FILE IN MDDP's

PRELIMINARY/FINAL DRAINAGE REPORT

FOR

VOYAGER PARKWAY PHASE 3B

(JET STREAM DRIVE TO INTERQUEST PARKWAY)

J·R ENGINEERING
A Subsidiary of Westrian

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PRELIMINARY/FINAL DRAINAGE REPORT
FOR
VOYAGER PARKWAY PHASE 3B
(JET STREAM DRIVE TO INTERQUEST PARKWAY)

April 2000
Revised May 2000

Prepared For:

PICOLAN, INC.
90 S. Cascade Avenue, Suite 1300
Colorado Springs, CO 80903
(719) 381-8441

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907-3449
(719) 593-2593

Job No. 8896.45

PRELIMINARY/FINAL DRAINAGE REPORT FOR VOYAGER PARKWAY PHASE 3B (JET STREAM DRIVE TO INTERQUEST PARKWAY)

J·R ENGINEERING
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DRAINAGE REPORT STATEMENT

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.

L. D. Rubey — 5-2-00

Luanne D. Rubey, Colorado P.E. #32339 — Date
For and On Behalf of JR Engineering, LLC

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

Business Name: Picolan, Inc.

By:

Title: Vice Pres

Address: 90 S. Cascade Avenue, Suite 1300

Colorado Springs, Colorado 80903

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

Tom Mulva Jr — May 3, 2000

City Engineer — Date
Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

PRELIMINARY/FINAL DRAINAGE REPORT
FOR VOYAGER PARKWAY PHASE 3B
(JET STREAM DRIVE TO INTERQUEST PARKWAY)

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APPENDICES

PRELIMINARY/FINAL DRAINAGE REPORT
FOR VOYAGER PARKWAY PHASE 3B
(JET STREAM DRIVE TO INTERQUEST PARKWAY)

PURPOSE

This document is the Preliminary/Final Drainage Report for Voyager Parkway Phase 3B from Jet Stream Drive to Interquest Parkway. The purpose of this report is to identify major drainageways, storm sewer, culvert and inlet locations, and areas tributary to the intersection of Interquest Parkway and Voyager Parkway. This report will analyze routing for developed roadway flows and the ability of existing facilities to handle these flows.

GENERAL DESCRIPTION

Voyager Parkway Phase 3B is located in Sections 17 and 21, Township 12 South, Range 66 West of the Sixth Principal Meridian in the County of El Paso, State of Colorado. The site is bounded by the Stout Property and Leach Property to the west and New Life Church to the east. Voyager Parkway Phase 3B initiates at Interquest Parkway and traverses north to the intersection of Jet Stream Drive and Voyager Parkway.

EXISTING DRAINAGE CONDITIONS

The project is located at the north boundary of the Elkhorn basin. The existing flows begin in Basin EX-G to the northeast and flow overland to the southwest. This 50.97-acre basin is not developed and consists of natural vegetation. At the south end of this basin, DP-1, the flow (Q_5 = 13.76 cfs and Q_{100} = 33.65 cfs) is conveyed through an existing 24" CMP culvert under Highway 83 to Basin EX-H. This pipe is not plugged and appears to be fully operational. It is estimated that it could carry ± 22 cfs flowing full. The remaining ± 12 cfs stays on the north side of the road in the existing ditch and flows west to Design Point 6.

Basin EX-H consists mainly of a roadside ditch flowing to the west along the south side of original Highway 83. This basin consists of 2.16-acres.

The average soil condition reflects Hydrologic Groups "A" and "B" (Blakeland No. 8 and Stapleton Nos. 83-84). This is represented and determined by the "Soil Survey of El Paso County Area," prepared by S.C.S. (see Appendix).

At the downstream end of Basin EX-H, DP-2A, the flow (Q_5 = 14.35 cfs, Q_{100} = 35.07 cfs), is conveyed to an existing 24" culvert under the north driveway of New Life Church into Basin EX-F. Currenlty, the existing 24" culvert can only convey Q_5 = 14.35 cfs and Q_{100} = 14 cfs. The remaining flow jumps a small berm and overflows overland to the south between the existing New Life Church and Pikes Peak Community College. It appears that the "Drainage Addendum No. 1 for New Life Church Filing No. 2," by Haynes and Associates, LTD., dated May 20, 1996 did not address the flows to DP-2A from Basin EX-G. This report did, however, indicate a Q_{100} = 34 cfs release from the existing detention pond at DP-3A at the southwest corner of New Life Church (northeast corner of Voyager and Interquest Parkways). The Fairlane Technology Park Drainage Report showed the drainage from EX-G and EX-H being conveyed to the south. However, the Drainage Report for Pikes Peak Community College North Campus, which was not reviewed by the City shows storm runoff being conveyed towards the west along Highway 83.

The "Master Drainage Plan for New Life Church and Preliminary and Final Drainage Report for New Life Church Filing No. 1," by KLH Engineering, Inc., dated April 1991 did not address the flows to DP-2 from Basin EX-G and indicated a 40 L.F.-18" RCP culvert was to be installed at this point to convey the upstream flows. This existing culvert is undersized to carry the ± 35 cfs for the 100-year event.

Basin EX-F includes a roadside ditch on the south side of the large radius around New Life Church in the original Highway 83. This basin collects drainage from Highway 83 and the flow to it from DP-2. New Life Church does not contribute to these flows. This basin conveys its flows to DP-3B, the upstream end of a 30" culvert at the northeast corner of the intersection of Interquest Parkway and original Highway 83 (Q_5 = 12.08 cfs, Q_{100} = 28.82 cfs). Recently, with the construction of the realignment driveway to the New Life Church off of original Highway 83,

an inlet and culvert were constructed (Design Point 2B). No design calculations for this system were shown in the Interquest Parkway drainage report.

It is at this 30" culvert DP-3 that the flows from the north and the detention pond release from New Life Church combine and flow under northbound and southbound original Highway 83 to the west. Adding these flows together yields a Q_{100} = 62.82 cfs at Design Point 3.

Basin EX-A is located to the west of Basin EX-G. This basin contributes to the roadside ditch on the north side of original Highway 83. This basin is 22-acres in size, has not been developed and consists of natural vegetation. Flows are conveyed in the ditch to an existing 36" culvert DP-6 flowing to the west under Jet Stream Drive intersection at original Highway 83 (Q_5 = 20 cfs, Q_{100} = 42 cfs).

Basin EX-B is a developed basin with an office building (International Bible Society). Per the "Preliminary and Final Drainage Report for International Bible Society Filing No. 1," by URS, dated August 1988, in this developed state, a detention pond was required with a pond release of DP-7 (Q_5 = 3.7 cfs, Q_{100} = 4.0 cfs). These flows combine with the flows from Basin EX-A in the north roadside ditch and enter the existing 36" culvert at Jet Stream Drive at Design Point 6 and 7 (Q_5 = 24.0 cfs, Q_{100} = 46.0 cfs).

Basins EX-C1 and EX-C2 collect primarily the flows in Jet Stream Drive from a high point approximately 300' north of the intersection. These flows are focused at two curb inlets and conveyed to the same existing 36" culvert as Basins EX-A and EX-B. Basin EX-C1 and EX-C2 contribute DP-9 (Q_5 = 1.21 cfs, Q_{100} = 2.21 cfs) and DP-8 (Q_5 = 1.62 cfs, Q_{100} = 2.97 cfs) respectively.

From here, all flow is conveyed to the west into a graded channel in Basin EX-E. There is an existing 24" CSP culvert at the existing Leach Driveway. This culvert appears to be full of sediment. Design Point 4 (Q_5 = 27.59 cfs, Q_{100} = 61.09 cfs) combines the flows from Basins EX-E, EX-C1, EX-C2, EX-B and EX-A.

PROPOSED DRAINAGE CHARACTERISTICS

After construction, original Highway 83 is to be realigned. The large radius at New Life Church will be straightened (see map "Developed Conditions"). Considering developed conditions, Basins EX-A, EX-B, EX-C1, EX-C2, EX-G and EX-H will remain unaltered; however, Basin PR-A, PR-B, PR-C, PR-D, PR-E and PR-F are modified as the result of this development.

In the future, if Basins EX-A, EX-B and EX-G are developed, the flows from these basins will need to be restricted to historic levels, or infrastructure to convey these flows will need to be constructed. Routing of the flows to the south, through the Pikes Peak Community College should be investigated at that time.

Basin PR-D will contain a proposed collector street (east to west) through the currently undeveloped area. The ultimate "build-out" is to connect Voyager Parkway (north to south) with the Jet Stream Drive – SH-83 intersection. This road configuration will incorporate a roadside ditch on its north side. Ultimately, per the "Northgate Master Development Drainage Plan (Black Squirrel Creek and Miscellaneous Basins)," by URS, Inc., dated August 1989, a future 36" diameter RCP pipe is anticipated to replace this ditch. Historic flows of Q_{10} = 22 cfs and Q_{100} = 50 cfs were shown in the previously approved report at Design Point 5A (Design Point 6 in URS report).

The ditch will convey flows to the west where there is a proposed flared end section in a sump condition DP-5 (Q_5 = 19.28 cfs, Q_{100} = 46.90 cfs). At this point a proposed 36" culvert is proposed to carry flows west under proposed Voyager Parkway to the existing collector right-of-way . Basin PR-A1 is designated as the north half of the collector. This area conveys flows from east to west. A 4' city standard inlet will be placed at Design Point 5B at the north "PCR" on the collector at Voyager Parkway (Q_5 = 2.88 cfs, Q_{100} = 5.27 cfs). This inlet will convey the flows to the 36" culvert under the intersection to the west. Combined flows of Q_5 = 20.43 cfs and Q_{100} = 49.10 cfs at Design Point 5A are below the historic rate of Q_{10} = 22 cfs and Q_{100} = 50 cfs.

Basin PR-C is a triangular shaped area created by the original SH-83 and the proposed Voyager Parkway-proposed collector intersection. This area will sheet flow to the south to the proposed roadside ditch along the future Voyager Parkway (DP-10). These flows are to be conveyed to the south through a proposed 12" culvert under the New Life Church driveway extension DP-10 (Q_5 = 0.81 cfs, Q_{100} = 1.89 cfs).

The Basin PR-E includes the east half of proposed Voyager Parkway up to the collector, as well as the south half of the collector road. Flows within the curb and gutter will follow curb and gutter to the south and enter a 4' city standard inlet DP-3 (Q_5 = 10.39 cfs, Q_{100} = 18.87 cfs). The inlet will in turn, convey the flows to the existing 30" culvert flowing to the west just north of Interquest Parkway at the intersection. The same 30" pipe is to be extended to the east and install a drop inlet collecting the flows that have entered the roadside ditch. DP-12 (Q_5 = 10.15, Q_{100} = 26.29 cfs) along with flows from the New Life Church Detention Pond (Q_{100} = 34 cfs).

Basin PR-B is designated as the west half of Voyager Parkway. Flows from this area will be conveyed from north to south along the proposed curb and gutter to a proposed 6' sump inlet at Design Point 4 (Q_5 = 10.21 cfs, Q_{100} = 18.54 cfs). From here, the flows connect into the existing 30" RCP culvert under Voyager Parkway.

Basin PR-A and PR-B flows will peak at the inlets in Voyager Parkway and 30" culvert before the major flows reach this area from the basins upstream (Q_{100} = 62.82 cfs).

EROSION CONTROL

The erosion process will be used along Voyager Parkway to Jet Stream Drive and along the collector. Check dams will be used in the roadside ditches, silt fences along slopes and straw bales at inlets. Disturbed areas will be required to be seeded with a native grass mixture and fertilized. The estimated erosion control cost for this area is $11,480.00.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence interval.

FLOODPLAIN STATEMENT

No portion of this project is within a designated F.E.M.A. floodplain as determined by Flood Insurance Rate Map Community Panel Number 0800 60 0152B, effective December 18, 1986. See the Appendix for a Floodplain Information Map which shows the location of the site.

OPINION OF PROBABLE COST (Public Facilities)

All proposed storm drainage improvements within this project will be considered non-reimbursable. Proposed improvements along with their estimated costs are listed in table below and total $37,536.00. Elkhorn is a non-fee basin. There are no reimbursable drainage costs associated with this project. Therefore, no drainage fee and pond fee will be due at the time of platting.

Item	Description	Quantity	Unit Cost	Total
1.	18" RCP	87 L.F.	$25/L.F.	$ 2,175.00
2.	24" RCP	35 L.F.	$35/L.F.	$ 1,225.00
3.	30" RCP	61 L.F.	$40/L.F.	$ 2,440.00
4.	36" RCP	262 L.F.	$50/L.F.	$13,100.00
5.	30" FES	2 EACH	$600/EA.	$ 1,200.00
6.	36" FES	2 EACH	$750/EA.	$ 1,500.00
7.	4' Inlet	2 EACH	$2,800/EA.	$ 5,600.00
8.	6' Inlet	1 EACH	$3,400/EA.	$ 3,400.00
9.	Drop Inlet	1 EACH	$2,000/EA.	$ 2,000.00
			Sub-Total	$32,640.00
		15% Engineering and Contingencies		$ 4,896.00
			TOTAL	**$37,536.00**

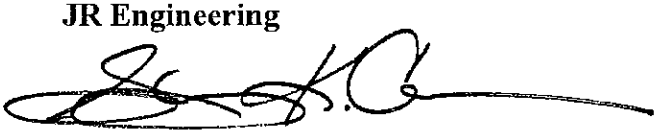
JR Engineering cannot and does not guarantee that the construction costs will not vary from the Opinions of Probable Construction Costs. These opinions represent our best judgement as design professionals familiar with the construction industry and this development. We recommend that construction assurances be posted as outlined in the "Drainage and Bridge Fees" section of this report for both public and private facilities.

SUMMARY

Construction of this site will not change the overall direction of flow. However, the parameter to the west, on the Leach Property must not exceed 50 cfs. This design remains under these flows. The flows at Interquest and Voyager are increased at the 30" culvert; however, peak flows will be arriving to this point at different times and will be contained in the 30" culvert. The project will not adversely affect the surrounding developments.

PREPARED BY:

JR Engineering



Stephen K. Crane
Senior Project Designer

/le/889645/prel fnl drng rpt

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated November 1991.

2. Soils Survey of El Paso County Area, Colorado Soil Conservation Service.

3. "Drainage Report for Ford Fairlane Technology Park," by URS Corporation, dated May 1986.

4. "Final Hydraulic Report (Phase I) Interstate 25 Fairlane Parkway Interchange," prepared by Daniel, Mann, Johnson, & Mendenhall, Inc., dated July 24, 1998.

5. "Final Hydraulic Report (Phase II) Interstate 25 Interquest Parkway/S.H. 83 Relocation," prepared by Daniel, Mann, Johnson, & Mendenhall, Inc., dated March 12, 1999.

6. "Drainage Addendum No. 1 for New Life Church Filing No. 2," prepared by Haynes and Associates, LTD., dated May 20, 1996.

7. "Master Drainage Plan for New Life Church and Preliminary and Final Drainage Report for New Life Church Filing No. 1," by KLH Engineering, Inc., dated April 1991.

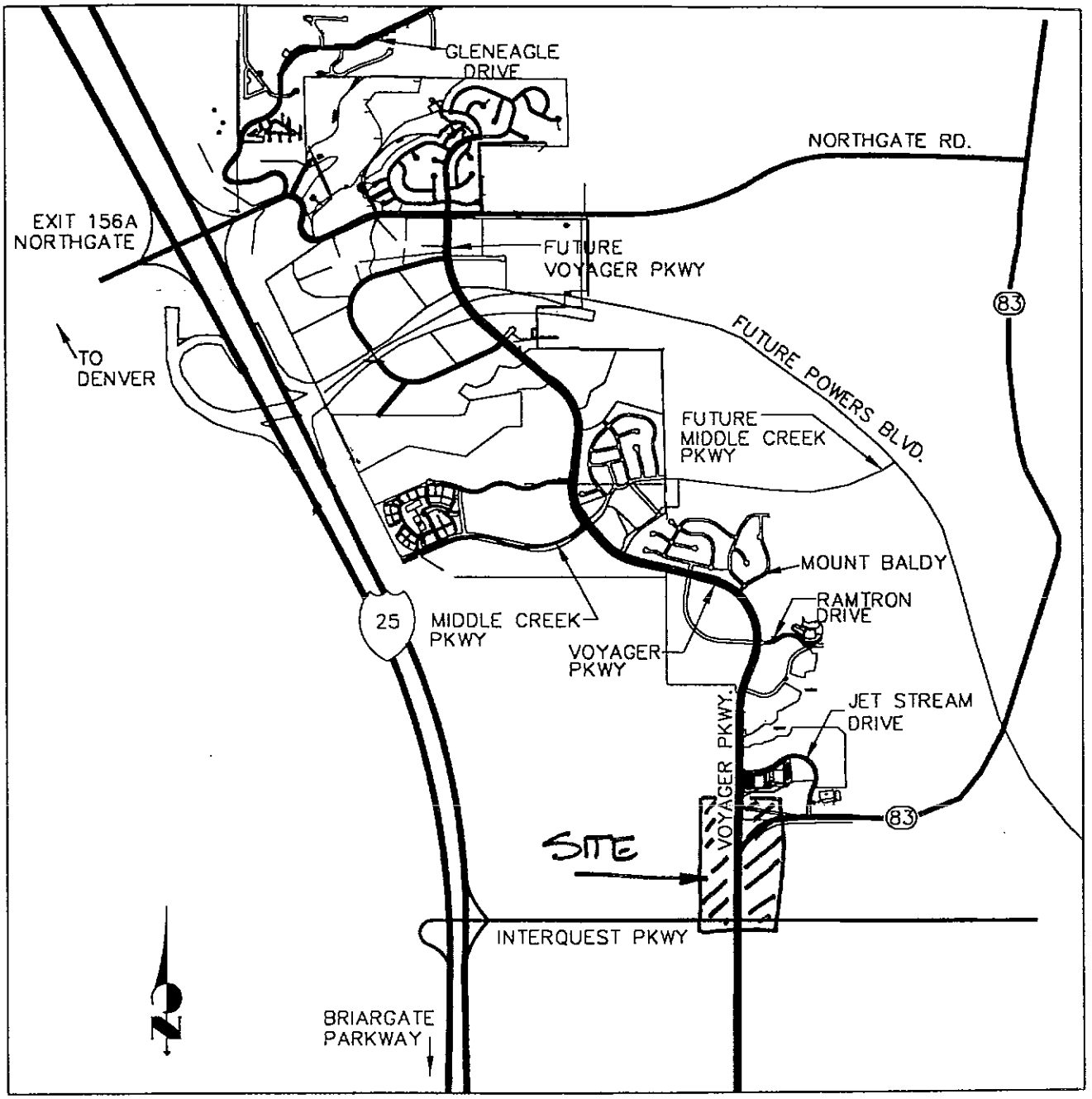
8. "Preliminary and Final Drainage Report for International Bible Society Filing No. 1," prepared by URS Consultants, dated August 1988.

9. "Northgate Filing No. 4 Middle Tributary Wastewater Pump Station Preliminary and Final Drainage Report," by URS Consultants, Inc., dated November 1989.

10. "Northgate Master Development Drainage Plan (Black Squirrel and Miscellaneous Basins)," by URS Consultants, Inc., dated November 1988, revised May 1989 and August 1989.

APPENDICES

VICINITY MAP



VICINITY MAP

N.T.S.

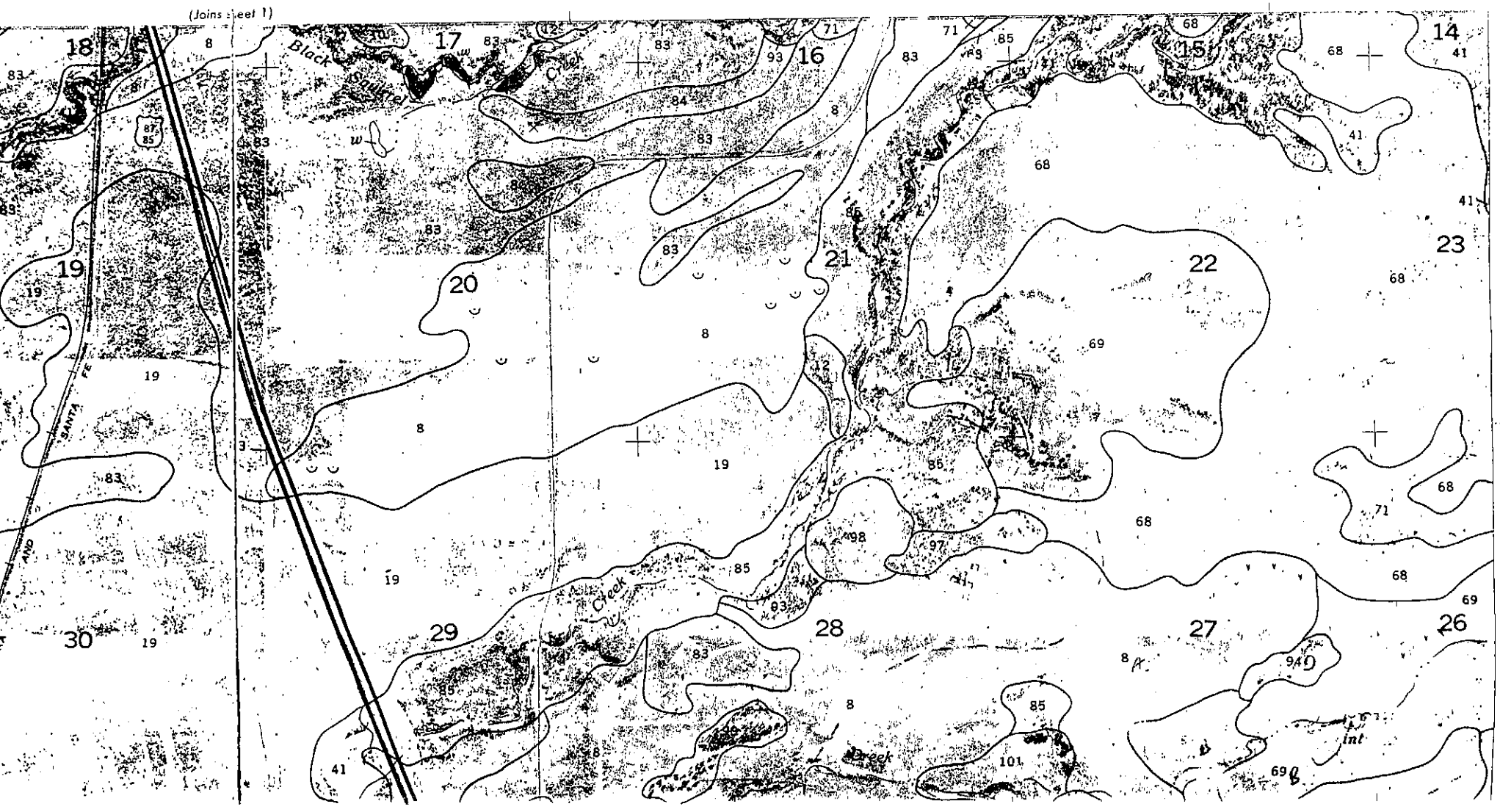
SOIL MAP (S.C.S. SURVEY)

(SHEET NO. 8)

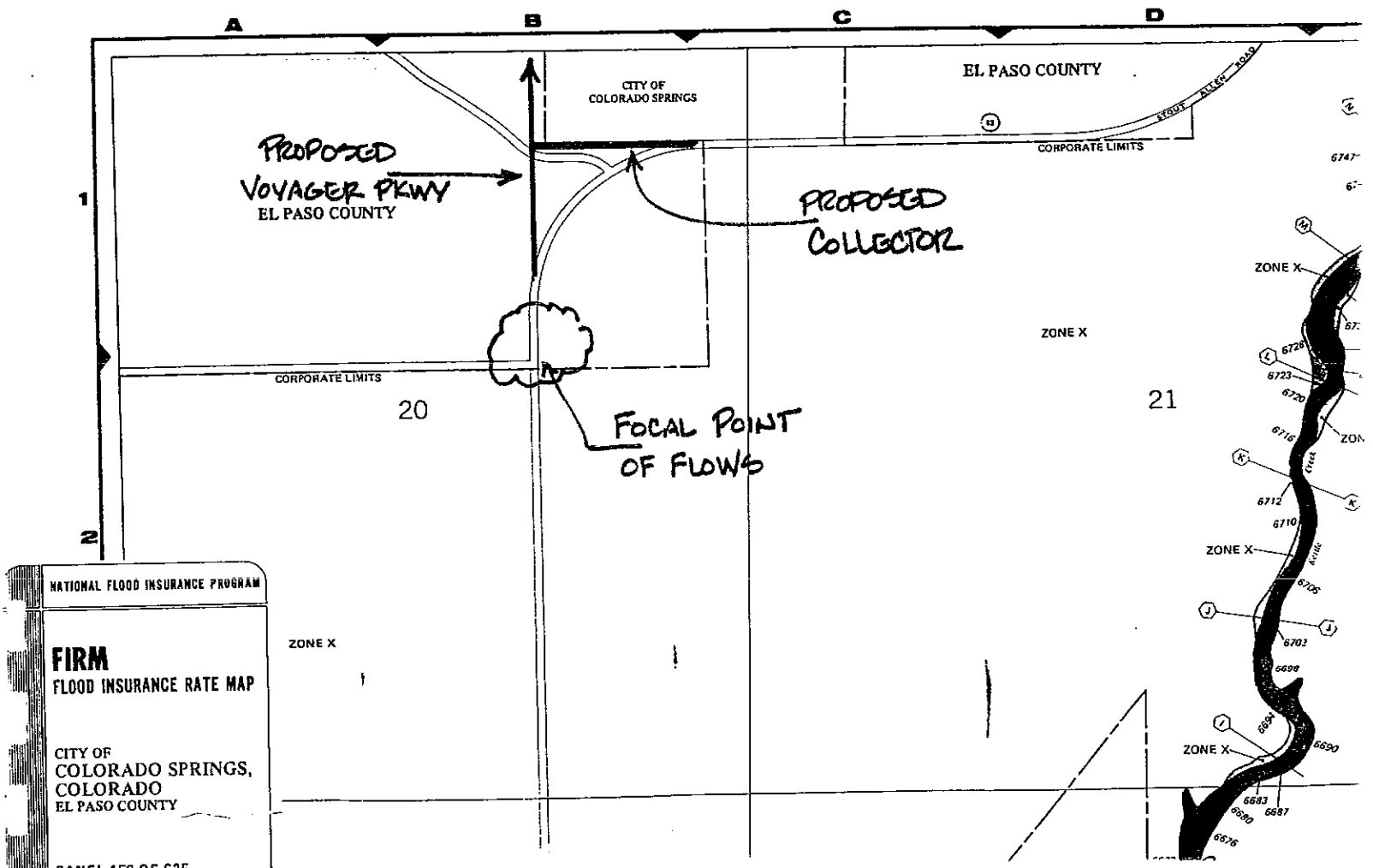
8 - BLAKELAND - A TYPE

83-84 - STAPLETON - B TYPE

SHEET NO. 8
EL PASO COUNTY AREA, COLORADO
(PIKEVIEW QUADRANGLE)



F.E.M.A. MAP



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
COLORADO SPRINGS,
COLORADO
EL PASO COUNTY

PANEL 152 OF 625
(SEE MAP INDEX FOR PANELS NOT PRINTED)

PANEL LOCATION

COMMUNITY-PANEL NUMBER
080060 0152 B

EFFECTIVE DATE:
DECEMBER 18, 1986

Federal Emergency Management Agency

NORTHGATE AREA (TRIBUTARY TO VOYAGER PARKWAY)

(Existing Area Drainage Summary)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5) (also See Runoff Summary)	WEIGHTED C(100)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Te (min)	STREETS/ PARKING Length (ft)	STREETS/ PARKING Slope (%)	STREETS/ PARKING Velocity (fps)	STREETS/ PARKING Te (min)	Te TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
EX-A	22.00	0.25	0.35	NO.S ARE FROM NORTHGATE MASTER DEVELOPMENT DRAINAGE REPORT							18.00	3.6	5.4	**19.80**	**41.58**
EX-B	5.05	0.66	0.79	NO.S ARE FROM INTL. BIBLE SOCIETY FILING NO. 1		14.50					14.50	4.0 POND	6.9 RELEASE=	13.33 3.7	27.53 4.0
EX-C1	0.258	0.90	0.95				300	1.7%	4.52	5.0	5.00	5.2	9.0	**1.21**	**2.21**
EX-C2	0.347	0.90	0.95				300	1.7%	4.5	5.0	5.00	5.2	9.0	**1.62**	**2.97**
EX-E	12.04	0.25	0.35	300	10.00	18.44	1270	2.36% EXISTING	3.71 GRADED	5.71 CHANNEL	24.15	2.7	4.6	**8.13**	**19.39**
EX-F	2.70	0.80	0.85	1150	31.00 EXISTING DITCH VEL.=4.08	4.70	100	6.0%	8.57	0.2	5.00	5.2	9.0	**11.25**	**20.69**
EX-F1	2.11	0.80	0.85	850	14.00 EXISTING DITCH VEL.=3.19	4.44	100	6.0%	8.57	0.2	5.00	5.2	9.0	**8.77**	**16.11**

ED

NORTHGATE AREA (TRIBUTARY TO VOYAGER PARKWAY)

(Existing Area Drainage Summary)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5) (ales Sec Runoff Summary)	C(100)	OVERLAND Length (ft)	Height (ft)	Tc (min)	STREETS/ PARKING Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	Q(100) (c.f.s.)
EX-G	50.98	0.15	0.20	1000	40.00	35.39	2655	2.18%	5.56	8.0	43.35	1.8	3.3	13.76	33.64
EX-H	2.16	0.15	0.20	1300	15.00 EXISTING DITCH VEL.=1.95	4.91					4.91	5.2	9.0	1.69	3.89

NORTHGATE AREA (TRIBUTARY TO VOYAGER PARKWAY)

(Developed Area Drainage Summary)

BASIN	AREA TOTAL (Ac)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREETS/ PARKING Length (ft)	STREETS/ PARKING Slope (%)	STREETS/ PARKING Velocity (fps)	STREETS/ PARKING Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (c.f.s.)	TOTAL FLOWS Q(100) (c.f.s.)
		Calcs See Runoff Summary													
PR-A	2.68	0.90	0.95				2536	1.8%	4.75	8.90	8.90	4.3	7.4	10.39	18.87
PR-A1	0.62	0.90	0.95				1172	2.7%	5.75	3.39	5.00	5.2	9.0	2.88	5.27
PR-B	2.27	0.90	0.95				1350	1.15%	3.8	6.0	6.00	5.0	8.6	10.21	18.54
PR-C	2.25	0.15	0.20	650	24.00	29.31					29.31	2.4	4.2	0.81	1.89
PR-D	6.58	0.30	0.55	1250	42.00	35.31					35.31	2.1	3.7	4.14	13.38
PR-E	0.40	0.25	0.35	500	6.00 NATURAL DITCH VEL= 3.30	2.53					5.00	5.2	9.0	0.52	1.27
PR-F	2.70	0.80	0.85	1150	31.00 NATURAL DITCH VEL= 4.08	4.70	100	6.00%	8.57	0.20	5.00	5.2	9.0	11.25	20.69
PR-F1	0.52	0.80	0.85	850	14.00 NATURAL DITCH VEL= 3.19	4.44	100	6.00%	8.57	0.20	5.00	5.2	9.0	2.18	4.01

NORTHGATE AREA (TRIBUTARY TO VOYAGER PARKWAY)
(Surface Routing Summary)

Design Point(s)	*Contributing Basins*	*Equivalent* CA_5	*Equivalent* CA_{100}	*Maximum* T_C	*Intensity*		*Flow*	
					I_5	I_{100}	Q_5	Q_{100}
6 AND 7	EX-A AND EX-B(EXIST. CONDITION)	P	8.50	18.00	3.6	5.4	*24.00*	*46.00*
F.E.S.	EX-A, EX-B, EX-C1 AND EX-C2(EXIST. CONDITION	7.21	9.06	18.00	3.6	5.4	*25.96*	*48.92*
5	EX-A, EX-B, EX-C1, EX-C2 AND PR-D(DEVELOPED)	9.18	12.68	35.31	2.1	3.7	*19.28*	*46.90*
2	EX-G AND EX-H @ OUTLET OF CULVERT	7.97	N/A	43.35	1.8	N/A	*14.35*	*14.00*
2A	EX-G AND EX-H	7.97	10.63	43.35	1.8	3.3	*14.35*	*35.07*
2B	EX-G, EX-H AND EX-F(EXIST. CONDITION)	2.48	3.86	15.81	3.3	5.7	*8.18*	*22.00*
3	NEW LIFE CHURCH PLUS DITCH FLOW @ FES	Q100=34	Q100=28.82	N/A	N/A	N/A	*N/A*	*62.82*
3B	EX-G, EX-H, EX-F AND EX-F1(EXIST. CONDITION)	4.17	5.65	20.26	2.9	5.1	*12.08*	*28.82*
11	EX-G, EX-H AND PR-F(PROP. CONDITION)	2.48	3.86	15.81	3.3	5.7	*8.18*	*22.00*
12	EX-G, EX-H, PR-E, PR-F AND PR-F1(DEVELOPED)	2.90	4.31	14.05	3.5	6.1	*10.15*	*26.29*
4	EX-A, EX-B, EX-C1, EX-C2 AND EX-E(EXISTING)	10.22	13.28	24.15	2.7	4.6	*27.59*	*61.09*
5A	EX-A, EX-B, EX-C1, EX-C2 AND PR-A1(DEVELOPED	9.73	13.27	35.31	2.1	3.7	*20.43*	*49.10*

6' INLET AT VOYAGER AND INTERQUEST
Worksheet for Circular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	INLETS ON VOYAGER AND COLLECTOR
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.032300	ft/ft
Depth	18.0	in
Diameter	18.00	in

Results		
Discharge	18.88	cfs
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.46	ft
Percent Full	100.00	
Critical Slope	0.028557	ft/ft
Velocity	10.68	ft/s
Velocity Head	1.77	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	20.31	cfs
Full Flow Capacity	18.88	cfs
Full Flow Slope	0.032300	ft/ft

4' INLET AT VOYAGER AND INTERQUEST
Worksheet for Circular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	INLETS ON VOYAGER AND COLLECTOR
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.016600	ft/ft
Depth	24.0	in
Diameter	24.00	in

Results		
Discharge	29.15	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.85	ft
Percent Full	100.00	
Critical Slope	0.014383	ft/ft
Velocity	9.28	ft/s
Velocity Head	1.34	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	31.35	cfs
Full Flow Capacity	29.15	cfs
Full Flow Slope	0.016600	ft/ft

PIPE FROM 4' INLET ON PROP'D COLLECTOR
Worksheet for Circular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	COLLECTOR ROAD INLET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Depth	1.50	ft
Diameter	18.00	in

Results		
Discharge	7.43	cfs
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.37e-7	ft
Critical Depth	1.06	ft
Percent Full	100.00	
Critical Slope	0.007032	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	1.77	ft
Froude Number	0.11e-3	
Maximum Discharge	7.99	cfs
Full Flow Capacity	7.43	cfs
Full Flow Slope	0.005000	ft/ft
Flow is subcritical.		

BASIN EX-H DITCH
Worksheet for Triangular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ROAD SIDE DITCHES
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.013800	ft/ft
Depth	1.00	ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V

Results		
Discharge	36.53	cfs
Flow Area	10.00	ft^2
Wetted Perimeter	20.10	ft
Top Width	20.00	ft
Critical Depth	0.96	ft
Critical Slope	0.016841	ft/ft
Velocity	3.65	ft/s
Velocity Head	0.21	ft
Specific Energy	1.21	ft
Froude Number	0.91	
Flow is subcritical.		

BASIN EX-H DITCH 2ND
Worksheet for Triangular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ROAD SIDE DITCHES
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.013800	ft/ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V
Discharge	3.72	cfs

Results		
Depth	0.42	ft
Flow Area	1.80	ft^2
Wetted Perimeter	8.53	ft
Top Width	8.49	ft
Critical Depth	0.39	ft
Critical Slope	0.022836	ft/ft
Velocity	2.06	ft/s
Velocity Head	0.07	ft
Specific Energy	0.49	ft
Froude Number	0.79	
Flow is subcritical.		

BASIN EX-H DITCH 3RD
Worksheet for Triangular Channel

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ROAD SIDE DITCHES
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.013800	ft/ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V
Discharge	2.98	cfs

Results		
Depth	0.39	ft
Flow Area	1.53	ft²
Wetted Perimeter	7.85	ft
Top Width	7.81	ft
Critical Depth	0.35	ft
Critical Slope	0.023524	ft/ft
Velocity	1.95	ft/s
Velocity Head	0.06	ft
Specific Energy	0.45	ft
Froude Number	0.78	
Flow is subcritical.		

DITCH ALONG ORIGINAL 83
Worksheet for Triangular Channel

EX-F 1 SI

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ORIGINAL 83 DITCH
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.027000	ft/ft
Depth	2.00	ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V

Results		
Discharge	324.47	cfs
Flow Area	40.00	ft^2
Wetted Perimeter	40.20	ft
Top Width	40.00	ft
Critical Depth	2.31	ft
Critical Slope	0.012587	ft/ft
Velocity	8.11	ft/s
Velocity Head	1.02	ft
Specific Energy	3.02	ft
Froude Number	1.43	
Flow is supercritical.		

DITCH ALONG ORIGINAL 83
Worksheet for Triangular Channel

EX-F 2nd

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ORIGINAL 83 DITCH
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.027000	ft/ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V
Discharge	20.69	cfs

Results		
Depth	0.71	ft
Flow Area	5.08	ft^2
Wetted Perimeter	14.32	ft
Top Width	14.25	ft
Critical Depth	0.77	ft
Critical Slope	0.018169	ft/ft
Velocity	4.08	ft/s
Velocity Head	0.26	ft
Specific Energy	0.97	ft
Froude Number	1.20	
Flow is supercritical.		

DITCH ALONG ORIGINAL 83 TO INTERQUEST

Worksheet for Triangular Channel

EX-F1

Project Description	
Project File	h:\fmw\project1.fm2
Worksheet	ORIGINAL 83 DITCH
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.016500	ft/ft
Depth	0.71	ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V

Results		
Discharge	16.17	cfs
Flow Area	5.08	ft^2
Wetted Perimeter	14.32	ft
Top Width	14.25	ft
Critical Depth	0.70	ft
Critical Slope	0.018775	ft/ft
Velocity	3.19	ft/s
Velocity Head	0.16	ft
Specific Energy	0.87	ft
Froude Number	0.94	
Flow is subcritical.		

JR Engineering, Ltd.

Colorado Springs | Denver | Fort Collins

Job Name VOYAGER PKWY Job No. 8896.45

Subject INLETS @ INTERQUEST

Source _____ Telephone _____ Meeting Date _____

With _____

$$Q_i = 1.7\left(L_i + 1.8(3)\right)\left(d_{MAX} + \frac{3}{12}\right)^{1.85} =$$

$d = 0.73'$ $\quad 1.7(4' + 5.4)(0.73' + .25)^{1.85} = 15.39'$ cfs

$\quad 1.7(\underline{\underline{6'}} + 5.4)(0.73' + 0.25)^{1.85} =$ **18.67' cfs**

$d = 0.83'$ $\quad 1.7(\underline{\underline{4'}} + 5.4)(0.83' + 0.25)^{1.85} =$ **18.43' cfs**

SKC

Signed

Client: _____ Job No: 8896.45

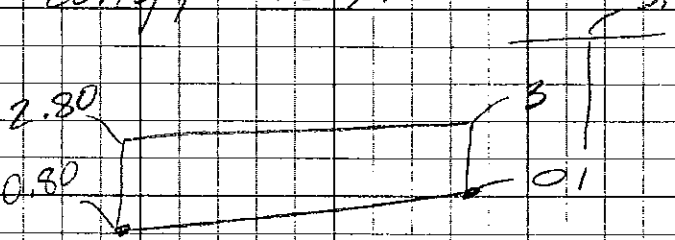
Project: _____ By: _____ Chk. By: _____ Date: _____

Subject: _____ Sheet No: ____ of ____

J·R ENGINEERING
A Subsidiary of Westrian

Calculate capacity of culvert -
24" CSPW / 30" ponding at New Life Church
Driveway - DP-2 - North entrance

40' long, 0.5 %.



- Discharge ± 14 cfs

Culvert - 24" CSP @ DP-1
Discharge ± 11 cfs, no head on pipe

Culvert Calculator Report
existing 30"

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	36.50	ft	Headwater Depth/ Height	3.23	
Computed Headwater Elevation	36.50	ft	Discharge	48.22	cfs
Inlet Control HW Elev	33.93	ft	Tailwater Elevation	32.03	ft
Outlet Control HW Elev	36.50	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	28.42	ft	Downstream Invert	28.02	ft
Length	160.59	ft	Constructed Slope	0.002491	ft/ft

Hydraulic Profile					
Profile	Pressure		Depth, Downstream	4.01	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	2.28	ft
Velocity Downstream	9.82	ft/s	Critical Slope	0.012070	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	36.50	ft	Upstream Velocity Head	1.50	ft
Ke	0.50		Entrance Loss	0.75	ft

Inlet Control Properties					
Inlet Control HW Elev	33.93	ft	Flow Control	Submerged	
Inlet Type	Square edge w/headwall		Area Full	4.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Ex 24" Culvert from basin EX-G at 83

Solve For: Discharge

Culvert Summary			
Allowable HW Elevation	3.00 ft	Headwater Depth/ Height	1.00
Computed Headwater Elevation	3.00 ft	Discharge	10.51 cfs
Inlet Control HW Elev	2.78 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev	3.00 ft	Control Type	Outlet Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.80 ft
Length	40.00 ft	Constructed Slope	0.005000 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.16 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.16 ft
Velocity Downstream	5.55 ft/s	Critical Slope	0.018038 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	3.00 ft	Upstream Velocity Head	0.24 ft
Ke	0.70	Entrance Loss	0.17 ft

Inlet Control Properties			
Inlet Control HW Elev	2.78 ft	Flow Control	Unsubmerged
Inlet Type	Mitered to slope	Area Full	3.1 ft²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

Culvert Calculator Report
existing 30"

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	3.00	ft	Headwater Depth/ Height	1.43	
Computed Headwater Elevation	34.78	ft	Discharge	34.00	cfs
Inlet Control HW Elev	34.78	ft	Tailwater Elevation	32.03	ft
Outlet Control HW Elev	34.74	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	31.21	ft	Downstream Invert	29.53	ft
Length	126.60	ft	Constructed Slope	0.013270	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.58	ft
Slope Type	Steep		Normal Depth	1.57	ft
Flow Regime	N/A		Critical Depth	1.98	ft
Velocity Downstream	10.36	ft/s	Critical Slope	0.007317	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	34.74	ft	Upstream Velocity Head	1.03	ft
Ke	0.50		Entrance Loss	0.52	ft

Inlet Control Properties					
Inlet Control HW Elev	34.78	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	4.9	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

JR Engineering Ltd
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Culvert Calculator Report
New Life Church 24" culvert, North Drive

Solve For: Discharge

Culvert Summary			
Allowable HW Elevation	3.50 ft	Headwater Depth/ Height	1.25
Computed Headwater Elevation	3.50 ft	Discharge	14.18 cfs
Inlet Control HW Elev	3.17 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev	3.50 ft	Control Type	Outlet Control

Grades			
Upstream Invert	1.00 ft	Downstream Invert	0.80 ft
Length	40.00 ft	Constructed Slope	0.005000 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.36 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.36 ft
Velocity Downstream	6.25 ft/s	Critical Slope	0.020778 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	3.50 ft	Upstream Velocity Head	0.32 ft
Ke	0.70	Entrance Loss	0.22 ft

Inlet Control Properties			
Inlet Control HW Elev	3.17 ft	Flow Control	Unsubmerged
Inlet Type	Mitered to slope	Area Full	3.1 ft²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

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DRAINAGE MAP

HYDROLOGIC CALCULATIONS