MASTER DEVELOPMENT DRAINAGE PLAN For LEON YOUNG SERVICE CENTER - SOUTH

MASTER DEVELOPMENT DRAINAGE PLAN
For
LEON YOUNG SERVICE CENTER - SOUTH

August, 2004

Project No. 02034-S

Prepared for:
Colorado Springs Utilities

Prepared by:
Obering, Wurth & Associates
Consulting Civil Engineers
Professional Land Surveyors

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APPENDIX

MAP POCKET

Obering, Wurth & Associates

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Professional Land Surveyors

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City of Colorado Springs
Engineering Unit
Subdivision Review
30 S. Nevada Ave., Suite 702
Colorado Springs, CO 80903

August, 2004

Re: Master Development
Drainage Plan for Leon Young
Service Center-South

Project No. 02034-S

Gentlemen:

Transmitted herewith is the Master Development Drainage Plan (MDDP) for Leon Young Service Center-South. The over 21 acres site is in Southern Colorado Springs. The site is located on the South side of Hancock Expressway opposite the Colorado Springs Utilities Leon Young Service Center. The site includes platted and unplatted areas that are located partially in the City and County. The site has a combination of developed and undeveloped areas within it with the majority of the developed area being storage yards. This MDDP drainage analysis was completed in accordance with the current City of Colorado Springs Drainage Criteria manual in order to satisfy submittal requirements for a Concept Plan that is being submitted in conjunction with an annexation request. This MDDP has been prepared for the City only since the annexation would result in the entire site being located within City limits.

If there are any questions or comments regarding any portion of this drainage analysis, please contact the undersigned.

Very truly yours,
Obering Wurth & Associates

Steven G. Baggs, P. E.

Reviewed by:
Roland G. Obering, P.E. & P.L.S.

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Master Development Drainage
Plan for Leon Young Service
Center - South

Project No. 02034-S

ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are current to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Roland G. Obering, P.E. & P.L.S. Colorado 13226

ROLAND G. OBERING REGISTERED 13226 11/02/04 P.E. & L.S. STATE OF COLORADO

DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all the requirements specified in this drainage report and plan.

COLORADO SPRINGS UTILITIES
Business Name

By

FAC. ENG./ARCH MANAGER.
Title

404 FONTANERO ST., BLDG 441, CS, CO
Address

CITY OF COLORADO SPRINGS

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer

11/3/04
Date

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FLOODPLAIN STATEMENT

To the best of my knowledge and belief, the Leon Young Service Center- South concept plan area is not located within a designated floodplain as shown on FIRM panels 08041CO733F and 08041CO741F dated March 17, 1997. A copy of a portion of the appropriate FIRM panels is included in the Appendix of this study.

Roland G. Obering, P.E. & P.L.S. Colorado No. 13226

I. GENERAL

The proposed Leon Young Service Center-South Concept Plan area is parcel of land consisting of approximately 21 acres located in South central Colorado Springs. The site is adjacent to the South right of way line of Hancock Expressway and is opposite the Leon Young Service Center which was platted as the Spring Creek Electric Service Center Filing No. 1. Railroad right of ways for the A.T. & S. F. Railroad and the D.&R.G.W. Railroad are adjacent to the South. This concept plan parcel is to be developed by Colorado Springs Utilities (CSU) and consists of a previously platted parcel known as Lot 1, Block 1 of Metro Subdivision and unplatted land. The platted area is fully developed with existing buildings and paved parking and storage lots. Drainage impacts from this developed area will be analyzed in this Master Development Drainage Plan (MDDP). The unplatted area consists of developed and undeveloped land. The developed land consists of paved and unpaved storage yards with some building structures. The paved storage yard on the East end of the site was constructed in 2002 and included drainage improvements that were documented in a drainage report submitted to the County prior to construction. The site is impacted by numerous utilities and drainage infrastructure. The site is located within the Spring Creek Drainage Basin and a Miscellaneous Drainage Basin with the majority of the site being in the Spring Creek Drainage Basin.

The undeveloped portions of the site generally drain to the South toward the railroad embankment. Depression areas and swales collect and direct runoff to two major bridge/culvert crossings under the railroad. The undeveloped areas are covered with native vegetation including grasses and trees. The soils in this area are Nelson-Jassel fine sandy loams that are classified as Hydrologic Soils Group B/D according to the Soil Survey of El Paso County by the Soil Conservation Service. The conservative Group "D" soil will be utilized in this drainage analysis. A copy of a portion of the Soil Survey Map is included in the Appendix. The concept plan proposed that this site will be developed with various paved storage yards, covered storage area, storage and other buildings, and a paved driver training (CDL) course. Bulk grading of the site would occur initially as fill material and financing becomes available. Final development of the site will occur in phases as money is appropriated for various projects.

II. DRAINAGE DESIGN CRITERIA

This MDDP has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2. The MDDP is to accompany a Concept Plan submittal for the Leon Young Service Center-South area and will provide an overall guide for phased development of the site. Recommendations included in this MDDP will be refined in Final Drainage Reports that will be prepared for the individual phases. Drainage studies referenced in the preparation of this report include:

1.) Spring Creek DBPS, prepared by URS Consultants, October, 1993.

2.) Spring Creek Electric Service Center Final Drainage Report, prepared by GMS, Inc., filed July 2, 1997.

3.) PDR/FDR for Leon Young Service Center South Storage Yard, prepared by Obering Wurth & Associates, submitted December, 2001.

4.) Metro Subdivision Drainage Report & Plan, prepared by Leigh Whitehead & Associates, approved but not dated.

The drainage conditions at the site have been estimated using the Rational Method for runoff computations as required by the City of Colorado Springs Drainage Criteria Manual for sites with less than 100 acres. A summary of all hydrologic calculations has been included in the Appendix of this report. Detention and water quality facilities have been identified however specific design calculations will be prepared at the time of final drainage report preparation. Storm sewer recommendations have been provided on the MDDP Drainage Plan included in the Appendix but are subject to refinement by final drainage report and final design.

III. DRAINAGE ISSUES

The proposed Leon Young Service Center-South site has three separate outfall locations that have distinct drainage issues. The site has been divided into various subbasins based on existing and proposed grading. These subbasins have been designated as W (West), M (Middle), E (East) and correspond to the three outfall locations. Runoff estimates have been determined based on these subbasins and summarized in the Appendix.

The West end of the site is identified by the "W" subbasins and is located within a miscellaneous Drainage Basin. This portion of the site has the most significant offsite drainage impacts. An existing major storm sewer crosses through this end of the site. According to the drainage report for Metro Subdivision, this system is the outfall for approximately 180 acres upstream of the site. This existing system consists of a 48" CSP and 54" CSP that combine into a 60" CSP which crosses this site. The existing 60" CSP daylights in Subbasin W-4 where a concrete transition channel conveys the runoff into a stone arch drainage tunnel under an abandoned railroad bed. The runoff then continues Southerly through a drainage crossing under the existing railroad track. The drainage pattern would be unchanged by the development of this site since all of the "W" subbasins currently drain to this outfall point. Subbasin W-4 is the only "W" subbasin that will be developed as a result of this proposed project. Subbasin W-5 will be the location of a detention/water quality facility. Existing flows for Subbasins W-1, W-2A, W-2B and W-3 as well as proposed flows from Subbasins W-4 and W-5 are shown on the Drainage Plan. Proposed

drainage facilities including a detention pond will allow the runoff to be conveyed efficiently through the improved site while maintaining the runoff quantity at its current level.

The middle portion of the site is also subject to some offsite drainage impacts. The "M" subbasins generate runoff that mostly flows to an existing natural channel located on the East side of the proposed detention/water quality facility in Subbasin M-4. This channel then conveys runoff to a 54" RCP culvert crossing under the existing railroad tracks. An existing 30" CMP storm sewer crosses Subbasin M-3 and also discharges into the previously mentioned natural channel. This storm sewer currently collects runoff from a portion of the Leon young Service Center and from the Hancock Expressway. An inlet also exists currently in Subbasin M-3. Subbasins M-2 and M-3 will be fully developed and will generate runoff that will need to be treated for water quality and be detained to insure that the runoff quantity reaching the 54" RCP outfall is unchanged by this development. Subbasin M-1, which consists of the South half of approximately 1730 ft. of Hancock Expressway will continue to drain into the 30" CMP after development occurs.

The East end of the Leon Young Service Center-South is represented by Subbasins E-1 and E-2. An existing storm sewer system serves both of these subbasins. This system was detailed in the PDR/FDR for Leon Young Service Center-South Storage Yard and was constructed in 2002 when the paved storage yard was constructed. Inlets were provided to drain the storage yard as well as the road ditch of Hancock Expressway with the storm sewer outfalling to the East of Subbasin E-2. Subbasin E-1 includes the South half of Hancock Expressway and will continue to contribute runoff to the existing storm sewer. The Subbasin E-2 basin was delineated to contain an area that is equivalent to the existing paved storage area. This will insure that the runoff leaving the site to the East is in accordance with the existing drainage report. Maintaining this existing system will not require a water quality facility since it was installed prior to the adoption of the water quality requirements.

IV. DRAINAGE SOLUTIONS

The proposed Leon Young Service Center-South development will require a combination of storm sewer, detention and water quality facilities in order to maintain existing drainage patterns and insure that runoff quantities do not increase at the three outfall locations. This drainage approach limits drainage facility recommendations to onsite improvements only and should prevent any downstream impact at this site. The West, Middle and East storm sewers are recommendations that are subject to refinement as final drainage reports are prepared for the site.

The West Storm Sewer is the most extensive storm sewer recommended at the site. The majority of these facilities in this system improve or extend existing facilities. Subbasin W-1 includes Hancock Expressway from Fountain Boulevard to this site. Two 15' opening D-10-R curb inlets are recommended as shown on the Drainage Plan to keep the street runoff within the

Miscellaneous Basin. The upstream inlet will connect to an existing storm sewer while the downstream inlet will include an 18"/24" storm sewer that will extend to a junction box in Subbasin W-4. Subbasin W-2A requires no additional facilities while Subbasin W-2B will require the replacement of a concrete trough with a 15' opening D-10-R curb inlet and a 24" RCP storm sewer that extends to the previously mentioned junction box. Subbasin W-3 has a grated inlet and 24" CMP pipe that will be replaced with a 10' opening curb inlet and 15" RCP storm sewer. Subbasin W-4 is the location of the junction box that connects the storm sewer facilities from Subbasins W-1, W-2B and W-3 to the existing 60" CSP. A 60" RCP will extend South from the junction box as shown on the Drainage Plan. It will extend to the wall along the Southerly edge of the site where it will discharge directly into the existing railroad crossing. An outfall transition/dissipator should be provided at this location. Actual runoff from Subbasin W-4 will not be directed to the junction box but will be directed overland through the paved CDL course to the West to the proposed detention/water quality facility in Subbasin W-5. The outfall facilities for the pond are subject to further analysis but will extend from the pond to the same outfall location as the 60" RCP. These facilities will be a combination of public and private facilities that will require drainage easements.

The Middle Storm Sewer System consists of an existing storm sewer that will be modified slightly and proposed storm sewers that will drain to a proposed detention/water quality facility. The existing storm sewer consist of a 30" CSP that extends across Subbasin M-3 from an existing 16' opening D-10-R curb inlet on the North side of the Hancock Expressway to an existing natural drainage on the South side of the site. There are two grated inlets on the line that will be eliminated. A 10' opening radial curb inlet will be added at the low point of Hancock Expressway at the site's proposed main entrance and will collect all runoff from Subbasin M-1. The outfall for this existing system will be unchanged by this development. Runoff from Subbasins M-2 and M-3 will be directed into proposed storm sewers. A combination of three 15' openings D-10-R curb inlets along the South side of Subbasin M-2 will collect runoff from Subbasin M-2. Storm sewer pipe ranging from 18" to 30" RCP will convey the runoff to the detention/water quality facility. A combination of two 15' D-10-R curb inlets and one 10' D-10-R curb inlet will be located on the Southerly edge of Subbasin M-3 and will collect the runoff from Subbasin M-3. Pipe ranging from 18" to 24" RCP will then convey the runoff to Subbasin M-4 where the detention/water quality facility is located. The detention/water quality facility will be subject to further analysis at the time of final drainage report preparation. The outfall facilities for the pond will be directed to the East to the existing natural channel. There are no improvements recommended for the natural channel that extends south to an existing 54" RCP outfall pipe under the railroad track.

The East Storm Sewer System is actually an existing system that will be modified to accommodate the improvements that occur on the east end of the site. The East end of the site is mostly developed with the paved storage area that was constructed several years ago. The existing storm sewer was also built at that time. Subbasin E-2 was delineated to insure that the amount of runoff entering this storm sewer will remain the same. Two grated inlets that collect

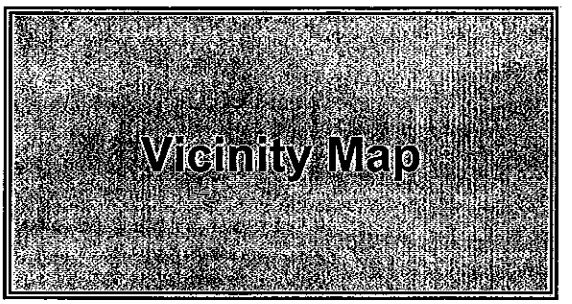
runoff from Hancock Expressway (Subbasin E-1) will be replaced with two 5' D-10-R curb inlets. Due to proposed curb reconfiguration and grading changes within the existing paved storage area, a portion of the existing storm sewer will need to be abandoned. A 10' grated D-9 inlet is proposed for the Southeast corner of Subbbasin E-1. This inlet will be connected to the existing storm sewer as shown on the Drainage Plan. The outfall of the existing storm sewer would be unchanged by the proposed facility changes recommended in the study. Also there would be no change to the overall existing drainage pattern.

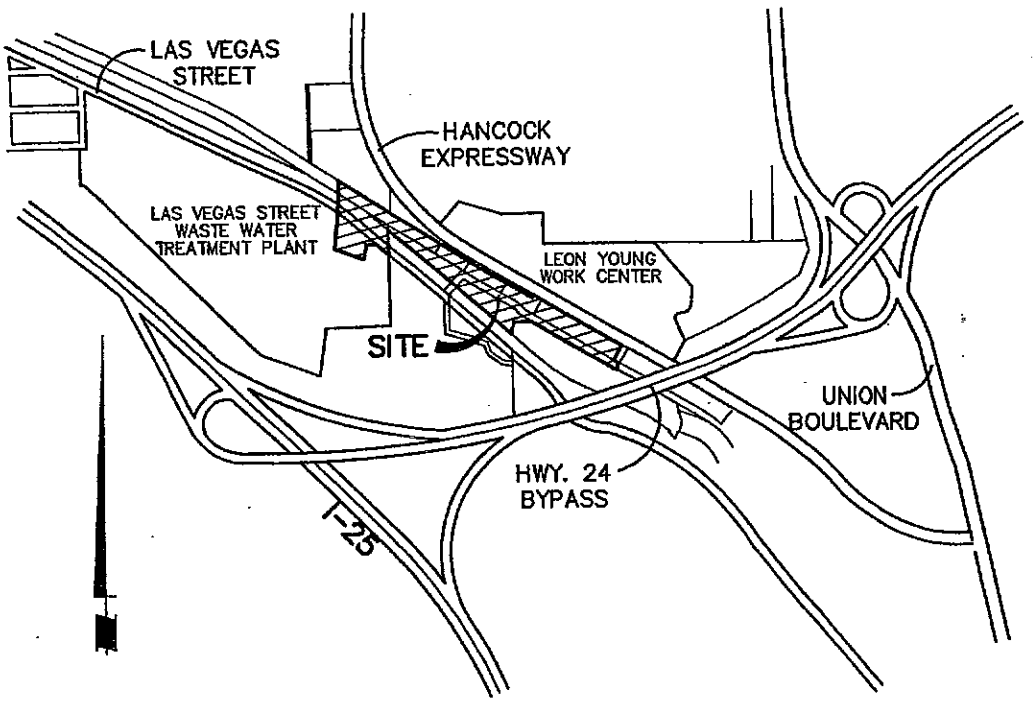
V. SUMMARY

This Master Development Drainage Plan has been prepared to accompany a Concept Plan and Annexation Plat application for Leon Young Service Center-South. Drainage facilities and water quality facilities will be required at this site. Preliminary storm sewer facilities have been determined and are shown on the attached Drainage Plan. Detention/water quality facilities have been identified and located for this site. Phased development of this site will require Final Drainage Reports. All facilities shown on the Drainage Plan are subject to final design.

This Master Development Drainage Plan has been prepared in accordance with the current City of Colorado Springs Drainage Manual Volumes 1 and 2. Supporting information is included in the Appendix. It is believed that all pertinent information has been considered in the preparation of this MDDP. The recommendations contained herein are subject to the conditions set forth.

Appendix

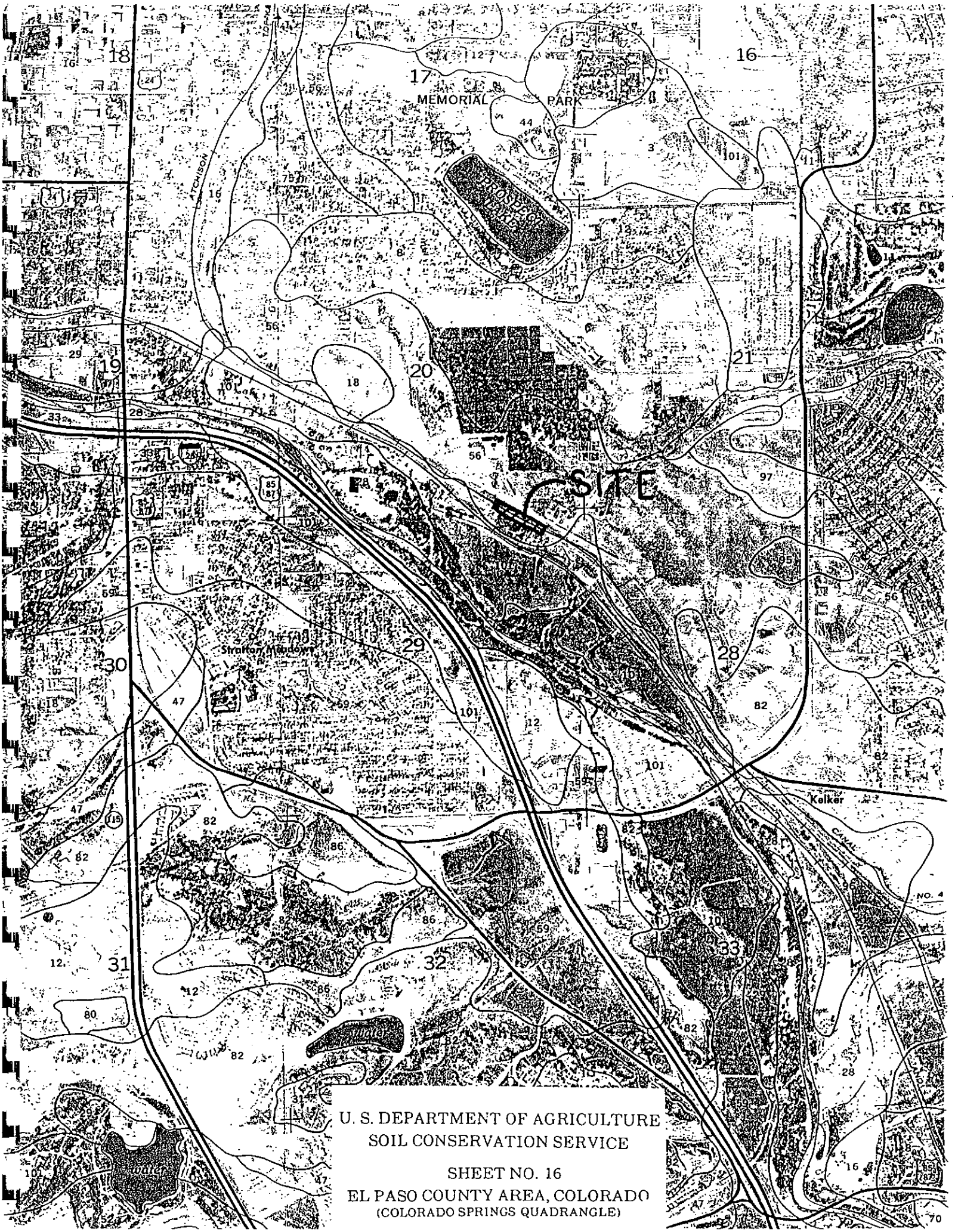

Vicinity Map



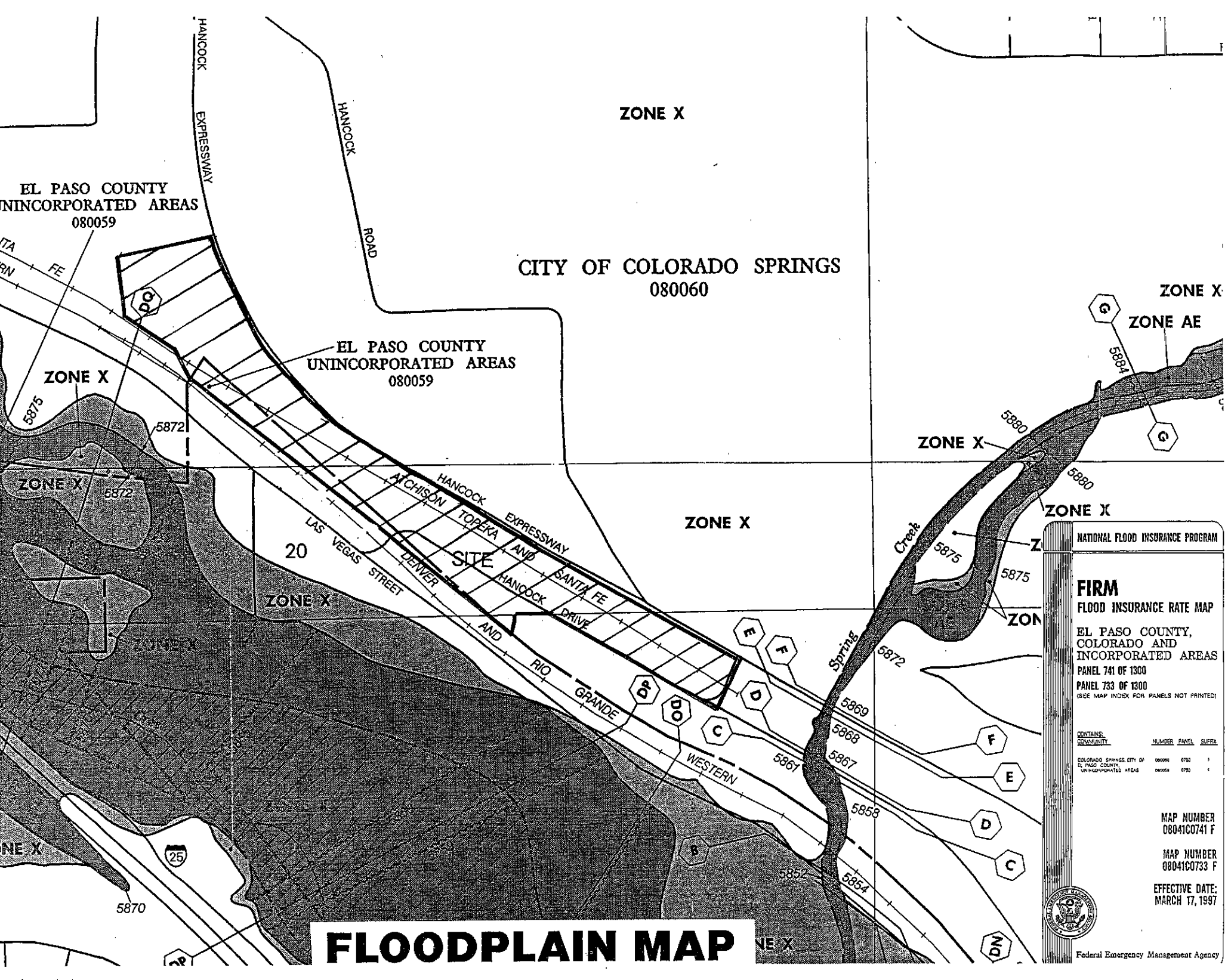
VICINITY MAP

N.T.S.

Soils Map


SITE
MEMORIAL PARK
Stratton Meadows
Kelker
CANAL NO. 4
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SHEET NO. 16
EL PASO COUNTY AREA, COLORADO
(COLORADO SPRINGS QUADRANGLE)

Floodplain Map



FLOODPLAIN MAP

Hydrologic Calculations

RATIONAL METHOD FOR RUNOFF COMPUTATIONS

BASIN	AREA	GEOMETRY		C		Tc	INTENSITY,in/hr		PEAK FLOW cfs	
	(acres)	Length	Height	5 yr	100 yr	min.	5 yr	100yr	5 yr	100yr
W-1	3.56	1950	84	0.9	0.95	5	5.1	9.07	16.3	30.7
W-2A	2.37	480	43	0.7	0.79	5	5.1	9.07	8.5	17
W-2B	2.68	800	39	0.8	0.87	5	5.1	9.07	10.9	21.1
W-3	0.64	180	10	0.9	0.95	5	5.1	9.07	2.9	5.5
W-4	2.81	660	12	0.74	0.82	9	4.3	7.65	8.9	17.6
W-5	0.39	70	23	0.3	0.45	5	5.1	9.07	0.6	1.6
M-1	2.08	1425	20	0.9	0.95	5	5.1	9.07	9.5	17.9
M-2	5.77	1120	20	0.81	0.88	8	4.5	8	21	40.6
M-3	3.2	260	6	0.83	0.9	7	4.75	8.33	12.6	24
M-4	0.6	50	11	0.3	0.45	5	5.1	9.07	0.9	2.4
E-1	0.87	670	14	0.9	0.95	5	5.1	9.07	4	7.5
E-2	2.68	690	17	0.83	0.89	6	4.9	8.65	10.9	20.6

OBERING, WURTH & ASSOCIATES
CONSULTING CIVIL ENGINEERS
PROFESSIONAL LAND SURVEYORS

LEON YOUNG WORK CENTER-SOUTH OF HANCOCK
OWA PROJECT NO. 02034
August, 2004

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JOB 02034 Leon Young Service Center - South
SHEET NO. 1 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY DATE
SCALE

Subbasin Calculations

1) **Subbasin W-1** Hancock Expressway $C_5 = 0.9$ $C_{100} = 0.95$

$L_{SE} = 1950'$ $h = 84'$ $S_{avg} = 4.3\%$

$V_{SE} = \frac{1.49}{0.016}(0.65)^{2/3}(0.043)^{1/2} = 14.5$ ft/s

$T_c = \frac{1950}{14.5} \div 60 = 2.24$ min Use 5 min $i_5 = 5.1$ $i_{100} = 9.07$

2) **Subbasin W-2A** Portion of Metro Sub - Fully Developed

33% LS, 67% HS $C_5 = (.33)(0.3) + (.67)(0.9) = 0.70$
$C_{100} = (.33)(0.45) + (.67)(0.95) = 0.79$

$L_{OL} = 120'$ $L_{SE} = 360'$ $h = 43$ $S_{avg} = 9\%$

$T_{OL} = 1.87(1.1 - 0.7)(120)^{0.5}(9)^{-0.33} = 4$ min

$V_{SE} = \frac{1.49}{0.016}(0.5)^{2/3}(.09)^{1/2} = 17.6$ ft/s $T_{ST} = \frac{360}{17.6} \div 60 = 0.34$ min

$T_c = 4 + 0.34 = 4.34$ min Use 5 min

3) **Subbasin W-2B** Portion of Metro Sub - Fully Developed

17% LS 83% HS $C_5 = (.17)(.3) + (.83)(.9) = 0.80$
$C_{100} = (.17)(.45) + (.83)(.95) = 0.87$

Use $T_c = 5$ min (same as W-2A)

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Subbasin Calculations (cont'd)

4) Subbasin W-3 Paved storage yard

$C_5 = 0.90$ $C_{100} = 0.95$

$T_c = 5$ min

5) Subbasin W-4 Future Storage Yard & CDL Course (Paved w/minimal LS)

$L_{OL} = 240'$ $L_{ST} = 420'$ $h = 12'$ $S_{avg} = 1.8\%$

27% LS / 73% HS $C_5 = (.27)(.3) + (.73)(0.9) = 0.74$

$C_{100} = (.27)(.45) + (.73)(.95) = 0.82$

$$T_{OL} = 1.87(1.1 - 0.74)(240)^{0.5}(1.8)^{-0.33} = 8.59 \text{ min}$$

$$V_{ST} = \frac{1.49}{0.016}(0.65)^{2/3}(0.018)^{1/2} = 9.4 \text{ ft/s} \quad T_{ST} = \frac{420}{9.4} \div 60 = 0.74 \text{ min}$$

$T_c = 8.59 + 0.74 = 9.33$ min Use 9 min

6) Subbasin W-5 Prop detention/water quality pond

$C_5 = 0.30$ $C_{100} = 0.45$

$T_c = 5$ min

7) Subbasin M-1 Hancock Expressway $L = 1425$, $h = 20'$ $S_{avg} = 1.4\%$

$$V_{ST} = \frac{1.49}{0.016}(0.65)^{2/3}(0.014)^{1/2} = 8.25 \text{ ft/s}$$

$$T_c = \frac{1425}{8.25} \div 60 = 2.88 \text{ min} \quad \text{Use } 5 \text{ min}$$

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Subbasin Calculations (cont'd)

8) Subbasin M-2 Prop Storage Yard & Future Bldg

$L_{OL} = 240'$ $L_{ST} = 880'$ $H = 20'$ $S_{avg} = 1.8\%$

15% LS / 85% HS $C_5 = (.15)(.3) + (.85)(.9) = 0.81$
$C_{100} = (.15)(.45) + (.85)(.95) = 0.88$

$T_{OL} = 1.87(1.1 - 0.81)(240)^{0.5}(1.8)^{-0.33} = 6.92$ min

$V_{St} = \frac{1.49}{0.016}(0.65)^{2/3}(.018)^{1/2} = 9.4$ ft/s $T_{St} = \frac{880}{9.4} \div 60 = 1.56$ min

$T_c = 6.92 + 1.56 = 8.48$ min Use 8 min

9) Subbasin M-3 Prop Storage Yard & Future Bldg

$L_{OL} = 260'$ $L_{St} = 530'$ $h = 6'$ $S_{avg} = 2.3\%$

11% LS / 89% HS $C_5 = (.11)(.3) + (.89)(.9) = 0.83$
$C_{100} = (.11)(.45) + (.89)(.95) = 0.90$

$T_{OL} = 1.87(1.1 - 0.83)(260)^{0.5}(2.3)^{-0.33} = 6.18$ min

$V_{storm} = 11.4$ ft/s $T_{storm} = \frac{530}{11.4} \div 60 = 0.78$ min

$T_c = 6.18 + 0.78 = 6.96$ Use 7 min

10) Subbasin M-4 Prop Detention/Water Quality Pond

$C_5 = 0.30$ $C_{100} = 0.45$

$T_c = 5$ min

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Subbasin Calculations (cont'd)

11) Subbasin E-1 Hancock Expressway $L = 670'$ $H = 14'$ $S_{avg} = 2.1\%$

$$V_{St} = \frac{1.49}{0.016}(.65)^{2/3}(0.021)^{1/2} = 10.1 \text{ ft/s}$$

$$T_c = \frac{670}{10.1} \div 60 = 1.1 \text{ min} \quad \text{Use 5 min}$$

12) Subbasin E-2 Prop & Existing storage Yard

$L_{OL} = 230'$ $L_{St} = 460'$ $H = 17'$ $S_{avg} = 2.5\%$

12% LS / 88% HS $\quad C_5 = (0.12)(.3) + (0.88)(.9) = 0.83$
$C_{100} = (0.12)(.45) + (0.88)(.95) = 0.89$

$$T_{OL} = 1.87(1.1 - 0.83)(230)^{0.5}(2.5)^{-0.33} = 5.65 \text{ min}$$

$$V_{St} = \frac{1.49}{0.016}(0.65)^{2/3}(0.025)^{1/2} = 11.0 \text{ ft/sec} \quad T_{St} = \frac{460}{11.0} \div 60 = 0.7 \text{ min}$$

$T_c = 5.65 + 0.7 = 6.35 \text{ min}$ Use 6 min

Inlet Calculator for Curb-Opening Inlets on Grade

Inputs					Outputs													
Inlet Description	S_x	S_o	Q	L_i	$(Q_i/Q)100$	$Q/S_o^{1/2}$	T	$F_w/S^{1/2}$	F_w	F_wT	L_1	L_2	L_3	Q_2	$L_i<=L_2$	$L_i>L_2$	Q_i	Q_c
	(%)	(%)	(cfs)	(ft.)	(%)	(cfs)	(ft.)			(ft.)	(ft.)	(ft.)	(ft.)	(cfs)			(cfs)	(cfs)
H.E. @ metro sub	2.00	2.13	16.30	15.00	55.34	111.69	17.82	13.54	1.98	35.20	27.11	16.28	58.08	9.79	X		9.02	7.28
100yr @ above	2.00	2.13	30.70	15.00	41.77	210.35	22.59	14.15	2.06	46.64	35.91	21.57	76.96	18.44	X		12.82	17.88
inlet@ basin bndry	2.00	1.00	7.28	15.00	73.06	72.80	15.18	13.13	1.31	19.93	15.34	9.22	32.88	4.37		X	5.32	1.96
100yr @ above	2.00	1.00	17.88	15.00	62.25	178.80	21.26	13.99	1.40	29.73	22.90	13.75	49.06	10.74		X	11.13	6.75
m-2 west inlet(100yr	2.00	1.24	18.20	15.00	60.59	163.44	20.55	13.90	1.55	31.81	24.50	14.71	52.49	10.93		X	11.03	7.17
m-2 mid inlet(100yr)	2.00	1.53	17.90	15.00	58.18	144.71	19.63	13.79	1.71	33.48	25.78	15.48	55.24	10.75	X		10.42	7.48
m-3 west inlet(100yr	1.25	0.50	7.30	10.00	60.18	103.24	23.21	13.14	0.93	21.57	14.42	7.89	35.59	3.99		X	4.39	2.91
m-3 mid inlet(100yr)	1.25	0.50	11.10	15.00	65.72	156.98	27.15	13.52	0.96	25.97	17.37	9.49	42.85	6.07		X	7.29	3.81
m-3 west inlet(100yr	1.78	2.00	12.30	15.00	59.98	86.97	17.45	13.22	1.87	32.63	24.26	14.24	53.84	7.22		X	7.38	4.92

Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual

Assuming: W(ft.)= 2 n= 0.016

Variable	Definition	Units
S_x	Cross slope of pavement	%
S_o	Longitudinal slope of pavement	%
Q	Rate of discharge in street	cfs.
Q_i	Rate of discharge intecepted by inlet	cfs.
T	Flow spread on pavement	ft.
L_i	Length of inlet opening	ft.
$(Q_i/Q)100$	Efficiency of inlet (percentage of total flow intercepted)	%
Qc	Rate of discharge not intercepted by inlet (flowby)	cfs.

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Inlet Calculator for Curb-Opening Inlets on Grade

Inputs					Outputs													
Inlet Description	S_x	S_o	Q	L_i	$(Q_i/Q)100$	$Q/S_o^{1/2}$	T	$F_w/S^{1/2}$	F_w	F_wT	L_1	L_2	L_3	Q_2	$L_i<=L_2$	$L_i>L_2$	Q_i	Q_c
	(%)	(%)	(cfs)	(ft.)	(%)	(cfs)	(ft.)			(ft.)	(ft.)	(ft.)	(ft.)	(cfs)			(cfs)	(cfs)
m-3 west inlet(100yr)	1.25	0.50	3.80	10.00	67.59	53.74	18.17	12.56	0.89	16.14	10.79	5.90	26.63	2.08		X	2.57	1.23
m-3 mid inlet(100yr)	1.25	0.50	5.50	15.00	74.43	77.78	20.87	12.89	0.91	19.02	12.72	6.95	31.39	3.01		X	4.09	1.41
m-3 east inlet(100yr)	1.78	2.00	5.90	15.00	68.40	41.72	13.25	12.54	1.77	23.50	17.47	10.25	38.77	3.46		X	4.04	1.86
e-1 west inlet(5yr)	1.20	2.57	2.10	5.00	38.02	13.10	10.98	11.31	1.81	19.91	13.15	7.13	32.84	1.14	X		0.80	1.30
e-1 west inlet(100yr)	1.20	2.57	4.10	5.00	28.15	25.58	14.11	11.89	1.91	26.89	17.76	9.63	44.37	2.22	X		1.15	2.95
e-1 east inlet(5yr)	1.40	3.09	3.20	5.00	31.24	18.20	11.28	11.67	2.05	23.14	16.01	8.95	38.17	1.79	X		1.00	2.20
e-1 west inlet(5yr)	1.40	3.09	6.40	5.00	22.88	36.41	14.62	12.29	2.16	31.58	21.85	12.22	52.11	3.58	X		1.46	4.94

Based on Table 7-2 (pg.7-19) of Colorado Springs Drainage Criteria Manual

Assuming: W(ft.)= 2 n= 0.016

Variable	Definition	Units
S_x	Cross slope of pavement	%
S_o	Longitudinal slope of pavement	%
Q	Rate of discharge in street	cfs.
Q_i	Rate of discharge intecepted by inlet	cfs.
T	Flow spread on pavement	ft.
L_i	Length of inlet opening	ft.
$(Q_i/Q)100$	Efficiency of inlet (percentage of total flow intercepted)	%
Qc	Rate of discharge not intercepted by inlet (flowby)	cfs.

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JOB 02034 Leon Young Service Center - South
SHEET NO. 1 OF 4
CALCULATED BY SGB DATE Aug '04
CHECKED BY _____ DATE _____
SCALE _____

Drainage Facility Solutions

1) Subbasin W-1

Runoff in Hancock Expressway currently flows to end of curb & gutter improvements and then across property to railroad crossing.

Provide curb inlet @ Metro Sub entrance and at Miscellaneous/Spring Creek basin boundary

Provide 2 - 15' D-10-R Inlets in Hancock. Reduces runoff entering Spring Creek Basin due to proposed curb on Hancock. Cross basin flow $Q_5 = 2$ cfs $Q_{100} = 6.8$ cfs
Inlets to connect to existing 60" CSP system

2) Subbasin W-2A

All runoff drains to existing facilities in Metro Sub.
No facilities required.

3) Subbasin W-2B

Existing concrete trough connects to existing concrete transition channel between 60" CSP and drainage tunnel.

Replace trough w/ D-10-R inlet & pipe

$Q_{DES} = Q_{100} = 21.1$ cfs 100yr pickup due to lack of overflow route

For 15' @ 9" Dep $Q_i = (3)(15)(0.75)^{1.5} \times 0.8 = 23.4$ cfs Use 15' D-10-R Inlet

Use 24" RCP @ 1% min to connect to junction box

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Drainage Facility Solutions (cont'd)

4) Subbasin W-3

Existing grated inlet drains paved storage area currently. Replace w/ prop 10' D-10-R due to proposed grading & curb location.

5) Subbasin W-4

Runoff from this subbasin needs to be detained and treated for water quality. Runoff will be conveyed via e&g to SE corner. A concrete chase will then carry the runoff to a detention/water quality pond

Facilities from Subbasins W-1, W-2B, W-3 will combine at a proposed junction box at the end of the existing 60" CSP. A 60" RCP extends out of the junction box south to an existing drainage crossing under the railroad

6) Subbasin W-5

Proposed Detention/Water Quality Facility

7) Subbasin M-1

Hancock Expressway - Replace Grated Inlet with curb inlet

$Q_5 = 9.5$ cfs

$Q_{Des} = Q_{100} = 17.9$ cfs @ $D = 9''/10'$ opn $Q_i = (3)(10)(.75)^{1.5} \times 0.8 = 15.6$ cfs

@ $D = 10''$ $Q_i = (3)(10)(0.833)^{1.5} \times 0.8 = 18.3$ cfs ✓

Use 10' opng Radial Curb Inlet

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Drainage Facility Solutions (cont'd)

8) Subbasin M-2

Runoff drains to south curb line where proposed curb inlets will collect runoff and convey it to a detention/water quality facility

→ Use 2 -15' D-10-R on grade (see inlet calculator)
(Prorated 100 yr Q for each inlet)
Sump inlet @ SE corner of subbasin

Q_{des} = 19.2 cfs For D=8" L_i=15 $Q_i = (3)(15)(.67)^{1.5} \times 0.8 = 19.7$ cfs

Use 15' D-10-R in sump w/ 30" RCP @ 1% (Q=40.6 cfs)

9) Subbasin M-3

Use 3 on grade inlets to collect the majority of the subbasin runoff (see inlet calcs)

10) Subbasin M-4

Proposed Detention/Water Quality Facility

11) Subbasin E-1

Hancock Expressway - Replace existing grated inlets with curb inlets (see inlet calcs)

Use 2 - 5' D-10-R inlets & connect to existing storm sewer.

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Drainage Facility Solutions (cont'd)

12) Subbasin E-2

(E-2) (M-3)

$Q_{design} = Q_5 = 10.9 + 1.9 + 2.2 = 15.0$ cfs

Use D-9 inlet @ SE corner

try 10' @ h = 8"

$Q_i = c A \sqrt{2gh} \times \frac{2}{3} = (0.6)(9.5)\sqrt{(2)(32.2)(.67)} \times \frac{1}{2}$

$Q_i = 18.7$ cfs ok Note: 100 yr overflow to go to Southeast

Use 21" HDPE @ 0.65%