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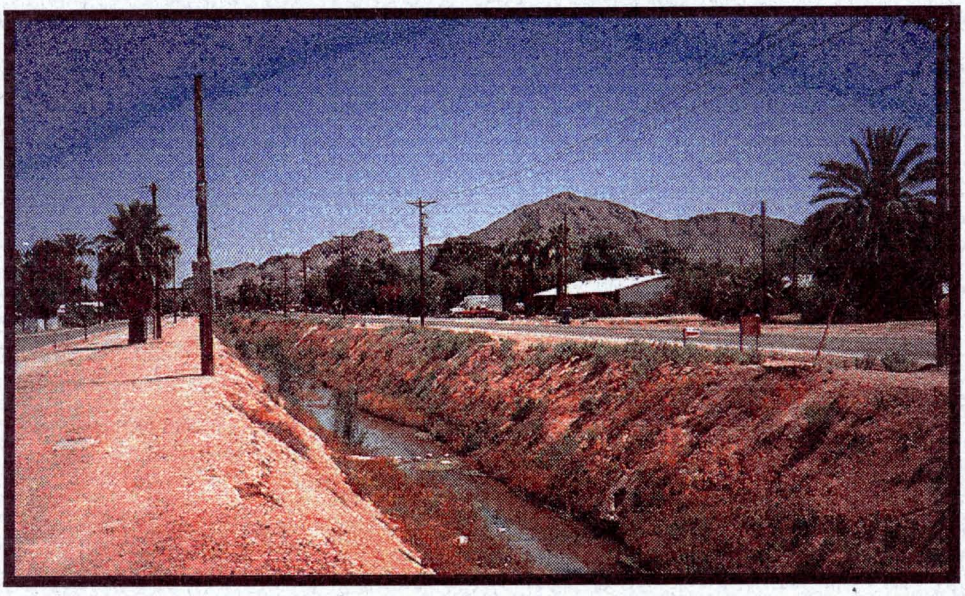
OLD CROSS CUT CANAL RECONSTRUCTION



BACKUP SPILLWAY CALCULATIONS

VOLUME 2

FLOOD CONTROL DISTRICT
RECEIVED
JUL 25 1994

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REMARKS

FCDMC PROJECT NO. 94-24
GREINER PROJECT NO. E002102

JULY 1994

PROCEDURES AND GENERAL CALCS

Spillway Analysis Procedure

1. Use "local" storm flows for spillway and curb opening design.

2. Determine locations where flow is no longer confined within roadway corridor and apply 4:1 expansion towards the Old Cross Cut Canal to determine spread of flow and corresponding width of concrete spillway needed at the curb line and on into the surface feature (CHIMP).

3. Establish a base cross-section location in the roadway corridor where flow is confined in order to compare flooding elevation for the existing and proposed conditions.

4. Perform a backwater analysis (Standard Step Method) for existing conditions to determine base flood elevation at base cross-section location.

5. Determine 10-year curb opening applying Pima County ratios to the local storm Q and use mannings equation at the curb line.

6. Perform a backwater analysis (Standard Step Method) for this 10-year opening with proposed roadway configurations.

   A. If the proposed condition flood elevation at base location is less than or equal to the existing flood elevation, use 10-year curb opening.
   B. If the proposed condition flood elevation at base location is higher than existing by 0.1 feet or more, widen curb opening and reanalyze until existing flood elevation is not worsened.

7. Once curb opening and concrete spillway widths have been determined, calculate velocities at toe of spillway for use in scour analysis.

8. Perform scour analysis (HEC 14) to determine the extent of the concrete spillway into the CHIMP to the west. Geosynthetic mat to be placed on the remaining area of the CHIMP beyond the concrete spillway to the west.

PROJECT NAME: OLD CROSS CUT CANAL
PROJECT NO.: E002102

SPILLWAY & CURB OPENING PARAMETERS

LOCAL STORM:
CONVERSION FACTOR TO Q10 FROM Q100: 0.45 (HIGHLY URBANIZED)

MANNING'S "n": 0.016 (ASPHALT)

DESIGN BY: RHF
DATE: 7-21-84

CHECKED BY: JUG
DATE: 7-21/84

STREET NAME	LOCAL STORM (cfs)	10-YR STORM (cfs)	SPILLWAY BY 4:1 (ft)	LENGTH OF OPENING (ft)	WETTED AREA (sq. ft.)	WETTED PERIMETER (ft)	SLOPE (ft/ft)	MANNING'S "n"	COMPUTED DISCHARGE (cfs)
HOLLEY	142	64	132	21	10.2905	21.5809	0.012	0.016	64
S. CEMETARY ENTRY	229	103	48	27	13.4514	27.9027	0.018	0.016	103
OAK	550	248	–	79	39.6065	80.2130	0.0116	0.016	248
N. CEMETARY ENTRY	239	108	64	37	18.7083	38.4166	0.01	0.016	108
VIRGINIA	547	246	149	234	117.0174	235.0348	0.0013	0.016	246
WINDSOR	108	49	67	17	8.6246	18.2493	0.01	0.016	49
S. OF THOMAS			49	49	24.5000	50.0000		0.016	
N. OF THOMAS			44	44					
PINCHOT	38	17	105	6	3.1890	7.3780	0.0102	0.016	17
EARLL	1509	679	96	96					
RICHARDSON	66	30	65	8	3.8907	8.7815	0.02	0.016	30
S. OF OSBORN			51	51					
N. OF OSBORN			53	53					

PROJECT NAME: OLD CROSS CUT CANAL
PROJECT NO.: E002102

SPILLWAY OUTLET LENGTH

SCOUR LENGTH CALCULATIONS FOR SPILLWAYS:

DESIGN BY: BHF
DATE: 7-21-94

CKED BY: JUG
DATE: 7-21-94

STREET NAME	STATION	DISCHARGE	AREA	Ye	D.I.	Ls/Ye	Ls	DIST. OF END OF CONC. SPILLWAY FROM BOX CNTRLINE.	WIDTH OF GEOGRID FROM END OF SPILLWAY TO TOP OF BANK	TOTAL HORZ. WIDTH OF PROTECTION CONCRETE AND GEOGRID
HOLLY	27+17.00	142	8.1444	2.02	4.33	24.60	49.64	16' WEST	38'	88'
S. CEMETARY DR.	33+57.34	229	12.4128	2.49	4.12	23.76	59.20	29' WEST	22'	51'
OAK	37+10							*	*	*
N. CEMETARY DR.	40+57.36	239	16.7316	2.89	2.96	18.79	54.35	21' WEST	33'	54'
VIRGINIA	50+24.83	570	46.786	4.84	1.95	13.98	67.64	37' WEST	17'	85'
WINDSOR	56+95.72	108	8.4889	2.06	3.12	19.52	40.22	1' WEST	38'	79'
THOMAS S.	62+53							25' EAST	50'	50'
THOMAS N.	64+53							22' EAST	43'	43'
PINCHOT	71+37.34	38	3.6972	1.36	3.11	19.45	26.44	9' WEST	17'	44'
EARLL	76+64	1509	74.1984	6.09	2.90	18.54	112.92	0'	58' WEST OF CL.	**
RICHARDSON	83+20	66	4.42	1.49	4.32	24.56	36.51	7' WEST	10'	**
OSBORN S.	89+25							1' EAST	80'	**
OSBORN N.	90+87.8							6' EAST	47' WEST OF CL.	**

* NO CONCRETE REQUIRED BEYOND THE INLET.
** NO CHIMP.

DEPARTMENT OF TRANSPORTATION
PIMA COUNTY
FLOOD CONTROL DISTRICT

HYDROLOGY MANUAL FOR ENGINEERING DESIGN AND FLOOD PLAIN MANAGEMENT WITHIN PIMA COUNTY, ARIZONA

SEPTEMBER, 1979

APPROXIMATE RATIOS OF LESSER MAGNITUDE FLOODS TO THE 100-YEAR FLOOD

In an attempt to both simplify and reduce the computational procedures and time involved in estimating peak discharge values for floods of lesser magnitude than the 100-year flood, the following procedure may be employed if the user so desires:

First, the predicted value for the peak discharge of the 100-year flood which would occur upon the watershed under investigation should be determined using the procedures as outlined within this Manual.

Next, peak discharge values for floods of lesser magnitude than the 100-year flood may be calculated approximately by multiplying the previously determined 100-year flood value for the watershed under investigation by the factors shown within the table below:

	RECURRENCE INTERVAL			
WATERSHED DEVELOPMENT	2-Yr.	10-Yr.	25-Yr.	50-Yr.
Rural	0.10	0.35	0.55	0.75
Suburban	0.15	0.40	0.60	0.80
Moderately Urban	0.20	0.45	0.65	0.85
Highly Urban	0.25	0.50	0.70	0.85

Where

Rural = Watersheds which will remain in a natural condition (undeveloped), or where the anticipated future development will be negligible.

Suburban = Watersheds which contain two (2) houses per acre, or less, with drainage improvements being relatively few or nonexistent.

*Moderately Urban = Watersheds which contain from two (2) to five (5) houses per acre (detached), with moderate to extensive drainage improvements present.

Highly Urban = Watersheds which contain more than five (5) houses per acre (including multiple dwellings, commercial and industrial development), with extensive drainage improvements present.

It is to be noted that the above factors are only applicable under typically "average" watershed conditions upon generally homogeneous drainage basins. For atypical or nonhomogeneous watersheds, all flood peaks, whatever their recurrence intervals, should be determined in a complete and detailed manner as outlined within this Manual; otherwise, serious errors might easily arise as a consequence of choosing expediency over good engineering judgement.

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 2

Subject Example Calculation for Concrete Spillway Length for Standard Spillways

By RHF Date 7-21-94 Checked By JUG Date 7/21/94

To determine the length of concrete spillway from CHIMP toe out into the CHIMP, FHWA HEC-14 Chapter V procedure was used to estimate the length of unprotected scour hole. The velocity and depth of flow at the toe of the CHIMP was calculated using the energy equation. The total width of concrete spillway multiplied by the depth of flow at the spillway toe computed the area of flow. Using the procedure outlined in HEC-14 Chapter V the area was converted to equivalent depth (Y_e). This value was used to calculate the length of scour hole. The concrete was ended at this distance and the geosynthetic mat was used to extend to the top of opposite bank, the west bank.

Example: Holley

$Q = 142$ cfs

Depth = 0.0617 ft. — Depth at toe of CHIMP

Width = 132 ft. — Full Width of Concrete Spillway

Area = 8.1444 — (Depth * Width)

$Y_e = (A/2)^{0.5} = 2.0180$

$$D.I. = \frac{Q}{\sqrt{g}\, Y_e^{5/2}} = 4.3257$$

$$L_s/Y_e = \alpha_e (DI)^{\beta} \left(\frac{t}{t_o}\right)^{\theta}$$

$t = 30$ Min estimated

$t_o = 316$ Min.

$\alpha_e = 11.75$

$\beta = 0.71$

$\theta = 0.125$

$L_s/Y_e = 24.60$

$L_s = 49.64'$ use 50'

WINDSOR AVENUE

Greiner

Job No. E002102 Project OLD CROSS CUT CANAL Sheet 1 of 1

Subject WINDSOR CURB OPENING

By JEB Date 6/2/94 Checked By RHF Date 7-20-94

WINDSOR -

- CALC 10 YR. STORM

  108 · 0.45 = 48.6

- CURB opening for 10 yr. using MANNINGS

  n = 0.016 Q = 48.6
  S = 0.01 y = 0.5 (CURB Ht.)
  B = 17.25' ⇒ 18.0'

- WE will use AN 18.0' opening IN CURB FOR 10 yr. STORM.

- 10 yr. CURB opening HAS NO AFFECT ON BACKWATER UPSTREAM OF CURB. THE BANK PROTECTION will NEED TO BE 67' long FROM APPROX. ROADWAY STA. 245+61 to STA 246+28. THIS IS THE EXTENTS OF THE APPROX. 4:1 SPREAD SHOWN ON MARKUP PLAN DRAWING, SEE ATTACHED.

- Curb Opening Width = 18'
- Total Width of Spillway (based on 4:1) = 67'
- Length of Spillway from E. CHIMP Top West = 40'-3"
- Length of geosynthetic Mat from W. End Spillway to W. Top of Bank = 38'
- Velocity at Bottom of spillway = 12.72 fps (Local Storm)
- Depth at Bottom of spillway = 0.13'

Exist WS EL. = 1211.78
10 year WS EL. = 1211.78 OK

Greiner

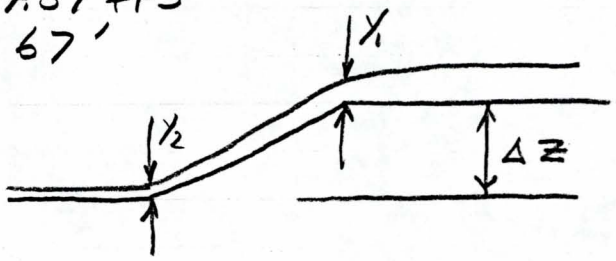
Job: OCCC | Project No. E002102 | Date 6/6/94
Description: Spillway velocity @ Toe of Slope | Computed By: JVG | Date 6/6/94
Checked By: SES | Sheet ___ of ___

Windsor

Local Storm → Q = 108 CFS
Curb opening = 18'

From SESCAL Run: 6/2/94 E002102 - Windsor
18' Curb opening W/O Backwater

Section #1 Froude = 1.36 (Super)
y_n = 0.72'
V = 4.57 fps
Top width = 67'



Energy Equation

$$y_1 + \frac{V_1^2}{2g} + \Delta z = y_2 + \frac{(Q/A_2)^2}{2g}$$

$A_2 = (y_2 \times b)$ $b = 67'$ $Q = 108$ CFS $\Delta z = 1.6'$

$$y_1 + \frac{V_1^2}{2g} + \Delta z = 0.72' + \frac{(4.57)^2}{64.4} + 1.6 = 2.64$$

$$2.64 = y_2 + \frac{\left(\frac{108}{y_2 \times 67}\right)^2}{64.4}$$

$$y_2 = 0.1267'$$

$$V_2 = \frac{108}{0.1267 \times 67} = 12.72 \text{ f.P.S.}$$

HYDRAULIC CALCULATOR

WINDSOR (LOCAL)

DATA FOR SUBCRITICAL SUPERCRITICAL FLOW

DISCHARGE : 108
BASE WIDTH : 67
UPSTREAM DEPTH : .72
UPSTREAM VELOCITY: 4.57
CHANNEL BOTTOM DATUM DIFFERENCE: 1.6

OUTPUT FOR SUBCRITICAL FLOW

DOWNSTREAM DEPTH (SUBCRITICAL) = 2.638126 > 0.89 (NO Hydraulic Jump)
DOWNSTREAM VELOCITY = .6110172

OUTPUT FOR SUPERCRITICAL FLOW

DOWNSTREAM DEPTH (SUPERCRITICAL) = .1265641
DOWNSTREAM VELOCITY = 12.73616

THOMAS ROAD

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 1

Subject Spillways - Design Summary.

By RHF Date 6/9/94 Checked By JVG Date 6/10/94

Roadway: Thomas Road

From the flow split analysis, it was determined that 57 cfs goes North and 210 cfs goes south for the Local Storm of 267 cfs. For the general storm, 30 cfs goes north and 126 cfs goes south. It was further determined from a roadway flow analysis that 21 cfs and 12 cfs will continue west along Thomas Road after the flow split. For design purposes, 100% of the flow as considered to go into the CHIMP with no flow continuing west. For this location the 4:1 expansion on the south side begins about 233' East of the Box £ at the north east property corner for the existing gas station. The 4:1 expansion on the north side is based on the western end of the berm which runs parallel to Thomas Road and is just north of Thomas.

An inlet will be put in the CHIMP to the north and south of Thomas Road. The proposed Multi-use path will be used for erosion control as it is located at back of gutter. Beyond this 12' wide path, geosynthetic mat will be used all around the concrete apron proposed at the inlet. The south curb opening width is 49'. While the north curb opening width is 44'.

Greiner

Job No. E002102 Project OLD CROSS Cut Sheet 1 of 1

Subject THOMAS SW CORNER Spillway Velocity

By JEB Date 6/8/94 Checked By JUG Date 6/10/94

THOMAS –

112' SPILLWAY LENGTH (LOCAL STORM)

$Q = 189$ (LOCAL)

$$Y_1 + \frac{V_1^2}{2g} + \Delta Z = Y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g}$$

$A_2 = (Y_2 * BW)$

$BW = 112$

$Y_1 = 0.66$

$V_1 = 5.55$

$\Delta Z = 2.08'$

$$EG_1 = Y_1 + \frac{V_1^2}{2g} + \Delta Z = 0.66 + \frac{(5.55)^2}{64.4} + 2.08 = 3.22 \checkmark$$

$$3.22 = Y_2 + \frac{\left(\frac{189}{Y_2 * 112}\right)^2}{64.4} =$$

Y_2	
.05	17.74
.03	49.16
.07	9.09
.09	5.55
.10	4.52
.12	3.19
.128	2.83
.11	3.76
.117	3.35
.112	3.64
.119	3.24 ✓

$Y_2 = .119$

$V_1 = 189 / .119(112) = 14.18$ fps ✓

PROJECT: Old Cross Cut Canal
JOB NO.: E002102

FLOW SPLIT ANALYSIS FOR SPILLWAY AND INLET DESIGN

LOCAL STORM DISCHARGE: 267
GENERAL STORM DISCHARGE: 156

ROADWAY RATING: Thomas Road

Elevation	North Roadway Capacity	South Roadway Capacity	South Overbank Capacity	Total Raodway Capacity
1210.74	0.76	19.70	0.41	20.87
1210.83	2.24	26.89	1.26	30.39
1210.92	4.83	35.50	3.08	43.41
1211.01	8.76	45.63	6.06	60.45
1211.10	14.25	58.85	10.57	83.67
1211.17	17.40	71.15	15.07	103.62
1211.27	26.20	90.19	23.63	140.02
1211.36	36.33	108.75	33.36	178.44
1211.46	47.68	130.92	47.34	225.94
1211.56	60.15	154.67	66.17	280.99

Elevation	Total Discharge	North Roadway Discharge	South Roadway Discharge	South Overbank Discharge
1211.53	267	57	149	61
1211.31	156	30	98	28

LOCAL STORM: TOTAL FLOW TO THE SOUTH = 210 cfs, NORTH = 57 cfs
GENERAL STORM: TOTAL FLOW TO THE SOUTH = 126 cfs, NORTH = 30 cfs

08:08:23 13-MAY-94

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SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

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The plotting program is furnished by Dr. Long-Cheng Huang.

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USER : SHI-EN SHIAU

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E002102 - OLD CROSS CUT CANAL: ROADWAY RATING TO DETERMINE THE FLOW IN THE SOUTH OVERBANK SECTION OF THOMAS ROAD -EAST OF 48th ST.

****

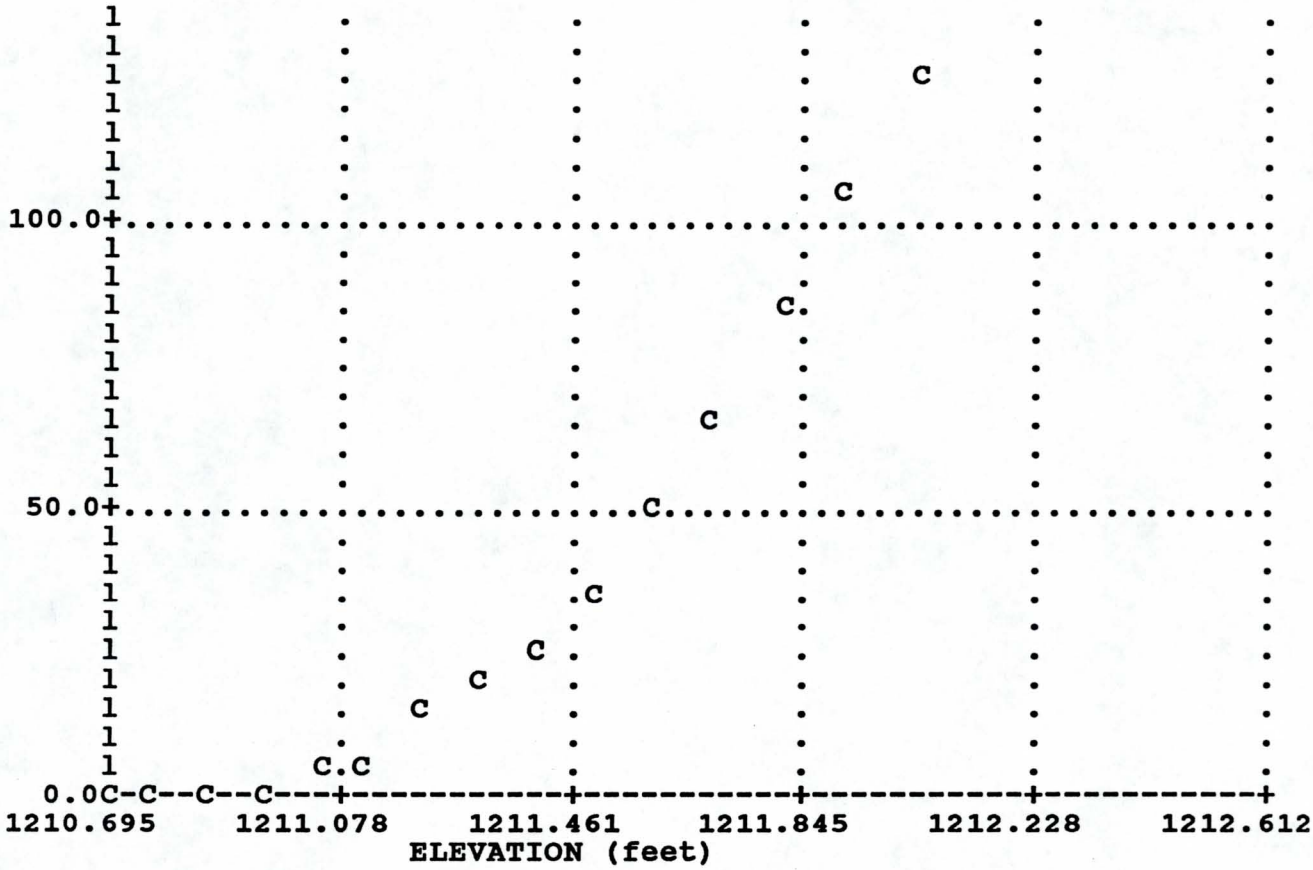
IRREGULAR CROSS SECTION

STA.	100.00	137.00	142.00
ELEV.	1211.46	1210.72	1210.61
N	0.016	0.016	0.016

Q (cfs)

ELEVATION (feet)

1211.460G.....



C : CULVERT/CHANNEL Q

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USER : SHI-EN SHIAU

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07:44:26   13-MAY-94
                SSSSS EEEEE SSSSS  CCCC   A   L
                S     E     S     C      A A  L          10-79
                SSSSS EEEEE SSSSS C     A   A L
                    S E         S C     AAAAA L        REVISED
                SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86

                COMPUTATIONAL HYDRAULIC DESIGN

                                          USER : SHI-EN SHIAU
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07:44:26   13-MAY-94

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                                          USER : SHI-EN SHIAU
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E002102 - OLD CROSS CUT CANAL: ROADWAY RATING TO DETERMINE THE FLOW IN THE SOUTH HALF SECTION OF THOMAS ROAD - EAST OF 48th STREET

****

IRREGULAR CROSS SECTION

STA.	142.00	142.00	174.30
ELEV.	1210.61	1210.01	1211.05
N	0.016	0.016	0.016

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        Q (cfs)

      ELEVATION (feet)
   1211.050+.....................................................G
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     1            .            .            .            .            .
     1            .            .            .            .            .
  66.8+.............................................................
     1            .            .            .C           .            .
     1            .            .            .            .            .
     1            .            .            .            .            .
     1            .            .            .            .            .
     1            .            .          C.             .            .
     1            .            .            .            .            .
     1            .            .            .            .            .
     1            .            .        C   .            .            .
     1            .            .            .            .            .
  33.4+.............................................................
     1            .            .      C     .            .            .
     1            .            .            .            .            .
     1            .            .  C         .            .            .
     1            .            .            .            .            .
     1            .            .C           .            .            .
     1            .        C   .            .            .            .
     1            .            .            .            .            .
     1            .      C     .            .            .            .
     1          C. C           .            .            .            .
   0.0C-C--C--C---+------------+------------+------------+------------+
 1210.095    1210.469    1210.843    1211.217    1211.591    1211.966
                      ELEVATION (feet)
```

C : CULVERT/CHANNEL Q

1

07:44:26 13-MAY-94

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USER : SHI-EN SHIAU

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07:27:28 13-MAY-94

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S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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USER : SHI-EN SHIAU

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USER : SHI-EN SHIAU

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E002102 - OLD CROSS CUT CANAL: ROADWAY RATING TO DETERMINE THE FLOW IN THE NORTH HALF SECTION OF THOMAS ROAD - EAST OF 48TH STREET

****

IRREGULAR CROSS SECTION

STA.	174.30	207.00	207.00	212.00	213.00
ELEV.	1211.05	1210.57	1211.06	1211.13	1212.13
N	0.016	0.016	0.045	0.045	0.045

```
        Q (cfs)

      ELEVATION (feet)
   1212.130+.....................................................G
```

```
     l            .            . C          .            .            .
42.8+.............................................................
     l            .            .            .            .            .
     l            .          C.             .            .            .
     l            .            .            .            .            .
     l            .       C    .            .            .            .
     l            .            .            .            .            .
     l            .     C      .            .            .            .
     l            .  C         .            .            .            .
     l            C.           .            .            .            .
     l       C    .            .            .            .            .
  0.0C-C--C------+------------+------------+------------+------------+
1210.655    1211.014    1211.373    1211.732    1212.091    1212.450
                      ELEVATION (feet)
```

C : CULVERT/CHANNEL Q

1

07:27:28 13-MAY-94

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : SHI-EN SHIAU

1

1 09:05:45 8-JUN-94

```
SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
```

COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

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09:05:45 8-JUN-94

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USER : SHI-EN SHIAU

****
E002102 - THOMAS SW CORNER SPILLWAY FLOW SPLIT ANALYSIS
BASED ON LOCAL STORM, CHANNEL/WEIR RATING

****

IRREGULAR CROSS SECTION

STA.	100.00	133.00
ELEV.	1210.10	1210.79
N	0.016	0.016

1

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	0.00	1.27	0.20
3.74	0.30	8.06	0.40
14.61	0.50	23.76	0.60
36.16	0.70	54.49	0.80
75.57	0.90	99.21	1.00
125.23	1.10	153.48	1.20
183.87	1.30	216.24	1.40
250.51	1.50	286.60	1.60
324.44	1.70	364.00	1.80
405.14	1.90	447.82	2.00

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	1210.21	1.27	1210.33
3.74	1210.45	8.06	1210.57
14.61	1210.69	23.76	1210.82
36.16	1210.95	54.49	1211.10
75.57	1211.26	99.21	1211.43
125.23	1211.59	153.48	1211.76
183.87	1211.93	216.24	1212.10
250.51	1212.27	286.60	1212.44
324.44	1212.62	364.00	1212.79
405.14	1212.97	447.82	1213.14

IRREGULAR WEIR GEOMETRY
COEFICIENT = 2.80

ELEVATION 1210.1 1210.1 1210.8 1210.9 1210.3 1210.4 1210.0 1210.6

STATION 100.00 113.00 113.00 140.00 140.00 190.00 253.00 253.00

WEIR FLOW ELEVATION-DISCHARGE CURVE

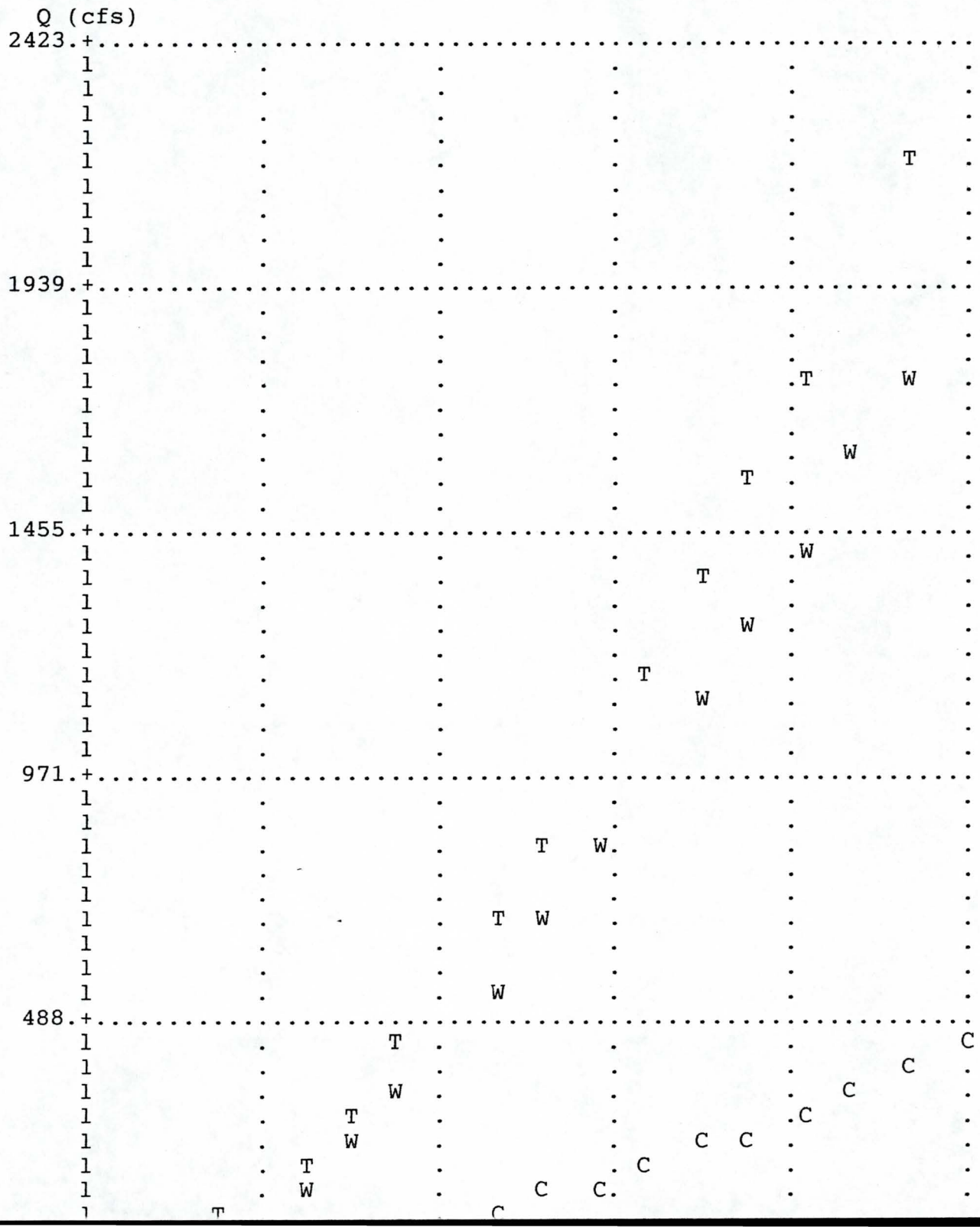
DISCHARGE	EG	DISCHARGE	EG
3.70	1210.21	11.78	1210.33
27.33	1210.45	57.33	1210.57
95.75	1210.69	141.31	1210.82
196.93	1210.95	275.88	1211.10
366.81	1211.26	468.67	1211.43
580.80	1211.59	702.60	1211.76
833.62	1211.93	973.23	1212.10
1121.19	1212.27	1277.11	1212.44
1440.81	1212.62	1612.01	1212.79
1790.07	1212.97	1975.07	1213.14

STAGE-DISCHARGE CURVE

LAKE LEVEL	CHANNEL Q	WEIR Q	TOTAL Q
1210.21	0.00	3.70	3.70
1210.33	1.27	11.78	13.05
1210.45	3.74	27.33	31.07
1210.57	8.06	57.33	65.39
1210.69	14.61	95.75	110.36
1210.82	23.76	141.31	165.07

1210.95	36.16	196.93	233.08
1211.10	54.49	275.88	330.37
1211.26	75.57	366.81	442.38
1211.43	99.21	468.67	567.88
1211.59	125.23	580.80	706.03
1211.76	153.48	702.60	856.08
1211.93	183.87	833.62	1017.49
1212.10	216.24	973.23	1189.46
1212.27	250.51	1121.19	1371.70
1212.44	286.60	1277.11	1563.71
1212.62	324.44	1440.81	1765.25
1212.79	364.00	1612.01	1976.01
1212.97	405.14	1790.07	2195.20
1213.14	447.82	1975.07	2422.89

1



```
     1       W W  .      C  C  C            .            .            .
   4.+---C--C-C--C--C--------+-----------+-----------+-----------+
1210.211    1210.797    1211.384    1211.971    1212.557    1213.144
                    ELEVATION (feet)
```

T : TOTAL Q, W : WEIR Q, C : CULVERT/CHANNEL Q

09:05:45 8-JUN-94

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : SHI-EN SHIAU

LOCAL STORM - 21 CFS channel (ROADWAY)
128 CFS TO CHIMP

GENERAL STORM - 12 CFS channel (ROADWAY)
86 CFS CHIMP

PINCHOT AVENUE

Greiner

Job No. E00210Z Project OLD CROSS CUT CANAL Sheet 1 of

Subject PINCHOT curb opening ANALYSIS

By JEB Date 6/1/94 Checked By JVG Date 6/10/94

PINCHOT –

I WAS DIRECTED TO LOOK AT THE EFFECT ON THE BACKWATER USING A 10 YEAR STORM CURB OPENING. 6' WAS CALCULATED AS THE OPENING LENGTH, USING MANNINGS. THE OPENING WILL BE CENTERED ON PINCHOT CENTERLINE.

WE WILL PROVIDE CONC. BANK PROTECTION TO THE EXTENT OF THE 4:1 EXPANSION FROM CONSTRAINTS. THE LENGTH IS 105'

FLOW WILL OVERTOPP THE CURB ELEVATION WITHIN THE 4:1 EXPANSION LIMITS.

Q_{Local} = 38 cfs $Q_{General}$ = 20 cfs

Curb opening width = 6'
Full Width of Spread = 105'
Spillway Length - from E. Toe of CHIMP to west end = 26' - 6"
Length of geosynthetic mat from W. end of spillway to w. Top of Bank = 17'-0"
Velocity at Bottom of spillway = 10.29 fps
Depth of Flow at bottom of spillway = 0.03 ft.

WS EL. Exist = 1212.39
WS EL 6' opening = 1212.46 OK
.07 < 0.1

HYDRAULIC CALCULATOR

PINCHOT (LOCAL)

DATA FOR SUBCRITICAL SUPERCRITICAL FLOW

DISCHARGE : 38
BASE WIDTH : 117
UPSTREAM DEPTH : .63
UPSTREAM VELOCITY: 2.19
CHANNEL BOTTOM DATUM DIFFERENCE: .97

OUTPUT FOR SUBCRITICAL FLOW

DOWNSTREAM DEPTH (SUBCRITICAL) = 1.673141 > 0.75 (No Hydraulic Jump)
DOWNSTREAM VELOCITY = .1941177

OUTPUT FOR SUPERCRITICAL FLOW

DOWNSTREAM DEPTH (SUPERCRITICAL) = 3.156577E-02
DOWNSTREAM VELOCITY = 10.28919

Greiner

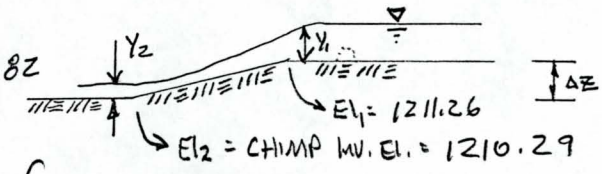
Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 2

Subject Spillway Velocities @ toe of Slope in CHIMP

By RHF Date 6-7-94 Checked By JVG Date 6/10/94

Pinchot

Spillway ℄ Sta. = 71+22.82



Local Storm → Q = 38 cfs C.O. = 6'

From SESCAL Run : 6-7-94 - E002102 - Pinchot 6.0' Curb opening w/ Backwater (upstream control)

Hydraulics

Section #2 Froude = 1.00 (critical)

$Y_1 = Y_0 = Y_c = 0.63'$

$V_1 = V_0 = V_c = 2.19$ fps

Top width = 116.5' Use 117'

$$\text{Energy Eq.} = Y_1 + \frac{V_1^2}{2g} + \Delta Z = Y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g}$$

$A_2 = (Y_2 * b)$

$b = 117'$

$Q = 38$ cfs

$\Delta Z = 1211.26 - 1210.29 = 0.97'$

$$Y_1 + \frac{(V_1^2)}{2g} + \Delta Z = 0.63 + \frac{(2.19)^2}{64.4} + 0.97' = 1.67447' \checkmark$$

$$1.67447 = Y_2 + \frac{\left(\frac{38}{Y_2 * 117}\right)^2}{64.4} \checkmark$$

$$\boxed{\begin{array}{l} Y_2 = 0.0316 \text{ ft} \\ V_2 = 10.28 \text{ fps} \end{array}} \checkmark$$

Greiner

Job No. E002102 Project OLD CROSS CUT CANAL Sheet 1 of 1

Subject PINCHOT CURB OPENING CALCS FOR Spillway Design

By JFB Date 5/31/94 Checked By JUG Date 6/10/94

PINCHOT -

DETERMINE CURB OPENING WIDTH FOR 10 YEAR DISCHARGE.
USING MANNINGS.

38 CFS • 0.45 = 17.1 CFS (10 YEAR)

B = 5.61352..... ≈ 5.61

- WE WILL USE A 6.0' OPENING FOR EASE OF CONSTRUCTION.

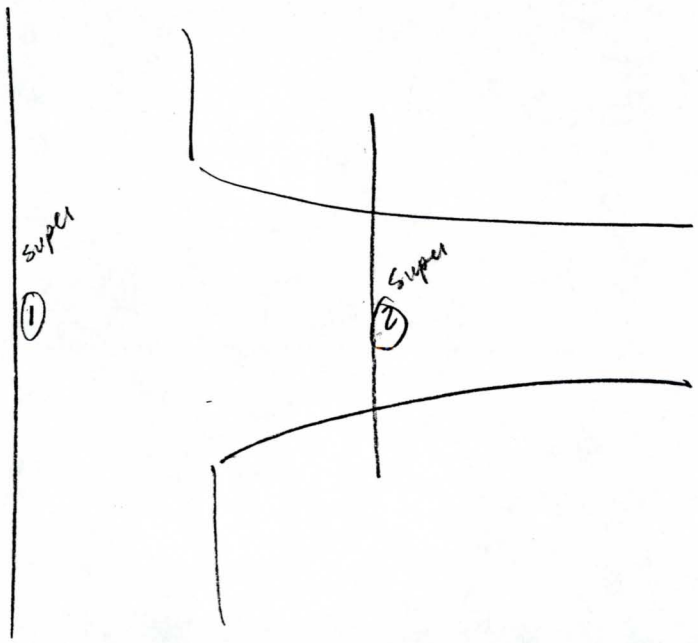
XSEC 1	100	1212.08	
	170	1212.29	
	170	1211.79	
	176	1211.81	
	176	1212.31	
	236.5	1212.46	

136.5

REACH = 75.5

XSEC 2	100	1212.33	.035
	140	1212.33	.016
	141	1212.02	.016
	156	1212.26	.016
	171	1212.12	.016
	172	1212.39	.035
	203	1212.64	.035

103'



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SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C.     A A  L          10-79
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COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

****

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The plotting program is furnished by Dr. Long-Cheng Huang.

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08:08:56 7-JUN-94

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USER : SHI-EN SHIAU

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E002102 - OLD CROSS CUT CANAL: PINCHOT - GENERAL STORM: Q = 20 cfs
BACKWATER ANALYSIS TO DETERMINE THE EFFECTS OF CURB OPENING NARROWING
FULL WIDTH =105' (Upstream Control)

****

IRREGULAR CROSS SECTION

STA.	100.00	140.00	141.00	156.00	171.00	172.00	203.00
ELEV.	1212.33	1212.33	1212.02	1212.26	1212.12	1212.39	1212.64
N	0.035	0.016	0.016	0.016	0.016	0.035	0.035

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  1211.900+-----------+----------+----------+----------+----------G
       100.0       121.0       142.0       163.0       184.0       205.0
                          STATION (feet)
```

G : CROSS SECTION GROUND POINT

1

SECTION # 2 STATION -75.50

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.19	105.00	10.14	0.0:1	0.0:1	105.19

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
1.12	1.97	0.01020	20.00	0.01600	0.19	1.83

CRITICAL AT CURRENT SECTION, NO BACKWATER EFFECT

BACKWATER COMPUTATION

WSEL	YO	TOP WIDTH	AREA	CONTRACTION	EXPANSION	PERIMETER
1212.09	0.19	105.00	10.92	0.10	0.30	105.21

FROUDE #	VELOCITY	FRIC. SLOPE	EG	N VALUE	FLOW LINE	LENGTH
1.00	1.83	0.00793	1212.15	0.01600	1211.90	-75.50

1

SUMMARY OF BACKWATER ANALYSIS

SECTION	STATION FEET	REACH LENGTH FEET	DISCHARGE CFS	FLOW LINE FEET	WATER SURFACE FEET
1	0.00	0.00	20.00	1212.02	1212.39
2	-75.50	-75.50	20.00	1211.90	1212.09

1

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SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
```

COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

****
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The plotting program is furnished by Dr. Long-Cheng Huang.

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07:25:10 7-JUN-94

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USER : SHI-EN SHIAU
****
E002102 - OLD CROSS CUT CANAL: PINCHOT - LOCAL STORM: Q = 38 cfs
BACKWATER ANALYSIS TO DETERMINE EFFECTS OF CURB OPENING NARROWING
CONSTRICTED WIDTH = 6' (upstream control)

****

IRREGULAR CROSS SECTION

STA.	100.00	140.00	141.00	156.00	171.00	172.00	203.00
ELEV.	1212.33	1212.33	1212.02	1212.26	1212.12	1212.39	1212.64
N	0.035	0.016	0.016	0.016	0.016	0.035	0.035

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1212.000+-----------+-----------+---G--G----+-----------+-----------+
       100.0       123.3       146.6       169.9       193.2       216.5
                          STATION (feet)
```

G : CROSS SECTION GROUND POINT

1

SECTION # 2 STATION -75.50

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.61	116.50	15.58	0.0:1	0.0:1	117.72

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
1.18	2.44	0.01020	38.00	0.01600	0.63	2.19

CRITICAL AT CURRENT SECTION, NO BACKWATER EFFECT

BACKWATER COMPUTATION

WSEL	YO	TOP WIDTH	AREA	CONTRACTION	EXPANSION	PERIMETER
1212.63	0.63	116.50	17.34	0.10	0.30	117.75

FROUDE #	VELOCITY	FRIC. SLOPE	EG	N VALUE	FLOW LINE	LENGTH
1.00	2.19	0.00712	1212.70	0.01600	1212.00	-75.50

1

SUMMARY OF BACKWATER ANALYSIS

SECTION	STATION FEET	REACH LENGTH FEET	DISCHARGE CFS	FLOW LINE FEET	WATER SURFACE FEET
1	0.00	0.00	38.00	1212.02	1212.46
2	-75.50	-75.50	38.00	1212.00	1212.63

EARLL DRIVE

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of

Subject Spillway Calculations

By RHF Date 6-15-94 Checked By JVG Date 6/17/94

Earll: This is a special location due to the magnitude of the local and general storms, 1509 and 1055, respectively. The 4:1 spread at the West curb of the proposed 48th st. is 96'. A back-water analysis for both storms determines that they are in supercritical condition.

Local Storm: Q = 1509 cfs
Fr. = 2.2 (Super critical)
Y_1 = 1.30 ft.
V_1 = 13.63 fps
Curb opening = 96 ft.
Y_2 = 0.97 ft.
V_2 = 16.18 fps

General Storm: Q = 1055 cfs
Fr = 2.3 (Super critical)
Y_1 = 1.05 ft.
V_1 = 12.20 fps
Curb Opening = 96 ft.
Y_2 = 0.73 ft
V_2 = 14.97 fps

Grate Elevation: 1211.90 (provides 4' of cover over box)

- Curb opening width = 96'
- Velocity at bottom = 20.41 fps
- Depth at bottom = 0.77 ft.

AT Earll the full 96' (4:1 spread) will be used for the curb opening - No 10 year

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet ____ of ____

Subject Spillways; Velocity at Toe of slope in CHIMP

By RHF Date 7-13-94 Checked By JVG Date 7/13/94

Earll Dr.:

Local Storm: 1509 cfs C.O. = 96'

From SESCAL Run 6-14-94: Backwater analysis upstream control

Section 2: $Y_1 = Y_0 = 1.30$ ft.

$V_1 = V_0 = 13.63$ fps

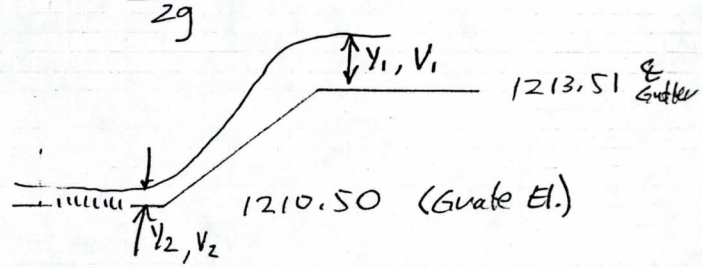
b = Top width = 96 ft.

Energy Equation: $Y_1 + \frac{V_1^2}{2g} + \Delta Z = Y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g}$

$A_2 = Y_2 * b$

$b = 96$ ft.

$\Delta Z = 3.01$ ft.



Box Sta.: 76+30.05

$$Y_1 + \frac{V_1^2}{2g} + \Delta Z = 1.30 + \frac{(13.63)^2}{2g} + 3.01' = 7.1947 \text{ ft.}$$

$$Y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g} = 7.19'$$

$$Y_2 + \frac{\left(\frac{1509}{(96 * Y_2)}\right)^2}{64.4} = 7.1947$$

Y_1	EG
.7	8.5299
.6	11.2573
.8	6.7947
.7769	7.1334
.777	7.1319
.776	7.1473
.775	7.1627
.774	7.1782
.773	7.1938
.7729	7.1954

$Y_1 = .7729$ Use .77

$V_1 = 20.41$ fps ✓

high velocities

RICHARDSON

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 1

Subject Spillway Calculations

By RHF Date 6-15-94 Checked By JVG Date 6/17/94

Roadway: Richardson sta. 83+20

Flow from Richardson will continue across 48th under existing conditions. For this reason, a spillway will be located here.

- Curb opening width = 8' (10-YR Flow)
- Full width of spread = 65' (4:1)
- Concrete will extend from the gutter west 48'
- geo synthetic mat will extend from the end of the concrete spillway west to the multi-use path.
- Velocity at grate is 14.93 fps
- Depth of flow is 0.07'

Exist WS. EL. = 1217.93

8' opening WS EL. = 1217.93 OK

Greiner

Job No. E002102 Project OLD CROSS CUT CANAL Sheet 1 of 2

Subject RICHARDSON Curb opening

By JEB Date 6/2/94 Checked By JVG Date 6/17/94

RICHARDSON -

CALC. 10YR. STORM. -

66 • 0.45 = 29.7 (10 yr.)

CURB OPENING FOR 10 yr. using mannings

n= 0.016 Q= 29.7

S= 0.02 y= 0.5 (CURB HT.)

B= 7.78' ≈ 8.0' OK

WE WILL USE AN 8' OPENING FOR A 10yr. STORM.

XSEC DATA:

1	100	1217.29	.016
	118	1217.38	.016
	131	1217.84	.016
2	100	1218.5	.016
	100	1218.0	.016
	130	1218.6	.016
65' CURB opening	165	1218.0	.016
	165	1218.5	0.16

RL = 40'
S= 0.02

ALT. 2	100	1218.5
	139	1219.0
	139	1218.5
	147	1218.5
	147	1219.0
	165	1218.5

- 10 yr. CURB OPENING HAS NO UPSTREAM BACKWATER AFFECT. THEREFORE WE ARE PROPOSING THE 10-yr. CURB opening. THE BANK PROTECTION WILL NEED TO BE 65' long FROM APPROX, ROADWAY STA. 272+05 to STA. 272+70. THIS IS THE EXTENTS OF 4:1 SPREAD SHOWN MARKED UP IN RED ON PLAN, SEE ATTACHED

Greiner

Job No. E002102 Project OLD CROSS CUT CANAL Sheet 2 of 2

Subject RICHARDSON Spillway Velocities

By JEB Date 6/6/94 Checked By JVG Date 6/17/94

RICHARDSON -

CURB OPENING - 8' (LOCAL STORM)

$$y_1 + \frac{V_1^2}{2g} + \Delta z = y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g}$$ Total spread width = 65'

$A_2 = (y_2 * b)$

$b = 65'$

$y_1 = .61$

$V_1 = 5.02$

$\Delta = 2.5$

$$Eg_1 = y_1 + \frac{V_1^2}{2g} + \Delta z = 0.61 + \frac{(5.02)^2}{2(32.2)} + 2.5 = 3.5$$

$Q = 66$

$$Eg_1 = y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g} \Rightarrow 3.5 = y_2 + \frac{\left(\frac{66}{y_2 * 65}\right)^2}{2(32.2)}$$

y_2 .068

$V_2 = 66/.068(65) = \underline{14.93 \text{ fps}}$

y_2	Eg_1
.1	1.7
.3	.47
.03	17.82
.09	2.07
.08	2.58
.07	3.33
.06	4.51
.065	3.85
.066	3.74
.067	3.63
→ .068	3.53

CURB opening - 5' (GENERAL STORM)

$$y_1 + \frac{V_1^2}{2g} + \Delta z = y_2 + \frac{\left(\frac{Q}{A_2}\right)^2}{2g}$$

$Q = 35 \text{ cfs}$ (General)

$A_2 = (y_2 * b)$

$b = 65$ $A_2 = 65 * 0.56 = 36.4$

$y_1 = 0.56$

$V_1 = 4.01$

$\Delta z = 2.5$

$$Eg_1 = y_1 + \frac{V_1^2}{2g} + \Delta z = 0.56 + \frac{(4.01)^2}{2(32.2)} + 2.5 = 3.31$$

$Q = 35$

$y_2 = 0.0371$

$$3.31 = y_2 + \frac{\left(\frac{35}{y_2 * B}\right)^2}{2(32.2)}$$

$$V_2 = \frac{Q}{y_2(b)} = \frac{35}{0.0371(65)} = \underline{14.51}$$

y_2	Eg_1
.05	1.85
.04	2.85
.03	5.03
.038	3.15
.037	3.33
.0375	3.24
→ .0371	3.31

```
SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

****

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The computer programs are furnished by the author and are accepted and used by the recipient individual or group entity with the express understanding that the author makes no warranties, express or implied concerning the accurary, completeness, reliability,usability, or suitability for any particular purpose of the information or data contained in the programs, or furnished in connection therewith, and the author shall be under no liability whatsoever to any such individual or group entity by reason of any use made thereof.

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The plotting program is furnished by Dr. Long-Cheng Huang.

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17:41:41 6-JUN-94

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

USER : SHI-EN SHIAU

****

E002102 - RICHARDSON 65' CURB OPENING W/ BACKWATER USING UPSTREAM CONTROL

****

IRREGULAR CROSS SECTION

.A.	100.00	118.00	131.00
ELEV.	1217.29	1217.38	1217.42
N	0.016	0.016	0.016

Q (cfs)

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1216.390G-----------+----------+----------+----------+----------+
       100.0      113.0      126.0      139.0      152.0      165.0
                        STATION (feet)
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G : CROSS SECTION GROUND POINT

SECTION # 2 STATION -40.00

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.35	65.00	14.01	0.0:1	0.0:1	65.43

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
1.79	4.71	0.02000	66.00	0.01600	0.45	3.20

BACKWATER COMPUTATION

WSEL	YO	TOP WIDTH	AREA	CONTRACTION	EXPANSION	PERIMETER
1216.70	0.31	65.00	11.30	0.10	0.30	65.35

FROUDE #	VELOCITY	FRIC. SLOPE	EG	N VALUE	FLOW LINE	LENGTH
2.47	5.84	0.04085	1217.23	0.01600	1216.39	-40.00

SUMMARY OF BACKWATER ANALYSIS

SECTION	STATION FEET	REACH LENGTH FEET	DISCHARGE CFS	FLOW LINE FEET	WATER SURFACE FEET
1	0.00	0.00	66.00	1217.29	1217.93
2	-40.00	-40.00	66.00	1216.39	1216.70

NC

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S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

****

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The plotting program is furnished by Dr. Long-Cheng Huang.

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17:46:52 6-JUN-94

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USER : SHI-EN SHIAU

****

E002102 - 8' CURB OPENING W/ BACKWATER USING UPSTREAM CONTROL

****

IRREGULAR CROSS SECTION

DA.	100.00	118.00	131.00
ELEV.	1217.29	1217.38	1217.42
N	0.016	0.016	0.016

Q (cfs)

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1216.560+------------+----------+----------G----------+----------+
        100.0      113.0      126.0      139.0      152.0      165.0
                          STATION (feet)

          G : CROSS SECTION GROUND POINT
```

SECTION # 2 STATION -40.00

NORMAL FLOW COMPUTATION

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.62	65.00	14.09	0.0:1	0.0:1	66.31

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
1.77	4.68	0.02000	66.00	0.01600	0.72	3.20

BACKWATER COMPUTATION

WSEL	YO	TOP WIDTH	AREA	CONTRACTION	EXPANSION	PERIMETER
1217.17	0.61	65.00	13.14	0.10	0.30	66.28

FROUDE #	VELOCITY	FRIC. SLOPE	EG	N VALUE	FLOW LINE	LENGTH
1.97	5.02	0.02514	1217.56	0.01600	1216.56	-40.00

SUMMARY OF BACKWATER ANALYSIS

SECTION	STATION FEET	REACH LENGTH FEET	DISCHARGE CFS	FLOW LINE FEET	WATER SURFACE FEET
1	0.00	0.00	66.00	1217.29	1217.93
2	-40.00	-40.00	66.00	1216.56	1217.17

NC

OSBORN ROAD

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of ____

Subject Extension of Spillway length

By RHF Date 7-8-94 Checked By JVG Date 7/13/94

S. of Osborn :

A spillway is proposed based on a 4:1 expansion at Osborn. the expansion at this point intercets the curb about 41.5' s. of the curb return. In order to have the low point of the roadway included in the curb cut and not have to provide an additional 3' curb opening to prevent ponding, the curb opening should extend to Road Sta. 278+25. Multi-Use Path at back of gutter equals end of concrete. Geosynthetic Mat is to be installed around the inlet and extend in all directions to the Multi-Use Path.

N. of Osborn :

The low point falls in the proposed curb opening. The north end of the curb open is at Roadway sta. 280+40. The Multi-use Path located at the back of gutter is to be used as the concrete protection for the roadway. Extending west from the west

PROJECT: Old Cross Cut Canal
JOB NO.: E002102

FLOW SPLIT ANALYSIS FOR SPILLWAY AND INLET DESIGN

LOCAL STORM DISCHARGE: 431
ROADWAY RATING: Osborn Road GENERAL STORM DISCHARGE: 235

Elevation	North Roadway Capacity	South Roadway Capacity	Total Roadway Capacity
1223.00	45.36	175.43	220.79
1223.10	59.94	209.69	269.63
1223.21	76.77	250.05	326.82
1223.32	98.29	293.09	391.38
1223.44	126.00	342.91	468.91
1223.56	156.33	395.85	552.18
1223.68	189.13	451.82	640.95
1223.80	224.34	510.43	734.77

Storm	Elevation	North Roadway Discharge	South Roadway Discharge	Total Discharge
General	1223.03	49.5	185.5	235.0
Local	1223.38	113.0	318.0	431.0

1 16:33:32 22-JUN-94

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SSSSS EEEEE SSSSS  CCCC   A   L
S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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COMPUTATIONAL HYDRAULIC DESIGN

Backup for Flow split analysis

USER : SHI-EN SHIAU

****

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16:33:32 22-JUN-94

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USER : SHI-EN SHIAU

****

E002102 - OSBORN ROADWAY RATING FOR NORTH SECTION TO DETERMINE FLOW IN THE NORTH SECTION OF OSBORN ROAD.

****

IRREGULAR CROSS SECTION

STA.	100.00	119.00	121.00	136.00	169.00
E' '.	1222.82	1221.84	1222.40	1222.57	1223.20
N	0.016	0.016	0.016	0.025	0.025

1

Q (cfs)

ELEVATION (feet)

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.90	69.00	77.07	0.0:1	0.0:1	70.57
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.57	3.40	0.00190	261.79	0.02028	1.55	4.96

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.00	69.00	83.97	0.0:1	0.0:1	70.77
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.57	3.59	0.00190	301.42	0.02028	1.62	5.21

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.10	69.00	90.87	0.0:1	0.0:1	70.97
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.58	3.78	0.00190	343.15	0.02028	1.70	5.44

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.20	69.00	97.77	0.0:1	0.0:1	71.17
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.59	3.96	0.00190	386.92	0.02028	1.77	5.66

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.30	69.00	104.67	0.0:1	0.0:1	71.37
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.59	4.13	0.00190	432.71	0.02028	1.85	5.87

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.40	69.00	111.57	0.0:1	0.0:1	71.57
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.60	4.31	0.00190	480.37	0.02028	1.93	6.08

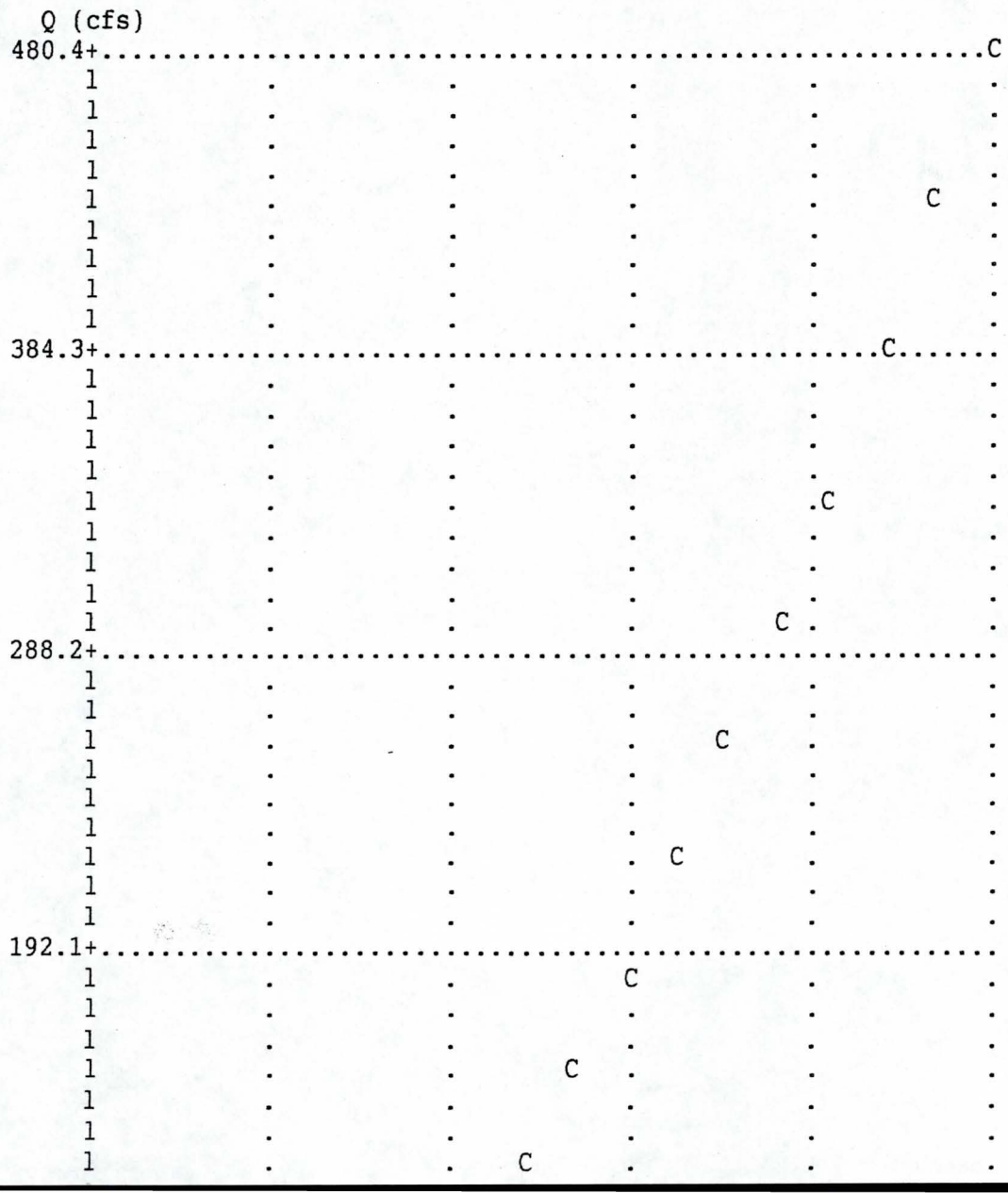
ELEVATION - DISCHARGE CURVE

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	0.00	6.65	0.60

9.84	0.70	15.46	0.80
23.03	0.90	32.89	1.00
45.36	1.10	59.94	1.20
76.77	1.30	98.29	1.40
126.00	1.50	156.33	1.60
189.13	1.70	224.34	1.80
261.79	1.90	301.42	2.00
343.15	2.10	386.92	2.20
432.71	2.30	480.37	2.40

DISCHARGE	EG/YN		DISCHARGE	EG/YN	
0.00	1222.38	.53	6.65	1222.48	.63
9.84	1222.58	.73	15.46	1222.68	.83
23.03	1222.78	.93	32.89	1222.89	1.04
45.36	1223.00	1.15	59.94	1223.10	1.25
76.77	1223.21	1.36	98.29	1223.32	1.47
126.00	1223.44	1.59	156.33	1223.56	1.71
189.13	1223.68	1.83	224.34	1223.80	1.95
261.79	1223.92	2.07	301.42	1224.04	2.19
343.15	1224.16	2.31	386.92	1224.28	2.43
432.71	1224.41	2.56	480.37	1224.53	2.68

General = 1223.83
Local = 1229.41



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1    17:03:58    22-JUN-94
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                 SSSSS EEEEE SSSSS C     A   A L
                     S E         S C     AAAAA L        REVISED
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Backup for Flow split analysis

COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

****

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17:03:58 22-JUN-94

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USER : SHI-EN SHIAU

****

E002102 - OSBORN ROADWAY RATING FOR SOUTH SECTION TO DETERMINE FLOW IN THE SOUTH SECTION OF OSBORN ROAD.

****

IRREGULAR CROSS SECTION

STA.	100.00	110.00	150.00	175.00
F' '.	1221.85	1221.85	1222.11	1222.82
N	0.025	0.025	0.016	0.016

1

Q (cfs)

ELEVATION (feet)

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.50	75.00	91.93	0.0:1	0.0:1	77.04
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.53	3.32	0.00190	305.06	0.02203	1.08	5.08

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.60	75.00	99.42	0.0:1	0.0:1	77.24
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.53	3.49	0.00190	347.12	0.02203	1.15	5.30

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.70	75.00	106.92	0.0:1	0.0:1	77.44
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.54	3.66	0.00190	391.23	0.02203	1.22	5.51

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.80	75.00	114.43	0.0:1	0.0:1	77.64
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	3.82	0.00190	437.40	0.02202	1.29	5.72

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.90	75.00	121.93	0.0:1	0.0:1	77.84
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	3.98	0.00190	485.46	0.02202	1.37	5.93

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.00	75.00	129.43	0.0:1	0.0:1	78.04
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.55	4.14	0.00190	535.41	0.02202	1.44	6.12

ELEVATION - DISCHARGE CURVE

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	0.00	3.28	0.20

8.53	0.30	17.14	0.40
28.48	0.50	42.57	0.60
59.47	0.70	79.26	0.80
101.98	0.90	128.35	1.00
158.90	1.10	191.95	1.20
227.42	1.30	265.14	1.40
305.06	1.50	347.12	1.60
391.23	1.70	437.40	1.80
485.46	1.90	535.41	2.00

32.71	0.53	— 1222.38
47.64	0.63	— 1222.48
65.41	0.73	— 1222.58
86.08	0.83	— 1222.68
109.89	0.93	— 1222.78
175.43	1.15	— 1223.0
209.69	1.25	— 1223.10
250.05	1.36	— 1223.21
293.09	1.47	— 1223.32
342.91	1.59	— 1223.44
395.85	1.71	— 1223.56
451.82	1.83	— 1223.68
510.43	1.95	— 1223.80

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	1221.95	3.28	1222.06
8.53	1222.16	17.14	1222.27
28.48	1222.38	42.57	1222.49
59.47	1222.60	79.26	1222.71
101.98	1222.82	128.35	1222.94
158.90	1223.05	191.95	1223.17
227.42	1223.29	265.14	1223.40
305.06	1223.52	347.12	1223.64
391.23	1223.76	437.40	1223.88
485.46	1224.00	535.41	1224.12

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