

MASTER DEVELOPMENT DRAINAGE PLAN

For

THE WOODMEN HEIGHTS COMMERCIAL CENTER

SAND CREEK DRAINAGE BASIN

Prepared for:

City of Colorado Springs Subdivision
30 North Nevada Avenue, Suite 702
Colorado Springs, CO 80903

On Behalf of:

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Prepared by:



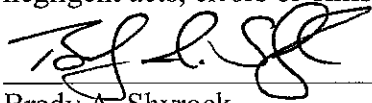
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NOVEMBER 2009

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct 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.



11/18/2009

SEAL

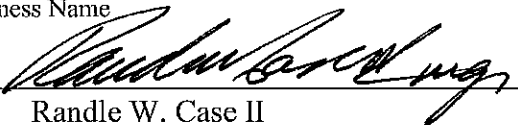
Brady A. Shyrock
Registered Professional Engineer
State of Colorado
No. 38164



Developer's Statement:

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

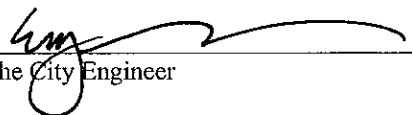
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Title: Manager
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City of Colorado Springs:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.


For the City Engineer

12.2.09
Date

Conditions:

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I. INTRODUCTION

The Woodmen Heights Commercial Center is a proposed 48.25 acre development consisting of commercial and multifamily land uses. The site was annexed into the City of Colorado Springs (City) in August of 2004, as part of the Woodmen Heights Metropolitan District, located in northeastern Colorado Springs, Colorado. This site was previously platted as Woodmen Heights No. 3. The objective of the Woodmen Heights Commercial Center Master Development Drainage Plan (WHCC MDDP) is to identify the major drainageways, ponding and detention areas, locations of culverts, bridges, open channels and drainage areas which are tributary to this development. This project is located within the Sand Creek Drainage Basin. Other drainage analyses for adjacent properties being submitted for concurrent review include *The Master Development Drainage Plan for Shiloh Mesa at Woodmen Heights*, prepared by Matrix Design Group, Inc (Shiloh Mesa MDDP) and the *Drainage Letter for Marksheffel Road Interim Design at Woodmen Heights* prepared by Matrix Design Group, Inc (Marksheffel Drainage Letter). All analyses were completed in accordance with the City of Colorado Springs / El Paso County Storm Drainage Criteria Manual.

Woodmen Road from Powers Boulevard to US Highway 24 is currently in the process of being expanded from a two-lane, 34-foot wide asphalt-surface roadway to a four-lane divided highway with varied right-of-way (ROW).

A. Project Location

The site area for construction is located in eastern Colorado Springs, Colorado northwest of the intersection of East Woodmen Road (Woodmen, or Woodmen Road) and North Marksheffel Road (Marksheffel or Marksheffel Road). See Vicinity Map, Appendix A.

1. General Location. Southwest $\frac{1}{4}$ of Section 4 of Township 13 South, Range 65 West of the Sixth Principal Meridian, El Paso County, State of Colorado.
2. Surrounding Streets. Existing Woodmen Road borders the site to the south, the proposed Marksheffel Road alignment is located directly to the east of the property, and Sand Creek Channel borders the project to the west and north. (See Vicinity Map, Appendix A)
3. Drainageway. The site is located within the Sand Creek Drainage Basin and is bound by Sand Creek on the north and west. A portion of the topography drains to the west directly into Sand Creek Channel. The majority of the runoff from the site flows southwest towards three 48-inch reinforced concrete pipes (RCP) located at the south end of the site. The three pipes convey the runoff under Woodmen Road and ultimately into the Sand Creek Channel.
4. Surrounding Developments. The following developments are located adjacent to the site.

South: The southern end of the property is bound by Woodmen Road. The property to the south of Woodmen Road currently is not platted and lies undeveloped.

East: The future Marksheffel Road alignment is located along the eastern border of the property. East of Marksheffel Road is a planned community development known as Shiloh Mesa at Woodmen Heights (Shiloh Mesa). This site is currently undeveloped.

B. Property Description

1. Project Area. The Woodmen Heights Commercial Center encompasses 48.25 acres of land. Currently, there exists a single family house and several small barns and sheds on the property. These structures will be removed for future development.
2. Ground Cover. The majority of the site is covered with sparse vegetation including natural grasses and some shrubs.
3. General Topography. Drainage patterns of the study area drain toward the Sand Creek channel from the northeast to the southwest, with slopes ranging from approximately 1%-4%.
4. General Soil Conditions. The Web Soil Survey, created by the Natural Resources Conservation Service, was utilized to investigate the existing general soil types within and tributary to the area impacting the site (See Soils Map within Appendix A). The soil types are present in the development area are shown in Table 1.1.

Table 1.1 - NRCS Soil Survey for El Paso County

<i>Soil ID No.</i>	<i>Soil</i>	<i>Hydrologic Classification</i>
9	Blakeland Fluvaquentic Haplaquolls	A
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A
71	Pring course sandy loam, 3 to 8 percent slopes	B

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater runoff rates. Hydrologic group “A” is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group “D” typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. Hydrologic group “B” soil classification was assumed across the site. This assumption is a conservative approach, based upon the fact that predominantly Type “B” soils (coarse sandy loam) exist on the site and the remaining Type “A” soil will exhibit Type “B” properties after grading and compaction have occurred.

5. Major Drainageways. The Woodmen Heights Commercial Center is located within the Sand Creek Drainage Basin. The Sand Creek Channel borders the study area to the north and west.
6. Irrigation Facilities. There are no known existing irrigation facilities on the site.
7. Existing Utilities. There are several existing utilities located on the property. A minor overhead electric line, running from the north to the south through the middle of the property, services the existing residential facilities. Additionally, three major petroleum / natural gas transmission lines running from the north to the south across the site adjacent to the channel. The Woodmen Heights Commercial Center and the Woodmen Heights Metropolitan District are coordinating with the owners of the transmission lines to redefine the blanket easement that covers the study area into a linear easement. Finally, there is an existing 24-inch water main located within an existing utility easement, which is identified as proposed Marksheffel Road ROW. The water main crosses Sand Creek Channel and continues in a general northwest direction.

II. HYDRAULIC AND HYDROLOGIC ANALYSIS

A. Major Basin Description

The Sand Creek Drainage Basin is a tributary to Fountain Creek. The Sand Creek Drainage Basin area is comprised of approximately 54 square miles, and is located in the east central portion of El Paso County. The Woodmen Heights Commercial Center is located in the upper regional sub-basin of Sand Creek.

According to *The Sand Creek Drainage Basin Planning Study* (SCDBPS), by Kiowa Engineering dated March 1996, channel improvements as well as the construction of a regional detention pond will be necessary for full development of this site. The recommended channel improvements per the SCDBPS will consist of selective riprap lining of the channel with grade control structures. Runoff from the Woodmen Heights Commercial Center development drains to an area defined as reach SC-8 in the SCDBPS. (See Appendix D)

B. Floodplain Statement

Review of the *Flood Insurance Rate Map Panel 535 (08041CO535 F)*, effective date March 17, 1997, published by the Federal Emergency Management Agency (FEMA), shows the Sand Creek Floodway and Floodplain for Sand Creek. A Letter of Map Revision (LOMR), dated December 7, 2005, exists for the channel in this region. The 100-year and 500-year floodplains are defined within the LOMR. (See Appendix A)

Channel Improvements, as specified in the SCDBPS, will be required with the development of Shiloh Mesa. It is anticipated that a 404 Permit will be required prior to construction of the channel improvements, and a LOMR will be required after channel improvements are completed to delineate the new floodplains.

C. Drainage Regulations

This report has been prepared in accordance to the criteria set forth in the *City of Colorado Springs and El Paso County Drainage Criteria Manual* (Drainage Criteria Manual), dated November 1991 and *Volume 2* of the City Drainage Criteria Manual, dated November 1, 2002. In addition to the City Criteria Manual, the *Urban Storm Drainage Criteria Manuals, Volumes 1-3*, published by the Urban Drainage and Flood Control District, latest update, have been used to supplement the Drainage Criteria Manual.

D. Design Frequency

The design frequency is based on the Drainage Criteria Manual. The 100-year storm event was used as the major storm for the project, and the 5-year storm event was used as the minor storm.

E. Design Discharge

1. Method of Analysis

The hydrology for this project uses the Rational Method as recommended by the Drainage Criteria Manual for the minor and major storms. The Rational Method is used for drainage basins less than 100-acres in size.

The Rational Method uses the following equation: $Q=C*I*A$

Where:

- Q = Maximum runoff rate in cubic feet per second (cfs)
- C = Runoff coefficient
- I = Average rainfall intensity in inches per hour
- A = Area of drainage sub-basin in acres

2. Runoff Coefficient

Rational Method coefficients are from Table 5-1 of the Drainage Criteria Manual for developed land use such as roadway and commercial areas, as well as undeveloped areas. See Appendix C for more information.

3. Time of Concentration

The time of concentration for the Rational Method was taken from the Drainage Criteria Manual. The time of concentration consists of the initial time of overland flow and the travel time in a channel to the inlet or point of interest. A minimum time of concentrations of 5 minutes was used for the final calculations.

4. Rainfall Intensity

The hypothetical rainfall depths for the 24-hour storm duration were estimated from the NOAA Atlas 2, Volume III-Colorado Isoplethial Figures 27 and 31. Table 2.1 lists the rainfall depth for each of the 24-hour storm events.

Table 2.1 - Rainfall Depth in Colorado Springs in the 24 Hour Storm Event

Storm Recurrence Interval	Rainfall Depth (inches)
5-year	2.6
100-year	4.4

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual updated Storm Intensity Curves Memo.

Intensity Equation: $I = 26.65 * \frac{P_1}{(10 + T_d)^{0.76}}$

F. Hydraulic Criteria

Storm sewer infrastructure was sized using *Bentley's StormCAD V8* computer program. A minimum slope of 0.5 percent was assumed throughout the proposed pipe network as well as a roughness coefficient that corresponds to a pipe material of concrete. The losses in junctions, pipes and manholes were calculated using the Federal Highway Administration (FHWA) HEC-22 methods.

III. EXISTING FACILITIES

A. *Sand Creek Basin Facility Analysis*

The SCDBPS outlines the drainage improvements required by the City, prior to development in this area. The SCDBPS proposed numerous regional detention ponds throughout the development area of the Woodmen Heights Metropolitan District. Other studies that have included the Woodmen Heights Commercial Center development area include *The Master Development Drainage Plan for Woodmen Heights* (Classic MDDP), by Classic Consulting Engineers and Surveyors, dated June 2004, and more recently *The Master Development Drainage Plan Update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No. 4* (ESI MDDP), by Engineering and Surveying Inc (ESI), dated February of 2006. The Classic MDDP proposed eliminating Detention Facilities No. 4 and 5, as outlined in the SCDBPS, and enlarging Facilities No. 3 and 6 to compensate for the loss of detention area.

Detention Facility No. 3 (Pond #3), is located inline with the main reach of the Sand Creek Channel just west of the proposed Marksheffel Road Alignment and north of Woodmen Road. This detention pond was sized to accommodate the developed stormwater runoff from the owners in the eastern portion of the Woodmen Heights Metropolitan District. Pond #3 is a 224 acre-foot facility with a total inflow of $Q_{100}=2883$ cubic feet per second (cfs) and a release rate of $Q_{100}=2242$ cfs. It was anticipated that this facility would be combined with a neighborhood park area. In addition to Pond #3, the Woodmen Heights Metropolitan District is responsible to complete the construction of Regional Pond #2, located adjacent to Security Service Field, approximately 3 miles downstream. Construction is underway to complete the interim condition of Pond #2.

The ESI MDDP was approved by the City in February of 2006, and functions as an amendment/update to the Classic MDDP. The ESI MDDP evaluated the previous analysis done in the Classic MDDP and resized Pond #3 to a 209 acre-foot facility. The reason for the decrease in size of Pond #3 can be attributed to the rerouting of runoff from 18.7 acres, known as Parcel 11 in the Classic MDDP, to Detention Facility No. 6. Minor changes were also made with respect to drainage analysis, such as an increased inflow of $Q_{100}=3207$ cfs to Pond #3 and a release rate of $Q_{100}=2240$ cfs. Both the Classic MDDP and the ESI MDDP, assumed that Pond #3 would accept developed flows from the Woodmen Heights Commercial Center development and would treat the runoff for water quality.

B. *Offsite Analysis*

The Classic MDDP and the ESI MDDP utilized the Soil Conservation Service Hydrograph method (SCS) for computing the hydrologic analysis. The impervious area of each basin was analyzed to compare the results from the ESI MDDP to those calculated using the Rational Method in this report (which will yield more conservative results). It was assumed that the time of concentration would remain the same for each analysis, and therefore the impervious area is the controlling factor for evaluating the peak runoff rates. For the proposed site, the ESI MDDP employed a curve number of 92. According to **Table 5-5** of the Drainage Criteria Manual,

Runoff Curve Numbers for Hydrologic Soil, a commercial area with a curve number of 92 corresponded to an 85 percent impervious area. Conversely, **Table 5-1** of the Drainage Criteria Manual, *Recommended Average Runoff Coefficients and Percent Impervious*, lists the runoff coefficients associated with the Rational Method for residential areas to be 65 percent impervious and 95 percent impervious for commercial areas. Comparing the acreage of impervious area from each analysis yielded similar results, and therefore the assumptions made for this analysis are valid. Refer to the Impervious Area Comparison Table in Appendix B.

Historically, a significant amount of runoff from tributary upstream basins is routed through this property from the adjacent development to the east, known as Shiloh Mesa. As previously mentioned, the Shiloh Mesa MDDP has been submitted to the City for concurrent review with this report (WHCC MDDP). Stormwater travels in a southwesterly direction across the Shiloh Mesa development to the southwest corner of the property where a significant portion of this runoff drains into the Woodmen Heights Commercial Center site. Runoff is then routed west along the southern boundary of the site and is conveyed in a southerly direction under Woodmen Road via three 48-inch RCP located approximately 715-feet west of Marksheffel Road. The Shiloh Mesa MDDP identified Design Point 8 on the Existing Conditions Drainage Map (417.53 acres, $Q(5) = 167.7$ cfs, $Q(100) = 408.3$ cfs) as the peak historic runoff conveyed onto the WHCC property from the Shiloh Mesa property.

C. Onsite Analysis

Drainage Sub-Basin SC (10.7 acres, $Q(5) = 7.75$ cfs, $Q(100) = 19.28$ cfs) is located along the western edge of the property. A portion of the Sand Creek Channel is contained in this basin, and all runoff generated within this basin flows directly to the creek.

Drainage Sub-Basin A (4.6 acres, $Q(5) = 3.97$ cfs, $Q(100) = 9.87$ cfs) is located in the south western portion of the site. The land is undeveloped and contains a dirt road for access to the existing house. This basin is covered with native grasses and shrubs. Runoff generated within this basin drains to Sand Creek.

Sub-Basin B composes the majority of the site. Sub-Basin B (29.1 acres, $Q(5) = 16.89$ cfs, $Q(100) = 42.02$ cfs) is located within the middle region of the site and contains the existing buildings including the house, a portion of the dirt road, and three 48-inch RCP's at Design Point 2. An existing swale routes the stormwater to the three 48-inch RCP outlet.

Sub-Basin C (3.9 acres, $Q(5) = 2.61$ cfs, $Q(100) = 6.53$ cfs) is located along the eastern property line. This basin accounts for runoff generated within the west half of the proposed Marksheffel Road. Runoff is routed to a roadside swale south to Design Point 1. Runoff from the undeveloped property to the east, known as Shiloh Mesa, enters the Woodmen Heights Commercial Center at Design Point 1, and then is routed to the west with the stormwater from Sub-Basin C toward Design Point 2. Design Point 2 outlets the property south across Woodmen Road through three existing 48-inch RCPs and ultimately to Sand Creek Channel via an existing swale on the south side of Woodmen Road. Table 3.1 summarizes the historic flow generated by the Woodmen Heights Commercial Center.

Table 3.1 - Summary of Historic Runoff

<i>WHCC Historic Sub-Basin Data</i>		<i>Peak Runoff</i>	
<i>Basin</i>	<i>Area (ac)</i>	<i>Q(5)</i>	<i>Q(100)</i>
SC	10.7	7.75	19.28
A	4.6	3.97	9.87
B	29.1	16.89	42.02
C	3.9	2.61	6.53
<hr/>			
Shiloh Mesa DP8 & C	413.7	161.77	395.22
DP1 & B	442.8	159.78	387.94

According to the *Final Hydrology and Hydraulics Report for Woodmen Road Powers to US 24* (Woodmen Road FDR), by DMJM Harris, dated October 15, 2007, the runoff from Woodmen Road is contained and routed within the Woodmen Road ROW. Curb inlets and bio-swales, as defined in the Woodmen Road FDR, are being used to convey and treat runoff. In general, runoff will be directed to the south of Woodmen Road and then to the west of Marksheffel Road. According to the Woodmen Road FDR, basin N14 is 17.6 acres of undeveloped land that drains to the northeast corner of the intersection of Woodmen Road and Marksheffel Road. The stormwater generated within this basin is conveyed in a southerly direction across Woodmen Road within an 18-inch RCP, then west across Marksheffel Road into an existing swale and ultimately into Sand Creek Channel.

IV. DRAINAGE FACILITY DESIGN / PROPOSED CONDITIONS

The runoff generated by the development of the Woodmen Heights Commercial Center will discharge into Sand Creek Channel at two locations, Design Point 5 and Design Point 9.

A. Previous Analysis for Offsite Runoff

As previously noted, the Woodmen Heights Commercial Center has been studied in the ESI MDDP. Parcels 22 and 23 of the ESI MDDP were used to estimate the runoff generated by the Woodmen Heights Commercial Center development. Additionally, Parcels 15, 20, and 21 constitute the Shiloh Mesa development located to the east, which conveys runoff through the Woodmen Heights Commercial Center site. Table 4.1 compares the peak flowrate for the major storm event between the ESI MDDP and the Shiloh Mesa MDDP. Both reports utilize two connections for conveyance of stormwater from Shiloh Mesa to the Woodmen Heights Commercial Center, and two connections to Sand Creek. The Woodmen Heights Commercial Center will accept offsite runoff at Design Point 30 and Design Point 21 (as labeled in the Shiloh Mesa MDDP), which corresponds to Design Point 6 and Design Point 2 of the Woodmen Heights Commercial Center analysis respectively. The Sand Creek outfall locations proposed in the ESI MDDP are designated as Pipe 38 and Pipe 41, and correspond to Design Point 5 and Design Point 9 within this study.

One key difference proposed in the Shiloh Mesa MDDP from what was recommended in the ESI MDDP is the routing of offsite runoff. The ESI MDDP routed offsite flows originating east of Shiloh Mesa through the Woodmen Heights Commercial Center to Sand Creek (at Design Point 5). Instead, the Shiloh Mesa MDDP proposes routing the offsite flow to Sand Creek upstream of the Marksheffel Road and Sand Creek Channel crossing (Design Point 31 of the SM MDDP). Table 4.1 offers a comparison of peak runoff generated between the Shiloh Mesa MDDP and the ESI MDDP.

Table 4.1 - Comparison of Offsite Analysis

Offsite Dev. Basin Data		Peak Runoff	
Design Point	Area (ac)	Q(5) (cfs)	Q(100) (cfs)
Shiloh Mesa MDDP DP-21	32.9	102.78	184.26
ESI MDDP PIPE 36	380.31	-	586.96
Shiloh Mesa MDDP DP-30	25.6	92.17	157.90
ESI MDDP PIPE 39	25.18	-	116.93

The peak runoff presented in the Shiloh Mesa MDDP will be utilized to design the Woodmen Heights Commercial Center storm sewer infrastructure. The Woodmen Heights Commercial Center recognizes that if the offsite flow is not routed to Sand Creek upstream of the proposed Marksheffel Road crossing, then the stormwater will be routed through the Woodmen Heights Commercial Center property to Sand Creek and additional analysis will be required.

B. Onsite Fully Developed Conditions

A sub-basin was created for the runoff generated within Sand Creek. The Sand Creek sub-basin, denoted as Sub-Basin SC (9.8 acres, $Q(5) = 6.52$ cfs, $Q(100) = 16.27$ cfs), will remain undeveloped until channel improvements occur. The land use designation of this basin will remain at historic levels. Further analysis is necessary for Pond #3 and the channel reach bordering this property as identified in the SCDBPS. Please refer to Appendix E for the Proposed Conditions Drainage Map as well as Section III-G for *Improvements to Sand Creek Channel*.

Runoff generated by Offsite Basin OS-10 (2.6 acres, $Q(5) = 8.23$ cfs, $Q(100) = 14.66$ cfs) will be conveyed by curb and gutter to inlets located within Marksheffel Road and Kenosha Drive. The stormwater that is collected at Design Point 1-A will be routed to the west within Kenosha Drive to Design Point 1 by 24-inch RCP. Refer to Table 4.2 for a Design Point summary.

Sub-Basin B (6.1 acres, $Q(5) = 13.65$ cfs, $Q(100) = 28.42$ cfs) is located in the northern portion of the Woodmen Heights Commercial Center. The land use of Sub-Basin B is designated as multifamily residential with grades sloping towards the southwest. Runoff will sheet flow to the parking lot curb and gutter where it will be conveyed to a sump inlet within Kenosha Drive at Design Point 1 or be collected by an internal storm sewer system and routed to Design Point 1. Design Point 1 denotes the location where stormwater from the western portion of Marksheffel Road (basin OS-10) is combined with runoff from Sub-Basin B. Runoff is conveyed downstream via 42-inch RCP from Design Point 1 to Design Point 4. Refer to Table 4.2 for a Design Point summary, or Appendix B for hydraulic calculations and StormCAD model information.

Offsite Sub-Basin OS-9 (1.2 acres, $Q(5) = 5.5$ cfs, $Q(100) = 10.3$ cfs) is located south of Sub-Basin OS-10. Runoff generated within this portion of Marksheffel Road (Sub-Basin OS-9) is routed south via curb and gutter to the intersection of Main Street and Marksheffel Road. Woodmen Heights Commercial Center will accept runoff from Marksheffel Road and Shiloh Mesa at Design Point 2 (delineated as Design Point 21 in the SM MDDP). A 54-inch RCP will convey the runoff from the Shiloh Mesa development to Design Point 2. Runoff will be routed to the west from Design Point 2 via 66-inch RCP. Refer to Table 4.2 for a design point summary.

Sub-Basin C (4.3 acres, $Q(5) = 13.09$ cfs, $Q(100) = 24.88$ cfs) is located to the west of offsite Sub-Basin OS-9. The land use of Sub-Basin C is neighborhood commercial, with grades sloping to the southwest. Runoff will be collected via sump inlets at Design Point 3 and join stormwater from Design Point 2. A 66-inch RCP will route flows to the west to Design Point 4. A design point summary is contained within Table 4.2.

The neighborhood commercial area south of Sub-Basin B and west of Sub-Basin C is designated as Sub-Basin F (2.3 acres, $Q(5) = 7.23$ cfs, $Q(100) = 13.69$ cfs). Runoff generated within Sub-Basin F drains to the southwest where it is collected by sump inlets at Design Point 4. Design

Point 4 is the location where runoff from Design Point 1 is combined with stormwater from Sub-Basin F and Design Point 3. A 42-inch RCP routes the stormwater south from Design Point 4 to the trunk 66-inch storm sewer line.

The northern outlet to the Sand Creek Channel is denoted as Design Point 5. Runoff is conveyed via a 66-inch diameter RCP. Refer to Table 4.2 for a design point summary and Table 4.3 for a comparison of peak flowrates at the outlet to Sand Creek.

Runoff generated by Offsite Sub-Basin OS-3 (1.4 acres, $Q(5) = 6.78$ cfs, $Q(100) = 12.09$ cfs) will be conveyed by curb and gutter to a sump inlet located at Design Point 6 (which corresponds to Design Point 30 in the SM MDDP). Runoff from the southern portion of the Shiloh Mesa development is routed to the west through the Woodmen Heights Commercial Center at Design Point 6 via a 60-inch RCP. Refer to Table 4.2 for a design point summary.

Sub-Basin E (9.4 acres, $Q(5) = 24.43$ cfs, $Q(100) = 46.35$ cfs) is a planned commercial area located in the southeast region of the Woodmen Heights Commercial Center development. Runoff will be collected by inlets within the parking lots and routed via subsequent storm sewer pipe to Design Point 7. At Design Point 7 the stormwater from Sub-Basin E combines with the flow from Design Point 6 (basins OS-2 and OS-3 as well as the southern portion of Shiloh Mesa). A 60-inch RCP conveys the stormwater to the west. Refer to Table 4.2 for a design point summary.

The area west of Kenosha Drive and south of Design Point 5 is designated as Sub-Basin J (4.0 acres, $Q(5) = 10.88$ cfs, $Q(100) = 20.67$ cfs). Sub-Basin J is a planned commercial development with runoff routed to Kenosha Drive. Curb and gutter convey the stormwater to sump inlets at Design Point 8. Stormwater from Sub-Basin D (9.1 acres, $Q(5) = 25.99$ cfs, $Q(100) = 52.05$ cfs) is also routed to the sump inlets at Design Point 8. Sub-Basin D is located between Sub-Basins J and E, and is entirely commercial development. Runoff generated within Sub-Basin D is combined with runoff from Sub-Basins J & E at Design Point 8. The stormwater is routed south via a 42-inch RCP to Design Point 9.

Design Point 9 denotes the total runoff routed to the southern outlet from Design Points 7 and 8. Design Point 9 will consist of a 60-inch RCP which conveys the runoff from the southern portion of Woodmen Heights Commercial Center as well as routed flows from the southern portion of the Shiloh Mesa development to Sand Creek. The 60-inch RCP matches the pipe diameter recommended in the ESI MDDP for the southern outlet. Refer to Table 4.2 for a Design Point summary and Table 4.3 for a comparison of peak flowrates at the outlet to Sand Creek.

Table 4.2 - Summary of Routed Developed Runoff

Design Point	Area (ac)	Q(5) (cfs)	Q(100) (cfs)	Description
1	8.75	21.57	38.65	Sub-basins OS-10 & B
1-A	2.61	8.23	14.66	Sub-basin OS-10
2	34.12	102.78	184.26	Shiloh Mesa MDDP DP 21
3	38.44	114.63	205.86	Sub-basin C & DP2
4	11.09	27.46	49.23	Sub-basin F & DP1
5	49.53	121.44	216.6	DP3 & DP4
6	27.03	92.17	157.9	Shiloh Mesa MDDP DP 30
7	36.41	100.51	178.95	Sub-basin E & DP6
8	13.09	40.83	72.7	Sub-basins J & D
9	49.5	137.94	245.67	DP7 & DP8

As previously noted, the Woodmen Heights Commercial Center will utilize two locations for outlets within Sand Creek (peak flowrates are Design Points 5 and 9). Design Point 9 is comparable to the previous analysis presented within the ESI MDDP for Pipe 41. The ESI MDDP estimated a drainage area of 49.51 acres would be routed to Sand Creek by Pipe 41. Pipe 41 is a 60-inch diameter pipe conveying a peak flowrate for the major storm of $Q(100) = 234.99$ cfs. The proposed area draining to Design Point 9 is 49.5 acres with a peak flow rate of $Q(100) = 245.67$ cfs. Since the land use of the property remains consistent with the assumption in the ESI MDDP, the volume of runoff routed to Sand Creek is the same as well. The minor difference in peak flowrates can be attributed to the different methods of analysis.

Design Point 5, however, is conveying a decrease in the stormwater volume from the rate estimated within the ESI MDDP for Pipe 38. Pipe 38 was modeled as an 84-inch RCP, with an estimated peak flowrate of $Q(100) = 648.71$ cfs. Design Point 5, on the other hand, has a peak flowrate of $Q(100) = 216.60$ cfs which is conveyed by a 66-inch RCP. The difference in runoff is attributed to the decrease in drainage area. Runoff from the area east of Shiloh Mesa will be routed to Sand Creek upstream of the Marksheffel Road crossing. This difference is an approximate decrease of 350 acres of drainage area.

C. Comparison of Studied Onsite Runoff

Sub-Basin Parcel 22, defined in the ESI MDDP, is located in the northern portion of the site. Parcel 22 contains 16.68 acres which have a land use characterization of neighborhood commercial / multi family. Runoff is collected in Pipe 37, which then joins the flow in Pipe 36 at Pipe 38. Pipe 38 outlets into Sand Creek. Pipes 36, 37, and 38 were sized in the ESI MDDP as 78-inch, 42-inch, and 84-inch diameter RCP respectively with a one percent slope. Refer to Table 4.3 for a comparison of peak flow rates at each outlet to Sand Creek.

Sub-basin Parcel 23 is situated in the southern half of the site. It is approximately 24.38 acres in size and the land use is community commercial. Runoff from Parcel 23 is collected by Pipe 40,

and joins the stormwater conveyed by Pipe 39 at Pipe 41. Pipe 41 outlets to Sand Creek at the proposed location of Pond #3. According to the ESI MDDP, the anticipated size of Pipe 41 is a 60-inch diameter RCP at a 1.0 percent slope. The comparison between the proposed peak flow rates at the outlet to Sand Creek and the estimated peak flowrates from the ESI MDDP are presented in Table 4.3.

Table 4.3- Comparison of Sand Creek Outlet Analysis

Offsite Dev. Basin Data	Peak Runoff		
	<i>Area (ac)</i>	<i>Q(5) (cfs)</i>	<i>Q(100) (cfs)</i>
WHCC MDDP DP-5	45.2	121.44	216.6
ESI MDDP PIPE 38	396.99	-	648.71
WHCC MDDP DP-9	49.5	137.94	245.67
ESI MDDP PIPE 41	49.51	-	234.99

D. Phasing of Improvements

For all scenarios associated with releasing runoff at greater than historic rates into the Sand Creek Channel, the downstream infrastructure must be installed prior to releasing runoff. Per the annexation agreement for Woodmen Heights No. 3, “Owners shall be responsible for conformance with the SCDBPS except that no storm drainage flows shall exit the property (Woodmen Heights No. 3) in excess of historic flow rates until the downstream drainage facilities on the main channel of Sand Creek between Woodmen Road and Constitution Avenue (to include Detention Pond No. 2 which is south of Barnes Road) are either in place in accord with the SCDBPS or the facilities that are in place are adequate to accept flows in excess of historic that Owner(s) desire to release.”

The first option of downstream infrastructure to be completed is the construction of Pond #2, which is located adjacent to Security Service Field, approximately three miles downstream of Woodmen Road. The owners of Shiloh Mesa could agree to participate on an equitable basis in exchange for the approval to release storm flows at the flow rates specified in the Classic and ESI MDDPs ($Q_{100}=2242$ cfs; refer to Section III-A of this report). Currently, construction activities are underway to complete the interim plans for this pond.

As provided for within the annexation agreement for Woodmen Heights No. 3, the second option the Owner(s) of the developable parcels adjacent to Sand Creek Channel have is to construct their own detention and water quality facilities and release at historic flow rates ($Q_{100}=387.94$ cfs from the Woodmen Heights Commercial Center corresponding to the historical analysis calculations in Appendix B) and in accord with the Classic and ESI MDDPs ($Q_{100}=2242$ cfs; refer to Section III-A of this report).

A potentially third viable option for this development is the planned regional Pond #3, located inline with the Sand Creek Channel immediately north of Woodmen Road. This pond was designed to detain developed flows from the eastern portion of the Woodmen Heights Master Plan development and was previously sized by both the Classic and ESI MDDPs. Pond #3 will contain a hydraulic outlet structure which controls the release of stormwater south of Woodmen Road to release rates as outlined in the Classic and ESI MDDPs ($Q_{100}=2242$ cfs; refer to Section III-A of this report). It is the professional opinion of this report, that the construction of Pond #3 and all associated channel improvements between Pond #3 and the most upstream point of discharge associated with the Woodmen Heights Commercial Center development, will not have any additional adverse impacts to Sand Creek Channel downstream of Pond #3.

The Woodmen Heights Commercial Center development can be broken into two areas (zones) for the purpose of phasing. Construction within each of these zones would require onsite and offsite infrastructure to ensure downstream facilities are not adversely impacted. Development in one zone does not require any storm sewer improvements in any other zone, as long as local grading, drainage, and erosion issues are consistent with the concept plan. Please refer to the Phasing Map included within Appendix E.

Zone 1 is identified as the northern most portion of the Woodmen Heights Commercial Center development. Zone 1 includes onsite Sub-Basins B, C, and F, as well as offsite Sub-Basins OS-9 and OS-10 (Marksheffel Road). This zone also encompasses the runoff generated within Shiloh Mesa at Design Point 2 (Design Point 21 of Shiloh Mesa MDDP). The runoff from these basins is routed toward Design Point 5. To discharge into Sand Creek, Regional Detention Pond #3 must be built to accommodate the developed runoff, or it must be shown that the developed release from Zone 1, along with any other releases, will not exceed historic flowrates. This may be accomplished through onsite detention. This detention could be considered temporary until the construction of Pond #3 is complete.

The southern portion of the Woodmen Heights Commercial Center development is denoted as **Zone 2**. Zone 2 consists of Sub-Basins D, E, and J, as well as runoff generated within the offsite Sub-Basin OS-3. Stormwater from the southern portion of Shiloh Mesa will be routed through this zone and must also be taken into account. The runoff routed through Zone 2 outlets at Design Point 9. To discharge into Sand Creek, Regional Detention Pond #3 must be built to accommodate the developed runoff, or it must be shown that the developed release from Zone 2, along with any other releases, will not exceed historic flowrates. This may be accomplished through onsite detention. This detention could be considered temporary until the construction of Pond #3 is complete.

In general, in order to discharge into Sand Creek, Regional Detention Pond #3 must be built to accommodate developed runoff, or it must be shown that the developed release from Zones 1 and 2, along with any other releases, will not exceed historic flowrates. This may be accomplished through onsite detention. This detention could be considered temporary until the construction of Pond #3 is complete.

E. Maintenance

Maintenance access for all proposed public drainage systems will be provided within any right-of-way or through means of an easement. The internal storm sewer infrastructure will be public and dedicated to the City. Once the regional pond and channel improvements are completed and approved and accepted by the City, the City will take over the maintenance responsibilities of the facilities. The regional pond and Sand Creek Channel Improvements will be dedicated to the City by means of a tract. An easement will be provided for any public storm sewer system which is located outside of the ROW. The following table outlines the non-reimbursable public infrastructure costs associated with this development.

Table 4.4 - Non-Reimbursable Public Facilities

Item	Unit	Quantity	Unit Cost	Extension
Type I Manhole	EA	10	\$3,770.00	\$ 37,700.00
18" RCP	LF	53	\$53.00	\$ 2,809.00
24" RCP	LF	753	\$65.00	\$ 48,945.00
42" RCP	LF	268	\$100.00	\$ 26,800.00
54" RCP	LF	119	\$180.00	\$ 21,420.00
60" RCP	LF	1151	\$200.00	\$ 230,200.00
66" RCP	LF	1138	\$220.00	\$ 250,360.00
D10R Inlet	EA	9	\$6,000.00	\$ 54,000.00
			Sub-Total	\$ 672,234.00
			15% Contingencies & Engineering	\$ 100,835.10
			Grand Total	\$ 773,069.10

F. Water Quality

According to the ESI MDDP, the water quality capture volume required for the Woodmen Heights Commercial Center development is included in the volume of the proposed regional detention pond, known as Pond #3. The ESI MDDP specified that an extended detention basin within Pond #3 will serve as the best management practice (BMP) structure for providing water quality.

Pond #3 will be dedicated to the City of Colorado Springs, who will own and maintain it. The pond has been designed to handle the developed flows for the Woodmen Heights Master Planned areas per the Classic and ESI MDDPs. Until the installation of Pond #3 is completed, runoff must be detained onsite to historic rates and treated for water quality prior to leaving the developed area.

G. Improvements to Sand Creek Channel

Detailed hydraulic analysis of the Sand Creek Channel will need to be completed for the reach located to the northwest and adjacent to the project site at the time of development. The channel improvements must be installed when any one of the following occur:

- Any undetained stormwater flows generated within the Shiloh Mesa development are released directly to Sand Creek
- Any development located adjacent to the Sand Creek Channel floodplain north and west of Tamarisk Wood and west of the western loop of Olive Wood
- The routing of runoff from offsite Sub-Basin OS-5 to the channel

Future development of Shiloh Mesa must conform with the SCDBPS, with the exception that no runoff shall leave the property in excess of historic flowrates until the downstream drainage facilities on the main channel of Sand Creek between Woodmen Road and Constitution Avenue (to include Detention Pond #2, located south of Barnes Road) are either in place in accordance with the SCDBPS, or the facilities that are in place are capable of accepting runoff in excess of the historic flowrates. According to the SCDBPS, the Sand Creek Channel Improvements associated with this development consist of two drop structures/grade control structures along with channel stabilization improvements. Subsequent analysis will be required for the design of the channel improvements to verify how they will connect to the regional detention facility known as Pond #3. The owner / developer has the option to construct the required channel improvements and regional detention facility adjacent to this development in lieu of paying drainage fees to the City. The drainage analysis and design are an owner / developer obligation and will be required with the submittal of a development plan. It must be demonstrated that the developed release does not exceed historic flowrates until the downstream facilities can accommodate the additional flow. Installation of the channel improvements is to take place concurrent to development of adjacent properties. The improvements shall adhere to the timing as outlined in the subsequent preliminary and/or final drainage reports.

H. Drainage, Bridge, and Pond Fees

The Woodmen Heights Commercial Center is located within the Sand Creek Drainage Basin. The WHMD was established by the property owners within Woodmen Heights to finance and construct certain infrastructure improvements within the District including all reimbursable public drainage improvements. Once the improvements have been installed, the City will take ownership and maintenance of all facilities through the dedication of ROW and/or the platting of land. The WHMD acknowledges their obligation to install the capital improvements listed in this report per City requirements for the development. Financial assurances may be required by the City prior to issuing building permits. The table below outlines the platting fees applicable to the Woodmen Heights Commercial Center development.

In order to reduce developed flows to historic levels in the Sand Creek Channel and the corresponding magnitude of infrastructure required downstream of this development, the need for regional detention in the upper portion of the Sand Creek basin has been identified in the

Classic MDDP. This will result in a unit drainage fee increase of \$3,691,140.35 (2004 dollars) within the Sand Creek Drainage Basin for unplatted acreage. No final drainage reports within the study area for the Woodmen Heights Commercial Center will be approved until such time as the proposed fee increase for the Sand Creek Drainage Basin has been addressed by the City Drainage Board.

Table 4.6 - Drainage and Bridge Fees

BASIN	AREA ACRE	DRAINAGE FEE/ACRE	BRIDGE FEE/ACRE	POND		TOTAL
				LAND	FACILITIES	
SAND CREEK	48.25	\$9,493	\$596	\$1,070	\$2,881	\$677,430

Total fees owed to the City are **\$677,430 at the time of platting**

Based on the approved Classic MDDP for the Woodmen Heights Master Plan (June 2004), the costs to install reimbursable public drainage improvements within the Sand Creek Basin for the Woodmen Heights Master Plan exceed the fees that would be collected by the City. Therefore, the fees associated with the Woodmen Heights Commercial Center development are fully offset by public drainage improvements constructed by the owner / developer or the WHMD.

V. CONCLUSION

The proposed Woodmen Heights Commercial Center development is in compliance with *Volumes I and II of the City Drainage Criteria Manual*, dated November 1991, and the SCDBPS. The overall design concept does not negatively impact downstream storm sewer infrastructure, and coincides with the previously approved drainage studies of this area and the surrounding properties.

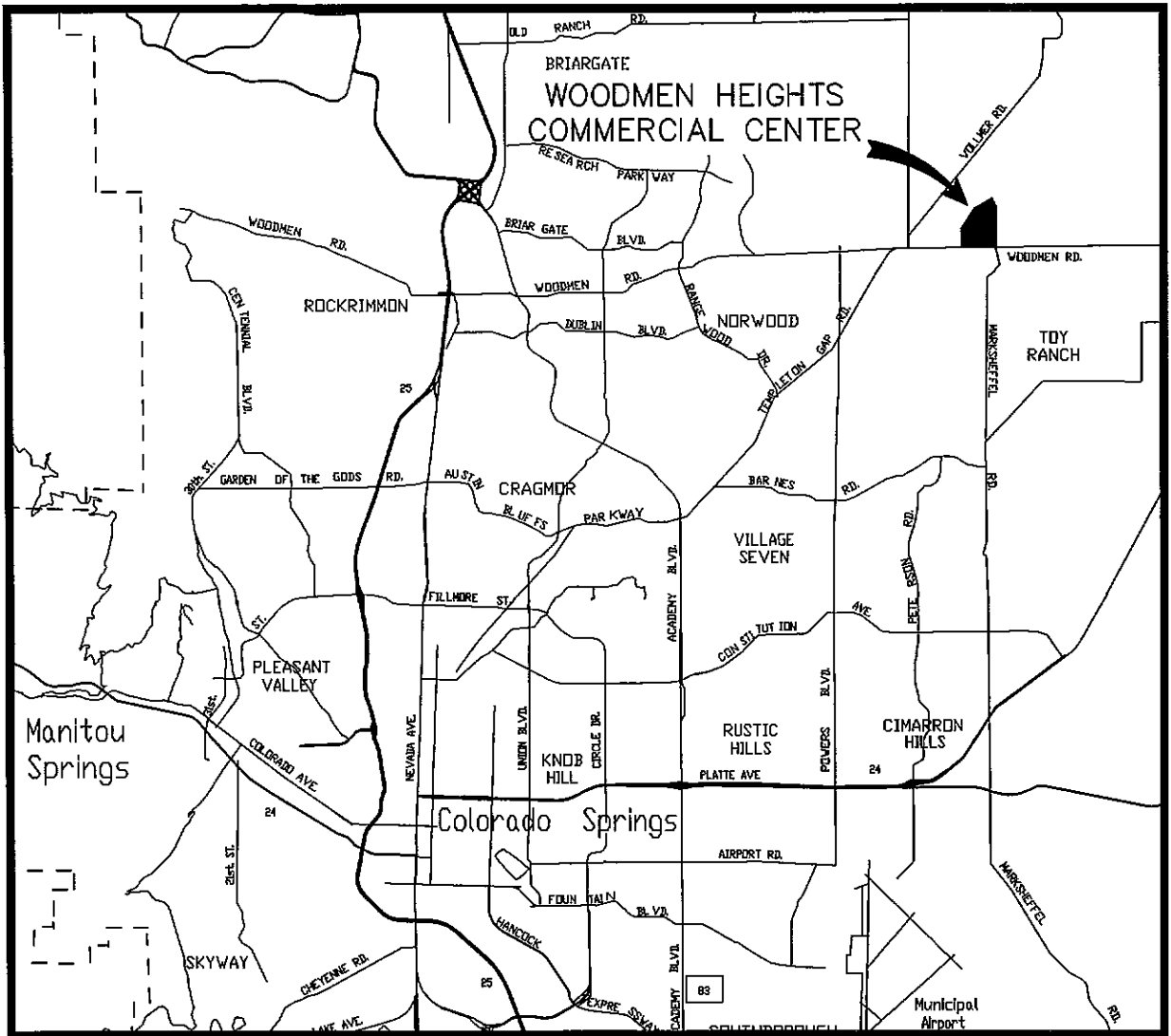
Redirecting the offsite flow from the east of Shiloh Mesa to upstream of the proposed crossing of Sand Creek with Marksheffel Road will have an economic benefit of decreasing the cost of storm sewer infrastructure through this development. However, this cost must be weighed against the added cost for improvements to the Sand Creek Channel upstream of the point of discharge. The Classic MDDP specified that the Woodmen Heights Commercial Center, will accept flows from Shiloh Mesa containing runoff from the off-site basin OS-5, and convey that flow to Sand Creek. The cost distribution for the added channel improvements will need to be coordinated between the Shiloh Mesa development, the Woodmen Heights Commercial Center development, and the Woodmen Heights Metropolitan District.

VI. REFERENCES

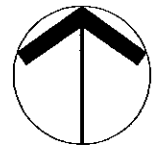
1. *Drainage Basin Planning Study for Sand Creek*, Kiowa Engineering, revised March 1996.
2. *City of Colorado Springs & El Paso County Drainage Criteria Manual*, dated November 1991.
3. *FEMA Flood Insurance Rate Map*, El Paso County Colorado and Incorporated Areas, Panels 751 and 753 of 1300. March 17, 1997.
4. *Soil Survey of El Paso County Area, Colorado*. United States Department of Agriculture Soil Conservation Service. Issued June 1981.
5. *Urban Storm Drainage Criteria Manual, Volumes 1-3*, Urban Drainage and Flood Control District, June 2001 and subsequent updates.
6. *Master Development Drainage Plan for Woodmen Heights Master Plan*, Classic Consulting Engineers and Surveyors, dated June 2004.
7. *Master Development Drainage Plan for Woodmen Heights Master Plan Update for Woodmen Heights and Final Drainage Report for Forrest Meadows Filing No. 1 and No. 4*, Engineer and Surveying, Inc., dated February 2006.

APPENDIX A

MAPS



VICINITY MAP



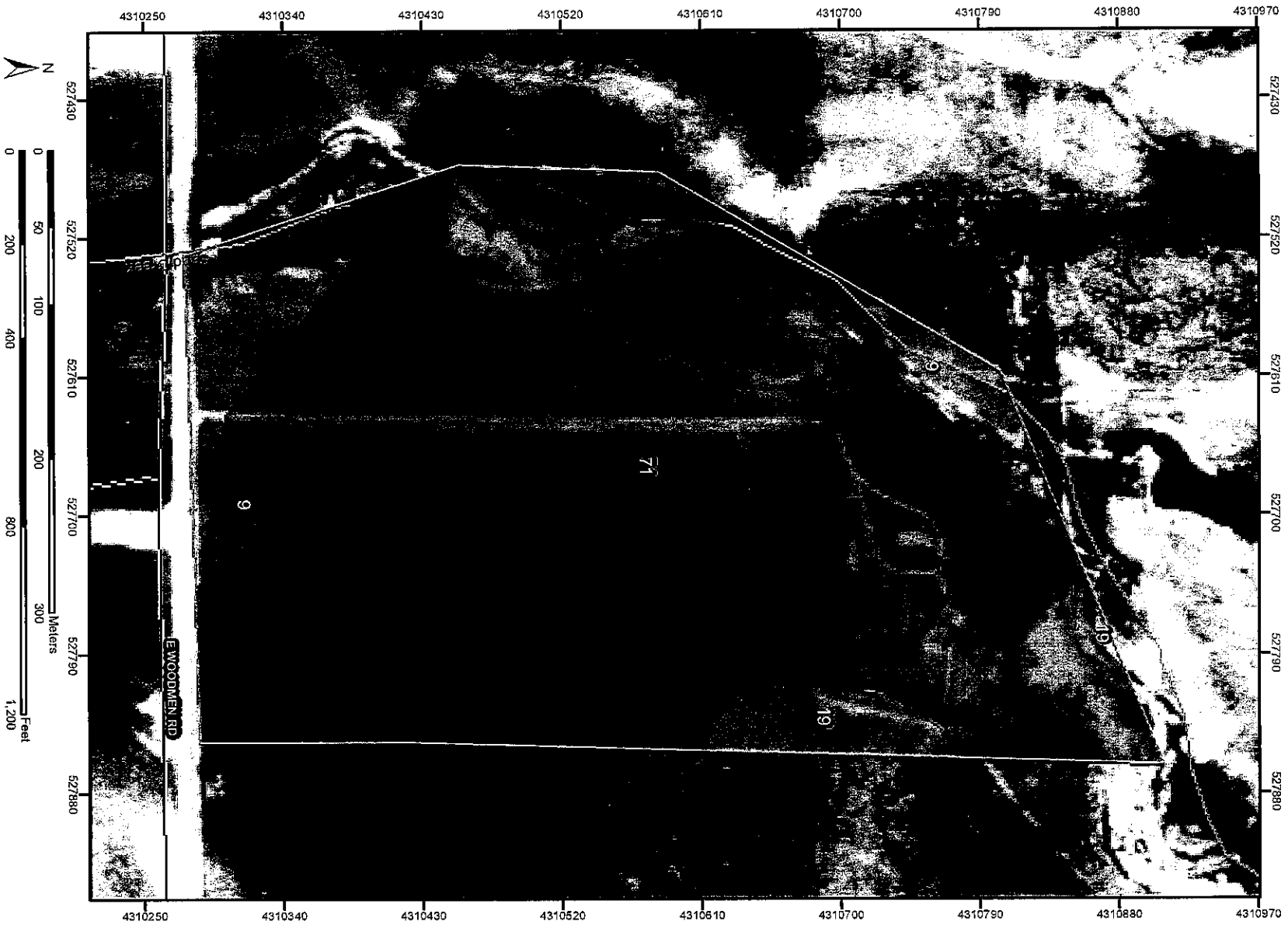
NORTH
N.T.S.



Matrix Design Group,
Integrated Design Solutions

2435 Research Parkway, Suite 300
 Colorado Springs, CO 80920
 Phone 719-575-0100
 Fax 719-575-0208


Hydrologic Soil Group—El Paso County Area, Colorado
(Woodmen Heights Commercial Center)



Hydrologic Soil Group—El Paso County Area, Colorado
(Woodmen Heights Commercial Center)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Soil Ratings

 A

 A/D

 B

 B/D

 C

 C/D

 D

Not rated or not available

Political Features


Municipalities

 Cities

 Urban Areas

Water Features

 Oceans

 Streams and Canals

Transportation


 Rails


Roads

 Interstate Highways

 US Routes

 State Highways

 Local Roads

 Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 13N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 4, Dec 20, 2006

Date(s) aerial images were photographed: 1999

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	A	5.2	11.1%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	1.5	3.3%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	40.3	85.6%
Totals for Area of Interest (AOI)			47.0	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

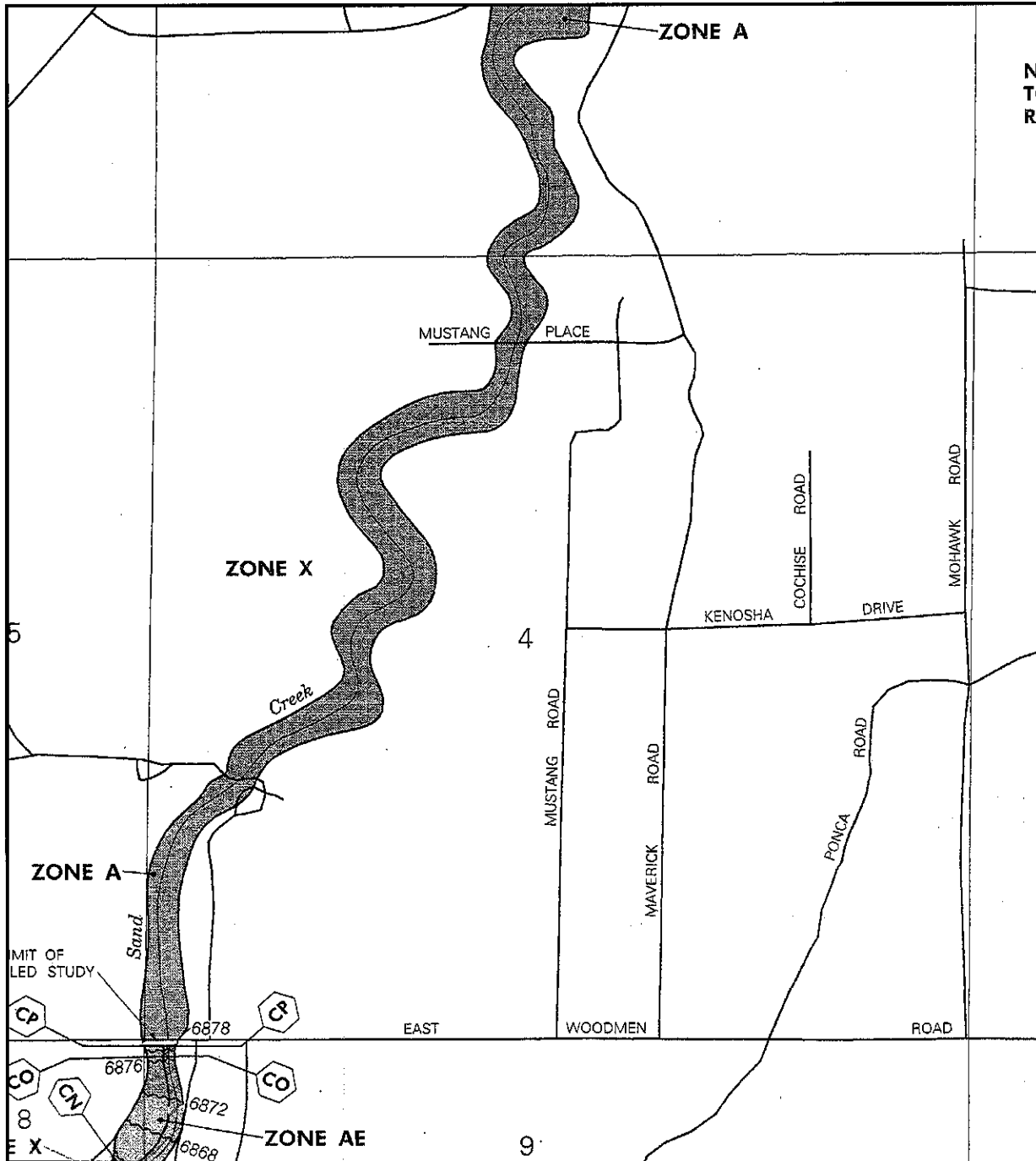
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

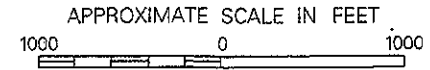
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower



NO
TO
RA



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 535 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:
COMMUNITY

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0535	F

EL PASO COUNTY,
UNINCORPORATED AREAS

NUMBER PANEL SUFFIX

MAP NUMBER
08041C0535 F

EFFECTIVE DATE:
MARCH 17, 1997



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



Federal Emergency Management Agency

Washington, D.C. 20472

AUG 15 2005

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Jim Bensberg
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903

IN REPLY REFER TO:

Case No.: 04-08-0779P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of **DEC 07 2005**
This Revision:

Dear Mr. Bensberg:

The Flood Insurance Study report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Sincerely,



Kelly A. Bronawice

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

For: Doug Bellomo, P.E., Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map
Annotated Flood Insurance Study Report

cc: Mr. Kevin Stilson, P.E., CFM
Regional Floodplain Administrator
Pikes Peak Regional Building Department



Kiowa Engineering Corporation



Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	NO PROJECT	HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	East Woodmen Road to Mustang Place	APPROXIMATE LATITUDE & LONGITUDE: 38.946, -104.681 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

FLOODING SOURCE(S) & REVISED REACH(ES)	Sand Creek - from approximately 2,200 feet downstream of East Woodmen Road to Mustang Place
---	---

SUMMARY OF REVISIONS						
Effective Flooding:	Zone A	No BFEs*	No Floodway	BFEs*	Floodway	Zone AE
Revised Flooding:	Zone AE	BFEs	Floodway	BFEs	Floodway	Zone AE
Increases:	YES	YES	YES	YES	YES	YES
Decreases:	NONE	NONE	NONE	YES	NONE	YES

* BFEs - Base Flood Elevations

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0535 F Date: March 17, 1997 TYPE: FIRM NO.: 08041C0545 F Date: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 FLOODWAY DATA TABLE: 5 PROFILES: 204P and 204P(a)

* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division

Emergency Preparedness and Response Directorate 105634 10.3.1.04080779P 1021AC



Federal Emergency Management Agency
Washington, D.C. 20472

**LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)**

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in black ink, appearing to read "P. Sacbibit".

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division

Emergency Preparedness and Response Directorate

105634 10.3.1.04080779P 1021AC



Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Federal Insurance and Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panels and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in black ink, appearing to read "P. Sacbibit".

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division

Emergency Preparedness and Response Directorate 105634 10.3.1.04080779P 102IAC



Federal Emergency Management Agency
Washington, D.C. 20472

**LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)**

PUBLIC NOTIFICATION OF REVISION

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below.

LOCAL NEWSPAPER

Name: *El Paso County News*

Dates: 08/31/2005 09/07/2005

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek	Approximately 2,100 feet downstream of East Woodmen Road	6,847	6,849	08041C0535 F
	Immediately downstream of Mustang Place	None	6,976	08041C0535 F

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick F. Sacbilit, P.E., CFM, Project Engineer
Hazard Identification Section
Mitigation Division

Emergency Preparedness and Response Directorate 105634 10.3.1.04080779P 102IAC

CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE UNINCORPORATED AREAS OF EL PASO COUNTY, COLORADO, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

On March 17, 1997, the Department of Homeland Security's Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the unincorporated areas of El Paso County, Colorado, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Division has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in this community is appropriate. The modified Base Flood Elevations (BFEs) revise the FIRM for the community.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate new topographic information along Sand Creek from approximately 2,200 feet downstream of East Woodmen Road to Mustang Place and has resulted in a revised delineation of the regulatory floodway, increases and decreases in SFHA width, and increased and decreased BFEs for Sand Creek. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	Modified BFE (feet)*
Approximately 2,100 feet downstream of East Woodmen Road	6,847	6,849
Immediately downstream of Mustang Place	None	6,976

*National Geodetic Vertical Datum, rounded to nearest whole foot

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Division must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Division reconsider the determination. Any request for reconsideration must be based on knowledge of changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Division's determination to modify the BFEs may itself be changed.

Any person having knowledge or wishing to comment on these changes should immediately notify:

The Honorable Jim Bensberg
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek (cont'd)		Revised Data						
BA	41,708	131	421	10.5	6,420.6	6,420.6	6,420.6	0.0
BB	42,116	300	544	8.0	6,426.3	6,426.3	6,426.3	0.0
BC	42,766	299	613	7.2	6,431.8	6,431.8	6,432.5	0.7
BD	44,396	74	353	12.4	6,453.6	6,453.6	6,453.6	0.0
BE	44,866	64	341	13.2	6,460.9	6,460.9	6,460.9	0.0
BF	45,876	106	403	11.2	6,473.1	6,473.1	6,473.1	0.0
BG	46,456	74	360	12.5	6,480.0	6,480.0	6,480.0	0.0
BH	47,091	140	442	10.2	6,495.4	6,495.4	6,495.8	0.4
BI	48,471	230	525	8.6	6,513.8	6,513.8	6,513.8	0.0
BJ	48,895	147	451	10.0	6,519.2	6,519.2	6,519.2	0.0
BK	49,550	140	390	10.8	6,526.7	6,526.7	6,526.7	0.0
BL	51,485	125	466	9.2	6,541.3	6,541.3	6,541.3	0.0
BM	52,380	60	324	13.3	6,554.7	6,554.7	6,554.9	0.2
BN	52,580	107	489	8.8	6,557.4	6,557.4	6,557.4	0.0
BO	53,095	120	426	10.1	6,566.7	6,566.7	6,566.7	0.0
BP	53,550	50	305	14.1	6,574.9	6,574.9	6,575.4	0.5
BQ	54,590	99	378	11.1	6,587.9	6,587.9	6,587.9	0.0
BR	55,645	39	308	13.6	6,608.5	6,608.5	6,608.5	0.0
BS	56,500	80	393	9.9	6,618.4	6,618.4	6,619.0	0.6
BT	57,495	170	490	8.0	6,633.5	6,633.5	6,634.1	0.6
BU	58,645	65	296	12.2	6,650.3	6,650.3	6,651.0	0.7
BV	59,485	150	390	9.2	6,664.7	6,664.7	6,664.7	0.0
BW	60,685	130	350	9.4	6,680.1	6,680.1	6,680.6	0.5
BX	62,275	60	255	11.8	6,706.9	6,706.9	6,707.5	0.6
BY	62,667	100	427	7.0	6,711.9	6,711.9	6,712.6	0.7
BZ	64,822	90	264	9.9	6,744.7	6,744.7	6,744.8	0.1

¹Feet Above Confluence With Fountain Creek

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FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

REVISED TO
SAND CREEK REFLECT LOMR
DATED DEC 07 2005

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY		INCREASE
						WITH FLOODWAY		
(FEET NGVD)								
Sand Creek (cont'd)								
CA	65,292	164	427	6.1	6,748.7	6,748.7	6,749.4	0.7
CB	66,092	41	223	11.7	6,761.2	6,761.2	6,762.2	1.0
CC	66,247	90	270	9.6	6,773.6	6,773.6	6,773.7	0.1
CD	67,647	50	218	11.9	6,782.6	6,782.6	6,783.3	0.7
CE	68,297	65	284	8.8	6,793.9	6,793.9	6,794.4	0.5
CF	69,147	50	213	11.7	6,804.5	6,804.5	6,804.5	0.0
CG	70,157	50	213	11.7	6,815.1	6,815.1	6,815.3	0.2
CH	70,577	205	347	7.2	6,823.9	6,823.9	6,824.5	0.6
CI	70,627	180	267	9.4	6,826.7	6,826.7	6,827.7	1.0
CJ	70,727	210	340	7.3	6,831.1	6,831.1	6,831.1	0.0
CK	70,807	195	334	7.5	6,832.5	6,832.5	6,832.5	0.0
CL	71,162	90	255	9.8	6,838.0	6,838.0	6,839.0	1.0
CM	71,977	226	503	5.2	6,847.4	6,847.4	6,848.3	0.9
CN	73,052	174	328	7.9	6,861.1	6,861.1	6,861.2	0.1
CO	73,644	237	364	7.1	6,870.2	6,870.2	6,870.2	0.0
CP	75,142	172	324	8.0	6,888.5	6,888.5	6,888.7	0.2
CQ	76,161	109	283	9.2	6,903.5	6,903.5	6,903.7	0.2
CR	77,846	100	272	9.6	6,926.1	6,926.1	6,926.7	0.6
CS	79,187	117	287	9.1	6,944.1	6,944.1	6,944.1	0.0
CT	80,808	102	277	9.4	6,969.2	6,969.2	6,969.4	0.2

Revised Data

¹Feet Above Confluence With Fountain Creek

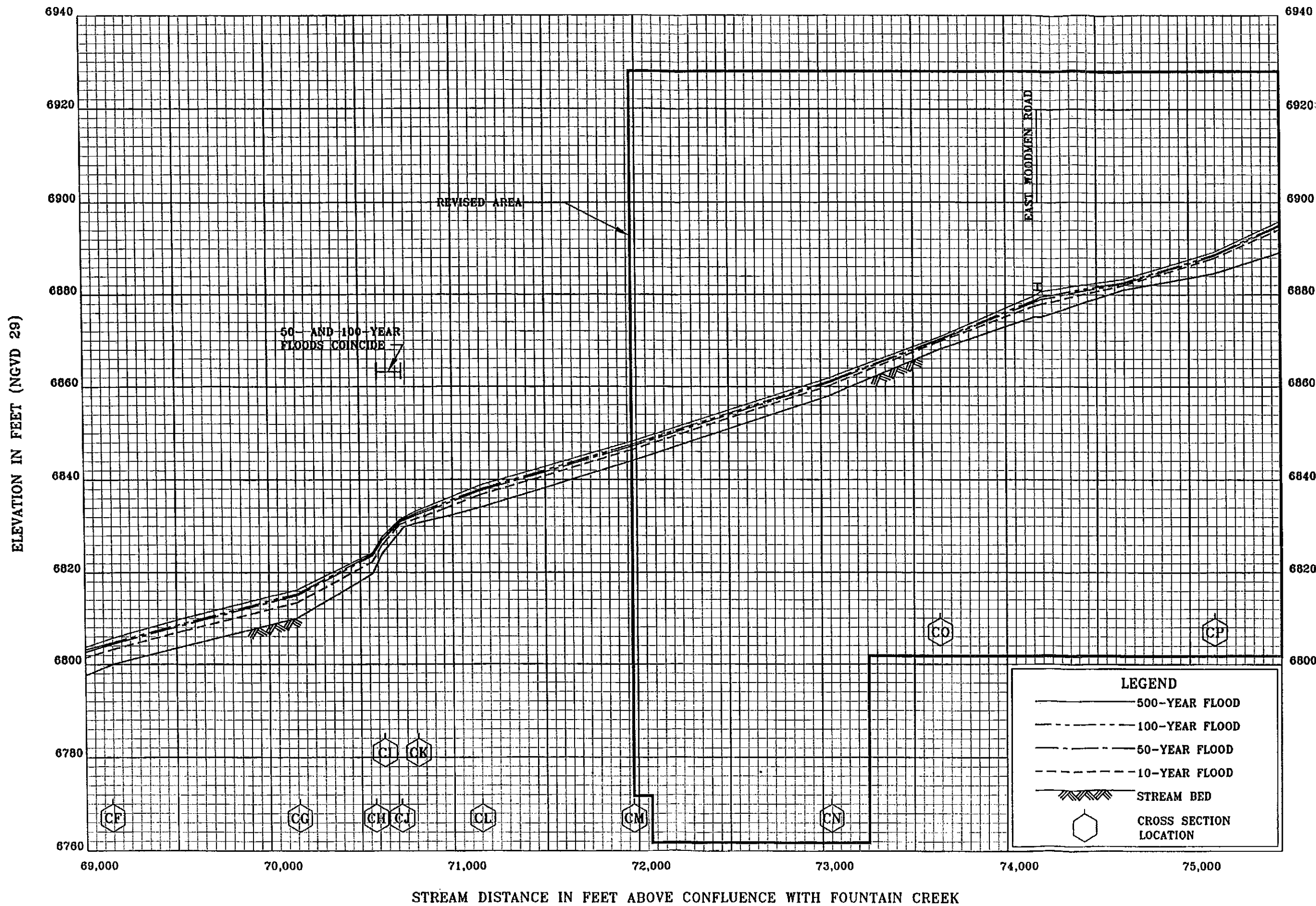
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FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

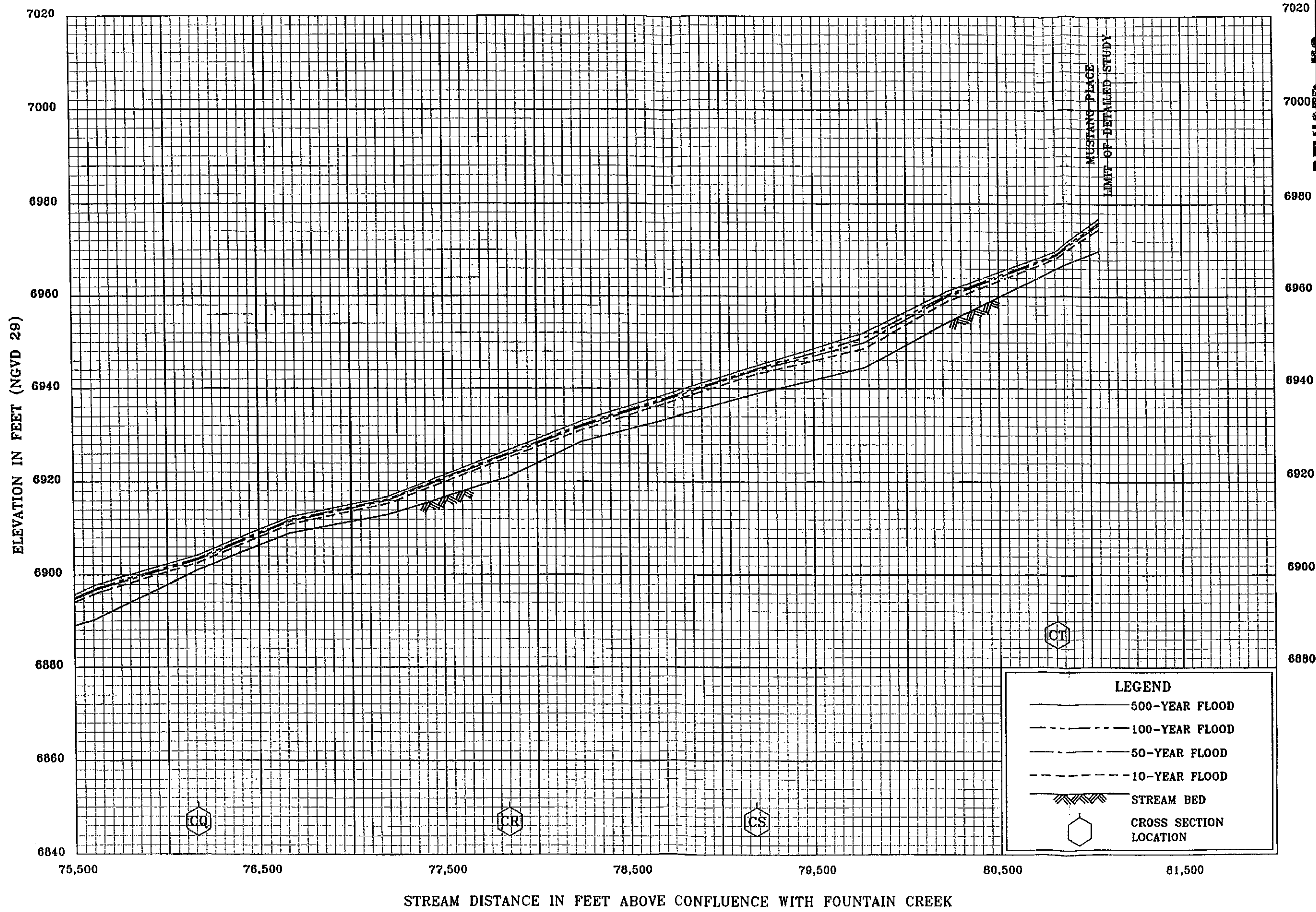
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DATED DEC 07 2005



REVISED TO REFLECT LOMR DATED DEC 07 2005

FLOOD PROFILES SAND CREEK

**FEDERAL EMERGENCY MANAGEMENT AGENCY
EL PASO COUNTY, CO
AND INCORPORATED AREAS**

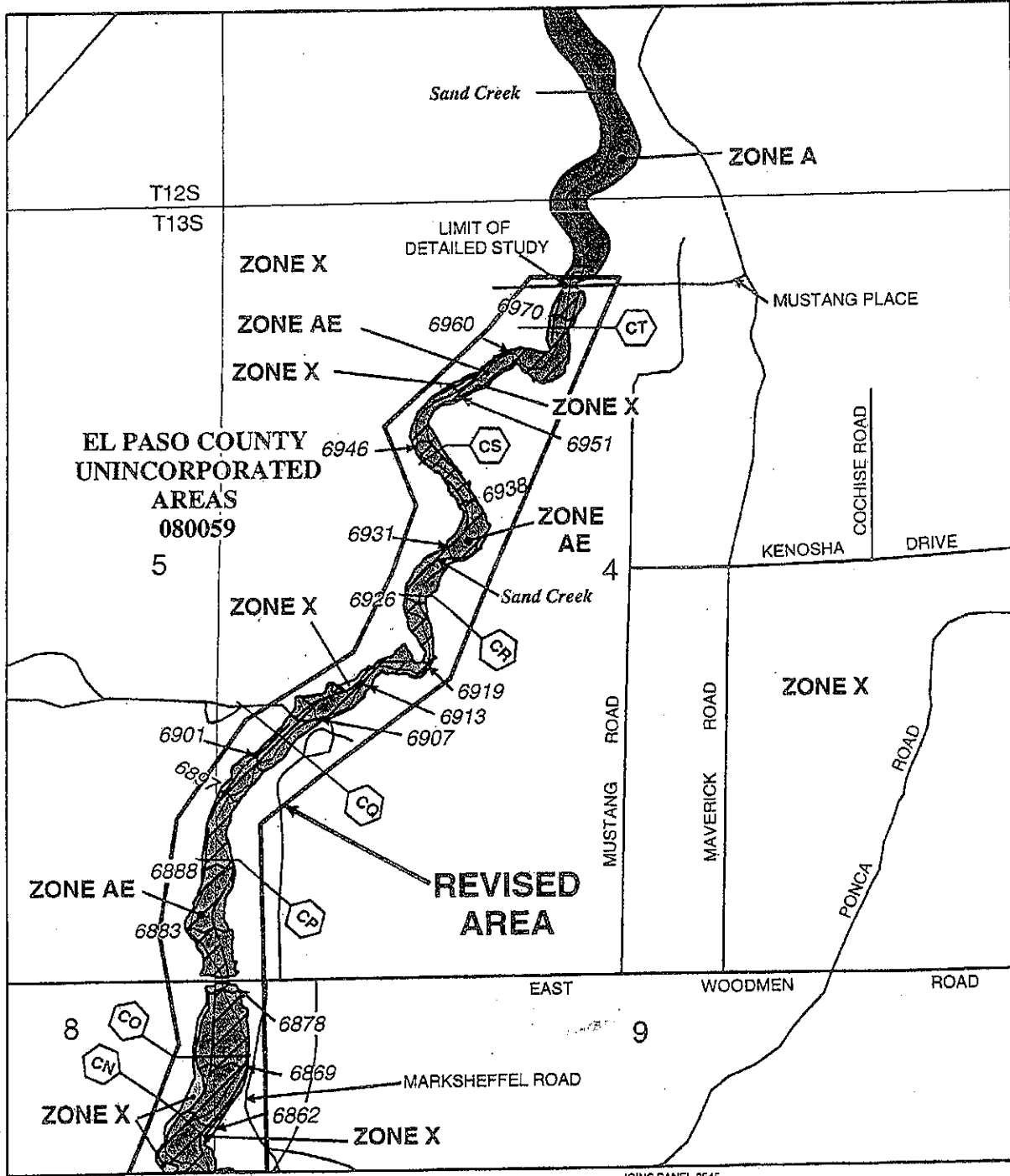


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 DATED DEC 07 2015

FLOOD PROFILES
 SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
 EL PASO COUNTY, CO
 AND INCORPORATED AREAS

204P(a)



Legend

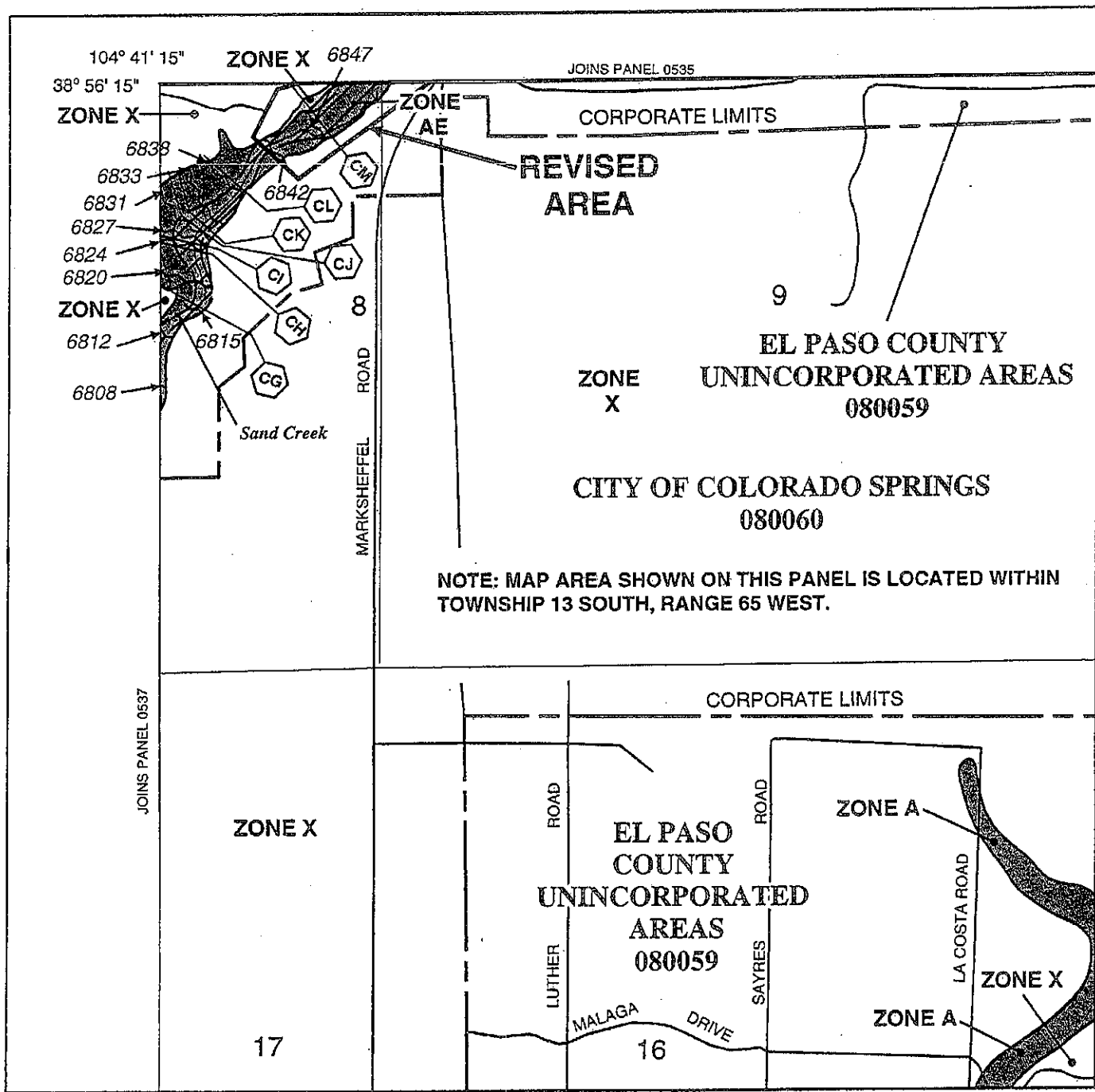
- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
 EL PASO COUNTY,
 COLORADO AND
 INCORPORATED
 AREAS
PANEL 535 OF 1300
 (SEE MAP INDEX FOR PANELS NOT PRINTED)
 CONTAINS:
 COMMUNITY NUMBER PANEL SUFFIX
 EL PASO COUNTY,
 UNINCORPORATED AREAS 080059 0535 F
 REVISED TO
 REFLECT LOMR
 DATED DEC 07 2005
 MAP NUMBER
 08041C0535 F
 EFFECTIVE DATE:
 MARCH 17, 1997

 Federal Emergency Management Agency

JOINS PANEL 0545



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 65 WEST.

Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

1,000 0 1,000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY
COLORADO AND
INCORPORATED
AREAS

PANEL 545 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL SUFFIX
COLORADO SPRINGS, CITY OF	080060	0545 F
EL PASO COUNTY UNINCORPORATED AREAS	080059	0545 F

REVISED TO REFLECT LOMR DATED DEC 07 2005

MAP NUMBER
08041C0545 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC AND HYDRAULIC CALCULATIONS



Historic Basin Hydrology

Sub-Basin Data			Design Point	Runoff Coefficients		CA		Initial/Overland Time (T _i)			Travel Time (T _t)				Final T _c	* ⁴ Intensity		Peak Runoff		Remarks
Basin	Area (sq-ft)	Area (ac)		C(5)	C(100)	CA(5)	CA(100)	Length (ft)	Slope (%)	* ¹ T _i (min)	Length (ft)	Slope (%)	* ³ Vel. (fps)	* ² T _t (min)	(min)	I(5) in/hr	I(100) in/hr	Q(5)	Q(100)	
SC	464305	10.7		0.25	0.35	2.68	3.75	50	33.0%	3.55	2350	1.4%	1.80	21.76	21.76	2.89	5.14	7.75	19.28	
A	201,695	4.6		0.25	0.35	1.15	1.61	100	2.0%	12.65	1000	2.3%	1.10	15.15	15.15	3.45	6.13	3.97	9.87	
B	1,266,531	29.1		0.25	0.35	7.28	10.20	100	2.0%	12.65	1750	1.8%	0.90	32.41	32.41	2.32	4.12	16.89	42.02	
C	170,651	3.9		0.25	0.35	0.98	1.37	100	2.0%	12.65	1800	2.5%	1.20	25.00	25.00	2.68	4.77	2.61	6.53	
SHILOH MESA MDDP DP8		409.8				87.42	119.49								46.00	1.88	3.34	164.10	399.20	REFER TO SHILOH MESA MDDP
SM MDDP DP8 & C		413.7	1			88.40	120.86			46.00	250	2.00%	2.5	1.67	47.67	1.83	3.27	161.77	395.22	
Routed DP1, B		442.8	2			95.68	131.06			47.67	470	1.70%	1.0	7.83	55.50	1.67	2.96	159.78	387.94	

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By Rich Eastland

Project: The Woodmen Heights Commercial Center MDDP

Printed 2/19/2009 13:52

* - Colorado Springs Drainage Criteria Manual $T_c = 1.87(1.1-C)L^{0.5}S^{-0.33}$, where C = 0.25

*² - $T_t = \text{Length}/\text{Velocity}$

*³ - Urban Drainage Figure RO-1

*⁴ - Colorado Springs Drainage Criteria Manual

$$I(5) = (26.65 * 1.5) * (10 + T_c)^{0.70}$$

$$I(100) = (26.65 * 2.67) * (10 + T_c)^{0.70}$$

WOODMEN HEIGHTS COMMERCIAL CENTER



MDDP Impervious Area Comparison Table

ESI SCS Impervious Area Table				
ESI Parcel	SCS Area (acres)	CN	% Imp*	Imp Area (acres)
Parcel 22	16.68	92	85%	14.2
Parcel 23	24.38	92	85%	20.7

Total Impervious Area 34.9

Rational Impervious Area Table				
Basin	Area (ac)	C(100)	% Imp*²	Imp Area (acres)
B	6.14	0.70	65%	4.0
C	4.32	0.80	70%	3.0
D	9.12	0.90	95%	8.7
E	9.38	0.80	70%	6.6
F	2.34	0.80	70%	1.6
OS-10	2.61	0.95	100%	2.6
OS-9	1.19	0.95	100%	1.2
OS-3	1.43	0.95	100%	1.4
J	3.97	0.80	70%	2.8

Total Impervious Area 31.9

* Table 5.5, Runoff Curve Numbers for Hydrologic Soil, DCM

*² Table 5.1, Recommended Average Runoff Coefficients and Percent Impervious, DCM

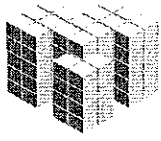


Proposed Individual Basin Hydrology

Sub-Basin Data			Runoff Coefficients		CA		Initial/Overland Time (T _i)			Travel Time (T _t)				* ⁵ T _c Check	Final T _c	* ⁴ Intensity		Peak Runoff		Remarks	
Basin	Design Point	Area (ac)	C(5)	C(100)	CA(5)	CA(100)	Length (ft)	Slope (%)	*T _i (min)	Length (ft)	Slope (%)	* ³ Vel. (fps)	* ² T _t (min)	Total T _t (min)	T _c =(L/180)+10 (min)	(min)	I(5) in/hr	I(100) in/hr	Q(5)	Q(100)	
SC		9.8	0.25	0.35	2.46	3.44	50	1.5%	9.83	2344	2.0%	2.5	15.63	25.46		25.46	2.65	4.73	6.52	16.27	
B		6.1	0.60	0.70	3.68	4.30	25	1.4%	7.20	840	2.0%	2.5	5.60	12.80	14.81	12.80	3.71	6.61	13.65	28.42	
C		4.3	0.75	0.80	3.24	3.46	25	1.4%	7.20	480	2.0%	2.5	3.20	10.40	12.81	10.40	4.04	7.19	13.09	24.88	
D		9.1	0.80	0.90	7.30	8.21	25	1.4%	7.20	1030	2.0%	2.5	6.87	14.06	15.86	14.06	3.56	6.34	25.99	52.05	
E		9.4	0.75	0.80	7.04	7.50	25	1.4%	7.20	1160	2.0%	2.5	7.73	14.93	16.58	14.93	3.47	6.18	24.43	46.35	
F		2.3	0.75	0.80	1.76	1.87	25	1.4%	7.20	410	2.0%	2.5	2.73	9.93	12.42	9.93	4.11	7.32	7.23	13.69	
J		4.0	0.75	0.80	2.98	3.18	25	1.4%	7.20	915	2.0%	2.5	6.10	13.30	15.22	13.30	3.65	6.50	10.88	20.67	
OS-3		1.4	0.95	0.95	1.33	1.33										5.00	5.10	9.09	6.78	12.09	
OS-9		1.2	0.95	0.95	1.14	1.14										5.10	5.08	9.04	5.50	10.30	
OS-10		2.6	0.95	0.95	2.48	2.48										16.40	3.32	5.91	8.23	14.66	

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 By Rich Eastland
 Project: The Woodmen Heights Commercial Center MDDP
 Printed 2/19/2009 14:01

* - Colorado Springs Drainage Criteria Manual $T_c = 1.87(1.1-C)L^{0.5}S^{-0.33}$
² - $T_t = \text{Length}/\text{Velocity}$
³ - Urban Drainage Figure RO-1
⁴ Colorado Springs Drainage Criteria Manual
 $I(5) = (26.65*1.5)/(10+T_c)^{0.76}$
 $I(100) = (26.65*2.67)/(10+T_c)^{0.76}$
⁵ For Urbanized Basins only



Matrix Design Group, Inc.
 Integrated Design Solutions *Infrastructure Engineering*
 Community Development
 Program Management

*Proposed Routed Basin Hydrology
 (StormCAD Summary Table)*

<i>Design Point</i>	<i>Area (ac)</i>	<i>Q(5) (cfs)</i>	<i>Q(100) (cfs)</i>	<i>Description</i>
1	8.75	21.57	38.65	Sub-basins OS-10 & B
1-A	2.61	8.23	14.66	Sub-basin OS-10
2	34.12	102.78	184.26	Shiloh Mesa MDDP DP 21
3	38.44	114.63	205.86	Sub-basin C & DP2
4	11.09	27.46	49.23	Sub-basin F & DP1
5	49.53	121.44	216.6	DP3 & DP4
6	27.03	92.17	157.9	Shiloh Mesa MDDP DP 30
7	36.41	100.51	178.95	Sub-basin E & DP6
8	13.09	40.83	72.7	Sub-basins J & D
9	49.5	137.94	245.67	DP7 & DP8

Shiloh Mesa at Woodmen Heights
Rational Method Routed Peak Flowrates

Outfall 11

Design Point	Contributing Area	Total Peak Discharge Q(5)	Total Peak Discharge Q(100)	Pipe Diameter	Contributing Basins
		cfs	cfs	inch	
1	4.3	5.13	9.12	36	OS-1
2	7.0	8.15	14.56	36	DP-1, A
3	12.9	22.69	40.66	36	DP-2, D
4	4.7	14.97	26.67	36	B,C
5	17.7	33.61	60.34	36	DP-3, DP-4
6	20.8	40.28	72.43	42	E, F, DP-5
7	31.2	59.61	107.36	42	G, H, DP-6, DP-9
8	7.1	5.69	10.13	30	I
9	11.0	15.30	27.53	36	DP-8, J
10	31.7	59.70	107.53	42	DP-7, K
11	31.7	59.70	107.53	42	DP-10

Outfall 31

Design Point	Contributing Area	Total Peak Discharge Q(5)	Total Peak Discharge Q(100)	Pipe Diameter	Contributing Basins
		cfs	cfs	inch	
12	6.5	30.69	54.63	36	L
13	7.4	34.50	61.44	42	DP-12, M
14	12.2	54.35	96.87	42	DP-13, N
15	15.2	65.23	116.52	54	DP-14, O
16	324.5	205.38	410.56	72	DP-32, P
17	328.6	215.39	428.44	72	DP-16, DP-33
31	348.4	344.82	568.12	84	DP-17, DP-15, EE
32	323.0	201.70	404.00	72	OS-5
33	4.1	15.22	27.39	30	OS-7, Q

Outfall 21

Design Point	Contributing Area	Total Peak Discharge Q(5)	Total Peak Discharge Q(100)	Pipe Diameter	Contributing Basins
		cfs	cfs	inch	
18	4.9	18.03	32.10	54	S
19	9.8	35.07	62.66	54	DP-18, T
20	27.1	94.44	169.01	54	DP-19, U, V
21	29.8	102.78	184.26	54	DP-20, OS-4, OS-9

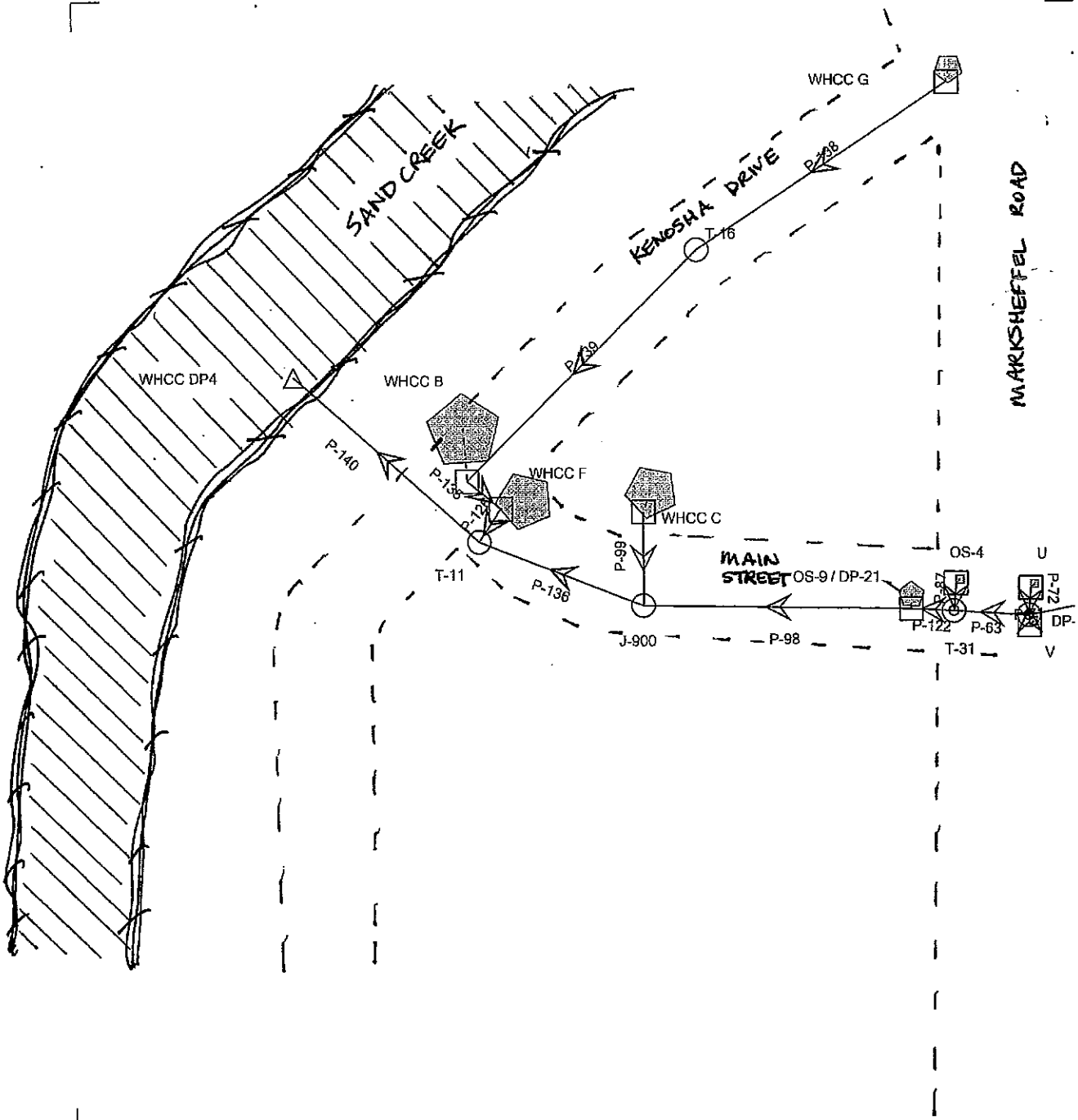
Outfall 30

Design Point	Contributing Area	Total Peak Discharge Q(5)	Total Peak Discharge Q(100)	Pipe Diameter	Contributing Basins
		cfs	cfs	inch	
22	3.3	15.37	27.37	30	W
23	6.6	21.40	38.09	30	X, Y
24	10.9	39.40	67.03	36	DP-22, DP-23, DP-25
25	1.0	4.40	7.83	18	Z
26	12.3	44.50	75.69	48	DP-24, AA
27	3.1	5.03	8.96	18	BB
28	21.2	80.95	136.95	48	DP-26, CC
29	24.3	84.67	144.53	48	DP-28, DP-27
30	27.0	92.17	157.90	60	DP-29, OS-2, OS-3

BENTLEY STORMCAD ANALYSIS

PHASING ZONE 1

Title: Print Preview



Title: Woodmen Heights Commercial Center

WHCC 11-14-08.stc

1/29/2009

Matrix Design Group, Inc
27 Slemmon Company Drive Suite 200 W
Watertown, CT 06795 USA +1-203-755-1666

Project Engineer: Rich Eastland
Bentley StormCAD V8 XM Edition
[08.09.081.00]
Page 1 of 2

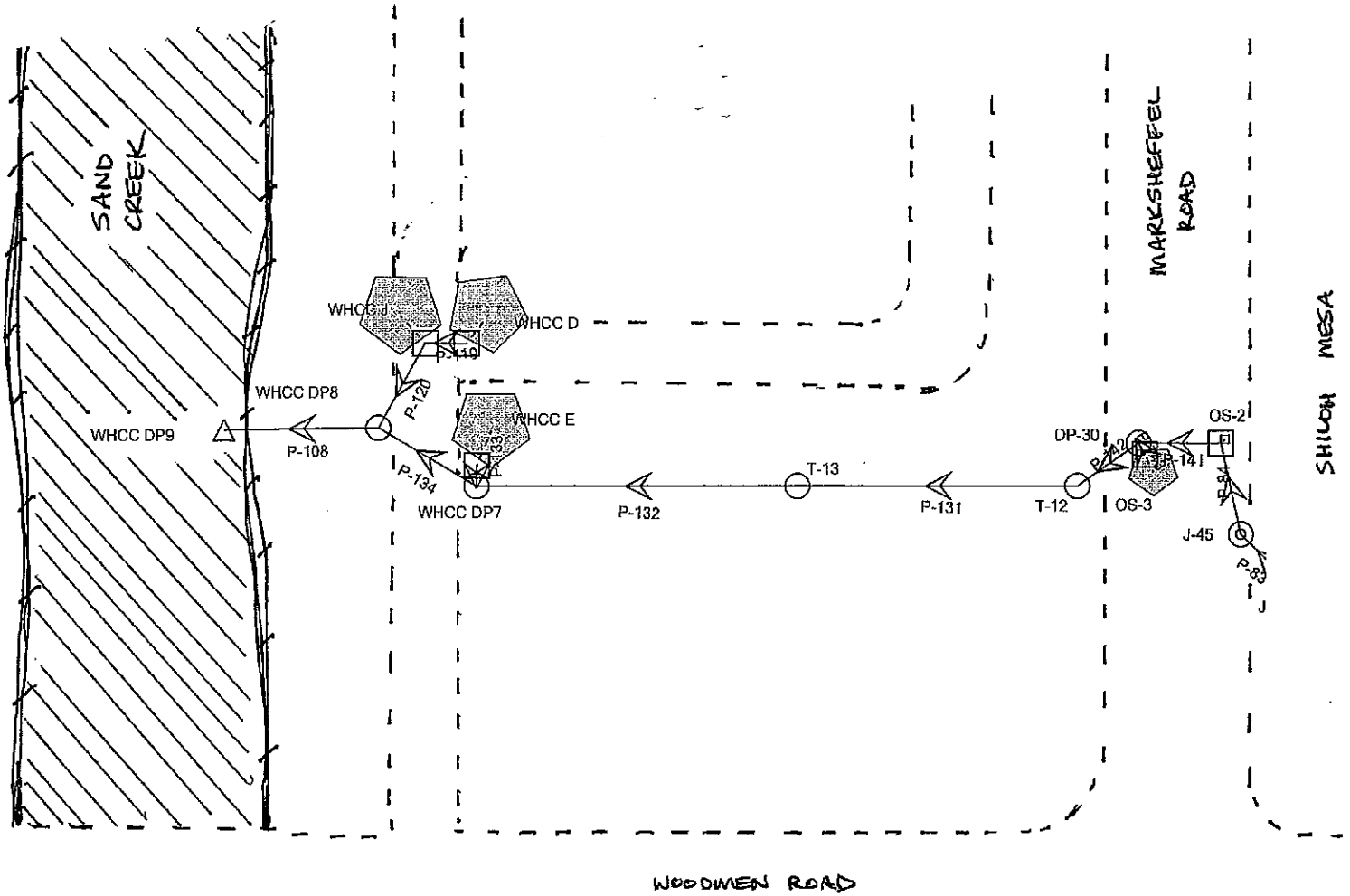
PHASING ZONE 2

Title: Print Preview

J-900

P-96

T-31



Title: Woodmen Heights Commercial Center

WHCC 11-14-08.stc

1/29/2009

Matrix Design Group, Inc
27 Siemon Company Drive Suite 200 W Watertown,
CT 06795 USA +1-203-755-1666

Project Engineer: Rich Eastland
Bentley StormCAD V8 XM Edition
[08.09.081.00]
Page 1 of 2

Woodmen Heights Commercial Center
StormCAD 100-Year
Pipe Report

Label	Length (ft)	Section Size	Material	Upstream Node	Upstream Ground Elevation (ft)	Upstream Invert Elevation (ft)	Downstream Ground Elevation (ft)	Downstream Invert Elevation (ft)	Downstream Node	Slope (ft/ft)	System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-98	243.2	48	Concrete	OS-9 / DP-21	6,910.00	6,903.11	J-900	6,913.50	6,901.89	0.005	26.209	6.975	184.26	11.06	6,906.91	6,905.53
P-99	100	24	Concrete	WHCC C	6,912.00	6,906.00	J-900	6,913.50	6,904.59	0.014	3.456	7.193	25.06	9.99	6,907.71	6,906.59
P-108	205.2	72	Concrete	WHCC DP7	6,893.00	6,883.22	WHCC DP7	6,881.00	6,881.00	0.011	40.162	6.108	247.28	15.64	6,887.63	6,884.83
P-119	45.6	36	Concrete	WHCC D	6,892.00	6,887.52	WHCC J	6,892.00	6,886.02	0.033	8.208	6.345	52.5	16.39	6,890.05	6,890.24
P-120	99.1	36	Concrete	WHCC J	6,892.00	6,885.72	WHCC DP7	6,893.00	6,884.72	0.01	11.384	6.336	72.7	7.56	6,889.66	6,889.14
P-122	250.6	48	Concrete	T-31	6,912.00	6,906.62	OS-9 / DP-21	6,910.00	6,904.11	0.01	25.079	7.05	178.21	14.01	6,910.49	6,907.49
P-126	35	18	Concrete	WHCC F	6,909.00	6,901.54	T-11	6,908.00	6,901.19	0.01	8.649	5.646	49.23	10.4	6,904.41	6,904.43
P-131	281.8	18	Concrete	T-12	6,897.50	6,888.68	T-13	6,897.25	6,887.27	0.005	21.274	7.243	157.17	10.52	6,892.27	6,891.76
P-132	449.9	18	Concrete	T-13	6,897.25	6,886.97	T-14	6,894.00	6,884.72	0.005	21.274	7.124	154.55	10.49	6,891.71	6,890.19
P-133	30	18	Concrete	WHCC E	6,894.00	6,887.52	T-14	6,894.00	6,886.92	0.02	7.504	6.176	46.71	13.25	6,890.50	6,890.52
P-134	178.8	18	Concrete	T-14	6,894.00	6,884.42	WHCC DP7	6,893.00	6,883.52	0.005	28.778	6.169	178.95	9.11	6,889.64	6,888.80
P-135	45	18	Concrete	WHCC B	6,910.00	6,902.30	WHCC F	6,909.00	6,901.84	0.01	6.778	5.658	38.65	9.85	6,904.65	6,904.74
P-136	416	18	Concrete	J-900	6,913.50	6,901.59	T-11	6,908.00	6,899.49	0.005	29.665	6.884	205.86	11.3	6,905.61	6,903.43
P-138	397.4	18	Concrete	WHCC G	6,925.00	6,911.50	T-16	6,916.50	6,907.52	0.01	2.48	5.913	14.78	7.68	6,912.89	6,908.70
P-139	320	18	Concrete	T-16	6,916.50	6,907.22	WHCC B	6,910.00	6,904.20	0.009	2.48	5.77	14.42	7.46	6,908.59	6,905.38
P-140	205.2	18	Concrete	T-11	6,908.00	6,899.19	WHCC DP4	6,896.00	6,896.00	0.016	38.315	5.637	217.72	17.79	6,903.32	6,901.50
P-141	157.4	18	Concrete	OS-2	6,897.55	6,890.75	DP-30	6,895.44	6,889.96	0.005	19.916	7.338	149.08	11.72	6,895.47	6,893.55
P-142	100	18	Concrete	DP-30	6,895.44	6,889.66	T-12	6,897.50	6,888.68	0.01	21.274	7.276	157.9	13.75	6,893.26	6,892.98
P-143	22.8	18	Concrete	OS-3	6,895.44	6,891.44	DP-30	6,895.44	6,891.66	-0.01	1.359	9.086	12.44	3.96	6,893.41	6,893.26

Woodmen Heights Commercial Center
StormCAD 5-Year
Pipe Report

Label	Length (ft)	Section Size	Material	Upstream Node	Upstream Ground Elevation (ft)	Upstream Invert Elevation (ft)	Downstream Ground Elevation (ft)	Downstream Invert Elevation (ft)	Downstream Node	Slope (ft/ft)	System CA (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
P-98	243.2	48	Concrete	OS-9 / DP-21	6,910.00	6,903.11	J-900	6,913.50	6,901.89	0.005	26.209	3.89	102.78	9.65	6,905.91	6,904.42
P-99	100	24	Concrete	WHCC C	6,912.00	6,906.00	J-900	6,913.50	6,904.59	0.014	3.456	4.041	14.08	8.58	6,907.26	6,905.52
P-108	205.2	72	Concrete	WHCC DP7	6,893.00	6,883.22	WHCC DP7	6,881.00	6,881.00	0.011	40.162	3.433	138.96	13.88	6,886.60	6,885.00
P-119	45.6	36	Concrete	WHCC D	6,892.00	6,887.52	WHCC J	6,892.00	6,886.02	0.033	8.208	3.565	29.49	13.94	6,889.20	6,888.06
P-120	99.1	36	Concrete	WHCC J	6,892.00	6,885.72	WHCC DP7	6,893.00	6,884.72	0.01	11.384	3.558	40.83	9.95	6,887.71	6,887.28
P-122	250.6	48	Concrete	T-31	6,912.00	6,906.62	OS-9 / DP-21	6,910.00	6,904.11	0.01	25.079	3.937	99.53	12.41	6,909.55	6,906.39
P-126	35	18	Concrete	WHCC F	6,909.00	6,901.54	T-11	6,908.00	6,901.19	0.01	8.649	3.15	27.46	8.91	6,903.16	6,902.82
P-131	281.8	18	Concrete	T-12	6,897.50	6,888.68	T-13	6,897.25	6,887.27	0.005	21.274	4.274	91.66	9.37	6,891.40	6,889.76
P-132	449.9	18	Concrete	T-13	6,897.25	6,886.97	T-14	6,894.00	6,884.72	0.005	21.274	4.19	89.86	9.32	6,889.66	6,887.62
P-133	30	18	Concrete	WHCC E	6,894.00	6,887.52	T-14	6,894.00	6,886.92	0.02	7.504	3.47	26.24	11.28	6,889.10	6,888.09
P-134	178.8	18	Concrete	T-14	6,894.00	6,884.42	WHCC DP7	6,893.00	6,883.52	0.005	28.778	3.465	100.51	9.61	6,887.27	6,887.13
P-135	45	18	Concrete	WHCC B	6,910.00	6,902.30	WHCC F	6,909.00	6,901.84	0.01	6.778	3.158	21.57	8.39	6,903.72	6,903.43
P-136	416	18	Concrete	J-900	6,913.50	6,901.59	T-11	6,908.00	6,899.49	0.005	29.665	3.833	114.63	9.94	6,904.56	6,902.18
P-138	397.4	18	Concrete	WHCC G	6,925.00	6,911.50	T-16	6,916.50	6,907.52	0.01	2.48	3.322	8.3	6.65	6,912.53	6,908.36
P-139	320	18	Concrete	T-16	6,916.50	6,907.22	WHCC B	6,910.00	6,904.20	0.009	2.48	3.23	8.07	6.46	6,908.23	6,905.04
P-140	205.2	18	Concrete	T-11	6,908.00	6,899.19	WHCC DP4	6,896.00	6,896.00	0.016	38.315	3.144	121.44	15.26	6,902.25	6,901.50
P-141	157.4	18	Concrete	OS-2	6,897.55	6,890.75	DP-30	6,895.44	6,889.96	0.005	19.916	4.349	87.3	9.1	6,893.60	6,892.79
P-142	100	18	Concrete	DP-30	6,895.44	6,889.66	T-12	6,897.50	6,888.68	0.01	21.274	4.298	92.17	12.04	6,892.39	6,891.79
P-143	22.8	18	Concrete	OS-3	6,895.44	6,891.44	DP-30	6,895.44	6,891.66	-0.01	1.359	5.105	6.99	2.22	6,892.88	6,892.60

Woodmen Heights Commercial Center
Storm CAD 100-Year
Catchment Report

Catchment Node	Area (acres)	Rational C	Catchment CA	Time of Concentration (min)	Outflow Node	Catchment Intensity	100-year Peak Discharge (cfs)
OS-4 Catchment	1.47	0.95	1.396	5.2	OS-4	8.995	12.66
OS-2 Catchment	1.27	0.95	1.207	5	OS-2	9.086	11.05
WHCC CATCH G	2.61	0.95	2.48	16.4	WHCC G	5.913	14.78
CATCHMENT OS-7	1.32	0.95	1.254	9.7	OS-7	7.386	9.34
WHCC CATCH B	6.14	0.7	4.298	12.8	WHCC B	6.61	28.64
OS-9 Catchment	1.19	0.95	1.13	11.2	OS-9 / DP-21	6.985	7.96
WHCC CATCH C	4.32	0.8	3.456	10.4	WHCC C	7.193	25.06
WHCC CATCH F	2.34	0.8	1.872	9.93	WHCC F	7.321	13.82
OS-3 Catchment	1.43	0.95	1.359	5	OS-3	9.086	12.44
WHCC CATCH J	3.97	0.8	3.176	13.3	WHCC J	6.502	20.81
WHCC CATCH E	9.38	0.8	7.504	14.93	WHCC E	6.176	46.71
WHCC CATCH D	9.12	0.9	8.208	14.06	WHCC D	6.345	52.5

Woodmen Heights Commercial Center
StormCAD 5-Year
Catchment Report

Catchment Node	Area (acres)	Rational C	Catchment CA	Time of Concentration (min)	Outflow Node	Catchment Intensity	5-year Peak Discharge (cfs)
OS-4 Catchment	1.47	0.95	1.396	5.2	OS-4	5.053	7.11
OS-2 Catchment	1.27	0.95	1.207	5	OS-2	5.105	6.21
WHCC CATCH G	2.61	0.95	2.48	16.4	WHCC G	3.322	8.3
CATCHMENT OS-7	1.32	0.95	1.254	9.7	OS-7	4.149	5.25
WHCC CATCH B	6.14	0.7	4.298	12.8	WHCC B	3.713	16.09
OS-9 Catchment	1.19	0.95	1.13	11.2	OS-9 / DP-21	3.924	4.47
WHCC CATCH C	4.32	0.8	3.456	10.4	WHCC C	4.041	14.08
WHCC CATCH F	2.34	0.8	1.872	9.93	WHCC F	4.113	7.76
OS-3 Catchment	1.43	0.95	1.359	5	OS-3	5.105	6.99
WHCC CATCH J	3.97	0.8	3.176	13.3	WHCC J	3.653	11.69
WHCC CATCH E	9.38	0.8	7.504	14.93	WHCC E	3.47	26.24
WHCC CATCH D	9.12	0.9	8.208	14.06	WHCC D	3.565	29.49

APPENDIX C

STANDARD DESIGN CHARTS AND TABLES

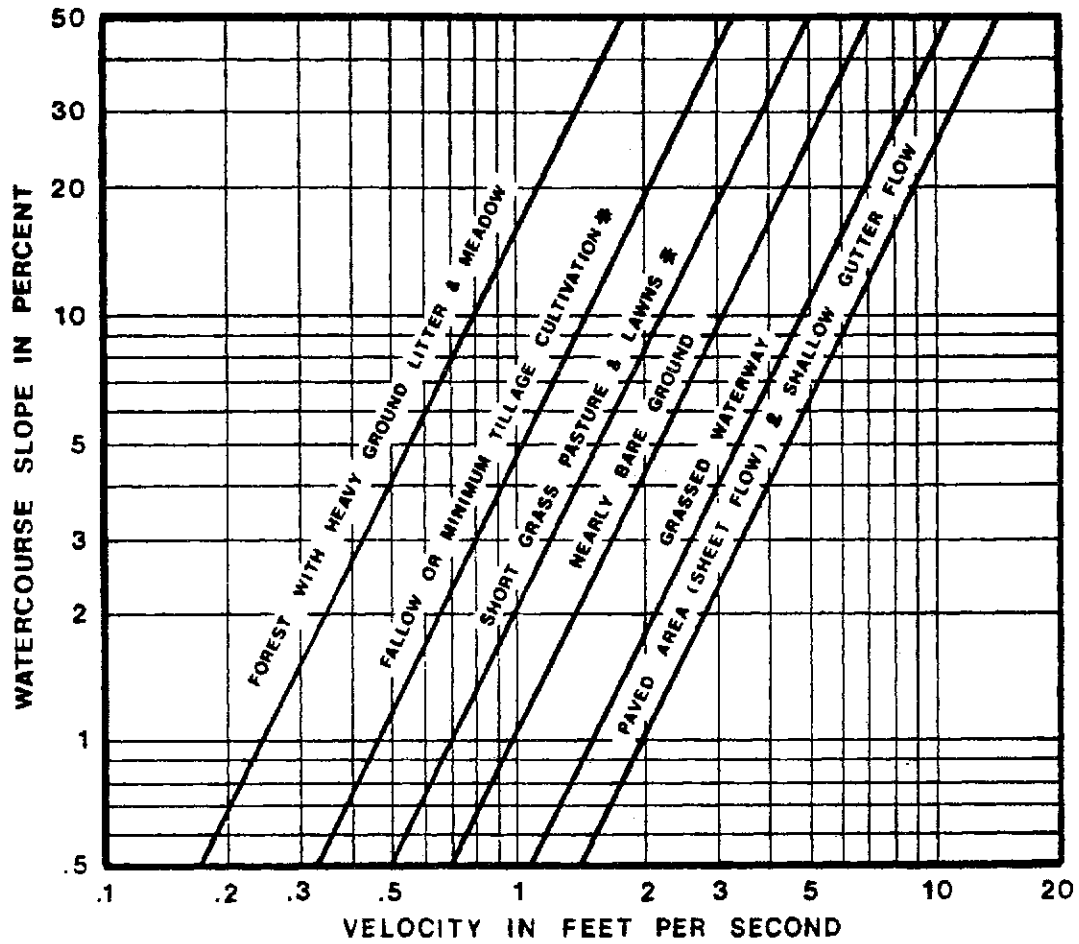


Figure RO-1—Estimate of Average Overland Flow Velocity for Use With the Rational Formula

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

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

* Hydrologic Soil Group

9/30/90

APPENDIX D

OTHER RELEVANT DRAINAGE ANALYSIS

**MASTER DEVELOPMENT DRAINAGE PLAN
UPDATE FOR WOODMEN HEIGHTS AND FINAL
DRAINAGE REPORT FOR FOREST MEADOWS
FILING NO. 1 AND NO. 4**

February 2006

Prepared for:

Morley Companies
15 North Nevada Avenue
Colorado Springs, CO 80903
(719) 471-1742

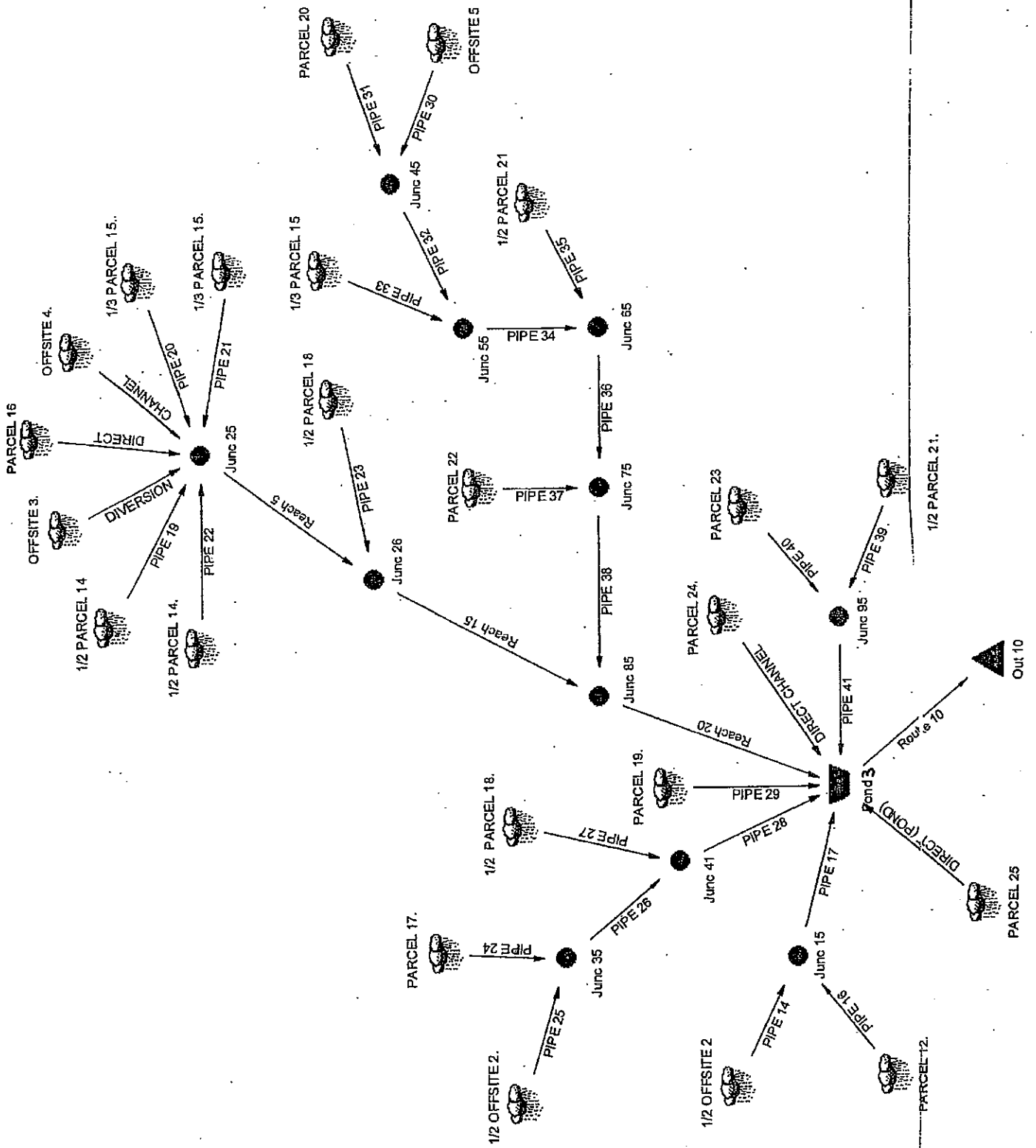
Prepared by:

ESI
ENGINEERING AND SURVEYING INC.

15 North Nevada Avenue
Colorado Springs, CO 80903
(719) 955-5485

Project #08-001

SCANNED



Name.... Watershed
 File.... G:\Projects\08001\Woodmen Heights\Pondpack\ESI\POND 3 ULT DEV ESI.PPW
 Storm... TypeIIA 24hr Tag: Dev100

Event: 100 yr

NETWORK SUMMARY -- LINKS
 (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = El Paso County

Storm Tag Name = Dev100

 Data Type, File, ID = Synthetic Storm TypeIIA 24hr
 Storm Frequency = 100 yr
 Total Rainfall Depth= 4.4000 in
 Duration Multiplier = 1
 Resulting Duration = 24.0000 hrs
 Resulting Start Time= .0000 hrs Step= .5000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Peak Time Trun. hrs	Peak Q cfs	End Points
CHANNEL	ADD	UN	624.572	7.2000	2457.30	OFFSITE 4.
		DL	624.572	7.2000	2457.30	
		DN	738.691	6.9500	2781.53	JUNC 25
DIRECT	ADD	UN	.340	6.1250	2.18	PARCEL 16
		DL	.340	6.1250	2.18	
		DN	738.691	6.9500	2781.53	JUNC 25
DIRECT (POND)	ADD	UN	3.195	6.2000	35.54	PARCEL 25
		DL	3.195	6.2000	35.54	
		DN	935.626	7.0500	3206.52	POND 20 IN
DIRECT CHANNEL	ADD	UN	.322	6.1250	2.07	PARCEL 24.
		DL	.322	6.1250	2.07	
		DN	935.626	7.0500	3206.52	POND 20 IN
DIVERSION	ADD	UN	98.617	6.5250	687.59	OFFSITE 3.
		DL	98.617	6.5250	687.59	
		DN	738.691	6.9500	2781.53	JUNC 25
PIPE 14	ADD	UN	49.309	6.5250	343.80	1/2 OFFSITE 2
		DL	49.309	6.5250	343.80	
		DN	63.634	6.2500	404.64	JUNC 15
PIPE 16	ADD	UN	14.325	6.0750	214.80	PARCEL 12.
		DL	14.325	6.0750	214.80	
		DN	63.634	6.2500	404.64	JUNC 15

Name.... Watershed
 File.... G:\Projects\08001\Woodmen Heights\Pondpack\ESI\POND 3 ULT DEV ESI.PPW
 Storm... TypeIIA 24hr Tag: Dev100

Aug 2.00

Event: 100 yr

NETWORK SUMMARY -- LINKS

(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File, ID = El Paso County

Storm Tag Name = Dev100

 Data Type, File, ID = Synthetic Storm TypeIIA 24hr
 Storm Frequency = 100 yr
 Total Rainfall Depth= 4.4000 in
 Duration Multiplier = 1
 Resulting Duration = 24.0000 hrs
 Resulting Start Time= .0000 hrs Step= .5000 hrs End= 24.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
CHANNEL	ADD	UN	624.572		7.2000	2457.30	OFFSITE 4.
		DL	624.572		7.2000	2457.30	
		DN	738.691		6.9500	2781.53	JUNC 25
DIRECT	ADD	UN	.340		6.1250	2.18	PARCEL 16
		DL	.340		6.1250	2.18	
		DN	738.691		6.9500	2781.53	JUNC 25
DIRECT (POND)	ADD	UN	3.195		6.2000	35.54	PARCEL 25
		DL	3.195		6.2000	35.54	
		DN	935.626		7.0500	3206.52	POND 20 IN
DIRECT CHANNEL	ADD	UN	.322		6.1250	2.07	PARCEL 24.
		DL	.322		6.1250	2.07	
		DN	935.626		7.0500	3206.52	POND 20 IN
DIVERSION	ADD	UN	98.617		6.5250	687.59	OFFSITE 3.
		DL	98.617		6.5250	687.59	
		DN	738.691		6.9500	2781.53	JUNC 25
PIPE 14	ADD	UN	49.309		6.5250	343.80	1/2 OFFSITE 2
		DL	49.309		6.5250	343.80	
		DN	63.634		6.2500	404.64	JUNC 15
PIPE 16	ADD	UN	14.325		6.0750	214.80	PARCEL 12.
		DL	14.325		6.0750	214.80	
		DN	63.634		6.2500	404.64	JUNC 15

NETWORK SUMMARY -- LINKS
 (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PIPE 17	ADD	UN	63.634		6.2500	404.64	JUNC 15
		DL	63.634		6.2500	404.64	
		DN	935.626		7.0500	3206.52	POND 20 IN
PIPE 19	ADD	UN	3.993		6.0250	65.19	1/2 PARCEL 14
		DL	3.993		6.0250	65.19	
		DN	738.691		6.9500	2781.53	JUNC 25
PIPE 20	ADD	UN	3.409		6.0000	56.54	1/3 PARCEL 15..
		DL	3.409		6.0000	56.54	
		DN	738.691		6.9500	2781.53	JUNC 25
PIPE 21	ADD	UN	3.768		6.0000	62.73	1/3 PARCEL 15.
		DL	3.768		6.0000	62.73	
		DN	738.691		6.9500	2781.53	JUNC 25
PIPE 22	ADD	UN	3.993		6.0250	65.19	1/2 PARCEL 14.
		DL	3.993		6.0250	65.19	
		DN	738.691		6.9500	2781.53	JUNC 25
PIPE 23	ADD	UN	3.689		6.0000	61.42	1/2 PARCEL 18
		DL	3.689		6.0000	61.42	
		DN	742.381		7.0000	2779.84	JUNC 26
PIPE 24	ADD	UN	3.222		6.0250	52.61	PARCEL 17.
		DL	3.222		6.0250	52.61	
		DN	52.531		6.4000	350.09	JUNC 35
PIPE 25	ADD	UN	49.309		6.5250	343.80	1/2 OFFSITE 2.
		DL	49.309		6.5250	343.80	
		DN	52.531		6.4000	350.09	JUNC 35
PIPE 26	ADD	UN	52.531		6.4000	350.09	JUNC 35
		DL	52.531		6.4000	350.09	
		DN	55.452		6.4000	354.63	JUNC 41
PIPE 27	ADD	UN	2.921		6.0000	48.63	1/2 PARCEL 18.
		DL	2.921		6.0000	48.63	
		DN	55.452		6.4000	354.63	JUNC 41

Type... Executive Summary (Links)
 Name... Watershed
 File... G:\Projects\08001\Woodmen Heights\Pondpack\ESI\POND 3 ULT DEV ESI.PPW
 Storm... TypeIIA 24hr Tag: Dev100

NETWORK SUMMARY -- LINKS
 (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PIPE 28	ADD	UN	55.452		6.4000	354.63	JUNC 41
		DL	55.452		6.4000	354.63	POND 20 IN
		DN	935.626		7.0500	3206.52	
PIPE 29	ADD	UN	.427		6.0000	8.91	PARCEL 19.
		DL	.427		6.0000	8.91	POND 20 IN
		DN	935.626		7.0500	3206.52	
PIPE 30	ADD	UN	34.135		6.1500	386.63	OFFSITE 5
		DL	34.135		6.1500	386.63	JUNC 45
		DN	39.173		6.1500	441.75	
PIPE 31	ADD	UN	5.038		6.0250	80.10	PARCEL 20.
		DL	5.038		6.0250	80.10	JUNC 45
		DN	39.173		6.1500	441.75	
PIPE 32	ADD	UN	39.173		6.1500	441.75	JUNC 45
		DL	39.173		6.1500	441.75	JUNC 55
		DN	43.518		6.1000	483.28	
PIPE 33	ADD	UN	4.345		6.0000	72.31	1/3 PARCEL 15
		DL	4.345		6.0000	72.31	JUNC 55
		DN	43.518		6.1000	483.28	
PIPE 34	ADD	UN	43.518		6.1000	483.28	JUNC 55
		DL	43.518		6.1000	483.28	JUNC 65
		DN	50.872		6.1000	586.96	
PIPE 35	ADD	UN	7.355		6.0250	116.93	1/2 PARCEL 21
		DL	7.355		6.0250	116.93	JUNC 65
		DN	50.872		6.1000	586.96	
PIPE 36	ADD	UN	50.872		6.1000	586.96	JUNC 65
		DL	50.872		6.1000	586.96	JUNC 75
		DN	55.742		6.0750	648.71	
PIPE 37	ADD	UN	4.870		6.0000	81.06	PARCEL 22
		DL	4.870		6.0000	81.06	JUNC 75
		DN	55.742		6.0750	648.71	

Type.... Executive Summary (Links)
 Name.... Watershed
 File.... G:\Projects\08001\Woodmen Heights\Pondpack\ESI\POND 3 ULT DEV ESI.PPW
 Storm... TypeIIA 24hr Tag: Dev100

NETWORK SUMMARY -- LINKS
 (UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
 (Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
PIPE 38	ADD	UN	55.742		6.0750	648.71	JUNC 75
		DL	55.742		6.0750	648.71	
		DN	798.123		7.0500	2845.28	JUNC 85
PIPE 39	ADD	UN	7.355		6.0250	116.93	1/2 PARCEL 21.
		DL	7.355		6.0250	116.93	
		DN	14.474		6.0000	234.99	JUNC 95
PIPE 40	ADD	UN	7.119		6.0000	118.54	PARCEL 23
		DL	7.119		6.0000	118.54	
		DN	14.474		6.0000	234.99	JUNC 95
PIPE 41	ADD	UN	14.474		6.0000	234.99	JUNC 95
		DL	14.474		6.0000	234.99	
		DN	935.626		7.0500	3206.52	POND 20 IN
REACH 15	REACH	UN	742.381		7.0000	2779.84	JUNC 26
		DL	742.381		7.0500	2776.02	
		DN	798.123		7.0500	2845.28	JUNC 85
REACH 20	REACH	UN	798.123		7.0500	2845.28	JUNC 85
		DL	798.123		7.1000	2841.97	
		DN	935.626		7.0500	3206.52	POND 20 IN
REACH 5	REACH	UN	738.691		6.9500	2781.53	JUNC 25
		DL	738.691		7.0000	2776.63	
		DN	742.381		7.0000	2779.84	JUNC 26
ROUTE 10	PONDrt	UN	935.626		7.0500	3206.52	POND 20 IN
			935.622		7.9000	2242.32	POND 20 OUT
ROUTE 10		DL	935.622		7.9000	2242.32	
		DN	935.622		7.9000	2242.32	OUT 10

Type.... Unit Hyd. Summary
 Name.... OFFSITE 5 Tag: Dev100
 File.... G:\Projects\08001\Woodmen Heights\Pondpack\ESI\POND 3 ULT DEV ESI.PPW
 Storm... TypeIIA 24hr Tag: Dev100

SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
 Duration = 24.0000 hrs Rain Depth = 4.4000 in
 Rain Dir = G:\Projects\08001\Woodmen Heights\Pondpack\ESI\
 Rain File -ID = - TypeIIA 24hr
 Unit Hyd Type = Default Curvilinear
 HYG Dir = G:\Projects\08001\Woodmen Heights\Pondpack\ESI\
 HYG File - ID = work_pad.hyg - OFFSITE 5 Dev100
 Tc = .4400 hrs
 Drainage Area = 323.000 acres Runoff CN= 65

=====
 Computational Time Increment = .05867 hrs
 Computed Peak Time = 6.1600 hrs
 Computed Peak Flow = 391.01 cfs

=====
 Time Increment for HYG File = .0250 hrs
 Peak Time, Interpolated Output = 6.1500 hrs
 Peak Flow, Interpolated Output = 386.63 cfs
 =====

DRAINAGE AREA

 ID:OFFSITE 5
 CN = 65
 Area = 323.000 acres
 S = 5.3846 in
 0.2S = 1.0769 in

Cumulative Runoff

 1.2682 in
 34.135 ac-ft

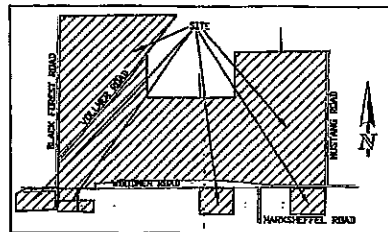
HYG Volume... 34.135 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc = .44000 hrs (ID: OFFSITE 5)
 Computational Incr, Tm = .05867 hrs = 0.20000 Tp
 Unit Hyd. Shape Factor = 483.432 (37.46% under rising limb)
 K = 483.43/645.333, K = .7491 (also, K = 2/(1+(Tr/Tp))
 Receding/Rising, Tr/Tp = 1.6698 (solved from K = .7491)
 Unit peak, qp = 831.76 cfs
 Unit peak time Tp = .29333 hrs
 Unit receding limb, Tr = 1.17333 hrs
 Total unit time, Tb = 1.46667 hrs

CLASSIC MDDP DRAINAGE BASIN MAP

DEVELOPED CONDITIONS
WOODMEN HEIGHTS
 MASTER DEVELOPMENT DRAINAGE PLAN
 JUNE, 2004



PIPE RUN SUMMARY

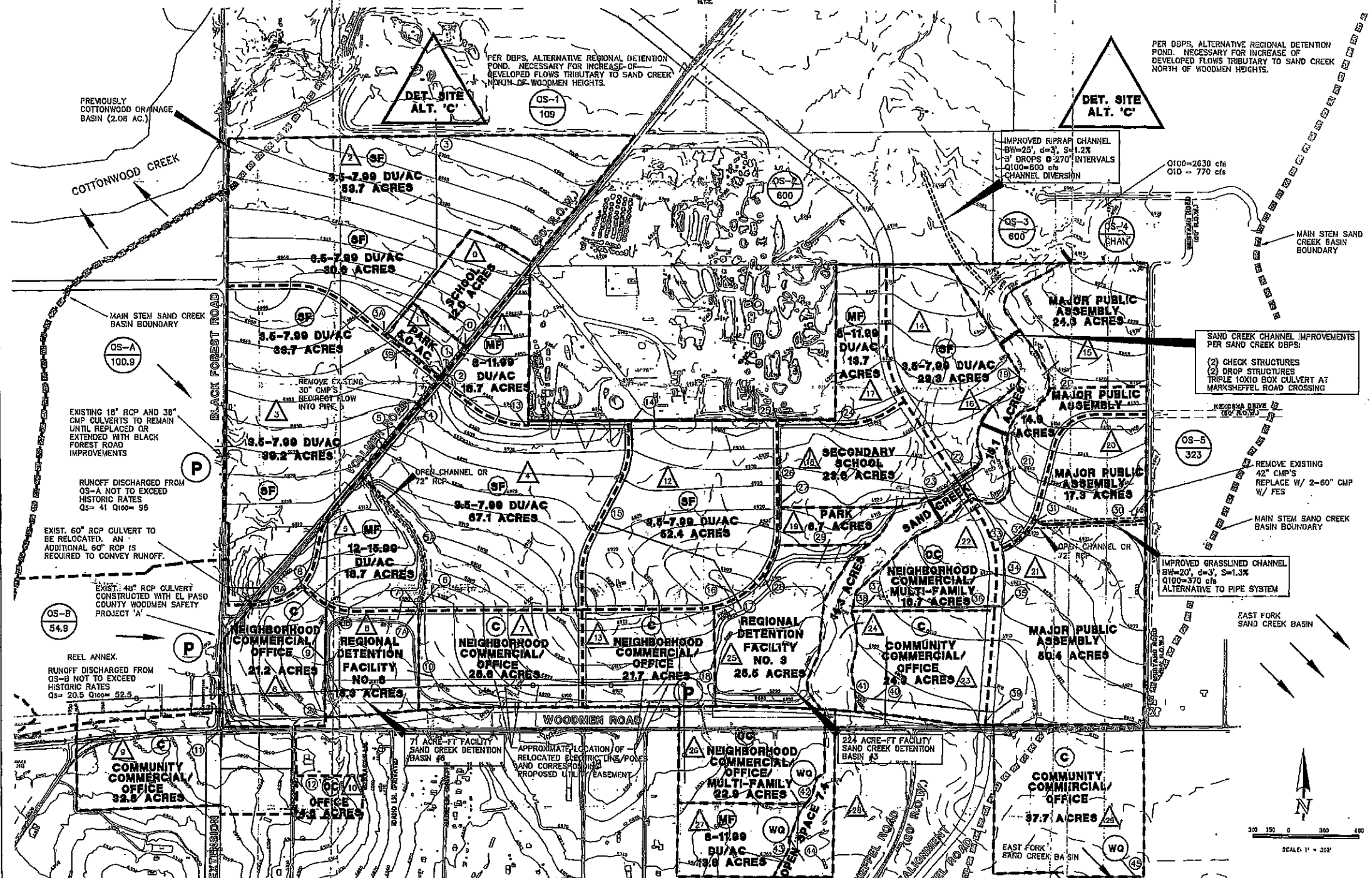
1 36" RCP @ 1.00%	10 12" RCP @ 1.00%	19 14" RCP @ 1.00%	28 18" RCP @ 1.00%	37 24" RCP @ 1.00%	46 36" RCP @ 1.00%
2 18" RCP @ 1.00%	11 14" RCP @ 1.00%	20 18" RCP @ 1.00%	29 24" RCP @ 1.00%	38 36" RCP @ 1.00%	47 48" RCP @ 1.00%
3 24" RCP @ 1.00%	12 18" RCP @ 1.00%	21 24" RCP @ 1.00%	30 36" RCP @ 1.00%	39 48" RCP @ 1.00%	48 60" RCP @ 1.00%
4 36" RCP @ 1.00%	13 24" RCP @ 1.00%	22 36" RCP @ 1.00%	31 48" RCP @ 1.00%	40 60" RCP @ 1.00%	49 72" RCP @ 1.00%
5 48" RCP @ 1.00%	14 36" RCP @ 1.00%	23 48" RCP @ 1.00%	32 60" RCP @ 1.00%	41 72" RCP @ 1.00%	50 90" RCP @ 1.00%
6 60" RCP @ 1.00%	15 48" RCP @ 1.00%	24 60" RCP @ 1.00%	33 72" RCP @ 1.00%	42 90" RCP @ 1.00%	51 108" RCP @ 1.00%
7 72" RCP @ 1.00%	16 60" RCP @ 1.00%	25 72" RCP @ 1.00%	34 90" RCP @ 1.00%	43 108" RCP @ 1.00%	52 126" RCP @ 1.00%
8 90" RCP @ 1.00%	17 72" RCP @ 1.00%	26 90" RCP @ 1.00%	35 108" RCP @ 1.00%	44 126" RCP @ 1.00%	53 144" RCP @ 1.00%
9 108" RCP @ 1.00%	18 90" RCP @ 1.00%	27 108" RCP @ 1.00%	36 126" RCP @ 1.00%	45 144" RCP @ 1.00%	54 162" RCP @ 1.00%

PARCEL RUNOFF SUMMARY

1 Q100 = 14.07 cfs Q10 = 1.57 cfs	2 Q100 = 24.07 cfs Q10 = 3.17 cfs	3 Q100 = 21.07 cfs Q10 = 2.67 cfs	4 Q100 = 43.07 cfs Q10 = 5.37 cfs	5 Q100 = 1.07 cfs Q10 = 0.17 cfs	6 Q100 = 41.07 cfs Q10 = 5.17 cfs
7 Q100 = 14.07 cfs Q10 = 1.57 cfs	8 Q100 = 24.07 cfs Q10 = 3.17 cfs	9 Q100 = 21.07 cfs Q10 = 2.67 cfs	10 Q100 = 43.07 cfs Q10 = 5.37 cfs	11 Q100 = 1.07 cfs Q10 = 0.17 cfs	12 Q100 = 41.07 cfs Q10 = 5.17 cfs
13 Q100 = 14.07 cfs Q10 = 1.57 cfs	14 Q100 = 24.07 cfs Q10 = 3.17 cfs	15 Q100 = 21.07 cfs Q10 = 2.67 cfs	16 Q100 = 43.07 cfs Q10 = 5.37 cfs	17 Q100 = 1.07 cfs Q10 = 0.17 cfs	18 Q100 = 41.07 cfs Q10 = 5.17 cfs
19 Q100 = 14.07 cfs Q10 = 1.57 cfs	20 Q100 = 24.07 cfs Q10 = 3.17 cfs	21 Q100 = 21.07 cfs Q10 = 2.67 cfs	22 Q100 = 43.07 cfs Q10 = 5.37 cfs	23 Q100 = 1.07 cfs Q10 = 0.17 cfs	24 Q100 = 41.07 cfs Q10 = 5.17 cfs
25 Q100 = 14.07 cfs Q10 = 1.57 cfs	26 Q100 = 24.07 cfs Q10 = 3.17 cfs	27 Q100 = 21.07 cfs Q10 = 2.67 cfs	28 Q100 = 43.07 cfs Q10 = 5.37 cfs	29 Q100 = 1.07 cfs Q10 = 0.17 cfs	30 Q100 = 41.07 cfs Q10 = 5.17 cfs
31 Q100 = 14.07 cfs Q10 = 1.57 cfs	32 Q100 = 24.07 cfs Q10 = 3.17 cfs	33 Q100 = 21.07 cfs Q10 = 2.67 cfs	34 Q100 = 43.07 cfs Q10 = 5.37 cfs	35 Q100 = 1.07 cfs Q10 = 0.17 cfs	36 Q100 = 41.07 cfs Q10 = 5.17 cfs
37 Q100 = 14.07 cfs Q10 = 1.57 cfs	38 Q100 = 24.07 cfs Q10 = 3.17 cfs	39 Q100 = 21.07 cfs Q10 = 2.67 cfs	40 Q100 = 43.07 cfs Q10 = 5.37 cfs	41 Q100 = 1.07 cfs Q10 = 0.17 cfs	42 Q100 = 41.07 cfs Q10 = 5.17 cfs
43 Q100 = 14.07 cfs Q10 = 1.57 cfs	44 Q100 = 24.07 cfs Q10 = 3.17 cfs	45 Q100 = 21.07 cfs Q10 = 2.67 cfs	46 Q100 = 43.07 cfs Q10 = 5.37 cfs	47 Q100 = 1.07 cfs Q10 = 0.17 cfs	48 Q100 = 41.07 cfs Q10 = 5.17 cfs
49 Q100 = 14.07 cfs Q10 = 1.57 cfs	50 Q100 = 24.07 cfs Q10 = 3.17 cfs	51 Q100 = 21.07 cfs Q10 = 2.67 cfs	52 Q100 = 43.07 cfs Q10 = 5.37 cfs	53 Q100 = 1.07 cfs Q10 = 0.17 cfs	54 Q100 = 41.07 cfs Q10 = 5.17 cfs

OPPOSITE RUNOFF SUMMARY

1 Q100 = 41.07 cfs Q10 = 5.17 cfs	2 Q100 = 24.07 cfs Q10 = 3.17 cfs	3 Q100 = 21.07 cfs Q10 = 2.67 cfs	4 Q100 = 43.07 cfs Q10 = 5.37 cfs	5 Q100 = 1.07 cfs Q10 = 0.17 cfs	6 Q100 = 41.07 cfs Q10 = 5.17 cfs
7 Q100 = 14.07 cfs Q10 = 1.57 cfs	8 Q100 = 24.07 cfs Q10 = 3.17 cfs	9 Q100 = 21.07 cfs Q10 = 2.67 cfs	10 Q100 = 43.07 cfs Q10 = 5.37 cfs	11 Q100 = 1.07 cfs Q10 = 0.17 cfs	12 Q100 = 41.07 cfs Q10 = 5.17 cfs
13 Q100 = 14.07 cfs Q10 = 1.57 cfs	14 Q100 = 24.07 cfs Q10 = 3.17 cfs	15 Q100 = 21.07 cfs Q10 = 2.67 cfs	16 Q100 = 43.07 cfs Q10 = 5.37 cfs	17 Q100 = 1.07 cfs Q10 = 0.17 cfs	18 Q100 = 41.07 cfs Q10 = 5.17 cfs
19 Q100 = 14.07 cfs Q10 = 1.57 cfs	20 Q100 = 24.07 cfs Q10 = 3.17 cfs	21 Q100 = 21.07 cfs Q10 = 2.67 cfs	22 Q100 = 43.07 cfs Q10 = 5.37 cfs	23 Q100 = 1.07 cfs Q10 = 0.17 cfs	24 Q100 = 41.07 cfs Q10 = 5.17 cfs
25 Q100 = 14.07 cfs Q10 = 1.57 cfs	26 Q100 = 24.07 cfs Q10 = 3.17 cfs	27 Q100 = 21.07 cfs Q10 = 2.67 cfs	28 Q100 = 43.07 cfs Q10 = 5.37 cfs	29 Q100 = 1.07 cfs Q10 = 0.17 cfs	30 Q100 = 41.07 cfs Q10 = 5.17 cfs
31 Q100 = 14.07 cfs Q10 = 1.57 cfs	32 Q100 = 24.07 cfs Q10 = 3.17 cfs	33 Q100 = 21.07 cfs Q10 = 2.67 cfs	34 Q100 = 43.07 cfs Q10 = 5.37 cfs	35 Q100 = 1.07 cfs Q10 = 0.17 cfs	36 Q100 = 41.07 cfs Q10 = 5.17 cfs
37 Q100 = 14.07 cfs Q10 = 1.57 cfs	38 Q100 = 24.07 cfs Q10 = 3.17 cfs	39 Q100 = 21.07 cfs Q10 = 2.67 cfs	40 Q100 = 43.07 cfs Q10 = 5.37 cfs	41 Q100 = 1.07 cfs Q10 = 0.17 cfs	42 Q100 = 41.07 cfs Q10 = 5.17 cfs
43 Q100 = 14.07 cfs Q10 = 1.57 cfs	44 Q100 = 24.07 cfs Q10 = 3.17 cfs	45 Q100 = 21.07 cfs Q10 = 2.67 cfs	46 Q100 = 43.07 cfs Q10 = 5.37 cfs	47 Q100 = 1.07 cfs Q10 = 0.17 cfs	48 Q100 = 41.07 cfs Q10 = 5.17 cfs
49 Q100 = 14.07 cfs Q10 = 1.57 cfs	50 Q100 = 24.07 cfs Q10 = 3.17 cfs	51 Q100 = 21.07 cfs Q10 = 2.67 cfs	52 Q100 = 43.07 cfs Q10 = 5.37 cfs	53 Q100 = 1.07 cfs Q10 = 0.17 cfs	54 Q100 = 41.07 cfs Q10 = 5.17 cfs



PER DBPS, ALTERNATIVE REGIONAL DETENTION POND, NECESSARY FOR INCREASE OF DEVELOPED FLOWS TRIBUTARY TO SAND CREEK NORTH OF WOODMEN HEIGHTS.

PER DBPS, ALTERNATIVE REGIONAL DETENTION POND, NECESSARY FOR INCREASE OF DEVELOPED FLOWS TRIBUTARY TO SAND CREEK NORTH OF WOODMEN HEIGHTS.

IMPROVED RIPRAP CHANNEL
 BW=25', d=3', S=1.2%
 3' DROPS @ 270' INTERVALS
 Q100=800 cfs
 CHANNEL DIVERSION

Q100=2630 cfs
 Q10 = 770 cfs

SAND CREEK CHANNEL IMPROVEMENTS PER SAND CREEK DBPS:
 (2) CHECK STRUCTURES
 (2) DROP STRUCTURES
 TRIPLE 10X10 BOX CULVERT AT MARKSHEFFEL ROAD CROSSING

REMOVE EXISTING 42" CMP'S
 REPLACE W/ 2'-60" CMP W/ FES

IMPROVED GRASSLINED CHANNEL
 BW=20', d=3', S=1.3%
 Q100=370 cfs
 ALTERNATIVE TO PIPE SYSTEM

REEL ANNEX
 RUNOFF DISCHARGED FROM OS-B NOT TO EXCEED HISTORIC RATES
 Q5= 20.5 Q100= 52.5

EXIST. 60" RCP CULVERT TO BE RELOCATED. AN ADDITIONAL 60" RCP IS REQUIRED TO CONVEY RUNOFF.

EXIST. 48" RCP CULVERT CONSTRUCTED WITH EL PASO COUNTY WOODMEN SAFETY PROJECT 'A'

REMOVE EXISTING 30" CMP'S
 REDIRECT FLOW INTO PIPE

REMOVE EXISTING 72" RCP

APPROXIMATE LOCATION OF RELOCATED ELECTRIC LINES/POLES AND CORRESPONDING PROPOSED UTILITY EASEMENT

27 ACRE-FT FACILITY SAND CREEK DETENTION BASIN #2

224 ACRE-FT FACILITY SAND CREEK DETENTION BASIN #3

SCALE: 1" = 300'

DEVELOPED CONDITIONS
 WOODMEN HEIGHTS
 2077.DD
 5/03/04
 SHEET 1 OF 1

CLASSIC
 CONSULTING
 ENGINEERS & SURVEYORS

155 Central Ave., Suite 200
 Cypress Bay, Okla. 73119
 (405) 429-4200
 (405) 429-4200 (fax)

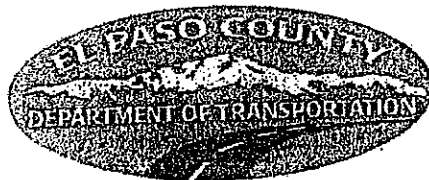
**FINAL
HYDROLOGY AND HYDRAULICS REPORT**

FOR

**WOODMEN ROAD
POWERS
TO
US 24
EL PASO COUNTY, COLORADO**

**September 22, 2006
REVISED: October 4, 2007**

PREPARED FOR:

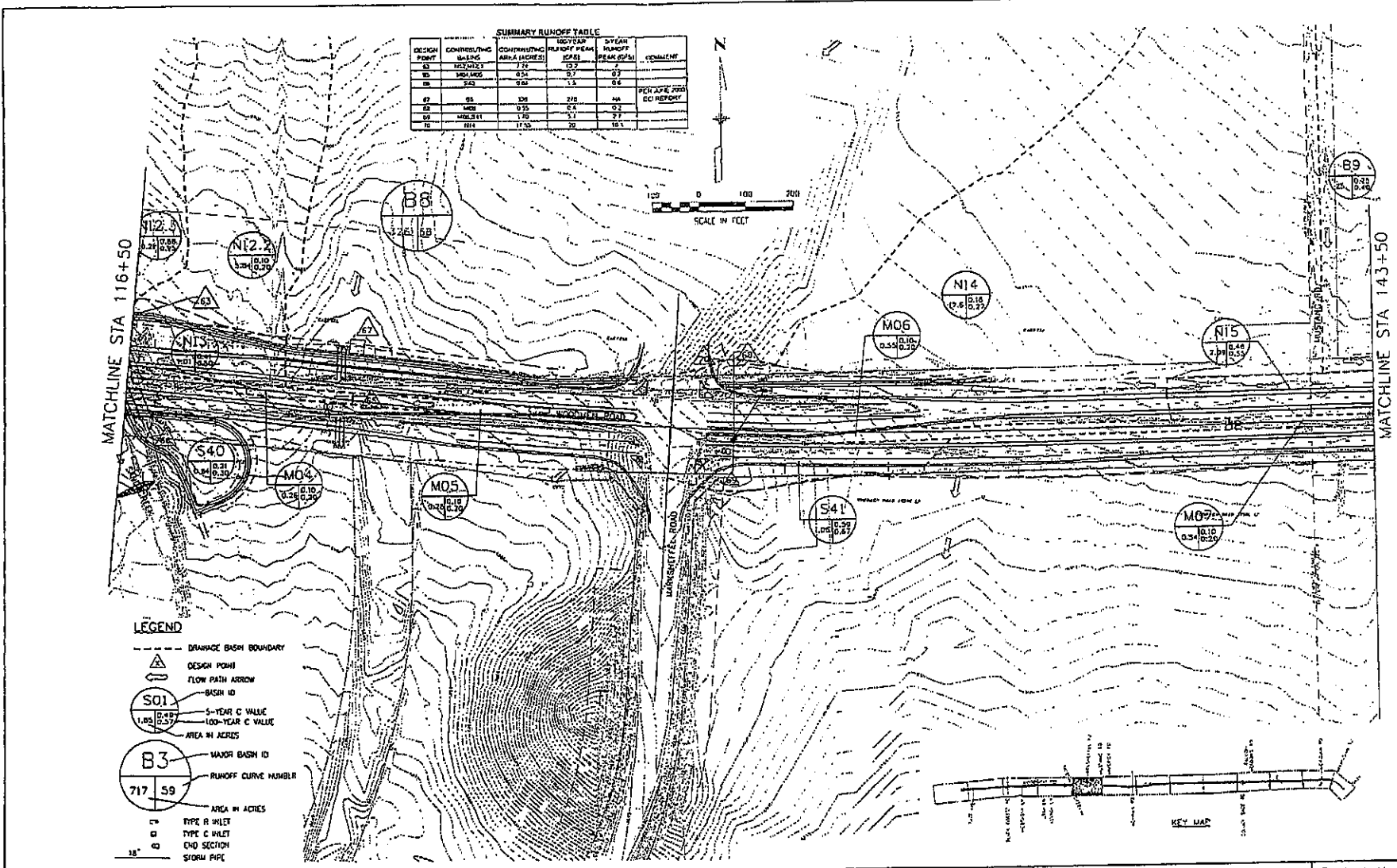


**EL PASO COUNTY
DEPARTMENT OF TRANSPORTATION
3275 AKERS DRIVE
PROJECT NUMBER STU M240-062**

PREPARED BY:

**DMJM HARRIS - AECOM
717 SEVENTEENTH STREET, SUITE 500
DENVER, COLORADO 80202**

10/5/2007 11:45:01 AM



SUMMARY RUNOFF TABLE

DESIGN POINT	CONTRIBUTING BASIN	CONTRIBUTING AREA (ACRES)	100-YEAR RUNOFF PEAK (CFS)	5-YEAR RUNOFF PEAK (CFS)	COMMENT
B3	WILSON	1.76	12.3	0.7	
B8	WILSON	0.54	3.7	0.7	
B9	WILSON	0.60	4.2	0.8	
B7	B3	3.30	24.0	NA	PER AFE 2001 ECI REPORT
B8	B3	0.39	2.8	0.3	
B9	B3	1.70	12.1	0.7	
B10	B3	11.35	80.0	10.1	

- LEGEND**
- DRAINAGE BASIN BOUNDARY
 - ▲ DESIGN POINT
 - FLOW PATH ARROW
 - S01 BASH ID
1.00 0.25
AREA IN ACRES
 - B3 MAJOR BASH ID
717 59
RUNOFF CURVE NUMBER
 - AREA IN ACRES
 - TYPE R INLET
 - TYPE C INLET
 - END SECTION
 - STORM PIPE

Computer File Information

Creation Date:	8/04/05	Initials:	LPS
Last Modification Date:	10/5/2007	Initials:	LPS
Full Path:	\\4954\4954_0604\cadd\drainage report\S44\bas03.dwg		
Drawing Scale:	1"=200'		
VB Ver.	08.00.01.19	Units:	ENGLISH

Sheet Revisions

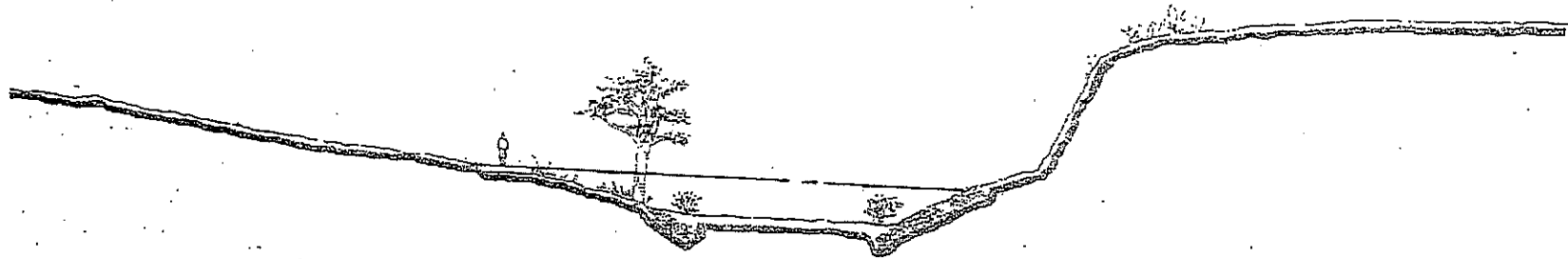
NO.	DESCRIPTION	DATE	BY

DMJM HARRIS | AECOM
 3250 Professional Place
 Colorado Springs, Colorado 80904
 Phone: (719) 386-8200 Fax: (719) 386-8338



As Constructed		WOODMEN ROAD		Project No
No Revisions:	-	SUB-BASIN PLAN - WOODMEN ROAD		STU M240
Revised:	-	Designer	DLK	1326
		Checker	LPS	
		Sheet Subseq:	ROADWAY	Sheet Number
		Subseq Sheets:	DRNBWS 3 of 13	

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN REPORT
CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO



PREPARED FOR:

City of Colorado Springs
Department of Comprehensive Planning, Development and Finance
Engineering Division
30 S. Nevada
Colorado Springs, Colorado 80903

PREPARED BY:

Kiowa Engineering Corporation
1011 North Weber
Colorado Springs, CO 80903

100-year peak discharge to levels. This will allow for the channel improvements to be constructed within the existing right-of way.

Reaches SC-5 and SC-6: A selective channel improvement concept has been recommended for these reaches. Detention in Reach SC-8 of the basin will maintain flows to historic peak discharge levels, however the low flows will increase in frequency and volume. For this reason it has been recommended to provide riprap channel linings at selective locations to at least the 10-year water surface and install grade controls. This will prevent the long-term degradation of the invert. A residual 100-year floodplain will remain and will offer opportunities for habitat replacement and open space preservation. Land adjacent to the drainageway is currently undeveloped or unplatted at this time which makes the feasibility of implementing this concept greater in comparison to the urbanized reaches of the creek.

Reaches SC-7 and SC-8: A selective improvement concept involving the localized lining of channel banks and grade control construction has been recommended for these reaches. The feasibility of this concept stems from the fact that flows will be reduced because of detention. Numerous individual rural ownerships cross the drainageway, however no habitable structures lie within the 100-year floodplain. Because of this, the economic feasibility of channelization concepts is low. Non-structural measures can be used to limit encroachments into floodprone areas. Additionally, the City of Colorado Springs Comprehensive plan recommends that the floodplains be maintained as open space. Potential habitat disturbances can be avoided with a selective plan, or simply replaced as part of the particular construction activity which caused the disturbance.

Reach SC-9: A floodplain preservation concept has been recommended for this reach. Little increase in urbanization is anticipated in this reach, and for this reason the existing drainageway is expected to remain stable. Localized improvements may be necessary to limit erosion caused by flow concentrations at culverts or storm sewers. Private ownership of the drainageway is anticipated to continue which lower the feasibility of channel concepts which require permanent right-of-ways or easements for construction and maintenance.

Reaches WF-1 through WF-3: A 100-year channel concept has been recommended for these reaches primarily because of the potential for flooding damages. Several roadway crossings are in need of replacement because of the flood hazard the constrictions create. Some open space enhancement potential exists for this concept since these reaches have been degraded visually by debris accumulation, bank sloughing and sedimentation. Little opportunity exists for widening the drainageway because the

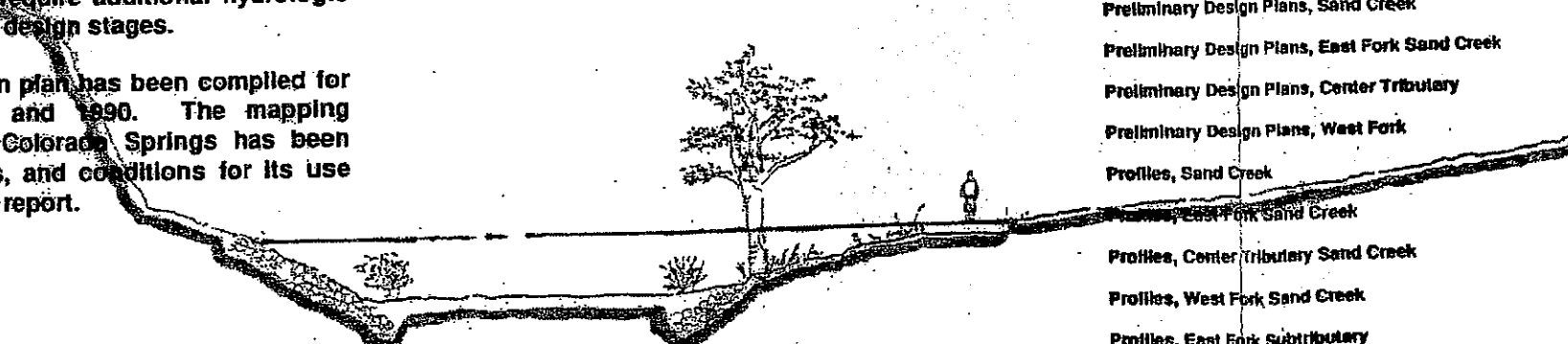
SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN OF SELECTED ALTERNATIVE

CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO

GENERAL NOTES

1. The information presented on these drawings is preliminary in nature and should be used for planning purposes only. The facilities shown in this master plan are subject to change and will require additional hydrologic and hydraulic design analysis during the final design stages.
2. Mapping used in the preparation of this basin plan has been compiled for aerial photographic mapping dated 1989 and 1990. The mapping information within the corporate limits of Colorado Springs has been supplied by the City Department of Utilities, and conditions for its use outlined in Section I of the preliminary design report.



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Panel No.

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Preliminary Design Plans, West Fork	WF1 - WF14
Profiles, Sand Creek	P1 - P 15
Profiles, East Fork Sand Creek	EFP1 - EFP13
Profiles, Center Tributary Sand Creek	CTP1 - CTP3
Profiles, West Fork Sand Creek	WFP1 - WFP5
Profiles, East Fork Subtributary	STP1 - STP5
Profiles, East Blorstadl Creek	EBP1 - EBP3
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Typical Channel Sections and Details	CS1 - CS7
Typical Detention Basin Detail	CS8

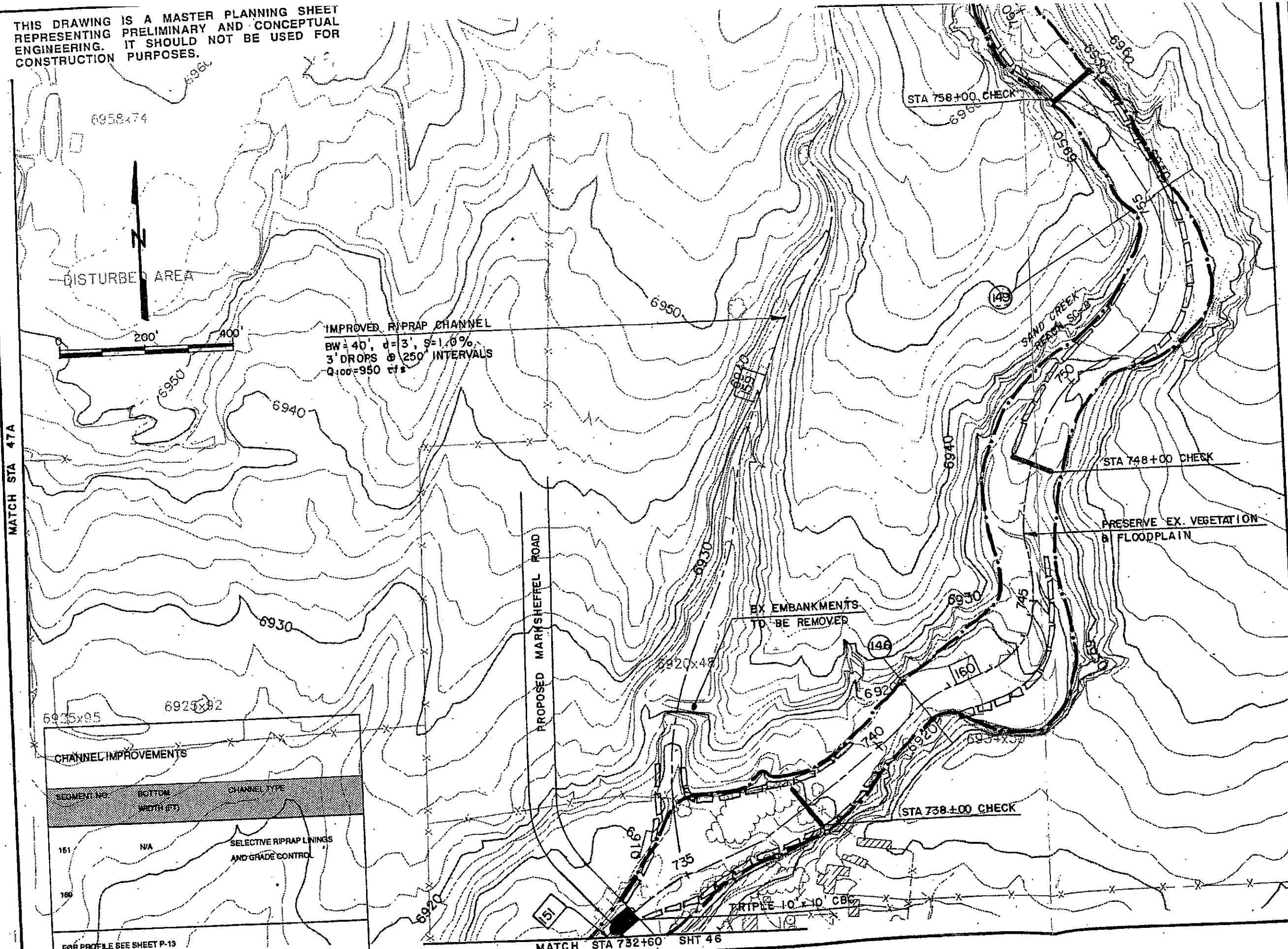
PREPARED FOR:

City of Colorado Springs
 Department of Comprehensive Planning, Development and Finance
 Engineering Division
 30 S. Nevada
 Colorado Springs, Colorado 80903

Prepared by:

Kowa Engineering Corporation
 1011 North Weber #200
 Colorado Springs, CO 80903

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.



IMPROVED RIPRAP CHANNEL
 BW = 40', d = 3', S = 1.0%
 3' DROPS @ 250' INTERVALS
 Q₁₀₀ = 950 cfs

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
151	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
160		

FOR PROFILE SEE SHEET P-13

Kiowa Engineering Corporation
 419 W. Bijou Street
 Colorado Springs, Colorado
 80905-1308

SAND CREEK DRAINAGE
 BASIN PLANNING STUDY
 PRELIMINARY DESIGN PLANS

Project No 90-04-C
 Date: 9-92
 Design: RNW
 Drawn: EAK
 Check: RNW
 Revisions:

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS

SEGMENT NO	BOTTOM WIDTH (FT)	CHANNEL TYPE
148-2	N/A	SELECTIVE RIPRAP LININGS AND GRADE CONTROL
151		

FOR PROFILE SEE SHEET P-13

Detention Criteria

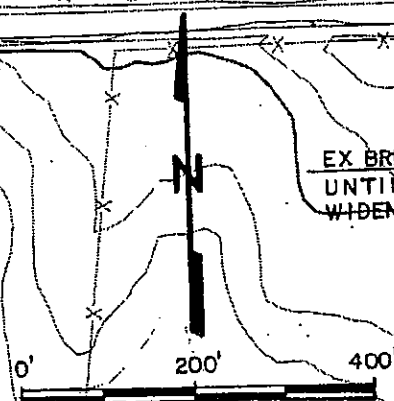
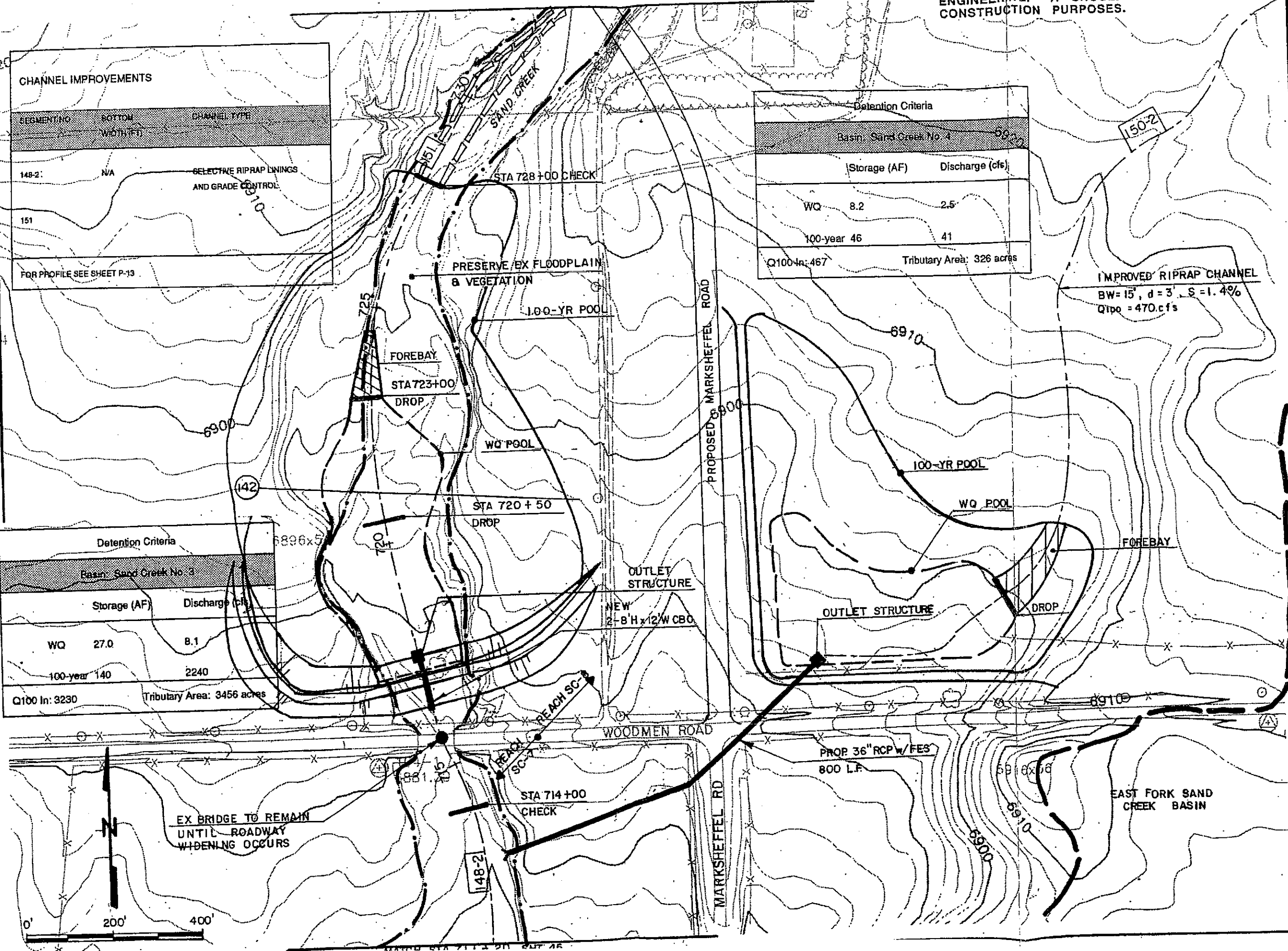
Basin	Storage (AF)	Discharge (cfs)
Sand Creek No. 4	8.2	2.5
100-year	46	41
Q100 In: 467	Tributary Area: 326 acres	

IMPROVED RIPRAP CHANNEL
 BW=15', d=3', S=1.4%
 Q100 = 470.cfs

Detention Criteria

Basin	Storage (AF)	Discharge (cfs)
Sand Creek No. 3	27.0	8.1
100-year	140	2240
Q100 In: 3230	Tributary Area: 3456 acres	

MATCH SHT 46B



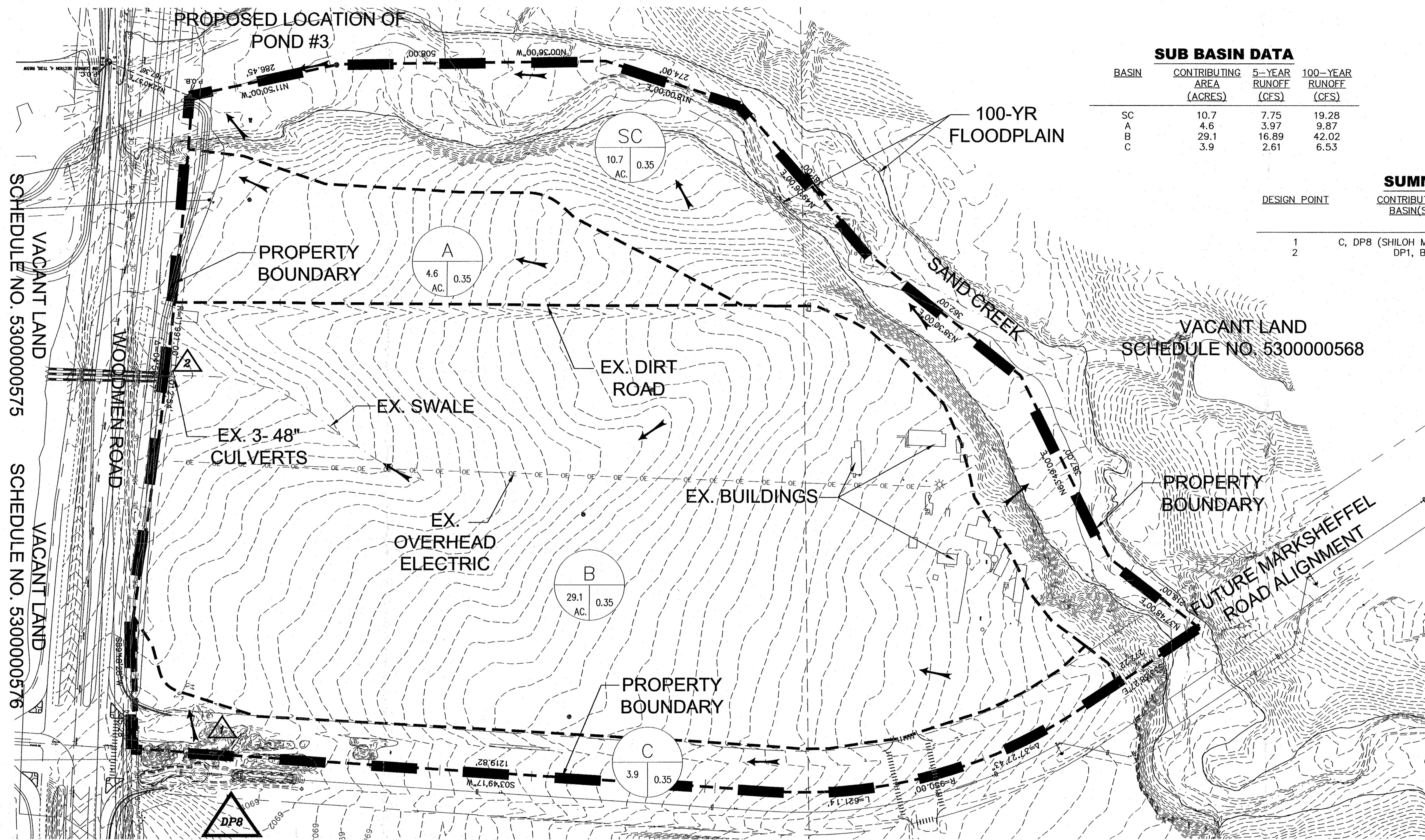
Kiowa Engineering Corporation
 419 W. Bijou Street
 Colorado Springs

SAND CREEK DRAINAGE BASIN PLANNING STUDY
 PRELIMINARY DESIGN PLANS

Project No 90-04
 Date: 9-92
 Design: RNW
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 Revisions:

APPENDIX E

DRAINAGE MAPS



SUB BASIN DATA

BASIN	CONTRIBUTING AREA (ACRES)	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
SC	10.7	7.75	19.28
A	4.6	3.97	9.87
B	29.1	16.89	42.02
C	3.9	2.61	6.53

SUMMARY RUNOFF TABLE

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (ACRES)	5-YEAR RUNOFF (CFS)	100-YEAR RUNOFF (CFS)
1	C, DP8 (SHILOH MESA MDDP)	413.70	161.77	395.22
2	DP1, B	442.8	159.78	387.94

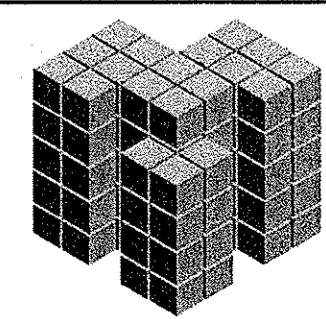
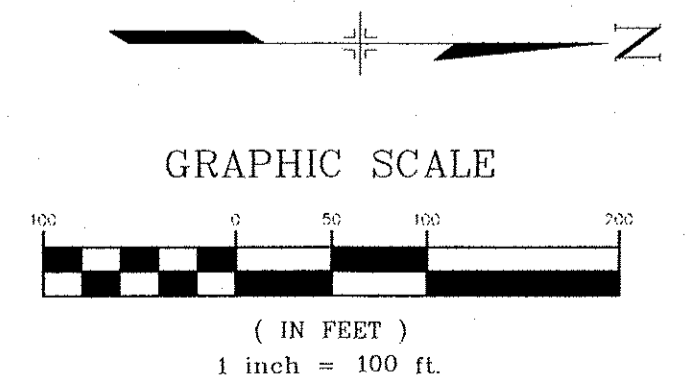
SHILOH MESA AT WOODMEN HEIGHTS
(CURRENTLY UNDEVELOPED)
SCHEDULE NO. 5300000480

EXISTING
CONDITONS
FROM SHILOH
MESA MDDP

LEGEND

- DRAINAGE BASIN BOUNDARY
- PROPOSED CONTOUR
- EXISTING CONTOUR
- PROPOSED STORM
- EXISTING STORM
- PROPOSED D10R INLET
- PROPOSED MANHOLE
- PROPOSED FLOW DIRECTION ARROW

- DESIGN POINT
- BASIN DESIGNATION
- "C" COEFFICIENT (100 YR)
- BASIN AREA (ACRES)

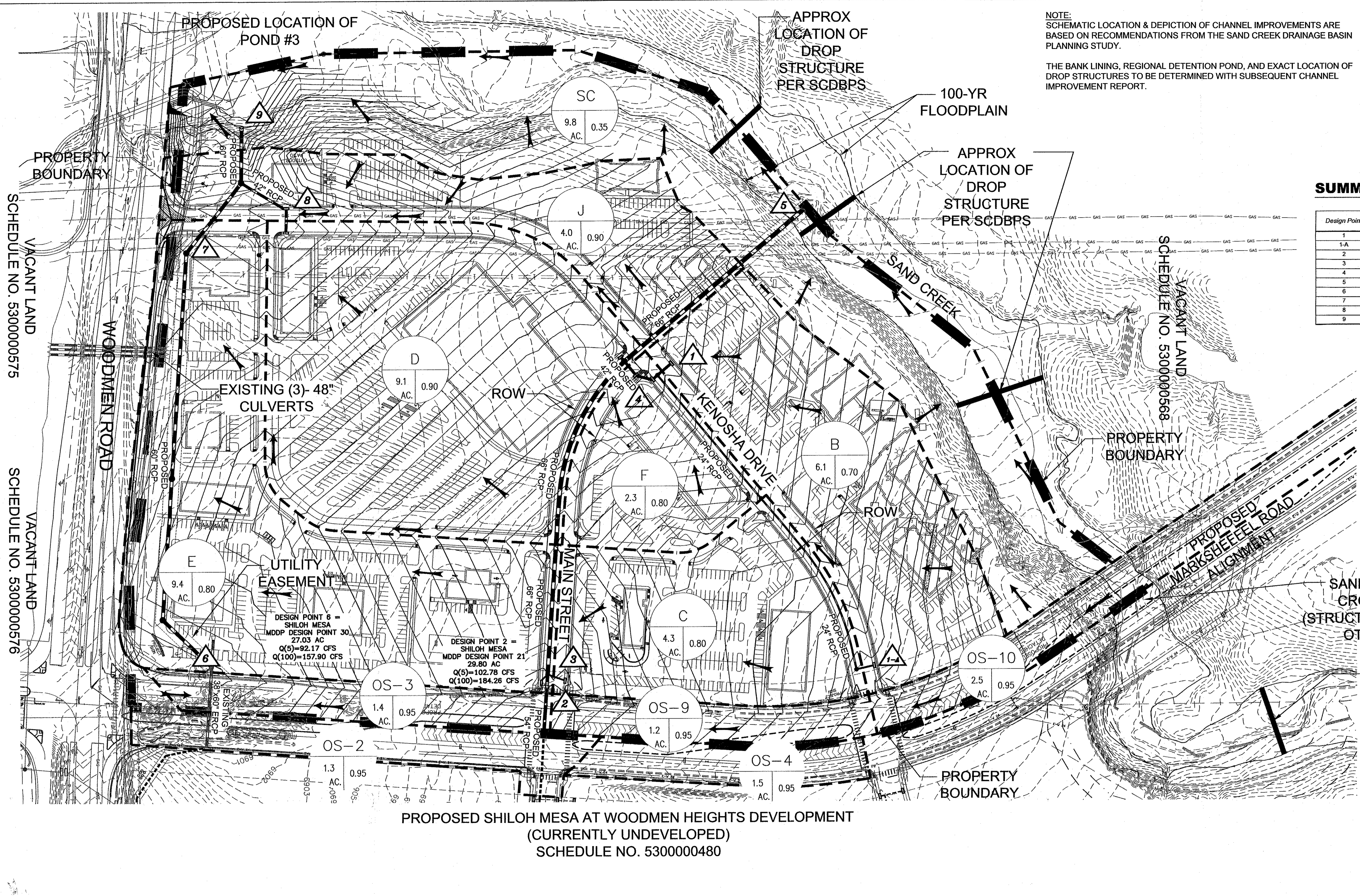


Matrix Design Group, Inc.
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THE WOODMEN HEIGHTS
COMMERCIAL CENTER
MASTER DEVELOPMENT DRAINAGE PLAN

DRAINAGE PLAN
EXISTING CONDITIONS

DESIGNED BY: RAE	SCALE: 1" = 100'	DATE ISSUED: FEBRUARY, 2009	DR01
DRAWN BY: RAE	HORIZ: N/A	MDG PROJECT NO: 06.052.018	
CHECKED BY: REP	VERT: N/A		



NOTE:
SCHEMATIC LOCATION & DEPICTION OF CHANNEL IMPROVEMENTS ARE
BASED ON RECOMMENDATIONS FROM THE SAND CREEK DRAINAGE BASIN
PLANNING STUDY.

THE BANK LINING, REGIONAL DETENTION POND, AND EXACT LOCATION OF
DROP STRUCTURES TO BE DETERMINED WITH SUBSEQUENT CHANNEL
IMPROVEMENT REPORT.

SUB BASIN DATA

Sub-Basin Data		Peak Runoff	
Basin	Area (ac)	Q(5) (cfs)	Q(100) (cfs)
SC	9.8	6.52	16.27
B	6.1	13.65	28.42
C	4.3	13.09	24.88
D	9.1	25.99	52.05
E	9.4	24.43	46.35
F	2.3	7.23	13.69
J	4.0	10.88	20.67
OS-3	0.0	6.78	12.09
OS-9	1.4	5.50	10.30
OS-10	1.2	8.23	14.66

SUMMARY RUNOFF TABLE

Design Point	Area (ac)	Q(5) (cfs)	Q(100) (cfs)	Description
1	8.75	21.57	38.65	Sub-basins OS-10 & B
1-A	2.61	8.23	14.66	Sub-basin OS-10
2	34.12	102.78	184.26	Shiloh Mesa MDDP DP 21
3	38.44	114.63	205.86	Sub-basin C & DP2
4	11.09	27.46	48.23	Sub-basin F & DP1
5	49.53	121.44	216.6	DF3 & DF4
6	27.03	92.17	157.9	Shiloh Mesa MDDP DP 30
7	36.41	100.51	178.95	Sub-basin E & DF6
8	13.09	40.83	72.7	Sub-basins J & D
9	49.5	137.94	245.67	DF7 & DF8

PROPOSED SHILOH MESA AT WOODMEN HEIGHTS DEVELOPMENT
(CURRENTLY UNDEVELOPED)
SCHEDULE NO. 5300000480

LEGEND

	EXISTING ELECTRIC		DRAINAGE BASIN BOUNDARY
	EXISTING FIBER OPTIC		PROPOSED CONTOUR
	EXISTING GAS		EXISTING CONTOUR
	EXISTING CULVERT		PROPOSED STORM
	PROPOSED EASEMENT		EXISTING STORM
	PROPOSED D10R INLET		PROPOSED MANHOLE
	PROPOSED FLOW DIRECTION ARROW		DESIGN POINT

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

DESIGN POINT

OS-3
1.99 AC. 0.38

BASIN DESIGNATION

"C" COEFFICIENT (100 YR)

BASIN AREA (ACRES)

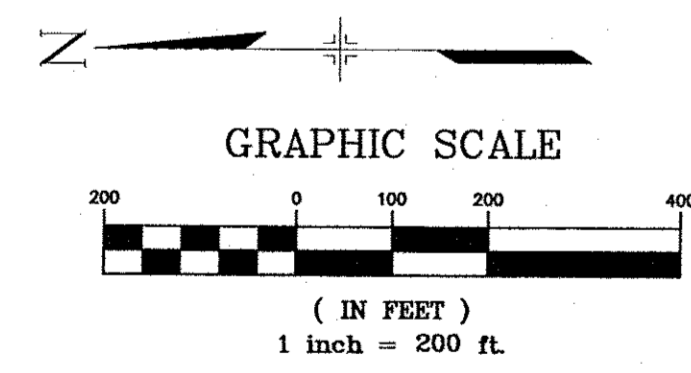
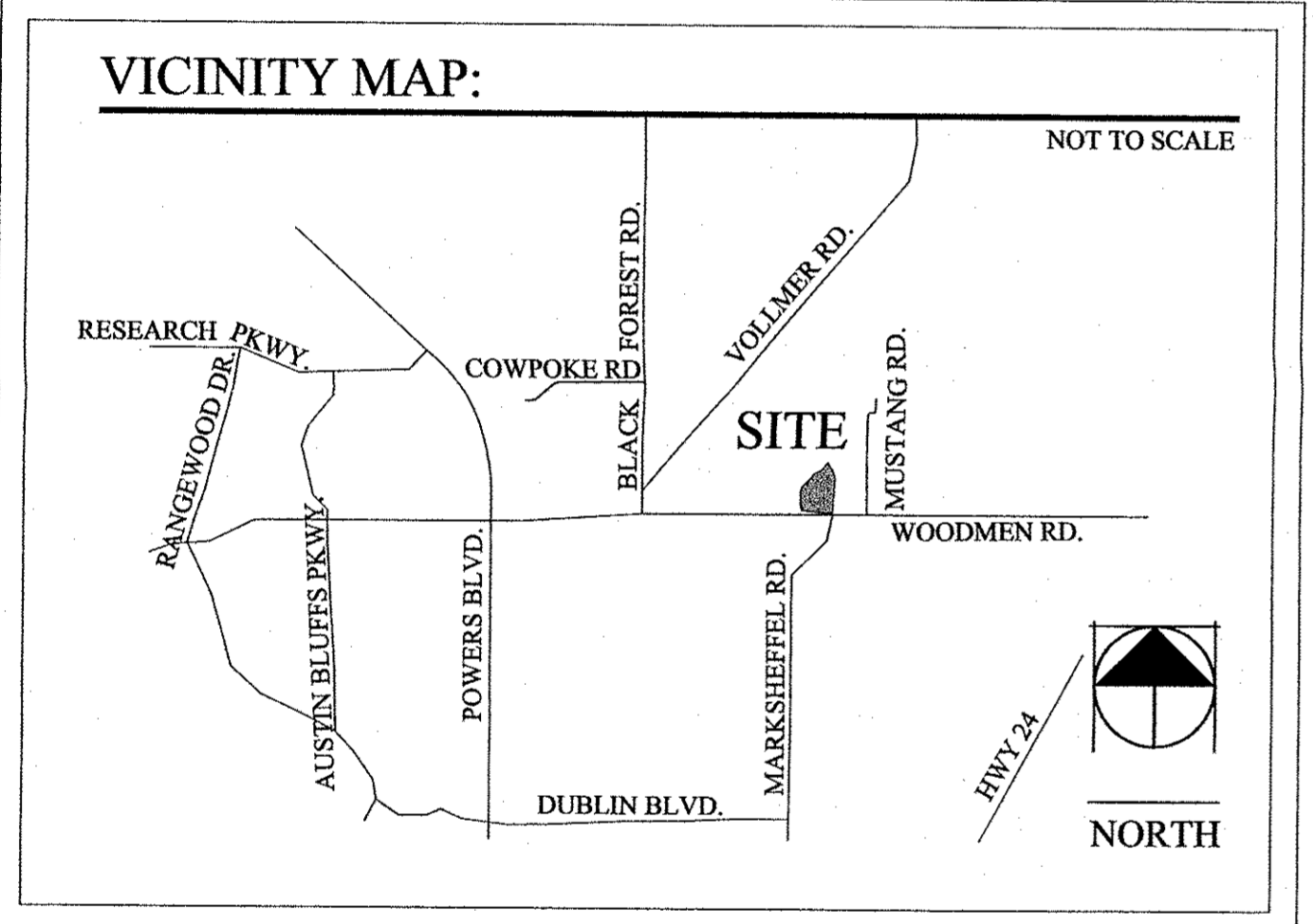
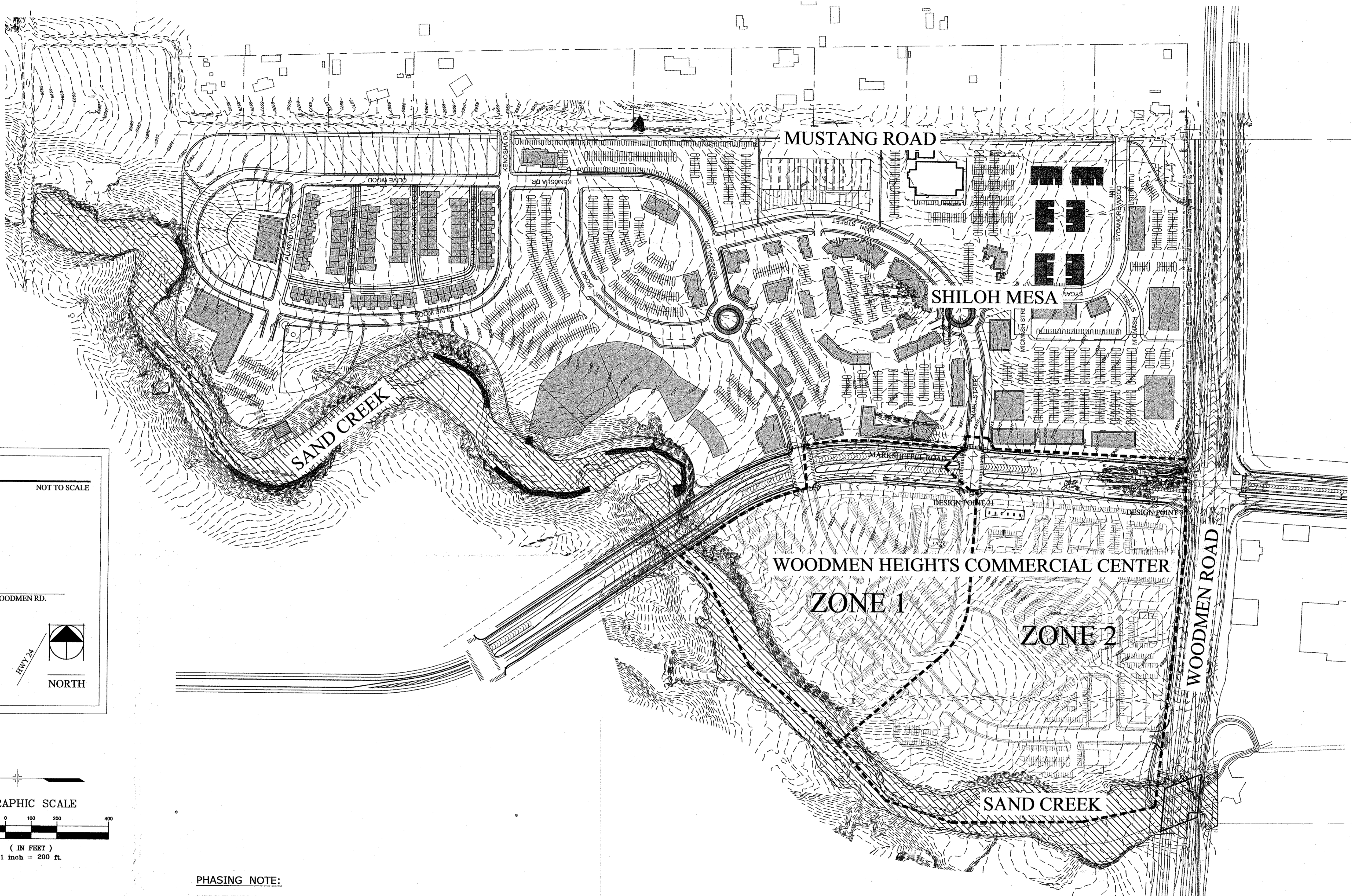
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THE WOODMEN HEIGHTS
COMMERCIAL CENTER
MASTER DEVELOPMENT DRAINAGE PLAN

**DRAINAGE PLAN
PROPOSED CONDITIONS**

DESIGNED BY: RAE	SCALE: HORIZ: 1" = 100'	DATE ISSUED: FEBRUARY, 2009	DR02
DRAWN BY: RAE	VERT: N/A	MDG PROJECT NO: 06.052.018	



PHASING NOTE:

IMPROVEMENTS TO MARKSHEFFEL ROAD WILL BE COMPLETED AS FOLLOWS:

1. A PHASED 1/2 SECTION OF MARKSHEFFEL ROAD WILL BE CONSTRUCTED BETWEEN WOODMEN ROAD AND THE 1ST INTERSECTION NORTH OF WOODMEN ROAD AS PART OF PHASE 1 OF THE DEVELOPMENT.
2. PRIOR TO DEVELOPMENT WITHIN PHASE 3, MARKSHEFFEL ROAD WILL BE COMPLETED BETWEEN WOODMEN ROAD AND KENOSHA DRIVE AS A FOUR LANE DIVIDED ROADWAY PURSUANT TO THE APPROVED TYPICAL SECTION WITHIN THE SHILOH MESA CONCEPT PLAN.

WOODMEN ROAD IS CURRENTLY UNDER CONSTRUCTION AND, UPON COMPLETION, WILL CONSIST OF A FOUR LANE DIVIDED RURAL EXPRESSWAY. PRIOR TO THE COMPLETION OF DEVELOPMENT WITHIN PHASE 3, WOODMEN ROAD WILL BE WIDENED TO A SIX LANE RURAL EXPRESSWAY.

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**WOODMEN HEIGHTS
 COMMERCIAL CENTER**
 MASTER DEVELOPMENT DRAINAGE PLAN

**PHASING PLAN
 PROPOSED CONDITIONS**

DESIGNED BY: BAS	SCALE	DATE ISSUED: FEBRUARY, 2009
DRAWN BY: BAS	HORIZ: 1" = 100'	
CHECKED BY: EDL	VERT: N/A	MDG PROJECT NO: 06.052.018

DR03