Canada | U.S. Department of Transportation Federal Highway Administration | Ontario | MDOT Michigan Department of Transportation

Canada-United States-Ontario-Michigan
Border Transportation Partnership

Practical Alternatives Evaluation Assessment Report

Stormwater Management Plan

Appendices

URS

July 2007
Revised December 2007

Appendices

Appendix A

Hydraulic Analysis
Post Development Condition

Appendix A.1

Alternative 1A

Titcombe Drain Crossing
Basin Drain Crossing
Cahill Drain Crossing
Cahill / Wolfe Drainage Along Talbot Road

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbei	0.00	
Maximum Disct	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

URS
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	181.40	m	Headwater Depth/Height	1.20	
Computed Headwater Elevat	180.32	m	Discharge	8.1000	m³/s
Inlet Control HW Elev.	180.32	m	Tailwater Elevation	179.70	m
Outlet Control HW Elev.	180.32	m	Control Type	Inlet Control	

Grades					
Upstream Invert	178.50	m	Downstream Invert	178.20	m
Length	58.00	m	Constructed Slope	0.005172	m/m

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.05	m
Slope Type	Steep		Normal Depth	1.05	m
Flow Regime	N/A		Critical Depth	1.14	m
Velocity Downstream	3.62	m/s	Critical Slope	0.004178	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.13	m
Section Size	2130 x 1520 mm		Rise	1.52	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	180.32	m	Upstream Velocity Head	0.57	m
Ke	0.20		Entrance Loss	0.11	m

Inlet Control Properties					
Inlet Control HW Elev.	180.32	m	Flow Control	Transition	
Inlet Type	90° headwall w 45° bevels		Area Full	3.3	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
Lennon Drain - Alt1A-100yr-Existing

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	182.00	m	Headwater Depth/Height	1.40	
Computed Headwater Elev:	181.91	m	Discharge	8.3000	m³/s
Inlet Control HW Elev.	181.91	m	Tailwater Elevation	180.85	m
Outlet Control HW Elev.	181.82	m	Control Type	Inlet Control	

Grades					
Upstream Invert	180.20	m	Downstream Invert	179.30	m
Length	138.00	m	Constructed Slope	0.006522	m/m

Hydraulic Profile					
Profile	CompositePressureProfileS1S2		Depth, Downstream	0.82	m
Slope Type	N/A		Normal Depth	0.82	m
Flow Regime	N/A		Critical Depth	1.02	m
Velocity Downstream	3.92	m/s	Critical Slope	0.003567	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.59	m
Section Size	1219 mm x 2591 mm		Rise	1.22	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	181.82	m	Upstream Velocity Head	0.51	m
Ke	0.20		Entrance Loss	0.10	m

Inlet Control Properties					
Inlet Control HW Elev.	181.91	m	Flow Control	N/A	
Inlet Type	90° headwall w 45° bevels		Area Full	3.2	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
Cahill Alt 1A-Future

Comments: Unknown Flow

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	183.50	m	Headwater Depth/Height	1.97	
Computed Headwater Elevat	183.26	m	Discharge	27.6000	m³/s
Inlet Control HW Elev.	183.26	m	Tailwater Elevation	180.23	m
Outlet Control HW Elev.	183.02	m	Control Type	Inlet Control	

Grades					
Upstream Invert	180.31	m	Downstream Invert	179.33	m
Length	192.00	m	Constructed Slope	0.005104	m/m

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.50	m
Slope Type	N/A		Normal Depth	N/A	m
Flow Regime	N/A		Critical Depth	1.50	m
Velocity Downstream	4.09	m/s	Critical Slope	0.006085	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	4.50	m
Section Size	4500 x 1500 mm		Rise	1.50	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	183.02	m	Upstream Velocity Head	0.85	m
Ke	0.20		Entrance Loss	0.17	m

Inlet Control Properties					
Inlet Control HW Elev.	183.26	m	Flow Control	Submerged	
Inlet Type	90° headwall w 45° bevels		Area Full	6.8	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m³/s

Results		
Depth	0.94	m
Flow Area	4.2	m²
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/m
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m³/s

Results		
Depth	0.94	m
Flow Area	4.2	m²
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/m
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Appendix A.2

Alternative 1B

Appendix A.2.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbei	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix A.2.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	181.40	m	Headwater Depth/Height	1.20	
Computed Headwater Elevat	180.32	m	Discharge	8.1000	m³/s
Inlet Control HW Elev.	180.32	m	Tailwater Elevation	179.70	m
Outlet Control HW Elev.	180.32	m	Control Type	Inlet Control	

Grades					
Upstream Invert	178.50	m	Downstream Invert	178.20	m
Length	58.00	m	Constructed Slope	0.005172	m/m

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.05	m
Slope Type	Steep		Normal Depth	1.05	m
Flow Regime	N/A		Critical Depth	1.14	m
Velocity Downstream	3.62	m/s	Critical Slope	0.004178	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.13	m
Section Size	2130 x 1520 mm		Rise	1.52	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	180.32	m	Upstream Velocity Head	0.57	m
Ke	0.20		Entrance Loss	0.11	m

Inlet Control Properties					
Inlet Control HW Elev.	180.32	m	Flow Control	Transition	
Inlet Type	90° headwall w 45° bevels		Area Full	3.3	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Appendix A.2.3

Cahill / Wolfe Drainage Along Talbot Road

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m³/s

Results		
Depth	0.94	m
Flow Area	4.2	m²
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/m
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Appendix A.2.4

Syphon Analysis

Appendix A.2.4.1

Turkey Creek

1

```
**********************************************
*    U.S. Environmental Protection Agency    *
*    Storm Water Management Model  (SWMM)    *
*                Version 4.4GU               *
*                                            *
*                 CDM/OSU Beta               *
*       Release Date - November 23, 1999     *
* Camp Dresser & McKee and Oregon State Univ. *
*          Chuck Moore and Wayne Huber       *
*  Compiled using Digital Visual Fortran 6.0 *
**********************************************

                 Developed by

**********************************************
*             Metcalf & Eddy, Inc.           *
*            University of Florida           *
*       Water Resources Engineers, Inc.      *
*     (Now Camp, Dresser and McKee, Inc.)    *
*              September 1970                *
**********************************************

         Distributed and Maintained by

**********************************************
*      U.S. Environmental Protection Agency  *
* Center for Exposure Assessment Modeling (CEAM)*
*    Athens Environmental Research Laboratory *
*            960 College Station Road        *
*            Athens, GA    30605-2720        *
**********************************************

**********************************************
*     This is a new release of SWMM.  If any *
*     problems occur executing this model    *
*     system, contact Mr. Frank Stancil,     *
*     U.S. Environmental Protection Agency.  *
*     706/355-8328 (voice)                   *
*     e-mail: stancil@athens.ath.epa.gov     *
*     Or contact Wayne C. Huber at Oregon St. U.*
*     541/737-6150 or wayne.huber@orst.edu   *
*     Or Michael F. Schmidt at Camp Dresser &*
*     McKee (904) 281-0170 SCHMIDTMF@CDM.COM *
**********************************************
```

```
          ************************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ************************************************


 ##########################################
 #         File names by SWMM Block       #
 #          JIN  -> Input to a Block      #
 #         JOUT  -> Output from a Block   #
 ##########################################

    JIN for Block #     1 File #    0  JIN.UF
   JOUT for Block #     1 File #    9  PCTmp1.int

 ##########################################
 # Scratch file names for this simulation. #
 ##########################################

 NSCRAT #     1 File #   21  SCRT1.UF
 NSCRAT #     2 File #   22  SCRT2.UF
 NSCRAT #     3 File #   23  SCRT3.UF
 NSCRAT #     4 File #   24  SCRT4.UF
 NSCRAT #     5 File #   25  SCRT5.UF
 NSCRAT #     6 File #   26  SCRT6.UF
 NSCRAT #     7 File #   27  SCRT7.UF
 NSCRAT #     8 File #   28  SCRT8.UF

 ************************************************
 *    Parameter Values on the Tapes Common Block   *
 ************************************************

  Number of Subcatchments in the Runoff Block (NW)..... 1000
  Number of Channel/Pipes in the Runoff Block (NG)..... 1000
  Number of Connections to Runoff Channels/Inlets (NCP).    6
  Number of Water Quality Constituents (MQUAL).........   20
  Number of Runoff Land Uses per Subcatchment (NLU).....   20
  Number of Groundwater Subcatchments in Runoff (NGW)...  100
  Number of Interface Locations for all Blocks (NIE).... 1000
  Number of Elements in the Transport Block (NET).......  500
  Number of Storage Junctions in Transport (NTSE).......  100
  Number of Transport interface input locations (NTHI)..  500
  Number of Transport interface output locations (NTHO).  500
  Number of Transport input locations on R lines (NTHR).   80
```

```
  Number of Transport printed output locations (NTOA)...   80
  Number of Tabular Flow Splitters in Transport (NTSP)..   50
  Number of Elements in the Extran Block (NEE)..... 4000
  Number of Pumps in Extran (NEP).....   75
  Number of Orifices in Extran (NEO)..... 200
  Number of Tide Gates/Free Outfalls in Extran (NTG).... 200
  Number of Extran Weirs (NEW)..... 400
  Number of Extran Printout Locations (NPO)..... 150
  Number of Tide Elements in Extran (NTE).....   50
  Number of Natural Channels (NNC)..... 1200
  Number of Storage Junctions in Extran (NVSE)..... 1000
  Number of Time History Data Points in Extran (NTVAL).. 500
  Number of Data Points for Variable Storage Elements
    in the Extran Block (NVST).....   25
  Number of Input Hydrographs in Extran (NEH)..... 500
  Number of Allowable Channel Connections to
    Junctions in the Extran Block (NCHN).....   15
  Number Rain Gages in Rain and Runoff (MAXRG)..... 200
  Number PRATE/VRATE Points for Extran Pump
    Input (MAXPRA).....   10
  Number of Variable Orifices in Extran (NVORF).....   50
  Number of Variable Orifice Data Points (NVOTIM).....   50
  Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
  Number of Storm Events for Rain Analysis (LSTORM).....20000
  Number of Plugs for Plug-flow in S/T (NPLUG)..... 3000
  Number Conduits for Extran Results to ASCII
    File (MXFLOW).....  400


 ********************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
 * developed 1973 by Camp, Dresser and McKee (CDM) with  *
 * modifications 1977-1991 by the University of Florida. *
 *                                                       *
 * Most recent update: March 1999 by CDM, Oregon         *
 * State University, and XP Software, Inc.               *
 *                                                       *
 * "Smooth runs the water where the brook is deep."      *
 *                   Shakespeare, Henry VI, II, III, 1   *
 ********************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Turkey Creek Existing Condition - 100-Year Flow

Control information for simulation

Integration cycles..... 1440

Length of integration step is..... 5.00 seconds
Simulation length..... 2.00 hours

Do not create equiv. pipes(NEQUAL). 0

Use metric units for I/O..... 1

Printing starts in cycle..... 1

Intermediate printout intervals of. 1 cycles
Intermediate printout intervals of. 0.08 minutes

Summary printout intervals of..... 1 cycles
Summary printout time interval of.. 0.08 minutes

Hot start file parameter (JREDO)... 0

Initial time (TZERO)..... 0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)..... 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX..... 30
SURTOL..... 0.0500

Default surface area of junctions.. 1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.

```
 NORMAL FLOW OPTION WHEN THE WATER
 SURFACE SLOPE IS LESS THAN THE
 GROUND SURFACE SLOPE (KSUPER=0)....

 NJSW INPUT HYDROGRAPH JUNCTIONS....     0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****        ANALYSIS MODULE         ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Existing Condition - 100-Year Flow


1
 ****************************************************
 *                    Conduit Data                  *
 ****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	1	2	2.40	2.40	
2	2	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	2	3	2.40	2.40	
3	3	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	3	4	2.40	2.40	
4	4	60.	TRAPEZOID	96.91	0.01500	9.75	4.64	4	5	2.40	2.40	
5	5	40.	TRAPEZOID	96.91	0.01500	9.75	4.64	5	6	2.40	2.40	

6	6	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	6	7	2.40	2.40
7	7	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	7	8	2.40	2.40
8	8	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	8	9	2.40	2.40
9	9	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	9	10	2.40	2.40
10	10	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	10	11	2.40	2.40

```
 ********************
 *  Conduit Volume  *
 ********************

 Input full depth volume.............    8.7220E+04 cubic meters

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY              ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                             ****                                ****        CAMP DRESSER & MCKEE INC.
                                              ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Existing Condition - 100-Year Flow


1
 ****************************************************
 *                  Junction Data                   *
 ****************************************************
```

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	QINST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS	
1	1	182.00	180.68	176.04	62.60	0.00	1	
2	2	182.00	180.64	176.00	0.00	0.00	1	2
3	3	182.00	180.60	175.96	0.00	0.00	2	3
4	4	182.00	180.56	175.92	0.00	0.00	3	4
5	5	182.00	180.54	175.90	0.00	0.00	4	5
6	6	182.00	180.52	175.88	0.00	0.00	5	6
7	7	182.00	180.48	175.84	0.00	0.00	6	7
8	8	182.00	180.44	175.80	0.00	0.00	7	8
9	9	182.00	180.40	175.76	0.00	0.00	8	9
10	10	182.00	180.36	175.72	0.00	0.00	9	10
11	11	182.00	180.32	175.68	0.00	0.00	10	

```
 ****************************************************
```

```
 *           FREE OUTFALL DATA (DATA GROUP I1)      *
 *          BOUNDARY CONDITION ON DATA GROUP J1     *
 ***************************************************

 OUTFALL AT JUNCTION....         11 HAS BOUNDARY CONDITION NUMBER...          1

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY              ****   EXTENDED TRANSPORT PROGRAM   ****         WATER RESOURCES DIVISION
 WASHINGTON, D.C.                             ****                                ****         CAMP DRESSER & MCKEE INC.
                                              ****          ANALYSIS MODULE       ****         ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Existing Condition - 100-Year Flow



 ***************************************************
 *         INTERNAL CONNECTIVITY INFORMATION       *
 ***************************************************

          CONDUIT      JUNCTION      JUNCTION
          -------      --------      --------
          90011            11             0
1
 *****************************************************
 *         BOUNDARY CONDITON INFORMATION             *
 *                  DATA GROUPS J1-J4                *
 *****************************************************



 BC NUMBER..          1 CONTROL WATER SURFACE ELEVATION IS..     178.80 METERS.
  TZERO =       1906195  0.0000000E+00

 ***********************************
 *    INITIAL MODEL CONDITION      *
 * INITIAL TIME =      0.00 HOURS  *
 ***********************************

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   0.00 /   176.04          2/   0.00 /   176.00          3/   0.00 /   175.96
         4/   0.00 /   175.92          5/   0.00 /   175.90          6/   0.00 /   175.88
         7/   0.00 /   175.84          8/   0.00 /   175.80          9/   0.00 /   175.76
        10/   0.00 /   175.72         11/   0.00 /   175.68
```

```
  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00      90011/       0.00

  CONDUIT/   VELOCITY
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   176.04/   176.00          2/   176.00/   175.96          3/   175.96/   175.92
       4/   175.92/   175.90          5/   175.90/   175.88          6/   175.88/   175.84
       7/   175.84/   175.80          8/   175.80/   175.76          9/   175.76/   175.72
      10/   175.72/   175.68


**********************************
*     FINAL MODEL CONDITION      *
*  FINAL TIME =      2.00 HOURS  *
**********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   2.86 /   178.90          2/   2.89 /   178.89          3/   2.92 /   178.88
       4/   2.95 /   178.87          5/   2.96 /   178.86          6/   2.97 /   178.85
       7/   3.00 /   178.84          8/   3.03 /   178.83          9/   3.06 /   178.82
      10/   3.09 /   178.81         11/   3.12 /   178.80

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/      62.60          2/      62.59          3/      62.61          4/      62.60
```

5/	62.59	6/	62.60	7/	62.60	8/	62.59
9/	62.60	10/	62.59	90011/	62.59		

CONDUIT/ VELOCITY

1/	1.31	2/	1.29	3/	1.27	4/	1.26
5/	1.25	6/	1.24	7/	1.22	8/	1.20
9/	1.19	10/	1.17				

CONDUIT/ CROSS SECTIONAL AREA

1/	47.94	2/	48.57	3/	49.22	4/	49.69
5/	50.02	6/	50.55	7/	51.24	8/	51.95
9/	52.67	10/	53.41				

CONDUIT/ FINAL VOLUME

1/	4793.90	2/	4856.83	3/	4921.51	4/	2981.39
5/	2000.85	6/	5055.19	7/	5124.48	8/	5195.12
9/	5267.39	10/	5340.97				

CONDUIT/ HYDRAULIC RADIUS

1/	1.94	2/	1.95	3/	1.97	4/	1.98
5/	1.99	6/	2.00	7/	2.01	8/	2.03
9/	2.05	10/	2.06				

CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION

1/	178.90/	178.89	2/	178.89/	178.88	3/	178.88/	178.87
4/	178.87/	178.86	5/	178.86/	178.85	6/	178.85/	178.84
7/	178.84/	178.83	8/	178.83/	178.82	9/	178.82/	178.81
10/	178.81/	178.80						

```
##################################################
#           Surcharge Iteration Summary          #
##################################################

Maximum number of iterations in a time step.....       22
Total number of iterations in the simulation..       3151
Average number of iterations per time step......     2.19
Surcharge iterations during the simulation......      271
Maximum surcharge flow error during simulation.. 4.73E+00 cms
Total number of time steps during simulation..       1440


1
 ************************************************
```

```
 *          CONDUIT COURANT CONDITION SUMMARY        *
 * TIME IN MINUTES DELT > COURANT TIME STEP          *
 ****************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ****************************************************
```

CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)
1	0.00	2	0.00	3	0.00	4	0.00
5	0.33	6	0.00	7	0.00	8	0.00
9	0.00	10	0.00				

1

```
 ************************************************
 *          CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT    =             CONDUIT LENGTH       *
 * TIME STEP = ------------------------------- *
 *              VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	17.23	2	17.25	3	17.91	4	12.67
5	8.85	6	22.33	7	17.08	8	17.08
9	17.08	10	16.96				

1

```
 ************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************
```

JUNCTION	INFLOW, CU M
1	4.5072E+05

JUNCTION	OUTFLOW, CU M
1	2.6693E+03

2	5.6062E+02
3	2.0810E+02
4	1.8592E+03
5	5.6534E+03
6	1.3183E+03
7	9.4449E+02
8	2.9801E+03
9	1.3814E+03
10	1.5085E+03
11	3.9284E+05

```
*********************************************************
* INITIAL SYSTEM VOLUME         =     9.0000E-03 CU M   *
* TOTAL SYSTEM INFLOW VOLUME    =     4.5072E+05 CU M   *
* INFLOW + INITIAL VOLUME       =     4.5072E+05 CU M   *
*********************************************************
* TOTAL SYSTEM OUTFLOW          =     4.1192E+05 CU M   *
* VOLUME LEFT IN SYSTEM         =     4.5538E+04 CU M   *
* OUTFLOW + FINAL VOLUME        =     4.5746E+05 CU M   *
*********************************************************
* ERROR IN CONTINUITY, PERCENT =          -1.50         *
*********************************************************
```

```
TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
VOLUME LEFT IN SYSTEM       =     6.7482E+04 CU. FT.
ERROR IN CONTINUITY PERCENT =         -63.64
```

- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	84	0.12
2	38	0.05	82	0.11
3	31	0.04	81	0.11
4	27	0.04	81	0.11
5	26	0.04	74	0.10
6	24	0.03	70	0.10
7	20	0.03	70	0.10
8	17	0.02	59	0.08
9	15	0.02	61	0.08
10	15	0.02	61	0.08

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

J U N C T I O N S U M M A R Y S T A T I S T I C S

Detroit River International Crossing
Turkey Creek Existing Condition - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	TIME OF OCCURENCE MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	182.00	180.68	178.96	0.3566	182.00	0	3	1.32	0.00	0.8	0.3	3.522E+04
2	182.00	180.64	178.94	0.3323	182.00	0	3	1.36	0.00	0.5	0.1	6.990E+04
3	182.00	180.60	178.91	0.2984	182.00	0	5	1.40	0.00	0.4	0.1	5.033E+04
4	182.00	180.56	178.89	0.3581	182.00	0	2	1.44	0.00	0.9	0.2	4.026E+04
5	182.00	180.54	178.88	0.3984	182.00	0	2	1.46	0.00	0.7	0.3	3.403E+04
6	182.00	180.52	178.87	0.3937	182.00	0	2	1.48	0.00	0.3	0.3	4.789E+04
7	182.00	180.48	178.85	0.3333	182.00	0	2	1.52	0.00	0.3	0.2	3.544E+04
8	182.00	180.44	178.84	0.3701	182.00	0	1	1.56	0.00	0.7	0.3	2.120E+04
9	182.00	180.40	178.83	0.3194	182.00	0	1	1.60	0.00	0.3	0.2	4.340E+04
10	182.00	180.36	178.82	0.3523	182.00	0	1	1.64	0.00	0.3	0.3	3.099E+04
11	182.00	180.32	178.81	0.0960	180.32	0	1	0.00	1.68	0.4	0.0	1.458E+04

1

C O N D U I T S U M M A R Y S T A T I S T I C S

Detroit River International Crossing
Turkey Creek Existing Condition - 100-Year Flow

CONDUIT	DESIGN FLOW	DESIGN VELOCITY	CONDUIT VERTICAL DEPTH	MAXIMUM COMPUTED FLOW	TIME OF OCCURRENCE	MAXIMUM COMPUTED VELOCITY	TIME OF OCCURRENCE	RATIO OF MAX. TO DESIGN	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS DOWNSTREAM	LENGTH CONDUIT OF NORM FLOW	SLOPE

NUMBER	(CMS)	(M/S)	(M)	(CMS)	HR.	MIN.	(MPS)	HR.	MIN.	FLOW	(M)	(M)	(MIN)	(M/M)
1	2.60E+02	2.69	4.640	-1.95E+02	0	3	4.06	0	0	-0.75	5.96	5.53	0.5	0.00040
2	2.60E+02	2.69	4.640	-2.28E+02	0	3	4.15	0	1	-0.88	5.53	6.04	0.3	0.00040
3	2.60E+02	2.69	4.640	-2.47E+02	0	3	4.14	0	1	-0.95	6.04	6.08	0.3	0.00040
4	2.38E+02	2.45	4.640	-4.24E+02	0	2	-4.77	0	2	-1.78	6.08	6.10	0.3	0.00033
5	2.91E+02	3.00	4.640	-7.58E+02	0	2	-8.07	0	2	-2.60	6.10	6.12	0.1	0.00050
6	2.60E+02	2.69	4.640	-5.79E+02	0	2	-6.64	0	2	-2.22	6.12	6.08	0.2	0.00040
7	2.60E+02	2.69	4.640	-7.19E+02	0	1	-8.32	0	2	-2.76	6.08	6.20	0.3	0.00040
8	2.60E+02	2.69	4.640	-7.36E+02	0	1	-8.37	0	1	-2.83	6.20	6.24	0.2	0.00040
9	2.60E+02	2.69	4.640	-7.29E+02	0	1	-7.76	0	1	-2.80	6.24	6.28	0.3	0.00040
10	2.60E+02	2.69	4.640	-7.66E+02	0	1	-7.96	0	1	-2.94	6.28	4.64	0.2	0.00040
90011	UNDEF	UNDEF	UNDEF	-7.66E+02	0	1								

1

```
*************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
*************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	62.38	0.4018	4.4914E+05	2.8606	96.9110
2	0.08	119.92	0.00	0.00	61.55	0.4045	4.4315E+05	2.8317	95.0900
3	0.08	119.92	0.00	0.00	60.79	0.5007	4.3772E+05	2.8606	96.9110
4	0.25	119.75	0.00	0.00	60.30	0.7906	4.3419E+05	2.8499	96.2355
5	0.58	119.42	0.00	0.00	59.26	0.7936	4.2664E+05	2.8606	96.9110
6	0.92	119.08	0.00	0.00	58.48	0.6124	4.2108E+05	2.7665	91.0556
7	1.00	119.00	0.00	0.00	57.33	0.7272	4.1280E+05	2.8039	93.3605
8	0.58	119.42	0.00	0.00	56.72	0.7770	4.0839E+05	2.7152	87.9453
9	0.17	119.83	0.00	0.00	55.68	0.6837	4.0092E+05	2.8136	93.9603
10	0.00	120.00	0.00	0.00	54.56	0.6524	3.9284E+05	2.8606	96.9110
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	54.56		3.9284E+05		

```
************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************
```

The Conduit with the largest average change... 5 had 0.794 percent

```
The Junction with the largest average change...          5 had      0.398 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*******************************************************
* Starting Date... November   16, 2006                *
*          Time...          16:24:48.900              *
*   Ending Date... November   16, 2006                *
*          Time...          16:24:53.510              *
*  Elapsed Time...               0.077 minutes.       *
*  Elapsed Time...               4.611 seconds.       *
*******************************************************
```

```
1          ************************************************
           *    U.S. Environmental Protection Agency      *
           *    Storm Water Management Model  (SWMM)      *
           *                Version 4.4GU                 *
           *                                              *
           *                 CDM/OSU Beta                 *
           *       Release Date - November 23, 1999       *
           * Camp Dresser & McKee and Oregon State Univ.  *
           *          Chuck Moore and Wayne Huber         *
           *  Compiled using Digital Visual Fortran 6.0   *
           ************************************************

                           Developed by

           ************************************************
           *             Metcalf & Eddy, Inc.             *
           *            University of Florida             *
           *       Water Resources Engineers, Inc.        *
           *     (Now Camp, Dresser and McKee, Inc.)      *
           *              September 1970                  *
           ************************************************

                    Distributed and Maintained by

           ************************************************
           *      U.S. Environmental Protection Agency    *
           * Center for Exposure Assessment Modeling (CEAM)*
           *    Athens Environmental Research Laboratory  *
           *            960 College Station Road          *
           *            Athens, GA    30605-2720          *
           ************************************************

           ************************************************
           *     This is a new release of SWMM.  If any   *
           *     problems occur executing this model      *
           *     system, contact Mr. Frank Stancil,       *
           *     U.S. Environmental Protection Agency.    *
           *     706/355-8328 (voice)                     *
           *     e-mail: stancil@athens.ath.epa.gov       *
           *     Or contact Wayne C. Huber at Oregon St. U.*
           *     541/737-6150 or wayne.huber@orst.edu     *
           *     Or Michael F. Schmidt at Camp Dresser &  *
           *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
           ************************************************
```

```
          ***********************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ***********************************************


##########################################
#         File names by SWMM Block       #
#          JIN  -> Input to a Block      #
#         JOUT  -> Output from a Block   #
##########################################

   JIN for Block #      1 File #     0  JIN.UF
  JOUT for Block #      1 File #     9  PCTmp1.int

##########################################
# Scratch file names for this simulation. #
##########################################

NSCRAT #      1 File #    21  SCRT1.UF
NSCRAT #      2 File #    22  SCRT2.UF
NSCRAT #      3 File #    23  SCRT3.UF
NSCRAT #      4 File #    24  SCRT4.UF
NSCRAT #      5 File #    25  SCRT5.UF
NSCRAT #      6 File #    26  SCRT6.UF
NSCRAT #      7 File #    27  SCRT7.UF
NSCRAT #      8 File #    28  SCRT8.UF

***************************************************
*    Parameter Values on the Tapes Common Block   *
***************************************************

 Number of Subcatchments in the Runoff Block (NW)..... 1000
 Number of Channel/Pipes in the Runoff Block (NG)..... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...   80
 Number of Tabular Flow Splitters in Transport (NTSP)..   50
 Number of Elements in the Extran Block (NEE)..... 4000
 Number of Pumps in Extran (NEP).....   75
 Number of Orifices in Extran (NEO).....  200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
 Number of Extran Weirs (NEW).....  400
 Number of Extran Printout Locations (NPO).....  150
 Number of Tide Elements in Extran (NTE).....   50
 Number of Natural Channels (NNC)..... 1200
 Number of Storage Junctions in Extran (NVSE)..... 1000
 Number of Time History Data Points in Extran (NTVAL)..  500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST).....   25
 Number of Input Hydrographs in Extran (NEH).....  500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN).....   15
 Number Rain Gages in Rain and Runoff (MAXRG)..... 200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA).....   10
 Number of Variable Orifices in Extran (NVORF).....   50
 Number of Variable Orifice Data Points (NVOTIM).....   50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG)..... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW).....  400


************************************************************
* Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)      *
* developed 1973 by Camp, Dresser and McKee (CDM) with     *
* modifications 1977-1991 by the University of Florida.    *
*                                                          *
* Most recent update: March 1999 by CDM, Oregon            *
* State University, and XP Software, Inc.                  *
*                                                          *
* "Smooth runs the water where the brook is deep."         *
*                    Shakespeare, Henry VI, II, III, 1     *
************************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

Control information for simulation

Integration cycles..... 1440

Length of integration step is..... 5.00 seconds
Simulation length..... 2.00 hours

Do not create equiv. pipes(NEQUAL). 0

Use metric units for I/O..... 1

Printing starts in cycle..... 1

Intermediate printout intervals of. 1 cycles
Intermediate printout intervals of. 0.08 minutes

Summary printout intervals of..... 1 cycles
Summary printout time interval of.. 0.08 minutes

Hot start file parameter (JREDO)... 0

Initial time (TZERO)..... 0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)..... 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX..... 30
SURTOL..... 0.0500

Default surface area of junctions.. 1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.

```
 NORMAL FLOW OPTION WHEN THE WATER
 SURFACE SLOPE IS LESS THAN THE
 GROUND SURFACE SLOPE (KSUPER=0)....

 NJSW INPUT HYDROGRAPH JUNCTIONS....     0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


1
 ***************************************************
 *                    Conduit Data                 *
 ***************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	1	2		2.40	2.40
2	2	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	2	3		2.40	2.40
3	3	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	3	4		2.40	2.40
4	4	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	4	5		2.40	2.40
5	5	15.	RECTANGLE	60.00	0.01300	15.00	4.00	5	50			

6	50	23.	RECTANGLE	50.00	0.01300	25.00	2.00	50	51	
7	51	40.	RECTANGLE	50.00	0.01300	25.00	2.00	51	55	
8	55	23.	RECTANGLE	50.00	0.01300	25.00	2.00	55	56	
9	56	15.	RECTANGLE	80.00	0.01300	20.00	4.00	56	6	
10	6	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	6	7	2.40 2.40
11	7	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	7	8	2.40 2.40
12	8	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	8	9	2.40 2.40
13	9	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	9	10	2.40 2.40
14	10	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	10	11	2.40 2.40

===> WARNING !!! (C*DELT/LEN) IN CONDUIT 5 IS 2.1 AT FULL DEPTH.
===> WARNING !!! (C*DELT/LEN) IN CONDUIT 56 IS 2.1 AT FULL DEPTH.

****
* Conduit Volume *
****

Input full depth volume..... 9.3620E+04 cubic meters
Conduit #... 51 has zero slope. 0.001 feet added to upstream invert.

===> Warning !! The upstream and downstream junctions for the following conduits
have been reversed to correspond to the positive flow and decreasing
slope EXTRAN convention. A negative flow in the output thus means
the flow was from your original upstream junction to your original
downstream junction. Any initial flow has been multiplied by -1.

1. Conduit #... 55 has been changed.

1---

ENVIRONMENTAL PROTECTION AGENCY **** EXTENDED TRANSPORT PROGRAM **** WATER RESOURCES DIVISION
WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

1

****
* Junction Data *
****

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	QINST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS

1	1	182.00	180.71	176.07	62.60	0.00	1	
2	2	182.00	180.67	176.03	0.00	0.00	1	2
3	3	182.00	180.63	175.99	0.00	0.00	2	3
4	4	182.00	180.59	175.95	0.00	0.00	3	4
5	5	182.00	180.55	175.91	0.00	0.00	4	5
6	50	182.00	179.90	175.90	0.00	0.00	5	50
7	51	182.00	166.31	164.30	0.00	0.00	50	51
8	55	182.00	166.30	164.30	0.00	0.00	51	55
9	56	182.00	179.87	175.87	0.00	0.00	55	56
10	6	182.00	180.50	175.86	0.00	0.00	56	6
11	7	182.00	180.46	175.82	0.00	0.00	6	7
12	8	182.00	180.42	175.78	0.00	0.00	7	8
13	9	182.00	180.38	175.74	0.00	0.00	8	9
14	10	182.00	180.34	175.70	0.00	0.00	9	10
15	11	182.00	180.30	175.66	0.00	0.00	10	

```
 ************************************************
 *          FREE OUTFALL DATA (DATA GROUP I1)     *
 *         BOUNDARY CONDITION ON DATA GROUP J1    *
 ************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...        1

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


 ************************************************
 *        INTERNAL CONNECTIVITY INFORMATION     *
 ************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90015           11           0
1
 ************************************************
 *        BOUNDARY CONDITON INFORMATION         *
```

```
*                  DATA GROUPS J1-J4                  *
*******************************************************



BC NUMBER..          1 CONTROL WATER SURFACE ELEVATION IS..     178.80 METERS.
 TZERO =       1906195  0.0000000E+00

**********************************
*    INITIAL MODEL CONDITION     *
* INITIAL TIME =      0.00 HOURS *
**********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   0.00 /   176.07         2/   0.00 /   176.03         3/   0.00 /   175.99
        4/   0.00 /   175.95         5/   0.00 /   175.91        50/   0.00 /   175.90
       51/   0.00 /   164.30        55/   0.00 /   164.30        56/   0.00 /   175.87
        6/   0.00 /   175.86         7/   0.00 /   175.82         8/   0.00 /   175.78
        9/   0.00 /   175.74        10/   0.00 /   175.70        11/   0.00 /   175.66

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         50/       0.00         51/       0.00         55/       0.00
       56/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00      90015/       0.00

  CONDUIT/   VELOCITY
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         50/       0.00         51/       0.00         55/       0.00
       56/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         50/       0.00         51/       0.00         55/       0.00
       56/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         50/       0.00         51/       0.00         55/       0.00
       56/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
```

```
        1/   176.07/   176.03         2/   176.03/   175.99         3/   175.99/   175.95
        4/   175.95/   175.91         5/   175.91/   175.90        50/   175.90/   164.30
       51/   164.31/   164.30        55/   175.87/   164.30        56/   175.87/   175.86
        6/   175.86/   175.82         7/   175.82/   175.78         8/   175.78/   175.74
        9/   175.74/   175.70        10/   175.70/   175.66


*********************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =      2.00 HOURS *
*********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   2.86 /   178.93         2/   2.89 /   178.92         3/   2.91 /   178.90
        4/   2.94 /   178.89         5/   2.97 /   178.88        50/   2.98 /   178.88
       51/  14.56*/   178.87        55/  14.56*/   178.86        56/   2.98 /   178.85
        6/   3.00 /   178.86         7/   3.02 /   178.84         8/   3.05 /   178.83
        9/   3.08 /   178.82        10/   3.11 /   178.81        11/   3.14 /   178.80

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/      62.57          2/      62.61          3/      62.59          4/      62.59
        5/      62.18         50/      62.89         51/      63.09         55/     -60.48
       56/      66.50          6/      62.31          7/      62.58          8/      62.68
        9/      62.48         10/      62.60      90015/      62.60

  CONDUIT/   VELOCITY
        1/       1.31          2/       1.29          3/       1.27          4/       1.26
        5/       1.39         50/       1.26         51/       1.26         55/      -1.21
       56/       1.11          6/       1.22          7/       1.21          8/       1.20
        9/       1.18         10/       1.16

  CONDUIT/ CROSS SECTIONAL AREA
        1/      47.85          2/      48.47          3/      49.12          4/      49.77
        5/      44.61         50/      50.00         51/      50.00         55/      50.00
       56/      59.73          6/      51.03          7/      51.69          8/      52.43
        9/      53.15         10/      53.90

  CONDUIT/  FINAL VOLUME
        1/    4785.28          2/    4847.46          3/    4912.26          4/    4977.36
        5/     669.11         50/    1150.00         51/    2000.00         55/    1150.00
```

56/	895.95	6/	5102.61	7/	5169.46	8/	5243.20
9/	5314.87	10/	5389.59				

CONDUIT/ HYDRAULIC RADIUS

1/	1.94	2/	1.95	3/	1.97	4/	1.98
5/	2.13	50/	0.93	51/	0.93	55/	0.93
56/	2.30	6/	2.01	7/	2.02	8/	2.04
9/	2.06	10/	2.07				

CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION

1/	178.93/	178.92	2/	178.92/	178.90	3/	178.90/	178.89
4/	178.89/	178.88	5/	178.88/	178.88	50/	178.88/	178.87
51/	178.87/	178.86	55/	178.85/	178.86	56/	178.85/	178.86
6/	178.86/	178.84	7/	178.84/	178.83	8/	178.83/	178.82
9/	178.82/	178.81	10/	178.81/	178.80			

```
##################################################
#           Surcharge Iteration Summary          #
##################################################

Maximum number of iterations in a time step.....       31
Total number of iterations in the simulation..       4109
Average number of iterations per time step......     2.85
Surcharge iterations during the simulation......     1229
Maximum surcharge flow error during simulation.. 6.92E+01 cms
Total number of time steps during simulation..       1440
```

1

```
+++++++++++++++++++++++++++++++++++++++++++++++++
+         CONDUIT COURANT CONDITION SUMMARY       +
+ TIME IN MINUTES DELT > COURANT TIME STEP        +
+++++++++++++++++++++++++++++++++++++++++++++++++
+ SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. +
+++++++++++++++++++++++++++++++++++++++++++++++++
```

CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)
1	0.00	2	0.00	3	0.00	4	0.00
5	118.58	50	118.25	51	117.75	55	117.92
56	118.08	6	0.00	7	0.00	8	0.00
9	0.00	10	0.00				

1

```
 ***********************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ***********************************************
 * COURANT    =            CONDUIT LENGTH       *
 * TIME STEP = ------------------------------- *
 *             VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ***********************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ***********************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	17.24	2	17.25	3	17.95	4	21.36
5	2.74	50	2.16	51	3.16	55	1.82
56	2.35	6	17.12	7	17.09	8	17.09
9	17.11	10	17.02				

1

```
 ************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ************************************************

 ***********************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ***********************************************
```

JUNCTION	INFLOW, CU M
1	4.5072E+05

JUNCTION	OUTFLOW, CU M
1	9.2710E+02
3	2.9048E+02
4	5.0193E+01
5	4.3016E+02
50	7.5294E+02
56	7.3184E+01
6	7.2493E+03
7	4.5054E+02
8	1.6235E+03
9	1.2573E+03
10	3.8129E+02
11	3.8971E+05

```
 ********************************************************
 * INITIAL SYSTEM VOLUME         =     1.0160E-02 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME    =     4.5072E+05 CU M  *
 * INFLOW + INITIAL VOLUME       =     4.5072E+05 CU M  *
 ********************************************************
 * TOTAL SYSTEM OUTFLOW          =     4.0319E+05 CU M  *
 * VOLUME LEFT IN SYSTEM         =     5.1608E+04 CU M  *
 * OUTFLOW + FINAL VOLUME        =     4.5480E+05 CU M  *
 ********************************************************
 * ERROR IN CONTINUITY, PERCENT =          -0.91        *
 ********************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM       =     9.8749E+04 CU. FT.
 ERROR IN CONTINUITY PERCENT =        -113.64
```

- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	91	0.13
2	74	0.10	91	0.13
3	74	0.10	92	0.13
4	74	0.10	92	0.13
6	24	0.03	82	0.11
7	20	0.03	25	0.03
8	17	0.02	57	0.08
9	15	0.02	63	0.09
10	15	0.02	63	0.09

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

```
 ************************************************************
 *   J U N C T I O N   S U M M A R Y   S T A T I S T I C S  *
 ************************************************************
```

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	TIME OF OCCURENCE MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	182.00	180.71	178.98	0.3684	182.00	0	5	1.29	0.00	0.8	0.3	4.880E+04
2	182.00	180.67	178.95	0.2199	181.93	0	7	1.26	0.07	0.3	0.0	9.721E+04
3	182.00	180.63	178.92	0.2144	182.00	0	7	1.37	0.00	0.3	0.1	9.732E+04
4	182.00	180.59	178.90	0.2467	182.00	0	6	1.41	0.00	0.2	0.1	9.882E+04
5	182.00	180.55	178.88	0.3865	182.00	0	6	1.45	0.00	0.3	0.1	5.312E+04
50	182.00	179.90	178.87	0.6565	182.00	0	2	2.10	0.00	2.8	0.1	1.240E+04
51	182.00	166.31	178.66	1.6342	181.41	0	2	15.11	0.59	117.9	0.0	2.441E+04
55	182.00	166.30	178.65	2.0175	180.96	0	6	14.65	1.04	117.9	0.0	2.441E+04
56	182.00	179.87	178.85	0.6963	182.00	0	2	2.13	0.00	2.4	0.1	1.356E+04
6	182.00	180.50	178.86	0.4825	182.00	0	2	1.50	0.00	0.6	0.3	5.323E+04
7	182.00	180.46	178.84	0.3419	182.00	0	2	1.54	0.00	0.2	0.1	4.803E+04
8	182.00	180.42	178.83	0.3371	182.00	0	1	1.58	0.00	0.2	0.2	1.597E+04
9	182.00	180.38	178.82	0.3148	182.00	0	1	1.62	0.00	0.5	0.1	4.363E+04
10	182.00	180.34	178.81	0.3738	182.00	0	1	1.66	0.00	0.2	0.2	9.404E+04
11	182.00	180.30	178.81	0.0957	180.30	0	1	0.00	1.70	0.3	0.0	4.259E+04

1

****
* CONDUIT SUMMARY STATISTICS *
****

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	2.60E+02	2.69	4.640	1.67E+02	0	0	4.06	0	0	0.64	5.93	5.88	0.8	0.00040
2	2.60E+02	2.69	4.640	1.42E+02	0	5	4.15	0	1	0.55	5.88	6.01	0.5	0.00040
3	2.60E+02	2.69	4.640	1.46E+02	0	9	3.94	0	1	0.56	6.01	6.05	0.4	0.00040
4	2.60E+02	2.69	4.640	1.56E+02	0	8	3.72	0	1	0.60	6.05	6.09	0.3	0.00040
5	1.62E+02	2.69	4.000	2.00E+02	0	7	6.76	0	2	1.24	6.09	6.10	0.1	0.00067

50	2.59E+03	51.89	2.000	7.04E+02	0	2	8.03	0	1	0.27	6.10	17.09	0.6	0.50413
51	1.83E+01	0.37	2.000	-2.30E+02	0	2	-4.60	0	2	-12.55	17.09	16.65	0.1	0.00003
55	2.59E+03	51.82	2.000	6.77E+02	0	2	6.23	0	2	0.26	6.12	16.65	0.5	0.50283
56	2.23E+02	2.79	4.000	-6.89E+02	0	2	-8.61	0	2	-3.09	6.12	6.14	0.1	0.00067
6	2.60E+02	2.69	4.640	-6.33E+02	0	2	-7.33	0	2	-2.43	6.14	6.10	0.0	0.00040
7	2.60E+02	2.69	4.640	-7.32E+02	0	1	-8.48	0	2	-2.81	6.10	6.22	0.1	0.00040
8	2.60E+02	2.69	4.640	-7.07E+02	0	1	-7.30	0	1	-2.72	6.22	5.85	0.2	0.00040
9	2.60E+02	2.69	4.640	-7.86E+02	0	1	-8.37	0	1	-3.02	5.85	6.30	0.2	0.00040
10	2.60E+02	2.69	4.640	-7.57E+02	0	1	-7.86	0	1	-2.91	6.30	4.64	0.3	0.00040
90015	UNDEF	UNDEF	UNDEF	-7.57E+02	0	1								

1

```
**************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
**************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	62.60	0.3486	4.5074E+05	2.8606	96.9110
2	0.08	119.92	0.00	0.00	61.93	0.3652	4.4592E+05	2.8606	96.9110
3	0.08	119.92	0.00	0.00	61.20	0.3023	4.4067E+05	2.8205	94.3929
4	0.25	119.75	0.00	0.00	60.47	0.4788	4.3537E+05	2.8606	96.9110
5	0.58	119.42	0.00	0.00	59.97	1.8271	4.3180E+05	2.4111	60.0000
50	1.08	118.92	0.00	0.00	60.08	0.1324	4.3261E+05	1.0787	50.0000
51	1.25	118.75	0.00	0.00	59.40	10.9593	4.2765E+05	0.9660	50.0000
55	1.67	118.33	0.00	0.00	-58.79	0.1639	-4.2326E+05	1.4793	50.0000
56	1.58	118.42	0.00	0.00	58.78	3.8133	4.2321E+05	2.6418	80.0000
6	1.33	118.67	0.00	0.00	57.56	0.9117	4.1440E+05	2.7102	87.6460
7	1.00	119.00	0.00	0.00	56.62	0.7945	4.0769E+05	2.6881	86.3271
8	0.58	119.42	0.00	0.00	55.67	0.7054	4.0084E+05	2.8606	96.9110
9	0.17	119.83	0.00	0.00	55.10	0.7921	3.9673E+05	2.8136	93.9603
10	0.00	120.00	0.00	0.00	54.13	0.6719	3.8971E+05	2.8606	96.9110
90015	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	54.13		3.8971E+05		

```
**********************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:  *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull   *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull   *
**********************************************************
```

```
 The Conduit with the largest average change...          51 had     10.959 percent
The Junction with the largest average change...          55 had      2.018 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

**************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
**************************************************
* Starting Date... November   17, 2006               *
*          Time...          9:34: 9.480              *
*   Ending Date... November   17, 2006               *
*          Time...          9:34:15.420              *
*  Elapsed Time...               0.099 minutes.      *
*  Elapsed Time...               5.941 seconds.      *
**************************************************
```

Appendix A.2.4.2

Lennon Drain

1

```
**************************************************
*    U.S. Environmental Protection Agency        *
*    Storm Water Management Model  (SWMM)        *
*                Version 4.4GU                   *
*                                                *
*                 CDM/OSU Beta                   *
*       Release Date - November 23, 1999         *
* Camp Dresser & McKee and Oregon State Univ.    *
*          Chuck Moore and Wayne Huber           *
*  Compiled using Digital Visual Fortran 6.0     *
**************************************************

                 Developed by

**************************************************
*             Metcalf & Eddy, Inc.               *
*            University of Florida               *
*       Water Resources Engineers, Inc.          *
*     (Now Camp, Dresser and McKee, Inc.)        *
*              September 1970                    *
**************************************************

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*      U.S. Environmental Protection Agency      *
* Center for Exposure Assessment Modeling (CEAM)*
*    Athens Environmental Research Laboratory    *
*            960 College Station Road            *
*            Athens, GA    30605-2720            *
**************************************************

**************************************************
*     This is a new release of SWMM.  If any     *
*     problems occur executing this model        *
*     system, contact Mr. Frank Stancil,         *
*     U.S. Environmental Protection Agency.      *
*     706/355-8328 (voice)                       *
*     e-mail: stancil@athens.ath.epa.gov         *
*     Or contact Wayne C. Huber at Oregon St. U.*
*     541/737-6150 or wayne.huber@orst.edu       *
*     Or Michael F. Schmidt at Camp Dresser &    *
*     McKee (904) 281-0170 SCHMIDTMF@CDM.COM     *
**************************************************
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          ***********************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ***********************************************


##########################################
#         File names by SWMM Block       #
#          JIN  -> Input to a Block      #
#         JOUT  -> Output from a Block   #
##########################################

   JIN for Block #      1 File #    0  JIN.UF
  JOUT for Block #      1 File #    9  PCTmp1.int

##########################################
# Scratch file names for this simulation. #
##########################################

NSCRAT #      1 File #   21  SCRT1.UF
NSCRAT #      2 File #   22  SCRT2.UF
NSCRAT #      3 File #   23  SCRT3.UF
NSCRAT #      4 File #   24  SCRT4.UF
NSCRAT #      5 File #   25  SCRT5.UF
NSCRAT #      6 File #   26  SCRT6.UF
NSCRAT #      7 File #   27  SCRT7.UF
NSCRAT #      8 File #   28  SCRT8.UF

***************************************************
*    Parameter Values on the Tapes Common Block   *
***************************************************

 Number of Subcatchments in the Runoff Block (NW)..... 1000
 Number of Channel/Pipes in the Runoff Block (NG)..... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
  Number of Transport printed output locations (NTOA)...   80
  Number of Tabular Flow Splitters in Transport (NTSP)..   50
  Number of Elements in the Extran Block (NEE)..... 4000
  Number of Pumps in Extran (NEP).....   75
  Number of Orifices in Extran (NEO).....  200
  Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
  Number of Extran Weirs (NEW).....  400
  Number of Extran Printout Locations (NPO).....  150
  Number of Tide Elements in Extran (NTE).....   50
  Number of Natural Channels (NNC)..... 1200
  Number of Storage Junctions in Extran (NVSE)..... 1000
  Number of Time History Data Points in Extran (NTVAL)..  500
  Number of Data Points for Variable Storage Elements
    in the Extran Block (NVST).....   25
  Number of Input Hydrographs in Extran (NEH).....  500
  Number of Allowable Channel Connections to
    Junctions in the Extran Block (NCHN).....   15
  Number Rain Gages in Rain and Runoff (MAXRG).....  200
  Number PRATE/VRATE Points for Extran Pump
    Input (MAXPRA).....   10
  Number of Variable Orifices in Extran (NVORF).....   50
  Number of Variable Orifice Data Points (NVOTIM).....   50
  Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
  Number of Storm Events for Rain Analysis (LSTORM).....20000
  Number of Plugs for Plug-flow in S/T (NPLUG)..... 3000
  Number Conduits for Extran Results to ASCII
    File (MXFLOW).....  400


 ********************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
 * developed 1973 by Camp, Dresser and McKee (CDM) with  *
 * modifications 1977-1991 by the University of Florida. *
 *                                                       *
 * Most recent update: March 1999 by CDM, Oregon         *
 * State University, and XP Software, Inc.               *
 *                                                       *
 * "Smooth runs the water where the brook is deep."      *
 *                   Shakespeare, Henry VI, II, III, 1   *
 ********************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Lennon Drain Existing Condition - 100-Year Flow

Control information for simulation

Integration cycles..... 4000

Length of integration step is..... 15.00 seconds
Simulation length..... 16.67 hours

Do not create equiv. pipes(NEQUAL). 0

Use metric units for I/O..... 1

Printing starts in cycle..... 1

Intermediate printout intervals of. 1 cycles
Intermediate printout intervals of. 0.25 minutes

Summary printout intervals of..... 1 cycles
Summary printout time interval of.. 0.25 minutes

Hot start file parameter (JREDO)... 0

Initial time (TZERO)..... 0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)..... 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX..... 30
SURTOL..... 0.0500

Default surface area of junctions.. 1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.

```
 NORMAL FLOW OPTION WHEN THE WATER
 SURFACE SLOPE IS LESS THAN THE
 GROUND SURFACE SLOPE (KSUPER=0)....

 NJSW INPUT HYDROGRAPH JUNCTIONS....     0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
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 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Existing Condition - 100-Year Flow


1
 ****************************************************
 *                    Conduit Data                  *
 ****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	1	2		5.20	8.70
2	2	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	2	3		5.20	8.70
3	3	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	3	4		5.20	8.70
4	4	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	4	5		5.20	8.70
5	5	60.	TRAPEZOID	46.22	0.03500	2.50	2.30	5	6		6.60	8.70

6	6	75. RECTANGLE	3.17	0.01500	2.60	1.22	6	7		
7	7	40. TRAPEZOID	21.80	0.03500	2.30	2.00	7	8	2.90	5.70
8	8	75. TRAPEZOID	18.18	0.03500	2.00	1.80	8	9	4.30	4.70
9	9	75. TRAPEZOID	18.18	0.03500	2.00	1.80	9	10	4.30	4.70
10	10	75. TRAPEZOID	18.18	0.03500	2.00	1.80	10	11	4.30	4.70

===> WARNING !!! (C*DELT/LEN) IN CONDUIT 7 IS 1.2 AT FULL DEPTH.

```
********************
*  Conduit Volume  *
********************
```

Input full depth volume..... 2.8121E+05 cubic meters

1---

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WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Lennon Drain Existing Condition - 100-Year Flow

1

```
*****************************************************
*                  Junction Data                    *
*****************************************************
```

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	QINST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS	
1	1	183.00	182.61	180.41	11.80	0.00	1	
2	2	183.00	182.47	180.27	0.00	0.00	1	2
3	3	183.00	182.33	180.13	0.00	0.00	2	3
4	4	183.00	182.13	179.93	0.00	0.00	3	4
5	5	183.00	182.03	179.73	0.00	0.00	4	5
6	6	183.00	181.91	179.61	0.00	0.00	5	6
7	7	183.00	181.46	179.46	0.00	0.00	6	7
8	8	183.00	181.38	179.38	0.00	0.00	7	8
9	9	183.00	181.03	179.23	0.00	0.00	8	9
10	10	183.00	180.88	179.08	0.00	0.00	9	10
11	11	183.00	180.73	178.93	0.00	0.00	10	

```
 ************************************************
 *          FREE OUTFALL DATA (DATA GROUP I1)     *
 *         BOUNDARY CONDITION ON DATA GROUP J1    *
 ************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...        1

1--------------------------------------------------------------------------------
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 WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Existing Condition - 100-Year Flow



 ************************************************
 *        INTERNAL CONNECTIVITY INFORMATION     *
 ************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90011           11           0
1
 ****************************************************
 *        BOUNDARY CONDITON INFORMATION             *
 *                 DATA GROUPS J1-J4                *
 ****************************************************



 BC NUMBER..          1 HAS NO CONTROL WATER SURFACE.
  TZERO =      1906195  0.0000000E+00

 ***********************************
 *    INITIAL MODEL CONDITION      *
 * INITIAL TIME =      0.00 HOURS  *
 ***********************************

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   0.00 /   180.41         2/   0.00 /   180.27         3/   0.00 /   180.13
         4/   0.00 /   179.93         5/   0.00 /   179.73         6/   0.00 /   179.61
         7/   0.00 /   179.46         8/   0.00 /   179.38         9/   0.00 /   179.23
        10/   0.00 /   179.08        11/   0.00 /   178.93
```

```
  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00      90011/       0.00

  CONDUIT/   VELOCITY
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00          6/       0.00          7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   180.41/   180.27          2/   180.27/   180.13          3/   180.13/   179.93
        4/   179.93/   179.73          5/   179.73/   179.61          6/   179.61/   179.46
        7/   179.46/   179.38          8/   179.38/   179.23          9/   179.23/   179.08
       10/   179.08/   178.93


*********************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =     16.67 HOURS *
*********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY: 16.667 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   1.11 /   181.52          2/   1.25 /   181.52          3/   1.39 /   181.52
        4/   1.59 /   181.52          5/   1.79 /   181.52          6/   1.90 /   181.51
        7/   1.34 /   180.80          8/   1.33 /   180.71          9/   1.32 /   180.55
       10/   1.30 /   180.38         11/   0.86 /   179.79

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
```

1/	11.77	2/	11.69	3/	11.61	4/	11.54
5/	11.48	6/	11.48	7/	11.48	8/	11.48
9/	11.48	10/	11.48	90011/	11.48		

CONDUIT/ VELOCITY

1/	0.03	2/	0.02	3/	0.02	4/	0.02
5/	0.37	6/	3.62	7/	1.07	8/	1.08
9/	1.11	10/	1.55				

CONDUIT/ CROSS SECTIONAL AREA

1/	422.16	2/	473.58	3/	536.38	4/	610.78
5/	30.62	6/	3.17	7/	10.73	8/	10.60
9/	10.35	10/	7.42				

CONDUIT/ FINAL VOLUME

1/	29551.41	2/	33150.29	3/	53638.02	4/	61078.38
5/	1837.36	6/	237.90	7/	429.35	8/	795.01
9/	775.93	10/	556.28				

CONDUIT/ HYDRAULIC RADIUS

1/	1.15	2/	1.29	3/	1.45	4/	1.63
5/	0.99	6/	0.42	7/	0.76	8/	0.74
9/	0.73	10/	0.62				

CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION

1/	181.52/	181.52	2/	181.52/	181.52	3/	181.52/	181.52
4/	181.52/	181.52	5/	181.52/	181.51	6/	181.51/	180.80
7/	180.80/	180.71	8/	180.71/	180.55	9/	180.55/	180.38
10/	180.38/	179.79						

```
####################################################
#           Surcharge Iteration Summary            #
####################################################

Maximum number of iterations in a time step.....       2
Total number of iterations in the simulation..      8001
Average number of iterations per time step......    2.00
Surcharge iterations during the simulation......       1
Maximum surcharge flow error during simulation.. 0.00E+00 cms
Total number of time steps during simulation..      4000
```

```
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 * TIME IN MINUTES DELT > COURANT TIME STEP     *
 ************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ************************************************
```

CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)
1	0.25	2	0.50	3	0.00	4	0.00
5	0.00	6	991.25	7	996.00	8	0.00
9	0.00	10	0.00				

1

```
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT    =            CONDUIT LENGTH       *
 * TIME STEP = ---------------------------------- *
 *             VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	23.95	2	22.19	3	29.36	4	27.23
5	18.18	6	11.29	7	11.02	8	22.31
9	20.58	10	20.94				

1

```
 ************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************
```

JUNCTION	INFLOW, CU M
1	7.0800E+05

JUNCTION	OUTFLOW, CU M

```
          11     5.8673E+05

 ******************************************************
 * INITIAL SYSTEM VOLUME         =     7.4000E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME    =     7.0800E+05 CU M  *
 * INFLOW + INITIAL VOLUME       =     7.0800E+05 CU M  *
 ******************************************************
 * TOTAL SYSTEM OUTFLOW          =     5.8673E+05 CU M  *
 * VOLUME LEFT IN SYSTEM         =     1.8209E+05 CU M  *
 * OUTFLOW + FINAL VOLUME        =     7.6882E+05 CU M  *
 ******************************************************
 * ERROR IN CONTINUITY, PERCENT =          -8.59       *
 ******************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM       =     1.1790E+05 CU. FT.
 ERROR IN CONTINUITY PERCENT =          4.76


- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS - - - - - - - - - - - - - - - - - - - - -

   OPEN CHANNEL   TIME STEP OF FIRST   TIME OF FIRST   TIME STEP OF LAST   TIME OF LAST
      NUMBER          OCCURRENCE       OCCURRENCE        OCCURRENCE       OCCURRENCE
                                         (HOURS)                            (HOURS)
   ------------   ------------------   -------------   -----------------   ------------
         1                1              0.00               1              0.00

   THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR
   PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH.  THIS WILL AFFECT THE MAXIMUM
   COMPUTED HEAD AND FLOWS IN THE MODEL.  IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED
   TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1
 ************************************************************
 *   J U N C T I O N   S U M M A R Y   S T A T I S T I C S  *
 ************************************************************


          Detroit River International Crossing
          Lennon Drain Existing Condition - 100-Year Flow

                      UPPERMOST     MEAN              MAXIMUM      TIME    METERS OF    METERS MAX.      LENGTH     LENGTH      MAXIMUM
               GROUND  PIPE CROWN  JUNCTION  JUNCTION JUNCTION      OF     SURCHARGE     DEPTH IS          OF         OF       JUNCTION
   JUNCTION ELEVATION  ELEVATION ELEVATION   AVERAGE   ELEV.    OCCURENCE   AT MAX     BELOW GROUND    SURCHARGE  FLOODING      AREA
```

NUMBER	(M)	(M)	(M)	% CHANGE	(M)	HR.	MIN.	ELEVATION	ELEVATION	(MIN)	(MIN)	(SQ.MET)
1	183.00	182.61	181.27	0.0685	182.52	0	0	0.00	0.48	0.0	0.0	2.607E+04
2	183.00	182.47	181.27	0.0591	181.71	0	0	0.00	1.29	0.0	0.0	2.607E+04
3	183.00	182.33	181.27	0.0487	181.62	0	1	0.00	1.38	0.0	0.0	3.141E+04
4	183.00	182.13	181.26	0.0315	181.52	16	40	0.00	1.48	0.0	0.0	3.721E+04
5	183.00	182.03	181.26	0.0361	181.52	16	40	0.00	1.48	0.0	0.0	1.962E+04
6	183.00	181.91	181.25	0.0486	181.51	16	39	0.00	1.49	0.0	0.0	1.033E+03
7	183.00	181.46	180.70	0.0307	180.80	16	40	0.00	2.20	0.0	0.0	3.744E+02
8	183.00	181.38	180.62	0.0245	180.71	16	40	0.00	2.29	0.0	0.0	8.012E+02
9	183.00	181.03	180.46	0.0227	180.55	16	40	0.00	2.45	0.0	0.0	1.043E+03
10	183.00	180.88	180.29	0.0193	180.38	16	40	0.00	2.62	0.0	0.0	9.927E+02
11	183.00	180.73	179.72	0.0133	179.79	16	40	0.00	3.21	0.0	0.0	8.074E+02

1

```
**********************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
**********************************************************
```

Detroit River International Crossing
Lennon Drain Existing Condition - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS DOWNSTREAM (M)	LENGTH CONDUIT OF NORM FLOW (MIN)	SLOPE (M/M)
1	1.69E+03	2.10	2.200	1.79E+03	0	0	2.85	0	0	1.06	2.11	2.02	0.3	0.00200
2	1.69E+03	2.10	2.200	1.75E+03	0	0	5.45	0	1	1.04	2.02	1.39	0.3	0.00200
3	1.69E+03	2.10	2.200	5.39E+02	0	1	1.79	0	1	0.32	1.39	1.59	0.3	0.00200
4	1.69E+03	2.10	2.200	2.21E+02	0	2	1.16	0	2	0.13	1.59	1.79	0.5	0.00200
5	6.73E+01	1.46	2.300	1.17E+01	0	3	1.41	0	3	0.17	1.79	1.90	1.0	0.00200
6	5.26E+00	1.66	1.220	1.15E+01	16	39	3.62	16	40	2.18	1.90	1.34	1.8	0.00200
7	2.95E+01	1.35	2.000	1.15E+01	16	40	1.91	0	4	0.39	1.34	1.33	7.5	0.00200
8	2.29E+01	1.26	1.800	1.15E+01	16	40	1.21	0	5	0.50	1.33	1.32	2.5	0.00200
9	2.29E+01	1.26	1.800	1.15E+01	16	38	1.26	0	7	0.50	1.32	1.30	1.5	0.00200
10	2.29E+01	1.26	1.800	1.15E+01	16	40	1.55	16	38	0.50	1.30	0.86	0.0	0.00200
90011	UNDEF	UNDEF	UNDEF	1.15E+01	16	40								

1

```
**********************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
```

```
*       MANUAL FOR FURTHER INFORMATION.          *
*************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	1000.00	0.00	0.00	12.23	0.0669	7.3409E+05	1.6751	627.0582
2	0.25	999.75	0.00	0.00	12.06	0.0679	7.2343E+05	1.2850	473.5616
3	0.25	999.75	0.00	0.00	11.35	0.0253	6.8101E+05	1.4461	536.3661
4	0.50	999.50	0.00	0.00	10.39	0.0271	6.2365E+05	1.6343	610.7724
5	0.50	999.50	0.00	0.00	9.84	0.0374	5.9042E+05	0.9892	30.6229
6	1.00	999.00	0.00	0.00	9.82	0.1841	5.8922E+05	0.5952	3.1720
7	1.75	998.25	0.00	0.00	9.81	0.0357	5.8889E+05	0.7601	10.7336
8	2.25	997.75	0.00	0.00	9.80	0.0259	5.8828E+05	0.7439	10.5999
9	3.25	996.75	0.00	0.00	9.79	0.0190	5.8749E+05	0.7348	10.3456
10	3.75	996.25	0.00	0.00	9.78	0.0136	5.8673E+05	0.6199	7.4170
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	9.78		5.8673E+05		

```
*********************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:  *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull   *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull   *
*********************************************************

 The Conduit with the largest average change...        6 had     0.184 percent
The Junction with the largest average change...        1 had     0.068 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

*****************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*****************************************************
* Starting Date... November   17, 2006                *
*          Time...          9:15:35.600               *
*   Ending Date... November   17, 2006                *
*          Time...          9:15:49. 50               *
```

```
*  Elapsed Time...              0.224 minutes.       *
*  Elapsed Time...             13.450 seconds.       *
**********************************************************
```

1

```
**************************************************
*    U.S. Environmental Protection Agency        *
*    Storm Water Management Model  (SWMM)        *
*                Version 4.4GU                   *
*                                                *
*                 CDM/OSU Beta                   *
*       Release Date - November 23, 1999         *
* Camp Dresser & McKee and Oregon State Univ.    *
*          Chuck Moore and Wayne Huber           *
*  Compiled using Digital Visual Fortran 6.0     *
**************************************************

                 Developed by

**************************************************
*             Metcalf & Eddy, Inc.               *
*            University of Florida               *
*       Water Resources Engineers, Inc.          *
*     (Now Camp, Dresser and McKee, Inc.)        *
*              September 1970                    *
**************************************************

          Distributed and Maintained by

**************************************************
*      U.S. Environmental Protection Agency      *
* Center for Exposure Assessment Modeling (CEAM) *
*    Athens Environmental Research Laboratory    *
*            960 College Station Road            *
*            Athens, GA    30605-2720            *
**************************************************

**************************************************
*     This is a new release of SWMM.  If any     *
*     problems occur executing this model        *
*     system, contact Mr. Frank Stancil,         *
*     U.S. Environmental Protection Agency.      *
*     706/355-8328 (voice)                       *
*     e-mail: stancil@athens.ath.epa.gov         *
*     Or contact Wayne C. Huber at Oregon St. U. *
*     541/737-6150 or wayne.huber@orst.edu       *
*     Or Michael F. Schmidt at Camp Dresser &    *
*     McKee (904) 281-0170 SCHMIDTMF@CDM.COM     *
**************************************************
```

```
          ************************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ************************************************


##########################################
#         File names by SWMM Block       #
#          JIN  -> Input to a Block      #
#         JOUT  -> Output from a Block   #
##########################################

   JIN for Block #      1 File #    0  JIN.UF
  JOUT for Block #      1 File #    9  PCTmp1.int

##########################################
# Scratch file names for this simulation. #
##########################################

NSCRAT #      1 File #   21  SCRT1.UF
NSCRAT #      2 File #   22  SCRT2.UF
NSCRAT #      3 File #   23  SCRT3.UF
NSCRAT #      4 File #   24  SCRT4.UF
NSCRAT #      5 File #   25  SCRT5.UF
NSCRAT #      6 File #   26  SCRT6.UF
NSCRAT #      7 File #   27  SCRT7.UF
NSCRAT #      8 File #   28  SCRT8.UF

**************************************************
*    Parameter Values on the Tapes Common Block   *
**************************************************

 Number of Subcatchments in the Runoff Block (NW)...... 1000
 Number of Channel/Pipes in the Runoff Block (NG)...... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...   80
 Number of Tabular Flow Splitters in Transport (NTSP)..   50
 Number of Elements in the Extran Block (NEE)..........  4000
 Number of Pumps in Extran (NEP).......................    75
 Number of Orifices in Extran (NEO)....................   200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....   200
 Number of Extran Weirs (NEW)..........................   400
 Number of Extran Printout Locations (NPO).............   150
 Number of Tide Elements in Extran (NTE)...............    50
 Number of Natural Channels (NNC)......................  1200
 Number of Storage Junctions in Extran (NVSE)..........  1000
 Number of Time History Data Points in Extran (NTVAL)..   500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST)..........................    25
 Number of Input Hydrographs in Extran (NEH)...........   500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN)................    15
 Number Rain Gages in Rain and Runoff (MAXRG)..........   200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA)......................................    10
 Number of Variable Orifices in Extran (NVORF).........    50
 Number of Variable Orifice Data Points (NVOTIM).......    50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG).......... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW)....................................... 400



 ************************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)      *
 * developed 1973 by Camp, Dresser and McKee (CDM) with     *
 * modifications 1977-1991 by the University of Florida.    *
 *                                                          *
 * Most recent update: March 1999 by CDM, Oregon            *
 * State University, and XP Software, Inc.                  *
 *                                                          *
 * "Smooth runs the water where the brook is deep."         *
 *                    Shakespeare, Henry VI, II, III, 1     *
 ************************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                    ****                          ****      CAMP DRESSER & MCKEE INC.
                                    ****        ANALYSIS MODULE   ****      ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles.................   12000

Length of integration step is......    5.00 seconds
Simulation length..................   16.67 hours

Do not create equiv. pipes(NEQUAL).       0

Use metric units for I/O...........       1

Printing starts in cycle...........       1

Intermediate printout intervals of.       1 cycles
Intermediate printout intervals of.    0.08 minutes

Summary printout intervals of......       1 cycles
Summary printout time interval of..    0.08 minutes

Hot start file parameter (JREDO)...       0

Initial time (TZERO)...............    0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ).............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........      30
                     SURTOL........  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
 NORMAL FLOW OPTION WHEN THE WATER
 SURFACE SLOPE IS LESS THAN THE
 GROUND SURFACE SLOPE (KSUPER=0)....

 NJSW INPUT HYDROGRAPH JUNCTIONS....     0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


1
 ****************************************************
 *                    Conduit Data                  *
 ****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	1	2		5.20	8.70
2	2	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	2	3		5.20	8.70
3	3	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	3	4		5.20	8.70
4	4	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	4	5		5.20	8.70
5	5	30.	RECTANGLE	3.12	0.01500	2.60	1.20	5	55			

6	55	35.	RECTANGLE	4.50	0.01500	3.00	1.50	55	6	0.00	0.30
7	6	50.	RECTANGLE	4.50	0.01500	3.00	1.50	6	66		
8	66	35.	RECTANGLE	4.50	0.01500	3.00	1.50	66	7		
9	7	10.	RECTANGLE	4.50	0.01500	3.00	1.50	7	8		
10	8	75.	TRAPEZOID	18.18	0.03500	2.00	1.80	8	9	4.30	4.70
11	9	75.	TRAPEZOID	18.18	0.03500	2.00	1.80	9	10	4.30	4.70
12	10	75.	TRAPEZOID	18.18	0.03500	2.00	1.80	10	11	4.30	4.70

===> WARNING !!! (C*DELT/LEN) IN CONDUIT 7 IS 1.9 AT FULL DEPTH.

****
* Conduit Volume *
****

Input full depth volume..... 2.7801E+05 cubic meters
Conduit #... 6 has zero slope. 0.001 feet added to upstream invert.

===> Warning !! The upstream and downstream junctions for the following conduits
have been reversed to correspond to the positive flow and decreasing
slope EXTRAN convention. A negative flow in the output thus means
the flow was from your original upstream junction to your original
downstream junction. Any initial flow has been multiplied by -1.

1. Conduit #... 66 has been changed.

1---

ENVIRONMENTAL PROTECTION AGENCY **** EXTENDED TRANSPORT PROGRAM **** WATER RESOURCES DIVISION
WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Lennon Drain Alternative 1B,2B Syphon - 100-Year Flow

1

****
* Junction Data *
****

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	QINST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS	
1	1	183.00	182.61	180.41	11.80	0.00	1	
2	2	183.00	182.47	180.27	0.00	0.00	1	2

```
   3         3    183.00    182.33    180.13      0.00      0.00         2        3
   4         4    183.00    182.13    179.93      0.00      0.00         3        4
   5         5    183.00    181.93    179.73      0.00      0.00         4        5
   6        55    183.00    181.17    179.67      0.00      0.00         5       55
   7         6    183.00    170.90    169.10      0.00      0.00        55        6
 ===> Warning all conduits connecting to Junction          6 lie above the Junction invert.
   8        66    183.00    170.60    169.10      0.00      0.00         6       66
   9         7    183.00    180.96    179.46      0.00      0.00        66        7
  10         8    183.00    181.18    179.38      0.00      0.00         7        8
  11         9    183.00    181.03    179.23      0.00      0.00         8        9
  12        10    183.00    180.88    179.08      0.00      0.00         9       10
  13        11    183.00    180.73    178.93      0.00      0.00        10


 ************************************************
 *          FREE OUTFALL DATA (DATA GROUP I1)     *
 *         BOUNDARY CONDITION ON DATA GROUP J1    *
 ************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...        1

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


 ************************************************
 *        INTERNAL CONNECTIVITY INFORMATION     *
 ************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90013           11            0
1
 ************************************************
 *        BOUNDARY CONDITON INFORMATION         *
 *                DATA GROUPS J1-J4             *
 ************************************************
```

```
BC NUMBER..          1 HAS NO CONTROL WATER SURFACE.
 TZERO =       1906195  0.0000000E+00

**********************************
*    INITIAL MODEL CONDITION     *
* INITIAL TIME =      0.00 HOURS *
**********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   0.00 /   180.41         2/   0.00 /   180.27         3/   0.00 /   180.13
        4/   0.00 /   179.93         5/   0.00 /   179.73        55/   0.00 /   179.67
        6/   0.00 /   169.10        66/   0.00 /   169.10         7/   0.00 /   179.46
        8/   0.00 /   179.38         9/   0.00 /   179.23        10/   0.00 /   179.08
       11/   0.00 /   178.93

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         55/       0.00          6/       0.00         66/       0.00
        7/       0.00          8/       0.00          9/       0.00         10/       0.00
    90013/       0.00

  CONDUIT/   VELOCITY
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         55/       0.00          6/       0.00         66/       0.00
        7/       0.00          8/       0.00          9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         55/       0.00          6/       0.00         66/       0.00
        7/       0.00          8/       0.00          9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/       0.00          2/       0.00          3/       0.00          4/       0.00
        5/       0.00         55/       0.00          6/       0.00         66/       0.00
        7/       0.00          8/       0.00          9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   180.41/   180.27         2/   180.27/   180.13         3/   180.13/   179.93
        4/   179.93/   179.73         5/   179.73/   179.67        55/   179.67/   169.40
        6/   169.10/   169.10        66/   179.46/   169.10         7/   179.46/   179.38
        8/   179.38/   179.23         9/   179.23/   179.08        10/   179.08/   178.93


**********************************
```

```
*     FINAL MODEL CONDITION     *
*  FINAL TIME =     16.67 HOURS *
**********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY: 16.667 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   1.14 /   181.55         2/   1.28 /   181.55         3/   1.42 /   181.55
        4/   1.62 /   181.55         5/   1.82 /   181.55        55/   1.60*/   181.27
        6/  12.05*/   181.15        66/  11.87*/   180.97         7/   0.91 /   180.37
        8/   1.32 /   180.70         9/   1.31 /   180.54        10/   1.28 /   180.36
       11/   0.85 /   179.78

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/      11.72          2/      11.55          3/      11.45          4/      11.23
        5/      11.16         55/      11.16          6/      11.16         66/     -11.16
        7/      11.16*         8/      11.16          9/      11.16         10/      11.16
    90013/      11.16

  CONDUIT/   VELOCITY
        1/       0.03          2/       0.02          3/       0.02          4/       0.02
        5/       3.58         55/       2.48          6/       2.48         66/      -3.09
        7/       3.34          8/       1.07          9/       1.10         10/       1.54

  CONDUIT/ CROSS SECTIONAL AREA
        1/     435.22          2/     486.71          3/     549.59          4/     624.10
        5/       3.12         55/       4.50          6/       4.50         66/       3.62
        7/       3.35          8/      10.39          9/      10.15         10/       7.26

  CONDUIT/  FINAL VOLUME
        1/   30465.41          2/   34069.54          3/   54958.80          4/   62409.62
        5/      93.60         55/     157.50          6/     225.00         66/     126.59
        7/      33.45          8/     779.13          9/     761.00         10/     544.85

  CONDUIT/ HYDRAULIC RADIUS
        1/       1.19          2/       1.32          3/       1.48          4/       1.67
        5/       0.41         55/       0.50          6/       0.50         66/       0.67
        7/       0.64          8/       0.74          9/       0.73         10/       0.61

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   181.55/   181.55         2/   181.55/   181.55         3/   181.55/   181.55
        4/   181.55/   181.55         5/   181.55/   181.27        55/   181.27/   181.15
```

```
        6/   181.15/   180.97        66/   180.37/   180.97         7/   180.37/   180.70
        8/   180.70/   180.54         9/   180.54/   180.36        10/   180.36/   179.78
```

```
 ##################################################
 #           Surcharge Iteration Summary          #
 ##################################################

 Maximum number of iterations in a time step.....       31
 Total number of iterations in the simulation..      26677
 Average number of iterations per time step......     2.22
 Surcharge iterations during the simulation......     2677
 Maximum surcharge flow error during simulation.. 1.52E+00 cms
 Total number of time steps during simulation..      12000
```

```
1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 * TIME IN MINUTES DELT > COURANT TIME STEP     *
 ************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ************************************************
```

CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)
1	0.00	2	0.00	3	0.00	4	0.00
5	832.67	55	990.67	6	990.00	66	989.92
7	989.58	8	0.00	9	0.00	10	0.00

```
1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT    =            CONDUIT LENGTH       *
 * TIME STEP = ------------------------------- *
 *             VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	24.99	2	23.01	3	30.32	4	28.57

5	4.82	55	2.82	6	4.72	66	2.69
7	1.69	8	20.78	9	21.25	10	20.95

1

```
 ************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ************************************************

 ********************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ********************************************
```

JUNCTION	INFLOW, CU M
1	7.0800E+05

JUNCTION	OUTFLOW, CU M
11	5.5374E+05

```
 ******************************************************
 * INITIAL SYSTEM VOLUME         =     7.2500E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME    =     7.0800E+05 CU M  *
 * INFLOW + INITIAL VOLUME       =     7.0800E+05 CU M  *
 ******************************************************
 * TOTAL SYSTEM OUTFLOW          =     5.5374E+05 CU M  *
 * VOLUME LEFT IN SYSTEM         =     1.8466E+05 CU M  *
 * OUTFLOW + FINAL VOLUME        =     7.3840E+05 CU M  *
 ******************************************************
 * ERROR IN CONTINUITY, PERCENT =          -4.29       *
 ******************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM        =     1.5432E+05 CU. FT.
 ERROR IN CONTINUITY PERCENT =          -0.08


- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS - - - - - - - - - - - - - - - - - - - - -
```

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	1	0.00

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

****
* J U N C T I O N S U M M A R Y S T A T I S T I C S *
****

Detroit River International Crossing
Lennon Drain Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	TIME OF OCCURENCE MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	183.00	182.61	181.24	0.0231	182.52	0	0	0.00	0.48	0.0	0.0	2.607E+04
2	183.00	182.47	181.24	0.0114	181.55	16	40	0.00	1.45	0.0	0.0	2.575E+04
3	183.00	182.33	181.24	0.0093	181.55	16	40	0.00	1.45	0.0	0.0	3.145E+04
4	183.00	182.13	181.23	0.0122	181.55	16	40	0.00	1.45	0.0	0.0	3.726E+04
5	183.00	181.93	181.23	0.0176	181.55	16	40	0.00	1.45	0.0	0.0	1.877E+04
55	183.00	181.17	180.94	1.4442	181.28	15	1	0.11	1.72	341.2	0.0	1.668E+03
6	183.00	170.90	180.81	1.1602	181.17	15	1	10.27	1.83	990.3	0.0	3.954E+03
66	183.00	170.60	180.68	0.9829	181.02	15	0	10.42	1.98	990.7	0.0	5.581E+03
7	183.00	180.96	180.47	0.6701	180.61	4	40	0.00	2.39	0.0	0.0	3.256E+03
8	183.00	181.18	180.58	0.2041	180.71	15	0	0.00	2.29	0.0	0.0	5.390E+02
9	183.00	181.03	180.42	0.0629	180.54	15	1	0.00	2.46	0.0	0.0	1.037E+03
10	183.00	180.88	180.25	0.0223	180.37	15	1	0.00	2.63	0.0	0.0	9.870E+02
11	183.00	180.73	179.69	0.0197	179.79	15	1	0.00	3.21	0.0	0.0	8.023E+02

1

****
* C O N D U I T S U M M A R Y S T A T I S T I C S *
****

Detroit River International Crossing
Lennon Drain Alternative 1B,2B Syphon - 100-Year Flow

	CONDUIT	MAXIMUM	TIME	MAXIMUM	TIME	RATIO OF	MAXIMUM DEPTH ABOVE	LENGTH CONDUIT

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	VERTICAL DEPTH (M)	COMPUTED FLOW (CMS)	OF OCCURRENCE HR.	OF OCCURRENCE MIN.	COMPUTED VELOCITY (MPS)	OF OCCURRENCE HR.	OF OCCURRENCE MIN.	MAX. TO DESIGN FLOW	INV. AT CONDUIT ENDS UPSTREAM (M)	INV. AT CONDUIT ENDS DOWNSTREAM (M)	OF NORM FLOW (MIN)	SLOPE (M/M)
1	1.69E+03	2.10	2.200	7.32E+02	0	0	2.04	0	0	0.43	2.11	1.28	28.7	0.00200
2	1.69E+03	2.10	2.200	2.50E+02	0	0	1.47	0	0	0.15	1.28	1.42	4.4	0.00200
3	1.69E+03	2.10	2.200	9.72E+01	0	2	0.88	0	2	0.06	1.42	1.62	2.8	0.00200
4	1.69E+03	2.10	2.200	7.55E+01	0	4	0.68	0	4	0.04	1.62	1.82	0.7	0.00200
5	5.14E+00	1.65	1.200	1.23E+01	4	28	3.94	4	28	2.39	1.82	1.61	17.0	0.00200
55	1.02E+02	22.75	1.500	1.13E+01	14	56	7.84	0	2	0.11	1.61	11.77	9.4	0.29343
6	8.48E-01	0.19	1.500	1.13E+01	14	56	2.50	14	56	13.28	12.07	11.93	0.6	0.00002
66	1.03E+02	22.85	1.500	-1.13E+01	14	56	-3.09	15	1	-0.11	1.15	11.93	0.0	0.29600
7	1.69E+01	3.76	1.500	1.17E+01	15	0	3.43	15	0	0.69	1.15	1.33	108.4	0.00800
8	2.29E+01	1.26	1.800	1.14E+01	15	0	1.09	0	12	0.50	1.33	1.31	17.2	0.00200
9	2.29E+01	1.26	1.800	1.13E+01	15	1	1.11	15	1	0.49	1.31	1.29	8.5	0.00200
10	2.29E+01	1.26	1.800	1.13E+01	15	1	1.54	15	1	0.49	1.29	0.86	0.0	0.00200
90013	UNDEF	UNDEF	UNDEF	1.13E+01	15	1								

1

```
**************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
**************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	1000.00	0.00	0.00	12.03	0.0125	7.2191E+05	1.1857	435.2089
2	0.08	999.92	0.00	0.00	11.53	0.0059	6.9179E+05	1.3189	486.6992
3	0.08	999.92	0.00	0.00	10.80	0.0084	6.4818E+05	1.4797	549.5795
4	0.25	999.75	0.00	0.00	9.82	0.0168	5.8950E+05	1.6677	624.0876
5	0.83	999.17	0.00	0.00	9.27	3.2861	5.5639E+05	0.5899	3.1200
55	1.67	993.92	0.00	4.42	9.27	0.0759	5.5624E+05	0.7104	4.5000
6	1.83	998.17	0.00	0.00	9.26	9.0791	5.5584E+05	0.7045	4.5000
66	9.92	990.08	0.00	0.00	-9.26	0.0750	-5.5581E+05	0.7033	3.9726
7	10.00	990.00	0.00	0.00	9.26	0.8226	5.5565E+05	0.6718	3.6499
8	10.08	989.92	0.00	0.00	9.26	0.2413	5.5531E+05	0.7406	10.5079
9	10.17	989.83	0.00	0.00	9.24	0.0746	5.5448E+05	0.7306	10.2297
10	10.75	989.25	0.00	0.00	9.23	0.0247	5.5373E+05	0.6160	7.3254
90013	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	9.23		5.5373E+05		

```
************************************************************
```

```
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:    *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull     *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull     *
************************************************************

 The Conduit with the largest average change...          6 had     9.079 percent
The Junction with the largest average change...         55 had     1.444 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

*********************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary    *
*********************************************************
* Starting Date... November   17, 2006                  *
*          Time...           9:35:20.890                *
*   Ending Date... November   17, 2006                  *
*          Time...           9:36: 1.700                *
*  Elapsed Time...                0.680 minutes.        *
*  Elapsed Time...               40.809 seconds.        *
*********************************************************
```

Appendix A.2.4.3

Cahill Drain

1

```
**************************************************
*    U.S. Environmental Protection Agency        *
*    Storm Water Management Model  (SWMM)        *
*                Version 4.4GU                   *
*                                                *
*                 CDM/OSU Beta                   *
*       Release Date - November 23, 1999         *
* Camp Dresser & McKee and Oregon State Univ.    *
*          Chuck Moore and Wayne Huber           *
*  Compiled using Digital Visual Fortran 6.0     *
**************************************************

                 Developed by

**************************************************
*             Metcalf & Eddy, Inc.               *
*            University of Florida               *
*       Water Resources Engineers, Inc.          *
*     (Now Camp, Dresser and McKee, Inc.)        *
*              September 1970                    *
**************************************************

          Distributed and Maintained by

**************************************************
*      U.S. Environmental Protection Agency      *
* Center for Exposure Assessment Modeling (CEAM) *
*    Athens Environmental Research Laboratory    *
*            960 College Station Road            *
*            Athens, GA    30605-2720            *
**************************************************

**************************************************
*     This is a new release of SWMM.  If any     *
*     problems occur executing this model        *
*     system, contact Mr. Frank Stancil,         *
*     U.S. Environmental Protection Agency.      *
*     706/355-8328 (voice)                       *
*     e-mail: stancil@athens.ath.epa.gov         *
*     Or contact Wayne C. Huber at Oregon St. U. *
*     541/737-6150 or wayne.huber@orst.edu       *
*     Or Michael F. Schmidt at Camp Dresser &    *
*     McKee (904) 281-0170 SCHMIDTMF@CDM.COM     *
**************************************************
```

```
          ************************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ************************************************


##########################################
#         File names by SWMM Block       #
#          JIN  -> Input to a Block      #
#         JOUT  -> Output from a Block   #
##########################################

   JIN for Block #      1 File #    0  JIN.UF
  JOUT for Block #      1 File #    9  PCTmpl.int

##########################################
# Scratch file names for this simulation. #
##########################################

NSCRAT #      1 File #   21  SCRT1.UF
NSCRAT #      2 File #   22  SCRT2.UF
NSCRAT #      3 File #   23  SCRT3.UF
NSCRAT #      4 File #   24  SCRT4.UF
NSCRAT #      5 File #   25  SCRT5.UF
NSCRAT #      6 File #   26  SCRT6.UF
NSCRAT #      7 File #   27  SCRT7.UF
NSCRAT #      8 File #   28  SCRT8.UF

************************************************
*    Parameter Values on the Tapes Common Block   *
************************************************

 Number of Subcatchments in the Runoff Block (NW)...... 1000
 Number of Channel/Pipes in the Runoff Block (NG)...... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
  Number of Transport printed output locations (NTOA)...   80
  Number of Tabular Flow Splitters in Transport (NTSP)..   50
  Number of Elements in the Extran Block (NEE)..... 4000
  Number of Pumps in Extran (NEP).....   75
  Number of Orifices in Extran (NEO)..... 200
  Number of Tide Gates/Free Outfalls in Extran (NTG).... 200
  Number of Extran Weirs (NEW)..... 400
  Number of Extran Printout Locations (NPO)..... 150
  Number of Tide Elements in Extran (NTE).....   50
  Number of Natural Channels (NNC)..... 1200
  Number of Storage Junctions in Extran (NVSE)..... 1000
  Number of Time History Data Points in Extran (NTVAL).. 500
  Number of Data Points for Variable Storage Elements
    in the Extran Block (NVST).....   25
  Number of Input Hydrographs in Extran (NEH)..... 500
  Number of Allowable Channel Connections to
    Junctions in the Extran Block (NCHN).....   15
  Number Rain Gages in Rain and Runoff (MAXRG)..... 200
  Number PRATE/VRATE Points for Extran Pump
    Input (MAXPRA).....   10
  Number of Variable Orifices in Extran (NVORF).....   50
  Number of Variable Orifice Data Points (NVOTIM).....   50
  Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
  Number of Storm Events for Rain Analysis (LSTORM).....20000
  Number of Plugs for Plug-flow in S/T (NPLUG)..... 3000
  Number Conduits for Extran Results to ASCII
    File (MXFLOW).....   400


 ********************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
 * developed 1973 by Camp, Dresser and McKee (CDM) with  *
 * modifications 1977-1991 by the University of Florida. *
 *                                                       *
 * Most recent update: March 1999 by CDM, Oregon         *
 * State University, and XP Software, Inc.               *
 *                                                       *
 * "Smooth runs the water where the brook is deep."      *
 *                   Shakespeare, Henry VI, II, III, 1   *
 ********************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                    ****                        ****    CAMP DRESSER & MCKEE INC.
                                    ****      ANALYSIS MODULE   ****    ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Existing Condition - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles.................    1440

Length of integration step is......    5.00 seconds
Simulation length..................    2.00 hours

Do not create equiv. pipes(NEQUAL).       0

Use metric units for I/O...........       1

Printing starts in cycle...........       1

Intermediate printout intervals of.       1 cycles
Intermediate printout intervals of.    0.08 minutes

Summary printout intervals of......       1 cycles
Summary printout time interval of..    0.08 minutes

Hot start file parameter (JREDO)...       0

Initial time (TZERO)...............    0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ).............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........      30
                     SURTOL........  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
 NORMAL FLOW OPTION WHEN THE WATER
 SURFACE SLOPE IS LESS THAN THE
 GROUND SURFACE SLOPE (KSUPER=0)....

 NJSW INPUT HYDROGRAPH JUNCTIONS....     0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Wolfe/Cahill Drain Existing Condition - 100-Year Flow


1
 ****************************************************
 *                    Conduit Data                  *
 ****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	1	2		2.00	2.00
2	2	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	2	3		2.00	2.00
3	3	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	3	4		2.00	2.00
4	4	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	4	5		2.00	2.00
5	5	40.	RECTANGLE	6.75	0.01500	4.50	1.50	5	6			

6	6	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	6	7	2.00	2.00
7	7	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	7	8	2.00	2.00
8	8	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	8	9	2.00	2.00
9	9	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	9	10	2.00	2.00
10	10	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	10	11	2.00	2.00

```
********************
*  Conduit Volume  *
********************

Input full depth volume.............    1.1315E+04 cubic meters

1-------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Wolfe/Cahill Drain Existing Condition - 100-Year Flow


1
 ****************************************************
 *                  Junction Data                   *
 ****************************************************
```

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	QINST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS	
1	1	183.00	181.74	179.48	12.10	0.00	1	
2	2	183.00	181.50	179.24	0.00	0.00	1	2
3	3	183.00	181.26	179.00	0.00	0.00	2	3
4	4	183.00	181.02	178.76	0.00	0.00	3	4
5	5	183.00	180.78	178.52	0.00	0.00	4	5
6	6	183.00	180.68	178.42	0.00	0.00	5	6
7	7	183.00	180.44	178.18	0.00	0.00	6	7
8	8	183.00	180.20	177.94	0.00	0.00	7	8
9	9	183.00	179.96	177.70	0.00	0.00	8	9
10	10	183.00	179.72	177.46	0.00	0.00	9	10
11	11	183.00	179.48	177.22	0.00	0.00	10	

```
************************************************
```

```
 *          FREE OUTFALL DATA (DATA GROUP I1)      *
 *         BOUNDARY CONDITION ON DATA GROUP J1     *
 ***************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...         1

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY              ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                             ****                                ****        CAMP DRESSER & MCKEE INC.
                                              ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Wolfe/Cahill Drain Existing Condition - 100-Year Flow



 ***************************************************
 *        INTERNAL CONNECTIVITY INFORMATION        *
 ***************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90011           11           0
1
 *****************************************************
 *        BOUNDARY CONDITON INFORMATION              *
 *                 DATA GROUPS J1-J4                 *
 *****************************************************



 BC NUMBER..          1 HAS NO CONTROL WATER SURFACE.
  TZERO =      1906195  0.0000000E+00

 ***********************************
 *    INITIAL MODEL CONDITION      *
 * INITIAL TIME =      0.00 HOURS  *
 ***********************************

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   0.00 /   179.48         2/   0.00 /   179.24         3/   0.00 /   179.00
         4/   0.00 /   178.76         5/   0.00 /   178.52         6/   0.00 /   178.42
         7/   0.00 /   178.18         8/   0.00 /   177.94         9/   0.00 /   177.70
        10/   0.00 /   177.46        11/   0.00 /   177.22
```

```
  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00      90011/       0.00

  CONDUIT/   VELOCITY
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
       1/       0.00          2/       0.00          3/       0.00          4/       0.00
       5/       0.00          6/       0.00          7/       0.00          8/       0.00
       9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   179.48/   179.24          2/   179.24/   179.00          3/   179.00/   178.76
       4/   178.76/   178.52          5/   178.52/   178.42          6/   178.42/   178.18
       7/   178.18/   177.94          8/   177.94/   177.70          9/   177.70/   177.46
      10/   177.46/   177.22


*********************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =      2.00 HOURS *
*********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   1.90 /   181.38          2/   1.90 /   181.14          3/   1.89 /   180.89
       4/   1.88 /   180.64          5/   1.86 /   180.38          6/   1.90 /   180.32
       7/   1.90 /   180.08          8/   1.89 /   179.83          9/   1.88 /   179.58
      10/   1.87 /   179.33         11/   1.29 /   178.51

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/      12.10          2/      12.10          3/      12.10          4/      12.10
```

5/	12.10	6/	12.10	7/	12.10	8/	12.10
9/	12.10	10/	12.10	90011/	12.10		

CONDUIT/ VELOCITY

1/	1.36	2/	1.36	3/	1.37	4/	1.39
5/	1.79	6/	1.36	7/	1.36	8/	1.37
9/	1.38	10/	1.89				

CONDUIT/ CROSS SECTIONAL AREA

1/	8.92	2/	8.89	3/	8.84	4/	8.70
5/	6.75	6/	8.92	7/	8.90	8/	8.85
9/	8.75	10/	6.41				

CONDUIT/ FINAL VOLUME

1/	891.86	2/	889.28	3/	883.55	4/	870.33
5/	270.00	6/	892.25	7/	890.12	8/	885.41
9/	874.71	10/	641.08				

CONDUIT/ HYDRAULIC RADIUS

1/	0.95	2/	0.95	3/	0.95	4/	0.94
5/	0.56	6/	0.95	7/	0.95	8/	0.95
9/	0.94	10/	0.80				

CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION

1/	181.38/	181.14	2/	181.14/	180.89	3/	180.89/	180.64
4/	180.64/	180.38	5/	180.38/	180.32	6/	180.32/	180.08
7/	180.08/	179.83	8/	179.83/	179.58	9/	179.58/	179.33
10/	179.33/	178.51						

```
##################################################
#           Surcharge Iteration Summary          #
##################################################

Maximum number of iterations in a time step.....        6
Total number of iterations in the simulation..       2890
Average number of iterations per time step......     2.01
Surcharge iterations during the simulation......       10
Maximum surcharge flow error during simulation.. 3.97E-02 cms
Total number of time steps during simulation..       1440
```

1

```
 ************************************************
```

```
 *          CONDUIT COURANT CONDITION SUMMARY        *
 * TIME IN MINUTES DELT > COURANT TIME STEP          *
 ****************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ****************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1      0.00          2      0.00          3      0.00          4      0.00
          5      0.00          6      0.00          7      0.00          8      0.00
          9      0.00         10      0.00

1
 ************************************************
 *          CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT    =             CONDUIT LENGTH       *
 * TIME STEP = ---------------------------------- *
 *              VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1     21.85          2     21.96          3     23.41          4     30.44
          5     12.05          6     29.42          7     42.38          8     37.77
          9     33.44         10     56.77

1
 ****************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ****************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

    JUNCTION   INFLOW, CU M
    --------  -------------
           1   8.7120E+04

    JUNCTION  OUTFLOW, CU M
    --------  -------------
           1   3.6105E+01
```

```
          11    7.9703E+04

 ******************************************************
 * INITIAL SYSTEM VOLUME         =     9.4000E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME    =     8.7120E+04 CU M  *
 * INFLOW + INITIAL VOLUME       =     8.7120E+04 CU M  *
 ******************************************************
 * TOTAL SYSTEM OUTFLOW          =     7.9739E+04 CU M  *
 * VOLUME LEFT IN SYSTEM         =     8.0054E+03 CU M  *
 * OUTFLOW + FINAL VOLUME        =     8.7744E+04 CU M  *
 ******************************************************
 * ERROR IN CONTINUITY, PERCENT =          -0.72       *
 ******************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM       =     7.3918E+03 CU. FT.
 ERROR IN CONTINUITY PERCENT =          -0.12
```

- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	4	0.01

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

```
 ************************************************************
 *   J U N C T I O N   S U M M A R Y   S T A T I S T I C S  *
 ************************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Existing Condition - 100-Year Flow

JUNCTION	GROUND ELEVATION	UPPERMOST PIPE CROWN ELEVATION	MEAN JUNCTION ELEVATION	MAXIMUM JUNCTION AVERAGE	MAXIMUM JUNCTION ELEV.	TIME OF OCCURENCE	METERS OF SURCHARGE AT MAX	METERS MAX. DEPTH IS BELOW GROUND	LENGTH OF SURCHARGE	LENGTH OF FLOODING	MAXIMUM JUNCTION AREA

NUMBER	(M)	(M)	(M)	% CHANGE	(M)	HR.	MIN.	ELEVATION	ELEVATION	(MIN)	(MIN)	(SQ.MET)
1	183.00	181.74	181.38	0.1772	183.00	0	0	1.26	0.00	0.3	0.2	2.438E+03
2	183.00	181.50	181.12	0.0655	181.14	0	54	0.00	1.86	0.0	0.0	1.701E+03
3	183.00	181.26	180.86	0.0638	180.89	1	22	0.00	2.11	0.0	0.0	8.485E+02
4	183.00	181.02	180.60	0.0664	180.64	1	55	0.00	2.36	0.0	0.0	8.444E+02
5	183.00	180.78	180.31	0.0705	180.38	1	4	0.00	2.62	0.0	0.0	5.098E+02
6	183.00	180.68	180.25	0.0716	180.32	1	4	0.00	2.68	0.0	0.0	5.162E+02
7	183.00	180.44	179.99	0.0614	180.08	1	4	0.00	2.92	0.0	0.0	8.506E+02
8	183.00	180.20	179.73	0.0610	179.83	1	5	0.00	3.17	0.0	0.0	8.491E+02
9	183.00	179.96	179.46	0.0604	179.59	1	23	0.00	3.41	0.0	0.0	8.457E+02
10	183.00	179.72	179.19	0.0598	179.33	1	9	0.00	3.67	0.0	0.0	8.110E+02
11	183.00	179.48	178.41	0.0414	178.51	1	40	0.00	4.49	0.0	0.0	6.651E+02

1

```
*********************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
*********************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Existing Condition - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS DOWNSTREAM (M)	LENGTH CONDUIT OF NORM FLOW (MIN)	SLOPE (M/M)
1	1.85E+01	1.50	2.260	1.64E+01	0	0	2.47	0	0	0.89	3.52	1.90	0.2	0.00240
2	1.85E+01	1.50	2.260	1.29E+01	0	2	2.11	0	1	0.70	1.90	1.89	0.1	0.00240
3	1.85E+01	1.50	2.260	1.22E+01	0	3	2.02	0	2	0.66	1.89	1.88	0.8	0.00240
4	1.85E+01	1.50	2.260	1.31E+01	0	4	2.08	0	4	0.71	1.88	1.86	0.0	0.00240
5	1.53E+01	2.27	1.500	1.33E+01	0	4	2.30	0	3	0.87	1.86	1.90	0.4	0.00250
6	1.85E+01	1.50	2.260	1.21E+01	1	28	1.96	0	5	0.66	1.90	1.90	0.0	0.00240
7	1.85E+01	1.50	2.260	1.21E+01	1	47	1.85	0	6	0.66	1.90	1.89	0.0	0.00240
8	1.85E+01	1.50	2.260	1.21E+01	1	28	1.86	0	7	0.66	1.89	1.89	0.0	0.00240
9	1.85E+01	1.50	2.260	1.21E+01	1	23	1.83	0	8	0.66	1.89	1.87	0.0	0.00240
10	1.85E+01	1.50	2.260	1.21E+01	1	40	1.89	1	41	0.66	1.87	1.29	0.0	0.00240
90011	UNDEF	UNDEF	UNDEF	1.21E+01	1	40								

1

```
*************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
```

```
          *       MANUAL FOR FURTHER INFORMATION.          *
          ***************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	12.11	0.1154	8.7187E+04	0.9497	8.9187
2	0.08	119.92	0.00	0.00	11.98	0.0708	8.6267E+04	0.9483	8.8929
3	0.08	119.92	0.00	0.00	11.86	0.0753	8.5367E+04	0.9453	8.8356
4	0.33	119.67	0.00	0.00	11.74	0.0842	8.4494E+04	0.9382	8.7034
5	0.92	119.08	0.00	0.00	11.64	0.1979	8.3829E+04	0.8361	6.7500
6	1.58	118.42	0.00	0.00	11.56	0.0648	8.3255E+04	0.9499	8.9225
7	2.33	117.67	0.00	0.00	11.44	0.0546	8.2361E+04	0.9488	8.9013
8	3.17	116.83	0.00	0.00	11.32	0.0502	8.1470E+04	0.9463	8.8543
9	3.92	116.08	0.00	0.00	11.19	0.0459	8.0586E+04	0.9405	8.7473
10	4.92	115.08	0.00	0.00	11.07	0.0459	7.9702E+04	0.8050	6.4109
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	11.07		7.9702E+04		

```
************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************

 The Conduit with the largest average change...          5 had     0.198 percent
The Junction with the largest average change...          1 had     0.177 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

*****************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*****************************************************
* Starting Date... November   16, 2006                *
*          Time...          16:31:49.300              *
*   Ending Date... November   16, 2006                *
*          Time...          16:31:53.630              *
```

```
*  Elapsed Time...                0.072 minutes.       *
*  Elapsed Time...                4.332 seconds.       *
**********************************************************
```

1

```
+-----------------------------------------+
+    U.S. Environmental Protection Agency  +
+    Storm Water Management Model  (SWMM)  +
+                Version 4.4GU              +
+                                           +
+                CDM/OSU Beta               +
+       Release Date - November 23, 1994    +
+ Camp Dresser & McKee and Oregon State Univ.+
+          Chuck Moore and Wayne Huber      +
+  Compiled using Digital Visual Fortran 6.0+
+-----------------------------------------+

                Developed by

+-----------------------------------------+
+             Metcalf & Eddy, Inc.          +
+            University of Florida          +
+       Water Resources Engineers, Inc.     +
+     (Now Camp, Dresser and McKee, Inc.)   +
+              September 1970               +
+-----------------------------------------+

         Distributed and Maintained by

+-----------------------------------------+
+      U.S. Environmental Protection Agency +
+ Center for Exposure Assessment Modeling (CEAM)+
+    Athens Environmental Research Laboratory+
+            960 College Station Road       +
+            Athens, GA     30605-2720      +
+-----------------------------------------+

+-----------------------------------------+
+     This is a new release of SWMM.  If any+
+     problems occur executing this model   +
+     system, contact Mr. Frank Stancil     +
+     U.S. Environmental Protection Agency. +
+     706/355-8328 (voice)                  +
+     e-mail: stancil@athens.ath.epa.gov    +
+     Or contact Wayne C. Huber at Oregon St. U.+
+     541/737-6150 or wayne.huber@orst.edu  +
+     Or Michael F. Schmidt at Camp Dresser &+
+     McKee (904) 281-0170 SCHMIDTMF@CDM.COM+
+-----------------------------------------+
```

```
          ********************************************
          *  This is an implementation of EPA SWMM 4.4GU  *
          *  "Nature is full of infinite causes which     *
          *   have never occurred in experience" da Vinci *
          ********************************************


##############################################
#         File names by SWMM Block           #
#          JIN  -> Input to a Block          #
#         JOUT  -> Output from a Block       #
##############################################

   JIN for Block #      1 File #     0  JIN.UF
  JOUT for Block #      1 File #     9  PCTmp1.int

##############################################
# Scratch file names for this simulation. #
##############################################

NSCRAT #      1 File #    21  SCRT1.UF
NSCRAT #      2 File #    22  SCRT2.UF
NSCRAT #      3 File #    23  SCRT3.UF
NSCRAT #      4 File #    24  SCRT4.UF
NSCRAT #      5 File #    25  SCRT5.UF
NSCRAT #      6 File #    26  SCRT6.UF
NSCRAT #      7 File #    27  SCRT7.UF
NSCRAT #      8 File #    28  SCRT8.UF

************************************************
*    Parameter Values on the Tapes Common Block   *
************************************************

 Number of Subcatchments in the Runoff Block (NW)..... 1000
 Number of Channel/Pipes in the Runoff Block (NG)..... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...   80
 Number of Tabular Flow Splitters in Transport (NTSP)..   50
 Number of Elements in the Extran Block (NEE)..... 4000
 Number of Pumps in Extran (NEP).....   75
 Number of Orifices in Extran (NEO).....  200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
 Number of Extran Weirs (NEW).....  400
 Number of Extran Printout Locations (NPO).....  150
 Number of Tide Elements in Extran (NTE).....   50
 Number of Natural Channels (NNC)..... 1200
 Number of Storage Junctions in Extran (NVSE)..... 1000
 Number of Time History Data Points in Extran (NTVAL)..  500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST).....   25
 Number of Input Hydrographs in Extran (NEH).....  500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN).....   15
 Number Rain Gages in Rain and Runoff (MAXRG).....  200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA).....   10
 Number of Variable Orifices in Extran (NVORF).....   50
 Number of Variable Orifice Data Points (NVOTIM).....   50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG)..... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW).....  400

 ************************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)      *
 * developed 1973 by Camp, Dresser and McKee (CDM) with     *
 * modifications 1977-1991 by the University of Florida.    *
 *                                                          *
 * Most recent update: March 1999 by CDM, Oregon            *
 * State University, and XP Software, Inc.                  *
 *                                                          *
 * "Smooth runs the water where the brook is deep."         *
 *                    Shakespeare, Henry VI, II, III, 1     *
 ************************************************************
```

WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

Control information for simulation

Integration cycles..... 1440

Length of integration step is..... 5.00 seconds
Simulation length..... 2.00 hours

Do not create equiv. pipes(NEQUAL). 0

Use metric units for I/O..... 1

Printing starts in cycle..... 1

Intermediate printout intervals of. 1 cycles
Intermediate printout intervals of. 0.08 minutes

Summary printout intervals of..... 1 cycles
Summary printout time interval of.. 0.08 minutes

Hot start file parameter (JREDO)... 0

Initial time (TZERO)..... 0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)..... 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX..... 30
SURTOL..... 0.0500

Default surface area of junctions.. 1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....      0

     INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

     IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

     CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

     JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

     JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

     Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

     SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

     Intermediate continuity output will not be created

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                         ****                                ****        CAMP DRESSER & MCKEE INC.
                                          ****          ANALYSIS MODULE       ****        ANNANDALE, VIRGINIA


     Detroit River International Crossing
     Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow


1
 ************************************************
 *                  Conduit Data                *
 ************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	1	2		2.00	2.00
2	2	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	2	3		2.00	2.00
3	3	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	3	4		2.00	2.00
4	4	70.	TRAPEZOID	12.27	0.03500	0.91	2.26	4	5		2.00	2.00
5	5	30.	TRAPEZOID	11.25	0.01500	4.50	1.50	5	55		2.00	2.00

6	55	15.	RECTANGLE	6.75	0.01500	4.50	1.50	55	66	
7	66	50.	RECTANGLE	6.75	0.01500	4.50	1.50	66	6	
8	6	15.	RECTANGLE	6.75	0.01500	4.50	1.50	6	77	
9	77	30.	TRAPEZOID	11.25	0.01500	4.50	1.50	77	7	2.00 2.00
10	7	70.	TRAPEZOID	12.27	0.01500	0.91	2.26	7	8	2.00 2.00
11	8	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	8	9	2.00 2.00
12	9	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	9	10	2.00 2.00
13	10	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	10	11	2.00 2.00

===> WARNING !!! (C*DELT/LEN) IN CONDUIT 55 IS 1.3 AT FULL DEPTH.
===> WARNING !!! (C*DELT/LEN) IN CONDUIT 6 IS 1.3 AT FULL DEPTH.

****
* Conduit Volume *
****

Input full depth volume..... 1.0296E+01 cubic meters
Conduit #... 66 has zero slope. 0.001 feet added to upstream invert.

===> Warning !! The upstream and downstream junctions for the following conduits
have been reversed to correspond to the positive flow and decreasing
slope EXTRAN convention. A negative flow in the output thus means
the flow was from your original upstream junction to your original
downstream junction. Any initial flow has been multiplied by -1.

1. Conduit #... 6 has been changed.

1

ENVIRONMENTAL PROTECTION AGENCY **** EXTENDED TRANSPORT PROGRAM **** WATER RESOURCES DIVISION
WASHINGTON, D.C. **** **** CAMP DRESSER & MCKEE INC.
**** ANALYSIS MODULE **** ANNANDALE, VIRGINIA

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

1

****
* Junction Data *
****

INP NUM	JUNCTION NUMBER	GROUND ELEV.	CROWN ELEV.	INVERT ELEV.	INST CMS	INITIAL DEPTH(M)	CONNECTING CONDUITS

1	1	183.00	181.70	179.44	2.10	0.00	1	
2	2	183.00	181.46	179.20	0.00	0.00	1	2
3	3	183.00	181.22	178.96	0.00	0.00	2	3
4	4	183.00	180.98	178.72	0.00	0.00	3	4
5	5	183.00	180.82	178.56	0.00	0.00	4	5
6	55	183.00	179.98	178.48	0.00	0.00	5	55
7	66	183.00	173.94	172.44	0.00	0.00	55	66
8	6	183.00	173.94	172.44	0.00	0.00	66	6
9	77	183.00	179.96	178.46	0.00	0.00	6	77
10	7	183.00	180.64	178.38	0.00	0.00	77	7
11	8	183.00	180.48	178.22	0.00	0.00	7	8
12	9	183.00	180.24	177.98	0.00	0.00	8	9
13	10	183.00	180.00	177.74	0.00	0.00	9	10
14	11	183.00	179.76	177.50	0.00	0.00	10	

```
+++++++++++++++++++++++++++++++++++++++++++++++
+          FREE OUTFALL DATA (DATA GROUP I1)    +
+         BOUNDARY CONDITION ON DATA GROUP J1   +
+++++++++++++++++++++++++++++++++++++++++++++++

OUTFALL AT JUNCTION....        11 HAS BOUNDARY C NDITION NUMBER...        1

1-----------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                           ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow


+++++++++++++++++++++++++++++++++++++++++++++++
+        INTERNAL CONNECTIVITY INFORMATION    +
+++++++++++++++++++++++++++++++++++++++++++++++

         CONDUIT     JUNCTION     JUNCTION
         -------     --------     --------
         90014           11           0
1
+++++++++++++++++++++++++++++++++++++++++++++++ ++++
+        BOUNDARY CONDITON INFORMATION          +
+                DATA GROUPS J1-J4              +
+++++++++++++++++++++++++++++++++++++++++++++++ ++++
```

```
BC NUMBER..          1 HAS NO CONTROL WATER SURFACE.
 TZERO =       1906195  0.0000000E+00

**********************************
*     INITIAL MODEL CONDITION    *
* INITIAL TIME =       0.00 HOURS *
**********************************

JUNCTION / DEPTH  / ELEVATION     ===>  "*" JUNCTION IS SURCHARGED.
        1/   0.00 /   179.44          2/   0.00 /   179.20          3/   0.00 /   178.96
        4/   0.00 /   178.72          5/   0.00 /   178.56         55/   0.00 /   178.48
       66/   0.00 /   172.44          6/   0.00 /   172.44         77/   0.00 /   178.46
        7/   0.00 /   178.38          8/   0.00 /   178.22          9/   0.00 /   177.98
       10/   0.00 /   177.74         11/   0.00 /   177.50

  CONDUIT/        FLOW    ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/        0.00           2/        0.00           3/        0.00           4/        0.00
        5/        0.00          55/        0.00          66/        0.00           6/        0.00
       77/        0.00           7/        0.00           8/        0.00           9/        0.00
       10/        0.00       90014/        0.00

  CONDUIT/   VELOCITY
        1/        0.00           2/        0.00           3/        0.00           4/        0.00
        5/        0.00          55/        0.00          66/        0.00           6/        0.00
       77/        0.00           7/        0.00           8/        0.00           9/        0.00
       10/        0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/        0.00           2/        0.00           3/        0.00           4/        0.00
        5/        0.00          55/        0.00          66/        0.00           6/        0.00
       77/        0.00           7/        0.00           8/        0.00           9/        0.00
       10/        0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/        0.00           2/        0.00           3/        0.00           4/        0.00
        5/        0.00          55/        0.00          66/        0.00           6/        0.00
       77/        0.00           7/        0.00           8/        0.00           9/        0.00
       10/        0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   179.44/   179.20          2/   179.20/   178.96          3/   178.96/   178.72
        4/   178.72/   178.56          5/   178.56/   178.48         55/   178.48/   172.44
```

```
      66/   172.44/   172.44          6/   178.43/   172.44         77/   178.46/   178.38
       7/   178.38/   178.22          8/   178.2 :/   177.98         9/   177.98/   177.74
      10/   177.74/   177.50


*********************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =      2.00 HOURS *
*********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCT ON IS SURCHARGED.
       1/   1.89 /   181.33         2/   1.88 /   181.08         3/   1.86 /   180.82
       4/   1.81 /   180.53         5/   1.70 /   180.26        55/   1.77*/   180.25
      66/   7.79*/   180.23         6/   7.71*/   180.15        77/   1.66*/   180.12
       7/   1.74 /   180.12         8/   1.89 /   180.11         9/   1.89 /   179.87
      10/   1.87 /   179.61        11/   1.29 /   178.79

  CONDUIT/       FLOW   ===> "*" CONDUIT USES TH : NORMAL FLOW OPTION.
       1/      12.10          2/      12.10          3/      12.10          4/      12.10
       5/      12.10         55/      12.10         66/      12.10          6/     -12.10
      77/      12.10          7/      12.10          8/      12.10          9/      12.10
      10/      12.10      90014/      12.10

  CONDUIT/   VELOCITY
       1/       1.37          2/       1.39          3/       1.44          4/       1.56
       5/       1.08         55/       1.79         66/       1.79          6/      -1.79
      77/       1.08          7/       1.47          8/       1.37          9/       1.38
      10/       1.89

  CONDUIT/ CROSS SECTIONAL AREA
       1/       8.84          2/       8.72          3/       8.43          4/       7.75
       5/      11.25         55/       6.75         66/       6.75          6/       6.75
      77/      11.25          7/       8.24          8/       8.85          9/       8.75
      10/       6.41

  CONDUIT/  FINAL VOLUME
       1/     884.47          2/     872.49          3/     842.70          4/     542.76
       5/     337.50         55/     101.25         66/     337.50          6/     101.25
      77/     337.50          7/     576.73          8/     885.41          9/     874.71
      10/     641.08
```

CONDUIT/ HYDRAULIC RADIUS

1/	0.95	2/	0.94	3/	0.92	4/	0.89
5/	1.00	55/	0.56	66/	0.56	6/	0.56
77/	1.00	7/	0.91	8/	0.95	9/	0.94
10/	0.80						

CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION

1/	181.33/	181.08	2/	181.08/	180.82	3/	180.82/	180.53
4/	180.53/	180.26	5/	180.26/	180.25	55/	180.25/	180.23
66/	180.23/	180.15	6/	180.15/	180.15	77/	180.12/	180.12
7/	180.12/	180.11	8/	180.11/	179.87	9/	179.87/	179.61
10/	179.61/	178.79						

```
##########################################################
#            Surcharge Iteration Summary                 #
##########################################################

Maximum number of iterations in a time step.....       16
Total number of iterations in the simulation..       3063
Average number of iterations per time step.....      2.13
Surcharge iterations during the simulation.....       183
Maximum surcharge flow error during simulation.. 5.47E-01 cms
Total number of time steps during simulation..       1440
```

1

```
**************************************************
*          CONDUIT COURANT CONDITION SUMMARY     *
* TIME IN MINUTES DELT > COURANT TIME STEP       *
**************************************************
* SEE BELOW FOR EXPLANATION OF COURANT TIME STEP *
**************************************************
```

CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)	CONDUIT #	TIME(MN)
1	0.00	2	0.00	3	0.00	4	0.00
5	0.25	55	117.42	66	114.08	6	115.50
77	0.08	7	0.00	8	0.00	9	0.00
10	0.00						

1

```
**********************************************
```

```
*          CONDUIT COURANT CONDITION SUMMARY     *
**********************************************
* COURANT    =             CONDUIT LENGTH       *
* TIME STEP = ------------------------------- *
*              VELOCITY + SQRT(GRVT*AREA/WIDTH) *
**********************************************
* AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
**********************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	21.83	2	21.91	3	23.28	4	20.53
5	9.42	55	1.90	66	5.51	6	1.57
77	6.90	7	14.89	8	22.23	9	24.30
10	34.41						

1

```
**********************************************
* EXTRAN CONTINUITY BALANCE AT THE LAST TIME STE *
**********************************************

**********************************************
* JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
**********************************************
```

JUNCTION	INFLOW, CU M
1	8.7120E+04

JUNCTION	OUTFLOW, CU M
1	3.5265E+01
11	7.9960E+04

```
*************************************************
* INITIAL SYSTEM VOLUME        =     8.8000E-03 CU M  *
* TOTAL SYSTEM INFLOW VOLUME   =     8.7120E+04 CU M  *
* INFLOW + INITIAL VOLUME      =     8.7120E+04 CU M  *
*************************************************
* TOTAL SYSTEM OUTFLOW         =     7.9995E+04 CU M  *
* VOLUME LEFT IN SYSTEM        =     7.3537E+03 CU M  *
* OUTFLOW + FINAL VOLUME       =     8.7348E+04 CU M  *
*************************************************
* ERROR IN CONTINUITY, PERCENT =          -0.26       *
*************************************************
```

TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
VOLUME LEFT IN SYSTEM = 7.7720E+03 CU. FT.
ERROR IN CONTINUITY PERCENT = -7.42

- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	4	0.01
5	68	0.09	1440	2.00
77	97	0.13	1440	2.00

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

****
* JUNCTION SUMMARY STATISTICS *
****

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	TIME OF OCCURENCE MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	183.00	181.70	181.33	0.179	183.00	0	0	1.30	0.00	0.3	0.2	2.438E+03
2	183.00	181.46	181.07	0.065	181.08	0	53	0.00	1.92	0.0	0.0	1.704E+03
3	183.00	181.22	180.80	0.065	180.82	1	42	0.00	2.18	0.0	0.0	8.361E+02
4	183.00	180.98	180.49	0.073	180.56	0	5	0.00	2.44	0.0	0.0	6.932E+02
5	183.00	180.82	180.18	0.156	180.26	0	57	0.00	2.74	0.0	0.0	1.821E+03
55	183.00	179.98	180.16	0.390	180.57	0	5	0.59	2.43	111.8	0.0	1.913E+03
66	183.00	173.94	179.94	1.466	180.82	0	4	6.87	2.18	115.8	0.0	2.341E+03
6	183.00	173.94	179.86	0.808	180.15	1	56	6.21	2.85	115.9	0.0	2.881E+03
77	183.00	179.96	180.04	0.320	180.12	0	56	0.16	2.88	110.6	0.0	1.591E+03

7	183.00	180.64	180.03	0.130	180.12	1	56	0.00	2.88	0.0	0.0	1.192E+03
8	183.00	180.48	180.01	0.067	180.11	1	36	0.00	2.89	0.0	0.0	7.163E+02
9	183.00	180.24	179.75	0.063	179.87	1	50	0.00	3.13	0.0	0.0	8.457E+02
10	183.00	180.00	179.47	0.059	179.61	1	49	0.00	3.39	0.0	0.0	8.110E+02
11	183.00	179.76	178.69	0.041	178.79	1	21	0.00	4.21	0.0	0.0	6.651E+02

1

```
*************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
*************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	TIME OF OCCURRENCE MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	1.85E+01	1.50	2.260	1.64E+01	0	0	2.46	0	0	0.89	3.56	1.88	0.2	0.00240
2	1.85E+01	1.50	2.260	1.28E+01	0	2	2.11	0	1	0.69	1.88	1.86	0.3	0.00240
3	1.85E+01	1.50	2.260	1.25E+01	0	6	2.00	0	2	0.68	1.86	1.84	0.3	0.00240
4	1.80E+01	1.47	2.260	1.63E+01	0	5	2.48	0	4	0.90	1.84	1.70	0.0	0.00229
5	3.88E+01	3.45	1.500	2.80E+01	0	4	7.54	0	4	0.72	1.70	2.09	0.3	0.00267
55	1.95E+02	28.83	1.500	2.65E+01	0	4	6.61	0	4	0.14	2.09	8.37	1.8	0.40267
66	1.38E+00	0.20	1.500	2.65E+01	0	4	3.92	0	4	19.23	8.37	7.71	0.1	0.00002
6	1.94E+02	28.78	1.500	-2.63E+01	0	4	-4.23	0	4	-0.14	1.66	7.71	0.0	0.40133
77	3.88E+01	3.45	1.500	2.87E+01	0	4	3.49	0	4	0.74	1.66	1.74	0.2	0.00267
7	4.20E+01	3.42	2.260	1.45E+01	0	6	2.88	0	6	0.34	1.74	1.89	0.8	0.00229
8	1.85E+01	1.50	2.260	1.21E+01	1	16	1.99	0	7	0.66	1.89	1.89	0.1	0.00240
9	1.85E+01	1.50	2.260	1.21E+01	1	12	1.91	0	7	0.66	1.89	1.87	0.0	0.00240
10	1.85E+01	1.50	2.260	1.21E+01	1	21	1.89	1	21	0.66	1.87	1.29	0.0	0.00240
90014	UNDEF	UNDEF	UNDEF	1.21E+01	1	21								

1

```
*************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION           *
*************************************************
```

LENGTH OF	LENGTH OF	LENGTH OF UPSTR. C	LENGTH DOWNSTR.	MEAN	TOTAL	MAXIMUM	MAXIMUM

CONDUIT NUMBER	DRY FLOW(MIN)	SUBCRITICAL FLOW(MIN)	CRITICAL FLOW(MIN)	CRITICAL FLOW(MIN)	FLOW (CMS)	AVERAGE % CHANGE	FLOW CUBIC MET	HYDRAULIC RADIUS(MET)	CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	12.11	0.1153	8.7190E+04	0.9458	8.8448
2	0.08	119.92	0.00	0.00	11.98	0.0695	8.6280E+04	0.9393	8.7250
3	0.08	119.92	0.00	0.00	11.86	0.0956	8.5401E+04	0.9231	8.4271
4	0.33	119.67	0.00	0.00	11.76	0.1699	8.4692E+04	0.8855	7.7539
5	0.83	119.17	0.00	0.00	11.69	0.3079	8.4199E+04	1.0037	11.2500
55	1.58	118.42	0.00	0.00	11.63	0.0295	8.3708E+04	0.8363	6.7500
66	2.08	117.92	0.00	0.00	11.61	7.0886	8.3579E+04	0.8108	6.7500
6	4.33	115.67	0.00	0.00	-11.55	0.0321	-8.3148E+04	0.8421	6.7500
77	4.33	115.67	0.00	0.00	11.52	0.2510	8.2934E+04	1.0037	11.2500
7	4.42	115.58	0.00	0.00	11.45	0.0637	8.2458E+04	0.9128	8.2392
8	4.50	115.50	0.00	0.00	11.35	0.0761	8.1731E+04	0.9463	8.8543
9	4.67	115.33	0.00	0.00	11.23	0.0474	8.0845E+04	0.9405	8.7473
10	5.00	115.00	0.00	0.00	11.11	0.0459	7.9959E+04	0.8050	6.4109
90014	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	11.11		7.9959E+04		

```
**************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
**************************************************
```

The Conduit with the largest average change... 66 had 7.089 percent
The Junction with the largest average change... 66 had 1.466 percent

===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU simulation ended normally.
Always check output file for possible warning messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

```
************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
************************************************
* Starting Date... November   17, 2006          *
*          Time...          9:34:42.  0         *
*   Ending Date... November   17, 2006          *
*          Time...          9:34:46.830         *
*  Elapsed Time...               0.081 minutes. *
*  Elapsed Time...               4.831 seconds. *
```

Appendix A.3

Alternative 2A

Cahill Drain Crossing
Lennon Drain Crossing
Basin Drain Crossing
Titcombe Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m³/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades			
Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile			
Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties			
Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
Lennon Drain - Alt2A-100yr-Existing

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	182.00	m	Headwater Depth/Height	1.54	
Computed Headwater Elevat	181.38	m	Discharge	8.3000	m³/s
Inlet Control HW Elev.	181.21	m	Tailwater Elevation	180.70	m
Outlet Control HW Elev.	181.38	m	Control Type	Outlet Control	

Grades					
Upstream Invert	179.50	m	Downstream Invert	179.20	m
Length	67.00	m	Constructed Slope	0.004478	m/m

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.50	m
Slope Type	N/A		Normal Depth	0.93	m
Flow Regime	N/A		Critical Depth	1.02	m
Velocity Downstream	2.63	m/s	Critical Slope	0.003567	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.59	m
Section Size	1219 mm x 2591 mm		Rise	1.22	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	181.38	m	Upstream Velocity Head	0.35	m
Ke	0.20		Entrance Loss	0.07	m

Inlet Control Properties					
Inlet Control HW Elev.	181.21	m	Flow Control	Submerged	
Inlet Type	90° headwall w 45° bevels		Area Full	3.2	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Culvert Calculator Report
Cahill Alt 2A-Future

Comments: Unknown Flow

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	184.40	m	Headwater Depth/Height	1.97	
Computed Headwater Elevat	182.77	m	Discharge	27.6000	m³/s
Inlet Control HW Elev.	182.77	m	Tailwater Elevation	181.14	m
Outlet Control HW Elev.	182.61	m	Control Type	Inlet Control	

Grades					
Upstream Invert	179.82	m	Downstream Invert	179.64	m
Length	74.00	m	Constructed Slope	0.002432	m/m

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.50	m
Slope Type	N/A		Normal Depth	N/A	m
Flow Regime	N/A		Critical Depth	1.50	m
Velocity Downstream	4.09	m/s	Critical Slope	0.006085	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	4.50	m
Section Size	4500 x 1500 mm		Rise	1.50	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	182.61	m	Upstream Velocity Head	0.85	m
Ke	0.20		Entrance Loss	0.17	m

Inlet Control Properties					
Inlet Control HW Elev.	182.77	m	Flow Control	N/A	
Inlet Type	90° headwall w 45° bevels		Area Full	6.8	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Appendix A.4

Alternative 2B

Appendix A.4.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbei	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

URS
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666

Appendix A.4.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	181.40	m	Headwater Depth/Height	1.20	
Computed Headwater Elevat	180.32	m	Discharge	8.1000	m³/s
Inlet Control HW Elev.	180.32	m	Tailwater Elevation	179.70	m
Outlet Control HW Elev.	180.32	m	Control Type	Inlet Control	

Grades					
Upstream Invert	178.50	m	Downstream Invert	178.20	m
Length	58.00	m	Constructed Slope	0.005172	m/m

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.05	m
Slope Type	Steep		Normal Depth	1.05	m
Flow Regime	N/A		Critical Depth	1.14	m
Velocity Downstream	3.62	m/s	Critical Slope	0.004178	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.13	m
Section Size	2130 x 1520 mm		Rise	1.52	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	180.32	m	Upstream Velocity Head	0.57	m
Ke	0.20		Entrance Loss	0.11	m

Inlet Control Properties					
Inlet Control HW Elev.	180.32	m	Flow Control	Transition	
Inlet Type	90° headwall w 45° bevels		Area Full	3.3	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Appendix A.5

Alternative 2B – Revised

Appendix A.5.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbe	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix A.5.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m³/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades			
Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile			
Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties			
Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Appendix A.5.3

Turkey Creek Hydraulic Analysis


10
9.9
9.8
9.7
9.6
14+500
183.00
178.50
14+000

Appendix A.5.3.1

Existing Condition

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: Turkey River
Project File : dric.prj
Run Date and Time: 15/11/2006 2:56:15 PM

Project in SI units

****

PLAN DATA

Plan Title: Plan 37
Plan File : o:\DRIC\19_WaterResources\hec\dric.p37

Geometry Title: existing
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g01

Flow Title : Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Plan Summary Information:

Number of:	Cross Sections	= 10	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

****

FLOW DATA

Flow Title: Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Flow Data (m3/s)

River	Reach	RS	100 yr	Regional
Turkey Creek	Main	10	39.5	62.6

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Turkey Creek	Main	100 yr		Normal S = 0.000375

* Turkey Creek Main Regional * Normal S = 0.000375
*

GEOMETRY DATA

Geometry Title: existing
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g01

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 10

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	183	76.736	183	99.766	182.5	101.278	182	102.644	181.5
104.01	181	105.363	180.5	106.485	180	107.607	179.5	108.729	179
109.851	178.5	110.973	178	112.095	177.5	113.217	177	116.947	176.56
117.547	176.36	119.547	176.36	120.147	176.56	123.877	177	124.941	177.5
126.005	178	127.069	178.5	128.133	179	129.197	179.5	130.261	180
131.624	180.5	132.798	181	134.684	181.5	136.554	182	264.86	182.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	116.947	.017	120.147	.03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
116.947 120.147 207.817 210.778 216.406 .1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.68	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.40	Reach Len. (m)	207.82	210.78	216.41
Crit W.S. (m)		Flow Area (m2)	8.25	6.41	8.13
E.G. Slope (m/m)	0.001101	Area (m2)	8.25	6.41	8.13
Q Total (m3/s)	39.50	Flow (m3/s)	9.99	19.62	9.89
Top Width (m)	16.78	Top Width (m)	6.87	3.20	6.71
Vel Total (m/s)	1.73	Avg. Vel. (m/s)	1.21	3.06	1.22
Max Chl Dpth (m)	2.04	Hydr. Depth (m)	1.20	2.00	1.21
Conv. Total (m3/s)	1190.6	Conv. (m3/s)	301.0	591.3	298.2
Length Wtd. (m)	211.47	Wetted Per. (m)	7.20	3.26	7.05
Min Ch El (m)	176.36	Shear (N/m2)	12.37	21.19	12.45
Alpha	1.80	Stream Power (N/m s)	14.98	64.86	15.15
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	3.89	5.02	4.35
C & E Loss (m)	0.03	Cum SA (1000 m2)	3.03	2.34	3.46

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	179.26	Element	Left OB	Channel	Right OB
Vel Head (m)	0.36	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.90	Reach Len. (m)	207.82	210.78	216.41
Crit W.S. (m)		Flow Area (m2)	11.93	8.00	11.72
E.G. Slope (m/m)	0.001143	Area (m2)	11.93	8.00	11.72
Q Total (m3/s)	62.60	Flow (m3/s)	16.96	28.90	16.74
Top Width (m)	18.95	Top Width (m)	7.99	3.20	7.77
Vel Total (m/s)	1.98	Avg. Vel. (m/s)	1.42	3.61	1.43
Max Chl Dpth (m)	2.54	Hydr. Depth (m)	1.49	2.50	1.51
Conv. Total (m3/s)	1851.8	Conv. (m3/s)	501.8	854.8	495.2
Length Wtd. (m)	211.51	Wetted Per. (m)	8.42	3.26	8.22
Min Ch El (m)	176.36	Shear (N/m2)	15.89	27.45	15.99
Alpha	1.82	Stream Power (N/m s)	22.59	99.18	22.83
Frctn Loss (m)	0.19	Cum Volume (1000 m3)	5.48	6.16	6.15
C & E Loss (m)	0.03	Cum SA (1000 m2)	3.54	2.34	3.96

CROSS SECTION

RIVER: Turkey Creek

REACH: Main RS: 9.9

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	120.028	182.5	136.616	182	137.952	181.5	139.286	181
140.62	180.5	141.772	180	142.859	179.5	143.941	179	145.023	178.5
146.105	178	147.187	177.5	148.269	177	149.351	176.5	152.673	176.06
153.273	175.86	155.273	175.86	155.873	176.06	159.195	176.5	160.399	177
161.603	177.5	162.805	178	164.002	178.5	165.197	179	166.39	179.5
167.992	180	169.998	180.5	172.048	181	174.284	181.5	180.916	182
191.253	182.5	277.679	183						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	152.673	.017	155.873	.03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
152.673 155.873 104.462 100.685 96.329 .1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.48	Element	Left OB	Channel	Right OB
Vel Head (m)	0.18	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.30	Reach Len. (m)	104.46	100.68	96.33
Crit W.S. (m)		Flow Area (m2)	10.23	7.69	10.63
E.G. Slope (m/m)	0.000579	Area (m2)	10.23	7.69	10.63
Q Total (m3/s)	39.50	Flow (m3/s)	9.96	19.28	10.26
Top Width (m)	18.08	Top Width (m)	7.22	3.20	7.66
Vel Total (m/s)	1.38	Avg. Vel. (m/s)	0.97	2.51	0.97
Max Chl Dpth (m)	2.44	Hydr. Depth (m)	1.42	2.40	1.39
Conv. Total (m3/s)	1642.2	Conv. (m3/s)	414.2	801.6	426.5
Length Wtd. (m)	100.42	Wetted Per. (m)	7.65	3.26	8.04
Min Ch El (m)	175.86	Shear (N/m2)	7.59	13.37	7.50
Alpha	1.85	Stream Power (N/m s)	7.39	33.51	7.24
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	1.97	3.53	2.32
C & E Loss (m)	0.00	Cum SA (1000 m2)	1.57	1.67	1.91

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	179.04	Element	Left OB	Channel	Right OB
Vel Head (m)	0.26	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.78	Reach Len. (m)	104.46	100.68	96.33
Crit W.S. (m)		Flow Area (m2)	13.93	9.22	14.55
E.G. Slope (m/m)	0.000698	Area (m2)	13.93	9.22	14.55
Q Total (m3/s)	62.60	Flow (m3/s)	16.67	28.63	17.30
Top Width (m)	20.25	Top Width (m)	8.26	3.20	8.80
Vel Total (m/s)	1.66	Avg. Vel. (m/s)	1.20	3.11	1.19
Max Chl Dpth (m)	2.92	Hydr. Depth (m)	1.69	2.88	1.65
Conv. Total (m3/s)	2369.7	Conv. (m3/s)	631.1	1083.9	654.7
Length Wtd. (m)	100.36	Wetted Per. (m)	8.79	3.26	9.28
Min Ch El (m)	175.86	Shear (N/m2)	10.85	19.33	10.73
Alpha	1.88	Stream Power (N/m s)	12.99	60.02	12.75
Frctn Loss (m)	0.08	Cum Volume (1000 m3)	2.80	4.34	3.31
C & E Loss (m)	0.00	Cum SA (1000 m2)	1.85	1.67	2.17

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.8

INPUT
Description: US of Huron Church Road
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	37.489	182	45.643	181.5	47.136	181	48.636	180.5
50.024	180	51.1	179.5	52.174	179	53.246	178.5	54.316	178
55.384	177.5	56.451	177	57.519	176.5	60.347	176.06	60.947	175.86
62.947	175.86	63.547	176.06	66.375	176.5	67.488	177	71.05	177.5
72.19	178	73.33	178.5	74.472	179	75.609	179.5	76.733	180
77.849	180.5	94.858	181	118.672	181.5	142.126	182	143.791	182.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	60.347	.017	63.547	.03

Bank Sta: Left 60.347, Right 63.547 — Lengths: Left Channel 24.356, Right Channel 24.248, Right 24.356 — Coeff Contr. .1 — Expan. .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.42	Element	Left OB	Channel	Right OB
Vel Head (m)	0.21	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.20	Reach Len. (m)	24.36	24.25	24.36
Crit W.S. (m)		Flow Area (m2)	8.54	7.38	11.02
E.G. Slope (m/m)	0.000709	Area (m2)	8.54	7.38	11.02
Q Total (m3/s)	39.50	Flow (m3/s)	8.75	19.90	10.85
Top Width (m)	18.77	Top Width (m)	6.47	3.20	9.11
Vel Total (m/s)	1.47	Avg. Vel. (m/s)	1.03	2.70	0.98
Max Chl Dpth (m)	2.34	Hydr. Depth (m)	1.32	2.31	1.21
Conv. Total (m3/s)	1483.3	Conv. (m3/s)	328.6	747.4	407.3
Length Wtd. (m)	24.28	Wetted Per. (m)	6.88	3.26	9.43
Min Ch El (m)	175.86	Shear (N/m2)	8.63	15.71	8.12
Alpha	1.94	Stream Power (N/m s)	8.85	42.39	8.00
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.99	2.77	1.28
C & E Loss (m)	0.02	Cum SA (1000 m2)	0.85	1.35	1.10

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.97	Element	Left OB	Channel	Right OB
Vel Head (m)	0.29	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.67	Reach Len. (m)	24.36	24.25	24.36
Crit W.S. (m)		Flow Area (m2)	11.80	8.88	15.53
E.G. Slope (m/m)	0.000813	Area (m2)	11.80	8.88	15.53
Q Total (m3/s)	62.60	Flow (m3/s)	14.55	29.00	19.05
Top Width (m)	20.84	Top Width (m)	7.47	3.20	10.18
Vel Total (m/s)	1.73	Avg. Vel. (m/s)	1.23	3.27	1.23
Max Chl Dpth (m)	2.81	Hydr. Depth (m)	1.58	2.77	1.53
Conv. Total (m3/s)	2195.7	Conv. (m3/s)	510.3	1017.3	668.0
Length Wtd. (m)	24.29	Wetted Per. (m)	7.99	3.26	10.60
Min Ch El (m)	175.86	Shear (N/m2)	11.78	21.67	11.68
Alpha	1.93	Stream Power (N/m s)	14.52	70.81	14.33
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	1.45	3.43	1.86
C & E Loss (m)	0.03	Cum SA (1000 m2)	1.03	1.35	1.25

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.7

INPUT
Description: DS of Huron Church Road
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	135.597	182	140.617	181.5	141.147	181	141.663	180.5
142.193	180	142.948	179.5	144.066	179	145.159	178.5	146.135	178
147.372	177.5	148.469	177	149.758	176.5	151.708	176.06	152.308	175.86
154.308	175.86	154.908	176.06	156.858	176.5	157.961	177	161.475	177.1
167.781	181.5	235.174	182						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	148.469	.017	157.961	.02

Bank Sta: Left 148.469, Right 157.961 — Lengths: Left Channel 35.414, Right Channel 35.414, Right 35.414 — Coeff Contr. .3 — Expan. .5

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.38	Element	Left OB	Channel	Right OB
Vel Head (m)	0.15	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.24	Reach Len. (m)	0.62	0.62	0.62
Crit W.S. (m)	177.50	Flow Area (m2)	1.74	18.68	5.10
E.G. Slope (m/m)	0.000396	Area (m2)	1.74	18.68	5.10
Q Total (m3/s)	39.50	Flow (m3/s)	1.19	33.49	4.82
Top Width (m)	17.43	Top Width (m)	2.80	9.49	5.14
Vel Total (m/s)	1.55	Avg. Vel. (m/s)	0.68	1.79	0.95

Max Chl Dpth (m)	2.38	Hydr. Depth (m)	0.62	1.97	0.99
Conv. Total (m3/s)	1985.3	Conv. (m3/s)	59.8	1683.1	242.4
Length Wtd. (m)	0.62	Wetted Per. (m)	3.06	9.86	5.50
Min Ch El (m)	175.86	Shear (N/m2)	2.21	7.36	3.60
Alpha	1.19	Stream Power (N/m s)	1.51	13.19	3.40
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.86	2.45	1.08
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.74	1.19	0.93

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.92	Element	Left OB	Channel	Right OB
Vel Head (m)	0.21	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.72	Reach Len. (m)	0.62	0.62	0.62
Crit W.S. (m)	177.87	Flow Area (m2)	3.32	23.25	7.74
E.G. Slope (m/m)	*0.000433	Area (m2)	3.32	23.25	7.74
Q Total (m3/s)	62.60	Flow (m3/s)	2.97	50.43	9.20
Top Width (m)	19.12	Top Width (m)	3.79	9.49	5.83
Vel Total (m/s)	1.82	Avg. Vel. (m/s)	0.89	2.17	1.19
Max Chl Dpth (m)	2.86	Hydr. Depth (m)	0.88	2.45	1.33
Conv. Total (m3/s)	3008.5	Conv. (m3/s)	142.8	2423.6	442.1
Length Wtd. (m)	0.62	Wetted Per. (m)	4.16	9.86	6.34
Min Ch El (m)	175.86	Shear (N/m2)	3.39	10.02	5.18
Alpha	1.21	Stream Power (N/m s)	3.03	21.72	6.16
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	1.27	3.04	1.58
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.89	1.19	1.06

BRIDGE

RIVER: Turkey Creek
REACH: Main RS: 9.65

INPUT
Description:
Distance from Upstream XS = .621
Deck/Roadway Width = 34.79
Weir Coefficient = 1.44
Upstream Deck/Roadway Coordinates
num= 9

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	181.74		90.83	182.081		118.067	182.057	
140.62	182.199	181.5	152.78	182.207	181.5	167.78	182.179	181.5
168.067	182.156		190.032	181.964		218.067	181.884	

Upstream Bridge Cross Section Data
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	135.597	182	140.617	181.5	141.147	181	141.663	180.5
142.193	180	142.948	179.5	144.066	179	145.159	178.5	146.135	178
147.372	177.5	148.469	177	149.758	176.5	151.708	176.06	152.308	175.86
154.308	175.86	154.908	176.06	156.858	176.5	157.961	177	161.475	177.1
167.781	181.5	235.174	182						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	148.469	.017	157.961	.02

Bank Sta: Left Right Coeff Contr. Expan.
148.469 157.961 .3 .5

Downstream Deck/Roadway Coordinates
num= 11

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	181.74		90.83	182.081		118.067	182.057	
133.85	182.157	181.5	137.28	182.199	181.5	152.78	182.207	181.5
165.46	182.179	181.5	168.067	182.156	181.5	175.93	182.11	181.5
190.032	181.964		218.067	181.884				

Downstream Bridge Cross Section Data
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	125.33	182	133.85	181.5	139.252	179.5	140.572	177
141.87	176.5	145.27	176.06	145.87	175.86	147.87	175.86	148.47	176.06

```
  151.87   176.5 152.973     177 156.487   177.1 159.275   179.5 161.948   180.5
  166.14     181 170.386   181.5 199.519     182

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02 140.572    .017 152.973     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
       140.572 152.973             .3       .5

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins           =
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #100 yr
*************************************************************************************************
* E.G. US. (m)          *     178.38  * Element              *Inside BR US *Inside BR DS *
* W.S. US. (m)          *     178.24  * E.G. Elev (m)        *     178.38  *     178.35  *
* Q Total (m3/s)        *      39.50  * W.S. Elev (m)        *     178.24  *     178.25  *
* Q Bridge (m3/s)       *      39.50  * Crit W.S. (m)        *     177.50  *     177.31  *
* Q Weir (m3/s)         *             * Max Chl Dpth (m)     *       2.38  *       2.39  *
* Weir Sta Lft (m)      *             * Vel Total (m/s)      *       1.55  *       1.32  *
* Weir Sta Rgt (m)      *             * Flow Area (m2)       *      25.52  *      29.91  *
* Weir Submerg          *             * Froude # Chl         *       0.41  *       0.33  *
* Weir Max Depth (m)    *             * Specif Force (m3)    *      29.14  *      33.37  *
* Min El Weir Flow (m)  *     181.95  * Hydr Depth (m)       *       1.46  *       1.67  *
* Min El Prs (m)        *     181.50  * W.P. Total (m)       *      18.42  *      19.41  *
* Delta EG (m)          *       0.03  * Conv. Total (m3/s)   *     1984.8  *     2482.2  *
* Delta WS (m)          *      -0.01  * Top Width (m)        *      17.43  *      17.91  *
* BR Open Area (m2)     *      99.65  * Frctn Loss (m)       *       0.01  *       0.00  *
* BR Open Vel (m/s)     *       1.55  * C & E Loss (m)       *       0.02  *       0.00  *
* Coef of Q             *             * Shear Total (N/m2)   *       5.38  *       3.83  *
* Br Sel Method         *Energy only  * Power Total (N/m s)  *       8.33  *       5.05  *
*************************************************************************************************

BRIDGE OUTPUT  Profile #Regional
*************************************************************************************************
* E.G. US. (m)          *     178.92  * Element              *Inside BR US *Inside BR DS *
* W.S. US. (m)          *     178.72  * E.G. Elev (m)        *     178.92  *     178.88  *
* Q Total (m3/s)        *      62.60  * W.S. Elev (m)        *     178.72  *     178.73  *
* Q Bridge (m3/s)       *      62.60  * Crit W.S. (m)        *     177.87  *     177.64  *
* Q Weir (m3/s)         *             * Max Chl Dpth (m)     *       2.86  *       2.87  *
* Weir Sta Lft (m)      *             * Vel Total (m/s)      *       1.82  *       1.61  *
* Weir Sta Rgt (m)      *             * Flow Area (m2)       *      34.31  *      38.79  *
* Weir Submerg          *             * Froude # Chl         *       0.44  *       0.37  *
* Weir Max Depth (m)    *             * Specif Force (m3)    *      49.38  *      55.26  *
* Min El Weir Flow (m)  *     181.95  * Hydr Depth (m)       *       1.79  *       2.07  *
* Min El Prs (m)        *     181.50  * W.P. Total (m)       *      20.36  *      20.71  *
* Delta EG (m)          *       0.04  * Conv. Total (m3/s)   *     3007.8  *     3671.7  *
* Delta WS (m)          *      -0.02  * Top Width (m)        *      19.11  *      18.73  *
* BR Open Area (m2)     *      99.65  * Frctn Loss (m)       *       0.01  *       0.00  *
* BR Open Vel (m/s)     *       1.82  * C & E Loss (m)       *       0.03  *       0.00  *
* Coef of Q             *             * Shear Total (N/m2)   *       7.16  *       5.34  *
* Br Sel Method         *Energy only  * Power Total (N/m s)  *      13.06  *       8.62  *
*************************************************************************************************
```

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.6

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	125.33	182	133.85	181.5	139.252	179.5	140.572	177
141.87	176.5	145.27	176.06	145.87	175.86	147.87	175.86	148.47	176.06
151.87	176.5	152.973	177	156.487	177.1	159.275	179.5	161.948	180.5
166.14	181	170.386	181.5	199.519	182				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	140.572	.017	152.973	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
140.572	152.973	3.943	3 4.798	.3	.5

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.35	Element	Left OB	Channel	Right OB
Vel Head (m)	0.10	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.25	Reach Len. (m)	3.94	3.00	4.80
Crit W.S. (m)		Flow Area (m2)	0.41	24.52	4.98
E.G. Slope (m/m)	0.000253	Area (m2)	0.41	24.52	4.98
Q Total (m3/s)	39.50	Flow (m3/s)	0.14	35.54	3.81
Top Width (m)	17.91	Top Width (m)	0.66	12.40	4.85
Vel Total (m/s)	1.32	Avg. Vel. (m/s)	0.35	1.45	0.77
Max Chl Dpth (m)	2.39	Hydr. Depth (m)	0.62	1.98	1.03
Conv. Total (m3/s)	2482.2	Conv. (m3/s)	9.1	2233.4	239.7
Length Wtd. (m)	3.18	Wetted Per. (m)	1.41	12.72	5.28
Min Ch El (m)	175.86	Shear (N/m2)	0.72	4.79	2.34
Alpha	1.12	Stream Power (N/m s)	0.25	6.94	1.80
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.83	1.69	0.91
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.68	0.81	0.75

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.88	Element	Left OB	Channel	Right OB
Vel Head (m)	0.15	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.73	Reach Len. (m)	3.94	3.00	4.80
Crit W.S. (m)		Flow Area (m2)	0.79	30.53	7.47
E.G. Slope (m/m)	0.000291	Area (m2)	0.79	30.53	7.47
Q Total (m3/s)	62.60	Flow (m3/s)	0.37	54.88	7.35
Top Width (m)	18.73	Top Width (m)	0.92	12.40	5.41
Vel Total (m/s)	1.61	Avg. Vel. (m/s)	0.47	1.80	0.98
Max Chl Dpth (m)	2.87	Hydr. Depth (m)	0.87	2.46	1.38
Conv. Total (m3/s)	3671.7	Conv. (m3/s)	21.7	3218.8	431.2
Length Wtd. (m)	3.22	Wetted Per. (m)	1.96	12.72	6.02
Min Ch El (m)	175.86	Shear (N/m2)	1.15	6.84	3.54
Alpha	1.13	Stream Power (N/m s)	0.54	12.29	3.48
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	1.20	2.09	1.31
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.81	0.81	0.86

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.5

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	58.964	182	67.647	181.5	80.298	176.5	83.844	176.06
84.444	175.86	86.444	175.86	87.044	176.06	90.59	176.5	92.841	177.5
98.2	180	99.757	180.5	106.622	181.5	138.493	182		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

0	.02	80.298	.017	90.59	.02

Bank Sta: Left 80.298 | Right 90.59 | Lengths: Left Channel Right = 39.545 39.545 39.545 | Coeff Contr. = .1 | Expan. = .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.34	Element	Left OB	Channel	Right OB
Vel Head (m)	0.12	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.22	Reach Len. (m)	39.55	39.55	39.55
Crit W.S. (m)		Flow Area (m2)	3.75	21.22	3.31
E.G. Slope (m/m)	0.000292	Area (m2)	3.75	21.22	3.31
Q Total (m3/s)	39.50	Flow (m3/s)	2.77	34.30	2.43
Top Width (m)	18.45	Top Width (m)	4.36	10.29	3.80
Vel Total (m/s)	1.40	Avg. Vel. (m/s)	0.74	1.62	0.73
Max Chl Dpth (m)	2.36	Hydr. Depth (m)	0.86	2.06	0.87
Conv. Total (m3/s)	2309.8	Conv. (m3/s)	161.9	2005.9	141.9
Length Wtd. (m)	39.55	Wetted Per. (m)	4.69	10.41	4.17
Min Ch El (m)	175.86	Shear (N/m2)	2.30	5.84	2.28
Alpha	1.20	Stream Power (N/m s)	1.69	9.45	1.67
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.82	1.62	0.89
C & E Loss (m)	0.02	Cum SA (1000 m2)	0.67	0.77	0.73

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.88	Element	Left OB	Channel	Right OB
Vel Head (m)	0.17	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.70	Reach Len. (m)	39.55	39.55	39.55
Crit W.S. (m)		Flow Area (m2)	6.13	26.15	5.38
E.G. Slope (m/m)	0.000334	Area (m2)	6.13	26.15	5.38
Q Total (m3/s)	62.60	Flow (m3/s)	5.69	51.94	4.96
Top Width (m)	20.69	Top Width (m)	5.57	10.29	4.83
Vel Total (m/s)	1.66	Avg. Vel. (m/s)	0.93	1.99	0.92
Max Chl Dpth (m)	2.84	Hydr. Depth (m)	1.10	2.54	1.11
Conv. Total (m3/s)	3425.3	Conv. (m3/s)	311.6	2842.2	271.4
Length Wtd. (m)	39.55	Wetted Per. (m)	5.99	10.41	5.31
Min Ch El (m)	175.86	Shear (N/m2)	3.35	8.23	3.32
Alpha	1.24	Stream Power (N/m s)	3.11	16.34	3.06
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	1.18	2.01	1.28
C & E Loss (m)	0.03	Cum SA (1000 m2)	0.80	0.77	0.83

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.4

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	22.451	182	30.035	181.5	50.694	176.5	57.847	176.06
58.447	175.86	60.447	175.86	61.047	176.06	68.2	176.5	77.642	180
80.038	180.5	84.157	181	86.382	181.5	87.423	182	124.022	182.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	50.694	.017	68.2	.02

Bank Sta: Left 50.694 | Right 68.2 | Lengths: Left Channel Right = 3.308 3.678 4.068 | Coeff Contr. = .1 | Expan. = .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.31	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.27	Reach Len. (m)	3.31	3.68	4.07
Crit W.S. (m)		Flow Area (m2)	6.47	36.06	4.23
E.G. Slope (m/m)	0.000103	Area (m2)	6.47	36.06	4.23
Q Total (m3/s)	39.50	Flow (m3/s)	2.96	34.65	1.89

Top Width (m)	29.59	Top Width (m)	7.31	17.51	4.77
Vel Total (m/s)	0.84	Avg. Vel. (m/s)	0.46	0.96	0.45
Max Chl Dpth (m)	2.41	Hydr. Depth (m)	0.88	2.06	0.88
Conv. Total (m3/s)	3900.9	Conv. (m3/s)	292.7	3421.6	186.6
Length Wtd. (m)	3.67	Wetted Per. (m)	7.52	17.60	5.09
Min Ch El (m)	175.86	Shear (N/m2)	0.86	2.06	0.83
Alpha	1.17	Stream Power (N/m s)	0.40	1.98	0.37
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.62	0.49	0.74
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.44	0.22	0.56

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.84	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.77	Reach Len. (m)	3.31	3.68	4.07
Crit W.S. (m)		Flow Area (m2)	10.68	44.88	6.97
E.G. Slope (m/m)	0.000114	Area (m2)	10.68	44.88	6.97
Q Total (m3/s)	62.60	Flow (m3/s)	6.10	52.62	3.89
Top Width (m)	33.03	Top Width (m)	9.39	17.51	6.13
Vel Total (m/s)	1.00	Avg. Vel. (m/s)	0.57	1.17	0.56
Max Chl Dpth (m)	2.91	Hydr. Depth (m)	1.14	2.56	1.14
Conv. Total (m3/s)	5862.1	Conv. (m3/s)	570.8	4927.4	363.8
Length Wtd. (m)	3.67	Wetted Per. (m)	9.67	17.60	6.54
Min Ch El (m)	175.86	Shear (N/m2)	1.24	2.85	1.19
Alpha	1.20	Stream Power (N/m s)	0.71	3.34	0.66
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.85	0.60	1.03
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.50	0.22	0.62

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.3

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	22.465	182	35.015	181.5	36.837	181	51.171	176.5
58.923	176.06	59.523	175.86	61.523	175.86	62.123	176.06	69.875	176.5
81.981	180.5	86.631	181	89.072	182	225.65	182.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	51.171	.017	69.875	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
51.171	69.875	3.308	5	4.166	.1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.31	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.27	Reach Len. (m)	3.31	5.00	4.17
Crit W.S. (m)		Flow Area (m2)	5.00	38.48	4.75
E.G. Slope (m/m)	0.000094	Area (m2)	5.00	38.48	4.75
Q Total (m3/s)	39.50	Flow (m3/s)	2.16	35.29	2.05
Top Width (m)	29.71	Top Width (m)	5.64	18.70	5.36
Vel Total (m/s)	0.82	Avg. Vel. (m/s)	0.43	0.92	0.43
Max Chl Dpth (m)	2.41	Hydr. Depth (m)	0.89	2.06	0.89
Conv. Total (m3/s)	4084.4	Conv. (m3/s)	223.5	3649.2	211.6
Length Wtd. (m)	4.49	Wetted Per. (m)	5.92	18.79	5.65
Min Ch El (m)	175.86	Shear (N/m2)	0.78	1.88	0.77
Alpha	1.15	Stream Power (N/m s)	0.34	1.72	0.33
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.60	0.35	0.72
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.42	0.16	0.54

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.83	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.78	Reach Len. (m)	3.31	5.00	4.17

Crit W.S. (m)		Flow Area (m2)	8.25	47.91	7.84
E.G. Slope (m/m)	0.000105	Area (m2)	8.25	47.91	7.84
Q Total (m3/s)	62.60	Flow (m3/s)	4.47	53.90	4.23
Top Width (m)	32.84	Top Width (m)	7.25	18.70	6.89
Vel Total (m/s)	0.98	Avg. Vel. (m/s)	0.54	1.13	0.54
Max Chl Dpth (m)	2.92	Hydr. Depth (m)	1.14	2.56	1.14
Conv. Total (m3/s)	6107.2	Conv. (m3/s)	435.8	5258.7	412.7
Length Wtd. (m)	4.45	Wetted Per. (m)	7.60	18.79	7.25
Min Ch El (m)	175.86	Shear (N/m2)	1.12	2.63	1.11
Alpha	1.18	Stream Power (N/m s)	0.61	2.96	0.60
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.82	0.43	1.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.47	0.16	0.59

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.2

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	12.725	181.5	14.44	181	16.148	180.5	17.868	180
19.579	179.5	21.223	179	22.754	178.5	24.249	178	25.742	177.5
27.224	177	28.735	176.5	36.975	176.06	37.575	175.86	39.575	175.86
40.175	176.06	48.415	176.5	49.851	177	51.275	177.5	52.723	178
54.188	178.5	55.665	179	57.16	179.5	58.63	180	60.657	180.5
65.963	181	67.032	181.5	68.12	182				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	36.975	.017	40.175	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
36.975	40.175	30.4	31.81	33.814	.1	.3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.31	Element	Left OB	Channel	Right OB
Vel Head (m)	0.05	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.26	Reach Len. (m)	30.40	31.81	33.81
Crit W.S. (m)		Flow Area (m2)	20.91	7.55	20.71
E.G. Slope (m/m)	0.000229	Area (m2)	20.91	7.55	20.71
Q Total (m3/s)	39.50	Flow (m3/s)	13.92	11.75	13.83
Top Width (m)	29.99	Top Width (m)	13.49	3.20	13.30
Vel Total (m/s)	0.80	Avg. Vel. (m/s)	0.67	1.56	0.67
Max Chl Dpth (m)	2.40	Hydr. Depth (m)	1.55	2.36	1.56
Conv. Total (m3/s)	2609.6	Conv. (m3/s)	919.8	776.3	913.5
Length Wtd. (m)	32.03	Wetted Per. (m)	13.79	3.26	13.61
Min Ch El (m)	175.86	Shear (N/m2)	3.41	5.19	3.42
Alpha	1.60	Stream Power (N/m s)	2.27	8.09	2.28
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.55	0.24	0.67
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.38	0.10	0.50

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.83	Element	Left OB	Channel	Right OB
Vel Head (m)	0.08	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.76	Reach Len. (m)	30.40	31.81	33.81
Crit W.S. (m)		Flow Area (m2)	28.02	9.15	27.71
E.G. Slope (m/m)	0.000265	Area (m2)	28.02	9.15	27.71
Q Total (m3/s)	62.60	Flow (m3/s)	22.69	17.41	22.50
Top Width (m)	32.97	Top Width (m)	15.00	3.20	14.77
Vel Total (m/s)	0.96	Avg. Vel. (m/s)	0.81	1.90	0.81
Max Chl Dpth (m)	2.90	Hydr. Depth (m)	1.87	2.86	1.88
Conv. Total (m3/s)	3843.1	Conv. (m3/s)	1392.8	1069.0	1381.3
Length Wtd. (m)	32.07	Wetted Per. (m)	15.38	3.26	15.16
Min Ch El (m)	175.86	Shear (N/m2)	4.74	7.29	4.76
Alpha	1.59	Stream Power (N/m s)	3.84	13.88	3.86
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.76	0.29	0.93
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.44	0.10	0.55

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.1

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	181.5	84.335	181.5	89.24	181	91.04	180.5	92.826	180
94.617	179.5	96.484	179	98.345	178.5	100.173	178	101.97	177.5
103.725	177	106.858	176.5	111.217	176.06	111.817	175.86	113.817	175.86
114.417	176.06	118.776	176.5	122.227	177	125.249	177.5	130.295	178
131.458	178.5	132.634	179	133.814	179.5	134.997	180	136.182	180.5
142.388	181	143.457	181.5	144.535	182	251.616	182		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	111.217	.017	114.417	.03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
111.217 114.417 0 0 0 .1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.30	Element	Left OB	Channel	Right OB
Vel Head (m)	0.09	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.21	Reach Len. (m)			
Crit W.S. (m)	177.38	Flow Area (m2)	15.54	7.39	18.67
E.G. Slope (m/m)	0.000375	Area (m2)	15.54	7.39	18.67
Q Total (m3/s)	39.50	Flow (m3/s)	11.90	14.52	13.08
Top Width (m)	31.36	Top Width (m)	11.80	3.20	16.36
Vel Total (m/s)	0.95	Avg. Vel. (m/s)	0.77	1.96	0.70
Max Chl Dpth (m)	2.35	Hydr. Depth (m)	1.32	2.31	1.14
Conv. Total (m3/s)	2038.5	Conv. (m3/s)	614.4	749.2	675.0
Length Wtd. (m)		Wetted Per. (m)	12.03	3.26	16.52
Min Ch El (m)	175.86	Shear (N/m2)	4.76	8.33	4.16
Alpha	1.95	Stream Power (N/m s)	3.64	16.37	2.91
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.82	Element	Left OB	Channel	Right OB
Vel Head (m)	0.11	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.71	Reach Len. (m)			
Crit W.S. (m)	177.71	Flow Area (m2)	21.94	9.00	27.19
E.G. Slope (m/m)	0.000375	Area (m2)	21.94	9.00	27.19
Q Total (m3/s)	62.60	Flow (m3/s)	19.16	20.16	23.29
Top Width (m)	34.39	Top Width (m)	13.65	3.20	17.53
Vel Total (m/s)	1.08	Avg. Vel. (m/s)	0.87	2.24	0.86
Max Chl Dpth (m)	2.85	Hydr. Depth (m)	1.61	2.81	1.55
Conv. Total (m3/s)	3231.8	Conv. (m3/s)	989.1	1040.6	1202.2
Length Wtd. (m)		Wetted Per. (m)	13.95	3.26	17.80
Min Ch El (m)	175.86	Shear (N/m2)	5.79	10.14	5.62
Alpha	1.83	Stream Power (N/m s)	5.05	22.71	4.81
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

SUMMARY OF MANNING'S N VALUES

River:Turkey Creek

Reach	River Sta.	n1	n2	n3
Main	10	.03	.017	.03
Main	9.9	.03	.017	.03
Main	9.8	.03	.017	.03
Main	9.7	.02	.017	.02
Main	9.65	Bridge		
Main	9.6	.02	.017	.02
Main	9.5	.02	.017	.02

				dric.rep	
*Main	* 9.4	*	.02*	.017*	.02*
*Main	* 9.3	*	.02*	.017*	.02*
*Main	* 9.2	*	.03*	.017*	.03*
*Main	* 9.1	*	.03*	.017*	.03*

SUMMARY OF REACH LENGTHS

River: Turkey Creek

Reach	River Sta.	Left	Channel	Right
*Main	* 10	* 207.817*	210.778*	216.406*
*Main	* 9.9	* 104.462*	100.685*	96.329*
*Main	* 9.8	* 24.356*	24.248*	24.356*
*Main	* 9.7	* 35.414*	35.414*	35.414*
*Main	* 9.65	*Bridge *	*	*
*Main	* 9.6	* 3.943*	3*	4.798*
*Main	* 9.5	* 39.545*	39.545*	39.545*
*Main	* 9.4	* 3.308*	3.678*	4.068*
*Main	* 9.3	* 3.308*	5*	4.166*
*Main	* 9.2	* 30.4*	31.81*	33.814*
*Main	* 9.1	* 0*	0*	0*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Turkey Creek

Reach	River Sta.	Contr.	Expan.
*Main	* 10	* .1*	.3*
*Main	* 9.9	* .1*	.3*
*Main	* 9.8	* .1*	.3*
*Main	* 9.7	* .3*	.5*
*Main	* 9.65	*Bridge *	*
*Main	* 9.6	* .3*	.5*
*Main	* 9.5	* .1*	.3*
*Main	* 9.4	* .1*	.3*
*Main	* 9.3	* .1*	.3*
*Main	* 9.2	* .1*	.3*
*Main	* 9.1	* .1*	.3*

Appendix A.5.3.2

Proposed Condition

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: Turkey River
Project File : dric.prj
Run Date and Time: 15/11/2006 2:55:20 PM

Project in SI units

****

PLAN DATA

Plan Title: Plan 36
Plan File : o:\DRIC\19_WaterResources\hec\dric.p36

Geometry Title: proposed
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g02

Flow Title : Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Plan Summary Information:

Number of:	Cross Sections	= 10	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 2	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

****

FLOW DATA

Flow Title: Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Flow Data (m3/s)

River	Reach	RS	100 yr	Regional
Turkey Creek	Main	10	39.5	62.6

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Turkey Creek	Main	100 yr		Normal S = 0.000375

```
* Turkey Creek    Main            Regional          *                              Normal S = 0.000375
*
*************************************************************************************************************************
*

*****************************************************************************

GEOMETRY DATA

Geometry Title: proposed
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g02

CROSS SECTION


RIVER: Turkey Creek
REACH: Main              RS: 10

INPUT
Description:
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
       0     183  76.736     183  99.766   182.5 101.278     182 102.644   181.5
  104.01     181 105.363   180.5 106.485     180 107.607   179.5 108.729     179
 109.851   178.5 110.973     178 112.095   177.5 113.217     177 116.947  176.56
 117.547  176.36 119.547  176.36 120.147  176.56 123.877     177 124.941   177.5
 126.005     178 127.069   178.5 128.133     179 129.197   179.5 130.261     180
 131.624   180.5 132.798     181 134.684   181.5 136.554     182  264.86   182.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .03 116.947    .017 120.147     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      116.947 120.147          207.817 210.778 216.406             .1       .3

CROSS SECTION OUTPUT  Profile #100 yr
*************************************************************************************************
* E.G. Elev (m)        *  178.60  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.34  * Wt. n-Val.           *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)        *  178.26  * Reach Len. (m)       *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)        *          * Flow Area (m2)       *    7.29  *    5.95  *    7.20  *
* E.G. Slope (m/m)     *0.001477  * Area (m2)            *    7.29  *    5.95  *    7.20  *
* Q Total (m3/s)       *   39.50  * Flow (m3/s)          *    9.74  *   20.10  *    9.66  *
* Top Width (m)        *   16.16  * Top Width (m)        *    6.55  *    3.20  *    6.41  *
* Vel Total (m/s)      *    1.93  * Avg. Vel. (m/s)      *    1.34  *    3.38  *    1.34  *
* Max Chl Dpth (m)     *    1.90  * Hydr. Depth (m)      *    1.11  *    1.86  *    1.12  *
* Conv. Total (m3/s)   *  1027.7  * Conv. (m3/s)         *   253.4  *   522.9  *   251.4  *
* Length Wtd. (m)      *  211.45  * Wetted Per. (m)      *    6.85  *    3.26  *    6.71  *
* Min Ch El (m)        *  176.36  * Shear (N/m2)         *   15.43  *   26.42  *   15.53  *
* Alpha                *    1.79  * Stream Power (N/m s) *   20.61  *   89.18  *   20.85  *
* Frctn Loss (m)       *    0.23  * Cum Volume (1000 m3) *    2.69  *    6.60  *    2.87  *
* C & E Loss (m)       *    0.03  * Cum SA (1000 m2)     *    2.28  *    2.51  *    2.58  *
*************************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*************************************************************************************************
* E.G. Elev (m)        *  179.19  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.43  * Wt. n-Val.           *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)        *  178.76  * Reach Len. (m)       *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)        *          * Flow Area (m2)       *   10.85  *    7.56  *   10.67  *
* E.G. Slope (m/m)     *0.001435  * Area (m2)            *   10.85  *    7.56  *   10.67  *
* Q Total (m3/s)       *   62.60  * Flow (m3/s)          *   16.68  *   29.45  *   16.47  *
* Top Width (m)        *   18.35  * Top Width (m)        *    7.68  *    3.20  *    7.47  *
* Vel Total (m/s)      *    2.15  * Avg. Vel. (m/s)      *    1.54  *    3.90  *    1.54  *
* Max Chl Dpth (m)     *    2.40  * Hydr. Depth (m)      *    1.41  *    2.36  *    1.43  *
* Conv. Total (m3/s)   *  1652.8  * Conv. (m3/s)         *   440.3  *   777.6  *   434.9  *
* Length Wtd. (m)      *  211.50  * Wetted Per. (m)      *    8.08  *    3.26  *    7.89  *
* Min Ch El (m)        *  176.36  * Shear (N/m2)         *   18.90  *   32.56  *   19.02  *
* Alpha                *    1.81  * Stream Power (N/m s) *   29.05  *  126.90  *   29.37  *
* Frctn Loss (m)       *    0.24  * Cum Volume (1000 m3) *    3.92  *    7.83  *    4.25  *
* C & E Loss (m)       *    0.03  * Cum SA (1000 m2)     *    2.69  *    2.51  *    3.01  *
*************************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
```

REACH: Main RS: 9.9

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	120.028	182.5	136.616	182	137.952	181.5	139.286	181
140.62	180.5	141.772	180	142.859	179.5	143.941	179	145.023	178.5
146.105	178	147.187	177.5	148.269	177	149.351	176.5	152.673	176.06
153.273	175.86	155.273	175.86	155.873	176.06	159.195	176.5	160.399	177
161.603	177.5	162.805	178	164.002	178.5	165.197	179	166.39	179.5
167.992	180	169.998	180.5	172.048	181	174.284	181.5	180.916	182
191.253	182.5	277.679	183						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	152.673	.017	155.873	.03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
152.673 155.873 104.462 100.685 96.329 .1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.34	Element	Left OB	Channel	Right OB
Vel Head (m)	0.23	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.11	Reach Len. (m)	104.46	100.68	96.33
Crit W.S. (m)		Flow Area (m2)	8.86	7.07	9.18
E.G. Slope (m/m)	0.000814	Area (m2)	8.86	7.07	9.18
Q Total (m3/s)	39.50	Flow (m3/s)	9.70	19.85	9.95
Top Width (m)	17.19	Top Width (m)	6.80	3.20	7.19
Vel Total (m/s)	1.57	Avg. Vel. (m/s)	1.09	2.81	1.08
Max Chl Dpth (m)	2.25	Hydr. Depth (m)	1.30	2.21	1.28
Conv. Total (m3/s)	1384.8	Conv. (m3/s)	339.9	696.1	348.8
Length Wtd. (m)	100.47	Wetted Per. (m)	7.18	3.26	7.54
Min Ch El (m)	175.86	Shear (N/m2)	9.85	17.28	9.71
Alpha	1.84	Stream Power (N/m s)	10.77	48.52	10.53
Frctn Loss (m)	0.11	Cum Volume (1000 m3)	1.01	5.23	1.10
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.90	1.84	1.11

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.92	Element	Left OB	Channel	Right OB
Vel Head (m)	0.32	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.59	Reach Len. (m)	104.46	100.68	96.33
Crit W.S. (m)		Flow Area (m2)	12.43	8.63	12.96
E.G. Slope (m/m)	0.000916	Area (m2)	12.43	8.63	12.96
Q Total (m3/s)	62.60	Flow (m3/s)	16.35	29.34	16.91
Top Width (m)	19.40	Top Width (m)	7.85	3.20	8.35
Vel Total (m/s)	1.84	Avg. Vel. (m/s)	1.32	3.40	1.31
Max Chl Dpth (m)	2.73	Hydr. Depth (m)	1.58	2.70	1.55
Conv. Total (m3/s)	2068.9	Conv. (m3/s)	540.2	969.7	558.9
Length Wtd. (m)	100.39	Wetted Per. (m)	8.34	3.26	8.80
Min Ch El (m)	175.86	Shear (N/m2)	13.37	23.72	13.22
Alpha	1.87	Stream Power (N/m s)	17.60	80.69	17.26
Frctn Loss (m)	0.11	Cum Volume (1000 m3)	1.50	6.12	1.69
C & E Loss (m)	0.01	Cum SA (1000 m2)	1.08	1.84	1.30

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.8

INPUT
Description: US of Huron Church Road
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	37.489	182	45.643	181.5	47.136	181	48.636	180.5
50.024	180	51.1	179.5	52.174	179	53.246	178.5	54.316	178
55.384	177.5	56.451	177	57.519	176.5	60.347	176.06	60.947	175.86
62.947	175.86	63.547	176.06	66.375	176.5	67.488	177	71.05	177.5
72.19	178	73.33	178.5	74.472	179	75.609	179.5	76.733	180
77.849	180.5	94.858	181	118.672	181.5	142.126	182	143.791	182.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	60.347	.017	63.547	.03

Bank Sta: Left 60.347, Right 63.547 — Lengths: Left Channel 24.356, Right Channel 24.248, Right 24.356 — Coeff Contr. .1 — Expan. .3

CROSS SECTION OUTPUT Profile #100 yr

			Left OB	Channel	Right OB
E.G. Elev (m)	178.22	Element	Left OB	Channel	Right OB
Vel Head (m)	0.36	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	177.86	Reach Len. (m)	24.36	24.25	24.36
Crit W.S. (m)		Flow Area (m2)	6.45	6.28	8.03
E.G. Slope (m/m)	0.001411	Area (m2)	6.45	6.28	8.03
Q Total (m3/s)	39.50	Flow (m3/s)	8.40	21.47	9.62
Top Width (m)	17.26	Top Width (m)	5.73	3.20	8.33
Vel Total (m/s)	1.90	Avg. Vel. (m/s)	1.30	3.42	1.20
Max Chl Dpth (m)	2.00	Hydr. Depth (m)	1.12	1.96	0.96
Conv. Total (m3/s)	1051.7	Conv. (m3/s)	223.7	571.7	256.2
Length Wtd. (m)	24.27	Wetted Per. (m)	6.07	3.26	8.58
Min Ch El (m)	175.86	Shear (N/m2)	14.69	26.62	12.95
Alpha	1.95	Stream Power (N/m s)	19.15	90.98	15.52
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.21	4.55	0.27
C & E Loss (m)	0.07	Cum SA (1000 m2)	0.24	1.52	0.36

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

			Left OB	Channel	Right OB
E.G. Elev (m)	178.80	Element	Left OB	Channel	Right OB
Vel Head (m)	0.42	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.37	Reach Len. (m)	24.36	24.25	24.36
Crit W.S. (m)		Flow Area (m2)	9.67	7.92	12.60
E.G. Slope (m/m)	0.001315	Area (m2)	9.67	7.92	12.60
Q Total (m3/s)	62.60	Flow (m3/s)	14.12	30.53	17.95
Top Width (m)	19.53	Top Width (m)	6.83	3.20	9.50
Vel Total (m/s)	2.07	Avg. Vel. (m/s)	1.46	3.85	1.42
Max Chl Dpth (m)	2.51	Hydr. Depth (m)	1.42	2.48	1.33
Conv. Total (m3/s)	1726.3	Conv. (m3/s)	389.5	841.9	494.9
Length Wtd. (m)	24.28	Wetted Per. (m)	7.28	3.26	9.85
Min Ch El (m)	175.86	Shear (N/m2)	17.13	31.30	16.49
Alpha	1.93	Stream Power (N/m s)	25.01	120.57	23.49
Frctn Loss (m)	0.02	Cum Volume (1000 m3)	0.34	5.29	0.46
C & E Loss (m)	0.06	Cum SA (1000 m2)	0.31	1.52	0.44

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.7

INPUT
Description: DS of Huron Church Road
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	135.597	182	140.617	181.5	146.159	178.5	146.159	176.5
151.177	176.06	151.777	175.86	153.777	175.86	154.377	176.06	159.395	176.5
159.395	178.5	165.459	181.5	235.174	182				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	146.159	.017	159.395	.02

Bank Sta: Left 146.159, Right 159.395 — Lengths: Left Channel 35.414, Right Channel 35.414, Right 35.414 — Coeff Contr. .3 — Expan. .5

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.14	Element	Left OB	Channel	Right OB
Vel Head (m)	0.14	Wt. n-Val.		0.017	
W.S. Elev (m)	178.00	Reach Len. (m)	0.62	0.62	0.62
Crit W.S. (m)	177.15	Flow Area (m2)		23.95	
E.G. Slope (m/m)	0.000472	Area (m2)		23.95	
Q Total (m3/s)	39.50	Flow (m3/s)		39.50	
Top Width (m)	13.24	Top Width (m)		13.24	
Vel Total (m/s)	1.65	Avg. Vel. (m/s)		1.65	
Max Chl Dpth (m)	2.14	Hydr. Depth (m)		1.81	
Conv. Total (m3/s)	1818.7	Conv. (m3/s)		1818.7	
Length Wtd. (m)	0.62	Wetted Per. (m)		16.33	
Min Ch El (m)	175.86	Shear (N/m2)		6.78	
Alpha	1.00	Stream Power (N/m s)		11.19	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.13	4.19	0.17
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.17	1.32	0.26

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.71	Element	Left OB	Channel	Right OB
Vel Head (m)	0.21	Wt. n-Val.		0.017	
W.S. Elev (m)	178.50	Reach Len. (m)	0.62	0.62	0.62
Crit W.S. (m)	177.50	Flow Area (m2)		30.60	
E.G. Slope (m/m)	0.000567	Area (m2)		30.60	
Q Total (m3/s)	62.60	Flow (m3/s)		62.60	
Top Width (m)	13.24	Top Width (m)		13.24	
Vel Total (m/s)	2.05	Avg. Vel. (m/s)		2.05	
Max Chl Dpth (m)	2.64	Hydr. Depth (m)		2.31	
Conv. Total (m3/s)	2629.0	Conv. (m3/s)		2629.0	
Length Wtd. (m)	0.62	Wetted Per. (m)		17.34	
Min Ch El (m)	175.86	Shear (N/m2)		9.81	
Alpha	1.00	Stream Power (N/m s)		20.07	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.23	4.82	0.31
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.23	1.32	0.32

BRIDGE

RIVER: Turkey Creek
REACH: Main RS: 9.65

INPUT
Description:
Distance from Upstream XS = .621
Deck/Roadway Width = 34.79
Weir Coefficient = 1.44
Upstream Deck/Roadway Coordinates
num= 9

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	181.74		90.83	182.081		118.067	182.057	
140.62	182.199	181.5	152.78	182.207	181.5	166.46	182.179	181.5
168.067	182.156		190.032	181.964		218.067	181.884	

Upstream Bridge Cross Section Data
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	135.597	182	140.617	181.5	146.159	178.5	146.159	176.5
151.177	176.06	151.777	175.86	153.777	175.86	154.377	176.06	159.395	176.5
159.395	178.5	165.459	181.5	235.174	182				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	146.159	.017	159.395	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
146.159	159.395	.3	.5

Downstream Deck/Roadway Coordinates
num= 11

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	181.74		90.83	182.081		118.067	182.057	
133.85	182.157	181.5	137.28	182.199	181.5	152.78	182.207	181.5
165.46	182.179	181.5	168.067	182.156	181.5	175.93	182.11	181.5
190.032	181.964		218.067	181.884				

Downstream Bridge Cross Section Data
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	125.33	182	133.85	181.5	140.248	179.5	140.248	176.5
145.27	176.06	145.87	175.86	147.87	175.86	148.47	176.06	153.492	176.5
153.492	179.5	161.948	180.5	166.14	181	170.386	181.5	199.519	182

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	140.248	.017	153.492	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
140.248	153.492	.3	.5

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Pressure and Weir flow
Submerged Inlet Cd =
Submerged Inlet + Outlet Cd = .8
Max Low Cord =

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #100 yr

E.G. US. (m)	178.14	Element	Inside BR US	Inside BR DS
W.S. US. (m)	178.00	E.G. Elev (m)	178.14	178.12
Q Total (m3/s)	39.50	W.S. Elev (m)	178.00	177.98
Q Bridge (m3/s)	39.50	Crit W.S. (m)	177.16	177.16
Q Weir (m3/s)		Max Chl Dpth (m)	2.14	2.12
Weir Sta Lft (m)		Vel Total (m/s)	1.65	1.67
Weir Sta Rgt (m)		Flow Area (m2)	23.95	23.69
Weir Submerg		Froude # Chl	0.39	0.40
Weir Max Depth (m)		Specif Force (m3)	28.57	28.17
Min El Weir Flow (m)	181.95	Hydr Depth (m)	1.81	1.79
Min El Prs (m)	181.50	W.P. Total (m)	16.33	16.30
Delta EG (m)	0.02	Conv. Total (m3/s)	1818.1	1788.3
Delta WS (m)	0.02	Top Width (m)	13.24	13.24
BR Open Area (m2)	87.72	Frctn Loss (m)	0.02	0.00
BR Open Vel (m/s)	1.67	C & E Loss (m)	0.00	0.00
Coef of Q		Shear Total (N/m2)	6.79	6.95
Br Sel Method	Energy only	Power Total (N/m s)	11.19	11.59

BRIDGE OUTPUT Profile #Regional

E.G. US. (m)	178.71	Element	Inside BR US	Inside BR DS
W.S. US. (m)	178.50	E.G. Elev (m)	178.71	178.69
Q Total (m3/s)	62.60	W.S. Elev (m)	178.50	178.47
Q Bridge (m3/s)	62.60	Crit W.S. (m)	177.50	177.50
Q Weir (m3/s)		Max Chl Dpth (m)	2.64	2.61
Weir Sta Lft (m)		Vel Total (m/s)	2.05	2.07
Weir Sta Rgt (m)		Flow Area (m2)	30.60	30.28
Weir Submerg		Froude # Chl	0.43	0.44
Weir Max Depth (m)		Specif Force (m3)	48.68	48.06
Min El Weir Flow (m)	181.95	Hydr Depth (m)	2.31	2.29
Min El Prs (m)	181.50	W.P. Total (m)	17.34	17.30
Delta EG (m)	0.02	Conv. Total (m3/s)	2628.3	2587.0
Delta WS (m)	0.03	Top Width (m)	13.24	13.24
BR Open Area (m2)	87.72	Frctn Loss (m)	0.02	0.00

* BR Open Vel (m/s)	* 2.07	* C & E Loss (m)	* 0.00	* 0.00	*
* Coef of Q	*	* Shear Total (N/m2)	* 9.82	* 10.05	*
* Br Sel Method	*Energy only	* Power Total (N/m s)	* 20.09	* 20.78	*

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.6

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	125.33	182	133.85	181.5	140.248	179.5	140.248	176.5
145.27	176.06	145.87	175.86	147.87	175.86	148.47	176.06	153.492	176.5
153.492	179.5	161.948	180.5	166.14	181	170.386	181.5	199.519	182

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	140.248	.017	153.492	.02

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
140.248 153.492 8.508 3 8.362 .3 .5

CROSS SECTION OUTPUT Profile #100 yr

* E.G. Elev (m)	* 178.12	* Element	* Left OB	* Channel	* Right OB *
* Vel Head (m)	* 0.14	* Wt. n-Val.	*	* 0.017	* *
* W.S. Elev (m)	* 177.98	* Reach Len. (m)	* 8.51	* 3.00	* 8.36 *
* Crit W.S. (m)	*	* Flow Area (m2)	*	* 23.69	* *
* E.G. Slope (m/m)	*0.000488	* Area (m2)	*	* 23.69	* *
* Q Total (m3/s)	* 39.50	* Flow (m3/s)	*	* 39.50	* *
* Top Width (m)	* 13.24	* Top Width (m)	*	* 13.24	* *
* Vel Total (m/s)	* 1.67	* Avg. Vel. (m/s)	*	* 1.67	* *
* Max Chl Dpth (m)	* 2.12	* Hydr. Depth (m)	*	* 1.79	* *
* Conv. Total (m3/s)	* 1788.3	* Conv. (m3/s)	*	* 1788.3	* *
* Length Wtd. (m)	* 3.00	* Wetted Per. (m)	*	* 16.30	* *
* Min Ch El (m)	* 175.86	* Shear (N/m2)	*	* 6.95	* *
* Alpha	* 1.00	* Stream Power (N/m s)	*	* 11.59	* *
* Frctn Loss (m)	* 0.00	* Cum Volume (1000 m3)	* 0.13	* 3.34	* 0.17 *
* C & E Loss (m)	* 0.06	* Cum SA (1000 m2)	* 0.17	* 0.85	* 0.26 *

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

* E.G. Elev (m)	* 178.69	* Element	* Left OB	* Channel	* Right OB *
* Vel Head (m)	* 0.22	* Wt. n-Val.	*	* 0.017	* *
* W.S. Elev (m)	* 178.47	* Reach Len. (m)	* 8.51	* 3.00	* 8.36 *
* Crit W.S. (m)	*	* Flow Area (m2)	*	* 30.28	* *
* E.G. Slope (m/m)	*0.000586	* Area (m2)	*	* 30.28	* *
* Q Total (m3/s)	* 62.60	* Flow (m3/s)	*	* 62.60	* *
* Top Width (m)	* 13.24	* Top Width (m)	*	* 13.24	* *
* Vel Total (m/s)	* 2.07	* Avg. Vel. (m/s)	*	* 2.07	* *
* Max Chl Dpth (m)	* 2.61	* Hydr. Depth (m)	*	* 2.29	* *
* Conv. Total (m3/s)	* 2587.0	* Conv. (m3/s)	*	* 2587.0	* *
* Length Wtd. (m)	* 3.00	* Wetted Per. (m)	*	* 17.30	* *
* Min Ch El (m)	* 175.86	* Shear (N/m2)	*	* 10.05	* *
* Alpha	* 1.00	* Stream Power (N/m s)	*	* 20.78	* *
* Frctn Loss (m)	* 0.00	* Cum Volume (1000 m3)	* 0.23	* 3.74	* 0.31 *
* C & E Loss (m)	* 0.09	* Cum SA (1000 m2)	* 0.23	* 0.85	* 0.32 *

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.5

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	58.964	182	66.492	180	66.492	176.5	80.892	176.06
81.492	175.86	83.492	175.86	84.092	176.06	98.492	176.5	98.492	180
99.757	180.5	103.154	181	106.622	181.5	138.493	182		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	66.492	.017	98.492	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
66.492	98.492	39.545	39.545	.3	.5

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.06	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.		0.017	
W.S. Elev (m)	178.03	Reach Len. (m)	0.14	0.14	0.14
Crit W.S. (m)	176.78	Flow Area (m2)		57.38	
E.G. Slope (m/m)	0.000071	Area (m2)		57.38	
Q Total (m3/s)	39.50	Flow (m3/s)		39.50	
Top Width (m)	32.00	Top Width (m)		32.00	
Vel Total (m/s)	0.69	Avg. Vel. (m/s)		0.69	
Max Chl Dpth (m)	2.17	Hydr. Depth (m)		1.79	
Conv. Total (m3/s)	4679.2	Conv. (m3/s)		4679.2	
Length Wtd. (m)	0.14	Wetted Per. (m)		35.15	
Min Ch El (m)	175.86	Shear (N/m2)		1.14	
Alpha	1.00	Stream Power (N/m s)		0.79	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.13	3.22	0.17
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.17	0.78	0.26

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.60	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.		0.017	
W.S. Elev (m)	178.56	Reach Len. (m)	0.14	0.14	0.14
Crit W.S. (m)	176.97	Flow Area (m2)		74.31	
E.G. Slope (m/m)	0.000079	Area (m2)		74.31	
Q Total (m3/s)	62.60	Flow (m3/s)		62.60	
Top Width (m)	32.00	Top Width (m)		32.00	
Vel Total (m/s)	0.84	Avg. Vel. (m/s)		0.84	
Max Chl Dpth (m)	2.70	Hydr. Depth (m)		2.32	
Conv. Total (m3/s)	7059.7	Conv. (m3/s)		7059.7	
Length Wtd. (m)	0.14	Wetted Per. (m)		36.21	
Min Ch El (m)	175.86	Shear (N/m2)		1.58	
Alpha	1.00	Stream Power (N/m s)		1.33	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.23	3.59	0.31
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.23	0.78	0.32

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

BRIDGE

RIVER: Turkey Creek
REACH: Main RS: 9.45

INPUT
Description:
Distance from Upstream XS = .143
Deck/Roadway Width = 36.402
Weir Coefficient = 1.44
Upstream Deck/Roadway Coordinates
num= 17

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	180.1		32.49	180		66.99	179.06	176.06
66.99	179.06	177.86	76.99	179.03	177.86	76.99	179.03	176.06
77.49	179.03	176.06	77.49	179.03	177.86	82.49	179.03	177.86
87.49	179.03	177.86	87.49	179.03	176.06	87.99	179.03	176.06

```
  87.99  179.03  177.86   97.99  179.03  177.86   97.99  179.03  176.06
 132.49   178.3          182.49     178

Upstream Bridge Cross Section Data
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0   182.5  58.964     182  66.492     180  66.492   176.5  80.892  176.06
  81.492  175.86  83.492  175.86  84.092  176.06  98.492   176.5  98.492     180
  99.757   180.5 103.154     181 106.622   181.5 138.493     182

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02  66.492    .017  98.492     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
        66.492  98.492             .3       .5

Downstream  Deck/Roadway Coordinates
    num=      17
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*************************************************************************
       0     180            9.55     180           44.05  179.06  176.06
   44.05  179.06  177.86   54.05  179.03  177.86   54.05  179.03  176.06
   54.55  179.03  176.06   54.55  179.03  177.86   59.55  179.03  177.86
   64.55  179.03  177.86   64.55  179.03  176.06   65.05  179.03  176.06
   65.05  179.03  177.86   75.05  179.03  177.86   75.05  179.03  176.06
  109.55   178.3          159.55     178

Downstream Bridge Cross Section Data
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
       0   182.5  22.451     182  30.035   181.5  43.553   179.5  43.553   176.5
  57.953  176.06  58.553  175.86  60.553  175.86  61.153  176.06  75.553   176.5
  75.553   179.5  84.157     181  86.382   181.5  87.423     182 124.022   182.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .02  43.553    .017  75.553     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
        43.553  75.553             .3       .5

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #100 yr
*********************************************************************************************
* E.G. US. (m)          *     178.06  * Element              *Inside BR US *Inside BR DS *
* W.S. US. (m)          *     178.03  * E.G. Elev (m)        *     178.06  *     178.05  *
* Q Total (m3/s)        *      39.50  * W.S. Elev (m)        *     178.02  *     178.01  *
* Q Bridge (m3/s)       *      39.50  * Crit W.S. (m)        *     176.80  *     176.80  *
* Q Weir (m3/s)         *             * Max Chl Dpth (m)     *       2.16  *       2.15  *
* Weir Sta Lft (m)      *             * Vel Total (m/s)      *       0.81  *       0.81  *
* Weir Sta Rgt (m)      *             * Flow Area (m2)       *      48.73  *      48.73  *
* Weir Submerg          *             * Froude # Chl         *       0.19  *       0.19  *
```

Weir Max Depth (m)		Specif Force (m3)	51.18		50.63
Min El Weir Flow (m)	179.02	Hydr Depth (m)			
Min El Prs (m)	177.86	W.P. Total (m)	69.58		69.58
Delta EG (m)	0.02	Conv. Total (m3/s)	2260.3		2260.2
Delta WS (m)	0.02	Top Width (m)			
BR Open Area (m2)	48.73	Frctn Loss (m)	0.01		0.00
BR Open Vel (m/s)	0.81	C & E Loss (m)	0.00		0.00
Coef of Q		Shear Total (N/m2)	2.10		2.10
Br Sel Method	Energy only	Power Total (N/m s)	1.70		1.70

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

BRIDGE OUTPUT Profile #Regional

			Inside BR US	Inside BR DS
E.G. US. (m)	178.60	Element	Inside BR US	Inside BR DS
W.S. US. (m)	178.56	E.G. Elev (m)	178.59	178.56
Q Total (m3/s)	62.60	W.S. Elev (m)	178.50	178.47
Q Bridge (m3/s)	62.60	Crit W.S. (m)	177.00	177.00
Q Weir (m3/s)		Max Chl Dpth (m)	2.64	2.61
Weir Sta Lft (m)		Vel Total (m/s)	1.28	1.28
Weir Sta Rgt (m)		Flow Area (m2)	48.73	48.73
Weir Submerg		Froude # Chl	0.27	0.27
Weir Max Depth (m)		Specif Force (m3)	79.45	78.09
Min El Weir Flow (m)	179.02	Hydr Depth (m)		
Min El Prs (m)	177.86	W.P. Total (m)	69.58	69.58
Delta EG (m)	0.07	Conv. Total (m3/s)	2260.3	2260.2
Delta WS (m)	0.07	Top Width (m)		
BR Open Area (m2)	48.73	Frctn Loss (m)	0.03	0.00
BR Open Vel (m/s)	1.28	C & E Loss (m)	0.00	0.02
Coef of Q		Shear Total (N/m2)	5.27	5.27
Br Sel Method	Energy only	Power Total (N/m s)	6.77	6.77

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.4

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	22.451	182	30.035	181.5	43.553	179.5	43.553	176.5
57.953	176.06	58.553	175.86	60.553	175.86	61.153	176.06	75.553	176.5
75.553	179.5	84.157	181	86.382	181.5	87.423	182	124.022	182.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	43.553	.017	75.553	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
43.553	75.553	5.639	5	6.353	.3	.5

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.04	Element	Left OB	Channel	Right OB
Vel Head (m)	0.02	Wt. n-Val.		0.017	
W.S. Elev (m)	178.02	Reach Len. (m)	5.64	5.00	6.35
Crit W.S. (m)		Flow Area (m2)		56.76	
E.G. Slope (m/m)	0.000074	Area (m2)		56.76	
Q Total (m3/s)	39.50	Flow (m3/s)		39.50	
Top Width (m)	32.00	Top Width (m)		32.00	
Vel Total (m/s)	0.70	Avg. Vel. (m/s)		0.70	
Max Chl Dpth (m)	2.16	Hydr. Depth (m)		1.77	
Conv. Total (m3/s)	4599.1	Conv. (m3/s)		4599.1	
Length Wtd. (m)	5.00	Wetted Per. (m)		35.11	
Min Ch El (m)	175.86	Shear (N/m2)		1.17	
Alpha	1.00	Stream Power (N/m s)		0.81	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.13	1.28	0.17
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.17	0.73	0.26

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.53	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.		0.017	
W.S. Elev (m)	178.50	Reach Len. (m)	5.64	5.00	6.35
Crit W.S. (m)		Flow Area (m2)		72.14	
E.G. Slope (m/m)	0.000086	Area (m2)		72.14	
Q Total (m3/s)	62.60	Flow (m3/s)		62.60	
Top Width (m)	32.00	Top Width (m)		32.00	
Vel Total (m/s)	0.87	Avg. Vel. (m/s)		0.87	
Max Chl Dpth (m)	2.64	Hydr. Depth (m)		2.25	
Conv. Total (m3/s)	6735.6	Conv. (m3/s)		6735.6	
Length Wtd. (m)	5.00	Wetted Per. (m)		36.07	
Min Ch El (m)	175.86	Shear (N/m2)		1.69	
Alpha	1.00	Stream Power (N/m s)		1.47	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.23	1.62	0.31
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.23	0.73	0.32

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.3

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182.5	22.465	182	35.015	181.5	36.837	181	47.673	178
47.673	176.5	58.823	176.06	59.423	175.86	61.423	175.86	62.023	176.06
73.173	176.5	73.173	178	81.981	180.5	86.631	181	89.072	182
225.65	182.5								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	47.673	.017	73.173	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
47.673	73.173	4.02	3.772	4.02	.1	.3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.04	Element	Left OB	Channel	Right OB
Vel Head (m)	0.04	Wt. n-Val.		0.017	
W.S. Elev (m)	178.00	Reach Len. (m)	4.02	3.77	4.02
Crit W.S. (m)		Flow Area (m2)		44.98	
E.G. Slope (m/m)	0.000122	Area (m2)		44.98	
Q Total (m3/s)	39.50	Flow (m3/s)		39.50	
Top Width (m)	25.50	Top Width (m)		25.50	
Vel Total (m/s)	0.88	Avg. Vel. (m/s)		0.88	
Max Chl Dpth (m)	2.14	Hydr. Depth (m)		1.76	
Conv. Total (m3/s)	3580.8	Conv. (m3/s)		3580.8	
Length Wtd. (m)	3.78	Wetted Per. (m)		28.57	
Min Ch El (m)	175.86	Shear (N/m2)		1.88	
Alpha	1.00	Stream Power (N/m s)		1.65	
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.13	1.03	0.17
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.17	0.59	0.26

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.53	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.020	0.017	0.020
W.S. Elev (m)	178.47	Reach Len. (m)	4.02	3.77	4.02
Crit W.S. (m)		Flow Area (m2)	0.39	56.97	0.38
E.G. Slope (m/m)	0.000138	Area (m2)	0.39	56.97	0.38
Q Total (m3/s)	62.60	Flow (m3/s)	0.09	62.43	0.08
Top Width (m)	28.82	Top Width (m)	1.68	25.50	1.64
Vel Total (m/s)	1.08	Avg. Vel. (m/s)	0.22	1.10	0.22
Max Chl Dpth (m)	2.61	Hydr. Depth (m)	0.23	2.23	0.23
Conv. Total (m3/s)	5321.4	Conv. (m3/s)	7.2	5307.2	7.1
Length Wtd. (m)	3.78	Wetted Per. (m)	1.75	28.58	1.71
Min Ch El (m)	175.86	Shear (N/m2)	0.30	2.70	0.30
Alpha	1.02	Stream Power (N/m s)	0.07	2.96	0.07
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	0.22	1.30	0.31
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.22	0.59	0.32

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.2

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	12.725	181.5	14.44	181	16.148	180.5	17.868	180
19.579	179.5	21.223	179	22.754	178.5	24.249	178	25.742	177.5
27.224	177	28.735	176.5	36.975	176.06	37.575	175.86	39.575	175.86
40.175	176.06	48.415	176.5	49.851	177	51.275	177.5	52.723	178
54.188	178.5	55.665	179	57.16	179.5	58.63	180	60.657	180.5
65.963	181	67.032	181.5	68.12	182				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	28.735	.017	48.415	.03

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
28.735 48.415 30.4 31.81 33.814 .1 .3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.03	Element	Left OB	Channel	Right OB
Vel Head (m)	0.06	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	177.98	Reach Len. (m)	30.40	31.81	33.81
Crit W.S. (m)		Flow Area (m2)	3.27	34.61	3.12
E.G. Slope (m/m)	0.000160	Area (m2)	3.27	34.61	3.12
Q Total (m3/s)	39.50	Flow (m3/s)	1.09	37.38	1.03
Top Width (m)	28.34	Top Width (m)	4.42	19.68	4.24
Vel Total (m/s)	0.96	Avg. Vel. (m/s)	0.33	1.08	0.33
Max Chl Dpth (m)	2.12	Hydr. Depth (m)	0.74	1.76	0.74
Conv. Total (m3/s)	3125.6	Conv. (m3/s)	86.1	2957.7	81.8
Length Wtd. (m)	31.85	Wetted Per. (m)	4.66	19.77	4.49
Min Ch El (m)	175.86	Shear (N/m2)	1.10	2.74	1.09
Alpha	1.20	Stream Power (N/m s)	0.37	2.96	0.36
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.13	0.88	0.17
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.16	0.50	0.25

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.52	Element	Left OB	Channel	Right OB
Vel Head (m)	0.08	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.44	Reach Len. (m)	30.40	31.81	33.81
Crit W.S. (m)		Flow Area (m2)	5.64	43.74	5.41
E.G. Slope (m/m)	0.000176	Area (m2)	5.64	43.74	5.41
Q Total (m3/s)	62.60	Flow (m3/s)	2.36	57.99	2.25
Top Width (m)	31.08	Top Width (m)	5.80	19.68	5.60
Vel Total (m/s)	1.14	Avg. Vel. (m/s)	0.42	1.33	0.42
Max Chl Dpth (m)	2.58	Hydr. Depth (m)	0.97	2.22	0.97
Conv. Total (m3/s)	4717.3	Conv. (m3/s)	178.1	4369.7	169.6
Length Wtd. (m)	31.88	Wetted Per. (m)	6.12	19.77	5.93
Min Ch El (m)	175.86	Shear (N/m2)	1.59	3.82	1.58
Alpha	1.26	Stream Power (N/m s)	0.67	5.07	0.66
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.21	1.11	0.30
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.21	0.50	0.30

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Turkey Creek
REACH: Main RS: 9.1

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	181.5	84.335	181.5	89.24	181	91.04	180.5	92.826	180
94.617	179.5	96.484	179	98.345	178.5	100.173	178	101.97	177.5
103.725	177	106.858	176.5	111.217	176.06	111.817	175.86	113.817	175.86
114.417	176.06	118.776	176.5	122.227	177	125.249	177.5	130.295	178
131.458	178.5	132.634	179	133.814	179.5	134.997	180	136.182	180.5
142.388	181	143.457	181.5	144.535	182	251.616	182		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.03	106.858	.017	118.776	.03

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
106.858	118.776	0	0	.1	.3

CROSS SECTION OUTPUT Profile #100 yr

E.G. Elev (m)	178.02	Element	Left OB	Channel	Right OB
Vel Head (m)	0.12	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	177.90	Reach Len. (m)			
Crit W.S. (m)	177.20	Flow Area (m2)	5.05	20.56	6.77
E.G. Slope (m/m)	0.000375	Area (m2)	5.05	20.56	6.77
Q Total (m3/s)	39.50	Flow (m3/s)	2.76	33.51	3.24
Top Width (m)	28.79	Top Width (m)	6.34	11.92	10.54
Vel Total (m/s)	1.22	Avg. Vel. (m/s)	0.55	1.63	0.48
Max Chl Dpth (m)	2.04	Hydr. Depth (m)	0.80	1.73	0.64
Conv. Total (m3/s)	2038.9	Conv. (m3/s)	142.2	1729.7	167.0
Length Wtd. (m)		Wetted Per. (m)	6.50	12.03	10.63
Min Ch El (m)	175.86	Shear (N/m2)	2.86	6.29	2.34
Alpha	1.54	Stream Power (N/m s)	1.56	10.25	1.12
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

CROSS SECTION OUTPUT Profile #Regional

E.G. Elev (m)	178.51	Element	Left OB	Channel	Right OB
Vel Head (m)	0.15	Wt. n-Val.	0.030	0.017	0.030
W.S. Elev (m)	178.36	Reach Len. (m)			
Crit W.S. (m)	177.53	Flow Area (m2)	8.32	26.00	12.13
E.G. Slope (m/m)	0.000375	Area (m2)	8.32	26.00	12.13
Q Total (m3/s)	62.60	Flow (m3/s)	5.41	49.53	7.66
Top Width (m)	32.27	Top Width (m)	8.00	11.92	12.35
Vel Total (m/s)	1.35	Avg. Vel. (m/s)	0.65	1.90	0.63
Max Chl Dpth (m)	2.50	Hydr. Depth (m)	1.04	2.18	0.98
Conv. Total (m3/s)	3232.0	Conv. (m3/s)	279.3	2557.1	395.5
Length Wtd. (m)		Wetted Per. (m)	8.22	12.03	12.53
Min Ch El (m)	175.86	Shear (N/m2)	3.72	7.95	3.56
Alpha	1.63	Stream Power (N/m s)	2.42	15.15	2.25
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

SUMMARY OF MANNING'S N VALUES

River:Turkey Creek

Reach	River Sta.	n1	n2	n3
Main	10	.03	.017	.03
Main	9.9	.03	.017	.03
Main	9.8	.03	.017	.03
Main	9.7	.02	.017	.02
Main	9.65	Bridge		
Main	9.6	.02	.017	.02
Main	9.5	.02	.017	.02
Main	9.45	Bridge		
Main	9.4	.02	.017	.02
Main	9.3	.02	.017	.02
Main	9.2	.03	.017	.03
Main	9.1	.03	.017	.03

SUMMARY OF REACH LENGTHS

River: Turkey Creek

Reach	River Sta.	Left	Channel	Right
Main	10	207.817	210.778	216.406
Main	9.9	104.462	100.685	96.329
Main	9.8	24.356	24.248	24.356
Main	9.7	35.414	35.414	35.414
Main	9.65	Bridge		
Main	9.6	8.508	3	8.362
Main	9.5	39.545	39.545	39.545
Main	9.45	Bridge		
Main	9.4	5.639	5	6.353
Main	9.3	4.02	3.772	4.02
Main	9.2	30.4	31.81	33.814
Main	9.1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Turkey Creek

Reach	River Sta.	Contr.	Expan.
Main	10	.1	.3
Main	9.9	.1	.3
Main	9.8	.1	.3
Main	9.7	.3	.5
Main	9.65	Bridge	
Main	9.6	.3	.5
Main	9.5	.3	.5
Main	9.45	Bridge	
Main	9.4	.3	.5
Main	9.3	.1	.3
Main	9.2	.1	.3
Main	9.1	.1	.3

Appendix A.6

Alternative 3

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	181.40	m	Headwater Depth/Height	1.20	
Computed Headwater Elevat	180.32	m	Discharge	8.1000	m³/s
Inlet Control HW Elev.	180.32	m	Tailwater Elevation	179.70	m
Outlet Control HW Elev.	180.32	m	Control Type	Inlet Control	

Grades					
Upstream Invert	178.50	m	Downstream Invert	178.20	m
Length	58.00	m	Constructed Slope	0.005172	m/m

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.05	m
Slope Type	Steep		Normal Depth	1.05	m
Flow Regime	N/A		Critical Depth	1.14	m
Velocity Downstream	3.62	m/s	Critical Slope	0.004178	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.13	m
Section Size	2130 x 1520 mm		Rise	1.52	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	180.32	m	Upstream Velocity Head	0.57	m
Ke	0.20		Entrance Loss	0.11	m

Inlet Control Properties					
Inlet Control HW Elev.	180.32	m	Flow Control	Transition	
Inlet Type	90° headwall w 45° bevels		Area Full	3.3	m²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Number	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix B

Hydrologic Analysis
Pre & Post Development Conditions

Appendix B.1

Pre-Development Condition

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 1A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	850	0.91	68.7	0.37	To TTcombe Drain
101	2.53	0.30	733	0.82	73.9	0.16	To Basin Drain
102	5.60	0.30	833	0.26	143.5	0.68	Pump to Mangin Drain
103	2.60	0.30	747	0.83	73.2	0.16	To Turkey Creek
104	2.50	0.30	353	0.52	99.0	0.21	Pump to Lenon Drain
105	2.50	0.30	533	0.67	84.6	0.18	To Lenon Drain
106	5.60	0.30	767	0.85	72.0	0.34	Pump to Cahill Drain
107	3.10	0.30	881	0.92	67.9	0.18	To Wolfe Drain
108	3.96	0.30	834	0.89	69.6	0.23	Pump to Wolfe Drain
109	6.60	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 1B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	885	0.93	67.5	0.36	To TTcombe Drain
101	2.70	0.30	468	0.62	89.0	0.20	To Basin Drain
102	5.38	0.30	670	0.78	76.3	0.34	Pump to Mangin Drain
103	4.50	0.30	847	0.90	69.0	0.26	Pump to Turkey Creek
104	2.74	0.30	451	0.61	90.2	0.21	Pump to Lenon Drain
105	7.21	0.30	1,016	1.02	63.3	0.38	Pump to Cahill Drain
106	6.17	0.30	1,498	1.31	52.6	0.27	Pump to Wolfe Drain
107	6.56	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100 - year Peak Flow (m^3/s)	Remarks
100	6.36	0.30	880	0.928	67.7	0.36	Drain to TTcombe Drain
101	1.69	0.30	483	0.626	88.3	0.13	Basin Drain
102	5.19	0.30	847	0.904	68.9	0.30	Pump to Mangin Drain
103	3.31	0.30	732	0.820	73.8	0.21	To Turkey Creek
104	4.93	0.30	556	0.696	82.4	0.34	Pump to Lennon Drain
105	2.61	0.30	529	0.667	84.8	0.19	To Cahill Drain
106	5.30	0.30	969	0.985	64.9	0.29	Pump to Cahill Drain
107	7.06	0.30	998	1.007	63.9	0.38	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.30	880	0.93	67.7	0.36	Drain to TTcombe Drain
101	2.13	0.30	482	0.63	88.2	0.16	Basin Drain
102	6.54	0.30	884	0.93	67.5	0.37	Pump to Mangin Drain
103	7.21	0.30	1453	1.29	53.4	0.32	Pump to Turkey Creek
104	2.34	0.30	421	0.58	92.8	0.18	Pump to Lennon Drain
105	5.77	0.30	1377	1.24	54.8	0.27	Pump to Cahill Drain
106	9.32	0.30	1023	1.03	63.0	0.49	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2B - Revised Proposed

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	810	0.88	70.2	0.37	To TTcombe Drain
101	8.67	0.30	1260	1.17	57.2	0.42	Pump To Basin Drain
102	6.22	0.30	1080	1.06	61.6	0.32	Pump to Lenon Drain
103	19.43	0.30	3240	2.22	35.0	0.57	Pump to Cahill Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Inlet Time (t_i)= 5 min
Average Velocity = 1.5 m/s

Rational Method Calculation
Existing Conidtion
Alternative 3

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	850	0.91	68.7	0.37	To TTcombe Drain
101	2.80	0.30	798	0.87	71.1	0.17	Pump to Basin Drain
102	0.34	0.30	342	0.50	101.7	0.03	Pump to Turkey Creek
103	0.34	0.30	342	0.50	101.7	0.03	Pump to Turkey Creek
104	0.14	0.30	140	0.29	138.1	0.02	Pump to Cahill Drain
105	0.19	0.30	194	0.35	124.6	0.02	Pump to Cahill Drain
106	0.17	0.30	174	0.33	129.1	0.02	Pump to Cahill Drain
107	0.19	0.30	191	0.35	125.3	0.02	Pump to Cahill Drain
108	2.16	0.30	774	0.85	72.1	0.13	Pump to Wolfe Drain
109	6.56	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Appendix B.2

Post Development Condition

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min

A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 1A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	850	0.24	149.6	2.40	To TTcombe Drain
101	2.53	0.90	733	0.22	155.9	0.99	To Basin Drain
102	5.60	0.90	833	0.24	150.5	2.12	Pump to Mangin Drain
103	2.60	0.90	747	0.22	155.2	1.02	To Turkey Creek
104	2.50	0.90	353	0.15	181.2	1.14	Pump to Lenon Drain
105	2.50	0.90	533	0.18	168.2	1.06	To Lenon Drain
106	5.60	0.90	767	0.23	154.0	2.17	Pump to Cahill Drain
107	3.10	0.90	881	0.25	148.0	1.16	To Wolfe Drain
108	3.96	0.90	834	0.24	150.4	1.50	Pump to Wolfe Drain
109	6.60	0.90	1737	0.41	114.9	1.91	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i) = 5 min

A: **2824.505** Average Velocity (v) = 1.5 m/s

B: **13.74**

C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 1B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	885	0.25	147.8	2.37	To TTcombe Drain
101	2.70	0.90	468	0.17	172.7	1.18	To Basin Drain
102	5.38	0.90	670	0.21	159.6	2.16	Pump to Mangin Drain
103	4.50	0.90	847	0.24	149.8	1.70	Pump to Turkey Creek
104	2.74	0.90	451	0.17	173.9	1.20	Pump to Lenon Drain
105	7.21	0.90	1,016	0.27	141.5	2.57	Pump to Cahill Drain
106	6.17	0.90	1,498	0.36	122.5	1.90	Pump to Wolfe Drain
107	6.56	0.90	1737	0.41	114.9	1.90	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min

A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 2A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.90	880	0.25	148.1	2.37	Drain to TTcombe Drain
101	1.69	0.90	483	0.17	171.7	0.73	Basin Drain
102	5.19	0.90	847	0.24	149.8	1.96	Pump to Mangin Drain
103	3.31	0.90	732	0.22	156.0	1.30	To Turkey Creek
104	4.93	0.90	556	0.19	166.7	2.07	Pump to Lennon Drain
105	2.61	0.90	529	0.18	168.5	1.11	To Cahill Drain
106	5.30	0.90	969	0.26	143.7	1.92	Pump to Cahill Drain
107	7.06	0.90	998	0.27	142.3	2.53	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Inlet Time (t_i)= 5 min
Average Velocity = 1.5 m/s

Rational Method Calculation
Proposed Conidtion
Alternative 2B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.90	880	0.25	148.1	2.37	Drain to TTcombe Drain
101	2.13	0.90	482	0.17	171.7	0.92	Basin Drain
102	6.54	0.90	884	0.25	147.9	2.44	Pump to Mangin Drain
103	7.21	0.90	1453	0.35	124.0	2.25	Pump to Turkey Creek
104	2.34	0.90	421	0.16	176.1	1.04	Pump to Lennon Drain
105	5.77	0.90	1377	0.34	126.7	1.84	Pump to Cahill Drain
106	9.32	0.90	1023	0.27	141.2	3.32	Pump to Wolfe Drain

STORM SEWER CALCULATIONS

FOR

Detroit River International Crossing Study

Alternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06

File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS				CONCENTRATION TIME (min)			CATCHMENT RUNOFF		PIPE CHARACTERISTICS				
				A (ha)	C	"AC"	ACCUM. "AC"	INLET	IN PIPE	TOTAL	"I" (mm/hr)	"Q" (m3/s)	LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
To 2BR - P1	1	2	1	0.310	0.90	0.28	0.28	5.00	1.26	6.26	214.24	0.166	90.00	600	0.30	0.336	1.19
	2	3	2	0.320	0.90	0.29	0.57	6.26	1.26	7.52	202.31	0.318	90.00	600	0.30	0.336	1.19
	3	4	3	0.320	0.90	0.29	0.86	7.52	1.04	8.56	191.71	0.454	90.00	800	0.30	0.724	1.44
	4	5	4	0.580	0.90	0.52	1.38	8.56	1.04	9.60	183.81	0.701	90.00	800	0.30	0.724	1.44
	5	6	5	0.610	0.90	0.55	1.93	9.60	0.90	10.50	176.58	0.942	90.00	1000	0.30	1.313	1.67
	6	7	6	0.320	0.90	0.29	2.21	10.50	0.90	11.40	170.82	1.048	90.00	1000	0.30	1.313	1.67
	7	8	7	0.320	0.90	0.29	2.50	11.40	0.90	12.30	165.44	1.147	90.00	1000	0.30	1.313	1.67
	8	9	8	0.320	0.90	0.29	2.79	12.30	0.38	12.67	160.41	1.240	90.00	1000	1.70	3.126	3.98
	9	10	9	0.310	0.90	0.28	3.07	12.67	0.38	13.05	158.40	1.347	90.00	1000	1.70	3.126	3.98
	10	11	10	0.310	0.90	0.28	3.35	13.05	0.38	13.43	156.44	1.451	90.00	1000	1.70	3.126	3.98
	11	12	11	1.080	0.90	0.97	4.32	13.43	0.38	13.80	154.52	1.849	90.00	1000	1.70	3.126	3.98
	12	13	12	0.320	0.90	0.29	4.61	13.80	0.62	14.42	152.66	1.949	90.00	1200	0.50	2.757	2.44
	13	14	13	0.320	0.90	0.29	4.90	14.42	0.62	15.03	149.72	2.031	90.00	1200	0.50	2.757	2.44
	14	15	14	0.320	0.90	0.29	5.18	15.03	0.62	15.65	146.90	2.109	90.00	1200	0.50	2.757	2.44
	15	16	15	0.720	0.90	0.65	5.83	15.65	0.62	16.26	144.19	2.329	90.00	1200	0.50	2.757	2.44
	16	17	16	0.320	0.90	0.29	6.12	16.26	0.62	16.88	141.59	2.400	90.00	1200	0.50	2.757	2.44
	17	18	17	0.320	0.90	0.29	6.41	16.88	0.62	17.50	139.08	2.469	90.00	1200	0.50	2.757	2.44
	18	19	18	0.320	0.90	0.29	6.70	17.50	0.62	18.11	136.66	2.535	90.00	1200	0.50	2.757	2.44
	19	20	19	0.310	0.90	0.28	6.98	18.11	0.62	18.73	134.34	2.596	90.00	1200	0.50	2.757	2.44
	20	21	20	0.320	0.90	0.29	7.26	18.73	0.68	19.41	132.09	2.658	90.00	1500	0.30	3.872	2.19
	21	22	21	0.320	0.90	0.29	7.55	19.41	0.68	20.10	129.69	2.713	90.00	1500	0.30	3.872	2.19
	22	23	22	0.320	0.90	0.29	7.84	20.10	0.68	20.78	127.38	2.766	90.00	1500	0.30	3.872	2.19
	23	24	23	0.320	0.90	0.29	8.13	20.78	0.68	21.46	125.15	2.817	90.00	1500	0.30	3.872	2.19
	24	25	24	0.320	0.90	0.29	8.42	21.46	0.68	22.15	123.01	2.867	90.00	1500	0.30	3.872	2.19
	25	26	25	0.320	0.90	0.29	8.70	22.15	0.68	22.83	120.94	2.916	90.00	1500	0.30	3.872	2.19
	26	27	26	0.320	0.90	0.29	8.99	22.83	0.68	23.52	118.95	2.962	90.00	1500	0.30	3.872	2.19
	27	28	27	0.320	0.90	0.29	9.28	23.52	0.68	24.20	117.02	3.008	90.00	1500	0.30	3.872	2.19
	28	29	28	0.320	0.90	0.29	9.57	24.20	0.68	24.89	115.16	3.052	90.00	1500	0.30	3.872	2.19
	29	30	29	0.320	0.90	0.29	9.86	24.89	0.68	25.57	113.36	3.095	90.00	1500	0.30	3.872	2.19
	30	31	30	0.320	0.90	0.29	10.14	25.57	0.68	26.26	111.62	3.136	90.00	1500	0.30	3.872	2.19
	31	32	31	0.310	0.90	0.28	10.42	26.26	0.68	26.94	109.94	3.174	90.00	1500	0.30	3.872	2.19
	32	33	32	0.310	0.90	0.28	10.70	26.94	0.68	27.63	108.31	3.211	90.00	1500	0.30	3.872	2.19
	33	34	33	0.320	0.90	0.29	10.99	27.63	0.68	28.31	106.73	3.249	90.00	1500	0.30	3.872	2.19
	34	35	34	0.320	0.90	0.29	11.28	28.31	0.68	29.00	105.20	3.286	90.00	1500	0.30	3.872	2.19
	35	36	35	0.320	0.90	0.29	11.57	29.00	0.68	29.68	103.72	3.323	90.00	1500	0.30	3.872	2.19
	36	37	36	0.320	0.90	0.29	11.85	29.68	0.68	30.36	102.28	3.358	90.00	1500	0.30	3.872	2.19
			Sub Total	13.170									3240.00				
	50	49	50	0.490	0.90	0.44	0.44	5.00	1.26	6.26	214.24	0.262	90.00	600	0.30	0.336	1.19
	49	48	49	0.320	0.90	0.29	0.73	6.26	1.04	7.30	202.31	0.409	90.00	800	0.30	0.724	1.44
	48	47	48	0.320	0.90	0.29	1.02	7.30	1.04	8.34	193.47	0.545	90.00	800	0.30	0.724	1.44
	47	46	47	0.320	0.90	0.29	2.76	8.34	0.79	9.14	185.43	1.419	90.00	1200	0.30	2.135	1.89
	46	45	46	0.320	0.90	0.29	3.05	9.14	0.79	9.93	179.75	1.519	90.00	1200	0.30	2.135	1.89
	45	44	45	0.320	0.90	0.29	3.34	9.93	0.79	10.73	174.43	1.613	90.00	1200	0.30	2.135	1.89
	44	43	44	0.320	0.90	0.29	3.63	10.73	0.79	11.52	169.43	1.702	90.00	1200	0.30	2.135	1.89

STORM SEWER CALCULATIONS

FOR

Detroit River International Crossing Study

Alternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06

File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	43	42	43	0.320	0.90	0.29	3.92	11.52	0.79	12.32	164.74	1.786	90.00	1200	0.30	2.135	1.89
	42	41	42	0.320	0.90	0.29	4.20	12.32	0.79	13.11	160.31	1.866	90.00	1200	0.30	2.135	1.89
	41	40	41	0.320	0.90	0.29	4.49	13.11	0.79	13.90	156.13	1.942	90.00	1200	0.30	2.135	1.89
	40	39	40	0.320	0.90	0.29	4.78	13.90	0.79	14.70	152.17	2.014	90.00	1200	0.30	2.135	1.89
	39	38	39	0.310	0.90	0.28	5.06	14.70	0.79	15.49	148.42	2.080	90.00	1200	0.30	2.135	1.89
	38	37	38	0.320	0.90	0.29	5.35	15.49	0.68	16.18	144.87	2.145	90.00	1500	0.30	3.872	2.19
			Sub Total	4.320													
	11a	12a	11a	0.140	0.90	0.13	0.13	5.00	0.84	5.84	214.24	0.075	90.00	450	1.00	0.285	1.79
	12a	13a	12a	0.180	0.90	0.16	0.29	5.84	0.84	6.67	206.16	0.164	90.00	450	1.00	0.285	1.79
	13a	47	13a	0.360	0.90	0.32	0.61	6.67	0.69	7.36	198.71	0.337	90.00	600	1.00	0.614	2.17
				0.680													
	14a	15a	14a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	15a	16a	15a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	16a	17a	16a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	17a	47	17a	0.400	0.90	0.36	0.85	7.51	0.69	8.20	191.81	0.449	90.00	600	1.00	0.614	2.17
				0.940													
	37	MH POND		0.320	0.90	0.29	17.49	30.36	0.53	30.89	100.89	4.887	90.00	1500	0.50	4.998	2.83
			Drainage Area	19.43							Peak Flow	4.887					
To 2BR - P2	51	52	51	0.320	0.90	0.29	0.29	5.00	1.18	6.18	214.24	0.171	90.00	450	0.50	0.202	1.27
	52	53	52	0.320	0.90	0.29	0.58	6.18	0.98	7.16	203.00	0.324	90.00	600	0.50	0.434	1.54
	53	54	53	0.310	0.90	0.28	0.86	7.16	0.81	7.97	194.63	0.461	90.00	800	0.50	0.935	1.86
	63	62	63	0.340	0.90	0.31	0.31	5.00	0.88	5.88	214.24	0.182	90.00	450	0.90	0.270	1.70
	62	61	62	0.320	0.90	0.29	0.59	5.88	0.73	6.61	205.74	0.339	90.00	600	0.90	0.583	2.06
	61	60	61	0.320	0.90	0.29	0.88	6.61	0.60	7.21	199.25	0.487	90.00	800	0.90	1.254	2.50
	60	59	60	0.320	0.90	0.29	1.17	7.21	0.74	7.95	194.21	0.629	90.00	800	0.60	1.024	2.04
	59	58	59	0.310	0.90	0.28	1.45	11.00	0.74	11.74	167.78	0.673	90.00	800	0.60	1.024	2.04
	58	57	58	0.320	0.90	0.29	1.74	11.74	0.74	12.47	163.51	0.787	90.00	800	0.60	1.024	2.04
	57	56	57	0.320	0.90	0.29	2.03	12.47	0.74	13.21	159.46	0.894	90.00	800	0.60	1.024	2.04
	56	55	56	0.320	0.90	0.29	2.31	13.21	0.74	13.94	155.62	0.997	90.00	800	0.60	1.024	2.04
	55	54	55	0.310	0.90	0.28	2.59	13.94	0.63	14.58	151.98	1.091	90.00	1000	0.60	1.857	2.36
													1080.00				
	1a	2a	1a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	2a	3a	2a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	3a	4a	3a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	4a	5a	4a	0.180	0.90	0.16	0.65	5.00	0.69	5.69	214.24	0.385	90.00	600	1.00	0.614	2.17
	5a	6a	5a	0.180	0.90	0.16	0.81	5.69	0.69	6.38	207.53	0.466	90.00	600	1.00	0.614	2.17
	6a	58	6a	0.200	0.90	0.18	0.99	6.38	0.69	7.07	201.24	0.552	90.00	600	1.00	0.614	2.17
	7a	8a	7a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	8a	9a	8a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	9a	10a	9a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	10a	58	10a	0.190	0.90	0.17	0.66	5.00	0.69	5.69	214.24	0.390	90.00	600	1.00	0.614	2.17

STORM SEWER CALCULATIONS
FOR
Detroit River International Crossing Study
Alternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06
File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	54	MH POND	54	0.560	0.90	0.50	5.60	14.68	0.49	15.17	148.51	2.303	90.00	1000	1.00	2.398	3.05
			Drainage Area	6.220							Peak Flow	2.303					
To 2BR - P3	64	65	64	0.320	0.90	0.29	0.29	5.00	0.59	5.59	214.24	0.171	90.00	450	2.00	0.403	2.54
	65	66	65	0.320	0.90	0.29	0.58	5.59	0.49	6.08	208.46	0.333	90.00	600	2.00	0.868	3.07
	66	67	66	0.320	0.90	0.29	0.86	6.08	0.40	6.48	203.93	0.488	90.00	800	2.00	1.870	3.72
	67	68	67	0.350	0.90	0.32	1.18	6.48	1.04	7.52	200.35	0.654	90.00	800	0.30	0.724	1.44
	68	69	68	0.280	0.90	0.25	1.43	7.52	0.90	8.42	191.69	0.760	90.00	1000	0.30	1.313	1.67
	69	70	69	1.090	0.90	0.98	2.41	8.42	0.90	9.32	184.85	1.235	90.00	1000	0.30	1.313	1.67
	70	71	70	0.310	0.90	0.28	2.69	9.32	0.79	10.11	178.51	1.331	90.00	1200	0.30	2.135	1.89
	71	72	71	0.890	0.90	0.80	3.49	10.11	0.79	10.91	173.26	1.676	90.00	1200	0.30	2.135	1.89
	73	74	73	0.330	0.90	0.30	3.79	10.91	0.79	11.70	168.34	1.767	90.00	1200	0.30	2.135	1.89
	74	75	74	0.310	0.90	0.28	4.07	11.70	0.79	12.50	163.70	1.845	90.00	1200	0.30	2.135	1.89
	75	76	75	0.320	0.90	0.29	4.36	12.50	0.79	13.29	159.33	1.923	90.00	1200	0.30	2.135	1.89
	76	77	76	0.310	0.90	0.28	4.64	13.29	0.79	14.09	155.21	1.993	90.00	1200	0.30	2.135	1.89
	77	78	77	0.310	0.90	0.28	4.91	14.09	0.79	14.88	151.30	2.059	90.00	1200	0.30	2.135	1.89
	78	79	78	0.310	0.90	0.28	5.19	14.88	0.79	15.67	147.60	2.123	90.00	1200	0.30	2.135	1.89
													1260.00				
	87	86	87	0.240	0.90	0.22	0.22	5.00	1.18	6.18	214.24	0.128	90.00	450	0.50	0.202	1.27
	86	85	86	0.310	0.90	0.28	0.50	6.18	0.40	6.58	203.00	0.278	90.00	600	3.00	1.063	3.76
	85	84	85	0.320	0.90	0.29	0.78	6.58	0.33	6.91	199.49	0.433	90.00	800	3.00	2.290	4.56
	84	83	84	0.310	0.90	0.28	1.06	6.91	0.33	7.24	196.69	0.579	90.00	800	3.00	2.290	4.56
	83	82	83	0.320	0.90	0.29	1.35	7.24	0.33	7.57	193.97	0.725	90.00	800	3.00	2.290	4.56
	82	81	82	0.320	0.90	0.29	1.64	7.57	0.28	7.85	191.33	0.868	90.00	1000	3.00	4.153	5.29
	81	80	81	0.310	0.90	0.28	1.92	7.85	0.40	8.25	189.12	1.004	90.00	1000	1.50	2.936	3.74
	80	79	80	0.310	0.90	0.28	2.20	8.25	0.40	8.66	186.08	1.132	90.00	1000	1.50	2.936	3.74
	79	MH POND	79	0.460	0.90	0.41	7.80	15.67	0.49	16.16	144.10	3.115	90.00	1200	0.80	3.487	3.08
			Drainage Area	8.670							Peak Flow	3.115					
To 2BR - P4	88	89	88	0.310	0.90	0.28	0.28	5.00	1.18	6.18	214.24	0.166	90.00	450	0.50	0.202	1.27
	89	90	89	0.320	0.90	0.29	0.57	6.18	0.59	6.78	203.00	0.319	90.00	450	2.00	0.403	2.54
	90	91	90	0.310	0.90	0.28	0.85	6.78	0.49	7.26	197.84	0.464	90.00	600	2.00	0.868	3.07
	91	92	91	0.330	0.90	0.30	1.14	7.26	0.49	7.75	193.79	0.614	90.00	600	2.00	0.868	3.07
	92	93	92	0.320	0.90	0.29	1.43	7.75	0.90	8.65	189.91	0.753	90.00	1000	0.30	1.313	1.67
	93	94	93	0.320	0.90	0.29	1.72	8.65	0.90	9.55	183.19	0.872	90.00	1000	0.30	1.313	1.67
	94	95	94	0.320	0.90	0.29	2.01	9.55	0.90	10.44	176.97	0.984	90.00	1000	0.30	1.313	1.67
	95	96	95	0.330	0.90	0.30	2.30	10.44	0.90	11.34	171.18	1.092	90.00	1000	0.30	1.313	1.67
													720.00				
	105	104	105	0.170	0.90	0.15	0.15	5.00	1.18	6.18	214.24	0.091	90.00	450	0.50	0.202	1.27
	104	103	104	0.320	0.90	0.29	0.44	6.18	0.98	7.16	203.00	0.248	90.00	600	0.50	0.434	1.54
	103	102	103	0.320	0.90	0.29	0.73	7.16	0.98	8.14	194.63	0.393	90.00	600	0.50	0.434	1.54
	102	101	102	0.320	0.90	0.29	1.02	8.14	0.81	8.94	186.96	0.527	90.00	800	0.50	0.935	1.86
	101	100	101	0.320	0.90	0.29	1.31	8.94	0.81	9.75	181.10	0.655	90.00	800	0.50	0.935	1.86
	100	99	100	0.320	0.90	0.29	1.59	9.75	0.81	10.56	175.62	0.775	90.00	800	0.50	0.935	1.86

S ORM SEWER CALCULATIONS

FOR

Detroit F iver International Crossing Stud)

Alternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06

File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	99	98	99	0.320	0.90	0.29	1.88	10.56	0.40	10.96	170.48	0.888	90.00	800	2.00	1.870	3.72
	98	97	98	0.320	0.90	0.29	2.17	11.00	0.40	11.40	167.78	1.008	90.00	800	2.00	1.870	3.72
	97	96	97	0.310	0.90	0.28	2.45	11.40	0.90	12.30	165.41	1.122	90.00	1000	0.30	1.313	1.67
													810.00				
	96	MH POND	96	1.080	0.90	0.97	5.72	12.30	0.62	12.92	160.39	2.543	90.00	1200	0.50	2.757	2.44
			Dralnage Area	6.360							Peak Flow	2.543					

DESIGN PARAMETERS:

I = a/(t+b)^c

100 Year Storm Parameters

a = 2824.51

b = 13.7400

c= 0.8800

manning's 0.0130

Min. veloc 0.8000 m/s

Max. velo 6.0000 m/s

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:

A: **2824.505**
B: **13.74**
C: **0.88**

Inlet Time (t_i)= 5 min
Average Velocity = 1.5 m/s

Rational Method Calculation
Proposed Conidtion
Alternative 3

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	850	0.24	149.6	2.40	To TTcombe Drain
101	2.80	0.90	798	0.23	152.4	1.08	Pump to Basin Drain
102	0.34	0.90	342	0.15	182.1	0.16	Pump to Turkey Creek
103	0.34	0.90	342	0.15	182.1	0.16	Pump to Turkey Creek
104	0.14	0.90	140	0.11	199.7	0.07	Pump to Cahill Drain
105	0.19	0.90	194	0.12	194.7	0.10	Pump to Cahill Drain
106	0.17	0.90	174	0.12	196.5	0.09	Pump to Cahill Drain
107	0.19	0.90	191	0.12	194.9	0.09	Pump to Cahill Drain
108	2.16	0.90	774	0.23	153.7	0.84	Pump to Wolfe Drain
109	6.56	0.90	1737	0.41	114.9	1.90	To Wolfe Drain

Appendix C

Stormwater Management Computations

Appendix C.1

Alternative 1A

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.4	min
Time Increment =	10.0	min
Release Rate =	367.1	l/s
Max.Storage =	2376	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.6	2380.56	2063.1	318.1	1745.0	
24.4	114.5	1822.33	2672.7	538.4	2134.3	
34.4	93.3	1485.01	3069.0	758.7	2310.4	
44.4	79.1	1257.93	3354.5	978.9	2375.6	<<<<
54.4	68.8	1094.07	3574.0	1199.2	2374.8	
64.4	61.0	969.93	3750.4	1419.4	2331.0	
74.4	54.8	872.45	3897.0	1639.7	2257.3	
84.4	49.9	793.76	4021.7	1859.9	2161.8	
94.4	45.8	728.82	4130.0	2080.2	2049.8	
104.4	42.4	674.27	4225.4	2300.5	1925.0	
114.4	39.5	627.76	4310.6	2520.7	1789.9	
124.4	36.9	587.60	4387.4	2741.0	1646.5	
134.4	34.7	552.56	4457.3	2961.2	1496.1	
144.4	32.8	521.70	4521.4	3181.5	1339.9	
154.4	31.1	494.31	4580.6	3401.7	1178.8	
164.4	29.5	469.81	4635.4	3622.0	1013.5	
174.4	28.1	447.77	4686.6	3842.2	844.4	
184.4	26.9	427.82	4734.6	4062.5	672.1	
194.4	25.7	409.69	4779.7	4282.8	496.9	
204.4	24.7	393.12	4822.2	4503.0	319.2	
214.4	23.7	377.92	4862.5	4723.3	139.3	
224.4	22.9	363.92	4900.8	4943.5	-42.8	
234.4	22.1	350.98	4937.2	5163.8	-226.6	
244.4	21.3	338.99	4971.9	5384.0	-412.2	

Modified Rational Method

Project Name : **Detroit River International Crossing Stormwater Management Study Alternative 1A**

November 14, 2006 9:58 AM

101		
Area =	2.53	ha
"C" =	0.9	
AC=	2.277	
Tc =	13.1	min
Time Increment =	10.0	min
Release Rate =	156.9	l/s
Max.Storage =	915	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.1	155.9	987.16	778.5	123.8	654.8	
23.1	118.1	747.36	1037.8	217.9	819.9	
33.1	95.6	605.12	1203.4	312.1	891.3	
43.1	80.6	510.45	1321.4	406.3	915.1	<<<<
53.1	69.9	442.65	1411.5	500.4	911.0	
63.1	61.9	391.57	1483.5	594.6	888.9	
73.1	55.5	351.63	1543.2	688.8	854.4	
83.1	50.5	319.48	1593.8	783.0	810.8	
93.1	46.3	293.03	1637.6	877.1	760.5	
103.1	42.8	270.85	1676.2	971.3	704.9	
113.1	39.8	251.97	1710.5	1065.5	645.1	
123.1	37.2	235.70	1741.5	1159.6	581.9	
133.1	35.0	221.52	1769.6	1253.8	515.9	
143.1	33.0	209.05	1795.4	1348.0	447.5	
153.1	31.3	197.98	1819.2	1442.1	377.1	
163.1	29.7	188.10	1841.2	1536.3	304.9	
173.1	28.3	179.21	1861.8	1630.5	231.3	
183.1	27.0	171.18	1881.0	1724.6	156.4	
193.1	25.9	163.87	1899.1	1818.8	80.3	
203.1	24.8	157.21	1916.1	1913.0	3.2	
213.1	23.9	151.09	1932.3	2007.1	-74.9	
223.1	23.0	145.46	1947.6	2101.3	-153.7	
233.1	22.2	140.27	1962.1	2195.5	-233.3	
243.1	21.4	135.45	1976.0	2289.6	-313.6	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

102		
Area =	5.60	ha
"C" =	0.9	
AC=	5.04	
Tc =	14.3	min
Time Increment =	10.0	min
Release Rate =	675.0	l/s
Max.Storage =	1363	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

102						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.3	150.5	2108.53	1803.5	577.4	1226.1	
24.3	115.0	1611.58	2345.4	982.4	1363.0	<<<<
34.3	93.6	1312.08	2696.8	1387.4	1309.3	
44.3	79.3	1110.79	2949.5	1792.4	1157.1	
54.3	68.9	965.68	3143.6	2197.5	946.2	
64.3	61.1	855.85	3299.6	2602.5	697.1	
74.3	54.9	769.65	3429.0	3007.5	421.5	
84.3	50.0	700.09	3539.2	3412.5	126.7	
94.3	45.9	642.72	3634.8	3817.6	-182.8	
104.3	42.4	594.53	3719.0	4222.6	-503.6	
114.3	39.5	553.46	3794.2	4627.6	-833.4	
124.3	37.0	518.01	3861.9	5032.6	-1170.7	
134.3	34.8	487.08	3923.6	5437.6	-1514.1	
144.3	32.8	459.84	3980.1	5842.7	-1862.6	
154.3	31.1	435.67	4032.3	6247.7	-2215.4	
164.3	29.6	414.05	4080.6	6652.7	-2572.1	
174.3	28.2	394.61	4125.8	7057.7	-2931.9	
184.3	26.9	377.02	4168.0	7462.7	-3294.7	
194.3	25.8	361.02	4207.8	7867.8	-3660.0	
204.3	24.7	346.40	4245.3	8272.8	-4027.5	
214.3	23.8	333.00	4280.8	8677.8	-4397.0	
224.3	22.9	320.65	4314.5	9082.8	-4768.3	
234.3	22.1	309.25	4346.6	9487.9	-5141.3	
244.3	21.3	298.68	4377.2	9892.9	-5515.7	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

	103	
Area =	2.60	ha
"C" =	0.9	
AC=	2.34	
Tc =	13.3	min
Time Increment =	10.0	min
Release Rate =	159.9	l/s
Max.Storage =	944	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

103						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.3	155.2	1009.34	805.5	127.6	677.8	
23.3	117.6	765.20	1069.7	223.6	846.2	
33.3	95.3	620.06	1238.9	319.5	919.3	
43.3	80.4	523.32	1359.6	415.5	944.1	<<<<
53.3	69.8	453.97	1451.8	511.4	940.4	
63.3	61.7	401.69	1525.6	607.4	918.2	
73.3	55.5	360.79	1586.7	703.3	883.4	
83.3	50.4	327.86	1638.6	799.3	839.3	
93.3	46.2	300.75	1683.6	895.3	788.3	
103.3	42.7	278.02	1723.1	991.2	731.9	
113.3	39.8	258.66	1758.4	1087.2	671.2	
123.3	37.2	241.98	1790.2	1183.1	607.0	
133.3	35.0	227.44	1819.0	1279.1	540.0	
143.3	33.0	214.64	1845.5	1375.0	470.5	
153.3	31.3	203.29	1869.9	1471.0	398.9	
163.3	29.7	193.15	1892.5	1566.9	325.6	
173.3	28.3	184.04	1913.6	1662.9	250.7	
183.3	27.0	175.79	1933.3	1758.9	174.5	
193.3	25.9	168.30	1951.9	1854.8	97.1	
203.3	24.8	161.45	1969.4	1950.8	18.7	
213.3	23.9	155.18	1986.0	2046.7	-60.7	
223.3	23.0	149.40	2001.7	2142.7	-141.0	
233.3	22.1	144.07	2016.7	2238.6	-222.0	
243.3	21.4	139.12	2030.9	2334.6	-303.6	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

	104	
Area =	2.50	ha
"C" =	0.9	
AC=	2.25	
Tc =	8.9	min
Time Increment =	10.0	min
Release Rate =	207.9	l/s
Max.Storage =	775	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

104						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
8.9	181.2	1133.71	606.9	111.3	495.6	
18.9	131.4	821.88	933.1	236.1	697.0	
28.9	103.9	649.73	1127.5	360.8	766.7	
38.9	86.3	539.82	1260.7	485.6	775.1	<<<<
48.9	74.1	463.24	1359.8	610.3	749.4	
58.9	65.0	406.65	1437.6	735.1	702.6	
68.9	58.0	363.03	1501.2	859.8	641.4	
78.9	52.5	328.32	1554.7	984.6	570.1	
88.9	48.0	300.00	1600.6	1109.3	491.3	
98.9	44.2	276.44	1640.8	1234.1	406.7	
108.9	41.0	256.51	1676.4	1358.9	317.5	
118.9	38.3	239.42	1708.3	1483.6	224.7	
128.9	35.9	224.58	1737.2	1608.4	128.9	
138.9	33.8	211.59	1763.6	1733.1	30.5	
148.9	32.0	200.10	1787.9	1857.9	-69.9	
158.9	30.4	189.86	1810.4	1982.6	-172.2	
168.9	28.9	180.68	1831.3	2107.4	-276.1	
178.9	27.6	172.40	1850.8	2232.1	-381.3	
188.9	26.4	164.90	1869.1	2356.9	-487.7	
198.9	25.3	158.05	1886.4	2481.6	-595.2	
208.9	24.3	151.79	1902.7	2606.4	-703.7	
218.9	23.3	146.03	1918.2	2731.1	-813.0	
228.9	22.5	140.72	1932.9	2855.9	-923.0	
238.9	21.7	135.81	1946.9	2980.7	-1033.8	

Modified Rational Method

Project Name : **Detroit River International Crossing Stormwater Management Study Alternative 1A**

November 14, 2006 9:58 AM

105		
Area =	2.50	ha
"C" =	0.9	
AC=	2.25	
Tc =	10.9	min
Time Increment =	10.0	min
Release Rate =	177.6	l/s
Max.Storage =	847	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

105						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.9	168.2	1052.40	689.7	116.4	573.3	
20.9	124.7	780.00	979.2	222.9	756.3	
30.9	99.8	624.05	1157.8	329.4	828.4	
40.9	83.5	522.40	1282.7	436.0	846.7	<<<<
50.9	72.0	450.61	1376.8	542.5	834.3	
60.9	63.5	397.05	1451.3	649.0	802.3	
70.9	56.8	355.47	1512.6	755.6	757.1	
80.9	51.5	322.21	1564.4	862.1	702.3	
90.9	47.2	294.95	1609.1	968.6	640.4	
100.9	43.5	272.19	1648.2	1075.2	573.1	
110.9	40.4	252.88	1683.0	1181.7	501.3	
120.9	37.8	236.28	1714.3	1288.2	426.1	
130.9	35.5	221.85	1742.7	1394.8	347.9	
140.9	33.4	209.18	1768.7	1501.3	267.3	
150.9	31.6	197.96	1792.6	1607.8	184.7	
160.9	30.0	187.95	1814.7	1714.4	100.3	
170.9	28.6	178.96	1835.3	1820.9	14.4	
180.9	27.3	170.84	1854.6	1927.4	-72.9	
190.9	26.1	163.48	1872.7	2034.0	-161.3	
200.9	25.1	156.76	1889.7	2140.5	-250.8	
210.9	24.1	150.60	1905.9	2247.0	-341.2	
220.9	23.2	144.94	1921.2	2353.6	-432.4	
230.9	22.3	139.71	1935.7	2460.1	-524.4	
240.9	21.6	134.87	1949.6	2566.6	-617.0	

Modified Rational Method

Project Name : **Detroit River International Crossing Stormwater Management Study Alternative 1A**

November 14, 2006 9:58 AM

106		
Area =	5.60	ha
"C" =	0.9	
AC=	5.04	
Tc =	13.5	min
Time Increment =	10.0	min
Release Rate =	338.5	l/s
Max.Storage =	2049	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

106						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.5	154.0	2158.36	1751.1	274.6	1476.5	
23.5	117.0	1639.46	2313.8	477.7	1836.1	
33.5	94.9	1329.98	2675.0	680.8	1994.2	
43.5	80.2	1123.29	2933.3	883.9	2049.4	<<<<
53.5	69.6	974.94	3130.9	1087.0	2043.8	
63.5	61.6	862.99	3289.1	1290.1	1999.0	
73.5	55.3	775.34	3420.3	1493.2	1927.0	
83.5	50.3	704.74	3531.7	1696.3	1835.3	
93.5	46.1	646.58	3628.2	1899.4	1728.8	
103.5	42.7	597.80	3713.2	2102.5	1610.6	
113.5	39.7	556.27	3788.9	2305.6	1483.3	
123.5	37.1	520.44	3857.2	2508.7	1348.4	
133.5	34.9	489.21	3919.2	2711.8	1207.4	
143.5	33.0	461.73	3976.1	2914.9	1061.2	
153.5	31.2	437.35	4028.6	3118.0	910.5	
163.5	29.7	415.56	4077.2	3321.1	756.1	
173.5	28.3	395.97	4122.6	3524.2	598.3	
183.5	27.0	378.25	4165.0	3727.3	437.7	
193.5	25.8	362.14	4205.0	3930.4	274.5	
203.5	24.8	347.43	4242.6	4133.5	109.1	
213.5	23.8	333.94	4278.3	4336.6	-58.4	
223.5	22.9	321.53	4312.1	4539.7	-227.6	
233.5	22.1	310.06	4344.3	4742.8	-398.6	
243.5	21.4	299.42	4375.0	4945.9	-571.0	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

	107	
Area =	3.10	ha
"C" =	0.9	
AC=	2.79	
Tc =	14.8	min
Time Increment =	10.0	min
Release Rate =	176.9	l/s
Max.Storage =	1164	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

107						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.8	148.0	1148.00	1018.7	157.0	861.7	
24.8	113.6	881.25	1310.7	263.1	1047.6	
34.8	92.7	719.30	1501.4	369.2	1132.2	
44.8	78.6	609.97	1639.2	475.3	1163.8	<<<<
54.8	68.5	530.91	1745.3	581.5	1163.8	
64.8	60.7	470.94	1830.7	687.6	1143.1	
74.8	54.6	423.80	1901.7	793.7	1108.0	
84.8	49.7	385.71	1962.2	899.9	1062.3	
94.8	45.7	354.25	2014.7	1006.0	1008.7	
104.8	42.3	327.81	2061.1	1112.1	948.9	
114.8	39.4	305.26	2102.4	1218.3	884.2	
124.8	36.8	285.78	2139.7	1324.4	815.4	
134.8	34.7	268.78	2173.7	1430.5	743.2	
144.8	32.7	253.80	2204.9	1536.7	668.2	
154.8	31.0	240.50	2233.6	1642.8	590.8	
164.8	29.5	228.61	2260.3	1748.9	511.4	
174.8	28.1	217.90	2285.2	1855.1	430.1	
184.8	26.8	208.21	2308.5	1961.2	347.3	
194.8	25.7	199.40	2330.5	2067.3	263.1	
204.8	24.7	191.35	2351.2	2173.4	177.7	
214.8	23.7	183.96	2370.8	2279.6	91.2	
224.8	22.8	177.16	2389.4	2385.7	3.6	
234.8	22.0	170.87	2407.1	2491.8	-84.8	
244.8	21.3	165.04	2424.0	2598.0	-174.0	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

	108	
Area =	3.96	ha
"C" =	0.9	
AC=	3.564	
Tc =	14.3	min
Time Increment =	10.0	min
Release Rate =	231.4	l/s
Max.Storage =	1471	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

108						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.3	150.4	1490.51	1275.9	198.1	1077.8	
24.3	115.0	1139.33	1658.9	336.9	1321.9	
34.3	93.6	927.64	1907.2	475.8	1431.5	
44.3	79.3	785.35	2085.9	614.6	1471.3	<<<<
54.3	68.9	682.78	2223.1	753.4	1469.7	
64.3	61.1	605.13	2333.4	892.3	1441.1	
74.3	54.9	544.19	2424.9	1031.1	1393.8	
84.3	50.0	495.02	2502.8	1169.9	1332.9	
94.3	45.9	454.45	2570.4	1308.8	1261.6	
104.3	42.4	420.38	2629.9	1447.6	1182.3	
114.3	39.5	391.35	2683.1	1586.5	1096.6	
124.3	37.0	366.28	2731.0	1725.3	1005.7	
134.3	34.8	344.41	2774.6	1864.1	910.4	
144.3	32.8	325.16	2814.5	2003.0	811.6	
154.3	31.1	308.06	2851.4	2141.8	709.6	
164.3	29.6	292.78	2885.6	2280.7	605.0	
174.3	28.2	279.03	2917.5	2419.5	498.1	
184.3	26.9	266.59	2947.4	2558.3	389.1	
194.3	25.8	255.28	2975.5	2697.2	278.4	
204.3	24.7	244.95	3002.1	2836.0	166.1	
214.3	23.8	235.47	3027.2	2974.8	52.3	
224.3	22.9	226.74	3051.0	3113.7	-62.7	
234.3	22.1	218.67	3073.7	3252.5	-178.8	
244.3	21.3	211.20	3095.3	3391.4	-296.0	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 1A

November 14, 2006 9:58 AM

	109	
Area =	6.60	ha
"C" =	0.9	
AC=	5.94	
Tc =	24.3	min
Time Increment =	10.0	min
Release Rate =	270.3	l/s
Max.Storage =	2847	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

109						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1897.41	2766.4	394.1	2372.3	
34.3	93.6	1545.12	3179.9	556.3	2623.6	
44.3	79.2	1308.26	3477.4	718.5	2758.9	
54.3	68.9	1137.47	3705.9	880.6	2825.3	
64.3	61.1	1008.17	3889.5	1042.8	2846.7	<<<<
74.3	54.9	906.68	4042.0	1205.0	2837.0	
84.3	49.9	824.78	4171.7	1367.2	2804.6	
94.3	45.9	757.21	4284.3	1529.3	2755.0	
104.3	42.4	700.47	4383.5	1691.5	2692.0	
114.3	39.5	652.09	4472.1	1853.7	2618.3	
124.3	37.0	610.34	4551.9	2015.9	2536.0	
134.3	34.8	573.90	4624.5	2178.1	2446.5	
144.3	32.8	541.82	4691.1	2340.2	2350.9	
154.3	31.1	513.35	4752.6	2502.4	2250.1	
164.3	29.5	487.89	4809.6	2664.6	2145.0	
174.3	28.2	464.98	4862.8	2826.8	2036.0	
184.3	26.9	444.25	4912.6	2989.0	1923.6	
194.3	25.8	425.41	4959.4	3151.1	1808.3	
204.3	24.7	408.19	5003.6	3313.3	1690.3	
214.3	23.8	392.40	5045.4	3475.5	1569.9	
224.3	22.9	377.85	5085.1	3637.7	1447.5	
234.3	22.1	364.41	5122.9	3799.9	1323.1	
244.3	21.3	351.96	5159.0	3962.0	1196.9	
254.3	20.6	340.38	5193.4	4124.2	1069.2	

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 1A

Stormerwater Management Facility No.	1A-P1	1A-P2	1A-P3	1A-P4	1A-P5	1A-P6	1A-P7	1A-P8	1A-P9	1A-P9
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**
Drainage Area (ha)	6.4	2.5	5.6	2.6	2.5	2.5	5.6	3.1	4.0	6.6
Imperviousness of Drainage Area	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	531	1,176	546	525	525	1,176	651	832	1,386
Extended Detention Volume[3] (m^3)	254	101	224	104	100	100	224	124	158	264
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	633	1,400	650	625	625	1,400	775	990	1,650
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**633**	**1,400**	**650**	**625**	**625**	**1,400**	**775**	**990**	**1,650**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot										
Assumed Bottom width	25.00	15.25	22.25	12.00	11.50	11.50	22.25	14.00	17.25	25.00
Volume	1668.75	860.72	1411.97	654.75	625.88	625.88	1411.97	777.75	1003.22	1668.75
Pond Bottom Area Requirement (m^2)	625	233	495	144	132	132	495	196	298	625
Pond Bottom width requirement assuming a square lot	25.00	15.25	22.25	12.00	11.50	11.50	22.25	14.00	17.25	25.00
Pond Area at Normal Water Level	1,600	915	1,388	729	702	702	1,388	841	1,040	1,600
Pond Area Requirement (m^2)	**3,364**	**2,328**	**3,053**	**2,025**	**1,980**	**1,980**	**3,053**	**2,209**	**2,525**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,658**	**5,663**	**4,225**	**4,160**	**4,160**	**5,663**	**4,489**	**4,935**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,919	3,996	2,479	2,414	2,414	3,996	2,745	3,209	4,468
Total Quality and Quantity Control Volume =	6,136	3,780	5,408	3,133	3,040	3,040	5,408	3,523	4,212	6,136
Approximate Volume of Excavation =	17,779	12,960	16,318	11,578	11,375	11,375	16,318	12,415	13,866	17,779

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m^3/ha - 40m^3/ha)

[3] Based on 40m^3/ha

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 1A.xls]Option 1A

11/17/2006

Appendix C.2

Alternative 1B

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.8	min
Time Increment =	10.0	min
Release Rate =	360.5	l/s
Max.Storage =	2395	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.8	147.8	2352.02	2093.3	320.9	1772.4	
24.8	113.5	1806.15	2691.2	537.2	2154.0	
34.8	92.7	1474.54	3081.8	753.5	2328.3	
44.8	78.6	1250.58	3364.1	969.8	2394.2	
54.8	68.4	1088.60	3581.5	1186.2	2395.4	<<<<
64.8	60.7	965.71	3756.6	1402.5	2354.1	
74.8	54.6	869.08	3902.2	1618.8	2283.4	
84.8	49.7	791.00	4026.2	1835.1	2191.1	
94.8	45.7	726.52	4133.9	2051.4	2082.5	
104.8	42.3	672.32	4228.9	2267.7	1961.2	
114.8	39.3	626.09	4313.7	2484.1	1829.7	
124.8	36.8	586.15	4390.3	2700.4	1689.9	
134.8	34.6	551.29	4459.9	2916.7	1543.2	
144.8	32.7	520.58	4523.8	3133.0	1390.8	
154.8	31.0	493.30	4582.8	3349.3	1233.4	
164.8	29.5	468.91	4637.5	3565.7	1071.8	
174.8	28.1	446.96	4688.6	3782.0	906.6	
184.8	26.8	427.09	4736.4	3998.3	738.1	
194.8	25.7	409.01	4781.4	4214.6	566.8	
204.8	24.7	392.50	4823.8	4430.9	392.9	
214.8	23.7	377.35	4864.0	4647.3	216.8	
224.8	22.8	363.40	4902.2	4863.6	38.6	
234.8	22.0	350.50	4938.5	5079.9	-141.4	
244.8	21.3	338.54	4973.2	5296.2	-323.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	101	
Area =	2.70	ha
"C" =	0.9	
AC=	2.43	
Tc =	10.2	min
Time Increment =	10.0	min
Release Rate =	201.9	l/s
Max.Storage =	890	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.2	172.7	1166.71	714.0	123.6	590.5	
20.2	127.0	858.16	1040.1	244.7	795.4	
30.2	101.2	683.72	1238.9	365.8	873.1	
40.2	84.5	570.84	1376.9	486.9	889.9	<<<<
50.2	72.8	491.49	1480.4	608.1	872.3	
60.2	64.0	432.49	1562.2	729.2	833.0	
70.2	57.3	386.81	1629.3	850.3	778.9	
80.2	51.9	350.34	1685.8	971.5	714.4	
90.2	47.4	320.50	1734.5	1092.6	641.9	
100.2	43.8	295.61	1777.2	1213.7	563.5	
110.2	40.6	274.52	1815.1	1334.9	480.2	
120.2	38.0	256.40	1849.1	1456.0	393.1	
130.2	35.6	240.65	1880.0	1577.1	302.9	
140.2	33.6	226.84	1908.2	1698.2	209.9	
150.2	31.8	214.62	1934.2	1819.4	114.8	
160.2	30.2	203.72	1958.2	1940.5	17.7	
170.2	28.7	193.94	1980.6	2061.6	-81.1	
180.2	27.4	185.12	2001.5	2182.8	-181.3	
190.2	26.2	177.11	2021.1	2303.9	-282.8	
200.2	25.1	169.80	2039.6	2425.0	-385.4	
210.2	24.1	163.11	2057.1	2546.2	-489.0	
220.2	23.2	156.96	2073.7	2667.3	-593.6	
230.2	22.4	151.28	2089.5	2788.4	-698.9	
240.2	21.6	146.03	2104.5	2909.6	-805.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	102	
Area =	5.38	ha
"C" =	0.9	
AC=	4.842	
Tc =	12.4	min
Time Increment =	10.0	min
Release Rate =	344.6	l/s
Max.Storage =	1917	m^3

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

Constant Inflows

	l/s

102						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
12.4	159.6	2148.49	1604.2	257.3	1346.9	
22.4	120.1	1616.27	2176.6	464.1	1712.5	
32.4	96.9	1303.93	2538.3	670.9	1867.5	
42.4	81.5	1097.36	2794.6	877.6	1917.0	<<<<
52.4	70.6	950.05	2989.5	1084.4	1905.1	
62.4	62.4	839.40	3145.0	1291.2	1853.8	
72.4	55.9	753.07	3273.3	1498.0	1775.4	
82.4	50.8	683.72	3382.1	1704.7	1677.4	
92.4	46.6	626.73	3476.2	1911.5	1564.7	
102.4	43.0	579.00	3558.9	2118.3	1440.7	
112.4	40.0	538.43	3632.6	2325.1	1307.5	
122.4	37.4	503.48	3698.9	2531.8	1167.1	
132.4	35.1	473.04	3759.1	2738.6	1020.5	
142.4	33.2	446.28	3814.2	2945.4	868.9	
152.4	31.4	422.56	3865.1	3152.1	712.9	
162.4	29.8	401.38	3912.2	3358.9	553.2	
172.4	28.4	382.35	3956.1	3565.7	390.4	
182.4	27.1	365.15	3997.1	3772.5	224.7	
192.4	26.0	349.52	4035.7	3979.2	56.5	
202.4	24.9	335.25	4072.1	4186.0	-113.9	
212.4	23.9	322.17	4106.6	4392.8	-286.2	
222.4	23.0	310.14	4139.3	4599.6	-460.3	
232.4	22.2	299.02	4170.4	4806.3	-636.0	
242.4	21.4	288.73	4200.0	5013.1	-813.1	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	103	
Area =	4.50	ha
"C" =	0.9	
AC=	4.05	
Tc =	14.4	min
Time Increment =	10.0	min
Release Rate =	260.9	l/s
Max.Storage =	1678	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

103						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.8	1686.11	1457.9	225.6	1232.3	
24.4	114.6	1290.37	1890.0	382.2	1507.8	
34.4	93.4	1051.35	2170.7	538.7	1632.0	
44.4	79.1	890.49	2372.9	695.2	1677.6	<<<<
54.4	68.8	774.44	2528.3	851.8	1676.5	
64.4	61.0	686.53	2653.2	1008.3	1644.9	
74.4	54.8	617.51	2757.0	1164.9	1592.1	
84.4	49.9	561.79	2845.3	1321.4	1523.8	
94.4	45.8	515.82	2921.9	1478.0	1443.9	
104.4	42.4	477.20	2989.5	1634.5	1354.9	
114.4	39.5	444.27	3049.8	1791.1	1258.7	
124.4	36.9	415.84	3104.1	1947.6	1156.5	
134.4	34.7	391.04	3153.6	2104.2	1049.4	
144.4	32.8	369.20	3199.0	2260.7	938.2	
154.4	31.1	349.81	3240.8	2417.3	823.5	
164.4	29.5	332.47	3279.7	2573.8	705.8	
174.4	28.1	316.87	3315.9	2730.4	585.5	
184.4	26.9	302.75	3349.8	2886.9	462.9	
194.4	25.7	289.91	3381.7	3043.5	338.3	
204.4	24.7	278.19	3411.9	3200.0	211.8	
214.4	23.8	267.43	3440.4	3356.6	83.8	
224.4	22.9	257.52	3467.4	3513.1	-45.7	
234.4	22.1	248.37	3493.2	3669.7	-176.5	
244.4	21.3	239.88	3517.8	3826.2	-308.5	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	104	
Area =	2.74	ha
"C" =	0.9	
AC=	2.466	
Tc =	10.0	min
Time Increment =	10.0	min
Release Rate =	207.7	l/s
Max.Storage =	896	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

104						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	173.9	1192.28	716.2	124.8	591.4	
20.0	127.7	875.16	1050.8	249.4	801.4	
30.0	101.6	696.48	1254.1	374.0	880.1	
40.0	84.8	581.08	1395.0	498.6	896.4	<<<<
50.0	72.9	500.07	1500.5	623.2	877.3	
60.0	64.2	439.89	1583.9	747.9	836.0	
70.0	57.4	393.32	1652.2	872.5	779.7	
80.0	52.0	356.16	1709.8	997.1	712.7	
90.0	47.5	325.77	1759.4	1121.7	637.6	
100.0	43.8	300.43	1802.8	1246.3	556.4	
110.0	40.7	278.96	1841.3	1371.0	470.3	
120.0	38.0	260.52	1875.9	1495.6	380.3	
130.0	35.7	244.50	1907.3	1620.2	287.1	
140.0	33.6	230.45	1935.9	1744.8	191.1	
150.0	31.8	218.02	1962.3	1869.4	92.9	
160.0	30.2	206.94	1986.8	1994.1	-7.3	
170.0	28.7	197.00	2009.5	2118.7	-109.2	
180.0	27.4	188.02	2030.7	2243.3	-212.6	
190.0	26.2	179.88	2050.7	2367.9	-317.2	
200.0	25.2	172.45	2069.5	2492.5	-423.0	
210.0	24.2	165.65	2087.3	2617.2	-529.9	
220.0	23.3	159.40	2104.1	2741.8	-637.7	
230.0	22.4	153.63	2120.2	2866.4	-746.2	
240.0	21.6	148.29	2135.4	2991.0	-855.6	

Modified Rational Method

Project Name : **Detroit River International Crossing Stormwater Management Study Alternative 1B**

November 14, 2006 10:30 AM

105		
Area =	7.21	ha
"C" =	0.9	
AC=	6.489	
Tc =	16.3	min
Time Increment =	10.0	min
Release Rate =	383.5	l/s
Max.Storage =	2796	m^3

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

Constant Inflows

	l/s

105						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
16.3	141.5	2552.29	2494.4	374.8	2119.6	
26.3	109.9	1981.87	3126.1	605.0	2521.1	
36.3	90.3	1628.74	3546.3	835.1	2711.2	
46.3	76.9	1387.42	3853.3	1065.2	2788.1	
56.3	67.2	1211.49	4091.6	1295.3	2796.3	<<<<
66.3	59.7	1077.23	4284.5	1525.5	2759.0	
76.3	53.8	971.20	4445.5	1755.6	2689.9	
86.3	49.1	885.23	4583.1	1985.7	2597.4	
96.3	45.1	814.03	4702.9	2215.8	2487.1	
106.3	41.8	754.04	4808.8	2446.0	2362.8	
116.3	39.0	702.76	4903.4	2676.1	2227.3	
126.3	36.5	658.41	4989.0	2906.2	2082.8	
136.3	34.3	619.63	5066.9	3136.3	1930.6	
146.3	32.5	585.42	5138.5	3366.4	1772.0	
156.3	30.8	555.02	5204.6	3596.6	1608.0	
166.3	29.3	527.79	5266.0	3826.7	1439.3	
176.3	27.9	503.27	5323.3	4056.8	1266.5	
186.3	26.7	481.06	5377.0	4286.9	1090.1	
196.3	25.5	460.85	5427.6	4517.1	910.5	
206.3	24.5	442.37	5475.3	4747.2	728.1	
216.3	23.6	425.40	5520.5	4977.3	543.2	
226.3	22.7	409.76	5563.5	5207.4	356.1	
236.3	21.9	395.31	5604.4	5437.6	166.8	
246.3	21.2	381.90	5643.4	5667.7	-24.3	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

106		
Area =	6.17	ha
"C" =	0.9	
AC=	5.553	
Tc =	21.6	min
Time Increment =	10.0	min
Release Rate =	272.5	l/s
Max.Storage =	2586	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

106						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
21.6	122.5	1890.43	2455.0	353.8	2101.2	
31.6	98.4	1518.58	2883.3	517.3	2365.9	
41.6	82.6	1274.48	3184.5	680.8	2503.7	
51.6	71.3	1101.28	3412.5	844.3	2568.2	
61.6	62.9	971.64	3593.8	1007.8	2586.0	<<<<
71.6	56.4	870.77	3743.1	1171.3	2571.9	
81.6	51.2	789.90	3869.5	1334.7	2534.7	
91.6	46.9	723.55	3978.6	1498.2	2480.4	
101.6	43.3	668.08	4074.4	1661.7	2412.7	
111.6	40.2	620.96	4159.6	1825.2	2334.4	
121.6	37.6	580.41	4236.2	1988.7	2247.5	
131.6	35.3	545.13	4305.8	2152.2	2153.6	
141.6	33.3	514.13	4369.5	2315.6	2053.8	
151.6	31.5	486.68	4428.1	2479.1	1949.0	
161.6	29.9	462.17	4482.4	2642.6	1839.8	
171.6	28.5	440.16	4533.1	2806.1	1727.0	
181.6	27.2	420.27	4580.4	2969.6	1610.8	
191.6	26.1	402.21	4624.9	3133.1	1491.8	
201.6	25.0	385.73	4666.8	3296.5	1370.3	
211.6	24.0	370.63	4706.5	3460.0	1246.5	
221.6	23.1	356.74	4744.2	3623.5	1120.6	
231.6	22.3	343.91	4779.9	3787.0	993.0	
241.6	21.5	332.03	4814.1	3950.5	863.6	
251.6	20.8	321.00	4846.7	4114.0	732.7	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM
Stormwater Management Study
Alternative 1B

	107	
Area =	6.56	ha
"C" =	0.9	
AC=	5.904	
Tc =	24.3	min
Time Increment =	10.0	min
Release Rate =	268.7	l/s
Max.Storage =	2829	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

107						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1885.91	2749.7	391.7	2358.0	
34.3	93.6	1535.76	3160.6	552.9	2607.7	
44.3	79.2	1300.33	3456.3	714.1	2742.2	
54.3	68.9	1130.58	3683.4	875.3	2808.1	
64.3	61.1	1002.06	3866.0	1036.5	2829.5	<<<<
74.3	54.9	901.19	4017.5	1197.7	2819.8	
84.3	49.9	819.78	4146.5	1358.9	2787.6	
94.3	45.9	752.63	4258.4	1520.1	2738.3	
104.3	42.4	696.22	4357.0	1681.2	2675.7	
114.3	39.5	648.14	4444.9	1842.4	2602.5	
124.3	37.0	606.64	4524.3	2003.6	2520.7	
134.3	34.8	570.43	4596.5	2164.8	2431.7	
144.3	32.8	538.54	4662.7	2326.0	2336.7	
154.3	31.1	510.24	4723.8	2487.2	2236.5	
164.3	29.5	484.93	4780.4	2648.4	2132.0	
174.3	28.2	462.16	4833.3	2809.6	2023.7	
184.3	26.9	441.56	4882.8	2970.8	1912.0	
194.3	25.8	422.83	4929.3	3132.0	1797.3	
204.3	24.7	405.72	4973.3	3293.2	1680.1	
214.3	23.8	390.02	5014.8	3454.4	1560.5	
224.3	22.9	375.56	5054.3	3615.6	1438.7	
234.3	22.1	362.20	5091.9	3776.8	1315.1	
244.3	21.3	349.82	5127.7	3938.0	1189.8	
254.3	20.6	338.31	5162.0	4099.1	1062.8	

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 1B

Stormerwater Management Facility No.	1B-P1	1B-P2	1B-P3	1B-P4	1B-P5	1B-P6	1B-P7	1B-P8
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**
Drainage Area (ha)	6.4	2.7	5.4	4.5	2.7	7.2	6.2	6.6
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	567	1,130	945	575	1,514	1,296	1,378
Extended Detention Volume[3] (m^3)	254	108	215	180	110	288	247	262
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	675	1,345	1,125	685	1,803	1,543	1,640
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**675**	**1,345**	**1,125**	**685**	**1,803**	**1,543**	**1,640**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot								
Assumed Bottom width	25.00	12.75	21.50	19.00	12.75	26.50	23.75	25.00
Volume	1668.75	699.47	1345.88	1137.75	699.47	1818.38	1549.22	1668.75
Pond Bottom Area Requirement (m^2)	625	163	462	361	163	702	564	625
Pond Bottom width requirement assuming a square lot	25.00	12.75	21.50	19.00	12.75	26.50	23.75	25.00
Pond Area at Normal Water Level	1,600	770	1,332	1,156	770	1,722	1,502	1,600
Pond Area Requirement (m^2)	**3,364**	**2,093**	**2,970**	**2,704**	**2,093**	**3,540**	**3,221**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,323**	**5,550**	**5,184**	**4,323**	**6,320**	**5,891**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,577	3,872	3,474	2,577	4,736	4,250	4,468
Total Quality and Quantity Control Volume =	6,136	3,276	5,218	4,612	3,276	6,555	5,799	6,136
Approximate Volume of Excavation =	17,779	11,887	15,933	14,694	11,887	18,610	17,105	17,779

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m^3/ha - 40m^3/ha)

[3] Based on 40m^3/ha

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 1B.xls]Option 1B
9:38 AM 16/11/2006

Appendix C.3

Alternative 2A

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:41 AM

Stormwater Management Study Alternative 2A

Project No. : 33015384

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3688	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	148.1	2356.05	2089.0	0.3	2088.7	
16.8	139.5	2219.63	2234.4	0.4	2234.1	
18.8	131.9	2099.04	2364.9	0.4	2364.5	
20.8	125.2	1991.63	2482.9	0.4	2482.5	
22.8	119.1	1895.32	2590.3	0.5	2589.8	
24.8	113.6	1808.44	2688.6	0.5	2688.0	
26.8	108.7	1729.65	2779.0	0.6	2778.4	
28.8	104.2	1657.85	2862.6	0.6	2861.9	
30.8	100.1	1592.13	2940.1	0.7	2939.5	
32.8	96.3	1531.73	3012.4	0.7	3011.7	
34.8	92.8	1476.03	3080.0	0.8	3079.2	
36.8	89.5	1424.48	3143.3	0.8	3142.6	
38.8	86.5	1376.63	3203.0	0.8	3202.1	
40.8	83.7	1332.09	3259.2	0.9	3258.3	
42.8	81.1	1290.52	3312.3	0.9	3311.4	
44.8	78.7	1251.62	3362.7	1.0	3361.7	
46.8	76.4	1215.15	3410.5	1.0	3409.5	
48.8	74.2	1180.87	3456.0	1.1	3455.0	
50.8	72.2	1148.60	3499.4	1.1	3498.3	
52.8	70.3	1118.15	3540.8	1.1	3539.7	
54.8	68.5	1089.38	3580.4	1.2	3579.2	
56.8	66.7	1062.15	3618.4	1.2	3617.1	
58.8	65.1	1036.32	3654.8	1.3	3653.5	
60.8	63.6	1011.81	3689.7	1.3	3688.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:42 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	101	
Area =	1.69	ha
"C" =	0.9	
AC=	1.521	
Tc =	10.4	min
Time Increment =	2.0	min
Release Rate =	0.1	l/s
Max.Storage =	959	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.4	171.7	725.83	451.5	0.1	451.4	
12.4	160.0	676.67	502.1	0.1	502.0	
14.4	150.0	634.11	546.6	0.1	546.5	
16.4	141.2	596.89	586.1	0.1	586.0	
18.4	133.4	564.04	621.6	0.1	621.4	
20.4	126.5	534.83	653.6	0.2	653.4	
22.4	120.3	508.67	682.6	0.2	682.5	
24.4	114.7	485.10	709.2	0.2	709.0	
26.4	109.7	463.75	733.7	0.2	733.4	
28.4	105.1	444.31	756.2	0.2	756.0	
30.4	100.9	426.53	777.1	0.2	776.9	
32.4	97.0	410.21	796.6	0.3	796.4	
34.4	93.5	395.16	814.8	0.3	814.6	
36.4	90.2	381.25	831.9	0.3	831.6	
38.4	87.1	368.34	847.9	0.3	847.6	
40.4	84.3	356.33	863.0	0.3	862.7	
42.4	81.6	345.13	877.3	0.3	877.0	
44.4	79.1	334.66	890.9	0.3	890.5	
46.4	76.8	324.84	903.7	0.4	903.3	
48.4	74.6	315.61	915.9	0.4	915.5	
50.4	72.6	306.93	927.5	0.4	927.2	
52.4	70.7	298.74	938.7	0.4	938.2	
54.4	68.8	291.01	949.3	0.4	948.9	
56.4	67.1	283.69	959.4	0.4	959.0	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM

Stormwater Management Study Alternative 2A

Project No. : 33015384

	102	
Area =	5.19	ha
"C" =	0.9	
AC=	4.671	
Tc =	14.4	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3005	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.4	149.8	1944.65	1681.5	0.3	1681.2	
16.4	141.0	1830.67	1802.6	0.3	1802.3	
18.4	133.2	1730.07	1911.2	0.3	1910.8	
20.4	126.3	1640.59	2009.2	0.4	2008.8	
22.4	120.2	1560.45	2098.3	0.4	2097.9	
24.4	114.6	1488.23	2179.8	0.4	2179.3	
26.4	109.6	1422.80	2254.7	0.5	2254.2	
28.4	105.0	1363.22	2323.8	0.5	2323.3	
30.4	100.8	1308.72	2388.0	0.5	2387.4	
32.4	96.9	1258.68	2447.7	0.6	2447.1	
34.4	93.4	1212.56	2503.5	0.6	2502.9	
36.4	90.1	1169.90	2555.8	0.7	2555.2	
38.4	87.0	1130.33	2605.0	0.7	2604.3	
40.4	84.2	1093.51	2651.4	0.7	2650.7	
42.4	81.6	1059.16	2695.2	0.8	2694.4	
44.4	79.1	1027.04	2736.7	0.8	2735.9	
46.4	76.8	996.93	2776.1	0.8	2775.3	
48.4	74.6	968.64	2813.6	0.9	2812.7	
50.4	72.5	942.01	2849.3	0.9	2848.4	
52.4	70.6	916.90	2883.4	0.9	2882.4	
54.4	68.8	893.18	2915.9	1.0	2915.0	
56.4	67.1	870.74	2947.2	1.0	2946.1	
58.4	65.4	849.46	2977.1	1.1	2976.0	
60.4	63.9	829.27	3005.8	1.1	3004.7	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	103	
Area =	3.31	ha
"C" =	0.9	
AC=	2.979	
Tc =	13.1	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1905	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
13.1	156.0	1291.98	1018.1	0.2	1017.9	
15.1	146.5	1212.89	1101.3	0.2	1101.1	
17.1	138.1	1143.47	1175.5	0.2	1175.3	
19.1	130.7	1082.02	1242.2	0.2	1241.9	
21.1	124.0	1027.22	1302.5	0.3	1302.2	
23.1	118.1	978.03	1357.5	0.3	1357.2	
25.1	112.7	933.61	1407.9	0.3	1407.6	
27.1	107.9	893.29	1454.3	0.3	1453.9	
29.1	103.4	856.51	1497.2	0.4	1496.8	
31.1	99.4	822.83	1537.0	0.4	1536.6	
33.1	95.6	791.85	1574.2	0.4	1573.8	
35.1	92.2	763.26	1609.0	0.4	1608.5	
37.1	89.0	736.79	1641.6	0.5	1641.1	
39.1	86.0	712.21	1672.3	0.5	1671.8	
41.1	83.2	689.32	1701.2	0.5	1700.7	
43.1	80.7	667.94	1728.6	0.5	1728.1	
45.1	78.2	647.93	1754.6	0.6	1754.0	
47.1	76.0	629.16	1779.3	0.6	1778.7	
49.1	73.8	611.52	1802.7	0.6	1802.1	
51.1	71.8	594.89	1825.1	0.6	1824.5	
53.1	69.9	579.21	1846.5	0.7	1845.8	
55.1	68.1	564.38	1867.0	0.7	1866.3	
57.1	66.5	550.34	1886.6	0.7	1885.9	
59.1	64.8	537.03	1905.4	0.7	1904.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	104	
Area =	4.93	ha
"C" =	0.9	
AC=	4.437	
Tc =	11.2	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	2809	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
11.2	166.7	2056.59	1379.3	0.2	1379.1	
13.2	155.8	1921.51	1519.3	0.3	1519.0	
15.2	146.3	1804.06	1642.9	0.3	1642.6	
17.2	137.9	1700.96	1753.1	0.4	1752.8	
19.2	130.5	1609.67	1852.2	0.4	1851.8	
21.2	123.9	1528.25	1941.9	0.4	1941.5	
23.2	118.0	1455.16	2023.6	0.5	2023.2	
25.2	112.6	1389.14	2098.5	0.5	2098.0	
27.2	107.8	1329.21	2167.5	0.6	2166.9	
29.2	103.3	1274.55	2231.3	0.6	2230.7	
31.2	99.3	1224.47	2290.6	0.6	2289.9	
33.2	95.5	1178.42	2345.8	0.7	2345.2	
35.2	92.1	1135.92	2397.5	0.7	2396.8	
37.2	88.9	1096.56	2446.1	0.8	2445.3	
39.2	85.9	1060.00	2491.7	0.8	2490.9	
41.2	83.2	1025.96	2534.8	0.8	2534.0	
43.2	80.6	994.16	2575.5	0.9	2574.7	
45.2	78.2	964.41	2614.2	0.9	2613.3	
47.2	75.9	936.49	2650.9	1.0	2649.9	
49.2	73.8	910.24	2685.8	1.0	2684.8	
51.2	71.8	885.52	2719.1	1.0	2718.1	
53.2	69.9	862.18	2750.9	1.1	2749.9	
55.2	68.1	840.13	2781.4	1.1	2780.3	
57.2	66.4	819.24	2810.5	1.2	2809.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:44 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	105	
Area =	2.61	ha
"C" =	0.9	
AC=	2.349	
Tc =	10.9	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1485	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.9	168.5	1100.45	718.2	0.1	718.1	
12.9	157.3	1027.35	793.8	0.1	793.7	
14.9	147.6	963.90	860.4	0.2	860.3	
16.9	139.1	908.27	919.8	0.2	919.6	
18.9	131.6	859.07	973.0	0.2	972.8	
20.9	124.8	815.24	1021.2	0.2	1021.0	
22.9	118.8	775.93	1065.1	0.3	1064.8	
24.9	113.4	740.45	1105.2	0.3	1105.0	
26.9	108.5	708.27	1142.2	0.3	1141.9	
28.9	104.0	678.94	1176.4	0.3	1176.0	
30.9	99.9	652.08	1208.1	0.4	1207.7	
32.9	96.1	627.40	1237.7	0.4	1237.3	
34.9	92.6	604.63	1265.3	0.4	1264.9	
36.9	89.4	583.56	1291.2	0.4	1290.8	
38.9	86.4	563.99	1315.6	0.4	1315.2	
40.9	83.6	545.78	1338.6	0.5	1338.1	
42.9	81.0	528.78	1360.4	0.5	1359.9	
44.9	78.5	512.87	1381.0	0.5	1380.5	
46.9	76.3	497.95	1400.6	0.5	1400.0	
48.9	74.1	483.92	1419.2	0.6	1418.6	
50.9	72.1	470.72	1436.9	0.6	1436.4	
52.9	70.2	458.26	1453.9	0.6	1453.3	
54.9	68.4	446.48	1470.1	0.6	1469.5	
56.9	66.7	435.34	1485.7	0.6	1485.0	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:44 AM

Stormwater Management Study Alternative 2A

Project No. : 33015384

	106	
Area =	5.3	ha
"C" =	0.9	
AC=	4.77	
Tc =	15.8	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3088	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
15.8	143.7	1905.35	1802.5	0.3	1802.2	
17.8	135.6	1798.50	1917.2	0.3	1916.9	
19.8	128.5	1703.69	2020.6	0.3	2020.2	
21.8	122.1	1618.95	2114.3	0.4	2114.0	
23.8	116.3	1542.73	2199.9	0.4	2199.5	
25.8	111.1	1473.79	2278.5	0.4	2278.0	
27.8	106.4	1411.11	2350.9	0.5	2350.4	
29.8	102.1	1353.87	2418.0	0.5	2417.5	
31.8	98.1	1301.37	2480.4	0.6	2479.9	
33.8	94.5	1253.03	2538.6	0.6	2538.1	
35.8	91.1	1208.37	2593.2	0.6	2592.5	
37.8	88.0	1166.99	2644.4	0.7	2643.7	
39.8	85.1	1128.51	2692.6	0.7	2691.9	
41.8	82.4	1092.65	2738.2	0.7	2737.5	
43.8	79.9	1059.14	2781.3	0.8	2780.5	
45.8	77.5	1027.75	2822.2	0.8	2821.4	
47.8	75.3	998.28	2861.1	0.8	2860.3	
49.8	73.2	970.56	2898.1	0.9	2897.2	
51.8	71.2	944.44	2933.4	0.9	2932.5	
53.8	69.4	919.77	2967.2	0.9	2966.3	
55.8	67.6	896.44	2999.5	1.0	2998.5	
57.8	65.9	874.34	3030.5	1.0	3029.5	
59.8	64.4	853.37	3060.2	1.0	3059.1	
61.8	62.9	833.45	3088.8	1.1	3087.7	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:44 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	107	
Area =	7.06	ha
"C" =	0.9	
AC=	6.354	
Tc =	16.1	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	4119	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.1	142.3	2513.93	2426.8	0.4	2426.4	
18.1	134.4	2374.39	2577.0	0.4	2576.6	
20.1	127.4	2250.41	2712.5	0.5	2712.0	
22.1	121.1	2139.48	2835.5	0.5	2835.0	
24.1	115.5	2039.62	2947.9	0.5	2947.4	
26.1	110.3	1949.22	3051.2	0.6	3050.6	
28.1	105.7	1866.96	3146.5	0.6	3145.8	
30.1	101.4	1791.78	3234.8	0.7	3234.1	
32.1	97.5	1722.79	3316.9	0.7	3316.2	
34.1	93.9	1659.23	3393.7	0.8	3392.9	
36.1	90.6	1600.48	3465.6	0.8	3464.8	
38.1	87.5	1546.01	3533.1	0.9	3532.3	
40.1	84.7	1495.34	3596.8	0.9	3595.9	
42.1	82.0	1448.10	3656.9	1.0	3656.0	
44.1	79.5	1403.93	3713.9	1.0	3712.9	
46.1	77.1	1362.55	3767.9	1.1	3766.9	
48.1	74.9	1323.69	3819.3	1.1	3818.2	
50.1	72.9	1287.12	3868.2	1.1	3867.1	
52.1	70.9	1252.64	3914.9	1.2	3913.7	
54.1	69.1	1220.08	3959.6	1.2	3958.3	
56.1	67.3	1189.28	4002.3	1.3	4001.0	
58.1	65.7	1160.09	4043.3	1.3	4042.0	
60.1	64.1	1132.39	4082.6	1.4	4081.3	
62.1	62.6	1106.06	4120.5	1.4	4119.0	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2A

Stormwater Management Facility No.	2A-P1	2A-P2	2A-P3	2A-P4	2A-P5	2A-P6	2A-P7	2A-P8
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**
Drainage Area (ha)	6.4	1.7	5.2	3.3	4.9	2.6	5.3	7.1
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	357	1,092	693	1,035	548	1,113	1,483
Extended Detention Volume[3] (m^3)	254	68	208	132	197	104	212	282
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	425	1,300	825	1,233	653	1,325	1,765
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**425**	**1,300**	**825**	**1,233**	**653**	**1,325**	**1,765**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot								
Assumed Bottom width	25.00	10.00	22.00	15.00	18.00	8.00	24.00	26.00
Volume	1668.75	543.75	1389.75	843.75	1059.75	444.75	1572.75	1767.75
Pond Bottom Area Requirement (m^2)	625	100	484	225	324	64	576	676
Pond Bottom width requirement assuming a square lot	25.00	10.00	22.00	15.00	18.00	8.00	24.00	26.00
Pond Area at Normal Water Level	1,600	625	1,369	900	1,089	529	1,521	1,681
Pond Area Requirement (m^2)	**3,364**	**1,849**	**3,025**	**2,304**	**2,601**	**1,681**	**3,249**	**3,481**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**3,969**	**5,625**	**4,624**	**5,041**	**3,721**	**5,929**	**6,241**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,227	3,955	2,884	3,321	1,989	4,293	4,646
Total Quality and Quantity Control Volume =	6,136	2,770	5,344	3,727	4,381	2,434	5,866	6,414
Approximate Volume of Excavation =	17,779	10,783	16,189	12,850	14,217	10,030	17,238	18,330

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m^3/ha - 40m^3/ha)

[3] Based on 40m^3/ha

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 2A.xls]Option 2A

9:39 AM 16/11/2006

Appendix C.4

Alternative 2B

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:46 AM

Stormwater Management Study Alternative 2B

Project No. : 33015384

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3688	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	148.1	2356.05	2089.0	0.3	2088.7	
16.8	139.5	2219.63	2234.4	0.4	2234.1	
18.8	131.9	2099.04	2364.9	0.4	2364.5	
20.8	125.2	1991.63	2482.9	0.4	2482.5	
22.8	119.1	1895.32	2590.3	0.5	2589.8	
24.8	113.6	1808.44	2688.6	0.5	2688.0	
26.8	108.7	1729.65	2779.0	0.6	2778.4	
28.8	104.2	1657.85	2862.6	0.6	2861.9	
30.8	100.1	1592.13	2940.1	0.7	2939.5	
32.8	96.3	1531.73	3012.4	0.7	3011.7	
34.8	92.8	1476.03	3080.0	0.8	3079.2	
36.8	89.5	1424.48	3143.3	0.8	3142.6	
38.8	86.5	1376.63	3203.0	0.8	3202.1	
40.8	83.7	1332.09	3259.2	0.9	3258.3	
42.8	81.1	1290.52	3312.3	0.9	3311.4	
44.8	78.7	1251.62	3362.7	1.0	3361.7	
46.8	76.4	1215.15	3410.5	1.0	3409.5	
48.8	74.2	1180.87	3456.0	1.1	3455.0	
50.8	72.2	1148.60	3499.4	1.1	3498.3	
52.8	70.3	1118.15	3540.8	1.1	3539.7	
54.8	68.5	1089.38	3580.4	1.2	3579.2	
56.8	66.7	1062.15	3618.4	1.2	3617.1	
58.8	65.1	1036.32	3654.8	1.3	3653.5	
60.8	63.6	1011.81	3689.7	1.3	3688.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM

Stormwater Management Study Alternative 2B

Project No. : 33015384

	101	
Area =	2.13	ha
"C" =	0.9	
AC=	1.917	
Tc =	10.4	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1209	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.4	171.7	915.18	568.6	0.1	568.5	
12.4	160.1	853.16	632.5	0.1	632.4	
14.4	150.0	799.48	688.6	0.1	688.5	
16.4	141.2	752.54	738.5	0.2	738.3	
18.4	133.4	711.11	783.2	0.2	783.0	
20.4	126.5	674.27	823.5	0.2	823.3	
22.4	120.3	641.28	860.2	0.2	860.0	
24.4	114.8	611.56	893.7	0.2	893.5	
26.4	109.7	584.63	924.5	0.3	924.2	
28.4	105.1	560.12	953.0	0.3	952.7	
30.4	100.9	537.70	979.3	0.3	979.0	
32.4	97.0	517.12	1003.9	0.3	1003.6	
34.4	93.5	498.15	1026.8	0.3	1026.5	
36.4	90.2	480.60	1048.4	0.3	1048.0	
38.4	87.1	464.33	1068.6	0.4	1068.2	
40.4	84.3	449.19	1087.6	0.4	1087.2	
42.4	81.6	435.06	1105.6	0.4	1105.2	
44.4	79.2	421.86	1122.7	0.4	1122.3	
46.4	76.8	409.48	1138.9	0.4	1138.4	
48.4	74.7	397.85	1154.3	0.5	1153.8	
50.4	72.6	386.90	1169.0	0.5	1168.5	
52.4	70.7	376.58	1183.0	0.5	1182.5	
54.4	68.8	366.83	1196.4	0.5	1195.8	
56.4	67.1	357.60	1209.2	0.5	1208.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	102	
Area =	6.54	ha
"C" =	0.9	
AC=	5.886	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3794	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	147.9	2419.42	2151.7	0.3	2151.3	
16.8	139.3	2279.53	2300.8	0.4	2300.4	
18.8	131.8	2155.85	2434.7	0.4	2434.3	
20.8	125.0	2045.68	2555.7	0.5	2555.3	
22.8	119.0	1946.88	2665.9	0.5	2665.4	
24.8	113.5	1857.74	2766.8	0.6	2766.2	
26.8	108.6	1776.89	2859.6	0.6	2859.0	
28.8	104.1	1703.20	2945.4	0.6	2944.8	
30.8	100.0	1635.75	3025.0	0.7	3024.4	
32.8	96.2	1573.76	3099.3	0.7	3098.5	
34.8	92.7	1516.58	3168.6	0.8	3167.9	
36.8	89.4	1463.66	3233.7	0.8	3232.9	
38.8	86.4	1414.54	3294.9	0.9	3294.1	
40.8	83.7	1368.81	3352.7	0.9	3351.8	
42.8	81.0	1326.12	3407.3	1.0	3406.3	
44.8	78.6	1286.19	3459.0	1.0	3458.0	
46.8	76.3	1248.73	3508.1	1.0	3507.1	
48.8	74.2	1213.54	3554.9	1.1	3553.8	
50.8	72.1	1180.39	3599.4	1.1	3598.3	
52.8	70.2	1149.12	3642.0	1.2	3640.8	
54.8	68.4	1119.57	3682.7	1.2	3681.4	
56.8	66.7	1091.60	3721.6	1.3	3720.4	
58.8	65.1	1065.08	3759.0	1.3	3757.7	
60.8	63.6	1039.90	3794.9	1.4	3793.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	103	
Area =	7.21	ha
"C" =	0.9	
AC=	6.489	
Tc =	21.1	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	4298	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
21.1	124.0	2236.91	2837.9	0.4	2837.5	
23.1	118.1	2129.82	2957.6	0.4	2957.2	
25.1	112.7	2033.12	3067.3	0.5	3066.8	
27.1	107.8	1945.33	3168.3	0.5	3167.8	
29.1	103.4	1865.27	3261.7	0.6	3261.2	
31.1	99.3	1791.93	3348.5	0.6	3347.9	
33.1	95.6	1724.49	3429.4	0.6	3428.8	
35.1	92.1	1662.24	3505.1	0.7	3504.4	
37.1	89.0	1604.61	3576.1	0.7	3575.4	
39.1	86.0	1551.09	3643.0	0.8	3642.2	
41.1	83.2	1501.24	3706.1	0.8	3705.3	
43.1	80.6	1454.69	3765.7	0.8	3764.9	
45.1	78.2	1411.12	3822.3	0.9	3821.4	
47.1	76.0	1370.25	3876.0	0.9	3875.1	
49.1	73.8	1331.82	3927.1	0.9	3926.2	
51.1	71.8	1295.63	3975.9	1.0	3974.9	
53.1	69.9	1261.48	4022.4	1.0	4021.4	
55.1	68.1	1229.19	4067.0	1.1	4065.9	
57.1	66.4	1198.62	4109.7	1.1	4108.6	
59.1	64.8	1169.62	4150.6	1.1	4149.5	
61.1	63.3	1142.09	4189.9	1.2	4188.8	
63.1	61.9	1115.90	4227.8	1.2	4226.6	
65.1	60.5	1090.97	4264.2	1.3	4263.0	
67.1	59.2	1067.19	4299.4	1.3	4298.1	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	104	
Area =	2.34	ha
"C" =	0.9	
AC=	2.106	
Tc =	9.7	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1323	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
9.7	176.1	1030.97	598.6	0.1	598.5	
11.7	163.8	959.23	672.1	0.1	672.0	
13.7	153.3	897.38	736.5	0.1	736.3	
15.7	144.1	843.47	793.4	0.2	793.3	
17.7	136.0	796.03	844.3	0.2	844.1	
19.7	128.8	753.95	890.2	0.2	890.0	
21.7	122.4	716.36	931.7	0.2	931.5	
23.7	116.6	682.55	969.7	0.3	969.4	
25.7	111.4	651.98	1004.5	0.3	1004.2	
27.7	106.6	624.20	1036.6	0.3	1036.3	
29.7	102.3	598.82	1066.3	0.3	1066.0	
31.7	98.3	575.55	1093.9	0.3	1093.6	
33.7	94.6	554.14	1119.7	0.4	1119.4	
35.7	91.3	534.35	1143.9	0.4	1143.5	
37.7	88.1	516.02	1166.5	0.4	1166.1	
39.7	85.2	498.98	1187.9	0.4	1187.5	
41.7	82.5	483.10	1208.1	0.5	1207.6	
43.7	80.0	468.26	1227.1	0.5	1226.7	
45.7	77.6	454.36	1245.2	0.5	1244.8	
47.7	75.4	441.31	1262.4	0.5	1261.9	
49.7	73.3	429.04	1278.8	0.5	1278.3	
51.7	71.3	417.48	1294.5	0.6	1293.9	
53.7	69.4	406.56	1309.4	0.6	1308.8	
55.7	67.7	396.23	1323.7	0.6	1323.1	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM

Stormwater Management Study Alternative 2B

Project No. : 33015384

	105	
Area =	5.77	ha
"C" =	0.9	
AC=	5.193	
Tc =	20.3	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3428	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
20.3	126.7	1829.17	2227.9	0.3	2227.6	
22.3	120.5	1739.54	2327.5	0.4	2327.1	
24.3	114.9	1658.80	2418.5	0.4	2418.1	
26.3	109.8	1585.66	2502.2	0.4	2501.7	
28.3	105.2	1519.09	2579.4	0.5	2578.9	
30.3	101.0	1458.21	2651.0	0.5	2650.5	
32.3	97.1	1402.32	2717.7	0.5	2717.2	
34.3	93.6	1350.81	2780.0	0.6	2779.4	
36.3	90.3	1303.19	2838.3	0.6	2837.7	
38.3	87.2	1259.01	2893.2	0.6	2892.6	
40.3	84.4	1217.91	2944.9	0.7	2944.3	
42.3	81.7	1179.58	2993.8	0.7	2993.1	
44.3	79.2	1143.73	3040.0	0.7	3039.3	
46.3	76.9	1110.14	3084.0	0.8	3083.2	
48.3	74.7	1078.58	3125.7	0.8	3125.0	
50.3	72.7	1048.89	3165.5	0.8	3164.7	
52.3	70.7	1020.88	3203.5	0.8	3202.7	
54.3	68.9	994.43	3239.8	0.9	3239.0	
56.3	67.1	969.40	3274.6	0.9	3273.7	
58.3	65.5	945.67	3308.0	0.9	3307.0	
60.3	63.9	923.16	3340.0	1.0	3339.0	
62.3	62.5	901.75	3370.8	1.0	3369.7	
64.3	61.1	881.39	3400.4	1.0	3399.3	
66.3	59.7	861.98	3428.9	1.1	3427.9	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:48 AM

Stormwater Management Study Alternative 2B

Project No. : 33015384

	106	
Area =	9.32	ha
"C" =	0.9	
AC=	8.388	
Tc =	16.4	min
Time Increment =	2.0	min
Release Rate =	0.5	l/s
Max.Storage =	5444	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.4	141.2	3291.72	3232.5	0.5	3232.0	
18.4	133.4	3110.58	3427.9	0.5	3427.3	
20.4	126.5	2949.49	3604.3	0.6	3603.7	
22.4	120.3	2805.23	3764.6	0.7	3764.0	
24.4	114.7	2675.25	3911.2	0.7	3910.5	
26.4	109.7	2557.50	4046.0	0.8	4045.2	
28.4	105.1	2450.29	4170.4	0.8	4169.6	
30.4	100.9	2352.24	4285.8	0.9	4284.9	
32.4	97.0	2262.21	4393.2	1.0	4392.3	
34.4	93.5	2179.24	4493.6	1.0	4492.6	
36.4	90.2	2102.51	4587.7	1.1	4586.6	
38.4	87.1	2031.33	4676.1	1.1	4675.0	
40.4	84.3	1965.10	4759.5	1.2	4758.3	
42.4	81.6	1903.32	4838.3	1.2	4837.0	
44.4	79.1	1845.55	4912.9	1.3	4911.6	
46.4	76.8	1791.40	4983.7	1.4	4982.3	
48.4	74.6	1740.54	5051.0	1.4	5049.6	
50.4	72.6	1692.66	5115.2	1.5	5113.7	
52.4	70.7	1647.52	5176.5	1.5	5175.0	
54.4	68.8	1604.87	5235.1	1.6	5233.5	
56.4	67.1	1564.51	5291.2	1.7	5289.5	
58.4	65.5	1526.26	5344.9	1.7	5343.2	
60.4	63.9	1489.95	5396.6	1.8	5394.8	
62.4	62.4	1455.44	5446.2	1.8	5444.4	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2B

Stormwater Management Facility No.	2B-P1	2B-P2	2B-P3	2B-P4	2B-P5	2B-P6	2B-P7
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**
Drainage Area (ha)	6.4	2.1	6.5	7.2	2.3	5.8	9.3
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	447	1,373	1,514	491	1,212	1,957
Extended Detention Volume[3] (m^3)	254	85	262	288	94	231	373
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	533	1,635	1,803	585	1,443	2,330
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**533**	**1,635**	**1,803**	**585**	**1,443**	**2,330**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot							
Assumed Bottom width	25.00	10.00	25.00	29.00	12.00	23.00	32.00
Volume	1668.75	543.75	1668.75	2082.75	654.75	1479.75	2424.75
Pond Bottom Area Requirement (m^2)	625	100	625	841	144	529	1,024
Pond Bottom width requirement assuming a square lot	25.00	10.00	25.00	29.00	12.00	23.00	32.00
Pond Area at Normal Water Level	1,600	625	1,600	1,936	729	1,444	2,209
Pond Area Requirement (m^2)	**3,364**	**1,849**	**3,364**	**3,844**	**2,025**	**3,136**	**4,225**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**3,969**	**6,084**	**6,724**	**4,225**	**5,776**	**7,225**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,227	4,468	5,202	2,479	4,122	5,791
Total Quality and Quantity Control Volume =	6,136	2,770	6,136	7,285	3,133	5,602	8,215
Approximate Volume of Excavation =	17,779	10,783	17,779	20,047	11,578	16,708	21,860

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m^3/ha - 40m^3/ha)

[3] Based on 40m^3/ha

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 2B.xls]Option 2B
9:39 AM 16/11/2006

Appendix C.5

Alternative 2B – Revised

Modified Rational Method

Project Name : Detroit River International Crossing November 17, 2006 3:49 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P1	
Area =	19.43	ha
"C" =	0.9	
AC=	17.487	
Tc =	30.9	min
Time Increment =	2.0	min
Release Rate =	0.6	l/s
Max.Storage =	12001	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
30.9	99.8	4853.23	8995.0	1.1	8993.9	
32.9	96.1	4669.57	9214.9	1.1	9213.8	
34.9	92.6	4500.15	9420.6	1.2	9419.4	
36.9	89.3	4343.34	9613.5	1.3	9612.3	
38.9	86.3	4197.76	9795.0	1.3	9793.7	
40.9	83.6	4062.22	9966.2	1.4	9964.8	
42.9	81.0	3935.70	10128.1	1.5	10126.7	
44.9	78.5	3817.31	10281.5	1.5	10280.0	
46.9	76.2	3706.27	10427.2	1.6	10425.6	
48.9	74.1	3601.92	10565.9	1.7	10564.2	
50.9	72.1	3503.65	10698.0	1.7	10696.3	
52.9	70.2	3410.93	10824.3	1.8	10822.4	
54.9	68.4	3323.30	10945.0	1.9	10943.1	
56.9	66.7	3240.35	11060.6	1.9	11058.7	
58.9	65.0	3161.70	11171.5	2.0	11169.5	
60.9	63.5	3087.01	11278.1	2.1	11276.0	
62.9	62.0	3016.00	11380.6	2.2	11378.4	
64.9	60.6	2948.39	11479.3	2.2	11477.0	
66.9	59.3	2883.93	11574.4	2.3	11572.1	
68.9	58.1	2822.42	11666.2	2.4	11663.8	
70.9	56.8	2763.64	11754.9	2.4	11752.4	
72.9	55.7	2707.41	11840.6	2.5	11838.1	
74.9	54.6	2653.58	11923.6	2.6	11921.0	
76.9	53.5	2601.97	12004.0	2.6	12001.3	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 17, 2006 3:46 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P2	
Area =	6.22	ha
"C" =	0.9	
AC=	5.598	
Tc =	15.2	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3614	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
15.2	146.3	2276.66	2072.2	0.3	2071.9	
17.2	137.9	2146.51	2211.3	0.3	2211.0	
19.2	130.5	2031.29	2336.4	0.4	2336.0	
21.2	123.9	1928.52	2449.6	0.4	2449.2	
23.2	118.0	1836.26	2552.8	0.4	2552.3	
25.2	112.6	1752.94	2647.3	0.5	2646.8	
27.2	107.8	1677.30	2734.3	0.5	2733.8	
29.2	103.3	1608.31	2814.9	0.6	2814.3	
31.2	99.3	1545.11	2889.7	0.6	2889.1	
33.2	95.5	1486.98	2959.4	0.6	2958.8	
35.2	92.1	1433.34	3024.6	0.7	3024.0	
37.2	88.9	1383.67	3085.9	0.7	3085.2	
39.2	85.9	1337.54	3143.5	0.8	3142.7	
41.2	83.2	1294.57	3197.9	0.8	3197.1	
43.2	80.6	1254.45	3249.3	0.8	3248.5	
45.2	78.2	1216.90	3298.0	0.9	3297.2	
47.2	75.9	1181.66	3344.3	0.9	3343.4	
49.2	73.8	1148.54	3388.4	0.9	3387.5	
51.2	71.8	1117.34	3430.5	1.0	3429.5	
53.2	69.9	1087.90	3470.6	1.0	3469.6	
55.2	68.1	1060.06	3509.0	1.1	3508.0	
57.2	66.4	1033.71	3545.8	1.1	3544.7	
59.2	64.8	1008.71	3581.1	1.1	3580.0	
61.2	63.3	984.97	3615.1	1.2	3613.9	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 17, 2006 3:47 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P3	
Area =	8.67	ha
"C" =	0.9	
AC=	7.803	
Tc =	16.2	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	5060	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.2	142.0	3080.76	2987.1	0.4	2986.7	
18.2	134.2	2910.13	3170.9	0.5	3170.4	
20.2	127.2	2758.50	3336.7	0.5	3336.2	
22.2	120.9	2622.80	3487.3	0.6	3486.7	
24.2	115.3	2500.61	3624.9	0.6	3624.3	
26.2	110.2	2389.97	3751.3	0.7	3750.6	
28.2	105.5	2289.29	3868.0	0.7	3867.3	
30.2	101.3	2197.25	3976.1	0.8	3975.4	
32.2	97.4	2112.78	4076.8	0.8	4076.0	
34.2	93.8	2034.95	4170.8	0.9	4170.0	
36.2	90.5	1963.00	4258.9	0.9	4258.0	
38.2	87.4	1896.28	4341.7	1.0	4340.8	
40.2	84.6	1834.22	4419.7	1.0	4418.7	
42.2	81.9	1776.34	4493.4	1.1	4492.4	
44.2	79.4	1722.23	4563.2	1.1	4562.1	
46.2	77.1	1671.53	4629.5	1.2	4628.3	
48.2	74.9	1623.91	4692.4	1.2	4691.2	
50.2	72.8	1579.09	4752.4	1.3	4751.2	
52.2	70.8	1536.84	4809.7	1.3	4808.4	
54.2	69.0	1496.94	4864.4	1.4	4863.1	
56.2	67.3	1459.18	4916.9	1.4	4915.4	
58.2	65.6	1423.40	4967.1	1.5	4965.6	
60.2	64.1	1389.45	5015.3	1.5	5013.8	
62.2	62.6	1357.18	5061.7	1.6	5060.2	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 17, 2006 4:09 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P4	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	12.9	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3656	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
12.9	157.1	2499.94	1938.0	0.3	1937.7	
14.9	147.4	2345.76	2099.9	0.3	2099.6	
16.9	138.9	2210.56	2244.2	0.4	2243.8	
18.9	131.4	2090.99	2373.7	0.4	2373.3	
20.9	124.7	1984.44	2490.9	0.5	2490.4	
22.9	118.7	1888.85	2597.5	0.5	2597.0	
24.9	113.3	1802.59	2695.2	0.6	2694.7	
26.9	108.4	1724.33	2785.1	0.6	2784.5	
28.9	103.9	1652.98	2868.3	0.6	2867.6	
30.9	99.8	1587.66	2945.4	0.7	2944.7	
32.9	96.0	1527.62	3017.4	0.7	3016.6	
34.9	92.5	1472.23	3084.6	0.8	3083.8	
36.9	89.3	1420.96	3147.7	0.8	3146.9	
38.9	86.3	1373.36	3207.1	0.9	3206.2	
40.9	83.5	1329.04	3263.1	0.9	3262.1	
42.9	80.9	1287.67	3316.0	1.0	3315.0	
44.9	78.5	1248.95	3366.2	1.0	3365.2	
46.9	76.2	1212.64	3413.8	1.0	3412.8	
48.9	74.1	1178.52	3459.2	1.1	3458.1	
50.9	72.0	1146.38	3502.4	1.1	3501.3	
52.9	70.1	1116.05	3543.7	1.2	3542.5	
54.9	68.3	1087.40	3583.2	1.2	3582.0	
56.9	66.6	1060.26	3621.0	1.3	3619.7	
58.9	65.0	1034.54	3657.3	1.3	3656.0	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2B-Revised Profile

Stormwater Management Facility No.	2BR - P1	2BR - P2	2BR - P3	2BR - P4
Drainage Area ID	103	102	101	100
Drainage Area (ha)	19.4	6.2	8.7	6.4
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	4,080	1,306	1,821	1,336
Extended Detention Volume[3] (m^3)	777	249	347	254
Erosion Control Volume[4], 25mm Storm (m^3)	4,858	1,555	2,168	1,590
Total Extended Detention Vol. Req't[5] (m^3)	**4,858**	**1,555**	**2,168**	**1,590**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot				
Assumed Bottom width	49.00	24.00	30.00	29.00
Volume	4872.75	1572.75	2193.75	2082.75
Pond Bottom Area Requirement (m^2)	2,401	576	900	841
Pond Bottom width requirement assuming a square lot	49.00	24.00	30.00	29.00
Pond Area at Normal Water Level	4,096	1,521	2,025	1,936
Pond Area Requirement (m^2)	**6,724**	**3,249**	**3,969**	**3,844**
Pond Area Requirement with 10 m buffer (m^2)	**10,404**	**5,929**	**6,889**	**6,724**
Total Quantity Control Volume @ 1.80m depth from NWL =	9,738	4,293	5,395	5,202
Total Quality and Quantity Control Volume =	14,611	5,866	7,588	7,285
Approximate Volume of Excavation =	33,933	17,238	20,641	20,047

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (25C

[3] Based on $40m^3/ha$

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 2B-Revised Profile.xls]Option 2B-Revised Profile
3:25 PM 17/11/2006

Appendix C.6

Alternative 3 – Tunnel

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 11:19 AM

Stormwater Management Study

Alternative 3

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.4	min
Time Increment =	10.0	min
Release Rate =	367.0	l/s
Max.Storage =	2376	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.6	2380.56	2063.1	318.1	1745.0	
24.4	114.5	1822.33	2672.7	538.3	2134.4	
34.4	93.3	1485.01	3069.0	758.6	2310.5	
44.4	79.1	1257.93	3354.5	978.8	2375.7	<<<<
54.4	68.8	1094.07	3574.0	1199.0	2374.9	
64.4	61.0	969.93	3750.4	1419.2	2331.2	
74.4	54.8	872.45	3897.0	1639.5	2257.5	
84.4	49.9	793.76	4021.7	1859.7	2162.0	
94.4	45.8	728.82	4130.0	2079.9	2050.1	
104.4	42.4	674.27	4225.4	2300.1	1925.3	
114.4	39.5	627.76	4310.6	2520.4	1790.2	
124.4	36.9	587.60	4387.4	2740.6	1646.8	
134.4	34.7	552.56	4457.3	2960.8	1496.5	
144.4	32.8	521.70	4521.4	3181.0	1340.4	
154.4	31.1	494.31	4580.6	3401.3	1179.3	
164.4	29.5	469.81	4635.4	3621.5	1014.0	
174.4	28.1	447.77	4686.6	3841.7	844.9	
184.4	26.9	427.82	4734.6	4061.9	672.6	
194.4	25.7	409.69	4779.7	4282.2	497.5	
204.4	24.7	393.12	4822.2	4502.4	319.8	
214.4	23.7	377.92	4862.5	4722.6	139.9	
224.4	22.9	363.92	4900.8	4942.8	-42.1	
234.4	22.1	350.98	4937.2	5163.1	-225.9	
244.4	21.3	338.99	4971.9	5383.3	-411.4	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 11:19 AM
Stormwater Management Study
Alternative 3

	101	
Area =	2.80	ha
"C" =	0.9	
AC=	2.52	
Tc =	13.9	min
Time Increment =	10.0	min
Release Rate =	167.3	l/s
Max.Storage =	1030	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.9	152.4	1067.32	888.0	139.2	748.8	
23.9	116.1	813.12	1164.4	239.6	924.8	
33.9	94.3	660.75	1342.7	340.0	1002.7	
43.9	79.7	558.69	1470.5	440.3	1030.1	<<<<
53.9	69.3	485.29	1568.4	540.7	1027.7	
63.9	61.4	429.81	1647.0	641.1	1005.9	
73.9	55.1	386.33	1712.2	741.5	970.7	
83.9	50.1	351.27	1767.6	841.9	925.8	
93.9	46.0	322.38	1815.6	942.2	873.4	
103.9	42.6	298.13	1858.0	1042.6	815.3	
113.9	39.6	277.47	1895.7	1143.0	752.7	
123.9	37.1	259.65	1929.7	1243.4	686.3	
133.9	34.8	244.10	1960.6	1343.8	616.9	
143.9	32.9	230.42	1989.0	1444.1	544.9	
153.9	31.2	218.28	2015.1	1544.5	470.6	
163.9	29.6	207.43	2039.4	1644.9	394.5	
173.9	28.2	197.66	2062.0	1745.3	316.8	
183.9	27.0	188.83	2083.2	1845.7	237.6	
193.9	25.8	180.81	2103.1	1946.0	157.1	
203.9	24.8	173.47	2121.9	2046.4	75.5	
213.9	23.8	166.75	2139.7	2146.8	-7.1	
223.9	22.9	160.56	2156.6	2247.2	-90.6	
233.9	22.1	154.84	2172.7	2347.6	-174.9	
243.9	21.3	149.54	2188.0	2447.9	-259.9	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 3

November 14, 2006 11:19 AM

	108	
Area =	2.16	ha
"C" =	0.9	
AC=	1.944	
Tc =	13.6	min
Time Increment =	10.0	min
Release Rate =	130.6	l/s
Max.Storage =	790	m^3

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

Constant Inflows

	l/s

108						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.6	153.7	830.43	677.6	106.6	571.0	
23.6	116.8	631.20	893.8	185.0	708.8	
33.6	94.8	512.25	1032.7	263.4	769.3	
43.6	80.1	432.75	1132.1	341.7	790.3	<<<<
53.6	69.5	375.67	1208.1	420.1	788.0	
63.6	61.5	332.57	1269.1	498.5	770.6	
73.6	55.3	298.82	1319.6	576.9	742.7	
83.6	50.3	271.64	1362.5	655.3	707.3	
93.6	46.1	249.24	1399.7	733.6	666.1	
103.6	42.6	230.45	1432.5	812.0	620.4	
113.6	39.7	214.44	1461.7	890.4	571.3	
123.6	37.1	200.64	1488.0	968.8	519.2	
133.6	34.9	188.61	1511.9	1047.1	464.7	
143.6	32.9	178.02	1533.8	1125.5	408.3	
153.6	31.2	168.62	1554.0	1203.9	350.1	
163.6	29.6	160.23	1572.8	1282.3	290.5	
173.6	28.3	152.68	1590.3	1360.7	229.6	
183.6	27.0	145.85	1606.6	1439.0	167.6	
193.6	25.8	139.64	1622.0	1517.4	104.6	
203.6	24.8	133.97	1636.6	1595.8	40.7	
213.6	23.8	128.77	1650.3	1674.2	-23.9	
223.6	22.9	123.98	1663.3	1752.6	-89.2	
233.6	22.1	119.56	1675.7	1830.9	-155.2	
243.6	21.4	115.46	1687.6	1909.3	-221.7	

Modified Rational Method

Project Name : **Detroit River International Crossing**
Stormwater Management Study
Alternative 3

November 14, 2006 11:19 AM

	109	
Area =	6.56	ha
"C" =	0.9	
AC=	5.904	
Tc =	24.3	min
Time Increment =	10.0	min
Release Rate =	268.7	l/s
Max.Storage =	2829	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

109						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1885.91	2749.7	391.8	2357.9	
34.3	93.6	1535.76	3160.6	553.0	2607.6	
44.3	79.2	1300.33	3456.3	714.3	2742.0	
54.3	68.9	1130.58	3683.4	875.5	2807.9	
64.3	61.1	1002.06	3866.0	1036.7	2829.2	<<<<
74.3	54.9	901.19	4017.5	1197.9	2819.6	
84.3	49.9	819.78	4146.5	1359.2	2787.3	
94.3	45.9	752.63	4258.4	1520.4	2738.0	
104.3	42.4	696.22	4357.0	1681.6	2675.3	
114.3	39.5	648.14	4444.9	1842.9	2602.1	
124.3	37.0	606.64	4524.3	2004.1	2520.2	
134.3	34.8	570.43	4596.5	2165.3	2431.2	
144.3	32.8	538.54	4662.7	2326.6	2336.1	
154.3	31.1	510.24	4723.8	2487.8	2236.0	
164.3	29.5	484.93	4780.4	2649.0	2131.4	
174.3	28.2	462.16	4833.3	2810.2	2023.0	
184.3	26.9	441.56	4882.8	2971.5	1911.3	
194.3	25.8	422.83	4929.3	3132.7	1796.6	
204.3	24.7	405.72	4973.3	3293.9	1679.3	
214.3	23.8	390.02	5014.8	3455.2	1559.7	
224.3	22.9	375.56	5054.3	3616.4	1437.9	
234.3	22.1	362.20	5091.9	3777.6	1314.3	
244.3	21.3	349.82	5127.7	3938.9	1188.9	
254.3	20.6	338.31	5162.0	4100.1	1061.9	

Stormwater Management Pond Area Requirement Calculation Sheet
OPTION 3

Stormwater Management Facility No.	3-P1	3-P2	N/A	N/A	N/A	N/A	N/A	N/A	3-P3	3-P3
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**
Drainage Area (ha)	6.4	2.8	0.3	0.3	0.1	0.2	0.2	0.2	2.2	6.6
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	588	71	71	29	40	36	40	454	1,378
Extended Detention Volume[3] (m^3)	254	112	14	14	6	8	7	8	86	262
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	700	85	85	35	48	43	48	540	1,640
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**700**	**85**	**85**	**35**	**48**	**43**	**48**	**540**	**1,640**
Assumed Permanent Pool Depth	1.50	1.50	N/A	N/A	N/A	N/A	N/A	N/A	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	N/A	N/A	N/A	N/A	N/A	N/A	1.80	1.80
Designed Slope V:1 H:	5.00	5.00	N/A	N/A	N/A	N/A	N/A	N/A	5.00	5.00
Trial and Error Method Assuming square lot										
Assumed Bottom width	25.00	14.00	N/A	N/A	N/A	N/A	N/A	N/A	11.00	25.00
Volume	1668.75	777.75	N/A	N/A	N/A	N/A	N/A	N/A	597.75	1668.75
Pond Bottom Area Requirement (m^2)	625	196	N/A	N/A	N/A	N/A	N/A	N/A	121	625
Pond Bottom width requirement assuming a square lot	25.00	14.00	N/A	N/A	N/A	N/A	N/A	N/A	11.00	25.00
Pond Area at Normal Water Level	1,600	841	N/A	N/A	N/A	N/A	N/A	N/A	676	1,600
Pond Area Requirement (m^2)	**3,364**	**2,209**	N/A	N/A	N/A	N/A	N/A	N/A	**1,936**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,489**	N/A	N/A	N/A	N/A	N/A	N/A	**4,096**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,745	N/A	N/A	N/A	N/A	N/A	N/A	2,351	4,468
Total Quality and Quantity Control Volume =	6,136	3,523	N/A	N/A	N/A	N/A	N/A	N/A	2,949	6,136
Approximante Volume of Excavation =	17,779	12,415	N/A	N/A	N/A	N/A	N/A	N/A	11,175	17,779

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness ($250m^3/ha$ - $40m^3/ha$)

[3] Based on $40m^3/ha$

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

* Drainage Area 108 and 109 Drain to same pond 3-P3

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