BELL ROAD PROJECT DRAINAGE STUDY

CALCULATIONS

DRAINAGE AREAS 1, 2 and 3

A530.801

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Description BELL Rd ON-SITE RUNOFF CALC.
E123061 J0501
Calculated by TMO Date 11/11/86 Sheet No. 1
Checked by _____ Date _____ of 1

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Flood Control District of MC Library
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Phoenix, AZ 85009

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation BELL Rd ON-SITE (2640' x 110')

Area 0.010 square miles

Upstream Elevation _____ Hydraulic Length 2640 feet

Downstream Elevation _____ Slope 0.0035 feet/feet

024

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment

Weighted CN= 98

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.016 L= 20.5 mi Lc 0.25 mi	L= _____ ft CN= _____
S= 18.5 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.10 hours	

Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: DRAINAGE AREA 1 (EX & FUTURE)
E123068. J0501
Calculated by: TMD Date: 8/15/86 Sheet No. 1
Checked by: M.C. Date: 8-28 of 6

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~101~~ 1001

Area: 0.07 square miles

Upstream Elevation: 1331 Hydraulic Length: 13,200 feet

Downstream Elevation: 1257 Slope: 0.0056 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.07	100%	RAILROAD	ROW	EX	B	79	DESERT (SCARIFIED)

Weighted CN= 79

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 2.50 mi Lc 1.26 mi	L= ft CN=
S= 29.6 ft/mi	S= % Lag= hours
Lag= 0.58 hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description

E123061 J0501

Calculated by TLD Date 8/15/86 Sheet No. 2

Checked by MC Date 8/20 of 6

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation (102) 1002

Area 0.10 square miles

Upstream Elevation 1292 Hydraulic Length 15,300 feet

Downstream Elevation 1197 Slope 0.0056 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.09	90%	RAILROAD	ROW	EX	B	79	DESERT
0.01	10	Co.	STREET			98	GRAND AVE

Weighted CN= (80.9) 81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 2.89 m; Lc 1.45 m;	L= ft CN=
S= 79.3 ft/m;	S= % Lag= hours
Lag= 0.65 hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TMP Date 8/15/86 Sheet No. 3
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(103)~~ 1003

Area 0.07 square miles

Upstream Elevation 1257 Hydraulic Length 13200 feet

Downstream Elevation 1197 Slope 0.0045 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.07	100	RAILROAD	ROW	EX	B	80	SUBTRACTED DEBRIET

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.035 L= 2.50 m; Lc 1.25 m;	L= ft CN=
S= 24.0 ft/m;	S= % Lag= hours
Lag= 0.61 hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TND Date 8/15/86 Sheet No. 4
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation (104) 1004

Area 0.09 square miles

Upstream Elevation 1220 Hydraulic Length 3300 feet

Downstream Elevation 1197 Slope 0.0070 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
009	100%	MARICOPA Co.		EXISTING	B	98	ALMOST COMPLETE ASPHALT PAVING

Weighted CN= 98

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.020 L= 0.62 mi Lc 0.31 mi	L= ft CN=
S= 36.8 ft/mi	S= % Lag= hours
Lag= 0.13 hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: _____ Date: _____ Sheet No. 5
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 1002

Area 0.10 square miles

Upstream Elevation 1282 Hydraulic Length 15,300 feet

Downstream Elevation 1197 Slope 0.0056 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.02	20%			FUTURE	–	98	GRAVEL AVE
0.08	80%				B	79	

Weighted CN= 82.2 (83)

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 2.89 mi Lc 1.45 mi	L= _____ ft CN= _____
S= 29.3 ft/mi	S= _____ % Lag= _____ hours
Lag= 0.65 hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123068 J0501
Calculated by: ____ Date: ____ Sheet No. 6
Checked by: ____ Date: ____ of 6

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 1002

Area 0.10 square miles

Upstream Elevation 1282 Hydraulic Length 15,300 feet

Downstream Elevation 1197 Slope 0.0056 feet/feet

GRAND AVE. EXPRESSWAY ASSUMPTION FOR FUTURE EXPANSION } 1/2 OF ROW DRAINS TO DA 1002 = 75'
OF THE 75', 40' is ROAD w/ 5' SHOULDERS ON EACH SIDE
CN= 67% (98) + 33% (80) = 92.1 (92)

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.04	40	COUNTY	ROW/ROAD	FUTURE	B	92	
0.06	60	"	ROW	"	B	99	

Weighted CN= (84.2) 84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
* N= 0.026 L= 2.89 mi Lc 1.45 mi	L= ____ ft CN= ____
S= 29.3 ft/mi	S= ____ % Lag= ____ hours
Lag= 0.57 hours	Adjust Lag:

* - REFLECTS INCREASED STREET COVERAGE

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description DA 2 - EXISTING -
E123068 J0501
Calculated by TMD Date 8/86 Sheet No. 1
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(203)~~ ~~201~~ 2001

Area 0.68 square miles

Upstream Elevation 1375 Hydraulic Length 8200 feet

Downstream Elevation 1310 Slope 0.0079 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.035	5%	MARICOPA Co.	R-43	EX	B	79	
0.028	4%	"	R43		D	86	
		"	N/A				
0.274	42				B	79	NATURAL
0.336	49				D	86	NATURAL

60% D
10% B

Weighted CN= ~~82.71~~ 83

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N=_____ L=_____m; Lc_____m;	L= 8200 ft CN= 83
S=_____ft/m;	S= 0.79 % ADJ Lag= 1.64 hours
Lag=_____hours	

Adjust Lag:
~ 10% OF AREA IMPERVIOUS
FIG 3.5
w/ CN=83 ∴ LF ≐ 0.94
1.74 HRS (0.94)

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by TMO Date 8/86 Sheet No. 2
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(210) 202~~ 2002

Area 0.85 square miles

Upstream Elevation 1312 Hydraulic Length 5300 feet

Downstream Elevation 1278 Slope 0.0064 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.27	32	C.O. PEORIA		EX.	B	79	DESERT
0.58	68				D	89	DESERT

Weighted CN= (85.8) 86

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= L= m; Lc m;	L= 5300 ft CN= 86
S= ft/m;	S= 0.64 % Lag= 1.23 hours
Lag= hours	Adjust Lag:

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Description: E123068 J0501

Calculated by TMD Date 8/15/86 Sheet No 13

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2003 X

Area 0.90 square miles

Upstream Elevation 1278 Hydraulic Length 5300 feet

Downstream Elevation 1248 Slope 0.0057 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.22	25	C. OF PEORIA		EX	D	89	DESERT
0.68	75				B	79	DESERT

Weighted CN= (31.5) 82

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ mi Lc _____ mi	L= 5300 ft CN= 82
S= _____ ft/mi	S= 0.57 % Lag= 1.50 hours
Lag= _____ hours	Adjust Lag: X

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Description E123061 J6501
Calculated by TNS Date 8/86 Sheet No 1/4A
Checked by ML Date 8-28 of 1/29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2002/~~A~~2003 Q2002 TMO 9/2/86

Area 1.75 square miles

Upstream Elevation 1312 Hydraulic Length 10,600 feet

Downstream Elevation 1248 Slope 0.0060 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.85	49%	Peoria		EX		86	
0.90	51%					82	

SEE INDIVIDUAL BREAKDOWN

Weighted CN= 84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$
N= ____ L= ____ mi Lc ____ mi	L= 10,600 ft CN= 84
S= ____ ft/mi	S= 0.60 % Lag= 2.38 hours
Lag= ____ hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description S. A #2 W/ALL 2
E123068 J0501
Calculated by TMD Date 8/10/86 Sheet No. 4
Checked by MC Date 8/27 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(213) 203~~ 2004

Area 1.00 square miles

Upstream Elevation 1281 Hydraulic Length 7150 feet

Downstream Elevation 1248 Slope 0.0046 feet/feet

LAND USE

.2-D
.8-B
0.35-ORCH

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.27	27%	C. OF PEORIA		EX	B	55	ORCHARD
0.10	10%				D	77	ORCHARD
0.53	53%				B	79 ✓	DESERT
0.10	10%				D	89	DESERT

Weighted CN= (73.3) 73

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= 0.055 L= 1.25 mi Lc 0.68 mi	L= 7150 ft CN= 73
S= 24.44 ft/mi	S= 0.46 % Lag= 2.77 ✓ hours
Lag= 0.44 hours	Adjust Lag: N/A

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TMD Date 8/86 Sheet No. 5
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(221)~~ 2005 ~~204~~ (WESTBROOK)

Area 1.00 square miles

Upstream Elevation 1248 Hydraulic Length 9100 feet

Downstream Elevation 1223 Slope (0.0049) 0.0027 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.3	30	C. OF PEORIA	R1-8-14	EX & FUT.	B	81	S. FAMILY
.23	23	"	R2	"		61	G. COURSE
.17	17	"	R2			85	CONDO
.13	13		R3			85	PATIO
.10	10		C-1			85	APTS
0.07	7					92	COMM.

Weighted CN= (78.3) 79

Kinematic

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= L= mi Lc mi	L= 9100 ft CN=
S= ft/mi	S= 0.27 % Lag= hours
Lag= hours	

Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: Small Area
E123061 J0501
Calculated by: [illegible] Date: 8/19/86 Sheet No. 26
Checked by: [illegible] Date: 8/28 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~(215) 205~~ 2006

Area: 1.00 square miles

Upstream Elevation: 1255 Hydraulic Length: 6,650 feet

Downstream Elevation: 1223 Slope: 0.0047 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.05	5%	C. OF PEORIA		EX	D	89	DESERT
0.95	95				B	79	DESERT

Weighted CN= ~~(79.5)~~ 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.035 L= 1.26 mi Lc 0.63 mi	L= 6650 ft CN= 80
S= 25.40 ft/mi	S= 0.48 % Lag= 2.09 hours
Lag= 0.42 hours	Adjust Lag: N/A

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123068. J0501

Calculated by TMD Date 8/86 Sheet No. 7

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(216)~~ 206 2007

Area 0.27 square miles

Upstream Elevation 1223 Hydraulic Length 6250 1.18 feet

Downstream Elevation 1199 Slope 0.0032 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.03	11	C. OF PEORIA		EX.	D	89	DESERT
0.24	89				B	79	DESERT

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= 0.03 L= 1.18 mi Lc 0.59 mi	L= 6250 ft CN= 80
S= 20.34 ft/mi	S= 0.38 % Lag= 2.23 hours
Lag= 0.35 hours	Adjust Lag: N/A

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date 8/86 Sheet No. 8
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(2127) 207~~ 2008

Area 0.24 square miles

Upstream Elevation 1224 Hydraulic Length 6700 feet

Downstream Elevation 1199 Slope 0.0037 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.02	8	C. OF PEORIA		EX	-	98	STREET
0.22	92				B	79	DESERT

Weighted CN= 1806 81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{\frac{1}{2}}$
N= 0.03 L= 1.27 mi Lc 0.63mi	L= 6700 ft CN= 81
S= 19.68 ft/mi	S= 0.37 % Lag= hours
Lag= 0.38 hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: JWD Date: 8/86 Sheet No. 9
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~(213) 2083~~ 2009

Area: 0.25 square miles

Upstream Elevation: 1226 Hydraulic Length: 6100 (300/5800) feet

Downstream Elevation: 1199 Slope: 0.0044 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	ACT./EQUIV. Zoning (ZONE CHANGE)	Development Status	Soil Group	CN	Comment
0.23	92	C. of PEORIA	R1-6	EX.	B	84	–
0.02	8		C-2		B	94	–

Weighted CN= ~~248~~ 85

Large or Elongated Watersheds	Small, Uniform Watersheds (KINEMATIC)
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____m; Lc____m;	L=____ft CN=____
S=____ft/m;	S=____% Lag=____hours
Lag=____hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068. J0501
Calculated by TWD Date 8-86 Sheet No. 10
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation (~~219~~ ~~209~~) #2010

Area 0.18 square miles

Upstream Elevation 1227 Hydraulic Length 5450 feet

Downstream Elevation 1204 Slope 0.0042 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.18	100%	C. OF PEORIA		EX	B	55	ORCHARD

Weighted CN= 55

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 1.03 mi Lc 0.52 mi	L= 5450 ft CN=
S= 22.33 ft/mi	S= 0.42 % Lag= hours
Lag= 0.32 hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TWD 18K Date 8/86 Sheet No. 11
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(224) 211~~ 2011

Area 0.12 square miles

Upstream Elevation 1245 Hydraulic Length 3,960 feet

Downstream Elevation 1244 Slope ~~0.0010~~ DEF. → 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.12	100%	Maricopa Co.	RH-10	Existing	D	89	Sun City Single Family

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____ mi Lc____ mi	L=____ ft CN=____
S=____ ft/mi	S=____ % Lag=____ hours
Lag=____ hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: Sun City - INBET FLOWS 2YR
E123068 J0501
Calculated by: [illegible] Date: 8/18/86 Sheet No. 12
Checked by: [illegible] Date: [illegible] of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

W2-SCW2

Drainage Area Designation: ~~(227)~~ ~~(210)~~ ~~2011~~ 2012

Area: 0.06 square miles

Upstream Elevation: 1248 Hydraulic Length: 2070 feet

Downstream Elevation: 1241 Slope: 0.0034 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Sun City Comment
.06	100%	Maricopa Co.	R1-10	Existing	D	89	Single Family

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N=____ L=____ mi Lc____ mi	L=____ ft CN=____
S=____ ft/mi	S=____ % Lag=____ hours
Lag=____ hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TMO/DK Date 8/86 Sheet No. 13
Checked by mi Date 8/86 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(225) 212~~ 2013

Area 0.10 square miles

Upstream Elevation 1237 Hydraulic Length 3740 feet

Downstream Elevation 1227 Slope 0.0027 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.09	85%	Maric. Co.	R1-10	Existing	D	89	Single Family
.10	15%		C-1	"	D	95	Commercial

.85(89) + .15(95) =

Weighted CN= (89.9) 90

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____m; Lc____m;	L=____ft CN=____
S=____ft/m;	S=____% Lag=____hours
Lag=____hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by JLD/DK Date 8/86 Sheet No. 14
Checked by [illegible] Date 8/28 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(228) 213~~ 2014

Area 0.12 square miles

Upstream Elevation 1241 Hydraulic Length 3110 feet

Downstream Elevation 1227 Slope 0.0045 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.06	50%	Maric. Co	R1-10	Existing	D	89	Single Family
.06	50%	"	R2	"	D	90	Multifamily

Weighted CN= (89.5) 90

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____mi Lc____mi	L=____ft CN=____
S=____ft/mi	S=____% Lag=____hours
Lag=____hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date 8/86 Sheet No. 15
Checked by [illegible] Date 8/18 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~2016~~ 2015

Area 0.05 square miles

Upstream Elevation 1228 Hydraulic Length 2010 feet
HEF. 0.0025

Downstream Elevation 1223 Slope ~~0.0017~~ feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Sun City Comment
.03	55%	Maric Co.	R1-10	Existing	D	89	Single Family
.02	45%		C-O	"	D	93	Commercial

.55(89) + .45(93) = 90.80

Weighted CN= (90.8) 91

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= L= mi Lc mi	L= ft CN=
S= ft/mi	S= % Lag= hours
Lag= hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TND/PK Date 8/86 Sheet No. 16
Checked by [illegible] Date 8/28 of 20

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(229)~~ ~~215~~ 2016

Area 0.04 square miles

Upstream Elevation 1228 Hydraulic Length 3240 feet

Downstream Elevation 1223 Slope ~~0.0015~~ DEF. 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment (Sun City)
.02	55%	Maric Co.	C-O	Existing	D	93	Commercial
.02	45%		R-2	"	D	90	Multifamily

$.55(93) + (.45)(90) = 91.65$

Weighted CN= (91.65) 92

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N=____ L=____m; Lc____m;	L=____ft CN=____
S=____ft/m;	S=____% Lag=____hours
Lag=____hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date [illegible] Sheet No. 17
Checked by [illegible] Date [illegible] of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(2010) 2.17~~ 2017

Area 0.11 square miles

Upstream Elevation 1243 Hydraulic Length 5200 feet

Downstream Elevation 1224 Slope 0.0037 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Sun City Comment
0.11	100%	Maric Co.	G. Course	Existing	D	80	GOLF COURSE

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n $((L\ Lca)/S^{0.5})^{0.38}$	Lag = $L^{0.8}\ (1000/(CN - 9))^{0.7}/1900\ S^{\frac{1}{2}}$
N= .03 L= .98 mi Lc .49 mi	L= ft CN=
S= 19.29 ft/mi	S= % Lag= hours
Lag= 0.31 hours	
	Adjust Lag: N/A

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description

E123068 J0501

Calculated by [illegible] Date 8 Aug Sheet No. 18

Checked by [illegible] Date 8/28 of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(23)~~ ~~(216)~~ 2018

Area 0.09 square miles

Upstream Elevation 1248 Hydraulic Length 6900 feet

Downstream Elevation 1224 Slope 0.0035 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.09	100%	Maric Co.	R1-10	Existing	D	89	Sun City Single Family

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____ mi Lc____ mi	L=____ ft CN=____
S=____ ft/mi	S=____ % Lag=____ hours
Lag=____ hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TMD/DC Date 3/3/6 Sheet No. 19
Checked by Date of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation (~~[illegible]~~) 2019

Area 0.08 square miles

Upstream Elevation 1224 Hydraulic Length 2580 feet

Downstream Elevation 1213 Slope 0.0043 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.04	50%	Maric Co.	R2	Existing	D	90	Multi family Res.
0.04	50%	"	C-O	"	D	93	Commercial

Sun City

$(.5 \times 90) + (.5 \times 93) = 91.5$

Weighted CN= (91.5) 92

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=____ L=____ mi Lc____ mi	L=____ ft CN=____
S=____ ft/mi	S=____ % Lag=____ hours
Lag=____ hours	Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061. J0501
Calculated by: TJO/DK Date: 8/86 Sheet No. 20
Checked by: _____ Date: _____ of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~(232) 218~~ 2020

Area: 0.34 square miles

Upstream Elevation: 1224 Hydraulic Length: 5040 feet

Downstream Elevation: 1212 Slope: ~~0.0024~~ DEF 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment (Sun City)
.19	55%	Maric Co.	G. Course	Existing	D	80	Golf Course
.05	15%		R1-10	"	D	89	Single Family
.07	20%		R2	"	D	90	Multifamily
.03	10%		R3		D	90	Multifamily

.55(80) + .15(89) + .20(90) + .10(90) = 84.35

Weighted CN = ~~(84.35)~~ 84

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= _____ L= _____ mi Lc _____ mi	L= 5040 ft CN= 84
S= _____ ft/mi	S= .24 % ADJ. Lag= 1.36 hours
Lag= _____ hours	

Adjust Lag: ~40% impervious area
(2) FROM Fig 3-5 (JR-55) w/CN of 84: L.F. = 0.81
CHANNEL IMPROVEMENTS (STREETS) HAVE OCCURRED ALONG ~40% OF WATER COURSE
(1) FROM Fig 3.4 (JR-55) w/ 84 ∴ LF = 0.81

2.03 HRS (0.81)(0.81) = 1.36 HRS

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Description: E123068 J0501
Calculated by: TWD Date: 8/86 Sheet No. 21
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: 2021

Area: 0.13 square miles

Upstream Elevation: 1212 Hydraulic Length: 4600 feet

Downstream Elevation: 1199 Slope: 0.0028 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	100	Maric Co.	-	EX	D	80	Sun City GOLF COURSE

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= 0.03 L= 0.37 mi Lc 0.43 mi	L= ____ ft CN= ____
S= 14.94 ft/mi	S= ____ % Lag= ____ hours
Lag= 0.30 hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by TMO/PK Date 8/86 Sheet No. 22
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(223) 220~~ 2022

Area 0.39 square miles

Upstream Elevation 1222 Hydraulic Length 7060 feet

Downstream Elevation 1195 Slope 0.0038 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.39	100	Maric Co	R1-10	EX "	D	89	Sun City Single Family

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = $24n\ (L\ Lca/S^{0.5})^{0.38}$	Lag = $L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N=____ L=____m; Lc____m;	L=____ft CN=____
S=____ft/m;	S=____% Lag=____hours
Lag=____hours	Adjust Lag:

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~221~~ ~~2022~~ 2023

Area 0.16 square miles

Upstream Elevation 1225 Hydraulic Length 4090 feet

Downstream Elevation 1217 Slope ~~0.0025~~ DEF 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.16	100%	Maric Co	R1-10	Existing	D	89	Sun City Single Family

Weighted CN= 89

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=_____ L=_____m; Lc_____m;	L=_____ft CN=_____
S=_____ft/m;	S=_____% Lag=_____hours
Lag=_____hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by TJD DL Date 9/86 Sheet No. 24
Checked by Date of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~222~~ ~~2023~~ 2024

Area 0.11 square miles

Upstream Elevation 1224 Hydraulic Length 4200 feet

Downstream Elevation 1216 Slope ~~0.0019~~ DEF. → 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.11	100%	Maric Co	G. Course	Existing	D	80	Sun City GOLF COURSE

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= .03 L= .80 mi Lc .44 mi	L= ft CN=
S= 10.05 ft/mi	S= % Lag= hours
Lag= 0.31 hours	

Adjust Lag:

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: TM/PK Date: 8/86 Sheet No. 25
Checked by: _____ Date: _____ of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~223~~ ~~2024~~ 2025

Area: 0.11 square miles

Upstream Elevation: 1217 Hydraulic Length: 4060 feet (110/3950)

Downstream Elevation: 1202 Slope: 0.0037 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment (Sun City)
.02	15%	Maric Co.	C-1	Existing	D	95	Commercial
.09	85%	"	R1-10	"		89	Single Family Res.

$(.15 \times 95) + (.85 \times 89) = 89.90$

Weighted CN = (90.1) 90

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= _____ ft CN= _____
S= _____ ft/m;	S= _____ % Lag= _____ hours
Lag= _____ hours	Adjust Lag:

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~2025~~ 2026

Area .06 square miles

Upstream Elevation 1217 Hydraulic Length 3200 feet

Downstream Elevation 1204 Slope 0.0058 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.06	100%	Maric Co.	G. Course	Existing	D	80	Sun City GOLF COURSE

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= .03 L= .61 mi Lc .32 mi	L= ft CN=
S= 21.45 ft/mi	S= % Lag= hours
Lag= 0.21 hours	Adjust Lag:

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Description: E123061 J0501
Calculated by: DMD/KK Date: 9/96 Sheet No. 22
Checked by: _____ Date: _____ of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: ~~225~~ ~~2026~~ 2027

Area: 0.30 square miles

Upstream Elevation: 1220

Downstream Elevation: 1202

Hydraulic Length: 8190 feet (110/8080)

Slope: ~~0.0022~~ 0.0025 feet/feet (IEF→) 0.00060

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.28	95%	Maric Co	R1-10	Existing	D	89	Single Family Res.
.02	5%		C-1	"		95	Commercial

Sun City

.05(95) + .95(89) = 89.30

Weighted CN= (89.4) 89

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=_____ L=_____m; Lc_____m;	L=_____ft CN=_____
S=_____ft/m;	S=_____% Lag=_____hours
Lag=_____hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description

E123068. J0501

Calculated by TYP PK Date 8/86 Sheet No. 23

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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(2368) 2260~~ ~~2027~~ 2028

Area 0.17 square miles

110/4650

Upstream Elevation 1214 Hydraulic Length 4760 feet

Downstream Elevation 1201 Slope 0.0027 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Sundry Comment
.14	85%	Maric Co	RH-10	Existing	D	89	Single Family
.03	15%	"	C-1	"		95	Commercial

.85(89) x .15(95) = 89.90

Weighted CN= (90.0) 90

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= L= m; Lc m;	L= ft CN=
S= ft/m;	S= % Lag= hours
Lag= hours	Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description

E123068 J0501

Calculated by TVP Date 9/8/ Sheet No. 20

Checked by Date of 29

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation ~~(2021)~~ ~~2028~~ 2029

Area 0.30 square miles

Upstream Elevation 1212 Hydraulic Length 4660 feet

Downstream Elevation 1200 Slope 0.0026 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.21	70%	Maric Co	R2	Existing	D	90	Multifamily
.09	30%		C-O	"	D	93	Commercial

.7(90) + .3(93) = 90.90

Weighted CN= (90.9) 91

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= L= m; Lc m;	L= ft CN=
S= ft/m;	S= % Lag= hours
Lag= hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123061 J0501
Calculated by TMO Date 8/27/86 Sheet No.
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BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation (211) 2030

Area 0.50 square miles

Upstream Elevation 1313 Hydraulic Length 5300 feet

Downstream Elevation 1278 Slope 0.0066 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	ACT. Zoning	Development Status	Soil Group	CN	Comment
0.38	75		RH-8	EX.	B	80	
0.12	25		-		B	79	DESERT

Weighted CN= (798) 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N= L= m; Lc m;	L= 5300 ft CN= 80
S= ft/m;	S= 0.66 % Lag= (1.49) 1.31 hours
Lag= hours	Adjust Lag: ASSUME - 20% IMP. FIG 3.5 LF = 0.88
	0.88(1.49) =

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Job: BELL ROAD MASTER DRAINAGE STUDY
Description: E123061 J0501
Calculated by: TMD Date: 8/27/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: 2031

Area: 0.50 square miles

Upstream Elevation: 1313 Hydraulic Length: 5300 feet

Downstream Elevation: 1279 Slope: 0.0064 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.06	12		–	EXISTING	D	77	Citrus
0.10	20		–		B	55	Citrus
0.07	4		R1-18		D	87	
0.32	64		R1-18		B	80	

Weighted CN= (74.9) 75

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= ____ L= ____ mi Lc ____ mi	L= 5300 ft CN= 75
S= ____ ft/mi	S= 0.64 % Lag= 1.63 (1.95) hours
Lag= ____ hours	

Adjust Lag:

ASSUME 15% IMP. FIG 3-5 I.F = 0.93

1.95(0.93) =

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Job: BELL ROAD PROJECT DRAINAGE

Description: E123061 J0501

Calculated by _____ Date _____ Sheet No

Checked by _____ Date _____ of

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2008A *

Area 0.18 square miles

Upstream Elevation 1224 Hydraulic Length 5280 feet

Downstream Elevation 1199 Slope 0.0047 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.18	100	PEORIA	COMM	FUTURE	B	92	

Weighted CN= 92

KINEMATIC

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{\frac{1}{2}}$
N= _____ L= _____ mi Lc _____ mi	L= _____ ft CN= _____
S= _____ ft/mi	S= _____ % Lag= _____ hours
Lag= _____ hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date [illegible] Sheet No. 18
Checked by [illegible] Date 8/28 of 22

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2008

Area 0.24 square miles

Upstream Elevation 1224 Hydraulic Length (6700) 6700 feet

Downstream Elevation 1199 Slope (.0037) 0.0037 feet/feet

0.24

TOTAL 0.24 mi²
.06 → 84
.18 → 92
CN = 90
for summ area calc to get 100y-24

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.06	27%	PEORIA	R1-6	Future	B	84	Resid./Med. Density
.18	73%			"	B	92	Commercial

Weighted CN= ~~84~~ 90 *

(~~0.22 mi² [illegible] commer. develop~~)

Large or Elongated Watersheds ✓	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38 (0.020) (1.14) 0.59	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½ (6000) (92)
N= (21.93) L= m; Lc m;	L= (.37) ft CN= (1.48)
S= (0.22) ft/m;	S= % Lag= hours
Lag= hours	

Adjust Lag:
(90%) Fig 3.5 → Lag ≈ .07

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date [illegible] Sheet No. 19
Checked by [illegible] Date 8-20 of 22

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2009

Area .25* square miles

Upstream Elevation 1226 Hydraulic Length (6100) 6700 feet

Downstream Elevation 1199 Slope (.0044) feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.23	92	PEORIA	R1-6	Future	B	84	Resid./Med. Density
0.02	8		C-2	BUILT	B	94	COMM.

Weighted CN= 84.85*

*(reduce area due to comm. [illegible] on site det.)

Kinematic

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= L= m; Lc m;	L= ft CN=
S= ft/m;	S= % Lag= hours
Lag= hours	

Adjust Lag:

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description
E123068 J0501
Calculated by [illegible] Date 3 [illegible] Sheet No. 20
Checked by [illegible] Date 8/28 of 22

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2010

Area .18* square miles

Upstream Elevation 1227 Hydraulic Length (5450) 6000 feet

Downstream Elevation 1204 Slope (.0042) 0.0038 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
.05	28%	PEORIA		Future	B	92	Commercial
.13	100%		R1-6	"	B	84	Resid./Med Density

TOTAL (0.18 mi²)
.05 → 92
0.13 → 84
86 for comm. area calc of 100-yr-24 rate

Weighted CN= 86*

Large or Elongated Watersheds ✓	Small, Uniform Watersheds
Lag = 24n (L Lca/S^0.5)^0.38 (0.020)	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½ (1000) (92)
N= ____ L= ____ mi Lc ____ mi	L= ____ (0.0042) ft CN= ____
S= ____ ft/mi	S= ____ % Lag= ____ hours (0.32)(.7) = 0.22 HRS
Lag= ____ hours	

For calc of [illegible] relation of [illegible] area for 100-yr-24 hr storm

Adjust Lag:

~~100%~~ (% IMP) FIG 3.5 → L.F. = .7

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123068 J0501
Calculated by: TMD Date: 8/27/86 Sheet No. 21
Checked by: mc Date: 8-28 of 22

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 202.1

Area 0.50 square miles

Upstream Elevation 1313 Hydraulic Length 5300 feet

Downstream Elevation 1279 Slope 0.0064 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.40	80		R1-18	FUTURE	B	80	
0.10	20		R1-18	"	D	87	

Weighted CN= (81.4) 81

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= ____ L= - m; Lc ____ m;	L= 5300 ft CN= 81
S= ____ ft/m;	S= 0.64 % Lag= 0.80 (1.46) hours
Lag= ____ hours	

Adjust Lag:
ASSUME PAVED STREETS ~ 50% IMP. CHANNELS
FIG 3.4 LF=.71
assume 40% impervious
fig 35 LF= 76
1.49(0.71)(0.76) = 0.80

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Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: E123061 J0501
Calculated by: TMD Date: 8/-2/92 Sheet No. 22
Checked by: [illegible] Date: 8/28 of 27

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation 2030

Area 0.50 square miles

Upstream Elevation 1313 Hydraulic Length 5300 feet

Downstream Elevation 1278 Slope 0.0066 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.50	100%		R1-18	FUTURE	B	80	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds ✓
Lag = 24n (L Lca/S^0.5)^0.38	Lag = L^0.8 (1000/CN - 9)^0.7/1900 S^½
N= ____ L= ____ mi Lc ____ mi	L= 5300 ft CN= 80
S= ____ ft/mi	S= 0.66 % Lag= 0.80 (1.49) hours
Lag= ____ hours	

Adjust Lag: ✓
ASSUME PAVED STREETS ~50% IMP. & PARKWAY
FIG 3.4 LF ≐ 0.71
assumed 40% imp. Fig 3.5, L.F. ≐ 0.76
1.49(0.71)(0.76) = 0.80

Greiner Engineering

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Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description DRAINAGE AREA 2
E123061 J0501
Calculated by TMO Date 9/3 Sheet No 1
Checked by _____ Date _____ of 21

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation 2007A

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) ~~0.016~~ 0.030

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 5280 FT.

Channel Slope (S) 0.0045 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) ~~32~~

Channel Bottom Width or Diameter (WD) 32 ft.

Side Slopes (Z) 0

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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation 2007B

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.016

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 5280 FT.

Channel Slope (S) 0.0045 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) T

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

Greiner Engineering

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by TMO Date 9/3 Sheet No 3

Checked by _____ Date _____ of 21

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation Z008A

Overland Flow Length (L) 110 ft.

Slope (S) 0.0047 ft./ft.

Roughness Factor (N) 0.016

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 5280 FT.

Channel Slope (S) 0.0047 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 40 ft.

Side Slopes (Z) 0

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by TMO Date 9/3 Sheet No 4

Checked by _____ Date _____ of 21

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation 20088

Overland Flow Length (L) 110 ft.

Slope (S) 0.0037 ft./ft.

Roughness Factor (N) ~~0.016~~ 0.030

Percentage of Subbasin Area Represented (A) _____

RK CARD

Channel Length (L) 5280 FT.

Channel Slope (S) 0.0037 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 32 ft.

Side Slopes (Z) 0

Greiner Engineering

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description SA-1 BELL ±2 - ALL
E123061 J0501
Calculated by TKD Date 3-10-86 Sheet No 5
Checked by _____ Date _____ of 2

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~2082~~ 2009

Overland Flow Length (L) 110 ft.

Slope (S) 0.0044 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 6100 FT.

Channel Slope (S) 0.0044 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 22 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~211~~ 2011

Overland Flow Length (L) 110 ft.

Slope (S) (DEF) - 0.0025 ~~0.001~~ ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3850 FT.

Channel Slope (S) (DEF) 0.0025 ~~0.001~~ FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

MK CARD

Drainage Area Designation ~~210~~ 2012

Overland Flow Length (L) 110 ft.

Slope (S) 0.0034 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 1960 FT.

Channel Slope (S) 0.0034 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) 0.06 square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

Greiner Engineering

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Job BELL ROAD PROJECT DRAINAGE STUDY

Description E123061 J0501

Calculated by TMD Date 8/18 Sheet No 8

Checked by _____ Date _____ of 21

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~212~~ 2013

Overland Flow Length (L) 110 ft.

Slope (S) ~~0.0027~~ 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3740 FT.

Channel Slope (S) 0.0027 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) – square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~213~~ 2014

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3000 FT.

Channel Slope (S) 0.0045 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~214~~ 2015

Overland Flow Length (L) 110 ft.

Slope (S) 0.0040 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2900 FT.

Channel Slope (S) DEF. 0.0025 0.0017 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) – square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC)

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~215~~ 2016

Overland Flow Length (L) 110 ft.

Slope (S) 0.0040 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3130 FT.

Channel Slope (S) DEF 0.0025 ~~0.0015~~ FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC)

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~216~~ 2018

Overland Flow Length (L) 110 ft.

Slope (S) 0.0035 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 6690 FT.

Channel Slope (S) 0.0035 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC)

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~219~~ 2019

Overland Flow Length (L) 110 ft.

Slope (S) 0.0043 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2470 FT.

Channel Slope (S) 0.0043 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) – square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC)

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~220(A)~~ ~~2002~~ 2022

Overland Flow Length (L) 110 ft.

Slope (S) 0.0071 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 75

RK CARD

Channel Length (L) 7060 FT.

Channel Slope (S) 0.0037 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) 0.39 square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) ~~30~~

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~223~~ ~~2024~~ 2025

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3950 FT.

Channel Slope (S) 0.0037 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) – square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~225~~ ~~2026~~ 2027

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 8080 FT.

Channel Slope (S) 0.0022 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

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BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~226~~ ~~2027~~ 2028

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 4650 FT.

Channel Slope (S) 0.0027 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation ~~2028~~ 2029

Overland Flow Length (L) 110 ft.

Slope (S) 0.0045 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 4550 FT.

Channel Slope (S) 0.0026 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) — square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 36 ft.

Side Slopes (Z) 0

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation 2003A (FUTURE)

Overland Flow Length (L) 110 ft.

Slope (S) 0.0049 ft./ft.

Roughness Factor (N) 0.030

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2400 FT.

Channel Slope (S) 0.0049 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) 0.26 square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 22 ft.

Side Slopes (Z) 0

Greiner Engineering

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Job BELL ROAD PROJECT DRAINAGE STUDY
Description E123061 J0501
Calculated by _____ Date _____ Sheet No 21
Checked by _____ Date _____ of 21

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

WK CARD

Drainage Area Designation 2003B (FUTURE)

Overland Flow Length (L) 110 ft.

Slope (S) 0.0049 ft./ft.

Roughness Factor (N) 0.030

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 6000 FT.

Channel Slope (S) 0.0049 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) 0.43 square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) _____

Channel Bottom Width or Diameter (WD) 32 ft.

Side Slopes (Z) 0

Greiner Engineering

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Phoenix 602 275-5400

Job: Bell Road
Description: DA1- offsite

Calculated by: RB Date: 3-24-87 Sheet No. ____
Checked by: (M) Date: 3-30 of ____

Drainage Area 1

off-site

Existing drainage structures are adequate for 2-year storm for DA 1003 and 1002

Replace 24" CMP in DA 1004
w/ ~~42~~" RCP.
36

Str. No.	Str.	Design flow	Qty	Unit Cost	Est. Cost.
101	~~42~~ 36 "RCP	53	110 LF	~~25~~ 69	~~9,000.~~ 8,000

30% appurtenances ~~3000~~ 2000
Subtotal ~~12000~~ 10,000
20% E+A 2000

total ~~14,000~~ $12,000

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Road
Description Quantities and Cost estimate.

Calculated by RB Date 3-24-87. Sheet No. ____
Checked by ____ Date ____ of ____

Table ____

Estimated Costs
Drainage Area 1 on-site
10-year frequency storm.

on-site
Facilities along Bell Road.

Structure	Quantity	Unit Cost	Estimated Cost
catch basins	74 ea.	$1200 ea.	89000.
24" RCP	2800 L.F.	$39.	109000.
18" RCP	5010 L.F.	$15	75150.
			$273000. Maricopa Co.

30% appurtenances	82000.
Subtotal	355000.
20% Engineering and Admin.	71000.
Total	426,000. Maricopa Co.

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Road
Description: check adequacy of existing culverts in DA 1.
Calculated by: RB Date: 3-24-87. Sheet No. ____
Checked by: (m) Date: 3-30 of ____

Assume that pipe is flowing full and slope = 0.5%.

DA 1003
$Q_2 = 7$ cfs
Exstg culvert 36" RCP

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} =$$

$$= \frac{1.49}{.012}(7.069)(.825)(.071) = 51 \text{ cfs}$$ ok

n = .012
A = 7.069
P = 9.425
$R^{2/3}$ = .825

DA 1004

$Q_2 = 53$ cfs

Exst'g culvert 24" CMP

$$Q = \frac{1.49}{.024} 3.142(.63)(.071) = 8.7 \text{ cfs}$$ N.G.

n = .024
A = 3.142
P = 6.283
$R^{2/3}$ = .63

Try: 42" RCP

Use 36" ϕ with 6' AHW From HEC 5 O.K.

$$Q = \frac{1.49}{.012}(9.621)(.915)(.071)$$

$$= 77.6 \text{ cfs}$$ ok.

n = .012
A = 9.621
P = 10.996
$R^{2/3}$ = .915

Use 42" RCP

DA 1002
$Q_2 = 16$ cfs Exstg culvert 24" RCP

$$Q = \frac{1.49}{.012}(3.142)(.63).071 = 17.45 \text{ cfs}$$ ok.

PROJECT: E123061.

DESIGNER: M.C.

87th Ave. Union Hills - Beardsley Rd.

DATE: A-3

HYDROLOGIC AND CHANNEL INFORMATION

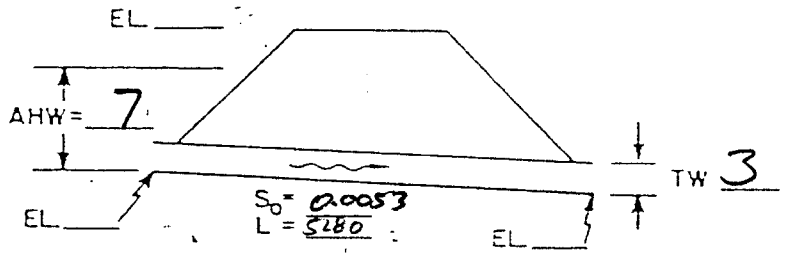
Q_1 = 82 TW$_1$ = _____

Q_2 = _____ TW$_2$ = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

10.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP	82	60"	.76	3.8		0.7/7.4			3		28	-	3.8			over design
RCP	82	48"	1.1	4.4		2.2/23.3						4.7	4.4			O.K.

SUMMARY & RECOMMENDATIONS:

Use 48" RCP

Figure 7

PROJECT: E123061 DESIGNER: M.C.

Bell Road 87th Ave to Nee River DATE: 1-3

HYDROLOGIC AND CHANNEL INFORMATION

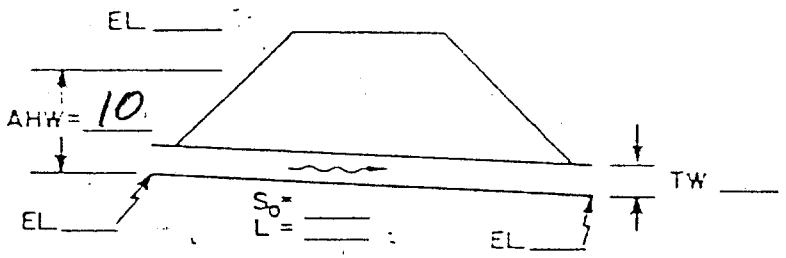
Q_1 = 48 TW_1 = _____

Q_2 = 31 TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



12.00-3.6 MEAN STREAM VELOCITY = _____
1.3 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP	48	48"	0.97	3.4		0.6 / 5.1			4		2	5.1			ℓ = 800	
	48	54"				.49 / 1.8			4½		2	4.3				use
RCP	31	36"	0.92	2.8		1.4 / 2.8			4.3	4.3	1	5.1			ℓ = 650	
	31	42"				.55 / 1.72			4.3			4.0				use

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: E123061

Bell Rd 87th - 91st Ave

DESIGNER: M.C.

DATE: 4-3

HYDROLOGIC AND CHANNEL INFORMATION

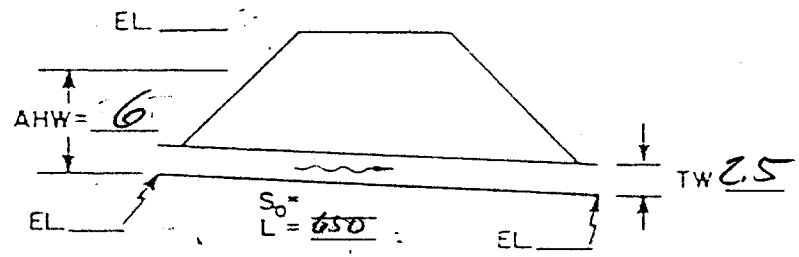
Q_1 = 48 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP	48	42"	0.97	3.4		$\frac{1.5}{2}$			2.5		2.5	2.7	3.1			N.G
RCP	48	36"	1.3	3.9		$\frac{3.25}{5.7}$			"		"	5.7	5.7			~~N.G.~~
	48	48"				$\frac{.75}{1}$			2.5				3			O.K

SUMMARY & RECOMMENDATIONS: use 36" RCP

Figure 7

PROJECT: E123061 DESIGNER: M.C.

Pipe along 91st Ave. between Basins DATE: 4-3

HYDROLOGIC AND CHANNEL INFORMATION

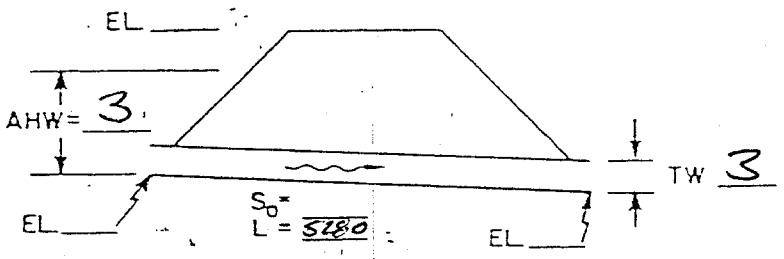
Q_1 = 37 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

10.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL HW=H+h_o−LS$_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS$_o$	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP	37	36	1.08	3.2		2/21			3	3	25	-1				O.K.
									"	"	"					
									"	"	"					

SUMMARY & RECOMMENDATIONS: USE 36" RCP

Figure 7

PROJECT: E123061. 91st Avenue - Bell Road to Union Hills

DESIGNER: M.C.

Outlet Pipe From Basin

DATE: 4-3

HYDROLOGIC AND CHANNEL INFORMATION

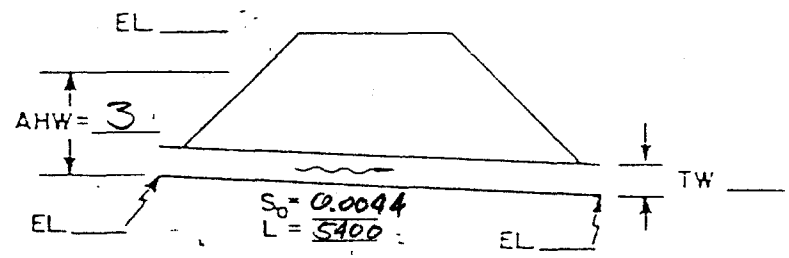
Q_1 = 24 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

10.8 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
RCP	24	24"				51			2	2	23	28		7.6		N.G.
RCP	24	36"	.77	2.3		0.8 / 8.6				3	"	-14		2.3		
RCP	24	30"	1.1	2.8		1.4 / 20.5				2.5	"	-3	2.8			O.K.

SUMMARY & RECOMMENDATIONS: Use 30" RCP

Figure 7

PROJECT: Bell Rd - DA 1 & 2 - ON-SITE - Q_{10}

DESIGNER: TMO

DATE: 12/1/86

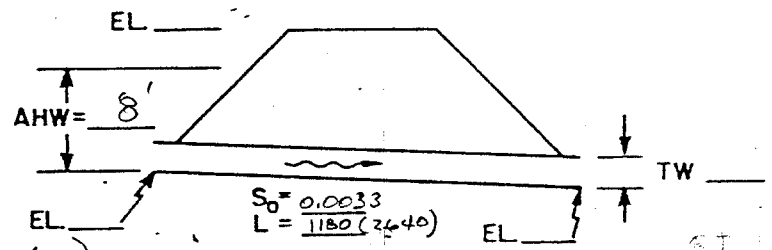
HYDROLOGIC AND CHANNEL INFORMATION

Reach 1 - 2640 - 12 cfs
" 2 - 5280 - 24 "
" 3 - 7920 - 36 "
" 4 - 9100 - 41 "

Q_1 = _____ : TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH Grand Ave to Agua Fria
STATION: (On-site Q_{10})



2.4 (5.3) MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	41	30"				5.3 / 12.7			2.5	2.5	3.9	11.3				NG
"	"	36"	1.12	3.4		2.15 / 5.2			3	3	3.9	4.3	4.3			ok (use)
1-RCP	36	36"	1.03	3.1		1.7 / 9.0			4.3	4.3	8.7	4.6	4.6			ok (use)
1-RCP	24	30"	1.06	2.65		1.9 / 10.1			4.6	4.6	"	6.0	6.0			ok (use)
1-RCP	12	24"	0.96	1.9		1.45 / 7.7			6.0	6.0	"	5.0	5.0			ok (use)

SUMMARY & RECOMMENDATIONS:
Reach 1 → 1-24" Reach 3 → 1-36" RCP
Reach 2 → 1-30" Reach 4 → 1-36" RCP
(Reach's from west to east)

Figure 7

PROJECT: Bell Rd

DESIGNER: YMD

DATE: 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

Reach 1 - 2640 - 12cfs

Reach 2 - 5,400 - 25cfs (2760)

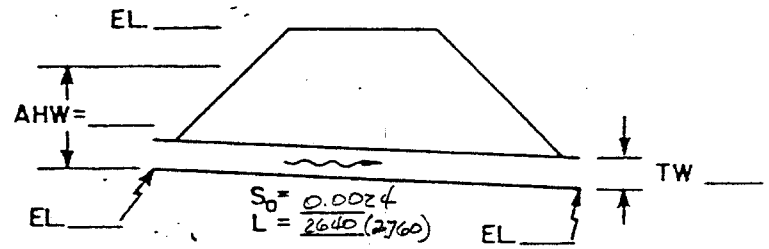
Q_1 = _____ : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Del Webb Blvd to Sun City Channel (115th)



5.3 (5.5) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1- RCP	25	30"	1.11	2.8		2.05/11.3				2.5	6.62	7.2	7.2			ok (use)
1-RCP	12	24"	0.96	1.9		1.45/7.7			7.2	7.2	6.3	8.6				ok (use)

SUMMARY & RECOMMENDATIONS:

Reach 1 - 24" RCP, Reach 2 - 30" RCP

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

DATE: 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 → 2640 - 12cfs

REACH 2 → 4,700 - 21cfs

(2060)

Q_1 = _____ : TW_1 = _____

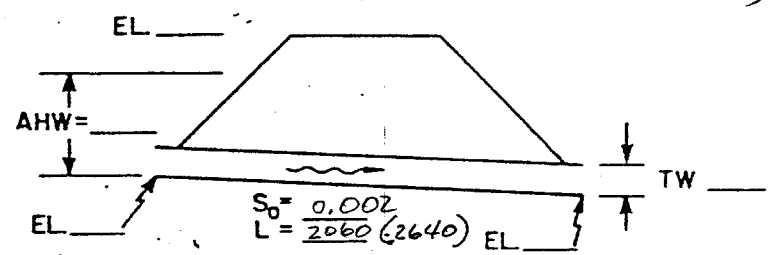
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

DEL WEBB to

STATION: 99th AVE (ON-SITE)



4.1 (5.3) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	21	24"				4.5/10.5			2	2	4.1	16.4				NG
"	21	30"	0.98	2.45		1.45/5.9			2.5	"	"	4.3	4.3			ok (use)
1-RCP	12	24"	0.96	1.92		1.45/7.7			4.3	4.3	5.3	6.7				ok (use)

SUMMARY & RECOMMENDATIONS:

REACH 1 - 24" RCP

REACH 2 - 30" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

Reach 1 → 3300', 15cfs

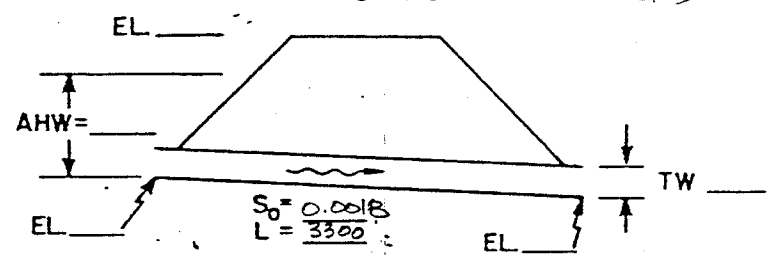
Q_1 = _____ : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Burns Ave to 99th (on-site Q's)



6.6

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	15	24"				2.3/15.2				2	5.9	11.3				NG
"	15	30"				0.73/4.8				2.5	"	1.4				ok (use)

SUMMARY & RECOMMENDATIONS:

1 - 30" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 - 1600' → 7 cfs

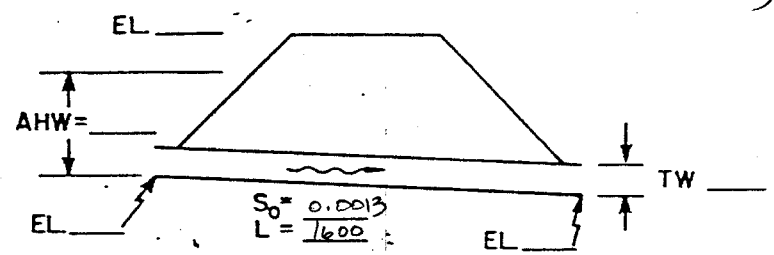
Q_1 = 7 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Burns Ave to DA2007A (on-site)



3.2

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	7	18"	1.1	1.65		2.15 / 6.9				1.5	2.1	6.3	6.3			ok (use)

SUMMARY & RECOMMENDATIONS:

1-18" RCP

Figure 7

PROJECT: Bell Rd D.A. #1 OFF-SITE Q^R Q10

DESIGNER: YMD

DATE: 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

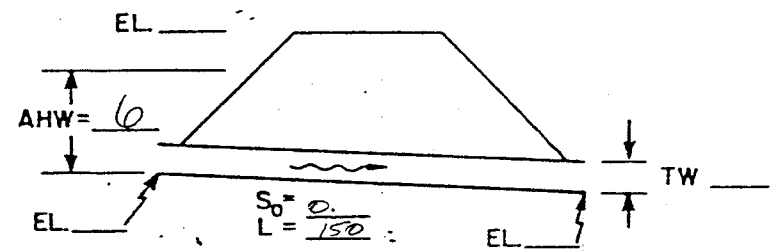
Q_1 = 48 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: GRAND / RAILROAD CULVERT



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	48	36"	1.3	3.9		—										OK
1-RCP	48	30"	2.2	5.5												OK (use)

SUMMARY & RECOMMENDATIONS:

1-30" RCP (24" RCP EXISTING)

Figure 7

PROJECT: Bell Rd

DESIGNER: YMO

DATE: 12/18/86

HYDROLOGIC AND CHANNEL INFORMATION

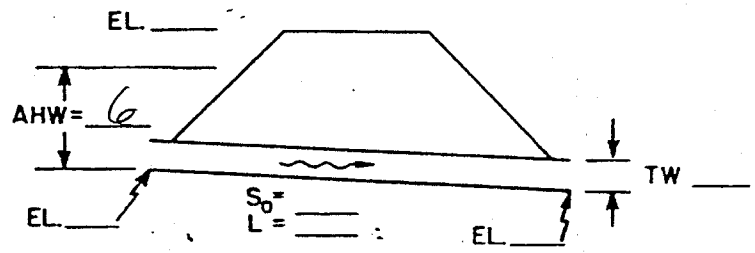
Q_1 = 26 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Railroad/Sun City West (off-site)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	26	24"	2	4												ok (use)

SUMMARY & RECOMMENDATIONS:

1-24" RCP * (36" RCP EXISTING)

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: # 12/1/86

HYDROLOGIC AND CHANNEL INFORMATION

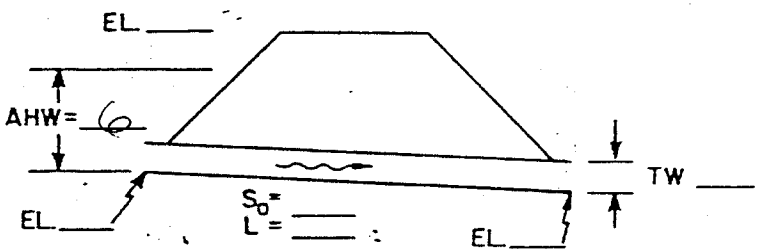
Q_1 = 96 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH Sun City West

STATION: Constr Area (off-site)



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-RCP	48	30"	2.2	5.5"												ok - use

SUMMARY & RECOMMENDATIONS:

2-30" RCP (24 RCP EXISTING)

Figure 7

Q10

PROJECT: Bell Rd -DA-2

DESIGNER: TMO

CONCEPT 1 (COMPLETE SYSTEM to 91st)

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

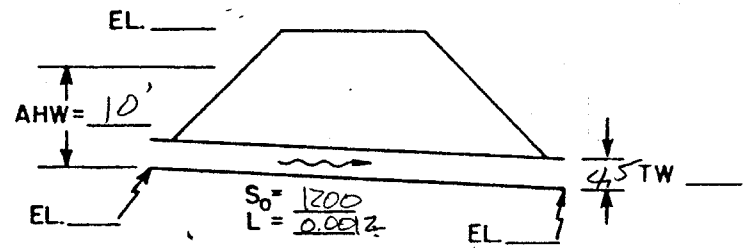
Q_1 = 96 (96) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH DA NEW R to NEW R

STATION:



2.4

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = <

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	96	60"	0.84	4.2		0.98/2.35		.	-	5	1.44	5.9				ok
"	"	54"	1	4.5		1.7/4.08				4.5	"	7.11				ok USE

SUMMARY & RECOMMENDATIONS:

1-54" RCP

Figure 7

PROJECT: BELL Rd

DESIGNER: [illegible]

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

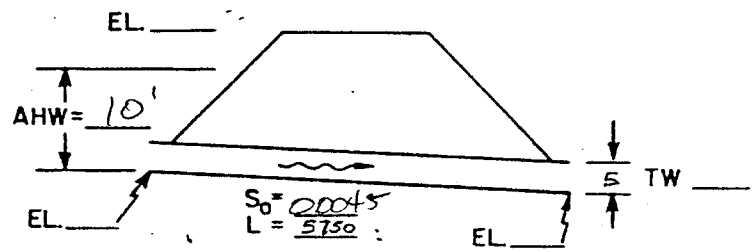
Q_1 = 1317 (1300) TW_1 = _____

Q_2 = 1626 (1650) TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2006 to BELL Rd

STATION: _____



11.5 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
4-RCBC	329	8'x6'	0.98	5.9		1.9 / 21.9				6	25.9	2.0	5.9			ok
4-RCBC	329	8'x5'	1.26	6.3		2.85 / 32.8				5	"	11.9				NG
4-RCBC	329	10'x5'	1	5		1.5 / 17.3				5	25.9	-3.7				OVER USE
4-RCBC	406	10'x5'	1.22	6.1		2.3 / 26.5				"	"	5.6	6.1			ok USE
4-RCBC	406	8'x6'				2.9 / 33.4				6	"	13.4				NG. (SYSTEM UNDER BELL @ 9/5I)

USE

NG

SUMMARY & RECOMMENDATIONS:

4-10'X5' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

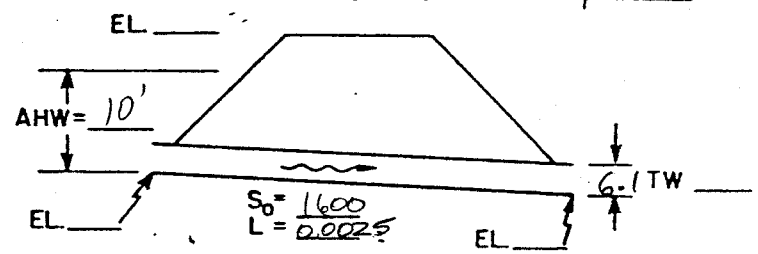
Q_1 = 38 (20) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH FROM 2007A to

STATION: 91st & Bell



3.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	38	42"				0.9 / 2.9			6.1	6.1	4	5.0				ok
1-RCP	38	36"	1.09	3.3		1.95 / 6.24			"	"	"	8.3	8.3			ok (USE)

SUMMARY & RECOMMENDATIONS:

1-36" RCP

Figure 7

PROJECT: BELL

DESIGNER: TWO

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

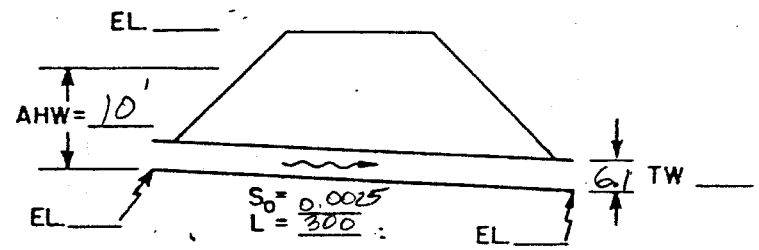
Q_1 = 351 (351) : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE , SAY Q_{25}
Q_2 = CHECK DISCHARGE , SAY Q_{50} OR Q_{100})

SKETCH 2008B to

STATION : BELL & 91st



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	351	8'x4'	1.83	7.3		5.2/3.1			6.1	6.1	0.75	8.5	8.5			ok (use)
1-RCBC	351	8'x5'	1.28	6.4		3.1/1.9			"	"	"	7.2	7.2			

SUMMARY & RECOMMENDATIONS:

1-8'x5 RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

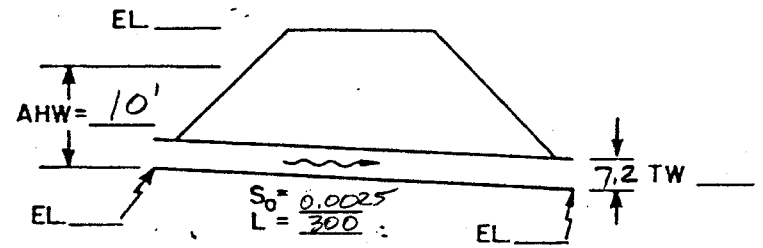
Q_1 = 314 (310) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2009 to 2008B

STATION: _____



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	314	8'x4'	1.63	6.5		4.2/2.5			7.2	7.2	0.75	9.0	9.0			o/k (USE)

SUMMARY & RECOMMENDATIONS:

1-8'x4' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: YMO

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 134 (134) TW_1 = _____

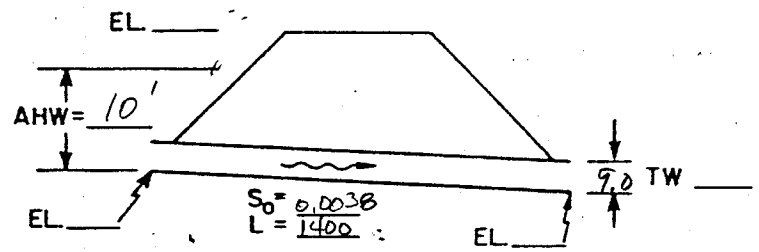
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

2010 to 2009

STATION : _____



2.8 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	134	8'x3'	1.09	3.3		1.6/4.5			9	9	5.3	8.2	8.2			ok (use)

SUMMARY & RECOMMENDATIONS:

1-8'x3' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: YMO

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

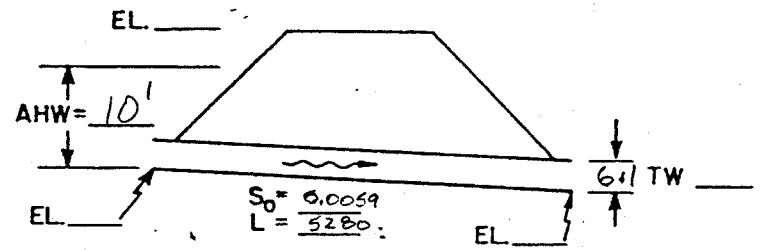
Q_1 = 891 (817) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2004 to 2006

STATION : _____



10.6

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	446	10'x5'	1.31	6.6		2.8 / 29.7			6.1	6.1	31.R	4.6	6.6			ok

SUMMARY & RECOMMENDATIONS:

2 - 10'x5' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

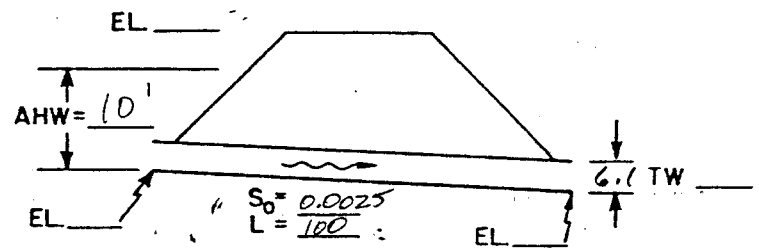
Q_1 = 287 (281) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 20038 to 2004

STATION: _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	287	8'x4'	1.48	5.9		3.6/0.7			6.1	6.1	0.25	6.6	6.6			OK

SUMMARY & RECOMMENDATIONS:

1-8'x4' RCBC

Figure 7

Q10

PROJECT: BELL RD -PA-Z 1 DET. BASIN CONCEPT 2 (COMPLETE SYSTEM to 91ST) DESIGNER: YMO DATE: 11/29/86

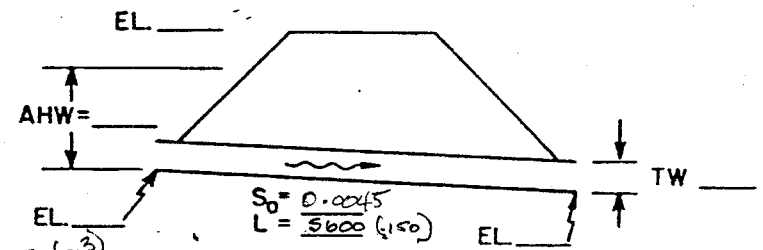
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 652 (675) TW_1 = _____

Q_2 = 948 (965) TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH STATION: 2006 to BELL



11.2 (0.3) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	326	10'x5'				1.5/16.8				7	25.9	-2.1				OVER
2 RCBC	326	8'x6'	0.98	5.9		1.8/20.2				7	"	1.3	5.9			OK (use)
2-RCBC	326	8'x5'	1.22	6.1		2.7/30.2				7	"	11.3				NG
2-RCBC	474	8'x6'	1.32	7.9		3.9/1.2				6	0.7	6.5	7.9			OK
3-RCBC	316	"	0.98	5.9		1.7/0.5				6	0.7	5.8	5.9			OK
2-RCBC	474	10'x5'	1.4	7.0		3.1/0.9				5	"	5.2	7.0			OK (use)

SUMMARY & RECOMMENDATIONS:

2-8'x6' FROM 2006 to BELL (NORTH SIDE)

2-10'x5' UNDER BELL RD

Figure 7

PROJECT: BELL RD

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

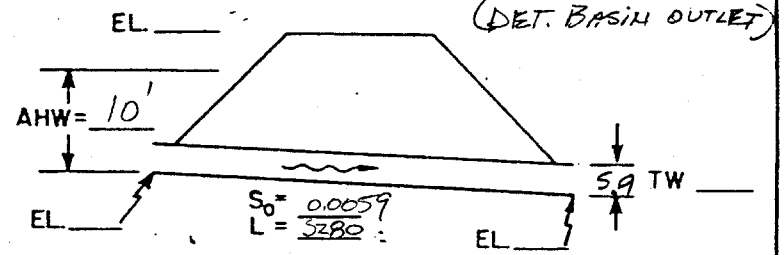
Q_1 = 278 (279.) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2004 to 2006 (DET. BASIN OUTLET)



10.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	278	6'x6'	1.07	6.4		2.55 / 27.0				6	31.2	1.83	6.4			OK (USE)
1-RCBC	278	8'x4'				3.4 / 36.0				5.9						NG

$HW=H+h_o-LS_o$

SUMMARY & RECOMMENDATIONS:

1-6'x6' RCBC

Figure 7

Q10

PROJECT: BELL Rd - DA-2 DESIGNER: YMO

CONCEPT 3 (91ST AVE SYSTEM ONLY) DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

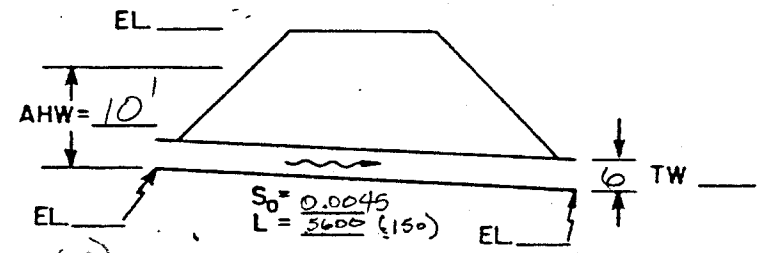
Q_1 = 846 (871) TW_1 = _____

Q_2 = 1026 (1120) TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2006 to BELL

STATION: _____



11.2 (0.3) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	282	10'x5'				1.1/12.3				5	25.9	-8.6				OVER
2-RCBC	423	10'x5'	1.22	6.1		2.5/28.0				6	25.2	8.8	8.8			OK
3-RCBC	282	8'x5'				2.0/22.4				5	25.9	1.5				ok
3-RCBC	342	8'x5'				1.6/17.9				5	25.9	-3.0				OVER
3-RCBC	342	8'x5'				3.4/38.1				5	"	17.2				NG
3-RCBC	342	8'x6'	1	6		2.1/0.6				6	0.7	5.9	6			OK
											"					

SUMMARY & RECOMMENDATIONS:

2-10'x5' RCBC FROM 2006 to BELL (NORTH SIDE) 5600

3-8'x6' " UNDER BELL (150)

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

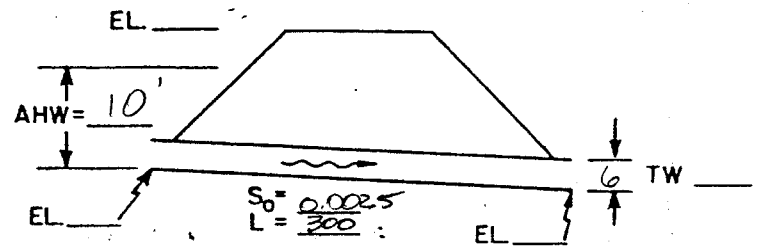
Q_1 = 220 (220) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 200813 to 91ST



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	220	8'x4'	1.4	5.6		2.0/1.2		-	6	6	0.75	6.5	6.5			OK (USE)

SUMMARY & RECOMMENDATIONS:

1-8'x4' RCBC

Figure 7

PROJECT: BELL Rd

DESIGNER: YMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

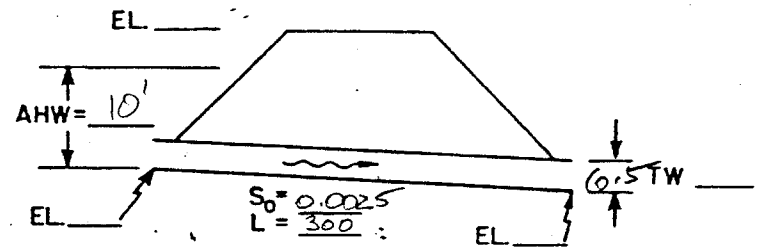
Q_1 = 183 (1[illegible]) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2009 to 2008B

STATION : _____



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	183	8'x3'	1.46	4.4		2.9/1.7			6.5	6.5	0.7	7.5	7.5			OK

SUMMARY & RECOMMENDATIONS:

1-8'x3'-RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: [illegible]

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

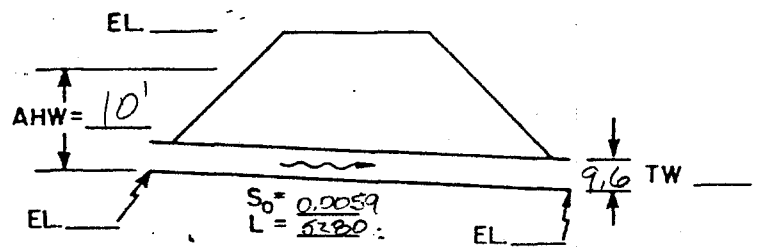
Q_1 = 641 (652) : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE , SAY Q_{25}
Q_2 = CHECK DISCHARGE , SAY Q_{50} OR Q_{100})

SKETCH 2004 to 2006

STATION : _____



10.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	320	10'x5'				1.4 / 14.8			8.8	8.8	31.2	-7.6				OVER
2-RCBC	320	8'x5'	0.99	4.9		2.6 / 27.5			"	"	" "	5.1	5.1			OK (VA)

SUMMARY & RECOMMENDATIONS:

2-8'x5' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: tmo

CONCEPT 3 (87th AVE SYSTEM)

DATE: 11/21/86

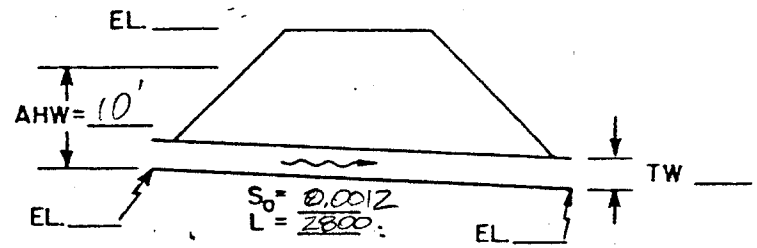
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 577 (585) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2006B to NEW
STATION: RIVER



5.6 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	289	8'x4'				3.5/19.6				4	3.4					MG
2-RCBC	289	8'x5'				2.0/11.2				5		12.8				MG
2-RCBC	289	8'x6'				1.5/8.4				6		11.0				MG
2-RCBC	289	10'x5'	0.93	4.65		1.18/6.6				5	"	8.2	8.2			OK (11.0)

SUMMARY & RECOMMENDATIONS:

1-10'x5' RCBC

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

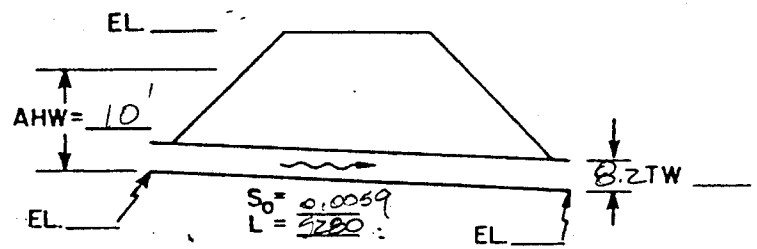
Q_1 = 357 (348) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2004 B to 2006B

STATION : _____



10.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	357	10'x5'				1.75 / 18.6			8.2	8.2	31.2	-45				OVER
1-RCBC	357	8'x5'				3.3 / 35.8			"	"	"	12.0				NG
1-RCBC	357	8'x6'	1.04	6.2		2.2 / 23.3			"	"	"	0.3	6.2			OK USE

SUMMARY & RECOMMENDATIONS: 1-8'x6' RCBC (MUST USE EVEN THO DOWN STREAM IS 1-10'x5' THE JUNCTION OF THESE TWO STRUCTURES WILL BE ~ 90°)

Figure 7

PROJECT: BELL Rd

DESIGNER: YMO

DATE: 11/4/86

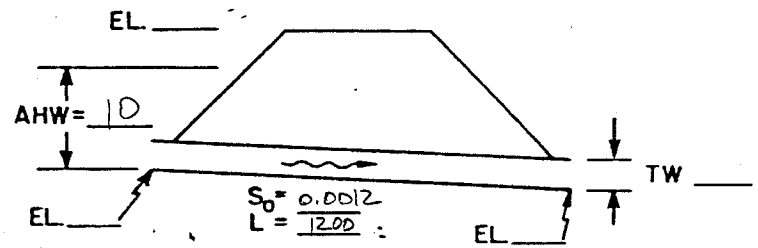
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 228 (228) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH NEW RIVER to
STATION: DA NEW R



2.4 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	228	8'x3'			4.6/11.0					3	1.44					NG
1-RCBC	228	8'x4'	1.18	4.7	2.2/5.3					4	"	7.8	7.8			OK (USE)

SUMMARY & RECOMMENDATIONS:

1- 8'x4' RCBC

Figure 7

PROJECT: BELL Rd

DESIGNER: Ymo

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

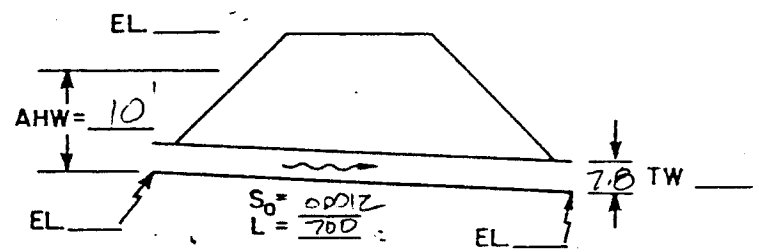
Q_1 = 134 (134) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2010 to DANEWR

STATION : _____



1.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	134	54"				3.4 / 7.8			7.8	7.8	0.84	11.7				MG
1-RCBC	134	8x3	1.1	3.3		1.6 / 2.24			"	"	"	9.2	9.2			ok USE

SUMMARY & RECOMMENDATIONS:

1-8'x3' RCBC

Figure 7

Q10

PROJECT: BELL Rd -DA-2 IDET. BASIN

DESIGNER: YMD

Concept 4 (91ST AVE SYSTEM)

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

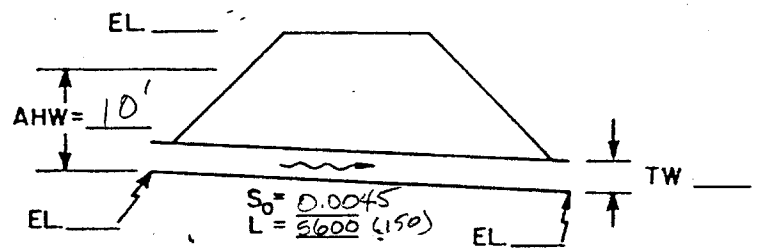
Q_1 = 347 ( ) TW_1 = _____

Q_2 = 541 ( ) TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2006 to BELL

STATION : _____



11.2 (0.3) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	347	10'x5'	1			1.6/17.9				5	25.2	-2.3				OVER
1-RCBC	347	8'x6'	1.02	6.1		2.1/23.5				6.3	"	4.6	6.1			ok
1-RCBC	"	8'x5'				3.1/34.7				5		14.5				NG
2-RCBC	271	6'x6'	1.05	6.3		2.4/0.9				6	5.7	6	6.3			

SUMMARY & RECOMMENDATIONS:

1-8'x6' RCBC FROM 2006 to BELL (NORTH SIDE)

2-6'x6' " UNDER BELL Rd

Figure 7

PROJECT: Bell Rd

DESIGNER: YMD

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

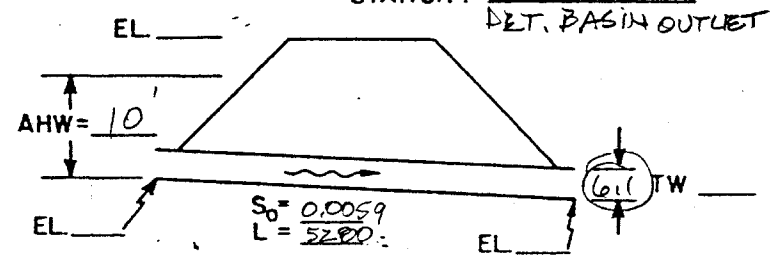
Q_1 = 139 (139) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH STATION: 2004 to 2006

DET. BASIN OUTLET



10.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	139	60"	1.1	5.5		2.1/22.2			6.1	6.1	31.2	-2.9	5.5			ok (UNO)
1 RCP	139	54"				3.7/39.2			"	"	"	14.1				NG

SUMMARY & RECOMMENDATIONS:

1-60" RCP

Figure 7

PROJECT: Bell Rd 1 DET. BASIN

CONCEPT 6D (87th AVE SYSTEM)

DESIGNER: TMO

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

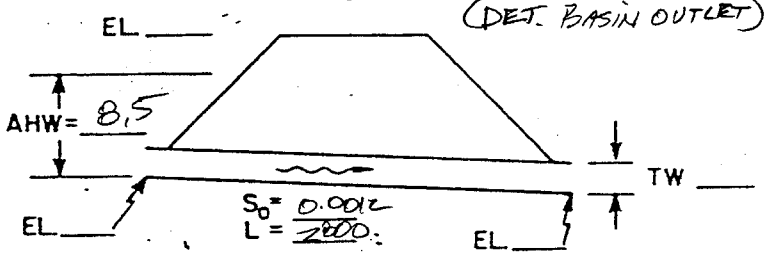
Q_1 = 110 (109) : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH NEW RIVER to

STATION : 2006 B (DET. BASIN OUTLET)



5.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	110	60"				1.3 / 7.3				5	3.4	8.9				MG (8.5 MAX)
1-RCP	110	66"	0.79	4.3		0.86 / 4.8				5.5	"	6.4	6.4			

SUMMARY & RECOMMENDATIONS:

1-66" RCP

Figure 7

PROJECT: Bell Rd

DALE 2
- ON-SITE - Q100

DESIGNER: TMO

DATE: 11/12/86

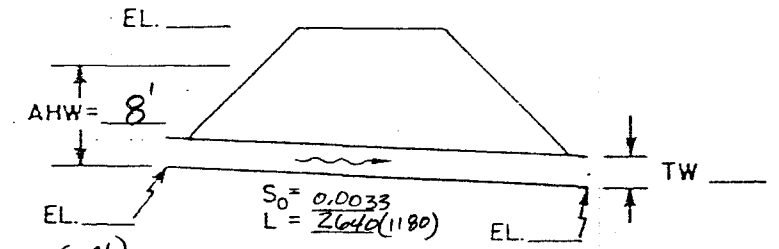
HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 - 2640' - 19cfs
2 - 5280' - 38 "
3 - 7920' - 57 "
4 - 9100' - 65 "

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH GRAND to AGUA FRIA
STATION: (ON-SITE RUNOFF)



5.28 (2.36) / 2640 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	65	42"	1.22	4.3		2.45/5.8				3.5	3.9	5.4	5.4			ok ✱
"	57	42"	1.1	3.9		1.95/10.3	15.64		5.4	5.4	8.1	7.0	7.0			ok ✱
"	38	36"				1.95/10.3			7.0	7.0						NG
1-RCP	38	42"	0.83	2.9		0.87/4.6			"	"	"	2.9	2.9			ok ✱
1-RCP	19	27"	1.1	2.5		2.05/10.8			2.9	2.9	"	5.0	5.0			ok ✱
1-RCP																
1-RCP																

SUMMARY & RECOMMENDATIONS:
REACH 1 → 1-27" RCP
" 2 → 1-42" RCP
REACH 3 → 1-42" RCP
REACH 4 → 1-42" RCP

Figure 7

PROJECT: BELL Rd

DESIGNER: TMD

DATE: 11/12/96

HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 - 2640' - 19cfs
REACH 2 - 2760 - 39cfs

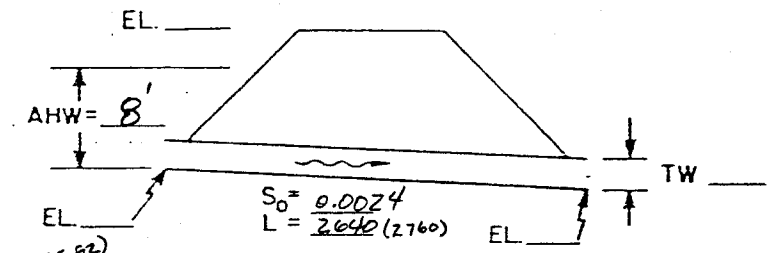
5400

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: DELL WEBB BLVD to SUN City CHANNEL (115th) (ON-SITE RUNOFF)



5.28 (5.52) / 2640' MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o-LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	39	36"	1.1	3.3	2.1 / 11.6					3	6.5	8.0	8.0			ok ☆
1-RCP	19	30"	0.9	2.25	1.22 / 6.44				8.0	8.0	6.3	8.1	8.1			ok ☆

SUMMARY & RECOMMENDATIONS:

REACH 1 → 1-30 RCP
REACH 2 → 1-36" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: YMO

DATE: 11/12/86

HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 → 2640' - 19 cfs (4700')

" 2 → 2060' - 34 cfs

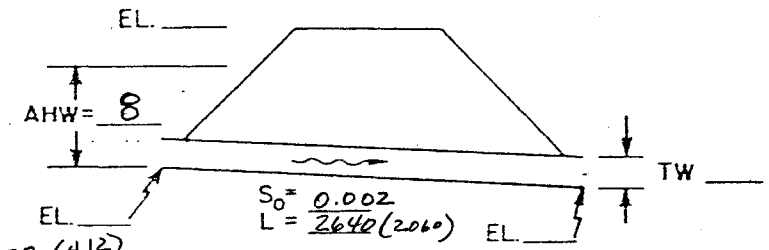
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH DELL WEBB to

STATION: 99th AVE (ON-SITE ①②)



$\frac{5.28}{2640}$ (4.12)

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	34	36"	0.98	2.9		1.6/6.6				3	4.1	5.5	5.5			ok ☆
"	19	27"				2.05/10.8			5.5	5.5	5.28	11.0				NG
"	19	30"	0.9	2.25		1.22/6.4			"	"	"	6.7	6.7			OK ☆

SUMMARY & RECOMMENDATIONS:

REACH 1 → 1-30" RCP

" 2 → 1-36" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/12/86

HYDROLOGIC AND CHANNEL INFORMATION

Reach 1 - 3300', 24cfs 3300'

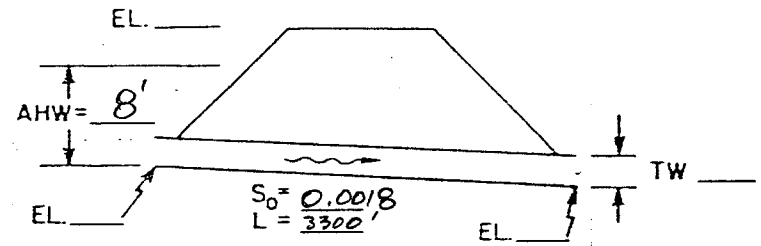
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH Burns to 99th Ave

STATION: (On-site Q'e)



6.6 / 3300'

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	24	27"				3.15 / 20.8				2.25	5.9					NG
"	"	30"				1.95 / 12.9				2.5		9.5				NG
"	"	33"				1.2 / 7.9				2.75		4.75				OK ✗

SUMMARY & RECOMMENDATIONS:

Reach 1 → 1-33" RCP

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

DATE: 11/12/86

HYDROLOGIC AND CHANNEL INFORMATION

REACH 1 → 1600' – 12cfs 1600'

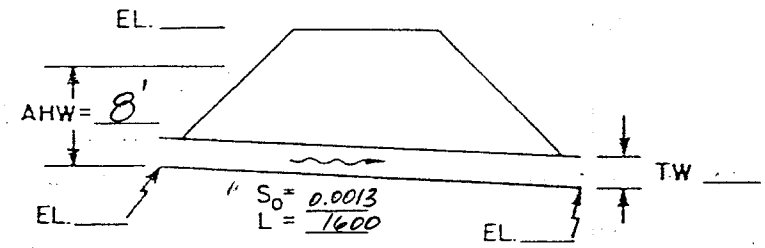
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH BURNS AVE to

STATION: DA 2007A (ON-SITE Q)



3.2 / 1600' MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	12	24"	0.96	1.92		1.45 / 4.6				2	2.1	4.5	4.5			o/c ☆

SUMMARY & RECOMMENDATIONS:

1-24" RCP

Figure 7

PROJECT: Bell Rd

DA 1

Q100 - OFF SITE

DESIGNER: TMO

DATE: 11/10/86

HYDROLOGIC AND CHANNEL INFORMATION

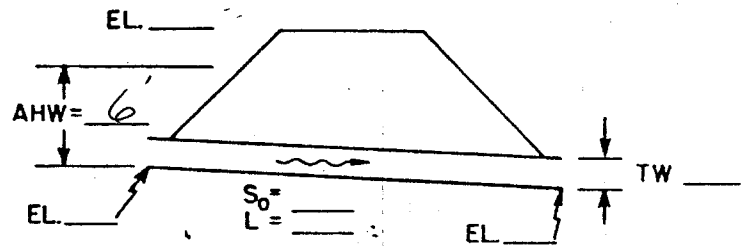
Q_1 = 85 (100YR) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH GRAND AVE/R.R.

STATION: CULVERT



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - RCP	85	48"	1.05	4.2												OVER
1 - RCP	85	42"	1.39	4.9												ok
1 - RCP	85	36"	2.05	6.15												ok (if AWH > 6') ☆

SUMMARY & RECOMMENDATIONS:

RECOMMEND 36" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/10/86

HYDROLOGIC AND CHANNEL INFORMATION

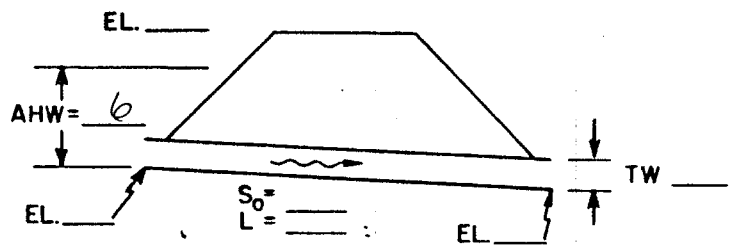
Q_1 = 59 (100 yr) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH RR to Sun City

STATION: West Culvert



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - RCP	59	36"	1.44	4.3												OVER
1 - RCP	59	30"	2.43	6.1												OK (if AHW > 6') ☆
1 - RCP	59	33"	1.83	5.0												OK

SUMMARY & RECOMMENDATIONS:

33" RCP

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/10/86

HYDROLOGIC AND CHANNEL INFORMATION

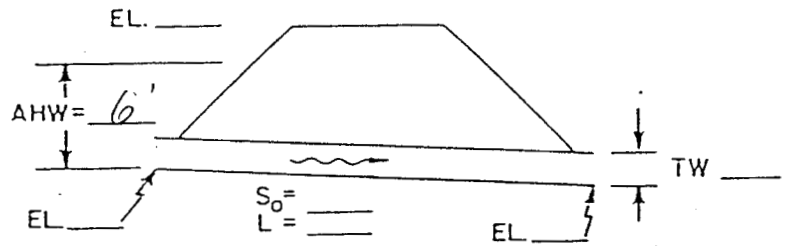
Q_1 = .154 (100 YR) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Sun City West Const. Area Culvert



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2 - RCP	77	42"	1.3	4.6												OVER
2 - RCP	77	36"	1.9	5.7												ok ☆

SUMMARY & RECOMMENDATIONS:

2 - 36" RCP

Figure 7

Approx. Check on Culvert Capacities @ Grand & Bell Rd

PROJECT: Bell Rd

DESIGNER: TMD

DA 1 Q100

DATE: 10/23/86

HYDROLOGIC AND CHANNEL INFORMATION

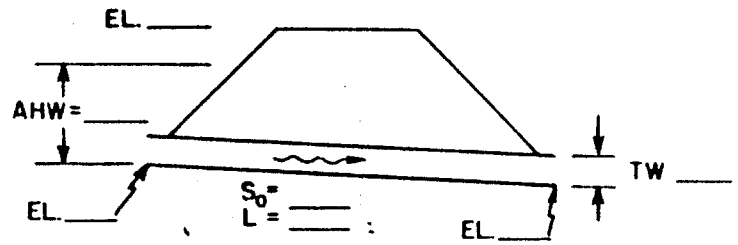
① 100YR = 85cfs
② 100YR = 59
③ 100YR = 154

Q_1 = _____ TW_1 = _____
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

	CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
GRAND/RR ①	1-RCP	22	24"	1.5	3												too SMALL
RR/Sun City W ②	1-RCP	35	36"		3												too SMALL
Sun City W. ③	1-RCP	13	24		2												too SMALL

SUMMARY & RECOMMENDATIONS:

USING SCALE 1 FOR RCP PIPES

Figure 7

er
eering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: DRAINAGE STRUCTURE SIZES FOR EACH CONCEPT DA2, Q100
Calculated by: TMO Date: 10/20/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

NO DET. BASINS -

CONCEPT ~~C2~~ 1 - 1 SYSTEM OUTFALL @ 91ST AVE

A	Q	LENGTH	SLOPE		STRUCTURE TYPE	(DEP./BW/TW) STRUCTURE SIZE
2004(A)	363	5280	0.0057 (0.0030)		E. CHANNEL	3.0/13/37
2004(B)	377	5280	0.0057 (0.0030)		E. CHANNEL	3.0/14/38
004A	847	2640	0.0040 (0.0025)		E. CHANNEL	3.0/46/70
2004A	584	50	0.0040	ok	RCB CULVERT	2-6'x4' RCBC
ET BASIN	2192 (*)	-	-		DET BASIN	
2006	2192	5280	0.0059		STORM DRAIN	5-10'x5' RCBC
BELL(91ST)	3297	5600	0.0045	*	STORM DRAIN	8-10'x5' RCBC
91ST AVE	83	1600	0.0025	ok	STORM DRAIN	1-54" RCP
2009	260	1400	0.0038	*	STORM DRAIN	1-8'x5' RCBC
2008B	613	300'	0.0025	*	STORM DRAIN	2-8'x5' RCBC
91ST	695	300'	0.0025		STORM DRAIN	2-8'x5' RCBC
UNDER BELL	3905	150'	0.0030		" "	8-10'x5' RCBC
GRNWAY	3905	5280	0.0050 (0.0015)		E. CHANNEL	4/184/215
to NEW R	3905	3100	0.0017 (0.0015)		E. CHANNEL	4/184/215
BASIN	3426( )	-	-		DET BASIN	
CHANNEL	188	1200'	0.0020		E. CHANNEL	3.4/2/29

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd

Description: DRAINAGE STR. SIZES
CONCEPT 2 TOTAL SYSTEM to 91 ST AVE

Calculated by: TMD Date: 11/3/86 Sheet No. 1

Checked by: _____ Date: _____ of 1

W/ DET. BASINS (1) DA2, Q100

CONCEPT 2

STA	Q	LENGTH	SLOPE	STRUCTURE (DEPTH/BW/TW)
2030 to 2004A	363	5280	0.0030	* E. CHANNEL, 3/13/37
2031 to 2004B	377	5280	0.0030	* E. CHANNEL, 3/14/38
2004B to 2004A	847	2640	0.0025	* E. CHANNEL, 3/46/70
2003B to 2004A	584	100	0.0040	* 2-6'x4' RCBC, CULVERT
2004 DET. BASIN	2192	—	—	V=88A-F, 8.1 FT DEEP, 694x694
2004 to 2006	1396	5280	0.0059	3-10'x5' RCBC
2006 to 91ST/BELL	2294	5600	0.0045	6-10'x5' RCBC
2007A to 91ST/BELL	83	1600	0.0025	1-54" RCP
2010 to 2009	260	1400	0.0038	1-8'x5' RCBC
2009 to 2008B	613	300	0.0025	2-8'x5' RCBC
2008B to 91ST/BELL	695	300	0.0025	2-8'x5' RCBC
91ST/BELL UNDER BELL	2886	150	0.0030	6-10'x5' RCBC
DA NEWR to N. RIVER	188	1200	0.0020	* E. CHANNEL, 3.4/2/29
91ST/BELL to N. RIVER	2886	8380	0.0015	E. CHANNEL, 4/128/160

* - from "NO DET. BASIN" Analysis

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD
Description: DRAINAGE STR. SIZES
CONCEPT 3 TOTAL SYSTEM to 91ST AVE
Calculated by: TMO Date: 11/4/86 Sheet No. 1
Checked by: Date: of 1

WITH 2 DET. BASINS Q100-DA-2
CONCEPT 3

STA	Q	LENGTH	SLOPE	STRUCTURE (DEP./BW/TW)
2030 to 2004A	363	5280	0.0030	E. CHANNEL, 3/13/37
2031 to 2004B	377	5280	0.0030	E. CHANNEL, 3/14/38
2004B to 2004A	847	2640	0.0025	E. CHANNEL 3/46/70
2003B to 2004A	584	100	0.0040	2-6'x4' RCBC, CULVERT
2004 DET. BASIN	2192	—	—	V = 72.3 AC-FT, 10.0' DEEP, 600 FT²
2004 to 2006A	1396	5280	0.0059	3-10'x5' RCBC
2006 DET. BASIN	2294	—	—	V = 77.4 A-F, 7.7 FT DEEP, 708 FT²
2006 to 91ST/BELL	1590	5600	0.0045	4-10'x5' RCBC
2007A to 91ST/BELL	83	1600	0.0025	* 1-54" RCP
2010 to 2009	260	1400	0.0038	* 1-8'x5 RCBC
2009 to 2008B	613	300	0.0025	* 2-8'x5' RCBC
2008B to 91ST/BELL	695	300	0.0025	* 2-8'x5' RCBC
91ST/BELL UNDER BELL	1999	150	0.0030	5-10'x5' RCBC
DA NEW R to N. RIVER	188	1200	0.0020	☆ E. CHANNEL, 3.4/2/29
91ST/BELL to N. RIVER	1999	8380	0.0015	E. CHANNEL, 4/85/117

* - from "1 DET. BASIN" analysis

☆ - from "NO DET. BASIN" analysis

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd
Description: DRAINAGE STR. SIZES
CONCEPT 4, DA2, Q100
Calculated by: YMMO Date: 11/3/87 Sheet No. 1
Checked by: _____ Date: _____ of 2

NO DET BASINS

CONCEPT ~~B2~~ 4, PART A - 91ST AVE SYSTEM OF PARALLEL DRAINAGE SYSTEMS

STA	Q	LENGTH	SLOPE	STRUCTURE TYPE	DEP/BW/TW STRUCTURE SIZE
2030 to 2004A	363	5280	0.0057 (0.0030)	E. CHANNEL	3/13/37 ✓
2003B to 2004A	584	100	0.0040	RCP CULVERT	2-6'x4' RCBC
2004A DET. BASIN	1430 ( )	–	–	DET. BASIN	
↕					
2004A to 2006A	1430	5280	0.0059	STORM DRAIN	3-10'x5' RCBC
2006A to BELL/91ST	1982	5600	0.0045 ☆	STORM DRAIN	5-10'x5' RCBC
2007A to 91ST	83	1600	0.0025 ok	STORM DRAIN	1-54" RCP
2009 to 2008B	355	300'	0.0025 ok	STORM DRAIN	2-8'x3' RCP
2008B to 91ST	436	300'	0.0025 ☆	STORM DRAIN	2-8'x3' RCBC
91ST/BELL UNDER BELL	2413	150'	0.0030		
BELL to GRNWAY	2413	5280	0.0050 (0.0015)	E. CHANNEL	4.0/107/139
GRNWAY to NEW R.	2413	3100	0.0017 (0.0015)	E. CHANNEL	4.0/107/139

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd
Description: DRNG STR. SIZES
Q100 - DA - 2
Calculated by: MMD Date: 11/13/86 Sheet No. 2
Checked by: _____ Date: _____ of 2

NO DET BASINS

CONCEPT ~~B2, DAET B~~ 4 - 87th AVE SYSTEM to NEW RIVER @ BELL Rd

STA	Q	LENGTH	SLOPE		STRUCTURE TYPE	STRUCTURE SIZE (DEP/BW/TW)
2031 to 2004B	377	5280	0.0057 (0.0030)		E. CHANNEL	3/14/38
2004B DET BASIN	847 (*)	-	-		DET BASIN	
2004B to 2006B	847	5280	0.0059	☆	STORM DRAIN	2-10'x5' RCBC
2006B to BELL/87th	1404	5280	0.0042	☆	STORM DRAIN	4-8'x6' RCBC
BELL/87th to NEW R.	1598	1600	0.0020		E. CHANNEL	3.5/75/103
BELL/87th to DA NEW R.	1598	700'	0.0012	☆	STORM DRAIN	5-8'x6' RCBC
* DA NEW R to NEW R.	188	1200	0.0020		STORM DRAIN	1-66" RCP
			0.0020		E. CHANNEL	3.4/2/29
* DA NEW R to NEW R. 1767 (ALL IN 1 CHANNEL)		1200	0.0020	☆	E. CHANNEL	3.5/80/108
		1200	0.0012	☆	STORM DRAIN	7-8'x6' RCBC

* options

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: DRAINAGE STR. SIZES
CONCEPT BZA 5, 1 SYSTEM to 91ST AVE & BELL
Calculated by: TMO Date: 11/3/86 Sheet No. 1
Checked by: _____ Date: _____ of 2

W/ DET BASINS

CONCEPT 5

STA	Q	LENGTH	SLOPE		STRUCTURE
					DEPTH/BW/TW
2030 to 2004A	363	5280'	0.0030		E. CHANNEL 3/13/37
2003B to 2004A	584	100'	0.0040		2-6'x4' RCBC, CULVERT
2004A DET. BASIN	1430	-	-		V = 76 A-F, 662 FT², 8.4 FT DEEP
2004A to 2006A	530	5280	0.0059		2-8'x4' RCBC
2006A to 91ST/BELL	1011	5600	0.0045		4-8'x4' RCBC
2007A to 91ST/BELL	83	1600	0.0025	*	1-54" RCP
2009 to 2008B	355	300	0.0025	*	2-8'x3' RCBC
2008B to 91ST/BELL	436	300	0.0025	*	1-8'x3' RCP
91ST/BELL UNDER BELL	1455	150	0.0025		4-8'x4' RCBC
BELL to GRENWAY	1455	5280	0.0015	*	5/37/77
GRENWAY to NEW R.	1455	3100	0.0015	*	5/37/77

* - FROM "NO DET. BASIN" ANALYSIS

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061

Description: DRAINAGE STRUCTURE SIZES

CONCEPT B2B5 1 SYSTEM to 87th & BELL

Calculated by: TMO Date: 11/3/86 Sheet No. 2

Checked by: _____ Date: _____ of 2

WITH DET. BASINS DA-2, Q100

STA	Q	LENGTH	SLOPE	STRUCTURE (DPTH/BW/TW)
2031 to 2004B	377	5280	0.0030	E. CHANNEL, 3/14/38
2004B to 2006B	847	5280	0.0059	2 - 10'x5' RCBC
DET. BASIN	1404	–	–	∀ = 72.3A-F, 600FT², 10FT DEEP
2006B to 2010	502	5280	0.0042	2 - 6'x6' RCBC (BASIN OUTLET)
2010 to DA NEWR	618	700	0.0012	2 - 10'x5' RCBC
DA NEWR to NEW R.	779	1200	0.0012	2 - 10'x5' RCBC

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Job: BELL RD
Description: DRG. STR. SIZES
Q100 - DAZ
Calculated by: TMO Date: 10/29/86 Sheet No. 1
Checked by: [illegible] Date: 11/6 of 1

NO DET BASINS

CONCEPT A2 ~~PART~~ 6 B, 87th AVE SYSTEM to NEW RIVER @ UNION HILLS

STA	Q	LENGTH	SLOPE	STRUCTURE TYPE	STRUCTURE SIZE
2031 to 2004B	377	5280	0.0057 (0.0030)	E. CHANNEL	3/14/38
2004B DET. BASIN	847K ✓)	–	–	DET BASIN	
2004B to 2006B	847	5280	0.0059 ☆	STORM DRAIN	2-10'x5' RCBC
2006B to NEW R.	1407	2800	0.0012 ☆	STORM DRAIN	6-10'x5' RCBC
2010 to DA NEW R	260	700	0.0012 ☆	STORM DRAIN	1-8'x4' ~~1-8'x5'~~ RCBC
DA NEW R to NEW R	447	1200	0.0012 ☆	STORM DRAIN	2-8'x5' RCBC

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL RD E123061
Description DRAINAGE STR. SIZES DA-2
CONCEPT ~~A2B~~ 1 SYSTEM to 87th & UNION HILLS
Calculated by TMO Date 10/3/86 Sheet No. 1
Checked by [illegible] Date 11/6 of 1

WITH DET. BASIN Q100

CONCEPT ~~2~~ 1

STA	Q	LENGTH	SLOPE	STRUCTURE (DEPTH/BW/TP)
* 2031 to 2004B	377	5280	0.0030	E. CHANNEL, 3/14/38
2004B to 2006B	847	5280	0.0059	2-10'x5' RCBC
2006B DET. BASIN	1407	-	-	V=72.3, 600FT², 10FT DEEP
2006B to NEW RIVER	503	2800	0.0012	2-8'x6' RCBC (BASIN OUTLET)
* 2010 to DA NEW R	260	700	0.0012	~~1-8'x5'~~ 1-8'x4' RCBC
* DA NEW R to NEW RIVER	447	1200	0.0012	2-8'x5' RCBC

* - FROM NO DETENTION ANALYSIS

PROJECT: Bell Rd

DESIGNER: TMO

Concept 1, DA2, Q100

DATE: 10/3/86

HYDROLOGIC AND CHANNEL INFORMATION

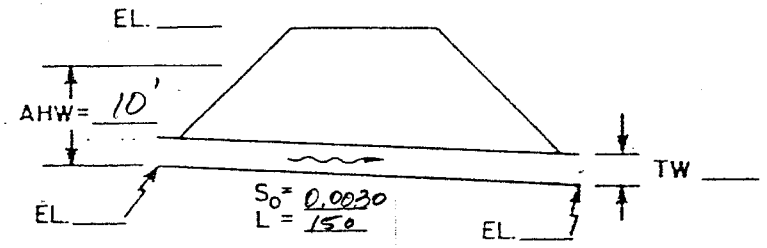
Q_1 = 3905 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Bell/91st under Bell



0.3 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW ± h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
8-RCBC	488	10'x5'	1.4	7.0		3.1 / 0.93				5	0.45	5.5	7.0		ok use

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

Concept C1

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

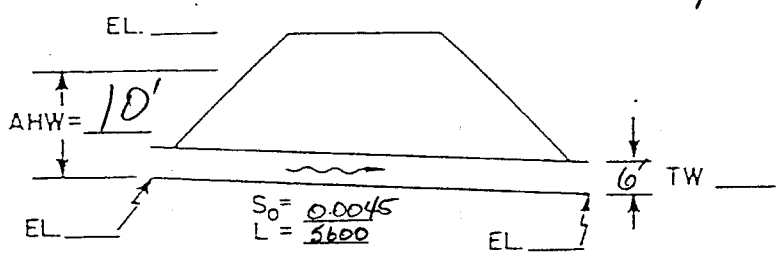
Q_1 = 3297 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 20006 to Bell/91st



11.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	O	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
8-RCBC	412	10'x5'	1.22	6.1		2.33 / 26.3			7.0*	7.0	25.2	8.1	8.1			GOOD use
10-RCBC	330	8'x5'	"			2.8 / 31.4			"	"	"	13.1				NG
11-RCBC	300	8'x5'	1.15	5.8		2.3 / 25.8			"	"	"	7.6	7.6			OK
9-RCBC	366	8'x6'	1.07	6.4		2.35 / 26.3			"	"	"	8.1	8.1			GOOD

SUMMARY & RECOMMENDATIONS:

* from downstream analysis

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

DATE: 10/29/86

CONCEPT C1

HYDROLOGIC AND CHANNEL INFORMATION

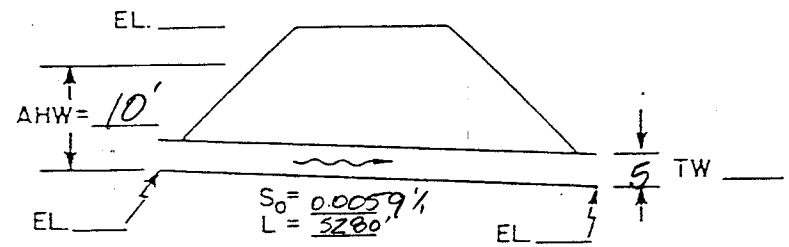
Q_1 = 2192 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2004A to 2006



(10,5.6) MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
4-RCBC	548	10'x5'				4.2				8.1	31.1	?				X N.G.
8-RCBC	274	10x5				1.05				"						oversized
6-RCBC	365	10'x5'				1.8				"						oversized
5-RCBC	438	10x5	1.69	8.5		2.6				"		4.8	8.5			ok USE
6-RCBC	365	8x6				2.3				"						X NG
7-RCBC	313	8x5								"					230/L.F.	X NG
8-RCBC	274	6x6	1.2	7.2						"						ok

SUMMARY & RECOMMENDATIONS:

* - from lower reach analysis (8-10'x5)

use 5 - 10'x5' RCBC - I DID!

Figure 7

— PIPE SIZES W/ NO DET. BASINS —

PROJECT: BELL RD E123061

DESIGNER: TMO

CONCEPT C1

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

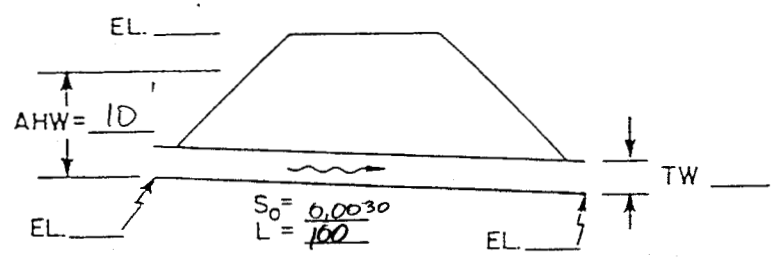
Q_1 = 584 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2003B to 2004A



0.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	292	8'x4'	1.48	5.92		3.6/0.72				*8.5	0.3	8.9	8.9			✓
2-RCBC	292	6'x4'	2.1	8.4		7.3/1.5				"	"	9.6	9.6			✓ use

SUMMARY & RECOMMENDATIONS:

* - from max. depth of det basin

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

DATE: 10/29/86

Concept C1

HYDROLOGIC AND CHANNEL INFORMATION

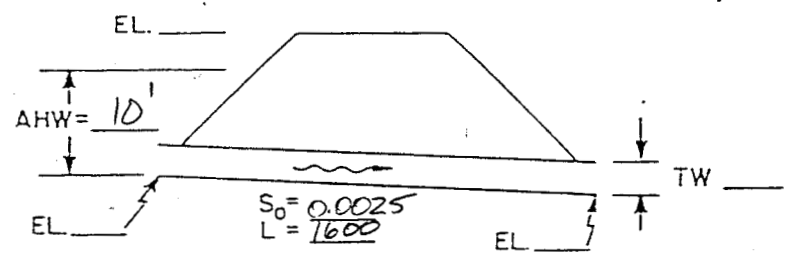
Q_1 = 83 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2007A to 91st/Bell



3.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCB	83	36"	2.05	6.15		9/28.8				7	4					X NG
1-RCB	83	60"				.72/2.3				7	"	5.3				ok
1-RCB	83	54"				1/3.2				7	"	6.9				ok (use)
1-RCB	83	42"				4.1/13.1				7	"	16.1				NG X
1-RCB	83	48"	1.04	4.16		2.3/7.4				7	"	10.4				ok (USE)

SUMMARY & RECOMMENDATIONS:

used 10'x5' @ confluence!

Figure 7

PROJECT: BELL RD E123061

DESIGNER: TMO

CONCEPT C1

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

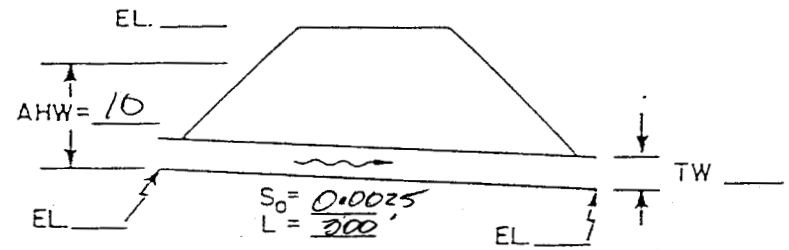
Q_1 = 695 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2008B to 91ST



0.6 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	348	8'x3'				10.5 / 6.3				7	0.75	12.6				NG
2-RCBC	348	8'x4'	1.75	7.0		5.2 / 3.1				"	"	9.4	9.4			ok
2-RCBC	348	8'x5'	1.25	6.25		3.1 / 1.9				"	"	8.4	8.1			ok - use

SUMMARY & RECOMMENDATIONS:

* from downstream analysis

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: DMO

DATE: 10/29/86

Concept C1

HYDROLOGIC AND CHANNEL INFORMATION

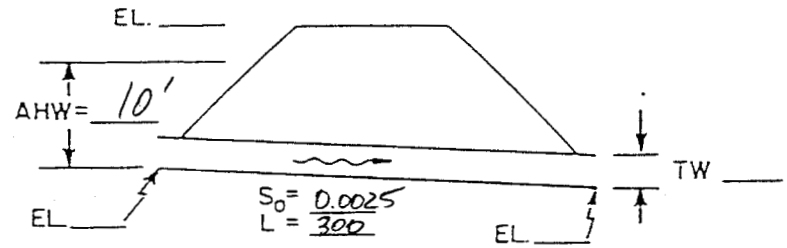
Q_1 = .613 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2009 to 2008B



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	306	6'x6'	1.15	6.9		3.2/1.9				* 8.1	0.75	9.3			700	ok
2-RCBC	306	8'x4'	1.57	6.3		4/2.4				"	0.75	9.8	9.8		400	ok
2-RCBC	306	8'x3'	2.75	8.25		8				"	0.75	12.1	12.1		370	X
2-RCBC	306	8'x5'	1.15	5.75		2.4/1.44				"	"	8.8	8.8			ok use

SUMMARY & RECOMMENDATIONS:

* from lower reach analysis (2-8'x5')

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

DATE: 10/29/06

Concept C1

HYDROLOGIC AND CHANNEL INFORMATION

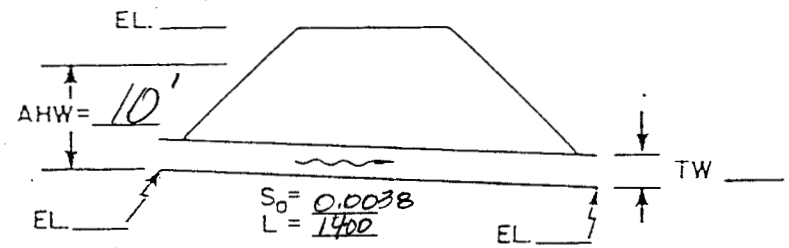
Q_1 = 260 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2010 to 2009



MEAN STREAM VELOCITY = _____

2.8' MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 - RCB	260	72"	1.15	6.9		3.15			8.0	9.1*	5.3	12.6				X
1 - RCBC	260	8x4'				2.8/7.8			"	9.1	"	11.6				X
1 - RCBC	260	8'x5'				1.7/4.8			"	"	"	8.6				GOOD (USE)

SUMMARY & RECOMMENDATIONS:

* - from lower reach analysis (2-8'x5')

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

Concept 2, DA2, Q100

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

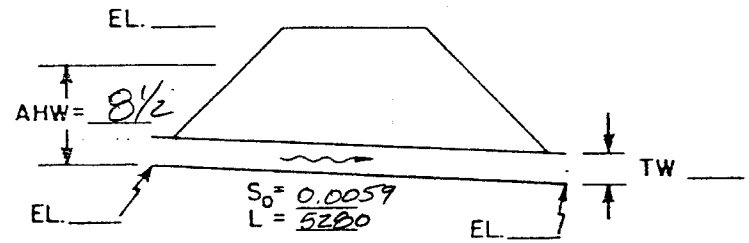
Q_1 = 1396 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH (DET BASIN, OUTLET)

STATION: 2004 to 2006



10.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	465	10'x5'	1.32	6.6		2.95 / 31.3			☆ 7.2	5.75	31.1	5.9	7.4			ok (use)
3-RCBC	465	8'x6'				3.6 / 38.2			7.2	"	"	13.1				NG

SUMMARY & RECOMMENDATIONS:

☆ 5.75 from downstream analysis, will use 6.6 ft + 1.5 ft for depth of det. basin (18 FT)

maintain basin depth @ 10'

Figure 7

PROJECT: Bell Rd

DESIGNER: YMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

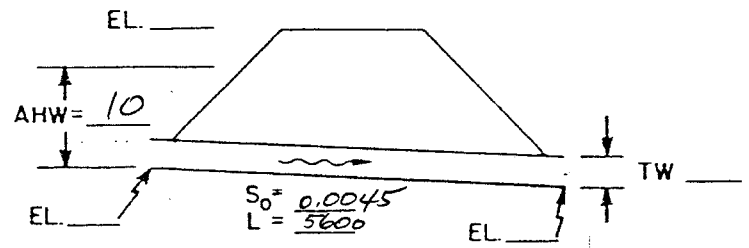
Q_1 = 2294 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 2006 to 91st/Bell

STATION : _____



11.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
5-RCBC	459	10'x5'		~~5.50~~		3.1/34.7			*5.75	5.75	25.2	15.3				N/G
6-RCBC	382	10'x5'	1.15	5.75		2.0/22.4			"	"	"	2.95	5.75			ok (use) more consistent w/ pipe size
6-RCBC	382	8'x6'	0.93	5.58		2.5/28.0			6	6	"	8.8				ok

SUMMARY & RECOMMENDATIONS:

* 5.75 from 91st/Bell analysis

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

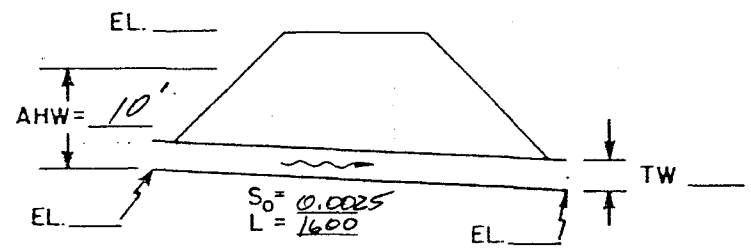
Q_1 = 83 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2007A to 91st/Bell



3.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	83	48"	1.13	4.5		2.3/7.3			*5.73	5.75	4	9.1	9.1			ok
1-RCP	83	54"	0.92	4.1		1.3/4.2			"	"	"	5.9	5.9			ok (use)

SUMMARY & RECOMMENDATIONS:

* from 91st/Bell analysis

use 54"

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

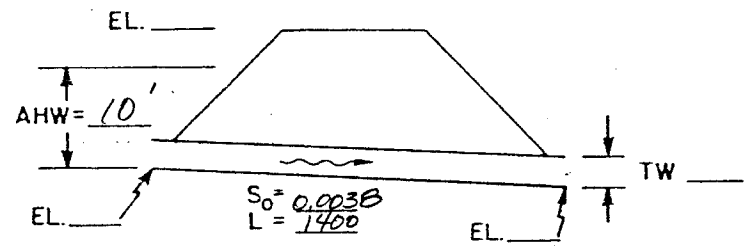
Q_1 = 260 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2010 to 2009



2.8 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
1-RCBC	260	8'x5'	1.0	5		1.75 / 4.9			* 8.9	8.9	5.3	8.5	8.5			ok use
1-RCBC	260	8'x4				2.9 / 8.1			"	"	"	11.9				NG
1-RCBC	260	8x5				[illegible] / 1.8				8.1		.	7.6	.		~~[illegible]~~
1-RCBC	260	8x4				2.9 / 8.1				8.1		10.9				N.G.

SUMMARY & RECOMMENDATIONS:

* 9.1 from downstream analysis

1- 8'x5' RCBC

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

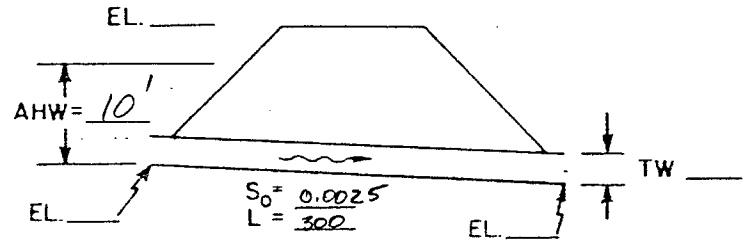
Q_1 = 613 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2009 to 2008B



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING H.W	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-RCBC	307	8'x5'	1.15	5.75		2.4 / 1.44			* 8.2		0.75	8.9	8.9			ok use
2-RCBC	307	8'x4'	1.59	6.4		4.0 / 2.4			"		"	9.9	9.9			ok

SUMMARY & RECOMMENDATIONS:

* from downstream analysis use 2-8'x5'

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

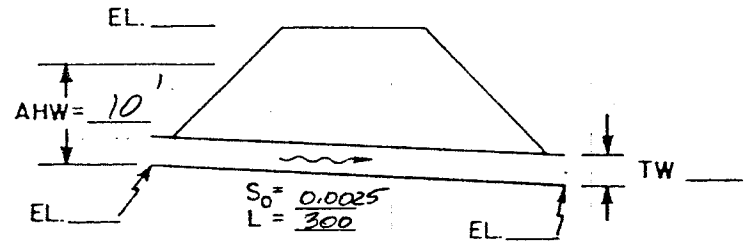
Q_1 = 695 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 200BB to 91st/BELL



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	348	8'x4'	1.78	7.1		5.1/3.1			7	7.	0.75	7.4				ok
2-RCBC	348	8'x5'	1.28	6.4		3.1/1.9					"	6.2	8.2			ok use

SUMMARY & RECOMMENDATIONS:

* - from downstream analysis

use 2- 8'x5'

5-18

Figure 7

PROJECT: Bell Rd

DESIGNER: TMD

DATE: 11/7/86

HYDROLOGIC AND CHANNEL INFORMATION

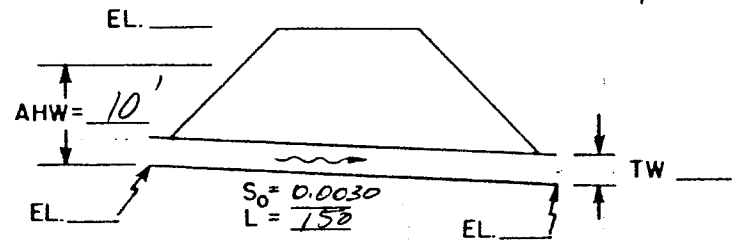
Q_1 = 2886 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH CULVERT / S. DRAIN

STATION: UNDER BELL/91ST



0.30 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o - LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
6-RCBC	481	10'x5'	1.4	7		3.2 / 0.96				5	0.45	5.9	7			Good
			1.4	7												

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: Bell Rd

DESIGNER: [illegible]

CONCEPT 3, DA 2, Q100

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

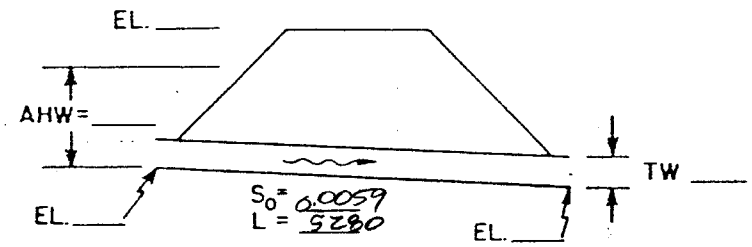
Q_1 = 1396* : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH (DET. BASIN OUTLET)

STATION: 2004 to 2006



10.6

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			HW/D	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
3-RCBC	465	10'x5'	1.32	6.6		2.95 / 31.3			*5.8	5.8	31.1	6.0	6.6			OK (use)

SUMMARY & RECOMMENDATIONS:

* 5.8 from downstream analysis

Figure 7

PROJECT: BELL RD

DESIGNER: [illegible]

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

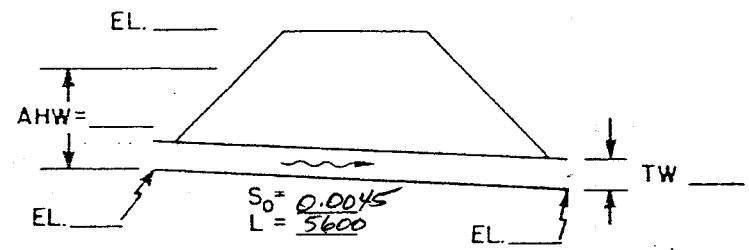
Q_1 = 1590* : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH (DET. BASIN OUTLET)

STATION: 2066 to 91ST/BELL



11.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	530	10'x5'				3.8 / 42.6			5.75*	5.75	25.2	23.1				NG
4-RCBC	398	10'x5'	1.16	5.8		2.2 / 24.6			"	"	"	5.2	5.8	✓		ok (use) P
4-RCBC	398	8'x5'				3.8 / 42.6						23.1				NG
4-RCBC	398	8'x6'				2.6 / 29.1			6			9.9				NG for det. outlet

SUMMARY & RECOMMENDATIONS:

* 5.75 from downstream analysis

Figure 7

PROJECT: BELL RD

DESIGNER: TMO

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

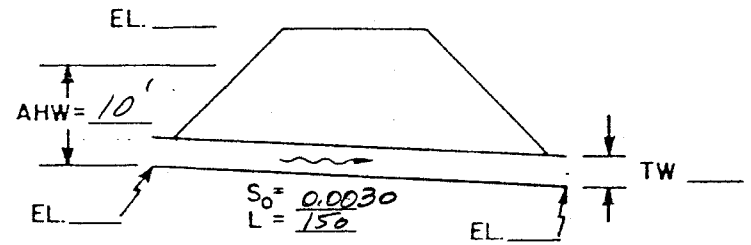
Q_1 = 1999 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH 91ST/BELL UNDER BELL RD

STATION : _____



0.3 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o - LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
5-RCBC	400	10'x5'	1.15	5.75	✓	2.1 / 0.6				5	0.45	5.2	5.75			ok use

SUMMARY & RECOMMENDATIONS:

Figure 7

DA-2, Q100

PROJECT: BELL Rd E123061 87th AVE SYSTEM DESIGNER: TMO

Concept 4 DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

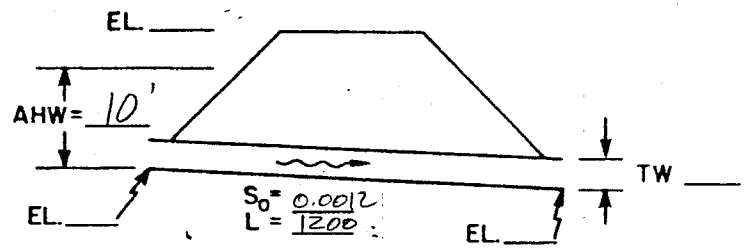
Q_1 = 1767 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: DA NEW R to NEW R



2.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
7-RCBC	252	8'x6'	~~.61~~ .77	4.6		1.05 / 2.5		·	6		1.44	7.1	7.1			OK
7-RCBC	252	10'x5'	.83	4.2		.85 / 1.7			5		"	5.3				OK

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: BELL RD E123061

CONCEPT B2B

DESIGNER: TMO

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

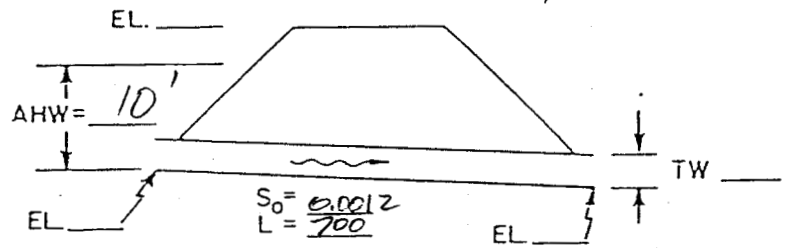
Q_1 = 1598 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 87th/BELL to DA NEWR



1.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
6-RCBC	267	8'x6'	1.05	6.3		1.25/1.75				7.1	.84	8.0	8.0			OK
5-RCBC	320	10'x5'	1.0	5		1.4/2.0				7.1	.84	8.3	-			OK
5-RCBC	320	8'x6'	0.95	5.7		1.75/2.45				"	"	8.7	8.7			

SUMMARY & RECOMMENDATIONS:

from lower reach analysis (7-8'x6')

5-18

51.75

Figure 7

PROJECT: BELL Rd E123061

CONCEPT B2B

DESIGNER: TMO

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 1404

Q_2 = _____

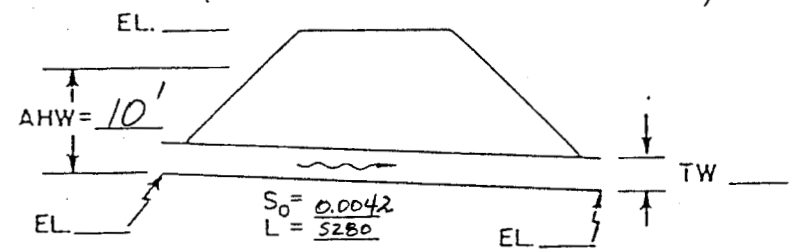
TW_1 = _____

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: I006B to Bell/87th



10.56

MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	468	8'x6'				3.8 / 40.1			8.7	8.7	22.2	25.4				X
4-RCBC	351	8'x6'	1.02	6.12		2.2 / 23.2				"	"	9.0	9.7			ok use
3-RCBC	468	10'x5				3.1 / 32.7				"	"	18.5				X
4-RCBC	351	10'x5'		5.3		1.7 / 17.9				"	"	3.7	5.3			ok

SUMMARY & RECOMMENDATIONS:

* - from lower reach analysis (5 8'x6')

Figure 7

PROJECT: BELL Rd E123061

CONCEPT B2-B

DESIGNER: TMO

DATE: 10/27/86

HYDROLOGIC AND CHANNEL INFORMATION

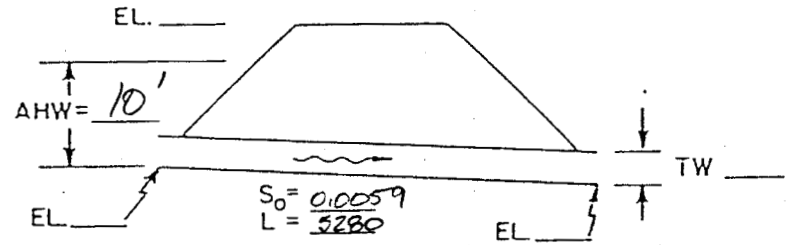
Q_1 = 847 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2004B to 2006B



10.56 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
												$HW=H+h_o-LS_o$				
2 - RCBC	424	8'x6'	1			3.1 / 32.7			9.7	9.7	31.1	11.7				NG
2 - RCBC	424	10'x5'	11	5		2.5 / 26.4					"	5	5			ok (use)
3 - RCBC	282	8'x5'	1			2.0 / 21.1				"						NG
3 - RCBC	282	8'x6'	1			1.35			"	"	"					NG

SUMMARY & RECOMMENDATIONS:

★ - from lower reach analysis

Figure 7

PROJECT: Bell Rd E123061

CONCEPT B2-B

DESIGNER: TMO

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 188

Q_2 =

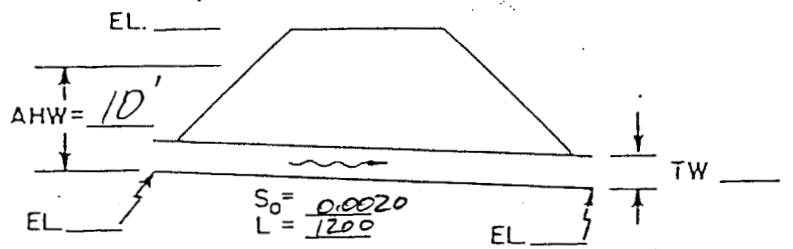
TW_1 =

TW_2 =

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: DA NEWR to NEWR



MEAN STREAM VELOCITY =

2.4 MAX. STREAM VELOCITY =

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCB	188	72"	0.92	5.5		1.75				6	2.4	7.8	7.8			GOOD
1-RCB	188	66"	1.06	5.8		2.6 / 6.2				5.5	"	9.3	9.3			GOOD (USE)

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: Bell Rd (91st AVE SYSTEM) DESIGNER: TMO

CONCEPT 4 DA 2-Q100 DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

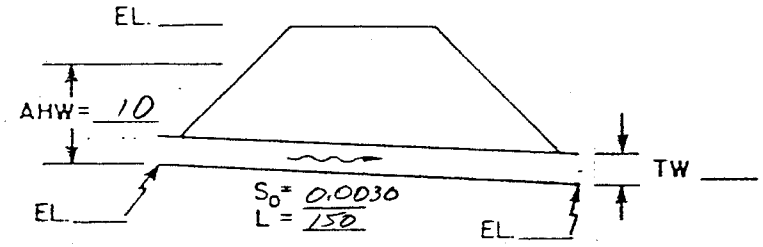
Q_1 = 2413 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



0.3 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
5-RCBC	483	10'x5'	1.42	7.1		3.35/1.0			5	5	0.45	5.5	7.1			ok use

SUMMARY & RECOMMENDATIONS:

5-10.K5

Figure 7

PROJECT: Bell Rd E123061

CONCEPT B2A

DESIGNER: TMO

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 1982

Q_2 = _____

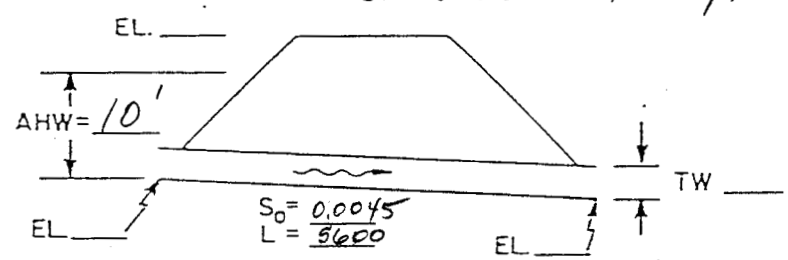
TW_1 = _____

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2006A to Bell/91ST



11.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
4 - RCBC	496	10'x5'				3.5/39.2				7.1	25.2					X
5 - RCBC	396	10'x5'	1.2	6		2.2/24.6				"	"	6.5	6.5			ok (use)
5 - RCBC	396	8'x6'				2.8/31.4				"	"	13.3				X
6 - RCBC	330	8'x5'				2.9/32.5				"	"	—				X
6 - RCBC	330	8'x6'	.97	5.8		2/22.4				"	"	4.3	5.8			ok

SUMMARY & RECOMMENDATIONS:

5- 10x5

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

CONCEPT BZ-A

DATE: 10/29/96

HYDROLOGIC AND CHANNEL INFORMATION

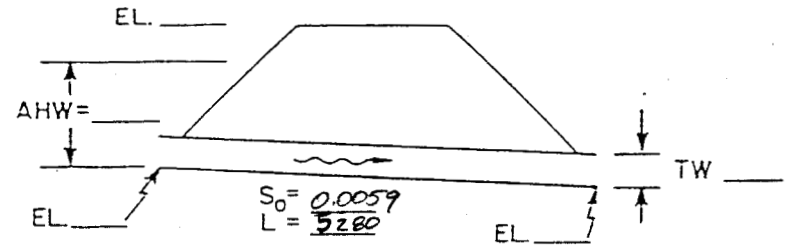
Q_1 = 1430 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2004A to 2006A



10.56 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H or d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	477	10'x5'	1.4	7.0		3.4 / 32.7		* 6.5		31.1	8.1	8.1			✓ USE
4-RCBC	358	8'x5'	1.35	6.8		3.2 / 33.8		"		"	9.2	9.2			✓
4-RCBC	358	8'x6'				2.3 / 24.3		"		"	1.3				over
3-RCBC	477	8'x6'				3.9		"			16.6				X

SUMMARY & RECOMMENDATIONS:

* - from lower reach analysis (5-10'x5')

3-10x5

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

CONCEPT B2-A

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

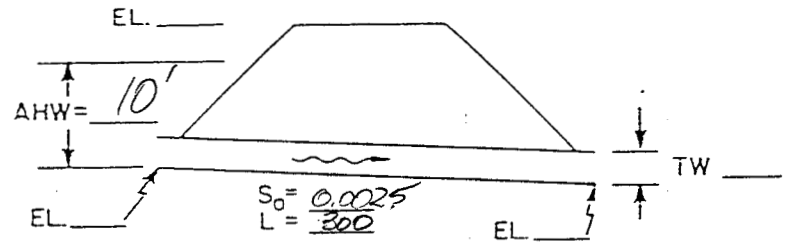
Q_1 = 355 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2009 to 2008B



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCP	178	72"	0.95	5.7		1.57/0.94				8.9	0.75	9.1				ok
2 RCP	178	66"	1.12	6.2		2.18/1.3				"	"	9.45				ok
2 RCP	178	60"	1.37	6.9		3.6/2.2				"	"	10.3				~~ok~~ NG
2 RCP	178	54"				6.4/3.8				"		11.95				~~ok~~ NG
2 RCP	178	48"				10.8/6.5				"		14.6				~~ok~~ NG
1-RCP	355	72"	1.5	9		6/3.6				"	"	11.7				NG
2-RCBC	178	8'x3'	1.38	4.14		2.9/1.7				"	"	9.9	9.9			ok use

SUMMARY & RECOMMENDATIONS:

* from lower reach analysis (1-8'x3')

Figure 7

PROJECT: Bell Rd R123061

DESIGNER: TMO

CONCEPT BZ-A

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

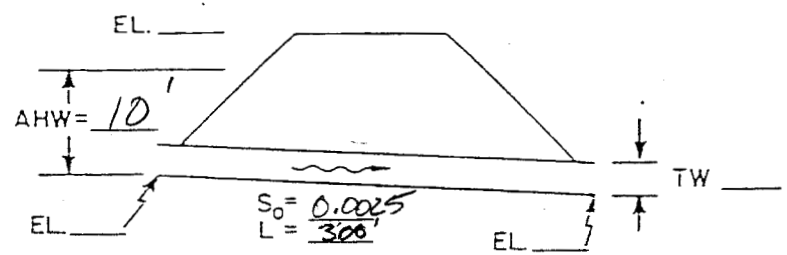
Q_1 = 436 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2008B to 91ST



0.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2 - RCP	218	54"	2.1	9.5		2.2/1.3				7.1	0.75	7.7	9.5			GOOD
2 - RCBC	218	8'x3'	1.75	5.3		4.1/2.5				"		8.9	8.9			ok
1 - RCBC	436	10'x5'	1.3	6.45		2.5/1.5				"		7.85	7.85			ok

SUMMARY & RECOMMENDATIONS:

* from downstream analysis 2 8'x3'

Figure 7

PROJECT: BELL Rd 91ST AVE SYSTEM DESIGNER: JMO

CONCEPT 5 DA 2, Q100 DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

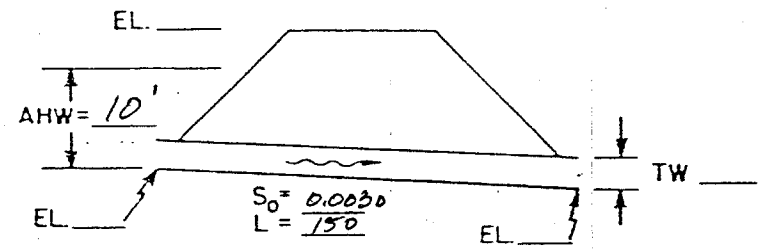
Q_1 = 1455 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH BELL & 91ST UNDER

STATION: BELL Rd



0.3 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
4-RCBC	364	8'x4'	1.04	4.2		5.54 / 1.65				4	0.45	5.2	5.2			OK use

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: BELL Rd

DESIGNER: TMO

CONCEPT B2A

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

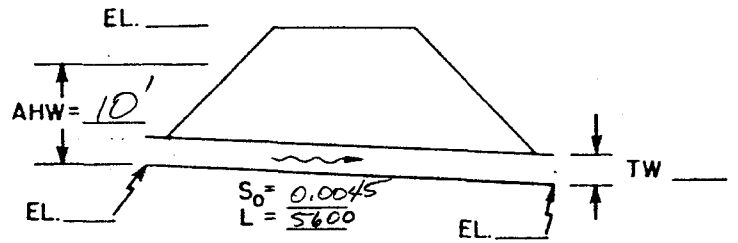
Q_1 = 1011 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH FROM 91st/BELL to

STATION: 2006A



11.2 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o - LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3-RCBC	337	10'x5'		"		1.55/17.3			*4		25.2	-.38				OVER
3-RCBC	337	8'x6'				1.95/21.8			4		"	0.6				ok-over
3-RCBC	337	8'x5'				2.85/31.9			4		"	10.7				NG
4-RCBC	253	6'x6'				2.1/23.5			4		"	2.3				ok
4-RCBC	253	8'x4'	1.26	5.0		2.6/29.1			4			7.9	7.9			ok use

SUMMARY & RECOMMENDATIONS:

* TW=4' because of 4 ft deep earthen channel to New River

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

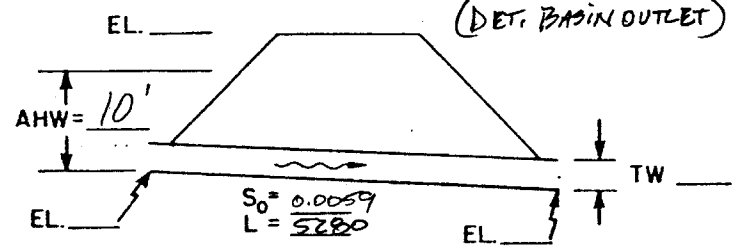
Q_1 = 530 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2006A (DET. BASIN OUTLET)



10.56 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	265	8'x4'	1.34	5.4		2.85 / 30.1			* 7.9		31.1	6.9	6.9			OK (USE)
2-RCBC	265	6'x5'	~~1.3~~			4.0 / 42.2						19.0				NG

SUMMARY & RECOMMENDATIONS:

* - from downstream analysis

Figure 7

PROJECT: BELL RD 87th AVE SYSTEM DESIGNER: TMO

CONCEPT 5, Q100 DA-2 DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 279 TW_1 = _____

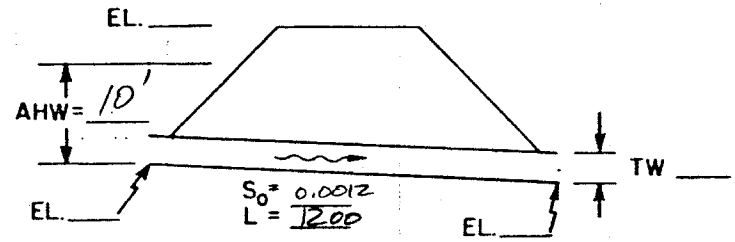
Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

FROM NEW RIVER to DA NEW R

STATION:



2.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	390	10'x5'	1.18	5.9		2.1/5.04			* 5		1.44	8.6	8.6			ok use
3-RCBC	260	8'x4'				2.85/6.8			5		"	10.4				NG
3-RCBC	260	6'x6'				2.2/5.3			5		"	8.8				ok

SUMMARY & RECOMMENDATIONS:

* 5' TW from New River flows

Figure 7

PROJECT: BELL

DESIGNER: TMD

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

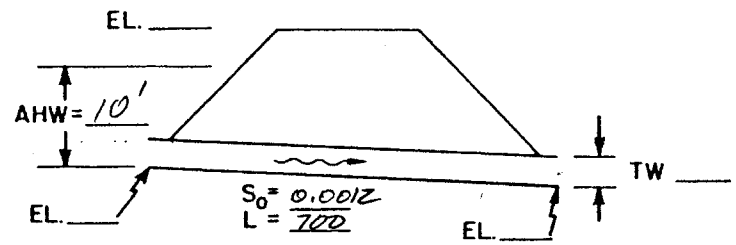
Q_1 = 618 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH FROM DA NEWK

STATION: to 2010



MEAN STREAM VELOCITY = _____

1.4 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2 - RCBC	309	8'x5'				2.4/3.4			* 8.6		0.84	11.2				NG
2 - RCBC	309	10'x5'	0.98	4.9		~~1.29~~ 1.8	1.35		"		"	9.6	9.6			ok USE
3 - RCBC	206	8'x4'				1.7/2.4			"		"	10.2				NG.
3 - RCBC	206	6'x6'	0			1.32/1.8						9.6				NG

SUMMARY & RECOMMENDATIONS:

* from lower system

Figure 7

PROJECT: BELL

DESIGNER: TMO

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

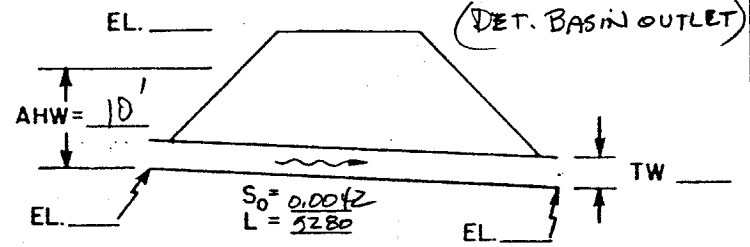
Q_1 = 502 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

FROM 2010 to
STATION: 2006 B DET. BASIN
(DET. BASIN OUTLET)



10.56 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	251	10'x5'				0.85/9.0			9.6	*9.6	22.2	-3.6				OVER
2-RCBC	251	8'x6'				1.05/11.1				"	"	-1.5				~~ok~~ OVER
2-RCBC	251	8'x5'	1	5		1.55/16.4				"	"	3.8				ok (TOO SHALLOW OF BASIN)
2-RCBC	251	8'x4'				2.6/27.5				"	"	14.9				NG
3-RCBC	167	8'x3'				2.25/23.8				"		11.2				NG
2-RCBC	251	6'x6'	0.96	5.8		2.0/21.1			"	"	"	8.5	8.7			OK (use) - good for det. basin elev, not consistent w/ pipe sizes tho!

SUMMARY & RECOMMENDATIONS:

* - from lower system analysis

Figure 7

PROJECT: Bell Rd

DESIGNER: TMO

CONCEPT B2B

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

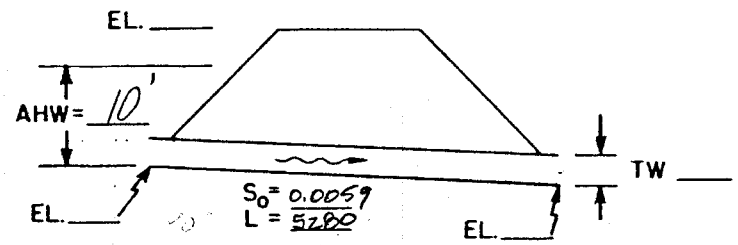
Q_1 = 847 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

FROM 2004 B to STATION: 2006B DET. BASIN



10.54 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	424	10'x5'	1.25	6.3		2.4/25.3			8.7	8.7	31.1	2.7				over (use)
2-RCBC	424	8x5'				4.5/47.5				"	"	24.9				NG
2-RCBC	424	8'x6'	1.18	7.1		3.1/32.7				"	"	10.1				o/c
CHECK → 2-RCBC	500	10'x5'	1.45	7.2		3.35/35.4				"	"	10	10			ok

SUMMARY & RECOMMENDATIONS:

* - from lower system analysis (Det. basin)

use 2-10'x5' RCBC because some flows may enter system between conc. pts when constr. 2-8'x6' would be undersized if such happened!

Figure 7

PROJECT: BELL RD E123061 DESIGNER: TMO

CONCEPT 6 DAZ, Q100 DATE: 10/29/96

HYDROLOGIC AND CHANNEL INFORMATION

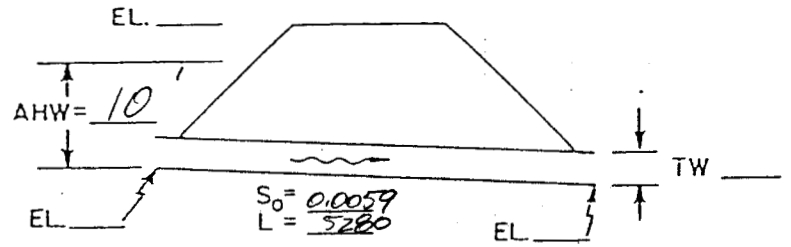
Q_1 = 847 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2004B to 2006B



10.56 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	424	8'x6'	1.2	7.2		3.1/32.7				*6.1	31.1	7.7	7.7			ok
2-RCBC	424	10'x5'	1.23	6.15		2.45/25.9				6.1	"	0.9	6.15			ok (use) - consistent w/downstream
3-RCBC	282	6'x6'	1.09	6.5		2.7/28.5				6.1		3.5	6.5			ok
3-RCBC	282	8'x4'				3.4/35.9				6.1		10.9				X
3-RCBC	282	8'x5'				2.05/21.6				"		—				OVER
2-RCBC	424	8'x5'	1.54	7.7		4.5/47.5				"	"	22.5				NG

SUMMARY & RECOMMENDATIONS:

* from lower reach analysis (6-10'x5')

Figure 7

PROJECT: Bell Rd E123061

DESIGNER: TMO

DATE: 10/29/86

Concept A2-B

HYDROLOGIC AND CHANNEL INFORMATION

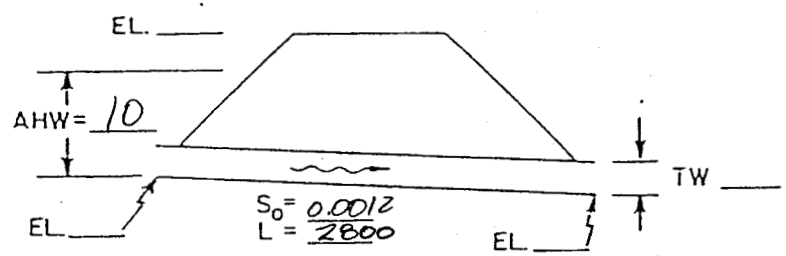
Q_1 = 1407 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2006B to NewR



MEAN STREAM VELOCITY = _____

5.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
3 - RCBC	469	10'x5'				3.15 / 15.8			5	5	3.36	17.8				X
4 - RCBC	352	10'x5'				1.7 / 8.5			5	5		10.5				? close
5 - RCBC	281	8'x6'	.88	5.3		1.4 / 7			6.	6	"	10.0				X
5 - RCBC	281	10'x5'	0.9	4.5		2 / 11.2			5		3.36	12.8				X
6 - RCBC	235	10'x5'	0.78	3.9		0.99 / 4.5				5	"	6.1	6.1			ok (USE)

SUMMARY & RECOMMENDATIONS:

W/ New River @ FLOODSTAGE = 5'

Figure 7

PROJECT: Bell Rd EI23061

DESIGNER: TMO

DATE: 10/29/86

Concept AZ-B

HYDROLOGIC AND CHANNEL INFORMATION

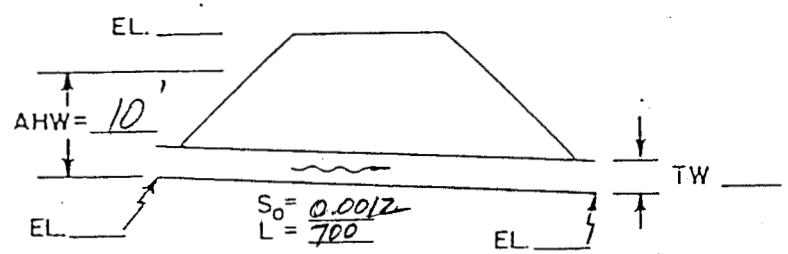
Q_1 = 260 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2010 to DA NewR



1.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	260	72"	1.15	6.9		3.2/4.5				6.6	0.8	10.3				X
1-RCBC	260	8'x4'				2.8/3.9				"	"	9.7				ok
1-RCBC	260	8'x5'				1.7/2.4				"	"	8.2				ok (use)

SUMMARY & RECOMMENDATIONS:

X - FROM LOWER REACH ANALYSIS No - use 8'x4'

Figure 7

PROJECT: Bell Rd E123061

CONCEPT A2-B

DESIGNER: TMO

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

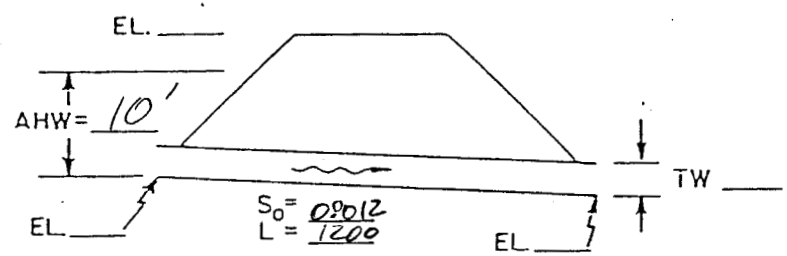
Q_1 = 447 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: DA NEWR to NEWR



2.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
~~2-RCP~~	~~224~~	~~60"~~								~~5~~	~~1.44~~	~~16.8~~				~~X~~
~~2-RCP~~	~~224~~	~~72"~~	~~1.05~~	~~6.3~~						~~6~~						~~GOOD USE~~
1 - RCBC	447	8'x5'				5.1/12.2				5		15.8				X
1 - RCBC	447	8'x6'				3.4/8.2				6		12.7				X
1 - 10x5	447	10x5				2.7/6.5				5		10.04				X
2 - RCBC	224	8'x5'	0.89	4.45		1.28/3.1				5		6.6	6.6			USE
2 - RCBC	224	8'x6'	.74	4.4		0.85/2.0				6		6.6	6.6			

SUMMARY & RECOMMENDATIONS:

Figure 7

Q100 DA2

PROJECT: BELL

CONCEPT A2B

DESIGNER: YMO

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

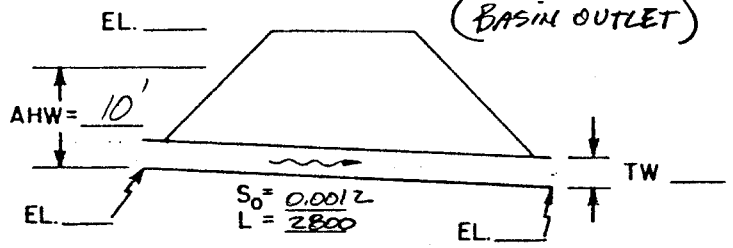
Q_1 = 503 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 2006B DET. BASIN to NEW RIVER (BASIN OUTLET)



5.6 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	252	8'x4'				2.7/15.1			5'	5	3.4	17.2				NG
2-RCBC	252	8'x6'	0.95	5.7		1.05/5.9	111		6.2			8.5	8.9			ok (ALLOW IN FREEBOARD BASIN) USE
2-RCBC	252	8'x5'				1.55/8.7			5		"	10.3				N.G.
				"												

SUMMARY & RECOMMENDATIONS:

assume 5' depth in NEW RIVER

Figure 7

PROJECT: BELL

DESIGNER: TMO

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

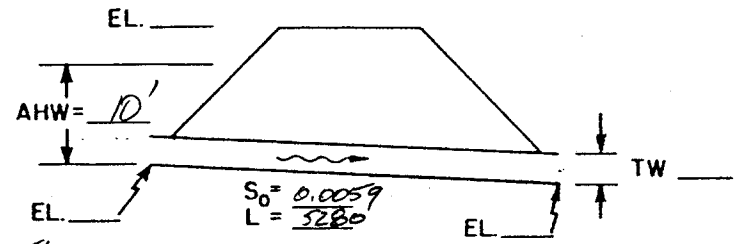
Q_1 = 847 (<1407) TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: FROM 2004B to 2006B DET. B,



10.56 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	424	10'x5'	1.25	6.25		2.4 / 25.3			8.6	-	31.1	2.8	6.25			use
2-RCBC	424	8'x6'				3.1 / 32.7			"		"	10.2				N.G.

SUMMARY & RECOMMENDATIONS:

* from downstream analysis

Figure 7

PROJECT: BELL Rd

DESIGNER: YMD

DATE: 11/4/86

HYDROLOGIC AND CHANNEL INFORMATION

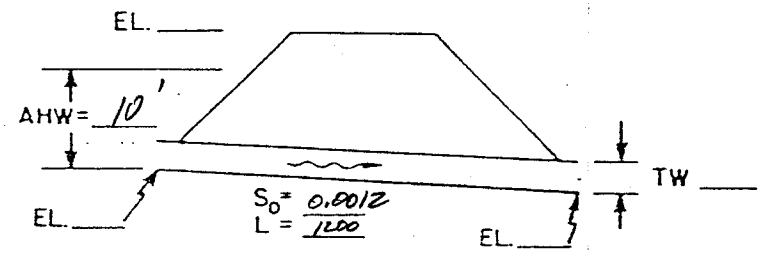
Q_1 = 447 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH DA NEW R to NEW RIVER

STATION :



2.4 MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-RCBC	224	8'x5'	0.9	4.5		1.31 / 3.1			5	5	1.44	6.7	6.7			ok (use)

SUMMARY & RECOMMENDATIONS:

Figure 7

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD FIZZOOL

Description: EXISTING CONDITIONS CHECK : D.A. #1

Calculated by: TWD Date: 3/21/96 Sheet No. 1 of 3

Checked by: _____ Date: _____

24 HOUR STORM PEAK Q

DRAINAGE AREA ID	AREA	CN	LAG TIME	2YR	5YR	10YR	50YR	100YR
1001	0.07	79	0.58	6	17	25	47	58
1002	0.10	81	0.65	10	26	38	69	85
(@ BELL) 1001/1002	0.17	-	-	10	26	38	69	85
(@ BELL) 1003	0.07	80	0.61	7	17	26	48	59
(@ BELL) 1004	0.09	98	0.13	53	79	96	136	154

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD EXCOL
Description: EXISTING CONDITIONS SUMMARY SHEET: DA #2
Calculated by: DJD Date: 3/21/06 Sheet No. 2 of 3
Checked by: _____ Date: _____

24 HOUR STORM PEAK Q_{CFS}

DRAINAGE AREA ID	AREA	CN	LAG TIME	2YR	5YR	10YR	50YR	100YR
2001	0.68	83	1.64	N/A	N/A	N/A	273	332
2002	0.85	86	1.23 } 2.38	N/A	N/A	N/A }	539	653
2003	0.90	82	1.50	N/A	N/A	N/A		
2004	1.00	73	2.77	12	44	73	159	204
2005	1.00	79	—	N/A	N/A	N/A	~~0~~(1054)	~~0~~(1264)
2006	1.00	80	2.09	39	101	150	288	355
2007	0.27	80	0.35	36	89	128	230	279
2008	0.24	81	0.38	35	82	117	209	253
(@ BELL) 2004/06/07/08	—	—	—	81	248	379	819	1039
(@ BELL) 2009	0.25	85	—	70	140	188	306	359
(@ BELL) 2010	0.18	55	0.32	~~0~~	~~0~~	5	35	53
(X-BELL) 09/010-10	—	—	—	137	309	434	836	1059
2011	0.12	89	—	45	80	104	160	186
2012	0.06	89	—	23	41	52	80	93
2013	0.10	90	—	40	70	89	136	157
2014	0.12	90	—	49	84	108	164	189
2015	0.05	91	—	21	36	46	69	80
2016	0.04	92	—	18	30	38	56	65
2017	0.11	80	0.31	16	37	53	96	117
2018	0.09	89	—	24	56	74	119	139
2019	0.08	92	—	37	61	76	113	130
2020	0.34	84	1.36	29	65	92	165	200
2021	0.13	80	0.30	19	44	63	114	139
2022	0.39	89	—	147	262	338	522	604
(X-BELL) 2011-2022	1.63	—	—	321	685	955	1604	1894
2023	0.16	89	—	60	108	139	214	248
2024	0.11	80	0.21	16	37	53	96	117
2025	0.11	90	—	44	77	98	150	173
2026	0.06	80	0.21	10	23	33	58	71

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job

Description

Calculated by Date Sheet No. (1)

Checked by Date of (2)

EXISTING

DRAINAGE AREA ID	AREA	CN	LAG TIME	2YR	5YR	10YR	50YR	100YR
2027	0.30	84	—	98	199	258	400	463
2028	0.17	90	—	63	119	152	232	268
2029	0.30	91		128	218	277	417	480
(X-BASIN) 2023-2029	1.21	—	—	399	762	994	1554	1805
2030	0.50	80	1.31	28	73	109	209	258
2031	0.50	75	1.63	12	41	65	137	175

Job ____ Description ____ Calculated by ____ Date ____ Checked by ____ Date ____ Sheet No. ____ of ____

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Greiner Engineering

— FUTURE —

D.A. ID	AREA	CN	LAG TIME	2yr	5yr	10yr	50yr	100yr
1001	0.07	79	0.58	6	17	25	47	58
(@Bell) 1002	0.10	84	0.54	16	34	48	82	99
(@Bell) 1003	0.07	80	0.61	7	17	26	48	59
(@Bell) 1004	0.09	98	0.13	53	79	96	136	154
2001	0.68	83	1.55	47	110	157	285	347
2002/03	1.06	87	1.66	104	214	293	498	593
2003A	0.26	83	N/A	66	136	184	305	360
2003B	0.43	83	N/A	105	221	301	501	593
2004	0.95	82	N/A	181	456	632	1072	1274
2005	1.00	79	N/A	0(183)	0(428)	0(604)	0(1054)	0(1264)
2006	0.94	81	N/A	150	426	598	1030	1230
2007A	0.06	84	N/A	10	29	43	71	84
2007B	0.21	92	N/A	96	159	199	299	342
2008A	0.18	92	N/A	82	136	171	256	293
2008B	0.06	84	N/A	10	29	43	71	84
2009	0.25	85	N/A	70	140	188	306	359
2010	0.13	84	N/A	49	105	140	225	263
*2030	0.50	80	0.80	41	105	156	295	363
2031	0.50	81	0.80	46	113	166	308	377
(UNDER BELL Rd) STORM DRAIN	–	–	–	436	792	792	792	792
(@ BELL Rd) SURFACE SURFACE	–	–	–	0	291	762	2334	3079

*- Sun City Fully Developed (#'s not included, see existing for specs)

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd ER3061
Description: ON-SITE SYSTEM DA #1
Q10
Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: RE Date: 12-2-86 of 2

Q10 - ON & OFFSITE - DA 1 & 2

TOWN OF SURPRISE

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
DYSART Rd EAST	350'	1-24" RCP	$39/L.F.	$13,700
DYSART Rd EAST (PAST 350')	1050'	1-30" RCP	$55/L.F.	$57,800
EL MIRAGE Rd, WEST	1200'	1-36" RCP	$69/L.F.	82,800
			TOTAL:	$154,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD
Description: ON-SITE SYSTEM
Q10 DA 1 & 2
Calculated by: TMO Date: 12/1/86 Sheet No. 2
Checked by: RB Date: 12-2-86 of 2

MARICOPA COUNTY

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
GRAND to AGUA FRIA				
1ST REACH	2290'	1-24" RCP	$39/L.F.	$89,300
2ND REACH	1590'	1-30" RCP	55/L.F.	87,500
D.A. #1 3RD REACH	1440' } 2620	1-36" RCP	69/L.F.	99,400
4TH REACH	1180' }	1-36" RCP	69/L.F.	81,400
DEL WEBB to 115th				
1ST REACH	2640'	1-24" RCP	39/L.F.	103,000
2ND REACH	2760'	1-30" RCP	55/L.F.	151,800
D.A. #2 **DELL WEBB to 99th**				
1ST REACH	2640	1-24" RCP	39/L.F.	103,000
2ND REACH	2060	1-30" RCP	55/L.F.	113,300
BURNS to 99th				
1ST REACH	3300'	1-30" RCP	55/L.F.	181,500
BURNS to 2007A				
1 REACH	1600'	1-18" RCP	30/L.F.	48,000

TOTALS $ 1,058,200

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd E123061
Description: Q10 - OFF SITE Q'S
D.A. 1
Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: RB Date: 12-2-86 of 1

DRAINAGE AREA 1
MARICOPA COUNTY

	LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
1/2	GRAND/RAILROAD	150'	1-30" RCP	55/L.F.	$8,300
*	RAILROAD/SUN CITY W.	150'	1-~~24~~ 36" RCP	60/L.F.	10,400
	SUN CITY W. CONSTR. AREA	300'	2-30" RCP	55/L.F.	16,500

TOTAL: $ ~~30,700~~

$35,200

* - DOWNSIZED CULVERT FROM 'EXISTING' TO 'PROPOSED'

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: Q10 COST ESTIMATES
DA-2
Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: RB Date: 11-2-86 of 2

CONCEPT 1 (NO DET) 1 SYSTEM

D.A. # STATION	STRUCTURE	LENGTH (FT)	(C.Y.) V	UNIT $	TOTAL $
2030 to 2004A	E. CHANNEL	5280	8,200	$2.50/C.Y.	$20,500
2031 to 2004B	E. CHANNEL	5280	8,700	2.50/C.Y.	21,800
2004B to 2004A	E. CHANNEL	2640	8,200	2.50/C.Y.	20,500
2003B to 2004A	1-8X4 RCBC	100	–	208/L.F.	20,800
2004A to 2006	2-10X5 RCBC	5280	–	546/L.F.	2,882,900
2006 to BELL/91ST	4-10X5 RCBC	5750	–	1034/L.F.	5,945,500
2010 to 2009	1-8X3 RCBC	1400	–	192/L.F.	268,800
2009 to 2008B	1-8X4 RCBC	300	–	208/L.F.	62,400
2008B to BELL/91ST	1-8X5 RCBC	300	–	222/L.F.	66,600
2007A to BELL/91ST	1-36" RCP	1600	–	69/L.F.	110,400
DA NEW R to NEW R.	1-54" RCP	1200	–	124/L.F.	148,800
BELL/91ST to NEW R.	E. CHANNEL	8380	116,400	2.50/C.Y.	291,000

SUB TOTAL: $9,860,000

ROW PURCHASE TOTAL: $2,831,600

TOTAL: $12,691,600

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd R123061
Description: LAND COST FOR ROW PURCHASES Q10
Calculated by: TMO Date: 12/1/86 Sheet No. 2
Checked by: RB Date: 12-2-86 of 2

DEER VALLEY to BEARDSLEY

91ST AVE - $75,000/AC - (RESID)

C1 & C2 CHANNEL - 42' X 5280', $381,800

87th AVE - $75,000/AC - (RESID)

C1 & C2 CHANNEL - 43' X 5280', $390,900

87th to 91ST AVE - $75,000/AC - (RESID)

C1 & C2 CHANNEL - 53' X 2640', $240,900

91ST & BEARDSLEY - $\bar{X}$ = $103,100/AC (COMM/RESID)

C2 DET. BASIN - 664' X 664', $1,043,500

C4 DET BASIN - 586' X 586', $812,800

87th & UNION HILLS $75,000/AC - (RESID)

C4 DET. BASIN - 584' X 584', $587,200

91ST & BELL to NEW RIVER $75,000/AC, (RESID)

C1 CHANNEL - 126' X 8380', $1,818,000

C2 CHANNEL - 90' X 8380, $1,298,600

C3 CHANNEL - 94' X 8380, $1,356,300

C4 CHANNEL - 68' X 8380 $981,100

CONCEPT C1 TOTAL:
$2,831,600

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: Q10 COST EST., DA-2

Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: LB Date: 12-2-86 of 2

CONCEPT 2 (1 DET BASIN) 1 SYSTEM

STATION	STRUCTURE	LENGTH (FT)	V (C.Y.)	UNIT $	TOTAL $
2030 to 2004A	E. CHANNEL	5280	8200	$ 2.50/C.Y.	$ 20,500
2031 to 2004B	E. CHANNEL	5280	8700	2.50/C.Y.	21,800
2004B to 2004A	E. CHANNEL	2640	8200	2.50/C.Y.	20,500
2003B to 2004A	1-8'x4' RCBC	100	–	208/L.F.	20,800
2004A DET. BASIN	DET. BASIN	–	104,900	2.50/C.Y.	262,300
2004A to 2006	1-6x6 RCBC	5280	–	198/L.F.	1,045,400
2006 to BELL/91ST	2-8x6 RCBC	5600	–	432/L.F.	2,419,200
2010 to 2009	1-8x3 RCBC	1400	–	192/L.F.	268,800
2009 to 2008B	1-8'x4 RCBC	300	–	208/L.F.	62,400
2008B to BELL/91ST	1-8x5 RCBC	300	–	222/L.F.	66,600
2007A to BELL/91ST	1-36" RCP	1600	–	69/L.F.	110,400
UNDER BELL/91ST	2-10x5 RCBC	150	–	546/L.F.	81,900
BELL/91ST to NEW R.	E. CHANNEL	8380	72,000	2.50/C.Y.	180,000
DA NEW R to NEW R.	1-54" RCP	1200	–	124/L.F.	148,800

SUB TOTAL: $ 4,729,400

ROW PURCHASE TOTAL: $ 3,355,700

TOTAL: $ 8,085,100

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL K4 K123061
Description: LAND COST FOR ROW PURCHASES Q10
Calculated by: TMO Date: 12/1/86 Sheet No. #2
Checked by: RB Date: 12-2-86 of #2

DEER VALLEY to BEARDSLEY

91ST AVE - $75,000/AC - (RESID)

1½ C2 CHANNEL - 42' X 5280', $381,800

87th AVE - $75,000/AC - (RESID)

1½ C2 CHANNEL - 43' X 5280', $390,900

87th to 91ST AVE - $75,000/AC - (RESID)

1½ C2 CHANNEL - 53' X 2640', $240,900

91ST & BEARDSLEY - $\bar{X}$ = $103,100/AC (COMM/RESID)

C2 DET. BASIN - 664' X 664', $1,043,500

C4 DET BASIN - 586' X 586', $812,800

87th & UNION HILLS $75,000/AC - (RESID)

C4 DET. BASIN - 584' X 584', $587,200

91ST & BELL to NEW RIVER $75,000/ac, (RESID)

C1 CHANNEL - 126' X 8380', $1,818,000

C2 CHANNEL - 90' X 8380, $1,298,600

C3 CHANNEL - 94' X 8380, $1,356,300

C4 CHANNEL - 68' X 8380, $981,100

CONCEPT C2 TOTAL:
$3,355,700

Greiner Engineering
Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD EIZ3061
Description: Q10 COST EST. DA-2

Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: R.E. Date: 12-2-86 of 2

CONCEPT 3 (NO DET) DUAL SYSTEM

STATION	STRUCTURE	(FT) LENGTH	(C.Y.) V	UNIT $	TOTAL $
2030 to 2004A	E. CHANNEL	5280	8,200	$2.50/CY	$ 20,500
2003B to 2004A	1-8X4 RCBC	100	—	$208/L.F.	20,800
2004A to 2006A	2-8'X5' RCBC	5280	—	409/L.F.	2,159,500
2006A to BELL/91ST	2-10X5 RCBC	5600	—	546/L.F.	3,057,600
2009 to 2008B	1-8X4 RCBC	300	—	208/L.F.	62,400
2008B to BELL/91ST	1-8'X5' RCBC	300	—	222/L.F.	66,600
2007A to BELL/91ST	1-36" RCP	1600	—	69/L.F.	110,400
BELL/91ST to NEW R.	E. CHANNEL	8380	76,800	2.50/C.Y.	192,000
2004B to 2006B	1-8X6 RCBC	5280	—	243/L.F.	1,283,000
2006B to NEW R.	1-10X5 RCBC	2800	—	284/L.F.	795,200
2010 to DA NEW R.	1-8X3 RCBC	700	—	192/L.F.	134,400
DA NEW R to NEW R.	1-8X4 RCBC	1200	—	208/L.F.	249,600

SUB TOTAL: $ ~~8,131,500~~ 8,152,000

ROW PURCHASE TOTAL: $ 1,356,300

TOTAL: ~~$9,487,800~~ $ 9,508,300

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: DELL 1.4 12150461
Description: LAND COST FOR ROW PURCHASES
Q10
Calculated by: TMO Date: 12/1/86 Sheet No. #2
Checked by: RB Date: 12-2-86 of #2

DEER VALLEY to BEARDSLEY

91ST AVE - $75,000/AC - (RESID)

1½C2 CHANNEL - 42'x5280', $381,800

87th AVE - $75,000/AC - (RESID)

1½C2 CHANNEL - 43'x5280', $390,900

87th to 91ST AVE - $75,000/AC - (RESID)

1½C2 CHANNEL - 53'x2640', $240,900

91ST & BEARDSLEY - $\bar{x}$ = $103,100/AC (COMM/RESID)

C2 DET. BASIN - 664'x664', $1,043,500

C4 DET BASIN - 586'x586', $812,800

87th & UNION HILLS $75,000/AC - (RESID)

C4 DET. BASIN - 584'x584', $587,200

91ST & BELL to NEW RIVER $75,000/ac, (RESID)

C1 CHANNEL - 126' x 8380', $1,818,000

C2 CHANNEL - 90' x 8380, $1,298,600

C3 CHANNEL - 94' x 8380, $1,356,300

C4 CHANNEL - 68' x 8380, $981,100

CONCEPT C3 TOTAL:
$1,356,300

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD E123061
Description: Q10 COST EST. DA-2

Calculated by: TMO Date: 12/1/86 Sheet No. 1
Checked by: RE Date: 12-2-86 of 2

CONCEPT 4 (1 DET @ 91ST & 87TH) DUAL SYSTEM

STATION	STRUCTURE	(FT) LENGTH	(C.Y.) V	UNIT $	TOTAL $
2031 to 2004B	E. CHANNEL	5280	8,700	$2.50 C.Y.	21,800
2003B to 2004A	1-8X4 RCBC	100	—	$208/L.F.	$20,800
2004A DET. BASIN	DET. BASIN	—	69,400	2.50/C.Y.	173,500
2004A to 2006A	1-60" RCP	5280	—	140/L.F.	739,200
2006A to BELL/91ST	1-8X6 RCBC	5600	—	243/L.F.	1,360,800
UNDER BELL/91ST	2-6'X6' RCBC	150	—	326/L.F.	48,900
BELL/91ST to NEW. R	E. CHANNEL	8380	44,700	2.50/C.Y.	111,800
2007A to BELL/91ST	1-36" RCP	1600	—	69/L.F.	110,400
2009 to 2008B	1-8X4 RCBC	300	—	208/L.F.	62,400
2008B to BELL/91ST	1-8X5 RCBC	300	—	222/L.F.	66,600
2004B to 2006B	1-8X6 RCBC	5280	—	243/L.F.	1,283,000
2006B DET. BASIN	DET BASIN	—	77,400	2.50/C.Y.	193,500
2006B to NEW R.	1-66" RCP	2800	—	145/L.F.	406,000
2010 to DA NEW R.	1-8X3 RCBC	700	—	192/L.F.	134,400
DA NEW R to NEW R.	1-8X4 RCBC	1200	—	208/L.F.	249,600

SUB TOTAL: $ ~~4,960,900~~ $4,482,700

ROW PURCHASE TOTAL: 2,381,100

TOTAL: ~~7,342,000~~ $7,363,800

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD 12150061
Description: LAND COST FOR ROW PURCHASES
Q10
Calculated by: TMO Date: 12/1/86 Sheet No. #2
Checked by: RB Date: 12-2-86 of #2

DEER VALLEY to BEARDSLEY

91ST AVE - $75,000/AC - (RESID)

C1&C2 CHANNEL - 42' X 5280', $381,800

87th AVE - $75,000/AC - (RESID)

C1&C2 CHANNEL - 43' X 5280', $390,900

87th to 91ST AVE - $75,000/AC - (RESID)

C1&C2 CHANNEL - 53' X 2640', $240,900

91ST & BEARDSLEY - $\bar{X}$ = $103,100/AC (COMM/RESID)

C2 DET. BASIN - 664' X 664', $1,043,500

C4 DET BASIN - 586' X 586', $812,800

87th & UNION HILLS $75,000/AC - (RESID)

C4 DET. BASIN - 584' X 584', $587,200

91ST & BELL to NEW RIVER $75,000/AC, (RESID)

C1 CHANNEL - 126' X 8380', $1,818,000

C2 CHANNEL - 90' X 8380, $1,298,600

C3 CHANNEL - 94' X 8380, $1,356,300

C4 CHANNEL - 68' X 8380, $981,100

CONCEPT 4 TOTAL:
$2,381,100

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: BELL Rd (ON-SITE) DRAINAGE SYSTEM (ALL JURISDICATIONS)
Calculated by: TMO Date: 11/12/86 Sheet No. 1
Checked by: [illegible] Date: 11-13 of 1

DRAINAGE AREA 1 & 2 Q100

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
GRAND to AGUA FRIA				
1ST REACH	2640'	1-27" RCP	$47/L.F.	$124,100
2ND "	2640'	1-42" RCP	$83/L.F.	$536,200
3RD "	2640 } 6,460	1-42" RCP		
4TH "	1180	1-42" RCP		
DEL WEBB to 115TH AVE				
1ST REACH	2640'	1-30" RCP	$55/L.F.	$145,200
2ND "	2760'	1-36" RCP	$69/L.F.	$190,400
DEL WEBB to 99TH AVE				
1ST REACH	2640'	1-30" RCP	$55/L.F.	$145,200
2ND "	2060'	1-36" RCP	$69/L.F.	142,100
BURNS to 99TH AVE				
1 REACH	3300'	1-33" RCP	$62/L.F.	$204,600
BURNS to DA 2007A				
1 REACH	1600'	1-24" RCP	$39/L.F.	$62,400

TOTAL: $1,550,200

NOTE: ALL OTHER PORTIONS OF BELL Rd NOT COVERED BY THE ABOVE SYSTEM WILL BE DIVERTED to NATURAL OR PROPOSED DRAINAGE SYSTEMS.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL Rd E123061
Description COST EST. FOR ON-SITE DRAINAGE SYSTEM D.A#1
Calculated by TMO Date 11/12/86 Sheet No. 1
Checked by Date 11-13 of 32

TOWN OF SURPRISE

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
DYSART Rd EAST	350'	1-~~27~~ 30" RCP	$47/L.F.	$ ~~16,500~~ 16,500
DYSART Rd EAST (PAST 350')	1050'	1-42" RCP	83/L.F.	87,200
EL MIRAGE Rd. WEST	1200'	1-42" RCP	83/L.F.	$99,600
			TOTAL:	$203,300

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL R J E123061
Description: COST EST. FOR ON-SITE DRAINAGE SYSTEM
Calculated by: TMO Date: 11/12/86 Sheet No. 2
Checked by: [illegible] Date: 11-13 of 2

MARICOPA COUNTY

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
GRAND to AGUA FRIA				
1ST REACH	2290'	1-27" RCP	$47/L.F.	$107,600
D.A.#1 2ND REACH	1590'	1-42" RCP		
3RD REACH	1440' } 4,210'	1-42" RCP	83/L.F.	$349,400
4th "	1180'	1-42" RCP		
				$475,400
DEL WEBB to 115th				
D.A.#2 1ST REACH	2640'	1-30" RCP	$55/L.F.	145,200
2ND REACH	2760'	1-36" RCP	69/L.F.	190,400
DEL WEBB to 99th				
1ST REACH	2640'	1-30" RCP	$55/L.F.	145,200
2ND REACH	2060	1-36" RCP	69/L.F.	142,100
BURNS to 99th				
1 REACH	3300'	1-33" RCP	$62/L.F.	204,600
BURNS to D.A. 2007A				
1 REACH	1600'	1-24" RCP	$39/L.F.	62,400

TOTAL: $1,346,900

-126,900

[illegible] $ [illegible]

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd R123061

Description: REQ'D PIPE SIZES FOR Q-100, D.A. #1 (OFF SITE)

Calculated by: JMO Date: 11/10/86 Sheet No. 1

Checked by: [illegible] Date: 11/[illegible] of 1

DRAINAGE AREA 1
MARICOPA COUNTY

LOCATION	LENGTH	STRUCTURE	UNIT $	TOTAL $
GRAND / RAILROAD	150 FT	(1)- 36" RCP	69/L.F.	$10,400
RAILROAD / S. City WEST	150 FT	(1)- ~~33~~ 36" RCP	~~62~~ 69/L.F.	~~9,300~~ 10,400
SUN City WEST CONSTR. AREA	300	(2) 36" RCP	69/L.F.	20,700
			TOTAL:	~~$40,400~~ 41,400

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD
Description: TOTAL COST PER CONCEPTS OFF SITE D.A. 2
Calculated by: TMO Date: 11/10/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

City of PEORIA

DRAINAGE AREA 2

CONCEPT C1 (COMPLETE SYSTEM to BELL/91ST to NEW R.)

CONCEPT 1	– NO DETENTION BASIN	$ 20,242,800
CONCEPT 2	– 1 DETENTION BASIN	$ 14,803,800 ~~15,060,600~~
CONCEPT 3	– 2 DETENTION BASINS	$ 14,978,800 ~~12,586,400~~

CONCEPT B2B (1 SYSTEM DOWN 87th AVE to BELL & NEW R.)
CONCEPT B2A (1 SYSTEM DOWN 91ST AVE to BELL to NEW R.)

CONCEPT 4	– NO DETENTION BASINS	$ 22,099,200
CONCEPT 5	– 1 DETENTION BASIN EA. SYSTEM	$ ~~13,332,600~~ 13,023,600

CONCEPT A2B (1 SYSTEM DOWN 87th to UNION HILLS & NEW R.)
CONCEPT B2A (1 SYSTEM DOWN 91ST to BELL to NEW R.)

CONCEPT 6	– NO DETENTION BASINS	$ 20,376,800
CONCEPT 7	– 1 DETENTION BASIN EA. SYSTEM	$ ~~13,031,600~~ $ 12,774,800

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD

Description: COST EST. FOR CONCEPT 1 OFF SITE

Calculated by: TMO Date: 11/5/86 Sheet No. 1

Checked by: Date: 11/12 of 1

City of PEORIA

CONCEPT ~~OF~~ 1

WITH NO DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV	(C.Y.) EXCAV. #	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50/C.Y.	36,800
2031 to 2004 B	5280	77.6	15,200	E. CHANNEL	2.50 C.Y.	38,000
2004 B to 2004A	2640	174.1	17,000	E. CHANNEL	2.50 C.Y.	42,~~500~~ 600
2003 B to 2004A	~~(200)~~ 100	–	–	2 - 6'x4' RCBC	286/L.F.	28,600
2004A to 2006A	~~(26,400)~~ 5280	–	–	5 - 10'x5' RCBC	1293/L.F.	6,827,000
2006 to BELL/91ST	~~(46,000)~~ 5750	–	–	8 - 10'x5' RCBC	2068/L.F.	11,891,000
2007A to BELL/91ST	1600	–	–	54" RCP	124/L.F.	198,400
2010 to 2009	1400	–	–	8'x5' RCBC	222/L.F.	310,800
2009 to 2008B	~~(600)~~ 300	–	–	2 - 8'x5 RCBC	409/L.F.	122,700
2008B to 91ST/BELL	~~(600)~~ 300	–	–	2 - 8'x5' RCBC	409/L.F.	122,700
BELL/91ST to NEW RIVER	8380	796.8	247,300	E. CHANNEL	2.50/C.Y.	618,300
DA NEWR to NEW R.	1200	53.0	2,400	E. CHANNEL	2.50/C.Y.	~~6,000~~
				TOTAL: $		20,242,800

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD FIZ3061
Description: QUANTITIES FOR CONCEPT ~~C1~~ 2 OFF-SITE DRAIN
Calculated by: TMO Date: 11/5/86 Sheet No. 1
Checked by: [illegible] Date: 1/13 of 1

City of PEORIA 2

CONCEPT ~~C1~~ (COMPLETE SYSTEM to 91ST/BELL to GRINWAY to NEW R.)

WITH 1 DETENTION BASIN

STA.	(FT) LENGTH	(FT³/FT) EXCAV	(C.Y.) EXCAV. #	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50/c.y.	36,800
2031 to 2004B	5280	77.6	15,200	E. CHANNEL	2.50/c.y.	38,000
2004B. to 2004A	2640	174.1	17,000	E. CHANNEL	2.50/c.y.	42,500
2003B to 2004A	100'	–	–	2-6'x4' RCBC	286/L.F.	28,600
* 2004A DET. BASIN	–	–	142,000	DET. BASIN	2.50/c.y.	355,000
2004 to 2006	5280'	–	–	3-10'x5' RCBC	791/L.F.	4,176,500
2006 to BELL/91ST (SOUTH SIDE)	5750'			6-10'x5' RCBC	1551/L.F.	8,918,300
2007A to BELL/91ST	1600	–	–	54" RCP	124/L.F.	198,400
2010 to 2009	1400	–	–	8'x5' RCBC	222/L.F.	310,800
2009 to 2008B	300	–	–	2-8'x5 RCBC	409/L.F.	122,700
2008B to 91ST/BELL	300	–	–	2-8'x5 RCBC	409/L.F.	122,700
BELL/91ST to NEW R.	8380	576.8	179,000	E. CHANNEL	2.50/c.y.	447,500
DA NEW R. to NEW R.	1200	53.0	2,400	E. CHANNEL	2.50/c.y.	~~6,000~~ 5,900

TOTAL: $ 14,803,800

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd
Description: COST EST. FOR CONCEPT 3 OFF-SITE DA2
Calculated by: TIMO Date: 11/5/86 Sheet No. 1
Checked by: Date: of 1

City of PEORIA

CONCEPT ~~CT~~ 3

WITH 2 DETENTION BASINS

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50 C.Y.	36,800
2031 to 2004B	5280	77.6	15,200	E. CHANNEL	2.50 C.Y.	38,000
2004B to 2004A	2640	174.1	17,000	E. CHANNEL	2.50 C.Y.	42,500
2003B to 2004A	100'			2-6'X4' RCBC	286/L.F.	28,600
2004 DET. BASIN	-	-	129,600	DET. BASIN	2.50/C.Y.	324,000
~~2004 DET. BASIN~~	~~(LAND PURCHASE)~~		~~9.40ac~~	~~" "~~	~~27,320/ac~~	~~256,800~~
2004 to 2006	5280'	-	-	3-10'X5' RCBC	791/L.F.	4,176,500
2006 DET. BASIN	-	-	124,900	DET. BASIN	2.50/C.Y.	$312,300
~~2006 DET. BASIN~~	~~(LAND PURCHASE)~~		~~12.84ac~~	~~" "~~	~~27,320/ac~~	~~350,800~~
2006 to BELL/91ST (SOUTH SIDE)	5750'	-	-	4-10'X5' RCBC	1034/L.F.	5,945,500
2007A to BELL/91ST	1600	-	-	54" RCP	124/L.F.	198,400
2010 to 2009	1400	-	-	8'X5' RCBC	222/L.F.	310,800
2009 to 2008B	300	-	-	2-8'X5 RCBC	409/L.F.	122,700
2008B to BELL/91ST	300'	-	-	2-8'X5' RCBC	409/L.F.	122,700
BELL/91ST to NEW R.	8380	404.8	125,600	E. CHANNEL	2.50/C.Y.	314,~~000~~ 100
DA NEW R to NEW R.	1200	53.0	2,400	E. CHANNEL	2.50/C.Y.	~~6,000~~

TOTAL: $ ~~12,586,400~~ 11,978,800

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd
Description: COST EST. FOR CONCEPT 4 OFF-SITE DA 2
Calculated by: TMO Date: 11/5/86 Sheet No. 1
Checked by: Date: of 2

City of PEORIA

CONCEPT ~~B2B~~ 4 (87th to BELL to NEW R.)

WITH NO DETENTION

STA.	LENGTH	(FT³/FT) EXCAV	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2031 to 2004B	5280	77.6	15,200	E. CHANNEL	$2.50/c.y.	38,000
2004B to 2006B	(~~10,560~~) 5280	–	–	2-10'X5' RCBC	546/L.F.	2,882,900
2006B to 2010	(~~21,120~~) 5280	–	–	4-8'X6' RCBC	813/L.F.	4,292,600
2010 to DA NEW R	(~~2,500~~) 700	–	–	5-8'X6' RCBC	1016/L.F.	711,200
DA NEW R. to NEW R.	(~~8,400~~) 1200	–	– ?	7 8'X6' RCBC	1423/L.F.	1,707,600
					TOTAL:	$9,632,300

87th AVE SYSTEM total: $ 9,632,300
91ST AVE SYSTEM TOTAL: $ 12,466,900
CONCEPT TOTAL: $22,099,200

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL 174
Description: COST EST FOR CONCEPT 4 OFF-SITE DAX2
Calculated by: TMD Date: 11/5/86 Sheet No. 62
Checked by: [illegible] Date: 11/13 of 2

CONCEPT ~~B2A~~ 4 (91ST to BELL to GRENWAY to NEW R.)

WITH NO DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50/C.Y.	36,800
2003B to 2004A	~~(200)~~ 100	–	–	2-6'X4' RCBC	286/L.F.	28,600
2004A to 2006A	~~(15,840)~~ 5280	–	–	3-10'X5' RCBC	791/L.F.	4,176,500
2006A to BELL/91ST (SOUTH SIDE)	~~(28,750)~~ 5750	–	–	5-10'X5' RCBC	1293/L.F.	7,434,800
2007A to BELL/91ST	1600	–	–	54" RCP	124/L.F.	198,400
2009 to 2008B	~~(600)~~ 300	–	–	2-8'X3' RCBC	350/L.F.	105,000
2008B to BELL/91ST	~~(600)~~ 300	–	–	2-8'X3' RCBC	350/L.F.	105,000
BELL/91ST to NEW. R.	8380	492	152,700	E. CHANNEL	2.50/C.Y.	381,800

TOTAL: $12,466,900

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd E123061
Description: QUANTITIES FOR ~~B2B~~ CONCEPT 5 OFF-SITE DA 2
Calculated by: TMO Date: 11/5/96 Sheet No. 1
Checked by: Date: of 2

City of PEORIA

CONCEPT ~~B2B~~ 5 (87th AVE SYSTEM to BELL Rd to NEW RIVER)

WITH DETENTION

STA	LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2031 to 2004B	5280	77.6	15,200	E. CHANNEL	$2.50/C.Y.	38,000
2004B to 2006B	5280	–	–	2-8'X6' RCBC	432/L.F.	2,281,000
2006B DET. BASIN	–	–	116,600	DET. BASIN	2.50/C.Y.	291,500
~~2006B DET. BASIN~~	~~(LAND PURCHASE)~~		~~9.4ac~~	~~" "~~	~~27,320/ac~~	~~256,800~~
2006B to 2010	5280	–	–	2-6'X6' RCBC	326/L.F.	1,721,300
2010 to DA NEW R.	700	–	–	2-10'X5' RCBC	546/L.F.	382,200
DA NEW R. to NEW R.	1200	–	–	2-10'X5' RCBC	546/L.F.	655,200
					TOTAL:	$5,626,000

87th AVE SYSTEM TOTAL: $ 5,626,000
91st AVE SYSTEM TOTAL: $ ~~7,706,600~~ 7,397,600
CONCEPT TOTAL $ ~~13,332,600~~ ~~13,075,800~~ 13,023,600

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: [illegible]
Description: QUANTITIES FOR CONCEPT ~~B2A~~ 5 OFFSITE DA 2
Calculated by: TMO Date: 11/5/96 Sheet No. ~~5~~ 2
Checked by: [illegible] Date: [illegible] of 2

CONCEPT ~~B2A~~ 5 (91ST AVE SYSTEM to 91ST & BELL to GRNWAY to NEW R.)

WITH DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50/C.Y.	36,800
2003B to 2004A	~~(200)~~ 100	–	–	2-6'x4'-RCBC	286/L.F.	28,600
2004A DET. BASIN	–	–	123,300	DET. BASIN	2.50/C.Y.	308,300
~~2004A DET. BASIN~~	~~(LAND PURCHASE)~~		~~11.3/ac~~	~~" "~~	~~27,320/ac~~	~~309,000~~
2004A to 2006A	~~(10,560)~~ 5280	–	–	2-8'x4' RCBC	381/L.F.	2,011,700
2006A to 91ST/BELL (SOUTH SIDE)	~~(23,000)~~ 5,750	–	–	4-8'x4' RCBC	762/L.F.	4,381,500
2007A to 91ST/BELL	1600	–	–	54" RCP	124/L.F.	198,400
2009 to 2008B	~~(600)~~ 300	–	–	2-8'x3' RCBC	350/L.F.	105,000
2008B to 91ST/BELL	~~(600)~~ 300	–	–	2-8'x3' RCBC	350/L.F.	105,000
91ST/BELL to NEW R.	8380	286.4	88,900	E. CHANNEL	2.50/C.Y.	222,300

TOTAL: $ ~~7,397,600~~
~~7,706,600~~

$ 7,397,600

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job
Description OFF SITE COST. EST
CONCEPT 6 DAXZ
Calculated by TMO Date 11/5/86 Sheet No. ~~2~~ 1
Checked by Date of 2

City OF PEORIA

CONCEPT ~~A2B~~ 6 (87th to UNION HILLS to NEW R.)

WITH NO DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2031 to 2004B	5280	77.6	15,200	E. CHANNEL	$2.50/C.Y.	38,000
2004B to 2006B	~~(10,560)~~ 5280	–	–	2-10'X5' RCBC	546/L.F.	2,882,900
2006B to NEW RIVER	~~(16,800)~~ 2800	–	–	6-10'X5' RCBC	1551/L.F.	4,342,800
2010 to DA NEW R.	700	–	–	8'X5' RCBC	222/L.F.	155,400
DA NEW R to NEW RIVER	~~(2400)~~ 1200	–	–	2-8'X5' RCBC	409/L.F.	490,800
					TOTAL:	$ 7,909,900

87th AVE SYSTEM total: $7,909,900
91ST AVE SYSTEM TOTAL: $12,466,900
CONCEPT TOTAL: $20,376,800

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL Rd - E123061
Description: OFF SITE COST EST.
CONCEPT 6 DRAFT 2
Calculated by: TMD Date: 11/5/86 Sheet No. ~~6~~ 2
Checked by: Date: of 2

City of PEORIA

CONCEPT ~~B2A~~ 6 (91ST to BELL to GRENWAY to NEW R.)

WITH NO DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV. ∀	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	751	14,700	E. CHANNEL	2.50/c.y.	36,800
2003B to 2004A	~~(200)~~ 100	–	–	2-6'x4' RCBC	286/L.F.	28,600
2004A to 2006A	~~(15,840)~~ 5280	–	–	3-10'x5' RCBC	791/L.F.	4,176,500
2006A to BELL/91ST (SOUTH SIDE)	~~(28,750)~~ 5750	–	–	5-10'x5' RCBC	1293/L.F.	7,434,800
2007A to BELL/91ST	1600	–	–	54" RCP	124/L.F.	198,400
2009 to 2008B	~~(600)~~ 300	–	–	2-8'x3' RCBC	350/L.F.	105,000
2008B to BELL/91ST	~~(600)~~ 300	–	–	2-8'x3' RCBC	350/L.F.	105,000
BELL/91ST to NEW. R.	8380	492	152,700	E. CHANNEL	2.50/c.y.	381,800

TOTAL: $12,466,900

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd E123061
Description: Cost Est. For Concept 7 Off-Site DA
Calculated by: DMO Date: 11/5/86 Sheet No. 1
Checked by: [illegible] Date: 11/[illegible] of 2

City of Peoria 7

Concept A2B (87th system to Union Hills to New River)
— WITH DETENTION —

STA.	LENGTH (FT)	EXCAV (FT²)	EXCAV ∀ (C.Y.)	STRUCTURE	UNIT $	TOTAL $
2031 to 2004B	5280	77.6	15,200	CHANNEL	2.50/C.Y.	38,000
2004B to 2006B	5280	–	–	2-10'X5' RCBC	546/L.F.	2,882,900
2006B DET. BASIN	–	–	116,600	DET. BASIN	2.50/C.Y.	291,500
~~2006B DET. BASIN~~	~~(LAND PURCHASE)~~		~~9.4ac~~	~~" "~~	~~27,320/ac~~	~~256,800~~
2006B to New River	2800	–	–	2-8'X6' RCBC	432/L.F.	1,209,600
2010 to DA New R.	700	–	–	8'X5' RCBC	222/L.F.	155,400
DA New R to New River	1200	–	–	2-8'X5'-RCBC	409/L.F.	490,800

TOTAL: $ ~~5,325,000~~ 5,068,200

87th Ave System Total: $ ~~5,325,000~~ 5,068,200
91st Ave System Total: $ ~~7,706,600~~
Concept Total: ~~$13,031,600~~ $12,774,800

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD E123061
Description: QUANTITIES FOR CONCEPT B2A I
OFF SITE
Calculated by: TMO Date: 11/5/96 Sheet No. 2
Checked by: Date: of 2

City of Peoria

CONCEPT B2A (91ST AVE SYSTEM to 91ST & BELL to GRENWAY to NEW R.)

WITH DETENTION

STA	(FT) LENGTH	(FT³/FT) EXCAV.	(C.Y.) EXCAV.	STRUCTURE	UNIT $	TOTAL $
2030 to 2004A	5280	75.1	14,700	E. CHANNEL	2.50/C.Y.	36,800
2003B to 2004A	100'	–	–	2-6'x4'-RCBC	286/L.F.	28,600
2004A DET. BASIN	–	–	123,300	DET. BASIN	2.50/C.Y.	308,300
~~2004A DET. BASIN~~	~~(LAND PURCHASE)~~		~~11.31ac~~	~~" "~~	~~27,320/ac~~	~~309,000~~
2004A to 2006A	5280	–	–	2-8'x4' RCBC	381/L.F.	2,011,700
~~2006A to 91ST/BELL (SOUTH SIDE)~~	~~5,750~~	~~–~~	~~–~~	~~4-8'x4' RCBC~~	~~762/L.F.~~	~~4,381,500~~
2007A to 91ST/BELL	1600	–	–	54" RCP	124/L.F.	198,400
2009 to 2008B	300	–	–	2-8'x3' RCBC	350/L.F.	105,000
2008B to 91ST/BELL	300	–	–	2-8'x3' RCBC	350/L.F.	105,000
91ST/BELL to NEW R.	8380	286.4	88,900	E. CHANNEL	2.50/C.Y.	222,300

TOTAL: ~~$7,706,600~~ 7,397,600

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BIEL RD E123061
Description: LAND $ FOR ROW PURCHASES Q100 & Q10
Calculated by: TMO Date: 11/13/86 Sheet No. 1 of 4
Checked by: _____ Date: _____

DEER VALLEY to BEARDSLEY
(2030 to 2004A)

91ST AVE ($75,000/ac) - RESID.
NO DET. 53' x 5280' $481,800 (CHANNEL)
~~w/ DET 53 x 4640' $423,400 (CHANNEL)~~
~~w/ DET 640' x 640' $705,200 (D. BASIN)~~

87th AVE ($75,000/ac) - RESID.
54' x 5280' $490,900

87th to 91ST ($75,000/ac) - RESID
(2004B to 2004A)
NO DET. 86' x 2640' $ 390,900
w/ DET. 86' x 2000' $ 296,100

91ST & BEARDSLEY
(2004A)
DET. 640' x 640' = $ 969,500

3.67 ac (400' x 400') - $175,000/ac - COMM
9.40 ac (640' x 640') - $75,000/ac - RESID
13.07

TOTAL COST: $1,347,300
AVG. COST = $103,100

91ST & UNION HILLS
(2006A)
DET. 748' x 748' $ 2,144,000

1.03 (100' x 450') - $75,000/ac - RESID
11.81 (717' x 717') - 175,000/ac - COMM
12.84

TOTAL COST: $ 2,144,000
AVG COST: $167,000

87th & UNION HILLS ($75,000) - RESID
(2006B)
DET. 640' x 640' $ 705,200

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job

Description

Calculated by TMO Date 11/2/86 Sheet No. 2

Checked by Date of 4

CHANNEL ALONG BELL to NEW RIVER ($175,000/ac) - COMM
(DA NEW R. to NEW RIVER)
45' X 1200' - $216,900

CHANNEL FROM BELL & 91ST TO NEW RIVER ($75,000/AC - RESID)

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD

Description: LAND $ FOR Q100 ALT'S

Calculated by: TMO Date: 11/13/86 Sheet No. 3 of 4

Checked by: _____ Date: _____

CONCEPT 1.

1) N. OF BELL TO NEW R.	45' X 1200' · $175,000/AC	= $216,900
2) BELL & 91ST TO NEW R.	231' X 8380 · $75,000/AC	= $3,333,000
3) DEER VALLEY to BEARDSLEY (91ST AVE)	53' X 5280' · $75,000/AC	= $481,800
4) DEER VALLEY TO BEARDSLEY (87TH AVE)	54' X 5280' · $75,000/AC	= $490,900
5) 87th TO 91ST (BEARDSLEY)	86' X 2640' · $75,000/AC	= $390,900
	TOTAL:	$4,913,500

CONCEPT 2

1) SEE CONCEPT 1., No. 1		= $216,900
2) " " ", No 3		= $481,800
3) " " ", No. 4		= $490,900
4) " " ", No. 5		= $390,900
5) BELL & 91ST TO NEW R.	176' X 8380' · $75,000/AC	= $2,539,400
6) DET. BASIN @ 91ST & BEARDSLEY	640' X 640' · $103,100/AC	= $962,500
	TOTAL:	$5,089,400

CONCEPT 3

1) - 5) SEE CONCEPT 2, No. 1-4 & 6 (1-4 & 6 TOTAL)		= $2,550,000
6) DET BASIN @ 91ST & UNION HILLS	748' X 748' · $167,000/AC	= $2,145,000
7) BELL & 91ST TO NEW R.	133' X 8380' · $75,000/AC	= $1,919,000
	TOTAL:	$6,614,000

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD

Description: LAND $ FOR Q100 ALT'S

Calculated by: TMO Date: 11/13/86 Sheet No. 4 of 4

Checked by: _____ Date: _____

CONCEPT 4

1) SEE CONCEPT 1., No. 3 & 4 (3 & 4 TOTAL) = $972,700
2) BELL & 91ST TO NEW R. 155' X 8380' @ 75,000/AC = 2,236,400

TOTAL: $ 3,209,100

CONCEPT 5

1) SEE CONCEPT 1, No. 3 & 4, (3 & 4 TOTAL) = $972,700
2) DET. BASIN @ 91ST & BEARPOLEY, 702' X 702' @ $103,100/AC = $1,166,400
3) DET BASIN @ 87th & UNION HILLS, 640' X 640' @ $75,000/AC = $705,200
4) BELL & 91ST TO NEW R., 93' X 8380' @ $75,000/AC = $1,341,800

= $ 4,186,100

CONCEPT 6

1) SEE CONCEPT 4

SAME COSTS AS CONCEPT 4

TOTAL: 3,209,100

CONCEPT 7

1) SEE CONCEPT 5

SAME COSTS AS CONCEPT 5

TOTAL: $ 4,186,100

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD B123061
Description: Q10 DET. BASINS SIZES
DA2
Calculated by: MMO Date: 12/1/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

CONCEPT 2 (1 DETENTION BASIN @ 91ST & BEARDSLEY)

BOTTOM DIMENSION: 560'X560'

NEED 50A-F @ 6.4'
+ 1.6' FREEBOARD

TOP DIMENSION: 624X624

TOTAL EXC. = 104,900 C.Y.

@6.4', V = 50 A-F
@8.0' V = 65 A-F

CONCEPT 4 (1 DET. BASIN @ 91ST & BEARDSLEY & 1 @ 87th & UNION HILLS)

91ST & BEARDSLEY

NEED 33 A-F @ 5.5'
+ 1.5' FREEBOARD

BOTTOM DIMENSION: 490' X 490'

TOP DIMENSION: 546' X 546'

TOTAL EXC = 69,400

@5.5', V = 33 A-F
@7.0, V = 43 A-F

87th & UNION HILLS

NEED: 37 A-F @ 6.4'
+ 1.6' FREEBOARD

BOTTOM DIMEN. 480' X 480'

TOP DIMEN. 544' X 544'

@6.4', V = 37 A-F
@8.0, V = 48 A-F

TOTAL EXC = 77,400 C.Y.

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD

Description: Q10 - OPEN CHANNEL FOR VARIOUS CONCEPTS

Calculated by: TMO Date: 12/1/86 Sheet No. 1

Checked by: _____ Date: _____ of 1

	STA	Q	SLOPE	LENGTH	DEPTH/T.W/B.W/AREA
	2030 to 2004A	156	0.0030	5280	3/26/2/42
	2031 to 2004B	166	0.0030	5280	3.0/29/2/44.6
	2004B to 2004A	357	0.0025	2640	4/37/5/84.0
C1	BELL/91ST to NEW R.	1626	0.0015	8380	4/110/78/374.9
C2	BELL/91ST to NEW R.	948	"	"	4/74/42/232.0
C3	BELL/91ST to NEW R	1026	"	"	4/78/46/247.4 (4.1)
4	BELL/91ST to NEW R	541	"	"	4/52/20/144.0 (3.7)

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL RD E123061
Description: DET. BASIN SIZES (ASSUMING SQ. DIMENSIONS) USING HEC-5 CHARTS & HEC1 ∀
Calculated by: YMO Date: 11/4/86 Sheet No. 1
Checked by: _____ Date: _____ of 2

DA-2, Q100

2004 DET. BASIN SIZE (CONCEPT ~~C1~~ 2) 1 BASIN
(61 AC-FT REQ'D + FREEBOARD)

BOTTOM DIMEN. 520'X520'

TOP DIMEN. 600'X600' (640'X640' w/ 20' BUFFER)

∀@ 8.5 = 60.1 A-F
∀@ 10.0 = 72.3 A-F

2004 DET. BASIN SIZE (CONCEPT ~~C1~~ 3) 2 BASINS (61 A-F + FREEBOARD REQ'D)

BOTTOM DIMEN. 520'X520' ∀@ 8.5' = 60.1 A-F

TOP DIMENSION. 600'X600' ∀@ 10.0 = 72.3 A-F
(640'X640' w/ BUFFER)

2006 DET. BASIN SIZE (60 A-F + FREEBOARD REQ'D)

BOTTOM DIMEN: 650'X650'

∀@ 5.8' = 60.4 FT

TOP DIMEN: 708'X708'
(748'X748' w/ BUFFER)

∀@ 7.3' = 77.4 AC-FT

2004 DET BASIN SIZE (CONCEPT ~~B2A~~ 5) 1 BASIN (61 A-F + FREEBOARD REQ'D)
(BEARDSLEY @ 91ST)

BOTTOM DIMEN: 595'X595'

∀@ 6.9' = 61.5 A-F

TOP DIMEN: 662'X662'
(702'X702' w/ BUFFER)
—11.31 ac—

∀@ 8.4' = 76.4 A-F

Greiner Engineering

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Tucson 602 327-3413
Phoenix 602 275-5400

Job
Description
Calculated by TMO Date 11/4/86 Sheet No. 2
Checked by Date of 2

DET. BASIN SIZES (CONCEPT ~~A2B~~ 7), 1 BASIN, (61 A-F + FREEBOARD REQ'D)
1 BASIN @ 87th/U. HILLS

BOTTOM DIMEN: 520'x520' ∀ @ 8.5' = 60.1

TOP DIMEN: 600'X600' ∀ @ 10.0 = 72.3
(640'x640' w/BUFFER)
-9.40 ac-

DET. BASIN SIZES (CONCEPT ~~B2B~~ 5)
1 BASIN @ 87th/U. HILLS,

BOTTOM DIMEN: 520'x520' ∀ @ 8.5' = 60.1 A-F

TOP DIMEN 600'X600' ∀ @ 10.0 72.3A-F
(640'x640 w/BUFFER)
-9.40 ac-

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: W3
E123061. J0501
Calculated by: MC. Date: 8-25 Sheet No. 1
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q3101

Area: 0.13 square miles

Upstream Elevation: 1229 Hydraulic Length: 2800 feet

Downstream Elevation: 1222 Slope: 0.0025 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	100	Glendale	SR-17	DEV	B	80	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= 2800 ft CN= 80
S= _____ ft/m;	S= 0.25 % Lag= 1.45 hours
Lag= _____ hours	Adjust Lag:
	0.79 (1.45) = 1.14 hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description Q2 routing W3
E123061 J0501
Calculated by MC Date 8-25 Sheet No 2
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q3101

Overland Flow Length (L) 500 ft.

Slope (S) 0.0025 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2600 FT.

Channel Slope (S) 0.0025 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 50 ft.

Side Slopes (Z) 0

RK

L = 4400'

S = 0.0041'/FT

N = 0.016

TRAP

WD = 100

Z = 0

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: W3
E123061 J0501
Calculated by: M.C. Date: 8-25 Sheet No. 3
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q3102

Area: 0.13 square miles

Upstream Elevation: 1225 Hydraulic Length: 2800 feet

Downstream Elevation: 1215 Slope: .0036 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	100	Glendale	SR-1)	DEV	B	80	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N=_____ L=_____ mi Lc_____ mi	L= 2800 ft CN= 80
S=_____ ft/mi	S= 0.36 % Lag= 1.21 hours
Lag=_____ hours	Adjust Lag:
	0.79 (1.21) = 0.95 hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: Q2 Routing W3
E123061 J0501
Calculated by: M.C. Date: 8-25 Sheet No 4
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q3102

Overland Flow Length (L) 240 ft.

Slope (S) .0036 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2850 FT.

Channel Slope (S) 0.0036 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 50 ft.

Side Slopes (Z) 0

RK

L= 3400'

S= 0.0029

N= 0.016

TRAP

WD= 100

Z = 0

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE
Description: W3
E123061 J0501
Calculated by: M.C. Date: 8-75 Sheet No. 5
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q3103

Area: 0.13 square miles

Upstream Elevation: 1230 Hydraulic Length: 3100 feet

Downstream Elevation: 1212 Slope: 0.0058 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	100	Glendale	SR-17	DEV	B	80	

Weighted CN= 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= 3100 ft CN= 80
S= _____ ft/mi	S= 0.58 % Lag= 1.03 hours
Lag= _____ hours	Adjust Lag:
	0.79 (1.03) = 0.81 hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description Q2 Routing W3
E123061 J0501
Calculated by M.C. Date 8-27 Sheet No 6
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q3103

Overland Flow Length (L) 240 ft.

Slope (S) 0.0058 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3400 FT.

Channel Slope (S) 0.0058 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 50 ft.

Side Slopes (Z) 0

RK

L= 1750

S= 0.0029

N= 0.016

TRAP

WD= 100

Z= 0

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description W3
E123061. J0501
Calculated by M.C. Date 8-25 Sheet No 7
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation Q3104

Area 0.13 square miles

Upstream Elevation 1230 Hydraulic Length 3200 feet

Downstream Elevation 1210 Slope 0.0063 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	100	Glendale	PAD	UNDEV	B	79	
						80	Future

Weighted CN= 79 / 80

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/S$^{0.5}$)$^{0.38}$	Lag = L$^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 S$^{1/2}$
N=_____ L=_____m; Lc_____m;	L=3200 ft CN= 79
S=_____ft/m;	S= 0.63 % Lag= 1.05 hours
Lag=_____hours	Adjust Lag: For future 0.79(1.05)= 0.83 hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE - (MD)
Description: W3
E123061. J0501
Calculated by: M.C. Date: 8-25 Sheet No. 8
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q3105

Area: 0.25 square miles

Upstream Elevation: 1230 Hydraulic Length: 3300 feet

Downstream Elevation: 1217 Slope: 0.0039 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Comment
0.13	50	Glendale	SR17	DEV	B	80	
0.12	50	"	SR12	DEV	B	81	

Weighted CN= 80.5

Large or Elongated Watersheds	Small, Uniform Watersheds
Lag = 24n (L Lca/$S^{0.5}$)$^{0.38}$	Lag = $L^{0.8}$ (1000/CN - 9)$^{0.7}$/1900 $S^{1/2}$
N= _____ L= _____ m; Lc _____ m;	L= 3300 ft CN= 80.5
S= _____ ft/m;	S= 0.39 % Lag= 1.30 hours
Lag= _____ hours	Adjust Lag:
	0.78(1.30) = 1.02 hrs

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description G2 EXIST. Routing W3
E123061 J0501
Calculated by _____ Date _____ Sheet No 9
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation G3105

Overland Flow Length (L) 300 ft.

Slope (S) 0.0039 ft./ft.

Roughness Factor (N) 0.035

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 3400 FT.

Channel Slope (S) 0.0039 FT./FT.

Channel Roughness (N) 0.016

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 50 ft.

Side Slopes (Z) 0

RK

L= 2700

S= 0.003

N= 0.4

TRAP

WD= 150

Z = 4

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: BELL ROAD PROJECT DRAINAGE STUDY
Description: W3
E123061 J6501
Calculated by: M.C. Date: 8-25 Sheet No. 10
Checked by: _____ Date: _____ of _____

BELL ROAD MASTER DRAINAGE
DRAINAGE AREA SUMMARY SHEET

Drainage Area Designation: Q3106

Area: 0.57 square miles

Upstream Elevation: 1230 Hydraulic Length: 5500 feet

Downstream Elevation: 1210 Slope: 0.0036 feet/feet

LAND USE

Subarea Square Miles	% Total Area	Jurisdiction	Zoning	Development Status	Soil Group	CN	Future CN Comment
0.57	8	Glendale	R-3	Ag	B	55	86
	4		R1-6	Citrus			85
	88		C-2				92

USE

Weighted CN= 55/91

Large or Elongated Watersheds	Small, Uniform Watersheds
$Lag = 24n\ (L\ Lca/S^{0.5})^{0.38}$	$Lag = L^{0.8}\ (1000/CN - 9)^{0.7}/1900\ S^{\frac{1}{2}}$
N= 0.4 L= 1 mi Lc 0.5 mi	L= 5500 ft CN= 55/91
S= 16.4 ft/mi	S= .36 % Lag= 4.07 hours (USE)
Lag= 4.36 hours	1.39
	Adjust Lag:
	0.74 (1.39) = 1.03

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job BELL ROAD PROJECT DRAINAGE STUDY
Description Q2 Routing W3
E123061 J0501
Calculated by MC Date 8-25 Sheet No 11
Checked by _____ Date _____ of _____

BELL ROAD MASTER DRAINAGE STUDY
KINEMATIC WAVE MODEL DATA SHEET

VK CARD

Drainage Area Designation Q3106

Overland Flow Length (L) 5300 ft.

Slope (S) 0.0036 ft./ft.

Roughness Factor (N) 0.40

Percentage of Subbasin Area Represented (A) 100

RK CARD

Channel Length (L) 2700 FT.

Channel Slope (S) 0.001 FT./FT.

Channel Roughness (N) 0.035

Contributing Area (CA) _____ square miles (leave blank if = to total Area)

Shape (TRAP, DEEP, CIRC) TRAP

Channel Bottom Width or Diameter (WD) 100 ft.

Side Slopes (Z) 4

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Concept plans, Alt. 1
D.A. & Q.100
Calculated by: R.H Date: 11/12/86 Sheet No. 1
Checked by: BGS Date: 11/17/86 of 2

Alt. 1

Proposing for storm Drains along 75th Ave. between Union Hills and Bell Rd to route the discharges north of Skunk Creek and east of 75th Ave. down to Bell Rd. An earthen channel along 75th Ave. from Bell Rd. to Skunk Creek. Also an earthen channel along Bell Rd. from 77th Ave. alignment to New River to carry discharges west of 75th Ave.

Results:

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
from North of Grovers to Grovers along 75th Ave.	1-66" RCP	1320 L.F.	$ 145	$ 191,400
from Grovers to just North of Bell Rd. along 75th Ave.	1-10'x5' RCBC	1,800 L.F.	284	511,200
from just North of Bell to Bell Rd. along 75th Ave.	2-8'x5' RCBC	780 L.F.	409	319,020
75th Ave. @ Bell to Skunk Creek	earthen Channel TW=~~47'~~84' D=~~3.4~~5'	4,040 C.Y.	2.50	10,100
	~~1.13 acre @ 175,000~~			~~395,500~~ 197,750
77th Ave. @ Bell to New River	earthen Channel TW=76' D=4'	42,453 C.Y.	2.50	106,130
	~~10.14 acre @ 175,000~~			~~1,774,500~~
Total				~~$ 3,110,100~~ $ 1,137,750

R.O.W. requirement - for the Channel along Bell Rd. a total of 92' of additional R/W is required.

for the Channel along 75th Ave. a total of 63' of additional R/W is required.

Utilities Conflicts - There is a 69KV overhead electric distribution line as well as an underground electric line along Bell Rd. which is in conflict with the entire length (4800') of the channel. Also overhead and underground electric lines along 75th Ave. which is in conflict with the entire length of the S.D. along Bell Rd; (3900').

Greiner Engineering

Greiner Engineering Sciences, Inc.
Tucson 602 327-3413
Phoenix 602 275-5400

Job Bell Rd. Project Drainage Study
Description Concept Plans - Alt. 2

Calculated by R.H Date 11/12/86 Sheet No. 1
Checked by BGS Date 11/17/86 of 1

Alt. 2

Storm Drains along 75th Ave. down to 820' North of Bell Rd. An 820'x340' detention basin North of Bell Rd. and east of 75th Ave. Storm Drain at the outlet of detention basin to Skunk Creek. Also 640'x430' detention basin north of Bell Rd. and just west of 77th Ave alignment. Storm Drain at the outlet to New River along Bell Rd.

Results:

Location	Structure (Item)	Quantity	Unit cost	Total cost
from North of Grovers to Grovers along 75th Ave.	1-66" RCP	1320 L.F.	$ 145	$ 191,400
from Grovers to just North of Bell Rd. along 75th Ave.	1-10'x5' RCBC	1800 L.F.	284	511,200
from just North of Bell Rd. to Bell Rd. along 75th Ave.	820'x340' Det. Basin	72,600 C.Y.	2.50	181,500
	6.4 acre @ $75,000			480,000
Bell Rd. to Skunk Creek	1-48" RCP	960 L.F.	98	94,080
West of 77th Ave. along Bell Rd.	640'x430' Det. Basin	80,667 C.Y.	2.50	201,670
	~~6.3 acre @ $175,000~~			~~1,102,500~~
D.B #2 to New River along Bell Rd.	1-66" RCP	4200 L.F.	145	609,000
		Total		~~$ 3,371,350~~ $ 1,710,000

ROW requirement - Requires 6.4 acre for detention basin @ 75th Ave. & Bell Rd. and 6.3 acres for detention basin @ 77th Ave. & Bell Rd.

Utilities Conflicts - same as alt. #1.

Greiner Engineering

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Phoenix 602 275-5400

Job: Bell Rd. project Drainage Study
Description: Storm Drain + Channel Sizing for DA 3, Alt. 2
Calculated by: R.H Date: 11/3/86 Sheet No. 1
Checked by: BGB Date: 11/17/86 of

Location	Length (ft)	Q (cfs)	Slope	Structure Size
DA 3101 to DA 3102	1320	178	0.0041	1-66" RCP
DA 3102 to DA 3103	1800	356	0.0029	1-10'x5' RCBC
East of 75th Ave. along Bell	—	608	—	780'x300' Det. Basin with 4:1 side slope + 10' deep
Bell Rd. to Skunk Creek	960	125 ~~81~~	0.0073	1-~~36"~~ 48" RCP
West of 77th Ave along Bell	—	1153	—	600'x390' Det. Basin with 4:1 side slope + ~~7'~~ ~~10'~~ 8' deep.
Det. Basin West of 75th Ave. to New River	4200	~~127~~ 111	0.0017	1-66" RCP

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Concept plan, Alt. 3

Calculated by: R.H Date: 11/17/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

Alt. 3

Alt. 3 is a Combination of alt. 1 + 2. Keeping the stormDrain System along 75th Ave An earthen Channel from Bell Rd. to Skunk Creek along 75th Ave. With the Same size as alt. 1. Same Detention Basin west of 77th Ave. and Storm sewer from Detention Basin to New River.

Results

Location	Structure (Item)	Quantity	unit cost	Total cost
from North of Grovers to Grovers along 75th Ave.	1-66" RCP	1,320 L.F.	$145	$191,400
from Grovers to just North of Bell Rd along 75th Ave.	1-10'x5' RCBC	1,800 L.F.	284	511,200
from just North of Bell Rd to Bell Rd. along 75th Ave.	2-8'x5' RCBC	780 L.F.	409	319,020
from Bell Rd to Skunk Creek along 75th Ave.	earthen channel TW= ~~47'~~ 84' D= ~~3.4'~~ 8'	40,40 c.Y.	2.50	10,100
	~~1.13 acres @ 175,000~~ 2.26			~~197,750~~ 395,500
West of 77th Ave.	640'x430' Det. Basin	80,667 c.Y.	2.50	201,670
	~~6.3 acres @ $175,000~~			~~1,102,500~~
from D.B to New River	1-66" RCP	4200 L.F.	145	609,000

Total ~~$3,142,640~~ $1,242,510

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Storm Drain & Channel Sizing for DA 3, Alt. 3
Calculated by: R.H Date: 11/3/86 Sheet No. 1
Checked by: _____ Date: _____ of 1

Location	Length (ft)	Q (cfs)	Slope	Structure Size
DA 3101 to DA 3102	1320	178	0.0041	66" RCP
DA 3102 to DA 3103	1800	356	0.0029	1-10'x5' RCBC
DA 3103 to DA 3104 @ Bell	780	532	0.0029	2-~~8'x4'~~ 8'x5' RCBC
75th Ave. @ Bell to Skunk Creek	960	605	0.0050	Conc. Channel: TW = ~~22'~~ 17', Z = ~~2~~ 4, D = ~~5'~~ 3.4
West of 77th Ave.	—	1153	—	600'x390' Det. Basin with 4:1 Side Slope & 10' deep
Det. Basin west of 75th Ave. to New River	4200	127	0.0017	1-66" RCP

Alternate 1: A storm drain would be located along 75th Avenue, extending from Bell Road to .25 miles north of Grovers Avenue, and outlet into Skunk Creek via pipe south of Bell Rd. along 75th Ave. A second storm drain would be located along Bell Rd. to convey to the New River, runoff concentrating at the 77th Ave. alignment. The 10-year discharge to Skunk Creek at 75th Ave. would be 274 cfs. The discharge to the New River would be 160 cfs. storm drain sizes would vary from 48-inch to 72"- inch pipes.

Cost Estimates

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
from north of Grovers to Grovers along 75th Ave.	1-48" RCP	1320 L.F.	$98	$130,000
from Grovers to just North of Bell along 75th Ave.	1-72" RCP	1800 L.F.	150	270,000
from just North of Bell to Bell along 75th Ave.	1-72" RCP	780 L.F.	150	120,000
from Bell Rd. to Skunk Creek along 75th Ave.	1-72" RCP	960 L.F.	150	150,000
from 77th Ave. to New River along Bell Rd.	1-72" RCP	4000	150	600,000
		Total Cost		$1,270,000

R.O.W. Requirements: No additional R/W for this alternate is required.

Alt. 2 : A storm drain would be located along 75th Avenue, extending from Bell Rd. to .25 miles north of Grovers Avenue, and outlet into Skunk Creek via open channel South of Bell Rd. along 75th Avenue. A second open channel would be located along Bell Rd. to convey to the New River, runoff concentrating at the 77th Ave. alignment. The 10-year discharge to Skunk Creek at 75th Ave. would be 274 cfs. The discharge to the New River would be 160 cfs. Stormdrain sizes would vary from 48-inch pipe to 72-inch pipe. open channel would be from 2.5 to 3.3 feet deep and range from 28 to 31 feet in top width.

Cost Estimates

Location	Structure (Item)	Quantity	Unit Cost	total Cost
from north of Grovers to Grovers along 75th Ave.	1-48" RCP	1320 L.F.	$98	$130,000
from Grovers to just north of Bell along 75th Ave.	1-72" RCP	1800 L.F.	150	270,000
from just north of Bell to Bell along 75th Ave.	1-72" RCP	780 L.F.	150	120,000
from Bell Rd. to Skunk Creek along 75th Ave.	open channel {TW=31', D=2.50'}	1900 C.Y. (TW=83)	2.50	5,000
	1.04 ac. @ $175,000	1.04 ac	175,000	182,000
		2.78	175,000	487,290 mc 1/8
from 77th Ave. to New River along Bell Rd.	open Channel {TW=28.4', D=3.3'}	7,500 C.Y.	2.50	20,000
	4.08 @ $175,000	4.08	175,000	714,000

~~Total Cost $1,450,000~~

R.O.W. Requirements: A Total of ~~5.12~~ 6.86 acres of R/W for this alternate is required.

Alternate 3: A storm drain would be located along 75th Avenue, extending from Bell Road to .25 miles north of Grovers avenue. A second storm drain would be located along Bell Rd. from 75th Ave. to New River. The 10 year discharge to New River would be 434 Cfs. Storm drain sizes would vary from 48-inch pipe to 2-8'x5' box culverts.

Cost Estimates

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
from north of Grovers to Grovers along 75th Ave.	1-48" RCP	1320 L.F.	$98	$130,000
from Grovers to just north of Bell along 75th Ave.	1-72" RCP	1800 L.F.	150	270,000
from just north of Bell Rd. to Bell Rd. along 75th Ave.	1-8'x5' RCBC	780 L.F.	222	170,000
from 75th Ave. to 77th Ave. along Bell Rd.	1-8'x5' RCBC	1900 L.F.	222	430,000
from 77th Ave. to New River along Bell Rd.	2-8'x5' RCBC	4000 L.F.	409	1,640,000
		Total cost		$2,640,000

R.O.W. Requirements: No additional R/W for this alternate is required.

Alternate 4: A storm drain would be located along 75th Ave. extending from Bell Rd. to .25 mile north of Grovers Ave. An open channel would be located along Bell Rd. from 75th Ave. to New River to convey runoffs from 75th Ave. and 77th Ave. concentrations. The 10-year discharge to 77th Ave. alignment would be 274 cfs. and the total discharge to New River would be 434 cfs. Storm drain sizes would vary from 48-inch pipe to 1-8'x5' box culvert. Open channel would be from

Cost Estimates

Location	Structure	Quantity	Unit Cost	total Cost
from north of Grovers to Grovers along 75th Ave.	1-48" RCP	1320 L.F.	$98	$130,000
from Grovers to just north of Bell Rd. along 75th Ave.	1-72" RCP	1800 L.F.	150	270,000
from just north of Bell to Bell along 75th Ave.	1-8'x5' RCBC	780 L.F.	222	170,000
from 75th Ave. to 77th Ave. along Bell Rd,	open channel {TW=31.60, D=3.70} ~~2.08~~ 4.34 ac. @ 175,000	4500 C.Y.	2.50	12000 ~~360,000~~ 760,000
from 77th Ave. to New River along Bell Rd.	open channel {TW=42.3, D=4.0} ~~5.35~~ 9.36 @ 175,000	15600	2.50	40,000 ~~940,000~~ 1,640,000

Total cost ~~$1,920,000~~

R.O.W. Requirements: A total of ~~7.43~~ 13.70 acres of R/W for this alternate is required.

Alternate 5: A storm drain would be located along 75th Ave., extending from Bell Rd. to .25 miles north of Grovers Ave. A pipe would be located along Bell Rd. to convey runoff concentrating at the 77th Ave. alignment. The outlet would consist of a storm drain to 75th Ave. ~~would be located~~ along 75th Ave. from Bell Rd. to Skunk Creek. The 10-year discharge to Skunk Creek at 75th Ave. would be 432 cfs. Storm drain sizes would vary from 48-inch pipe to 1-8'x5' box culvert.

Cost Estimates

Location	Structure (Item)	Quantity	Unit Cost	Total Cost
from north of Grovers to Grovers along 75th Ave.	1-48" RCP	1320	$ 98	$ 130,000
from Grovers to just north of Bell along 75th Ave.	1-72" RCP	1800	150	270,000
from just north of Bell Rd. to Bell Rd. along 75th Ave.	1-72" RCP	780	150	120,000
from 77th Ave. to 75th Ave. along Bell Rd.	1-66" RCP	1900	145	280,000
from Bell Rd. to Skunk Creek along 75th Ave.	1-8'x5' RCBC	960	222	210,000
			Total Cost	$ 1,010,000

R.o.W. Requirements: No additional R/W for this alternate is required.

PROJECT: Bell Rd Drainage

DESIGNER: R.H

Alt. 1 from DA 3103 to DA 3104 @ Bell Rd. DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 532cfs

Q_2 = _____

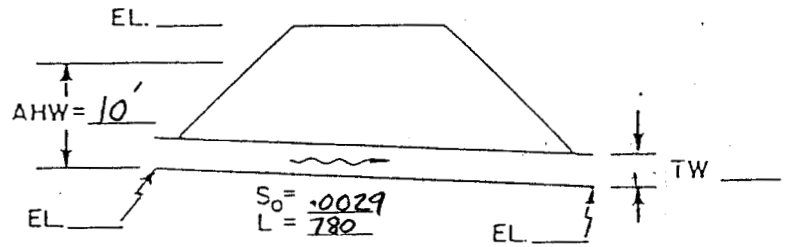
TW_1 = _____

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

1.56 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	O	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-RCBC	266	8'x4'	1.30	5.5	.5	~~4.68~~ 3.2			4'	4'	2.26	~~6.42~~ 6				O.K.
2-RCBC	"	6'x5'			"	5.62			5'	5'	"	8.36				O.K.
2-RCBC	"	8'x3'			"	9.67			3'	3'	"	10.41				N.G.
2-RCBC	266	8'x5'				11/3				5		5.0				

SUMMARY & RECOMMENDATIONS:

~~use 2-8'x4'~~ use 2-8'x5' RCBC

Figure 7

PROJECT: Bell Rd. Drainage

DESIGNER: R.H

Alt. 1 from DA 3102 to DA 3103

DATE: 10/29/86

HYDROLOGIC AND CHANNEL INFORMATION

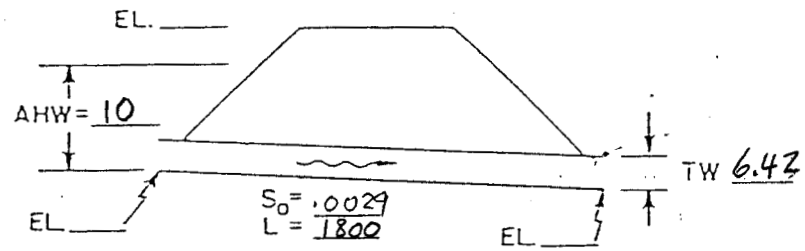
Q_1 = 356 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave



MEAN STREAM VELOCITY = _____

3.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	356	10x5			.5	1.7 ~~5.94~~ 6.42			6 ~~6.42~~	6 ~~6.42~~	5.22	7.5 ~~7.14~~				O.K.
1 RCBC		8x6			"	2.2 ~~7.86~~			"	"	"	~~8.76~~ 9.2				O.K.
1 RCBC		8x5			"	10.8			"	"	"	12.0				N.G.
1 RCP	178	60"				12.24			"	"	"	13.44				N.G.
1 RCBC	356	10x5				1.4 ~~6.5~~			5.8	5.8		7.1				O.K

SUMMARY & RECOMMENDATIONS:

Use 10'x5' RCBC ✓

Figure 7

PROJECT: Bell Rd. Drainage

DESIGNER: R.H.

Alt. 1 from DA 3101 to DA 3102

DATE: 10/30/86

HYDROLOGIC AND CHANNEL INFORMATION

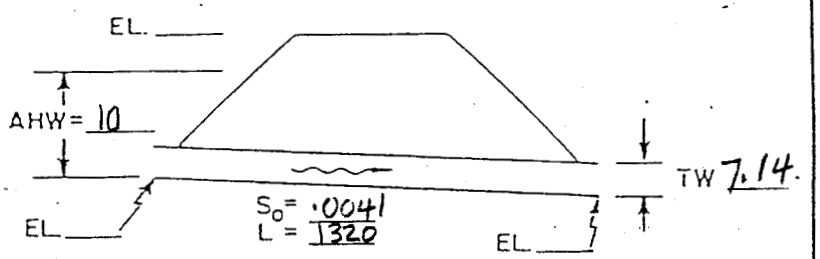
Q_1 = 178 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

2.64 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	178	60"			0.2	8.98			7.14	7.14	5.41	10.71				N.G
1-RCP	"	66"			"	6.97			"	"	5.41	7.80	9			O.K.
1-RCP	178	66"				6.3			7.1			8				O.K.

SUMMARY & RECOMMENDATIONS:

Use 66" RCPC ✓

Figure 7

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Concept plan, Alt. 2. Q10
DA 3
Calculated by: R.H Date: 11/26/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Location	Length (ft)	Q (cfs)	slope	Structure size
North of Grovers to Grovers along 75th Ave.	1320	80	.0041	1-48" RCP
Grovers to just North of Bell along 75th Ave.	1800	161	.0029	1-72" RCP
just north of Bell to Bell along 75th Ave.	780	243	.0029	1-72" RCP
Bell Rd. to Skunk Creek along 75th Ave.	960	274	.005	TW=31', D=2.50', BW=11'
77th Ave. to New River along Bell Rd.	4000	160	.0017	TW=28.4', D=3.30', BW=2'

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. Project Drainage Study
Description: Concept Plan Alt. 1, Q100
D.A 3
Calculated by: R.H Date: 11/24 Sheet No. ____
Checked by: ____ Date: ____ of ____

Location	Length (ft)	Q (cfs)	Slope	Structure size
North of Grovers to Grovers along 75th Ave	1320	80	.0041	1-48" RCP
Grovers to just North of Bell along 75th Ave.	1800	161	.0029	1-72" RCP
just North of Bell to Bell along 75th Ave.	780	243	.0029	1-72" RCP
Bell Rd. to Skunk Creek along 75th Ave.	960	274	.0073	1-72" RCP
77th Ave. to New River along Bell Rd.	4000	160	.0017	1-72" RCP

PROJECT: Bell Rd. project 10-year frequency DESIGNER: R.H.

Alt. 1 from Bell Rd. To Skunk Creek along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

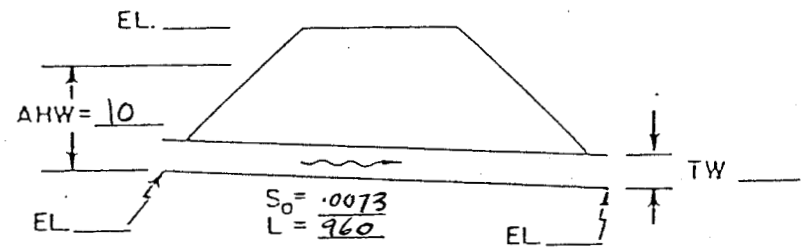
Q_1 = 274 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

1.92 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1RCBC	274	8X3	2.3	6.9	0.5	6.5/12.5			3	3	7.0	8.5	"			o.k.
1RCP	"	66"	1.66	9.1	0.2	5.4/10.4			5.5	5.5	"	8.9				o.k.
1RCP	"	72"	1.32	7.9	"	3.44/6.6	3.6/6.9		6	6	"	5.8	7.9		✓	o.k.
1RCP	274	78"	1.1	7.2									7.2			
1RCP	274	84"	.95	6.7	"								6.7			

SUMMARY & RECOMMENDATIONS:

Use 1-72" RCP ok ~~Use 1-84" RCP~~

Figure 7

PROJECT: Bell Rd. Project — 10-year frequency — DESIGNER: R.H.

Alt. 1 from just North of Bell Rd. to Bell Rd. along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

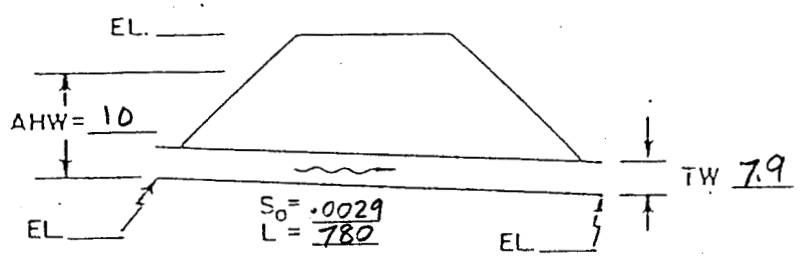
Q_1 = 243 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

1.56 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1RCP	243	66"	1.47	8.1	0.2	4.3/6.7			7.9	7.9	2.3	12.3				N.G.
1RCP	"	72"	1.22	7.3	"	2.8/4.4			"	"	"	10	✓			o.k.
1RCP		72"							7.2							
1RCP		72"				4.4			6.7		2.3	6.6				
					"											

SUMMARY & RECOMMENDATIONS:

Use 1-72" RCP

Figure 7

PROJECT: Bell Rd. Project 10-year frequency DESIGNER: R.H

Alt. 1 from Grovers to jus North of Bell Rd. along 75th Ave DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

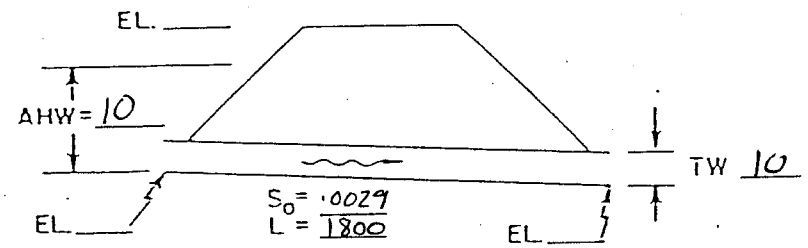
Q_1 = .161 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = 3.6

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	161	60"	1.34	6.7	0.2	1.75/6.3			10	10	5.2	11.1				N.G.
1 RCP	"	72"	0.87	5.2	"	0.8/2.9			"	"	"	7.7	7.7			O.K.
1 RCP	"	66"	1.02	5.6	"	1.42/5.1			"	"	"	9.9				O.K.
1 RCP		66				5.1			8.8		5.2	8.7				ok
					"											

SUMMARY & RECOMMENDATIONS:

ok

Use 1-~~72"~~ RCP ~~[illegible]~~ , 66" RCP

Figure 7

PROJECT: Bell Rd. project 10-year frequency DESIGNER: R.H

All.1 from North of Grovers to Grovers along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

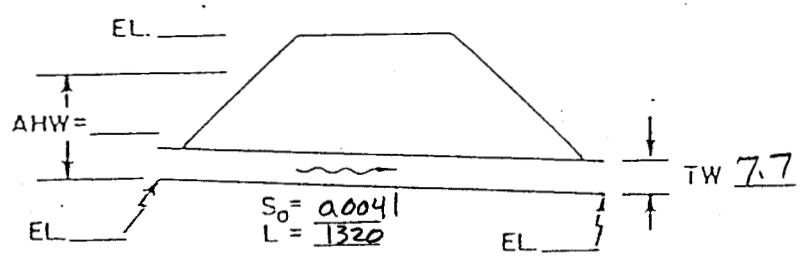
Q_1 = 80 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

2.64

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	80	48"	1.08	4.3	0.2	2.1/5.5			7.7	7.7	5.4	7.8	7.8			ok.
1 RCP	"	42"	1.5	5.3	"	3.8/10.0			"	"	"	12.3				N.G.
1 RCP		48"				5.5			8.0		5.4	8.9				ok
					"											

SUMMARY & RECOMMENDATIONS:

Use 1-48" RCP

Figure 7

PROJECT: Bell Rd. Project 10-year frequency

DESIGNER: R.H

Alt. 1 from 77th Ave. to New River along Bell Rd.

DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

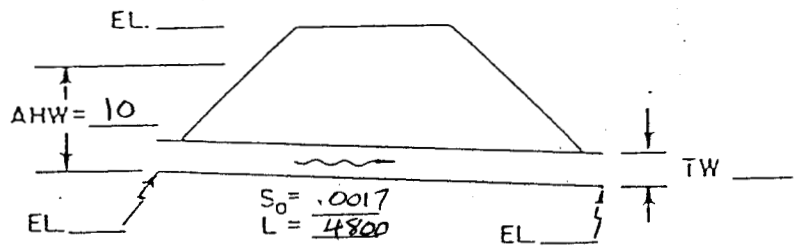
Q_1 = 160 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 77th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = 9.6

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	160	72"	0.87	5.2	0.2	1.75 / ~~16.8~~ 12			6	6	8.2	~~14.6~~ 9.8				N.G. ok
1 RCBC	"	8x4	0.9	3.6	0.5	1.1 / 10.6			4	4	"	6.4	6.4			O.K.
1 RCBC	"	8x3	1.28	3.8		2.2 / 21.1			3	3	"	15.9				N.G.
1 RCBC	"	6x5	0.88	4.4		1.5 / 14.4			5	5	"	11.2				N.G.
1 RCP	160	84"	0.6	~~4.2~~	"	~~.58~~										

SUMMARY & RECOMMENDATIONS:

Use 1-~~8x4~~ RCBC use 1-72" RCP

Figure 7

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. project Drainage Study
Description: Concept plan Alt. ~~3~~, Q10
DA 3
Calculated by: R.H Date: 11/24/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Location	Length (ft)	Q (cfs)	Slope	Structure size
north of Grovers to Grovers along 75th Ave.	1320	80	.0041	1-48" RCP
Grovers to just north of Bell along 75th Ave.	1800	161	.0029	1-72" RCP
Just north of Bell Rd. to Bell Rd. along 75th Ave.	780	243	.0029	1-8'x5' RCBC
75th Ave. to 77th Ave. along Bell Rd.	1900	274	.0030	1-8'x5' RCBC
77th Ave. to New River along Bell Rd.	4000	434	.0017	2-8'x5' RCBC

PROJECT: Bell Rd. Project — 10-year frequency — DESIGNER: R.H

Alt. 2 from 77th Ave. to New River along Bell Rd. — DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

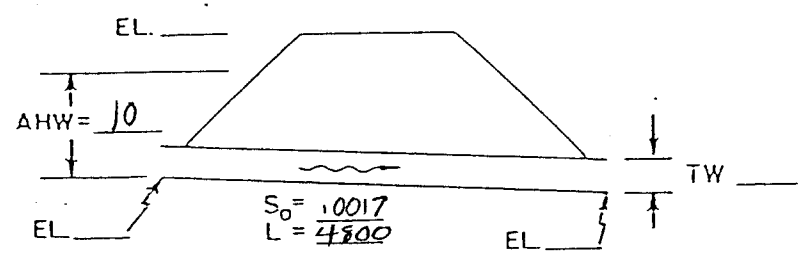
Q_1 = 434 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Bell Rd + 77th Ave.



MEAN STREAM VELOCITY = _____

9.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	434	10x5	1.28	6.4	0.5	2.5/24			5	5	8.2	20.8				N.G.
2 RCBC	217	6x5	1.07	5.4	"	2.7/25.9			"	"	"	22.7				N.G.
2 RCBC	"	8x4	1.14	4.6	"	1.95/18.7			4	4	"	14.5				N.G.
2 RCBC	"	8x5	.88	4.4	"	~~1.15~~/11.0	2 11.5		5	5	"	7.8	5.3 ~~7.8~~			O.K.
2 RCBC	"	6x6	.89	5.3	"	1.5/14.4			6	6	"	12.2				N.G.

SUMMARY & RECOMMENDATIONS:

Use 2-8'x5' RCBC ✓

Figure 7

PROJECT: Bell Rd. Project 10-year frequency DESIGNER: R.H

Alt. 2 from 75th Ave. to 77th Ave. along Bell Rd. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

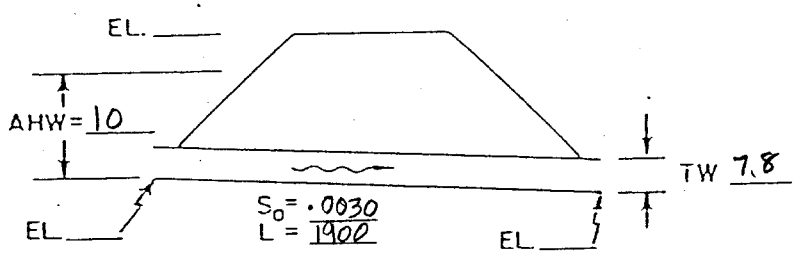
Q_1 = 274 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Bell Rd + 77th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

3.8

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	274	8X5	1.05	5.25	0.5	1.9/7.2			~~7.8~~	7.8	5.7	9.3	~~7.8~~ 9.3			
1 RCBC	"	10X5	.88	4.4	"	1.05/4			"	"	"	6.1				
					"											

SUMMARY & RECOMMENDATIONS:

Use 1-8X5 RCBC ✓

Figure 7

PROJECT: Bell Rd. project 10-year frequency DESIGNER: R.H

Alt. 2 from just North of Bell Rd. to Bell Rd. along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

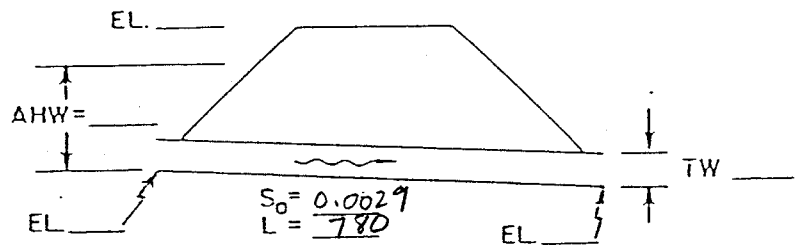
Q_1 = .243 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: Bell Rd & 75th Ave.



MEAN STREAM VELOCITY = _____

1.56 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	243	8x5	0.94	4.7	0.5	1.5 / 2.3			9.3	9.3	2.3	9.3	9.3			

SUMMARY & RECOMMENDATIONS:

Use 1-8'x5' RCBC

Figure 7

PROJECT: Bell Rd. project 10-year frequency DESIGNER: R.H

Alt. 2 from Grovers to just North of Bell Rd. along 75th Ave DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

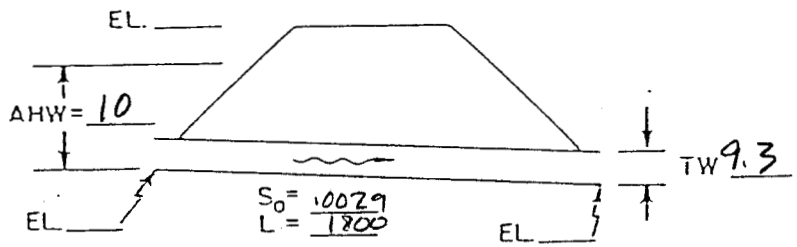
Q_1 = 161 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

3.6 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	161	8x5	0.72	3.6	0.5	.65/2.3			9.8	9.3	5.2	6.4	6.4			O.K.
1 RCP	~~161~~	72"				1.35/4.5			9.0		5.2		9.1			ok

SUMMARY & RECOMMENDATIONS:

~~Use 1-8'x5' RCBC~~ use 72" RCP

Figure 7

PROJECT: Bell Rd. Project

DESIGNER: R.H

Alt. 2 from North of Grovers to Grovers along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

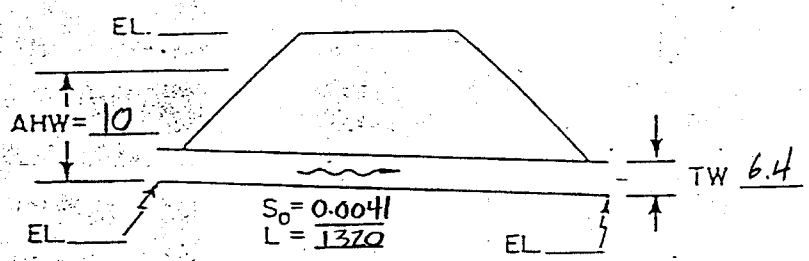
Q_1 = 80 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

2.64 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	80	60"	0.75	3.8	0.2	0.68 / 1.8			6.4	6.4	5.4	2.8				o.k.
1 RCP	"	54"			"	1.4 / 3.7			"	"	"	4.7				o.k.
1 RCP	"	48"			"	2.1 / 5.5			"	"	"	6.5	6.5			o.k
1 RCP	"	42"			"	3.8 / 10.0			"	"	"	"				N.G.
1 RCP	"	48"				5.5			9.1		5.4		9.2			ok
					"											

SUMMARY & RECOMMENDATIONS:

Use 1-48" RCP

Figure 7

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. project Drainage Study
Description: Concept plan Alt. ~~2~~ 4, Q10
DA 3
Calculated by: R.H Date: 11/24/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Location	Length (ft)	Q (cfs)	Slope	Structure size
north of Grovers to Grovers along 75th Ave.	1320	80	.0041	1-48" RCP
Grovers to just north of Bell along 75th Ave.	1800	161	.0029	1-72" RCP
just north of Bell Rd. to Bell Rd, along 75th Ave.	780	243	.0029	1-8'x5' RCBC
75th Ave. to 77th Ave. along Bell Rd.	1900	274	.0030	open chann. { TW=31.60, BW=2.0, D=3.70' } ~~1-8x5' RCBC~~
77th Ave. to New River along Bell Rd,	4000 ~~4800~~	434	.0017	open chann. { TW=42.3', BW=10.3', D=4.0' } ~~2-8x5' RCBC~~

TABLE ___

ESTIMATED COSTS

DRAINAGE AREA 3

2-YEAR FREQUENCY STORM

	STRUCTURE	QUANTITY	UNIT COST	ESTIMATED COST
	~~48" RCP~~	~~1300 L.F.~~	~~90/L.F.~~	~~$~~
	72" RCP	2600 L.F.	150/L.F	$390,000
Facilities North of Bell Road (Glendale	48" RCP	1320 L.F.	98/L.F.	129,000
Facilities Along Bell Road (Glendale)	66" RCP	1900 L.F.	145/L.F.	276,000
Facilities South of Bell Road (Glendale)	54" RCP	960 L.F.	220/L.F.	211,000
30% Appurtenances				300,000
20% Engineering And Administration				260,000
Sub-Total				$1,570,000

PROJECT: E123061 Skunk Creek to 75th Ave & Bell Rd, 77th to Aiw River DESIGNER: M.C.

D.A. 3 DATE: 7

HYDROLOGIC AND CHANNEL INFORMATION

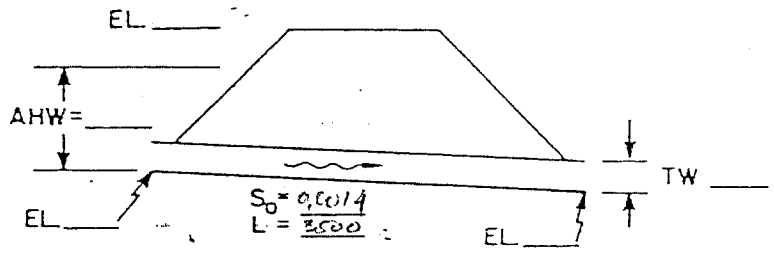
Q_1 = 24 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



7 MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP	24	30"				1.8 / 12.6					5		7.6		L = 3500	
RCP	24	30"				2.1 / 6.3					10				L = 1500	

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: Bell Rd.

Bell Rd to Skunk Creek

DESIGNER: M.C.

DATE: 5-12

HYDROLOGIC AND CHANNEL INFORMATION

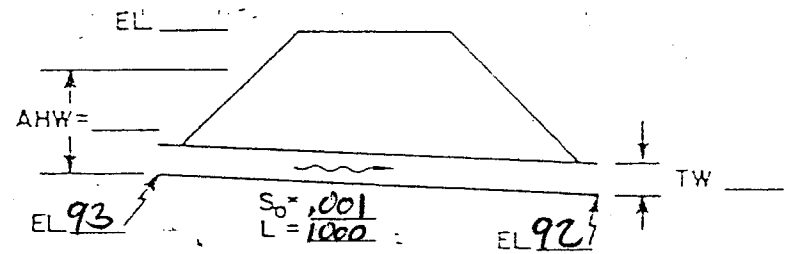
Q_1 = 432 : TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H+h_o−LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-RCBC	216	6X5	1.14	5.7		6.4			2.5		1	7.9	7.9			
2-RCBC	216	6X6				3.7			3		1	5.7	5.7			use

SUMMARY & RECOMMENDATIONS:

Figure 7

Greiner Engineering

Greiner Engineering Sciences, Inc.

Tucson 602 327-3413
Phoenix 602 275-5400

Job: Bell Rd. project Drainage Study
Description: Concept plan, Alt 3, Q18
DA 3
Calculated by: R.H Date: 11/24/86 Sheet No. ____
Checked by: ____ Date: ____ of ____

Location	Length (ft)	Q (cfs)	Slope	Structure Size
north of Grovers to Grovers along 75th Ave.	1320	80	.0041	1-48" RCP
Grovers to just north of Bell along 75th Ave.	1800	161	.0029	1-72" RCP
just north of Bell to Bell along 75th Ave.	780	243	.0029	1-72" RCP
77th Ave. to 75th Ave. along Bell Rd.	1900	160	.0030	1-66" RCP
Bell Rd. to Skunk Creek along 75th Ave.	960	432	.0073	1-8'x5' RCBC

PROJECT: Bell Rd. project

DESIGNER: R.H

Alt. 3 from Bell Rd. to Skunk Creek along 75th Ave.

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

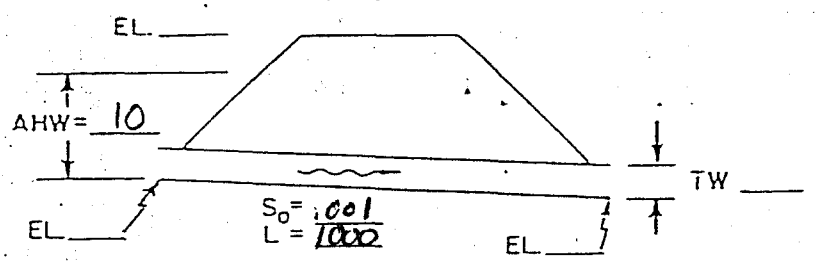
Q_1 = 432 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

1.92 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2 RCBC	216	8x5	.88	4.4	0.5	1.15/7.2			5	5	1.0	0.2				O.K.
2 RCBC	216	8x4	1.14	4.6	"	1.96/3.8			4	4	"	0.8				O.K.
2RCBC	216	6x5			"	2.7/5.2			5	5	"	3.2				O.K.
2RCBC	216	8X3			"	4.0/7.7			3	3	"	3.7				O.K.
1RCBC	432	10x5	1.25	6.3	"	2.5/4.8			5	5	"	2.8				O.K.
1RCBC	"	8x5	1.58	7.9		4.7/9.0			5	5	"	7.0	7.9	✓		~~OK~~ ~~use~~
1RCBC	"	~~8~~ 6x6	1.25	7.5	"	3.3/12.1	3.2/6.1		6	6	"	5.1	7.5			None

SUMMARY & RECOMMENDATIONS:

use 2-6'x5'

~~use 1-8x6 RCBC~~ ~~use 1-10'x5'~~ ~~use 1-8x6'~~

Figure 7

PROJECT: Bell Rd. Project

DESIGNER: R.H.

Alt. 3 from 77th Ave. to 75th Ave. along Bell Rd.

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

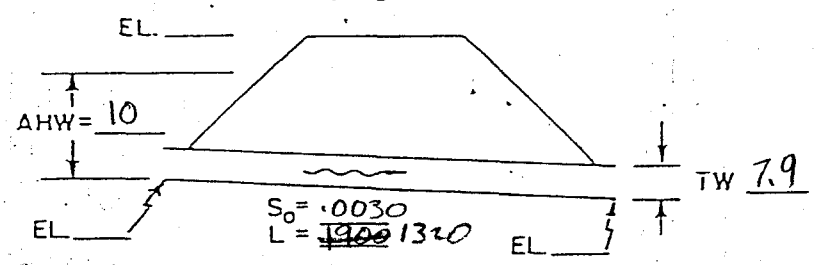
Q_1 = 160 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 77th Ave.



2.6 MEAN STREAM VELOCITY = _____

~~3.8~~ MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1RCBC	160	8x5	0.72	3.6	0.5	.65/2.5			7.9	7.9	5.7	4.7				o.k.
1RCBC	"	6x5	0.88	4.4	"	1.5/5.7			"	"	"	7.9				o.k.
1RCP	"	72"			0.2	1.2/4.6			"	"	"	6.8				o.k.
1RCP	"	66"	1.02	5.6	"	1.8/6.8	1.9/7.2	.7	"	"	"	9.4				o.k. ✓
1RCP	160	60"			"	2.85/10.8			~~6.3~~		5.7	11.9				N.G.
									3.2							

SUMMARY & RECOMMENDATIONS:

Use 1-66" RCP

Figure 7

PROJECT: Bell Rd. Project

DESIGNER: R.H.

Alt. 3 from just north of Bell Rd. To Bell Rd. along 75th Ave.

DATE: 11/21/86

HYDROLOGIC AND CHANNEL INFORMATION

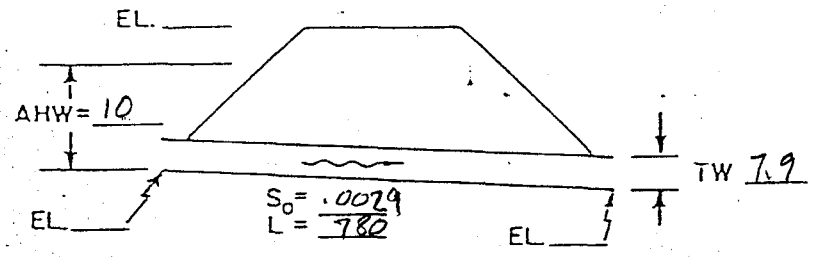
Q_1 = .243 TW_1 = ____

Q_2 = ____ TW_2 = ____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : ____



MEAN STREAM VELOCITY = ____

1.56 MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1RCBC	2.43	8x5	0.94	4.7	0.5	1.5/2.3			7.9	7.9	2.3	7.9	7.9			O.K.
1RCBC	"	6x5			"	3.6/5.6			"	"	"	11.2				
1RCP	"	72"	1.22	7.3	0.2	2.8/4.4			"	"	"	10	✓			O.K
1RCP	2.43	72"				4.4			6.3		2.3	6.4				✓
					"				3.2			3.1				

SUMMARY & RECOMMENDATIONS:

USC 1-72" RCP

Figure 7

PROJECT: Bell Rd. Project — 10-year frequency — DESIGNER: R.H

Alt. 3 — from Grovers to jus North of Bell Rd. along 75th Ave — DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

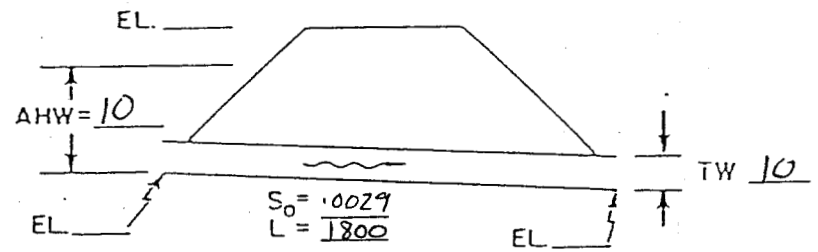
Q_1 = .161 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = 3.6

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING H.W.	OUTLET VELOCITY	COST	COMMENTS
1 RCP	161	60"	1.34	6.7	0.2	1.75 / 6.3			10	10	5.2	11.1	"			N.G.
1 RCP	"	72"	0.87	5.2	"	0.8 / 2.9			"	"	"	7.7	7.7			O.K.
1 RCP	"	66"	1.02	5.6	"	1.42 / 5.1			"	"	"	9.9				O.K.
1 RCP		66"				5.1			8.4		5.2	8.3				O.K.
1 RCP	161	60"			"	6.3			8.4		5.2	9.5				O.K.

SUMMARY & RECOMMENDATIONS:

ok

Use 1-72" RCP

~~use 1-60" RCP~~

1-8×5 = 22.2

1-10×5 = 28.4

72 - 150

66 - 140

5-18

Figure 7

PROJECT: Bell Rd. project 10-year frequency DESIGNER: R.H

Alt. 3 from North of Grovers to Grovers along 75th Ave. DATE: 11/20/86

HYDROLOGIC AND CHANNEL INFORMATION

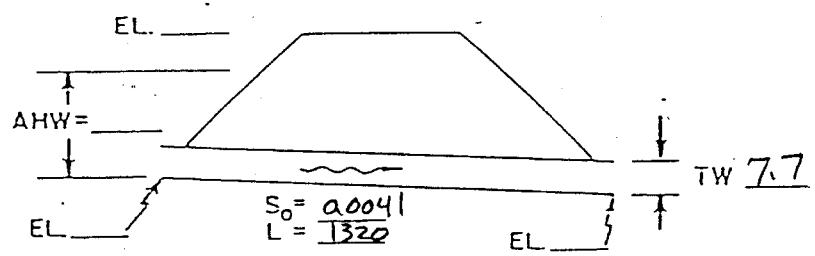
Q_1 = 80 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}; Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

2.64

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCP	80	48"	1.08	4.3	0.2	2.1/5.5			7.7	7.7	5.4	7.8	7.8			ok.
1 RCP	"	42"	1.5	5.3	"	3.8/10.0			"	"	"	12.3				N.G.
1 RCP	80	48"				5.5			9.5		5.4	9.6				ok

SUMMARY & RECOMMENDATIONS:

Use 1-48" RCP

Figure 7

PROJECT: Bell Rd. Drainage

Alt. 2 from RR01 to Skunk Creek

DESIGNER: R.H

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = ~~81~~ 125 cfs

Q_2 = _____

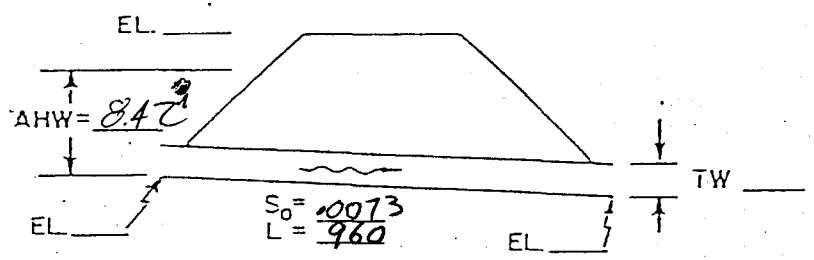
TW_1 = _____

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____

1.92 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	81	60"			0.2	1.38			5	5	7.01	-0.63				N.G.
1-RCP	81	48"				4.15			4	4	"	1.14				N.G.
1-RCP	81	42"	1.5	5.25		7.33			3.5	3.5	"	3.82				~~N.G.~~ O.K.
1-RCP	81	36"	2.4	7.2		16.32			3	3	"	12.31	12.1			~~O.K.~~ N.G.
1-RCP	125	42"	2.6	9.1		12.2/9.5				3½		14.7				N.G.
1-RCP	125	48"	1.7	6.5		10.6/5.5			4	4		7.6	7.6			O.K.

SUMMARY & RECOMMENDATIONS:

~~Use 36" RCP~~

Use 1-48" RCP

Dir. = 9.62

Figure 7

PROJECT: Bell Rd. Drainage

Alt. 2 from RR02 to New River

DESIGNER: R.H

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 127 Cfs

Q_2 = 111

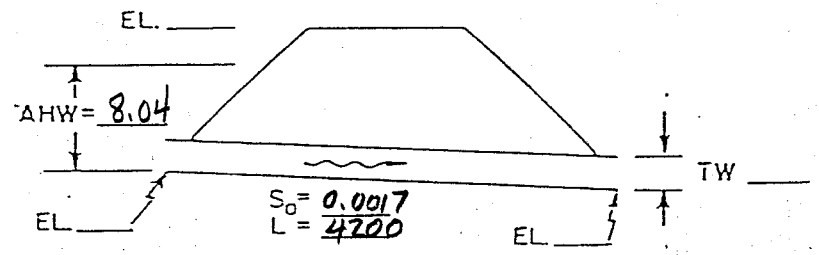
TW_1 = _____

TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 77th Ave.



MEAN STREAM VELOCITY = _____

8.4 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1-RCP	127	60"			.2	15.12			5	5	7.14	12.98				N.G.
1-RCP	"	66"	.86	4.73	"	10.08			5.5	5.5	"	8.44	✓			O.K.
1-RCP	"	72"	.75	4.50	"	6.3			6	6	"	5.16				O.K.
1-RCP	111	60"				1.38 77.6				5		9.5				N.G.

SUMMARY & RECOMMENDATIONS:

Use 1-66" RCP ✓

Figure 7

PROJECT: Bell Rd. Drainage

Alt. 2 from DA 3102 to RR01

DESIGNER: R.H

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

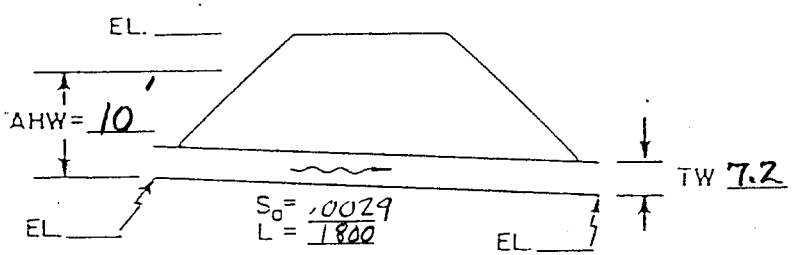
Q_1 = 356 cfs TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: 75th Ave.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

3.6

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
1 RCBC	356	10'x5'			0.5	5.94			7.2	~~7.2~~ 6.8	5.22	~~7.92~~ 5				O.K.
1 RCBC	"	8'x5'			"	10.8			"	"	"	~~12.78~~ 8				N.G.
1 RCBC	"	8'x6'			"	7.56			"	"	"	~~9.54~~ 7				O.K.

SUMMARY & RECOMMENDATIONS:

Use 1-10'x5' RCBC

Figure 7

PROJECT: Bell Rd. Drainage

DESIGNER: R.H

All.2 from DA 3101 to DA 3102

DATE: 11/3/86

HYDROLOGIC AND CHANNEL INFORMATION

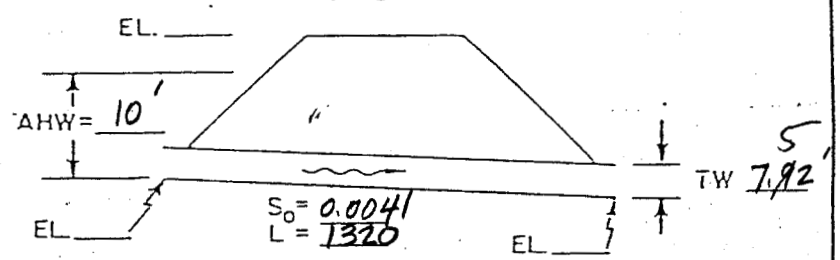
Q_1 = 178 cfs TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

2.64 MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H+h_o−LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
1-RCP	178	66"			0.2	6.07			7.92	7.92 5	5.41	8.58				O.K.
1-RCP	"	60"			"	8.98			"	"	"	11.50				N.G.

SUMMARY & RECOMMENDATIONS:

Use 66" RCP

Figure 7