ENGINEERING
PLANNING
SURVEYING

File BU2004-1529 Hansen's Tree Svc. 104 Hansen Ct.

STORM WATER DETENTION ANALYSIS
PREPARED BY: BAX ENGINEERING CO., INC.
HANSEN INDUSTRIAL PARK - O' FALLON, MO
BAX PROJECT NO. **95-6743AB**
September 03, 2004
REVISED: September 29, 2004

INTRODUCTION:

The presently undeveloped tract of land is located in the City of O' Fallon, Missouri. A proposed dry detention basin located along the Northern edge of the development will be used as the detention facility for the watershed area that will discharge to that point of the development. The storage volume and outflow rate shall be proportioned to insure that the peak rate of runoff leaving the site under post-developed conditions is less than or equal to the peak rate of runoff leaving the site under pre-developed conditions for the 2, 15, 25, and 100-year - 20 minutes design storms.

GENERAL SITE DATA AND RUNOFF CALCULATIONS:

The pre-developed P.I. factors to be used for the analysis are:

2 year	0-5%	Impervious	1.15	cfs/ac
15 year	0-5%	Impervious	1.87	cfs/ac
25 year	0-5%	Impervious	2.31	cfs/ac
100 year	0-5%	Impervious	2.95	cfs/ac
2 year	100%	Impervious	2.39	cfs/ac
15 year	100%	Impervious	3.85	cfs/ac
25 year	100%	Impervious	4.75	cfs/ac
100 year	100%	Impervious	6.08	cfs/ac

The post-developed P.I. factors to be used for the analysis are:

2 year	0-5%	Impervious	1.15	cfs/ac
15 year	0-5%	Impervious	1.87	cfs/ac
25 year	0-5%	Impervious	2.31	cfs/ac
100 year	0-5%	Impervious	2.95	cfs/ac

BAX ENGINEERING CO., INC.
1052 South Cloverleaf Drive
St. Peters, MO 63376-6445
636-928-5552 FAX 928-1718

2 year	30%	Impervious	1.29	cfs/ac
15 year	30%	Impervious	2.09	cfs/ac
25 year	30%	Impervious	2.58	cfs/ac
100 year	30%	Impervious	3.30	cfs/ac
2 year	100%	Impervious	2.39	cfs/ac
15 year	100%	Impervious	3.85	cfs/ac
25 year	100%	Impervious	4.75	cfs/ac
100 year	100%	Impervious	6.08	cfs/ac

TIME OF CONCENTRATION:

Of the inflows to the basin, the most remote point lies at the Southwest corner of the site. Flows will travel approximately 465 feet overland to a area inlet. Time of concentration is estimated as follows:

T(overland): L = 465 feet

Elevation difference = 18.00 feet
T(overland) = 3.00 minutes: See Figure 1

T(storm pipe): L = 515 feet

Estimated velocity 7 feet per second
T(storm pipe) = 1.22 minutes

Total time = 4.22 use **4 minutes**

BASIN PEAK INFLOWS:

Inflows to the basin have been estimated from the drainage area map included in the construction plans.

2 year-20 minute storm:

On site	0.30 ac	x	1.15 cfs/ac	= 0.35 cfs
On site	3.26 ac	x	1.29 cfs/ac	= 4.21 cfs
On site	7.60 ac	x	2.39 cfs/ac	= 18.16 cfs
Off site	2.57 ac	x	1.15 cfs/ac	= 2.96 cfs
Off site	9.49 ac	x	2.39 cfs/ac	= + 22.68 cfs
			Total	= 48.36 cfs

15 year-20 minute storm:

On site	0.30 ac	x	1.87 cfs/ac	= 0.56 cfs
On site	3.26 ac	x	2.09 cfs/ac	= 6.81 cfs
On site	7.60 ac	x	3.85 cfs/ac	= 29.26 cfs
Off site	2.57 ac	x	1.87 cfs/ac	= 4.81 cfs
Off site	9.49 ac	x	3.85 cfs/ac	= + 36.54 cfs
			Total	= 77.98 cfs

25 year-20 minute storm:

On site	0.30 ac	x	2.31 cfs/ac	= 0.69 cfs
On site	3.26 ac	x	2.58 cfs/ac	= 8.41 cfs
On site	7.60 ac	x	4.75 cfs/ac	= 36.10 cfs
Off site	2.57 ac	x	2.31 cfs/ac	= 5.94 cfs
Off site	9.49 ac	x	4.75 cfs/ac	= + 45.08 cfs
			Total	= 96.22 cfs

100 year-20 minute storm:

On site	0.30 ac	x	2.95 cfs/ac	= 0.89 cfs
On site	3.26 ac	x	3.30 cfs/ac	= 10.76 cfs
On site	7.60 ac	x	6.08 cfs/ac	= 46.21 cfs
Off site	2.57 ac	x	2.95 cfs/ac	= 7.58 cfs
Off site	9.49 ac	x	6.08 cfs/ac	= + 57.70 cfs
			Total	= 123.14 cfs

2 year-20 minute storm:	48.36 cfs
15 year-20 minute storm:	77.98 cfs
25 year-20 minute storm:	96.22 cfs
100 year-20 minute storm:	123.14 cfs

REQUIRED ATTENUATION: (20 minute storms)

The Required Attenuation can be found by subtracting the existing runoff rate from the proposed runoff rate for the developed portion of the site. The proposed runoff is made up of the basin inflows and any water that is going to bypass the detention basin. All bypassing water will be accounted for in the detention calculations.

Existing Runoff

2 year-20 minute storm:

12.93 ac x 1.15 cfs/ac = 14.87 cfs

15 year-20 minute storm:

12.93 ac x 1.87 cfs/ac = 24.18 cfs

25 year-20 minute storm:

12.93 ac x 2.31 cfs/ac = 29.87 cfs

100 year-20 minute storm:

12.93 ac x 2.95 cfs/ac = 38.14 cfs

Proposed Runoff

2 year-20 minute storm:

0.76 ac	x	1.15 cfs/ac	=	0.87 cfs
3.26 ac	x	1.29 cfs/ac	=	4.21 cfs
8.91 ac	x	2.39 cfs/ac	= +	21.29 cfs
		TOTAL	=	26.37 cfs

15 year-20 minute storm:

0.76 ac	x	1.87 cfs/ac	=	1.42 cfs
3.26 ac	x	2.09 cfs/ac	=	6.81 cfs
8.91 ac	x	3.85 cfs/ac	= +	34.30 cfs
		TOTAL	=	42.53 cfs

25 year-20 minute storm:

0.76 ac	x	2.31 cfs/ac	=	1.76 cfs
3.26 ac	x	2.58 cfs/ac	=	8.41 cfs
8.91 ac	x	4.75 cfs/ac	= +	42.32 cfs
		TOTAL	=	52.49 cfs

100 year-20 minute storm:

0.76 ac	x	2.95 cfs/ac	=	2.24 cfs
3.26 ac	x	3.30 cfs/ac	=	10.76 cfs
8.91 ac	x	6.08 cfs/ac	= +	54.17 cfs
		TOTAL	=	67.17 cfs

Required Attenuation

DESIGN STORM	PROPOSED RUNOFF		EXISTING RUNOFF		REQUIRED ATTENUATION
2 year	26.37 cfs	-	14.87 cfs	=	11.50 cfs
15 year	42.53 cfs	-	24.18 cfs	=	18.35 cfs
25 year	52.49 cfs	-	29.87 cfs	=	22.62 cfs
100 year	67.17 cfs	-	38.14 cfs	=	29.03 cfs

PERMITTED RELEASE RATE:

The permitted release rate of the basin was found by subtracting the required attenuation from the peak inflow to the basin for each design storm:

DESIGN STORM	PEAK INFLOW	-	REQUIRED ATTENUATION	=	PERMITTED RELEASE
2 year	48.36 cfs	-	11.50 cfs	=	36.86 cfs
15 year	77.98 cfs	-	18.35 cfs	=	59.63 cfs
25 year	96.22 cfs	-	22.62 cfs	=	73.60 cfs
100 year	123.14 cfs	-	29.03 cfs	=	94.11 cfs

STORM ROUTING CALCULATIONS AND RESULTS:

A computer program was used in routing the design 2, 15, 25, and 100 year-20 minute storms through the detention basin. As found in the routing calculations, the results are as follows:

20 MIN STORM	PEAK INFLOW	PERMITTED RELEASE RATE	CALCULATED RELEASE RATE	PEAK ELEVATION
2 year	48.36 cfs	36.86 cfs	36.70 cfs	551.73 ft
15 year	77.98 cfs	59.63 cfs	59.06 cfs	554.17 ft
25 year	96.22 cfs	73.60 cfs	73.20 cfs	555.26 ft
100 year	123.14 cfs	94.11 cfs	93.55 cfs	556.63 ft

CHECK 100-YEAR OUTFLOW:(low-flow slots blocked)

WEIR FLOW $Q = C \times L \times H\ (3/2)$

Where 100-YEAR FLOW Q	=	123.14 cfs
C	=	3.0
L	=	15.71 ft
H	=	1.90 ft
Sill	=	557.10 ft
100 yr h/w	=	559.00 ft

SEDIMENT VOLUME CALCULATION

The basin shall be analyzed to accommodate 2 years of sediment storage.

- The Drainage area to the basin = 23.22 Acres
- Rational method runoff coefficient 'c' = 0.6
- Annual sediment storage volume (from Figure 6) = 125 ft^3/Acre
- The sediment volume and storage required =

2 years of sediment storage = 23.22 Acres (125 ft^3/Acre/Year)(2 Years)

2 years of sediment storage = 5,805 ft^3

To provide for additional sediment storage the top of the overflow sill will be set at 557.10. Volume between the 100-year high water of 556.63 and the overflow sill elevation of 557.10 is 6,244.12 ft^3.

6,244.12 ft^3 provided > 5,808 ft^3 required

SUMMARY:

2 Year - 20 MINUTE HIGH-WATER	551.73 ft
15 Year - 20 MINUTE HIGH-WATER	554.17 ft
25 Year - 20 MINUTE HIGH-WATER	555.26 ft
100 Year - 20 MINUTE HIGH-WATER	556.63 ft
100 Year - 20 MINUTE HIGH-WATER (low-flow blocked)	559.00 ft
LOW-FLOW SLOT	3.33' W x 1.00' H
LOW-FLOW ELEVATION	546.00 ft
MIDDLE-FLOW SLOT	1.33' W x 5.30' H
MIDDLE-FLOW ELEVATION	551.80 ft
EMERGENCY OVERFLOW STRUCTURE	60" STANDPIPE
EMERGENCY OVERFLOW SILL	557.10 ft
TOP OF BERM	560.00 ft

ENGINEERING

PLANNING

SURVEYING

PROJECT: HANSEN INDUSTRIAL PARK
DATE: 09/29/2004 PROJECT NO: 95-6743AB
DESIGNED: JLJ CHECKED: CLH

TIME OF CONCENTRATION FOR SMALL DRAINAGE BASINS

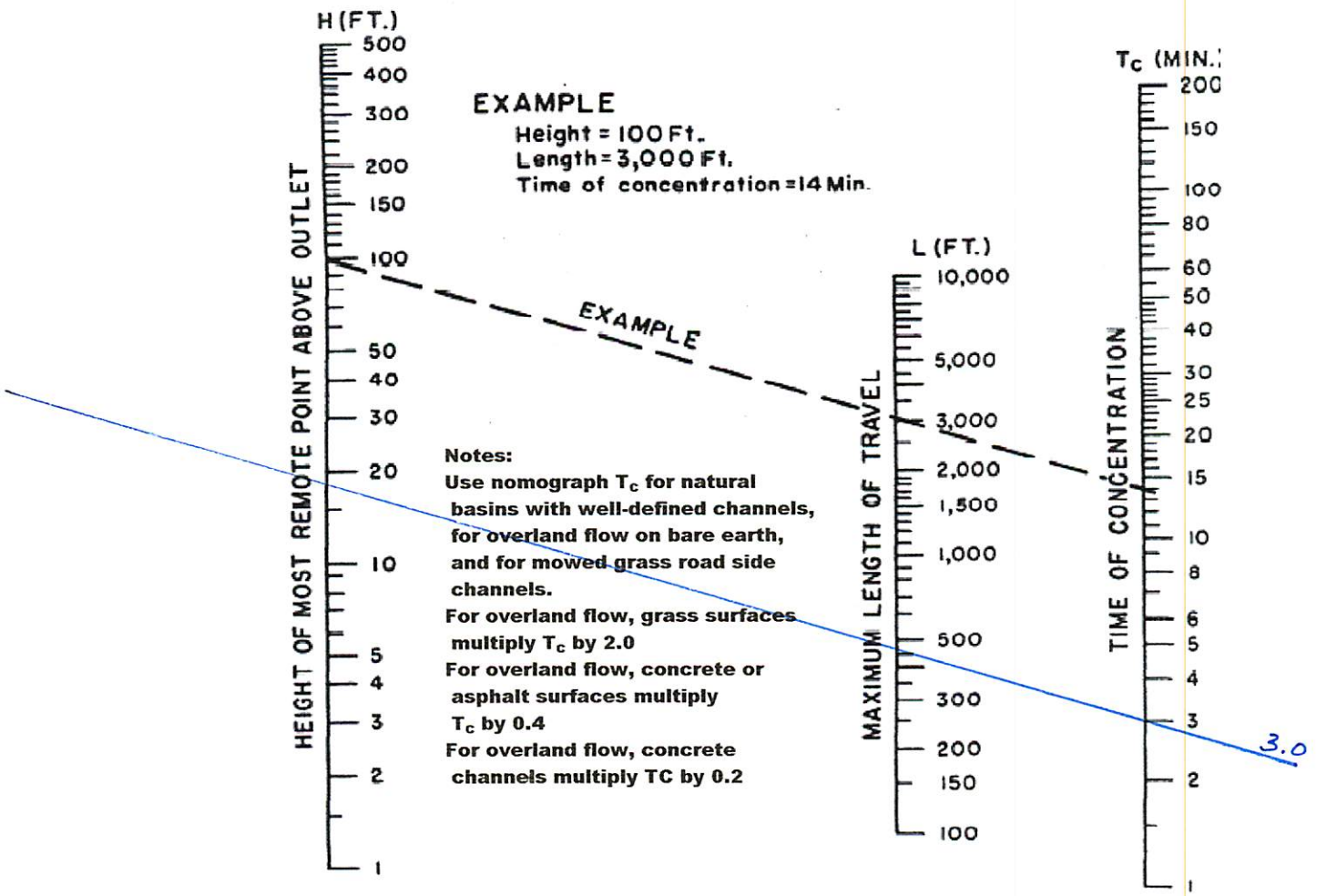
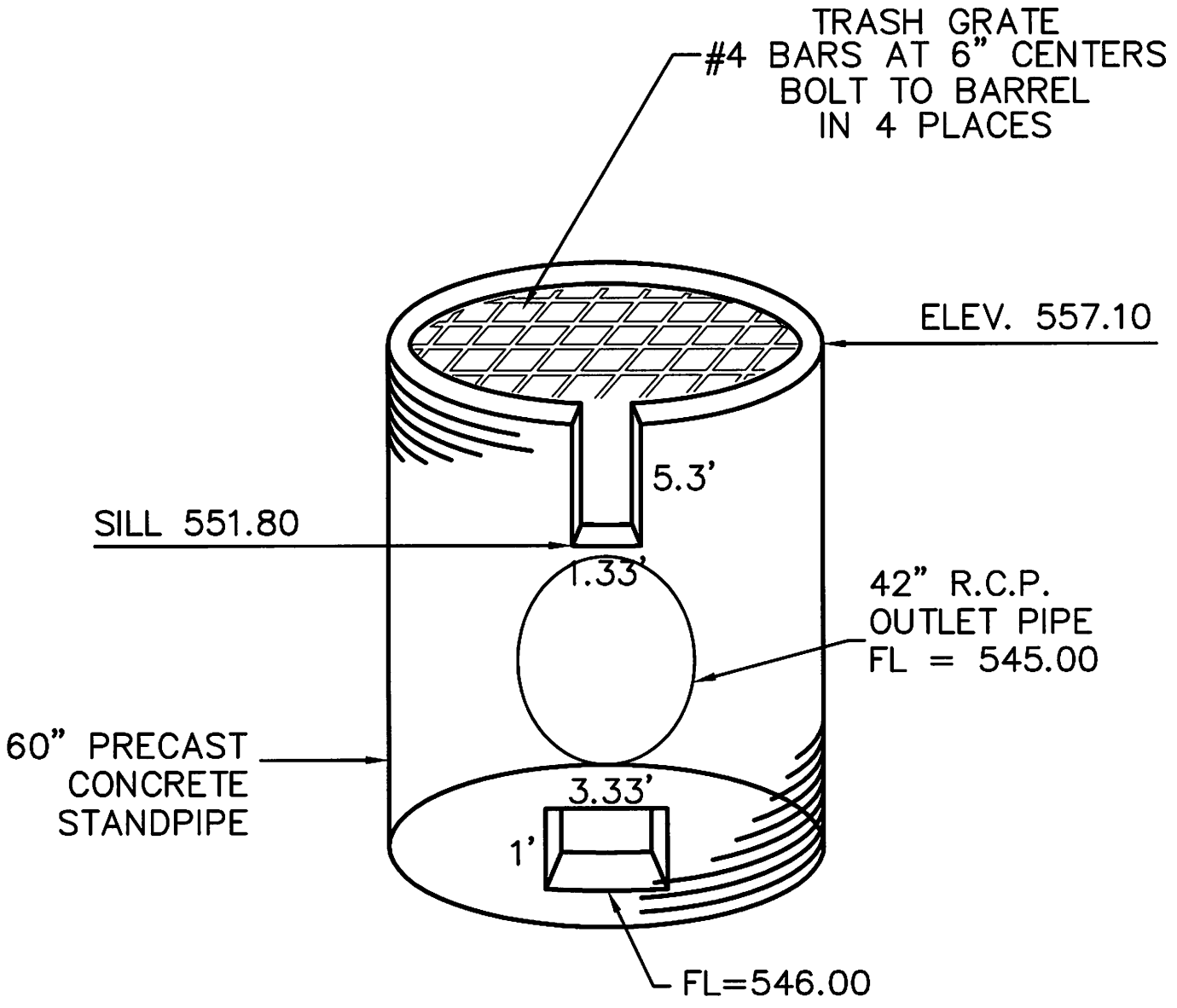


FIGURE 1

BAX ENGINEERING CO., INC.
1052 South Cloverleaf Drive
St. Peters, MO 63376-6445
636-928-5552 FAX 928-1718



OVERFLOW STRUCTURE DETAIL

NOT TO SCALE

15 YEAR HIGHWATER 554.17
100 YEAR HIGHWATER 556.63

95-6743AB
09/29/2004

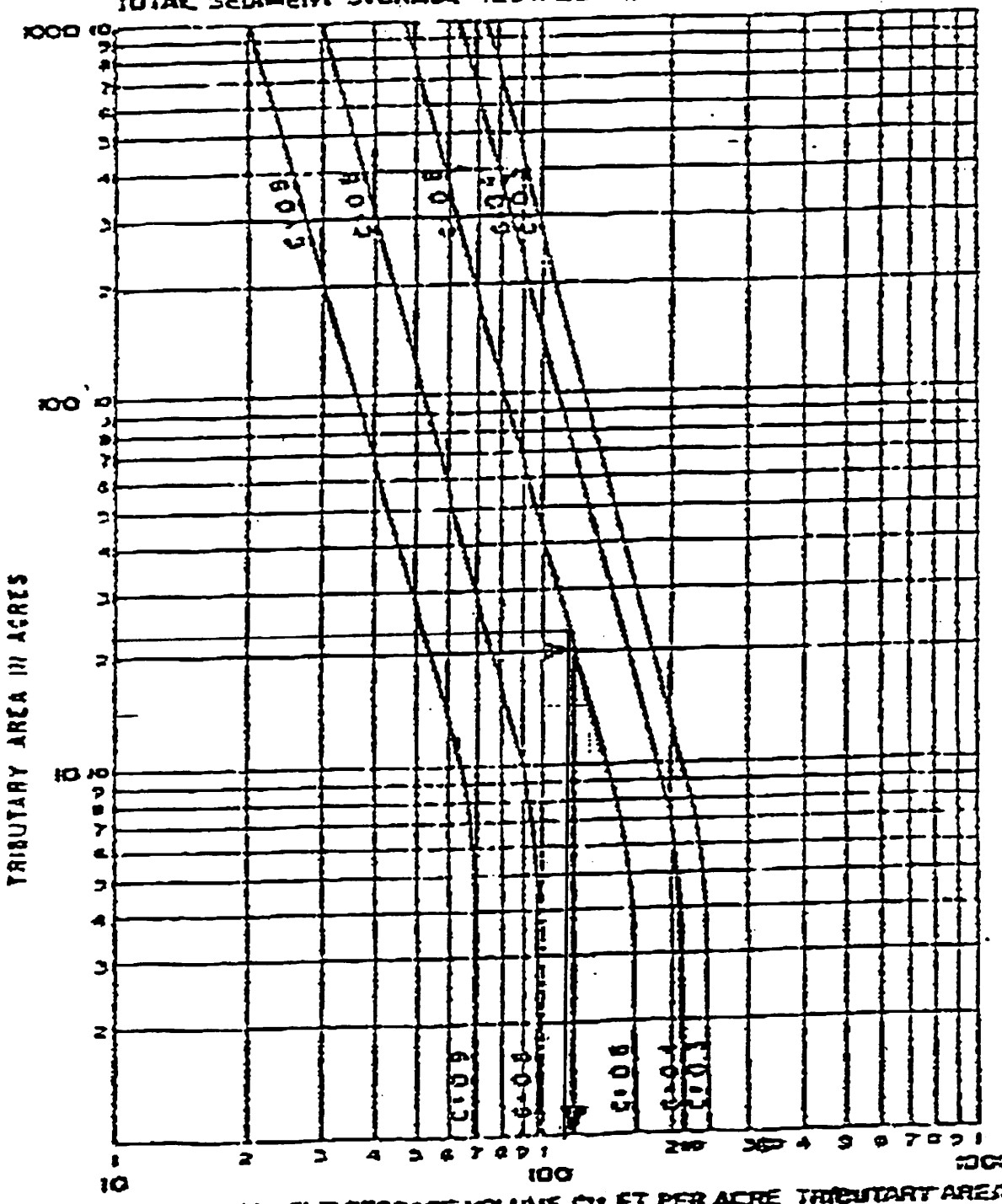
EXAMPLE:

TRIBUTARY AREA = 20 ACRES

RATIONAL METHOD RUNOFF COEFFICIENT "C" = 0.6

SEDIMENT STORAGE = 120 CU FT PER ACRE PER YEAR

TOTAL SEDIMENT STORAGE = 120 x 20 = 2400 CU. FT. PER YEAR.



ANNUAL SEDIMENT STORAGE


Table of Contents


Table of Contents (continued)

TIME vs. ELEVATION (ft)

Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	546.00	546.92	547.70	548.20	548.76
5.00	549.21	549.54	549.80	550.01	550.21
10.00	550.39	550.55	550.71	550.86	550.99
15.00	551.12	551.25	551.37	551.48	551.58
20.00	551.69	551.73	551.68	551.53	551.27
25.00	550.95	550.63	550.30	549.98	549.62
30.00	549.21	548.71	548.03	546.93	546.00

TIME vs. ELEVATION (ft)

Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	546.00	547.18	548.15	548.87	549.57
5.00	550.15	550.63	551.05	551.44	551.80
10.00	552.12	552.42	552.68	552.93	553.15
15.00	553.35	553.53	553.70	553.85	553.99
20.00	554.11	554.17	554.11	553.94	553.65
25.00	553.31	552.98	552.66	552.35	552.04
30.00	551.73	551.42	551.11	550.79	550.47
35.00	550.14	549.80	549.42	548.97	548.40
40.00	547.55	546.00			

TIME vs. ELEVATION (ft)

Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	546.00	547.34	548.36	549.18	549.95
5.00	550.63	551.22	551.75	552.22	552.63
10.00	553.01	553.34	553.64	553.91	554.15
15.00	554.37	554.57	554.75	554.91	555.06
20.00	555.20	555.26	555.19	555.00	554.68
25.00	554.31	553.95	553.60	553.26	552.93
30.00	552.61	552.30	551.99	551.69	551.38
35.00	551.06	550.74	550.42	550.09	549.75
40.00	549.36	548.90	548.30	547.38	546.00

TIME vs. ELEVATION (ft)

Output Time increment = 1.00 min
Time on left represents time for first value in each row.

Time min					
.00	546.00	547.55	548.62	549.56	550.44
5.00	551.30	552.03	552.66	553.21	553.70
10.00	554.12	554.50	554.83	555.13	555.40
15.00	555.64	555.86	556.06	556.25	556.41
20.00	556.56	556.63	556.56	556.34	556.00
25.00	555.58	555.18	554.79	554.42	554.05
30.00	553.70	553.36	553.03	552.71	552.39
35.00	552.08	551.78	551.47	551.15	550.84
40.00	550.51	550.19	549.85	549.48	549.04
45.00	548.50	547.71	546.28	546.00	

TIME vs. VOLUME (cu.ft)

Time min	Output Time increment = 1.00 min Time on left represents time for first value in each row.				
.00	0	90	562	1222	2408
5.00	3795	5064	6256	7381	8454
10.00	9481	10464	11411	12320	13198
15.00	14044	14862	15653	16420	17163
20.00	17884	18225	17843	16756	14989
25.00	12923	10930	9014	7176	5429
30.00	3788	2281	969	92	0

TIME vs. VOLUME (cu.ft)

Time min	Output Time increment = 1.00 min Time on left represents time for first value in each row.				
.00	0	188	1136	2702	5212
5.00	8130	10912	13586	16168	18671
10.00	21078	23366	25520	27538	29424
15.00	31182	32821	34347	35762	37080
20.00	38303	38875	38279	36595	33904
25.00	30838	27980	25311	22809	20451
30.00	18203	16036	13935	11906	9950
35.00	8074	6282	4583	3004	1587
40.00	429	0			

TIME vs. VOLUME (cu.ft)

Time min	Output Time increment = 1.00 min Time on left represents time for first value in each row.				
.00	0	279	1507	3672	7042
5.00	10945	14694	18319	21807	25114
10.00	28217	31114	33813	36325	38656
15.00	40822	42831	44696	46426	48030
20.00	49520	50204	49449	47358	44026
25.00	40239	36724	33461	30423	27593
30.00	24950	22470	20130	17895	15736
35.00	13645	11626	9682	7817	6035
40.00	4353	2796	1404	305	0

TIME vs. VOLUME (cu.ft)

Output Time increment = 1.00 min

Time min	Time on left represents time for first value in each row.				
.00	0	429	2068	5143	9813
5.00	15192	20382	25334	29984	34321
10.00	38352	42097	45571	48794	51785
15.00	54557	57130	59519	61736	63795
20.00	65705	66590	65631	62957	58696
25.00	53849	49352	45181	41311	37719
30.00	34385	31283	28396	25701	23176
35.00	20797	18536	16357	14247	12206
40.00	10240	8352	6543	4833	3233
45.00	1788	578	3	0	

File.... E:\PONDPACK\6000P[illegible]\6743AB\6743AB-9.0.PPW

POND VOLUME CALCULATIONS

Planimeter scale: 1.00 ft/in

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
546.00	.000	0	0	0	0
548.00	1381.000	1381	1381	921	921
550.00	5456.000	5456	9582	6388	7309
552.00	7462.000	7462	19299	12866	20174
554.00	9605.000	9605	25533	17022	37196
556.00	11994.000	11994	32332	21555	58751
558.00	14620.000	14620	39856	26571	85322
560.00	17475.000	17475	48079	32053	117375

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 546.00 ft
Increment = .10 ft
Max. Elev.= 560.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Weir-Rectangular	3	--->	TW	551.800	560.000
Orifice-Area	2	--->	TW	547.000	560.000
Weir-Rectangular	1	--->	TW	546.000	547.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

Structure ID = 3
Structure Type = Weir-Rectangular

# of Openings	=	1
Crest Elev.	=	551.80 ft
Weir Length	=	1.33 ft
Weir Coeff.	=	3.000000

Weir TW effects (Use adjustment equation)

Structure ID = 2
Structure Type = Orifice-Area

# of Openings	=	1
Invert Elev.	=	546.00 ft
Area	=	3.3330 sq.ft
Top of Orifice	=	547.00 ft
Datum Elev.	=	546.50 ft
Orifice Coeff.	=	.600

Structure ID = 1
Structure Type = Weir-Rectangular

# of Openings	=	1
Crest Elev.	=	546.00 ft
Weir Length	=	3.33 ft
Weir Coeff.	=	3.000000

Weir TW effects (Use adjustment equation)

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 30
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .10 cfs
Max. Q tolerance = .10 cfs

File.... E:\PONDPACK\6000P[illegible]\6743AB\6743AB-9.0.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
546.00	.00	Free Outfall		1
546.10	.32	Free Outfall		1
546.20	.89	Free Outfall		1
546.30	1.64	Free Outfall		1
546.40	2.53	Free Outfall		1
546.50	3.54	Free Outfall		1
546.60	4.65	Free Outfall		1
546.70	5.86	Free Outfall		1
546.80	7.15	Free Outfall		1
546.90	8.54	Free Outfall		1
547.00	11.34	Free Outfall		2
547.10	12.43	Free Outfall		2
547.20	13.42	Free Outfall		2
547.30	14.35	Free Outfall		2
547.40	15.22	Free Outfall		2
547.50	16.04	Free Outfall		2
547.60	16.82	Free Outfall		2
547.70	17.57	Free Outfall		2
547.80	18.29	Free Outfall		2
547.90	18.98	Free Outfall		2
548.00	19.65	Free Outfall		2
548.10	20.29	Free Outfall		2
548.20	20.92	Free Outfall		2
548.30	21.52	Free Outfall		2
548.40	22.11	Free Outfall		2
548.50	22.69	Free Outfall		2
548.60	23.25	Free Outfall		2
548.70	23.79	Free Outfall		2
548.80	24.33	Free Outfall		2
548.90	24.85	Free Outfall		2
549.00	25.36	Free Outfall		2
549.10	25.87	Free Outfall		2
549.20	26.36	Free Outfall		2
549.30	26.84	Free Outfall		2
549.40	27.32	Free Outfall		2
549.50	27.79	Free Outfall		2
549.60	28.24	Free Outfall		2
549.70	28.70	Free Outfall		2

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Converge		Notes
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
549.80	29.14	Free Outfall		2
549.90	29.58	Free Outfall		2
550.00	30.01	Free Outfall		2
550.10	30.44	Free Outfall		2
550.20	30.86	Free Outfall		2
550.30	31.27	Free Outfall		2
550.40	31.68	Free Outfall		2
550.50	32.08	Free Outfall		2
550.60	32.48	Free Outfall		2
550.70	32.88	Free Outfall		2
550.80	33.27	Free Outfall		2
550.90	33.65	Free Outfall		2
551.00	34.03	Free Outfall		2
551.10	34.41	Free Outfall		2
551.20	34.78	Free Outfall		2
551.30	35.15	Free Outfall		2
551.40	35.51	Free Outfall		2
551.50	35.87	Free Outfall		2
551.60	36.23	Free Outfall		2
551.70	36.58	Free Outfall		2
551.80	36.93	Free Outfall		3 +2
551.90	37.40	Free Outfall		3 +2
552.00	37.98	Free Outfall		3 +2
552.10	38.62	Free Outfall		3 +2
552.20	39.31	Free Outfall		3 +2
552.30	40.05	Free Outfall		3 +2
552.40	40.82	Free Outfall		3 +2
552.50	41.64	Free Outfall		3 +2
552.60	42.48	Free Outfall		3 +2
552.70	43.36	Free Outfall		3 +2
552.80	44.26	Free Outfall		3 +2
552.90	45.20	Free Outfall		3 +2
553.00	46.16	Free Outfall		3 +2
553.10	47.14	Free Outfall		3 +2
553.20	48.15	Free Outfall		3 +2
553.30	49.18	Free Outfall		3 +2
553.40	50.23	Free Outfall		3 +2
553.50	51.31	Free Outfall		3 +2

File.... E:\PONDPACK\6000P[illegible]\6743AB\6743AB-9.0.PPW

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
553.60	52.40	Free Outfall		3 +2
553.70	53.52	Free Outfall		3 +2
553.80	54.65	Free Outfall		3 +2
553.90	55.81	Free Outfall		3 +2
554.00	56.98	Free Outfall		3 +2
554.10	58.17	Free Outfall		3 +2
554.20	59.38	Free Outfall		3 +2
554.30	60.61	Free Outfall		3 +2
554.40	61.85	Free Outfall		3 +2
554.50	63.12	Free Outfall		3 +2
554.60	64.39	Free Outfall		3 +2
554.70	65.69	Free Outfall		3 +2
554.80	67.00	Free Outfall		3 +2
554.90	68.32	Free Outfall		3 +2
555.00	69.66	Free Outfall		3 +2
555.10	71.02	Free Outfall		3 +2
555.20	72.39	Free Outfall		3 +2
555.30	73.77	Free Outfall		3 +2
555.40	75.17	Free Outfall		3 +2
555.50	76.59	Free Outfall		3 +2
555.60	78.01	Free Outfall		3 +2
555.70	79.46	Free Outfall		3 +2
555.80	80.91	Free Outfall		3 +2
555.90	82.38	Free Outfall		3 +2
556.00	83.87	Free Outfall		3 +2
556.10	85.36	Free Outfall		3 +2
556.20	86.87	Free Outfall		3 +2
556.30	88.39	Free Outfall		3 +2
556.40	89.93	Free Outfall		3 +2
556.50	91.48	Free Outfall		3 +2
556.60	93.04	Free Outfall		3 +2
556.70	94.61	Free Outfall		3 +2
556.80	96.19	Free Outfall		3 +2
556.90	97.79	Free Outfall		3 +2
557.00	99.40	Free Outfall		3 +2
557.10	101.02	Free Outfall		3 +2
557.20	102.66	Free Outfall		3 +2
557.30	104.30	Free Outfall		3 +2

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
557.40	105.96	Free Outfall	3	+2
557.50	107.63	Free Outfall	3	+2
557.60	109.30	Free Outfall	3	+2
557.70	111.00	Free Outfall	3	+2
557.80	112.70	Free Outfall	3	+2
557.90	114.41	Free Outfall	3	+2
558.00	116.14	Free Outfall	3	+2
558.10	117.87	Free Outfall	3	+2
558.20	119.62	Free Outfall	3	+2
558.30	121.38	Free Outfall	3	+2
558.40	123.15	Free Outfall	3	+2
558.50	124.92	Free Outfall	3	+2
558.60	126.71	Free Outfall	3	+2
558.70	128.51	Free Outfall	3	+2
558.80	130.32	Free Outfall	3	+2
558.90	132.15	Free Outfall	3	+2
559.00	133.98	Free Outfall	3	+2
559.10	135.82	Free Outfall	3	+2
559.20	137.67	Free Outfall	3	+2
559.30	139.53	Free Outfall	3	+2
559.40	141.40	Free Outfall	3	+2
559.50	143.29	Free Outfall	3	+2
559.60	145.18	Free Outfall	3	+2
559.70	147.08	Free Outfall	3	+2
559.80	148.99	Free Outfall	3	+2
559.90	150.91	Free Outfall	3	+2
560.00	152.84	Free Outfall	3	+2

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
546.00	.00	0	0	.00	.00	.00
546.10	.32	0	3	.00	.32	.32
546.20	.89	1	14	.00	.89	.93
546.30	1.64	3	31	.00	1.64	1.75
546.40	2.53	7	55	.00	2.53	2.78
546.50	3.54	14	86	.00	3.54	4.01
546.60	4.65	25	124	.00	4.65	5.48
546.70	5.86	39	169	.00	5.86	7.17
546.80	7.15	59	221	.00	7.15	9.12
546.90	8.54	84	280	.00	8.54	11.33
547.00	11.34	115	345	.00	11.34	15.18
547.10	12.43	153	418	.00	12.43	17.53
547.20	13.42	199	497	.00	13.42	20.05
547.30	14.35	253	583	.00	14.35	22.78
547.40	15.22	316	677	.00	15.22	25.75
547.50	16.04	388	777	.00	16.04	28.99
547.60	16.82	471	884	.00	16.82	32.54
547.70	17.57	565	998	.00	17.57	36.42
547.80	18.29	671	1119	.00	18.29	40.66
547.90	18.98	789	1246	.00	18.98	45.29

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 546.00 ft
Starting Volume = 0 cu.ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = 1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
548.00	19.65	921	1381	.00	19.65	50.34
548.10	20.29	1066	1521	.00	20.29	55.81
548.20	20.92	1225	1667	.00	20.92	61.75
548.30	21.52	1399	1820	.00	21.52	68.17
548.40	22.11	1589	1981	.00	22.11	75.09
548.50	22.69	1796	2147	.00	22.69	82.54
548.60	23.25	2019	2321	.00	23.25	90.55
548.70	23.79	2260	2501	.00	23.79	99.13
548.80	24.33	2519	2688	.00	24.33	108.31
548.90	24.85	2798	2881	.00	24.85	118.11
549.00	25.36	3096	3082	.00	25.36	128.56
549.10	25.87	3414	3289	.00	25.87	139.68
549.20	26.36	3754	3503	.00	26.36	151.49
549.30	26.84	4115	3723	.00	26.84	164.01
549.40	27.32	4499	3951	.00	27.32	177.28
549.50	27.79	4905	4185	.00	27.79	191.30
549.60	28.24	5336	4425	.00	28.24	206.10
549.70	28.70	5791	4673	.00	28.70	221.72
549.80	29.14	6271	4927	.00	29.14	238.16
549.90	29.58	6777	5188	.00	29.58	255.47

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 546.00 ft
Starting Volume = 0 cu.ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = 1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
550.00	30.01	7309	5456	.00	30.01	273.63
550.10	30.44	7859	5549	.00	30.44	292.39
550.20	30.86	8418	5643	.00	30.86	311.47
550.30	31.27	8987	5737	.00	31.27	330.85
550.40	31.68	9566	5832	.00	31.68	350.55
550.50	32.08	10154	5928	.00	32.08	370.54
550.60	32.48	10751	6025	.00	32.48	390.86
550.70	32.88	11359	6122	.00	32.88	411.51
550.80	33.27	11976	6221	.00	33.27	432.46
550.90	33.65	12603	6320	.00	33.65	453.76
551.00	34.03	13240	6420	.00	34.03	475.36
551.10	34.41	13887	6520	.00	34.41	497.30
551.20	34.78	14544	6622	.00	34.78	519.58
551.30	35.15	15211	6724	.00	35.15	542.19
551.40	35.51	15889	6827	.00	35.51	565.15
551.50	35.87	16577	6931	.00	35.87	588.43
551.60	36.23	17275	7036	.00	36.23	612.06
551.70	36.58	17984	7141	.00	36.58	636.05
551.80	36.93	18703	7247	.00	36.93	660.38
551.90	37.40	19434	7354	.00	37.40	685.20

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
552.00	37.98	20174	7462	.00	37.98	710.46
552.10	38.62	20925	7563	.00	38.62	736.13
552.20	39.31	21687	7664	.00	39.31	762.21
552.30	40.05	22458	7766	.00	40.05	788.66
552.40	40.82	23240	7869	.00	40.82	815.50
552.50	41.64	24032	7972	.00	41.64	842.71
552.60	42.48	24835	8077	.00	42.48	870.30
552.70	43.36	25648	8181	.00	43.36	898.28
552.80	44.26	26471	8287	.00	44.26	926.63
552.90	45.20	27305	8393	.00	45.20	955.37
553.00	46.16	28150	8500	.00	46.16	984.48
553.10	47.14	29005	8607	.00	47.14	1013.96
553.20	48.15	29871	8715	.00	48.15	1043.85
553.30	49.18	30748	8824	.00	49.18	1074.11
553.40	50.23	31636	8934	.00	50.23	1104.77
553.50	51.31	32535	9044	.00	51.31	1135.80
553.60	52.40	33445	9155	.00	52.40	1167.22
553.70	53.52	34366	9266	.00	53.52	1199.05
553.80	54.65	35298	9379	.00	54.65	1231.25
553.90	55.81	36242	9491	.00	55.81	1263.87

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 546.00 ft
Starting Volume = 0 cu.ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = 1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
554.00	56.98	37196	9605	.00	56.98	1296.86
554.10	58.17	38162	9718	.00	58.17	1330.25
554.20	59.38	39140	9832	.00	59.38	1364.05
554.30	60.61	40129	9946	.00	60.61	1398.24
554.40	61.85	41130	10062	.00	61.85	1432.84
554.50	63.12	42141	10177	.00	63.12	1467.82
554.60	64.39	43165	10294	.00	64.39	1503.21
554.70	65.69	44200	10411	.00	65.69	1539.02
554.80	67.00	45247	10529	.00	67.00	1575.22
554.90	68.32	46306	10647	.00	68.32	1611.86
555.00	69.66	47377	10766	.00	69.66	1648.88
555.10	71.02	48459	10886	.00	71.02	1686.31
555.20	72.39	49554	11007	.00	72.39	1724.18
555.30	73.77	50660	11128	.00	73.77	1762.45
555.40	75.17	51780	11250	.00	75.17	1801.16
555.50	76.59	52910	11372	.00	76.59	1840.26
555.60	78.01	54053	11495	.00	78.01	1879.79
555.70	79.46	55210	11619	.00	79.46	1919.77
555.80	80.91	56377	11743	.00	80.91	1960.16
555.90	82.38	57558	11868	.00	82.38	2000.99

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 546.00 ft
Starting Volume = 0 cu.ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = 1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
556.00	83.87	58751	11994	.00	83.87	2042.24
556.10	85.36	59957	12119	.00	85.36	2083.91
556.20	86.87	61175	12245	.00	86.87	2126.04
556.30	88.39	62406	12371	.00	88.39	2168.58
556.40	89.93	63650	12498	.00	89.93	2211.58
556.50	91.48	64906	12626	.00	91.48	2254.99
556.60	93.04	66174	12755	.00	93.04	2298.84
556.70	94.61	67457	12884	.00	94.61	2343.16
556.80	96.19	68751	13013	.00	96.19	2387.90
556.90	97.79	70059	13144	.00	97.79	2433.10
557.00	99.40	71380	13275	.00	99.40	2478.73
557.10	101.02	72714	13406	.00	101.02	2524.81
557.20	102.66	74061	13538	.00	102.66	2571.37
557.30	104.30	75422	13671	.00	104.30	2618.35
557.40	105.96	76796	13805	.00	105.96	2665.82
557.50	107.63	78183	13939	.00	107.63	2713.71
557.60	109.30	79583	14074	.00	109.30	2762.07
557.70	111.00	80998	14210	.00	111.00	2810.92
557.80	112.70	82425	14346	.00	112.70	2860.20
557.90	114.41	83867	14483	.00	114.41	2909.98

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 546.00 ft
Starting Volume = 0 cu.ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = 1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
558.00	116.14	85322	14620	.00	116.14	2960.20
558.10	117.87	86790	14757	.00	117.87	3010.88
558.20	119.62	88273	14894	.00	119.62	3062.06
558.30	121.38	89769	15032	.00	121.38	3113.68
558.40	123.15	91280	15171	.00	123.15	3165.81
558.50	124.92	92804	15310	.00	124.92	3218.38
558.60	126.71	94341	15450	.00	126.71	3271.42
558.70	128.51	95894	15590	.00	128.51	3324.97
558.80	130.32	97460	15731	.00	130.32	3378.97
558.90	132.15	99040	15873	.00	132.15	3433.49
559.00	133.98	100635	16016	.00	133.98	3488.45
559.10	135.82	102243	16159	.00	135.82	3543.90
559.20	137.67	103866	16302	.00	137.67	3599.88
559.30	139.53	105504	16447	.00	139.53	3656.31
559.40	141.40	107156	16592	.00	141.40	3713.26
559.50	143.29	108822	16737	.00	143.29	3770.68
559.60	145.18	110503	16884	.00	145.18	3828.59
559.70	147.08	112199	17031	.00	147.08	3887.04
559.80	148.99	113909	17178	.00	148.99	3945.95
559.90	150.91	115635	17326	.00	150.91	4005.40

LEVEL POOL ROUTING DATA

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
560.00	152.84	117375	17475	.00	152.84	4065.32

LEVEL POOL ROUTING SUMMARY

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 2
Outflow HYG file = NONE STORED - BASIN OUT 2

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	48.36 cfs	at	4.00 min
Peak Outflow	=	36.70 cfs	at	21.00 min
Peak Elevation	=	551.73 ft		
Peak Storage	=	18225 cu.ft		

MASS BALANCE (cu.ft)

+ Initial Vol	=	0
+ HYG Vol IN	=	58032
- Infiltration	=	0
- HYG Vol OUT	=	58032
- Retained Vol	=	0
Unrouted Vol	=	0 cu.ft (.000% of Outflow Volume)

LEVEL POOL ROUTING SUMMARY

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 15
Outflow HYG file = NONE STORED - BASIN OUT 15

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	77.98 cfs	at	4.00 min
Peak Outflow	=	59.06 cfs	at	21.00 min
Peak Elevation	=	554.17 ft		
Peak Storage	=	38875 cu.ft		

MASS BALANCE (cu.ft)

+ Initial Vol	=	0
+ HYG Vol IN	=	93577
- Infiltration	=	0
- HYG Vol OUT	=	93577
- Retained Vol	=	0
Unrouted Vol	= -	cu.ft (.000% of Inflow Volume)

LEVEL POOL ROUTING SUMMARY

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 25
Outflow HYG file = NONE STORED - BASIN OUT 25

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	96.22 cfs	at	4.00 min
Peak Outflow	=	73.20 cfs	at	21.00 min
Peak Elevation	=	555.26 ft		
Peak Storage	=	50204 cu.ft		

MASS BALANCE (cu.ft)

+ Initial Vol	=	0
+ HYG Vol IN	=	115465
- Infiltration	=	0
- HYG Vol OUT	=	115465
- Retained Vol	=	0
Unrouted Vol	=	0 cu.ft (.000% of Outflow Volume)

LEVEL POOL ROUTING SUMMARY

HYG Dir = E:\PONDPACK\6000PLUS\6743AB\
Inflow HYG file = NONE STORED - BASIN IN 100
Outflow HYG file = NONE STORED - BASIN OUT 100

Pond Node Data = BASIN
Pond Volume Data = BASIN
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	546.00 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	123.14 cfs	at	4.00 min
Peak Outflow	=	93.55 cfs	at	21.00 min
Peak Elevation	=	556.63 ft		
Peak Storage	=	66590 cu.ft		

MASS BALANCE (cu.ft)

+ Initial Vol	=	0
+ HYG Vol IN	=	147770
- Infiltration	=	0
- HYG Vol OUT	=	147770
- Retained Vol	=	0
Unrouted Vol	= -	cu.ft (.000% of Inflow Volume)

Index of Starting Page Numbers for ID Names

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

GENERAL PERMIT

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo. as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No. :	MO-R106820
Owner:	Hansen Tree Service
Owner's Address:	2121 Collier Corporate Parkway, St. Charles, MO 63303
Continuing Authority:	SAME
Continuing Authority Address:	SAME
Facility Name:	Hansen Industrial Park
Facility Address:	Elaine Drive, O'Fallon, MO 63366
Legal Description:	Sec. 30, T47N, R3E, St. Charles County
Receiving Stream:	Tributary to Peruque Creek (U)
First Class. & ID#:	Peruque Creek (P) (0216)
USGS & Sub Water ID#:	07110009-010-002

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION **SIC#1542**

All Outfalls

Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading, and other activity that results in the destruction of the root zone).

This permit authorizes only wastewater, including storm waters, discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System; it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

February 8, 2002
Effective Date

September 30, 2004
Issue Date THS

February 7, 2007
Expiration Date
MO 780-1481 (7-94)

Stephen M. Mahfood, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

Director, St. Louis Regional Office

MICHAEL J. BALLMANN
FIRE CHIEF

O'FALLON FIRE PROTECTION DISTRICT

119 EAST ELM STREET, O'FALLON MO 63366-2600 (636-272-3493)
(636-240-5312)
FAX 272-7857

RECEIVED

OCT 15 2004

BAX ENGINEERING

October 12, 2004

Ms. April Jones
Bax Engineering Co., Inc.
1052 S. Cloverleaf Drive
St. Peters, MO. 63376

Re: Hansen Industrial Park – Lot 4

Dear Ms. Jones:

The O'Fallon Fire Protection District has reviewed and approved the site plan submitted for the above project.

Address assignment for this project is pending at this time.

If I can be of any further assistance, please do not hesitate to contact me at (636)240-5312 (ext. 107).

Sincerely,

Mark Morrison

Mark A. Morrison
Assistant Fire Marshal