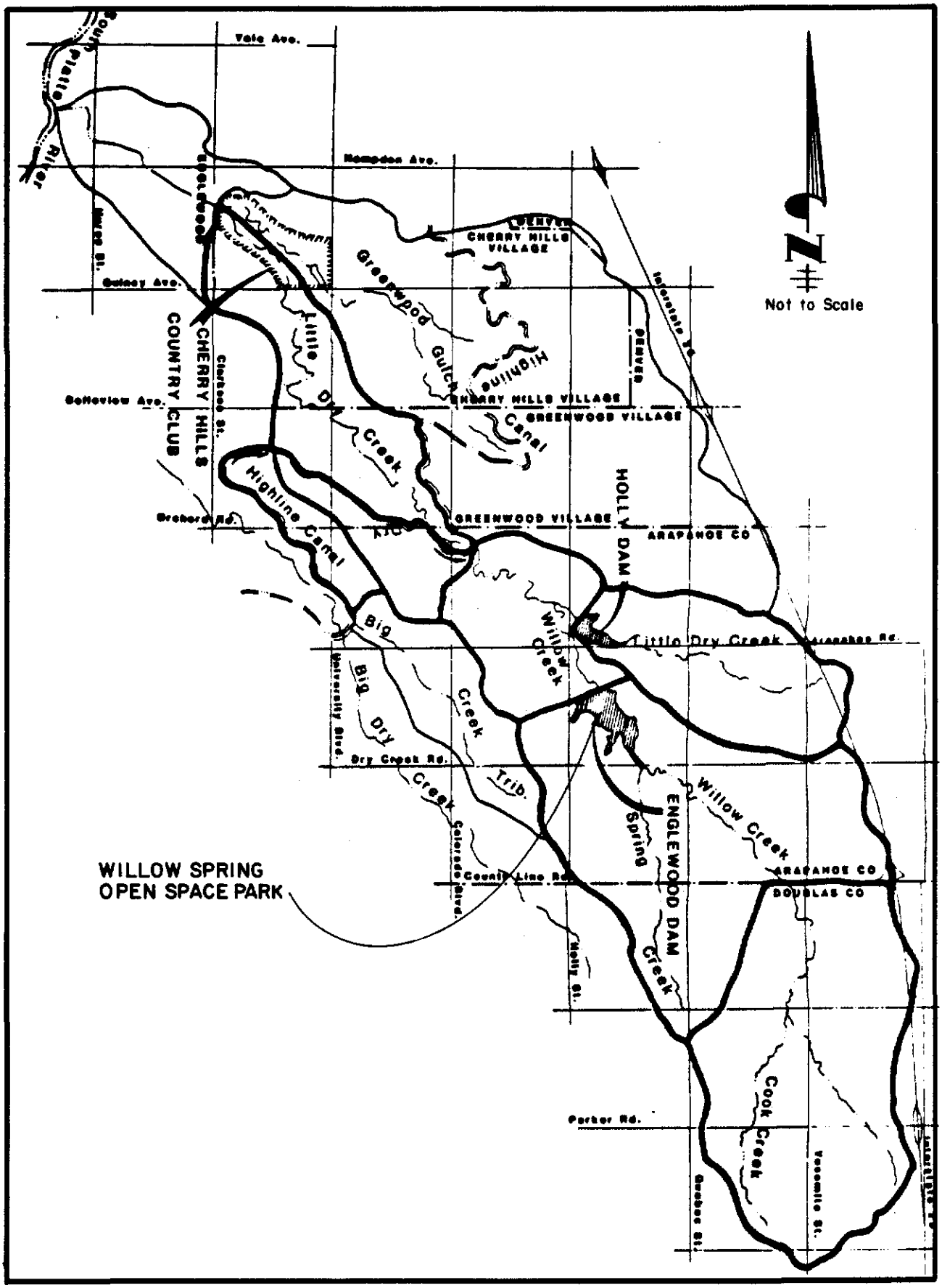


Figure 2
Basin Boundaries Map

Dam/Willow Spring site relative to the overall Little Dry Creek drainage basin. Several tributaries enter Willow Creek on or near the Willow Spring site. Spring Creek enters Willow Creek south of the site just upstream of Dry Creek Road; and the Foxhill Park tributary enters Willow Creek at the south end of the site. Additional local drainage tributaries enter from the adjacent subdivisions to the east and west. There are no irrigation ditches or canals on the site.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The project site lies within the Willow Creek drainage basin, which is tributary to the Little Dry Creek basin. Flood Hazard Area Delineation and Master Planning studies were completed for the basin in 1974 (Reference 3). Improvements to Englewood Dam at the site were completed in 1975.

With the exception of some undeveloped tracts in the upper basin area, the Willow Creek drainage basin is fully developed with a combination of residential, commercial and light industrial land uses.

B. Sub-Basin Description

Since the original construction of Englewood Dam in 1936, the project site has been an area subject to inundation by flood waters impounded by the dam. The 100-year pool elevation for the present structure is elevation 5,600, which effectively inundates the majority of the area upstream of the dam.

In addition to Willow Creek, offsite flows enter the site via the Foxhill Park tributary from the south and local drainage outfalls from adjacent subdivisions to the east and west. Outflow from the site is via the Englewood Dam pipe spillway for all flood events to an impoundment elevation of 5,607 (300-year flood frequency). Above this elevation the emergency overflow spillway becomes functional to a maximum discharge capacity of 34,200 cfs at the maximum reservoir elevation of 5,618.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

The Arapahoe County Storm Drainage Design and Technical Criteria was used in the preparation of this study. Supplementary data was provided by the County for the most recent floodplain modeling of Willow Creek completed under the Flood

Insurance Study for Arapahoe county. Information on Englewood Dam was provided by the Urban Drainage and Flood Control District.

B. Development Criteria Reference and Constraints

Major Drainage

The primary drainage studies relating to the site are the 1974 Major Drainageway Plan (Reference 3) and the Flood Insurance Study (FIS) for Arapahoe County (Reference 4). Since the site is planned as an open space park, its use is compatible with the temporary impoundment and storage of floodwater by Englewood Dam. Thus the floodplain is not a constraint to the proposed site usage, nor is the proposed site use intended to adversely affect the floodplain.

On-Site Drainage

The majority of the existing maintenance facility site along Holly Street lies outside of the 100-year floodplain, and drains into the adjacent open space area by sheet flow. The improved maintenance facility is intended to drain by sheet flow in similar fashion.

C. Hydrological Criteria

The 100-year discharge of 6,100 cfs for Willow Creek entering the site at Dry Creek Road was confirmed by both the UDFCD Master Plan and the Flood Insurance Study. The 100-year peak flow at the dam outlet is 190 cfs, increasing to 390 cfs at the Arapahoe road culverts downstream (Reference 4).

For site drainage design for the maintenance facility, the rational method was used to determine the peak 5-year and 100-year discharges.

D. Hydraulic Criteria

Low water crossings for the improved trail will be concrete structures designed to span the low flow channel to accommodate low flows and frequent storm flows to bank full channel capacity. The structures will be designed to be overtopped by large storm flows. Handrails will be included at each crossing.

Site drainage from the maintenance facility will be designed to leave the site in a non-erosive sheet flow pattern and drain into the adjacent open space.

E. Variances From Criteria

A variance is requested for the County stormwater detention requirement as stated in Policy Section 3.3.6 of the Arapahoe County Storm Drainage Design and

Technical Criteria. We request that the requirement for provision of stormwater detention at the proposed maintenance facility be waived in light of the site's location within a major regional stormwater detention facility.

IV. DRAINAGE FACILITY DESIGN

A. Major Drainage Impacts

As Drawing Nº 1 indicates, the 100-year floodplain upstream of the dam will flood the major portion of the Willow Creek Open Space Park to an elevation of 5,600. Trail use will be interrupted as the level of flooding will inundate all or most of the improved and unimproved trails at the site. The proposed maintenance building at Holly Street will not be affected as it is outside the 100-year flood limit and has its lowest first floor elevation planned for elevation 5,601. All or portions of the future improved trail planned along Willow Creek downstream of the dam will also be impacted by the 100-year flood. All facilities are planned to accommodate 100-year flooding without adversely affecting flood elevations, storage or conveyance.

B. Specific Details

Maintenance Facility Site

Drawing Nº 2 shows the existing conditions at the maintenance facility site, while Drawing Nº 3 illustrates the proposed plan of improvements. Site drainage calculations were completed to quantify and compare the runoff leaving the site for each condition. As the plans and calculations indicate, the 5-year runoff remains essentially the same, while the 100-year runoff increases slightly. It is proposed to allow the runoff to leave the site in a sheet flow manner. There are several reasons for this concept.

1. The existing site currently drains in this manner, with no adverse impacts (i.e., erosion).

2. Runoff quantities for the proposed site are essentially the same as the existing conditions, and the proposed configuration (i.e., how and where runoff is directed off the site) is also the same.

3. To effectively capture storm runoff in a conventional inlet and pipe system would require constructing sump inlets or curb and gutter with inlets and a pipeline into the nearby wetland area. This would not only cause disturbance of the wetland area but also create a point discharge condition with potential for erosion from concentrated flow.

4. The site is small and of low impact to the present condition as it is essentially a remodel and not a radical change in land use or percent impervious.

5. With release of site drainage in a non-erosive sheet flow manner, the adjacent native grasses and wetland area can benefit from use of the stormwater runoff as an irrigation resource.

As stated earlier in the report, a variance is requested from the County's stormwater detention requirement as the proposed maintenance facility is sited within a major regional stormwater detention facility.

Trail Design

Where the improved trail is proposed to cross Willow Creek or other significant drainageway, low water crossing structures will be constructed. A typical low water crossing is illustrated in the drawings in the Appendix. The crossings will be precast or cast-in-place reinforced concrete of sufficient length to span the low flow channel. The travel width will be 12 feet to allow adequate clearance for passing bicyclists or pedestrians. Handrails will be included and designed to collapse under debris loading by extreme flooding to avoid impact on upstream flood levels.

To allow access into the broad wetland area for nature walks, a section of boardwalk trail is proposed. The boardwalk trail would be limited to pedestrian and bicycle use only.

The proposed second phase trail downstream of Englewood Dam will follow along the west side of the Willow Creek channel. the trail will be constructed of concrete in areas where it is adjacent to the creek. Local storm drain inflows from the west will be piped beneath the path. The trail will be designed to accommodate maintenance vehicles for the South Suburban Park and Recreation District and the Urban Drainage and Flood Control District. Final plans for this section will also include repair of local erosion along the drainageway. Drawings 4 and 5 show a preliminary plan and profile along this section of trail. The 100-year floodplain, profile and discharges were obtained from the Flood Insurance Report Update prepared for Arapahoe County by Love and Associates, Inc. A copy of the hydrologic and hydraulic information from that study is contained in the Appendix.

Some inter-agency coordination will be required to complete the portion of trail just upstream of Arapahoe Road. As shown on Drawing Nº 4, the trail will run along the east side of one of the future mini-warehouse buildings and a

restaurant/retail facility proposed as part of the Center at Homestead development. Relocation of an existing Southgate sanitary sewer will be required to enable building construction. Final trail design will need to be reviewed a approved by Arapahoe County, the South Suburban Park and Recreation District and the Urban Drainage and Flood Control District.

V. CONCLUSIONS

A. Compliance with Standards

The Arapahoe County Storm Drainage Design and Technical Criteria (Reference 1) were used in the runoff calculations for the proposed maintenance facility improvements. Information from the Urban Drainage and Flood Control District (References 2 and 3) and the Flood Insurance Study (Reference 4) were also used in the design.

B. Drainage Concept

The proposed maintenance facilities improvements will have no adverse impact on adjacent property from local storm runoff. In addition, the 100-year floodplain is unaffected by the proposed facility. All improved trails proposed for the site are designed for safe recreational use and compatibility with the stream and floodplain environment. The trails are also intended to provide access for maintenance vehicles.

REFERENCES

1. Arapahoe County Storm Drainage Design and Technical Criteria — September, 1985

2. Urban Storm Drainage Criteria Manual; Denver Regional Council of Governments — Latest Revision

3. Major Drainageway Planning, Little Dry Creek, Volumes 1 and 2, Urban Drainage and Flood Control District — February, 1974

4. Flood Insurance Study, Arapahoe County, Colorado, Report Technical Data prepared by Love & Associates, Inc. — March, 1992

5. Englewood Dam-Willow Creek Reserve, Preliminary Report and Master Plan prepared by Thomas J. Kane as part of a senior project in Landscape Architecture at Colorado State University — May, 1988

APPENDIX

SITE DRAINAGE CALCULATIONS

DETERMINE RUNOFF FROM EXISTING MAINTENANCE FACILITY

Site area draining to Northeast = 1.9 AC.

Impervious Area = Bldg roofs = 7,300 SF ± = 0.17 AC.

So Percent Impervious = 0.17/1.9 = 9 percent

FROM UDFCD TABLE 3-1, USE "C" values for Playgrounds (13% imp)

so for 5yr storm, C = 0.20

for 100yr storm C = 0.50

$$\text{TIME OF CONCENTRATION} \approx \text{Travel time Thru site} = \frac{1.8(1.1 - C_5)\sqrt{L}}{\sqrt[3]{S}}$$

$$= \frac{1.8(1.1 - 0.20)\sqrt{500}}{\sqrt[3]{3.5}}$$

= 24 minutes

FROM ACSDDTC FIGURE 501,

5yr Intensity = 2.50

100yr Intensity = 4.85

SO EXISTING SHEET FLOW FROM SITE IS AS FOLLOWS:

$Q = CIA$

$Q_5 = 0.20 \times 2.5 \times 1.9 = 1.0$ cfs

$Q_{100} = 0.50 \times 4.85 \times 1.9 = 4.6$ cfs

DETERMINE RUNOFF FROM PROPOSED MAINTENANCE FACILITY

Site Area Draining to Northeast = 2.1 Ac.

Additional Offsite Area (slope) = 0.3 Ac

total = 2.4 Ac.

Impervious Area = Proposed Roof surface & Paving

= 13,860 SF = 0.32 Ac

SD Percent Impervious = 0.32/2.4 = .13 percent

FROM UDFCD TABLE 3-1, USE "C" values for 13% impervious

For 5yr storm C = 0.20

For 100yr storm C = 0.50

AVG. OVERLAND SLOPE = 18'/450' = 4%.

Time of Concentration = $\frac{1.8(1.1-0.2)\sqrt{450}}{\sqrt[3]{4}}$ < 22 min.

FROM ACSDDTC FIG. 501

5yr Intensity = 2.6

100yr Intensity = 5.1

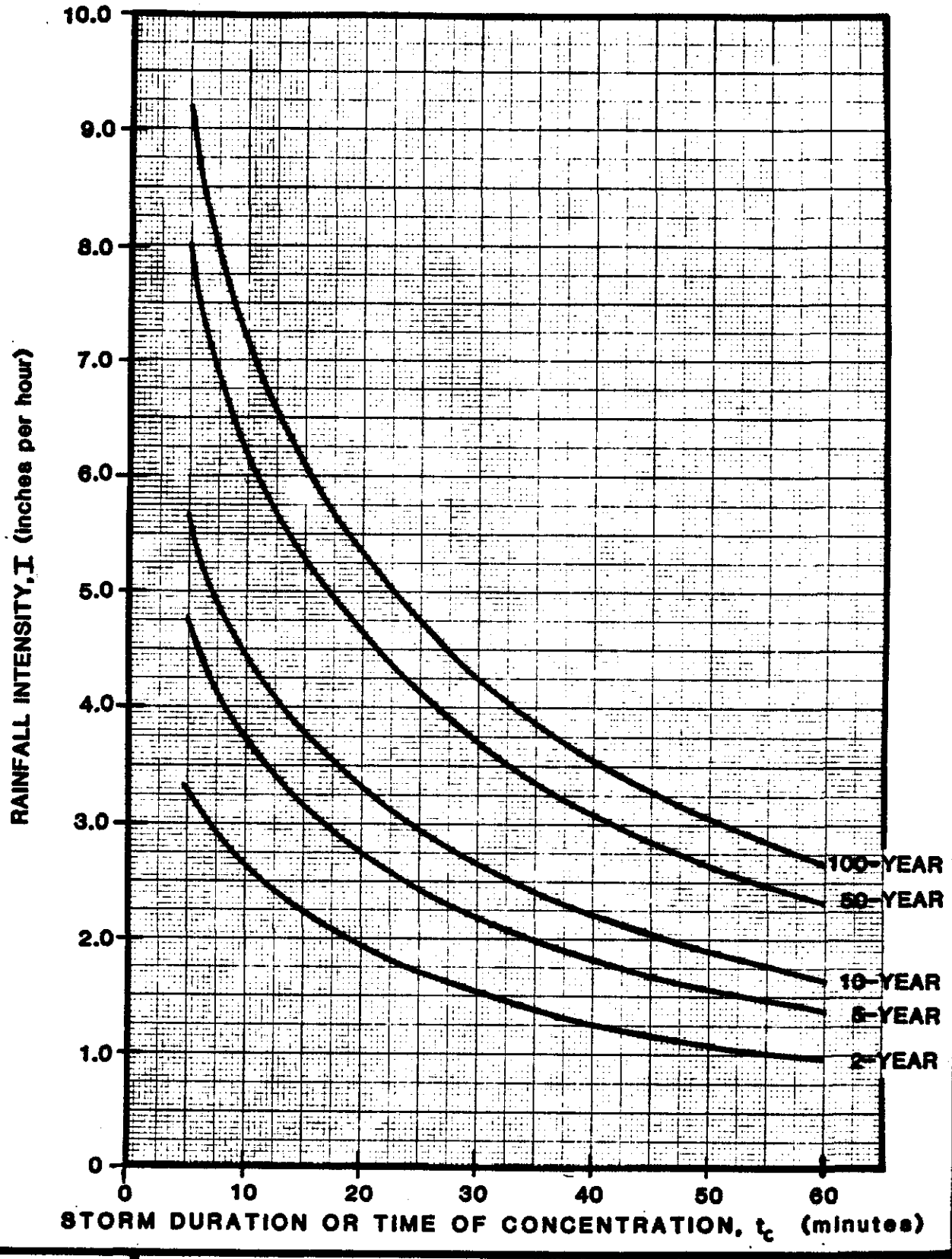
SO SHEET FLOW FROM PROPOSED SITE IS AS FOLLOWS:

$Q = CIA$

$Q_5 = 0.20 \times 2.6 \times 2.4 = 1.2$ cfs

$Q_{100} = 0.50 \times 5.1 \times 2.4 = 6.1$ cfs

TIME - INTENSITY - FREQUENCY CURVES



Date: NOV 1984
Rev:

REFERENCE:

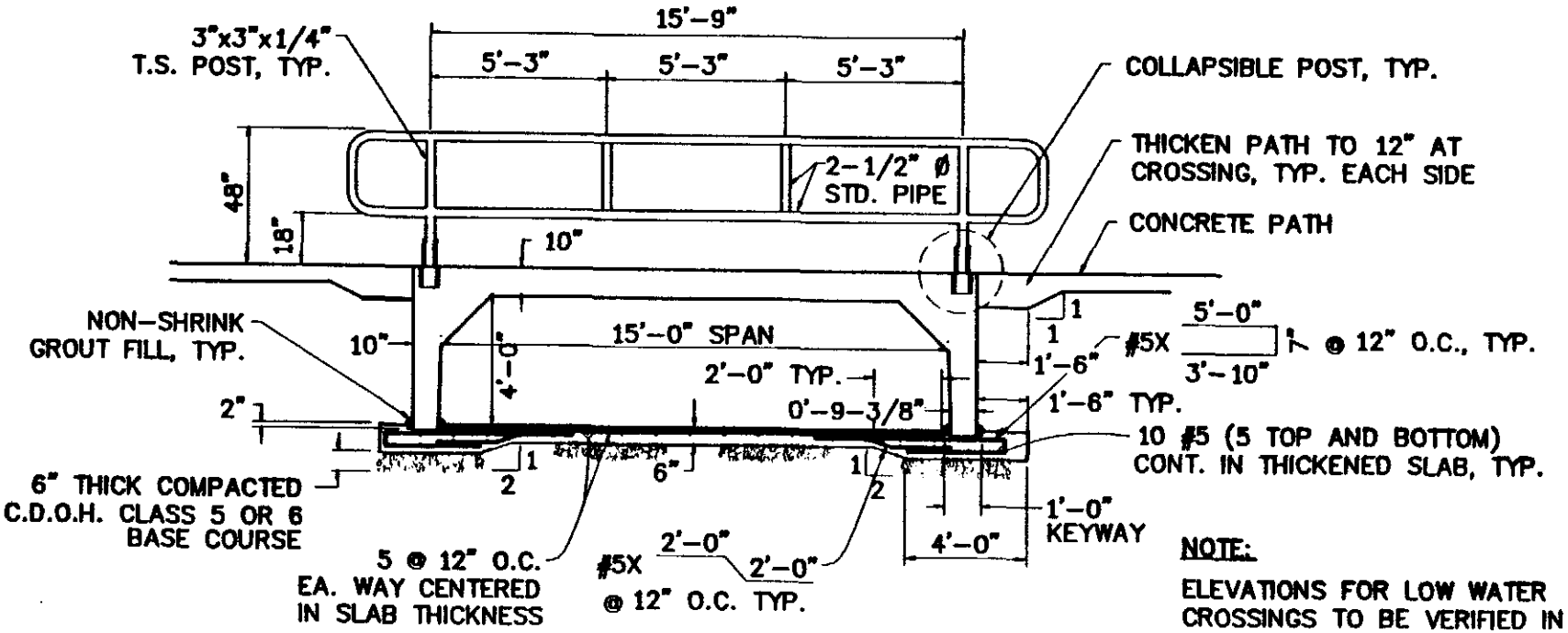
TABLE 3-1 (42)

RECOMMENDED RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY 2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	70	.60	.65	.70	.80
Residential:					
Single-Family	*	.40	.45	.50	.60
Multi-Unit (detached)	50	.45	.50	.60	.70
Multi-Unit (attached)	70	.60	.65	.70	.80
1/2 Acre Lot or Larger	*	.30	.35	.40	.60
Apartments	70	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Acres	90	.80	.80	.85	.90
Parks, Cemetaries:	7	.10	.18	.25	.45
Playgrounds:	13	.15	.20	.30	.50
Schools:	50	.45	.50	.60	.70
Railroad Yard Areas	20	.20	.25	.35	.45
Undeveloped Areas:					
Historic Flow Analysis- Greenbelts, Agricultural	2	(See "Lawns")			
Offsite Flow Analysis (when land use not defined)	45	.43	.47	.55	.65
Streets:					
Paved	100	.87	.88	.90	.93
Gravel (Packed)	40	.40	.45	.50	.60
Drive and Walks:	96	.87	.87	.88	.89
Roofs:	90	.80	.85	.90	.90
Lawns, Sandy Soil	0	.00	.01	.05	.20
Lawns, Clayey Soil	0	.05	.15	.25	.50

NOTE: These Rational Formula coefficients may not be valid for large basins.

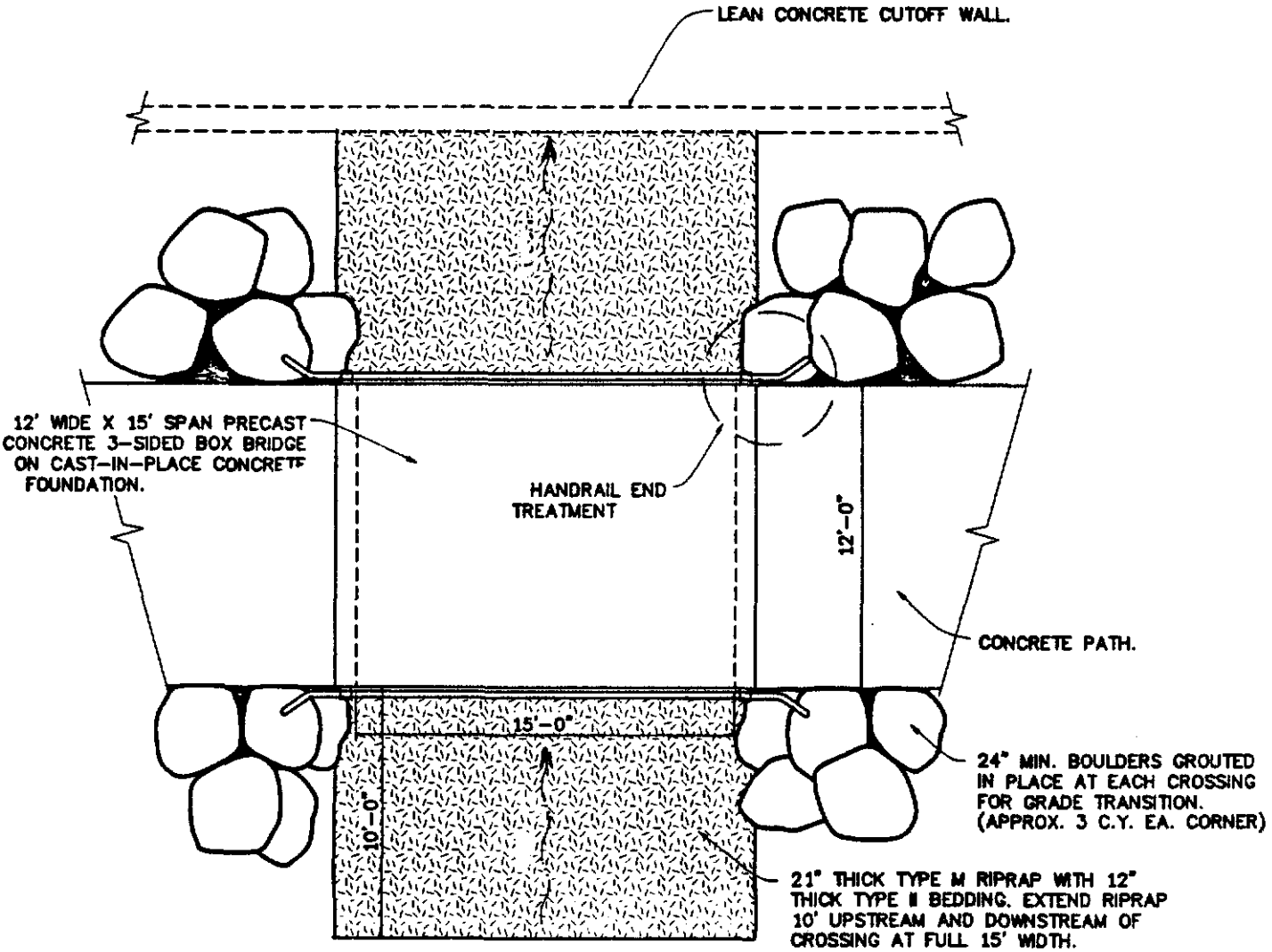
*See Figure 2-1 for percent impervious.



NOTE:

ELEVATIONS FOR LOW WATER CROSSINGS TO BE VERIFIED IN THE FIELD BY ENGINEER.

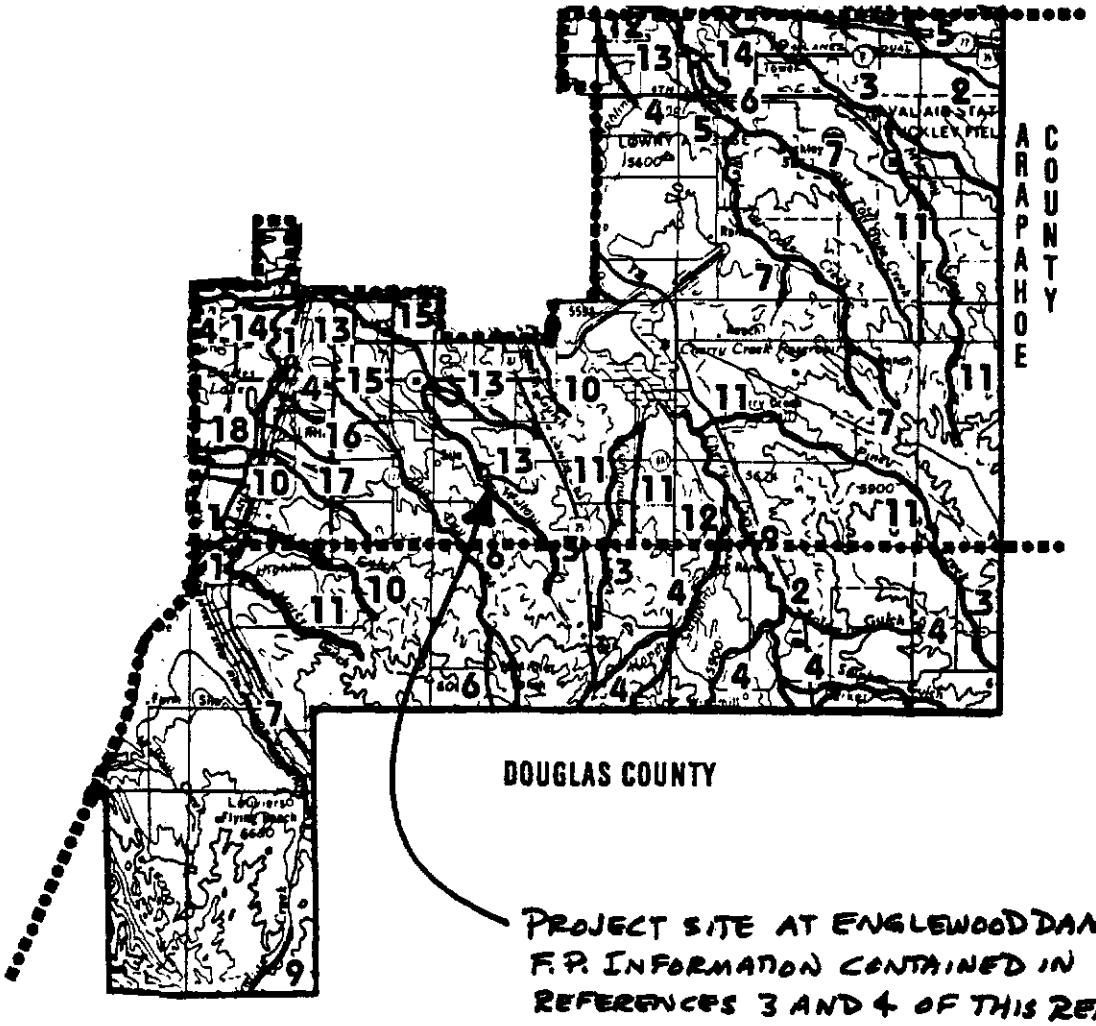
LOW WATER CROSSING ELEVATION



LOW WATER CROSSING PLAN

MAJOR DRAINAGE AND FLOODPLAIN INFORMATION

FLOODPLAIN INFORMATION FOR ARAPAHOE AND DOUGLAS COUNTY WITHIN UD&FCD



REFER to TABLE 201 for reports corresponding to numbers on this figure.

Love & Associates, Inc.
water resource consultants
2996 Centennial Court South Suite C
Boulder, Colorado 80301-5421
Phone (303) 449-3439
FAX (303) 449-3832

April 19, 1991

Mr. Bill Rothenmeyer, P.E.
Arapahoe County Engineering
5334 South Prince Street
Littleton, Colorado 80166

REF: 8924C - HYDROLOGY REVIEW - ARAPAHOE COUNTY, COLORADO - LIMITED MAP MAINTENANCE PROGRAM (LMMP) CONTRACT NO. EMW-90-C-3132

INTRODUCTION

Love & Associates, Inc. has completed the review of available hydrology for the Arapahoe County Limited Map Maintenance Program (LMMP). According to our contract with FEMA, Love & Associates, Inc. will perform detailed flood studies (10-, 50-, 100-, and 500-year profiles and a floodway run) where detailed studies were previously conducted and approximate flood studies (100-year profile only) where approximate studies were previously conducted. The creeks included in the LMMP are Piney Creek (detailed), Big Dry Creek (detailed), Goldsmith Gulch (approximate), and Willow Creek (approximate). In general, the only source for hydrology for these creeks is the previous Flood Insurance Studies (FIS) and HEC-2 decks, although some additional information was available for Big Dry Creek and Willow Creek .

GOLDSMITH GULCH

The only source of information for Goldsmith Gulch in the LMMP study reach is the previous FIS HEC-2 deck in which the discharge varies by reach. At Dayton Street the 100-year discharge is 1090 cfs and at the outlet of Arapahoe Lake the 100-year discharge is 800 cfs.

PINEY CREEK

The only source of information for Piney Creek hydrology is the previous FIS HEC-2 deck in which the discharge varies by reach. Table 1 shows the discharges at Parker Road.

Table 1. Piney Creek at Parker Road

Return Period (year)	FIS (cfs)
10	5400
50	8500
100	9800
500	21,000

WILLOW CREEK

The primary source of information for Willow Creek is the McCall, Ellingson & Morrill (1974) report which was used for the previous FIS. Unfortunately, the computer model input is unavailable for this study. Greenhorn & O'Mara (1989) used the McCall, Ellingson & Morrill report as a basis for a study located upstream of Englewood Dam. Downstream of Englewood Dam, the McCall, Ellingson & Morrill report presents a flow rate at the confluence with Little Dry Creek, but does not report the outflow rate of the dam. McLaughlin Water Engineers (1986) present flow rates for the outlet of Englewood Dam and at the confluence with Little Dry Creek. The 100-year discharge from each of these sources is presented in Table 2.

Table 2. Willow Creek 100-year discharges (cfs).

D/S ENGLEWOOD DAM		U/S ENGLEWOOD DAM			
Confluence w/Little Dry Creek (0.37 sq-m)	Englewood Dam outlet (outflow)	Dry Creek Road (8.1 sq-m)	Upstream of confluence w/tributary (6.9 sq-m)	Quebec Street (6.55 sq-m)	Mineral Avenue (5.46 sq-m)
660[1] 880[2]	190[2]	6100[1]	5200[1]	5070[3]	4600[1]

1 McCall, Ellingson & Morrill (1974), used for previous FIS
2 McLaughlin Water Engineers (1986)
3 Greenhorn & O'Mara (1989), Prorated by square-root of drainage area.

BIG DRY CREEK

Two sources of information exist for Big Dry Creek. The first is previous FIS HEC-2 deck and the second is a FEMA accepted Letter Of Map Revision (LOMR) for the channel from approximately 2000 feet upstream of South Colorado Boulevard to approximately 1000 feet downstream of South Colorado Boulevard. Table 3 shows the flow rates for Big Dry Creek at South Colorado Boulevard. Unfortunately, the 100-year flow rates for the two FEMA accepted studies differ by over 1000 cfs at this location.

Table 3. Big Dry Creek at South Colorado Boulevard

Return Period (yr) (year)	FIS (1974) (cfs)	LOMR (1988)
10	6673	
50	8520	
100	9757	8600
500	15,968	

RECOMMENDATIONS

For Goldsmith Gulch and Piney Creek, we recommend that the discharges from the Previous FIS HEC-2 decks be used. For Willow Creek upstream of Englewood Dam, we recommend that the discharges presented in Table 2 be used. For Willow Creek downstream of Englewood Dam, we recommend that an outlet discharge of 190 cfs be used and the previous FIS 100-year discharge of

660 cfs be used at the confluence with Little Dry Creek. For intermediate locations, we propose to interpolate between these values based on drainage area. For Big Dry Creek, FEMA recommends that the previous FIS values be used except in the vicinity of South Colorado Boulevard. At this location FEMA recommends that the LOMR 100-year discharge be used (because it is the most recent FEMA accepted discharge) and that the 10-, 50- and 500-year discharges be reduced by the same percentage.

Please respond to Love & Associates, Inc. with any comments regarding these recommendations by May 3, 1991.

Sincerely,

LOVE & ASSOCIATES, INC.

Lyle W. Zevenbergen, Ph.D.

Reviewed by

David J. Love, P.E.

LWZ/DJL:JG

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*  U.S. ARMY CORPS OF ENGINEERS           *
*  HYDROLOGIC ENGINEERING CENTER          *
*  609 SECOND STREET, SUITE D             *
*  DAVIS, CALIFORNIA 95616-4687           *
*        (916) 756-1104                   *
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 HEC-2 WATER SURFACE PROFILES

 Version   4.6.0;  February 1991
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T1      WILLOW CREEK DOWNSTREAM OF ENGLEWOOD DAM
T2      LOVE & ASSCIATES # 8924C MAY, 1991 LWZ
T3      LOWER WILLOW CREEK

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ
        0        2        0        0        0        0        0        0    537.5

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
       -1        0       -1

J6  IHLEQ     ICOPY    SUBDIV   STRTDS     RMILE
        0        0        0      930

NC      .035     .035      .035       .1        .3
QT         1      660

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X1       930       12      268      278         0        0        0
GR    538.57      200   537.7       215    535.41      247   533.14      268   531.12      270
GR     530.9      272   531.32      275    534.05      278   533.15      286   535.03      297
GR     539.4      312   544.47      330

  CROSS SECTION DOWNSTREAM OF HOLLY

X1       998       13      269      286       668       68       68
GR     541.7      200   540.79      217    537.74      233    536.7      248   532.98      269
GR    531.54      271   531.67      274    531.75      277   532.88      279   534.44      286
GR    534.11      293   538.48      322    544.92      356

  DOWNSTREAM FACE OF HOLLY RD

NC         0        0        0       .6        .8
QT         1      390
X1      1045       13      274      286        47       47       47
X3        10        0        0        0         0        0    542.5    542.5
GR    542.86      200   542.37      231    538.31      254   533.69      266   532.96      274
GR    532.25      276   532.36      279    532.08      283   533.32      286   534.56      295
GR    539.16      304   544.07      321    545.63      337

  UPSTREAM FACE OF HOLLY RD
  CROSS SECTION B
  One CMP arched culvert 9.2-ft wide by 6.2-ft high modeled by one equivalent
  box culvert 6.2-ft high by 7.23-ft wide
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SC     1.024      .50      2.5        0       6.2     7.23      122      8.1    532.70    532.36
X1      1167       12      221      244       122      122      122
X2         0        0        2    538.9    546.15
X3        10        0        0        0         0        0        0
X4         1   544.82      260                                      546.6    546.3
BT         3      200    547.1        0       260   546.15        0      266    547.77         0
GR    545.63      200   543.06      213    540.85      221   535.37    231.5    533.27       234
GR     532.7      236   532.84      239    533.36    240.5      535      244    540.89       252
GR    547.77      266   547.77      277

NC      .045     .045      .040

X1      1192       11      306      320        25       25       25
X3                                 281
GR    541.79      200   538.84      248    536.61      283   536.25      306   532.63       309
GR    531.42      313   532.95      318    536.24      320   538.48      328   543.31       337
GR    549.67      345

NC         0        0        0       .1        .3
X1      1342       11      268      283       150      150      150
GR    543.06      200   541.05      225    538.67      261   537.66      268   533.74       270
GR    530.96      275   532.01    280.5    537.22      283   537.21      304   540.42       316
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GR	542.76	331								

CROSS SECTION C

NC	.037	.037	.035							
X1	1502	14	272	283	160	160	160			
GR	544.21	200	543.35	232	540.82	261	539.83	272	537.51	273
GR	536.67	274	533.51	275	533.34	277	533.94	280	537.84	283
GR	540.38	301	543.29	325	545.41	358	547.19	380		
X1	1627	15	279	303	125	125	125			
GR	546.25	200	544.45	230	543.62	252	540.96	267	539.13	279
GR	536.71	281	536.14	283	535.16	285	534.91	287	534.55	291
GR	536.51	293	539.31	303	539.25	312	544.36	332	544.66	369

CROSS SECTION D

X1	1706	18	235	278	79	79	79			
GR	546.08	200	544.05	221	541.07	235	536.83	247	535.27	249
GR	535.07	251	535.3	252	536.88	254	537.19	258	536.54	263
GR	535.63	264	535.5	265	535.37	267	536.97	269	539.19	278
GR	542.99	290	544.15	317	545.07	357				

NC	0	0	0	.6	.8					
X1	1734	9	243	279	28	28	28			
X3	10	0	0	0	0	0	0	544.17	544.17	
GR	547.28	200	545.95	220	543.66	232	540.44	243	536.55	250
GR	536.78	272	540.24	279	543.8	291	545.05	318		

EAST ARAPAHOE ROAD
Three 66-inch RCP culverts

BC	3.014	.50	2.5	0	5.5	0	144.5	1.1	537.27	536.29
X1	1878.5	21	454	496	144.5	144.5	144.5			
X2	0	0	2	542.77	550.81					
X3	10	0	0	0	0	0	0	550.81	552.35	
BT	2	436	550.81	0	520	552.35	0			
GR	547.66	200	548.17	200.5	547.46	205	548.18	205.5	548.34	209
GR	549.75	230	550.33	259	551.64	290	551.77	320	551.50	350
GR	551.35	380	551.44	400	551.20	416	549.77	436	543.61	454
GR	539.16	464	537.27	486	543.81	496	545.57	505	548.08	520
GR	551.10	539								

CROSS SECTION E

X1	1930	21	465	479	51.5	51.5	51.5			
GR	548.05	200	548.56	200.5	551.25	230	551.22	260	551.63	290
GR	552.61	320	552.88	350	552.95	380	553.3	400	552.97	419
GR	550.3	439	545.86	453	540.79	465	537.64	466	536.45	469
GR	537.03	475	539.36	479	543.79	501	545.27	514	547.79	524
GR	550.67	535								

CROSS SECTION F

QT	1	310								
X1	2117	13	292	309	187	187	187			
GR	553.96	200	553.17	225	550.27	260	545.1	275	541.13	292
GR	539.16	294	538.33	297	538.81	299	541.29	300	542.05	309
GR	544.61	319	550.18	339	552.77	354				
X1	2317	19	346	360	200	200	200			
GR	555.44	200	555.29	230	554.84	270	552.8	300	550.99	315
GR	547.28	329	541.71	346	540.53	348	540.45	350	540.47	352
GR	541.44	353	540.56	356	540.49	357	540.57	359	541.99	360
GR	543.87	369	546.73	379	550.54	391	551.47	400		

CROSS SECTION G

X1	2517	17	323	344	200	200	200			
GR	559.39	200	558.56	230	556.26	262	553.05	286	551.46	300
GR	547.93	314	544.86	323	543.62	329	541.65	331	541.58	333
GR	541.89	336	543.81	339	544.2	344	549.57	359	552.51	371
GR	553.58	390	554.71	400						

X1	2717	20	250	271	200	200	200			
GR	557.3	200	554.66	219	551.47	235	548.61	244	547.24	249
GR	545.77	250	545.03	254	543.5	255	543.14	258	543.38	260
GR	544.45	262	543.45	264	543.37	265	543.35	266	545.21	269
GR	546.53	271	549.09	281	552.37	295	552.95	314	554.61	343

CROSS SECTION H

NC	.04	.04	.037							
X1	2917	13	224	241	200	200	200			
GR	556.92	200	551.42	200	548.53	216	547.17	224	545.36	227
GR	544.91	230	545.64	234	546.42	237	547.77	241	551.73	254
GR	554.32	272	555.19	293	555.68	315				
X1	3098	12	251	268	181	181	181			
GR	559.66	200	557.17	216	551.44	240	548.67	251	547.32	252
GR	546.33	255	547.26	262	548.48	264	549.29	268	551.71	293
GR	555.3	319	557.04	343						
X1	3293	14	279	291	195	195	195			
GR	564.63	200	563.29	224	561.75	245	555.86	263	548.95	279
GR	547.12	281	547.17	284	547.35	287	548.83	291	550.27	301
GR	555.06	315	558.85	334	559.56	354	560.83	379		

CROSS SECTION I

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X1     3434        12       254       270       141       141       141
GR   562.82       200    559.08       222    550.31       243    549.22       254    547.84       258
GR   547.71       263    547.56       269     549.7       270    550.19       275    555.37       292
GR   562.34       320    563.24       337

NC      .040      .045      .037
QT         1       190
X1     3574        12       236       248       140       140       140
GR   562.63       200    561.31       222    551.08       233    549.88       236    547.72       238
GR   546.83       240    546.99       245    550.18       248    552.75       285    557.26       309
GR   557.72       330    560.14       351

X1     3709        12       260       271       135       135       135
GR   554.63       200    554.78       219    550.76       243    551.04       260    547.46       262
GR   547.78       264    548.05       269    549.85       271    550.07       278    553.05       298
GR   558.31       331    557.77       360
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NC       .04       .04      .035
X1      3909        16       225       244       200       200       200
X3         0         0         0         0         0       275    558.34
GR   562.49       200    558.54       212    557.25       220    554.54       225    550.38       228
GR   548.95       231    548.44       233    549.12       240    551.23       244    553.19       261
GR   558.34       275    552.16       285    552.71       315    553.21       327    564.76       342
GR   564.98       362
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CROSS SECTION J

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X1     3993        20       220       248        85        85        85
X3        0         0         0         0         0       288    563.55
GR   556.14       200    555.44       201    554.05       209    552.96       220    550.42       222
GR    550.2       228    549.11       230    548.69       234    549.17       242    550.19       243
GR   551.56       245    557.98       248     559.8       258    563.55       288    554.94       300
GR   554.21       315    556.19       321    563.62       344    565.14       372    565.22       394
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CROSS SECTION K

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X1     4055        16       246       291        62        62        62
X3        0         0         0         0         0       331    564.26
GR   562.59       200    561.86       219    560.79       246    559.42       254    553.19     259.5
GR   553.69     276.5    559.42       277    560.49       291    560.78       314    564.26       331
GR   562.54       341    560.82       343    560.21       352    562.72       353    564.19       374
GR   564.61       399
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

```
*PROF 1
0

CCHV=      .100 CEHV=      .300
*SECNO 930.000
   930.000      6.60    537.50       .00    537.50    537.64       .14       .00       .00    533.14
     660.0     229.1     209.3     221.7      98.2      57.3      79.2        .0        .0    534.05
       .00      2.33      3.65      2.80      .035      .035      .035      .000    530.90    217.79
  .000912        0.        0.        0.         0         0         0       .00     87.68    305.48

*SECNO 998.000
   998.000      6.18    537.72       .00       .00    537.88       .16       .24       .01    532.98
     660.0     169.1     331.6     159.2      68.0      86.5      67.4       1.5        .7    534.44
       .02      2.49      3.83      2.36      .035      .035      .035      .000    531.54    233.28
  .000999      668.      68.       68.          2         0         0       .00     83.68    316.96

CCHV=      .600 CEHV=      .800
*SECNO 1045.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .38

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      542.50 ELREA=      542.50

  1045.000      5.62    537.70       .00       .00    538.29       .59       .06       .34    532.96
     390.0        .0     390.0        .0        .0      63.3        .0       1.7        .8    533.32
       .02       .00      6.17       .00      .000      .035      .000      .000    532.08    274.00
  .002396       47.       47.       47.          2         0         0       .00     12.00    286.00

SPECIAL CULVERT

SC  CUNO      CUNV      ENTLC      COFQ      RDLEN      RISE      SPAN      CULVLN      CHRT      SCL      ELCHU      ELCHD
     1         .024       .50      2.50        .00      6.20      7.23      122.00         8        1     532.70     532.36

CHART  8 - BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
SCALE  1 - WINGWALLS FLARED 30 TO 75 DEGREES

5140, NORMAL DEPTH EXCEEDS CULVERT HEIGHT
*SECNO 1167.000
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL CULVERT INLET CONTROL
EGIC = 539.986 EGOC = 539.722 PCWSE= 537.697 ELTRD= 546.150

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRLN
539.99	539.72	1.70	0.	390.	4.087	44.8	546.15	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 546.60 ELREA= 546.30

1167.000	7.03	539.73	.00	.00	539.99	.26	1.70	.00	540.85
390.0	.0	390.0	.0	.0	85.4	.0	1.9	.8	535.00
.03	.00	4.09	.00	.000	.035	.000	.000	532.70	223.15
.001408	122.	122.	122.	2	0	0	.00	20.85	244.00

*SECNO 1192.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.90

3470 ENCROACHMENT STATIONS= 281.0 345.0 TYPE= 1 TARGET= -281.000

1192.000	8.64	540.06	.00	.00	540.12	.06	.02	.12	536.25
390.0	134.0	228.1	27.9	90.3	99.3	23.9	2.0	.8	536.24
.04	1.48	2.30	1.16	.045	.040	.045	.000	531.42	281.00
.000391	25.	25.	25.	2	0	0	.00	49.95	330.95

CCHV= .100 CEHV= .300
*SECNO 1342.000

1342.000	9.16	540.12	.00	.00	540.19	.07	.06	.00	537.66
390.0	24.6	261.3	104.1	29.6	108.9	76.8	2.7	1.1	537.22
.06	.83	2.40	1.35	.045	.040	.045	.000	530.96	239.06
.000479	150.	150.	150.	2	0	0	.00	75.82	314.88

*SECNO 1502.000

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .30

1502.000	6.59	539.93	.00	.00	540.53	.59	.18	.16	539.83
390.0	.0	343.8	46.2	.1	53.0	15.6	3.2	1.2	537.84
.06	.03	6.49	2.96	.037	.035	.037	.000	533.34	270.81
.005174	160.	160.	160.	2	0	0	.00	27.05	297.86

*SECNO 1627.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.98

1627.000	6.12	540.67	.00	.00	540.86	.19	.29	.04	539.13
390.0	9.4	353.4	27.1	7.7	96.9	16.4	3.5	1.4	539.31
.07	1.22	3.65	1.65	.037	.035	.037	.000	534.55	268.92
.001322	125.	125.	125.	2	0	0	.00	48.63	317.55

*SECNO 1706.000

1706.000	5.77	540.84	.00	.00	540.94	.10	.08	.01	541.07
390.0	.0	385.9	4.1	.0	149.0	4.3	3.7	1.4	539.19
.08	.00	2.59	.95	.000	.035	.037	.000	535.07	235.65
.000764	79.	79.	79.	2	0	0	.00	47.56	283.21

CCHV= .600 CEHV= .800
*SECNO 1734.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 544.17 ELREA= 544.17

1734.000	4.31	540.86	.00	.00	541.01	.15	.03	.04	540.44
390.0	.0	390.0	.0	.0	125.4	.0	3.8	1.5	540.24
.08	.00	3.11	.00	.000	.035	.000	.000	536.55	243.00
.001085	28.	28.	28.	1	0	0	.00	36.00	279.00

SPECIAL CULVERT

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SC	CUNO	CUNV	ENTLC	COFQ	RDLEN	RISE	SPAN	CULVLN	CHRT	SCL	ELCHU	ELCHD

3	.014	.50	2.50	.00	5.50	.00	144.50	1	1	537.27	536.29

CHART 1 - CONCRETE PIPE CULVERT; NO BEVELED RING ENTRANCE
SCALE 1 - SQUARE EDGE ENTRANCE WITH HEADWALL

*SECNO 1878.500

SPECIAL CULVERT OUTLET CONTROL
EGIC = 542.020 EGOC = 542.373 PCWSE= 540.857 ELTRD= 550.810

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRLN
542.02	542.37	1.37	0.	390.	3.344	71.3	550.81	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 550.81 ELREA= 552.35

1878.500	4.93	542.20	.00	.00	542.37	.17	1.37	.00	543.61
390.0	.0	390.0	.0	.0	116.6	.0	4.2	1.6	543.81
.10	.00	3.34	.00	.000	.035	.000	.000	537.27	457.17
.001418	145.	145.	145.	2	0	0	.00	36.37	493.54

*SECNO 1930.000

1930.000	5.81	542.26	.00	.00	542.59	.34	.09	.13	540.79
390.0	3.7	336.8	49.5	2.6	68.1	20.9	4.4	1.6	539.36
.10	1.44	4.94	2.36	.037	.035	.037	.000	536.45	461.51
.002162	52.	52.	52.	0	0	0	.00	31.91	493.42

*SECNO 2117.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .36

2117.000	4.55	542.88	.00	.00	543.59	.71	.70	.30	541.13
310.0	24.5	282.4	3.1	6.6	40.4	1.4	4.7	1.8	542.05
.11	3.70	7.00	2.25	.037	.035	.037	.000	538.33	284.47
.010435	187.	187.	187.	2	0	0	.00	27.80	312.27

*SECNO 2317.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.02

2317.000	4.01	544.46	.00	.00	544.76	.30	.92	.25	541.71
310.0	27.9	245.0	37.0	11.5	51.4	14.3	5.0	1.9	541.99
.12	2.43	4.76	2.58	.037	.035	.037	.000	540.45	337.62
.002562	200.	200.	200.	2	0	0	.00	33.43	371.05

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 2517.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .48

2517.000	3.73	545.31	.00	.00	546.05	.75	.94	.36	544.86
310.0	.4	304.9	4.7	.3	43.7	1.7	5.2	2.0	544.20
.13	1.50	6.98	2.75	.037	.035	.037	.000	541.58	321.70
.011181	200.	200.	200.	2	0	0	.00	25.39	347.09

*SECNO 2717.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.64

2717.000	3.99	547.13	.00	.00	547.54	.41	1.28	.20	545.77
310.0	.8	308.4	.8	.6	60.1	.7	5.5	2.1	546.53
.14	1.36	5.13	1.12	.037	.035	.037	.000	543.14	249.08
.004135	200.	200.	200.	2	0	0	.00	24.23	273.31

*SECNO 2917.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .59

2917.000	3.44	548.35	548.21	.00	549.17	.83	1.30	.34	547.17
310.0	11.3	297.8	.9	4.1	40.1	.5	5.7	2.3	547.77
.15	2.79	7.43	1.70	.040	.037	.040	.000	544.91	217.09
.011695	200.	200.	200.	4	15	0	.00	25.79	242.89

*SECNO 3098.000

3098.000	4.00	550.33	.00	.00	550.84	.51	1.47	.19	548.67
310.0	13.6	286.1	10.3	5.5	48.3	5.6	5.9	2.4	549.29
.16	2.49	5.93	1.85	.040	.037	.040	.000	546.33	244.42
.005995	181.	181.	181.	3	0	0	.00	34.30	278.72

*SECNO 3293.000

3293.000	4.30	551.42	.00	.00	551.76	.34	.82	.10	548.95
310.0	15.9	233.3	60.8	7.1	45.4	20.6	6.2	2.5	548.83
.17	2.24	5.14	2.95	.040	.037	.040	.000	547.12	273.28
.003083	195.	195.	195.	2	0	0	.00	31.08	304.36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV

Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 3434.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.54

3434.000	4.43	551.99	.00	.00	552.14	.15	.27	.11	549.22
310.0	59.6	221.9	28.5	27.8	64.4	15.5	6.5	2.7	549.70
.18	2.14	3.45	1.83	.040	.037	.040	.000	547.56	238.98
.001307	141.	141.	141.	2	0	0	.00	41.92	280.90

*SECNO 3574.000

3574.000	5.39	552.22	.00	.00	552.32	.10	.15	.03	549.88
190.0	8.2	152.7	29.1	5.9	54.2	29.9	6.8	2.8	550.18
.20	1.39	2.82	.97	.040	.037	.045	.000	546.83	231.78
.000850	140.	140.	140.	2	0	0	.00	45.58	277.36

*SECNO 3709.000

3709.000	4.93	552.39	.00	.00	552.45	.06	.10	.03	551.04
190.0	39.6	105.9	44.5	33.4	45.1	35.2	7.2	3.0	549.85
.22	1.19	2.35	1.26	.040	.037	.045	.000	547.46	233.24
.000705	135.	135.	135.	2	0	0	.00	60.36	283.60

*SECNO 3909.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .67

3470 ENCROACHMENT STATIONS= .0 275.0 TYPE= 1 TARGET= 274.999

3909.000	4.14	552.58	.00	.00	552.74	.16	.20	.09	554.54
190.0	.0	181.1	8.9	.0	54.4	7.9	7.6	3.2	551.23
.23	.00	3.33	1.13	.000	.035	.040	.000	548.44	226.42
.001581	200.	200.	200.	2	0	0	.00	29.26	255.67

*SECNO 3993.000

3470 ENCROACHMENT STATIONS= .0 288.0 TYPE= 1 TARGET= 287.999

3993.000	4.10	552.79	.00	.00	552.88	.09	.10	.04	552.96
190.0	.0	190.0	.0	.0	77.1	.0	7.7	3.2	557.98
.24	.00	2.47	.00	.000	.035	.000	.000	548.69	220.14
.000897	85.	85.	85.	2	0	0	.00	25.44	245.57

*SECNO 4055.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= .0 331.0 TYPE= 1 TARGET= 330.999

4055.000	1.78	554.97	554.97	.00	555.71	.74	.15	.52	560.79
190.0	.0	190.0	.0	.0	27.5	.0	7.8	3.2	560.49
.25	.00	6.91	.00	.000	.035	.000	.000	553.19	257.93
.018066	62.	62.	62.	20	14	0	.00	18.68	276.61

THIS RUN EXECUTED 31DEC91 08:03:19

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

LOWER WILLOW CREEK

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	930.000	.00	.00	.00	530.90	660.00	537.50	.00	537.64	9.12	3.65	234.76	218.54
	998.000	68.00	.00	.00	531.54	660.00	537.72	.00	537.88	9.99	3.83	221.91	208.77
*	1045.000	47.00	.00	.00	532.08	390.00	537.70	.00	538.29	23.96	6.17	63.26	79.68
	1167.000	122.00	546.15	538.90	532.70	390.00	539.73	.00	539.99	14.08	4.09	95.42	103.95
*	1192.000	25.00	.00	.00	531.42	390.00	540.06	.00	540.12	3.91	2.30	213.55	197.27
	1342.000	150.00	.00	.00	530.96	390.00	540.12	.00	540.19	4.79	2.40	215.38	178.25

*	1502.000	160.00	.00	.00	533.34	390.00	539.93	.00	540.53	51.74	6.49	68.66	54.22
*	1627.000	125.00	.00	.00	534.55	390.00	540.67	.00	540.86	13.22	3.65	121.03	107.26
	1706.000	79.00	.00	.00	535.07	390.00	540.84	.00	540.94	7.64	2.59	153.28	141.13
	1734.000	28.00	.00	.00	536.55	390.00	540.86	.00	541.01	10.85	3.11	125.41	118.42
-	1878.500	144.50	550.81	542.77	537.27	390.00	542.20	.00	542.37	14.18	3.34	116.63	103.56
E	1930.000	51.50	.00	.00	536.45 E	390.00	542.26	.00	542.59	21.62	4.94	91.63	83.87
*	F 2117.000	187.00	.00	.00	538.33 F	310.00	542.88	.00	543.59	104.35	7.00	48.34	30.35
*	2317.000	200.00	.00	.00	540.45	310.00	544.46	.00	544.76	25.62	4.76	77.29	61.25
*	G 2517.000	200.00	.00	.00	541.58 G	310.00	545.31	.00	546.05	111.81	6.98	45.67	29.32
*	2717.000	200.00	.00	.00	543.14	310.00	547.13	.00	547.54	41.35	5.13	61.45	48.21
*	H 2917.000	200.00	.00	.00	544.91 H	310.00	548.35	548.21	549.17	116.95	7.43	44.69	28.67

1

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	3098.000	181.00	.00	.00	546.33	310.00	550.33	.00	550.84	59.95	5.93	59.27	40.04
	3293.000	195.00	.00	.00	547.12	310.00	551.42	.00	551.76	30.83	5.14	73.11	55.83
*	I 3434.000	141.00	.00	.00	547.56 I	310.00	551.99	.00	552.14	13.07	3.45	107.74	85.76
	3574.000	140.00	.00	.00	546.83	190.00	552.22	.00	552.32	8.50	2.82	90.02	65.16
	3709.000	135.00	.00	.00	547.46	190.00	552.39	.00	552.45	7.05	2.35	113.68	71.54
*	3909.000	200.00	.00	.00	548.44	190.00	552.58	.00	552.74	15.81	3.33	62.26	47.78
	J 3993.000	85.00	.00	.00	548.69 J	190.00	552.79	.00	552.88	8.97	2.47	77.05	63.43
*	K 4055.000	62.00	.00	.00	553.19 K	190.00	554.97	554.97	555.71	180.66	6.91	27.51	14.14

1

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LOWER WILLOW CREEK

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	930.000	660.00	537.50	.00	.00	.00	87.68	.00
	998.000	660.00	537.72	.00	.22	.00	83.68	68.00
*	1045.000	390.00	537.70	.00	-.02	.00	12.00	47.00
	1167.000	390.00	539.73	.00	2.03	.00	20.85	122.00
*	1192.000	390.00	540.06	.00	.33	.00	49.95	25.00
	1342.000	390.00	540.12	.00	.06	.00	75.82	150.00
*	1502.000	390.00	539.93	.00	-.19	.00	27.05	160.00
*	1627.000	390.00	540.67	.00	.73	.00	48.63	125.00
	1706.000	390.00	540.84	.00	.17	.00	47.56	79.00
	1734.000	390.00	540.86	.00	.02	.00	36.00	28.00
	1878.500	390.00	542.20	.00	1.34	.00	36.37	144.50
	1930.000	390.00	542.26	.00	.06	.00	31.91	51.50
*	2117.000	310.00	542.88	.00	.63	.00	27.80	187.00
*	2317.000	310.00	544.46	.00	1.57	.00	33.43	200.00
*	2517.000	310.00	545.31	.00	.85	.00	25.39	200.00
*	2717.000	310.00	547.13	.00	1.82	.00	24.23	200.00
*	2917.000	310.00	548.35	.00	1.22	.00	25.79	200.00
	3098.000	310.00	550.33	.00	1.98	.00	34.30	181.00
	3293.000	310.00	551.42	.00	1.09	.00	31.08	195.00
*	3434.000	310.00	551.99	.00	.57	.00	41.92	141.00
	3574.000	190.00	552.22	.00	.23	.00	45.58	140.00
	3709.000	190.00	552.39	.00	.18	.00	60.36	135.00
*	3909.000	190.00	552.58	.00	.18	.00	29.26	200.00
	3993.000	190.00	552.79	.00	.21	.00	25.44	85.00

1

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	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	4055.000	190.00	554.97	.00	2.18	.00	18.68	62.00

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO= 1045.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 1192.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 1502.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 1627.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 2117.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 2317.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 2517.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 2717.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 2917.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 3434.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 3909.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 4055.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4055.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4055.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

South Suburban
Park and Recreation District

6631 South University Boulevard
Littleton, Colorado 80121
Administrative Office (303) 798-5131
Fax (303) 798-3030

July 7, 1993

Mr. John Manus
Arapahoe County Planning Dept.
5334 S. Prince Street
Littleton, CO 80166

Dear John:

We have had discussions with Bernie Lash, Consultant for the Center at Homestead, Project #Z93-004 and Hank Saipe, the developer with regards to the proposed storage facility and specifically the zero lot line configuration. We also have decided that the proposed Willow Creek Trail alignment needs to be adjacent to the drainage so that it may be available for maintenance by Urban Drainage & Flood Control District.

South Suburban has concluded that the zero lot line will not detract from the proposed Willow Creek Trail plans that provide for an 8-10 foot trail along the west side of the drainage contingent upon the following understanding:

1. The developer is responsible for the security of his development by the use of solid walls that face the trail and the maintenance and cleaning of those walls in the advent of graffiti.

2. The developer is responsible for security fencing between buildings along zero lot line and the maintenance and repair of such fencing.

3. The developer will refer grading and engineering plans to South Suburban that may affect existing grades and any drainage to South Suburban property.

4. The developer will obtain any required construction easements under the conditions of District policy should grading, access, or excavations take place across our property line.

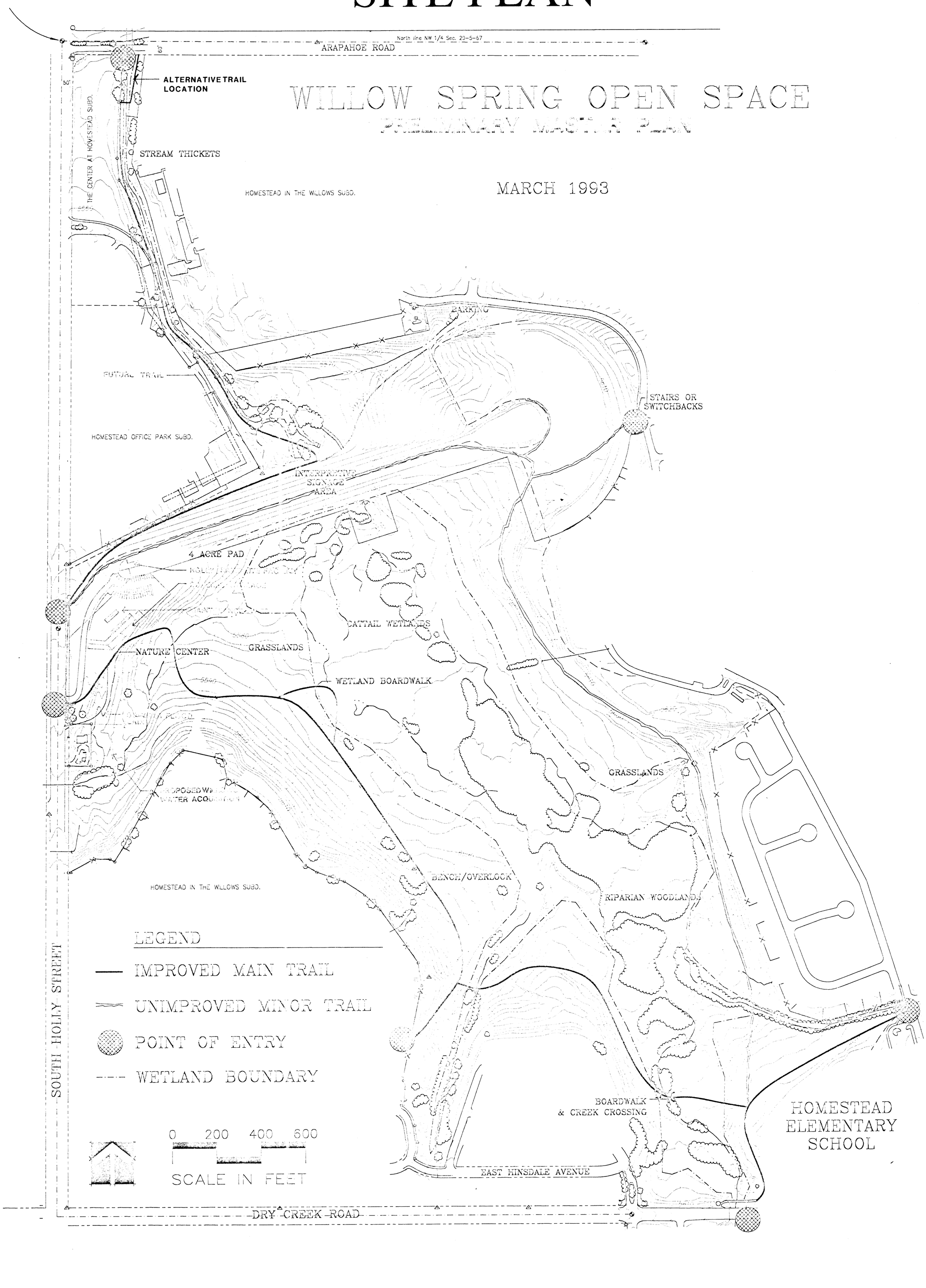
We feel that if these conditions can be met and the developer can keep and close working relation-ship with us, we can both realize successful projects.

Sincerely,

Brian Muller

cc: Mr. Bernard Lash
Mr. Hank Saipe

SITE PLAN



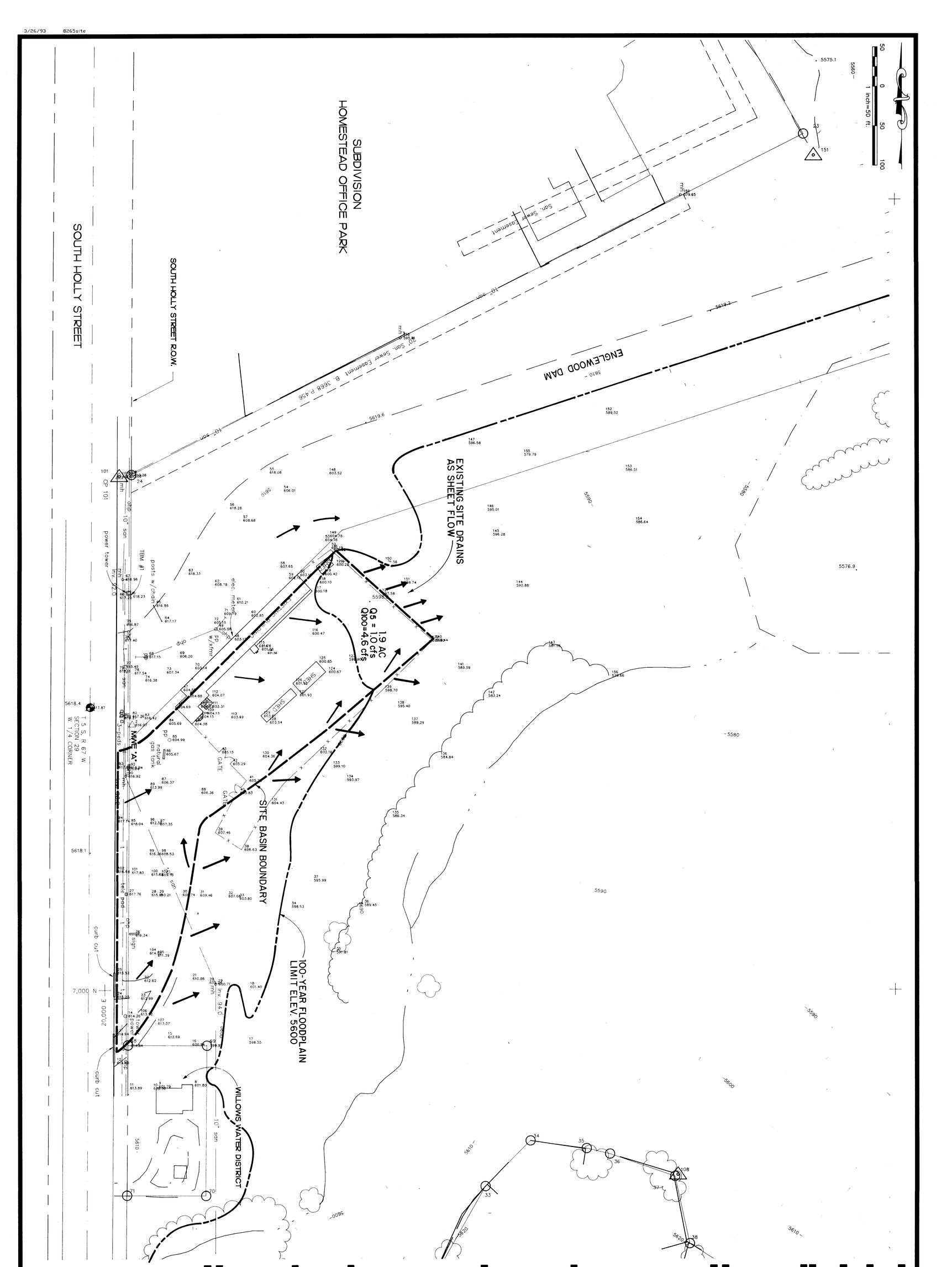
WILLOW SPRING OPEN SPACE

PRELIMINARY MASTER PLAN

MARCH 1993

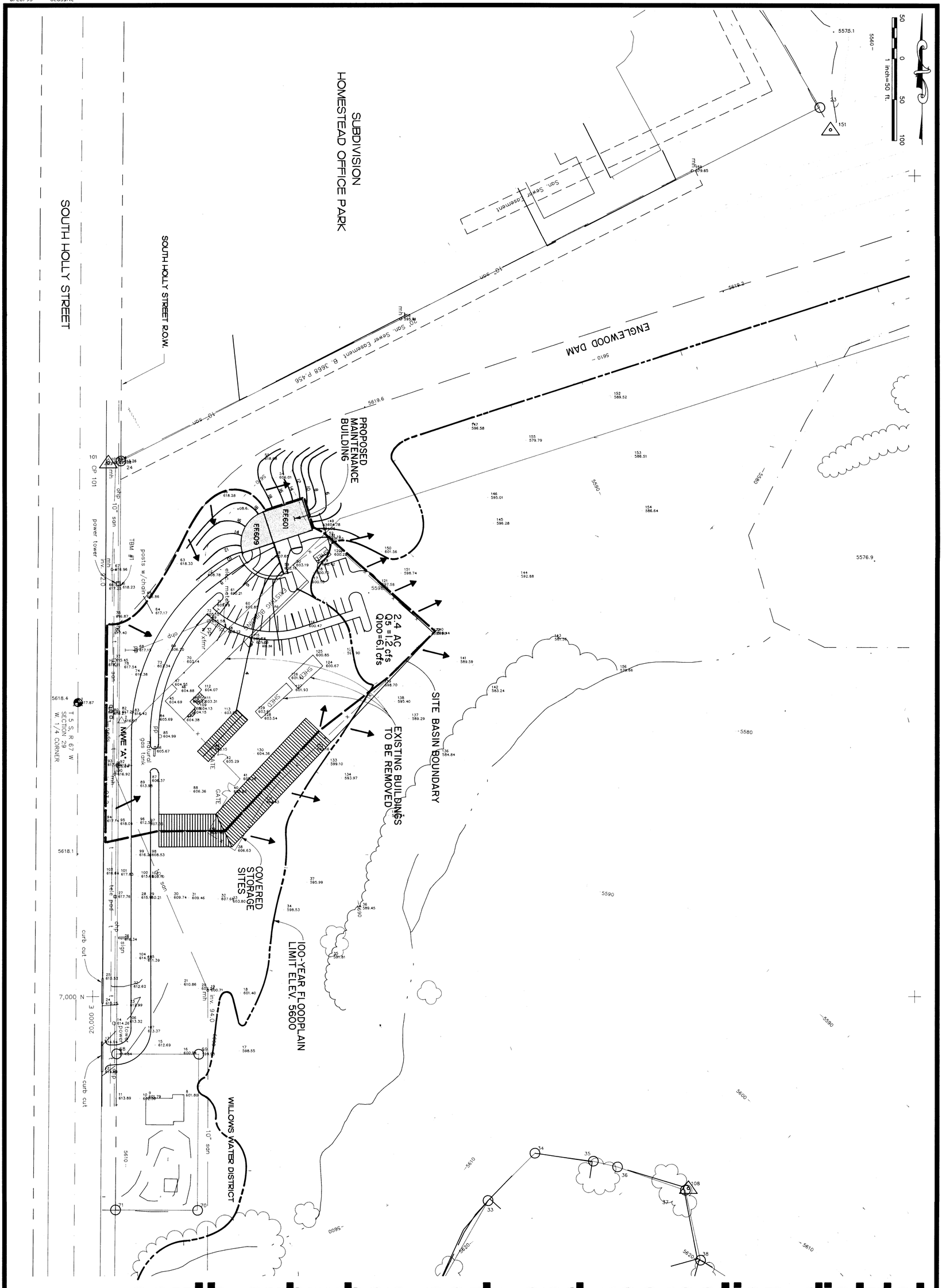
DRAWING NO. 1

3/26/93 8265site



south suburban park and recreation district

sheet 2	MWE McLaughlin Water Engineers, Ltd. 2420 Alcott Street Denver Co. 80211	project: WILLOW SPRINGS OPEN SPACE
		sheet title: SITE PLAN EXISTING MAINTENANCE FACILITY



south suburban park and recreation district

sheet		project	sheet title
3	MWE McLaughlin Water Engineers, Ltd. 2420 Alcott Street Denver Co. 80211	WILLOW SPRINGS OPEN SPACE	SITE PLAN PROPOSED MAINTENANCE FACILITY

50 0 50 100
1 inch=50 ft.

ARAPAHOE ROAD

SOUTH HOLLY STREET

SOUTH HOLLY CIRCLE

APPROXIMATE 100-YEAR FLOODPLAIN LIMIT

Q100 = 390 cfs

Q100 = 310 cfs

WILLOW CREEK

PROPOSED TRAIL CROSSING

PROPOSED CENTER AT HOMESTEAD

PHASE 2 TRAIL

PIPE LOCAL DRAINAGE BENEATH PATH

24" RCP

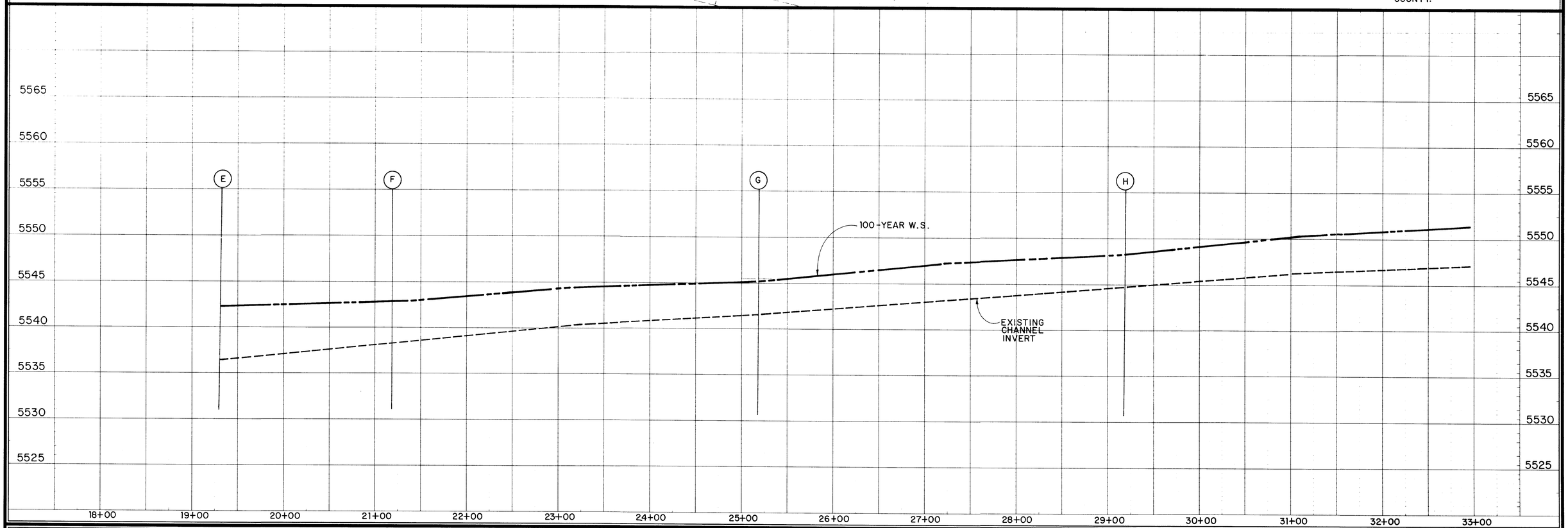
30" RCP

MATCH LINE

DWG 5

NOTE:
COORDINATE LOCAL STORM DRAIN OUTFALLS WITH TRAIL DESIGN.

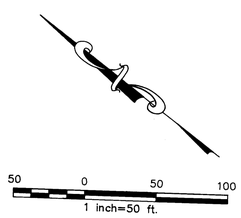
NOTE:
100-YEAR FLOODPLAIN INFORMATION AND PROFILE DATA OBTAINED FROM FIS MAP UPDATE FOR ARAPAHOE COUNTY.

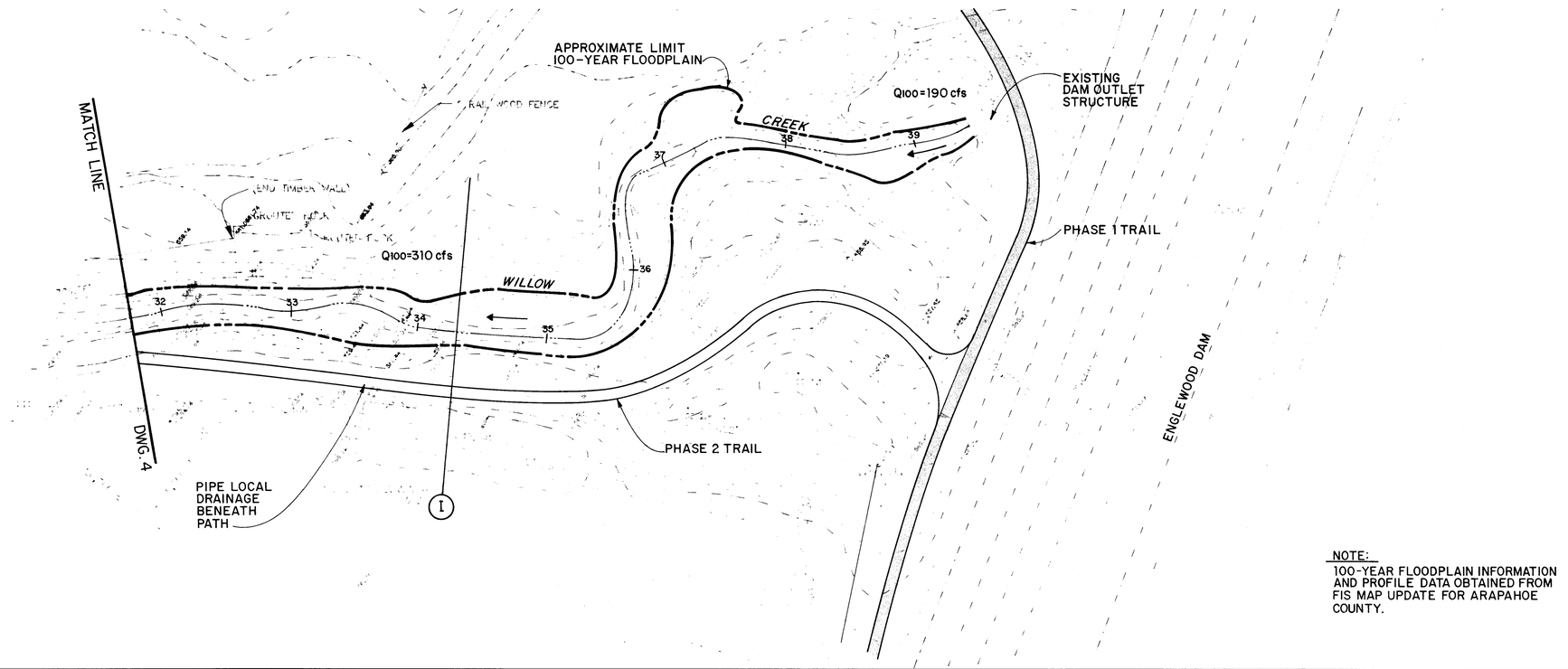


SOUTH SUBURBAN PARK AND RECREATION DISTRICT	WILLOW SPRING OPEN SPACE PARK	PLAN AND PROFILE WILLOW CREEK DOWNSTREAM OF ENGLEWOOD DAM	McLaughlin Water Engineers, Ltd. 2420 Alcott Street Denver Co. 80211	DESIGN: DDT DETAIL: DDT CHECK: JMP	PROJECT NUMBER 82-065.040P DATE: SEPT., 1993	DRAWING NUMBER 4

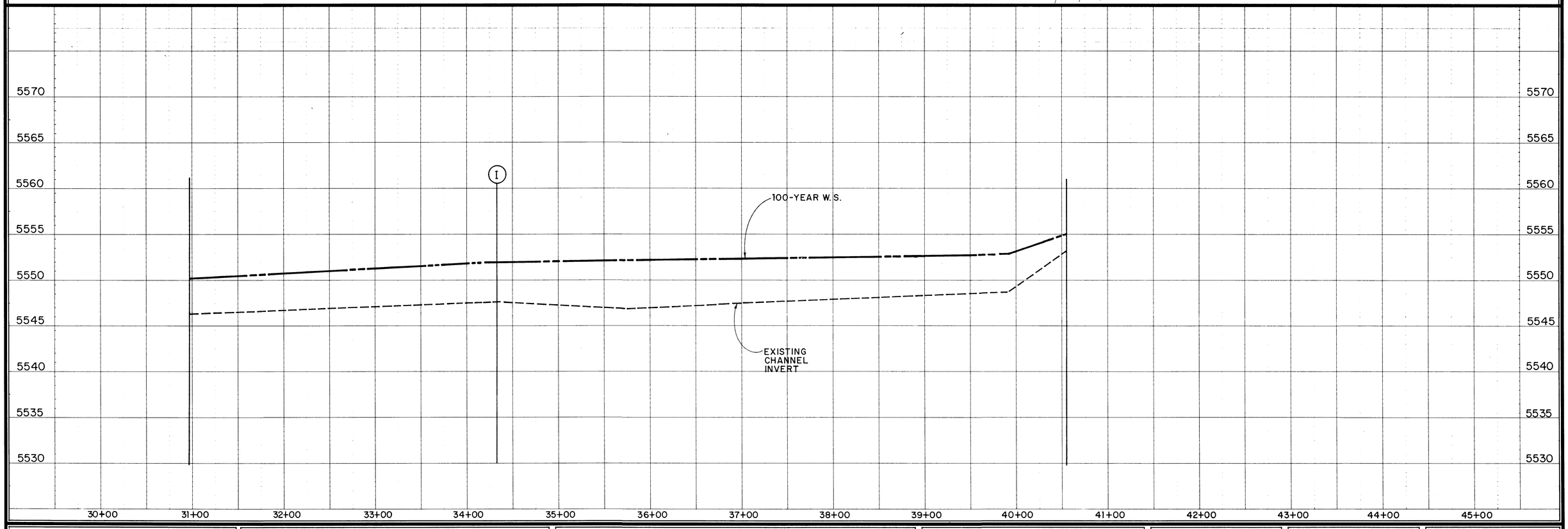
WILOWFP1

9/27/93





NOTE:
100-YEAR FLOODPLAIN INFORMATION AND PROFILE DATA OBTAINED FROM FIS MAP UPDATE FOR ARAPAHOE COUNTY.



WILOWPP2

9/27/93

SOUTH SUBURBAN PARK AND RECREATION DISTRICT	WILLOW SPRING OPEN SPACE PARK	PLAN AND PROFILE WILLOW CREEK DOWNSTREAM OF ENGLEWOOD DAM	McLaughlin Water Engineers, Ltd. 2420 Alcott Street Denver Co. 80211	DESIGN: DETAIL: CHECK:	PROJECT NUMBER 82-065.040P DATE: SEPT., 1993	DRAWING NUMBER 5