

**ATTACHMENT B.14-3**  
**Stormwater Calculation Package**

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249 Western Avenue  
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## Kibby Expansion Wind Project

### Stormwater Design Calculations

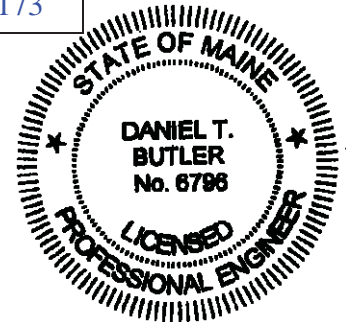
#### Table of Contents

Pre- and Post-Development Curve Number Calculations		1 – 4
Culvert Sizing Calculations		5 – 149
Conveyance Swale Sizing Calculations		150 – 167
Phosphorus Control Calculations		168 – 173

A handwritten signature in blue ink that reads "Daniel T. Butler".

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Daniel T. Butler, PE



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December 18, 2009

Date



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<b>PROJECT:</b>	Kibby Expansion Wind Power Project
<b>Project No:</b>	170019.0000.0000
<b>Subject:</b>	Curve Number Comparison
<b>Calculated By:</b>	PGT
<b>Checked By:</b>	DTB
<b>Date:</b>	November 23, 2009
<b>Revised Date:</b>	

**Assumptions:**

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.  
 Land cover types as referenced from recent aerial photography and site visits.  
 Soil types and hydrologic soil groups are referenced from the USDA RUSLE 2 related attributes for Somerset County Area and Parts of Franklin and Oxford Counties Maine Dated 11/28/06

**Determine the Pre-development weighted curve number (CN)**

**Watershed 1S - Sisk Mountain - Pre-development (Kibby Stream Watershed)**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	954.55	54.56%	70	66819
Woods, Good, HSG D	602.76	34.45%	77	46413
Brush, Good, HSG C	184.70	10.56%	65	12006
Brush, Good, HSG D	1.08	0.06%	73	79
Gravel Road, HSG C	6.47	0.37%	89	576
<b>Total Watershed =</b>	<b>1749.56</b>	<b>100.00%</b>		<b>125891</b>
			<b>Total Weighted CN =</b>	<b>72</b>

**Watershed 1S - Sisk Mountain - Post-development (Kibby Stream Watershed)**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	946.57	54.10%	70	66260
Woods, Good, HSG D	556.26	31.79%	77	42832
Brush, Good, HSG C	190.46	10.89%	65	12380
Brush, Good, HSG D	32.97	1.88%	73	2407
Gravel Road, HSG C	12.71	0.73%	89	1131
Gravel Road, HSG D	7.80	0.45%	91	710
Turbine Pads	2.79	0.16%	91	254
<b>Total Watershed =</b>	<b>1749.56</b>	<b>100.00%</b>		<b>125974</b>
			<b>Total Weighted CN =</b>	<b>72</b>



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<b>Date:</b>	November 23, 2009
<b>Revised Date:</b>	

**Assumptions:**

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.  
 Land cover types as referenced from recent aerial photography and site visits.  
 Soil types and hydrologic soil groups are referenced from the USDA RUSLE 2 related attributes for Somerset County Area and Parts of Franklin and Oxford Counties Maine Dated 11/28/06

**Determine the Pre-development weighted curve number (CN)**

**Watershed 1S - Sisk Mountain - Pre-development (Gold Brook Watershed)**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	155.24	43.15%	70	10867
Woods, Good, HSG D	174.71	48.56%	77	13453
Brush, Good, HSG C	26.51	7.37%	65	1723
Brush, Good, HSG D	0.80	0.22%	73	58
Gravel Road, HSG C	2.54	0.71%	89	226
Total Watershed =	359.8	100.00%		26327
<b>Total Weighted CN =</b>				<b>73</b>

**Watershed 1S - Sisk Mountain - Post-development (Gold Brook Watershed)**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	155.24	43.15%	70	10867
Woods, Good, HSG D	168.53	46.84%	77	12977
Brush, Good, HSG C	26.51	7.37%	65	1723
Brush, Good, HSG D	5.45	1.51%	73	398
Gravel Road, HSG C	2.54	0.71%	89	226
Gravel Road, HSG D	1.22	0.34%	91	111
Turbine Pads	0.31	0.09%	91	28
Total Watershed =	359.8	100.00%		26330
<b>Total Weighted CN =</b>				<b>73</b>



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<b>Subject:</b>	Curve Number Comparison
<b>Calculated By:</b>	PGT
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<b>Date:</b>	November 23, 2009
<b>Revised Date:</b>	

**Assumptions:**

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.  
 Land cover types as referenced from recent aerial photography and site visits.  
 Soil types and hydrologic soil groups are referenced from the USDA RUSLE 2 related attributes for Somerset County Area and Parts of Franklin and Oxford Counties Maine Dated 11/28/06

**Determine the weighted curve number (CN)**

**Watershed 1S - Collector Substation - Pre-development**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	47.63	77.10%	70	3334
Woods, Good, HSG D	9.63	15.59%	77	742
Brush, Good, HSG C	3.94	6.38%	65	256
Grass, HSG C	0.58	0.93%	74	43
Total Watershed =	61.78	100.00%		4374
<b>Total Weighted CN =</b>				<b>71</b>

**Watershed 1S - Collector Substation - Post-development**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	46.36	75.04%	70	3245
Woods, Good, HSG D	9.63	15.59%	77	742
Brush, Good, HSG C	4.12	6.67%	65	268
Building/Fdn	0.03	0.05%	98	3
Gravel, HSG C	0.18	0.29%	89	16
Substation	0.47	0.76%	55	26
Grass, HSG C	0.99	1.60%	74	73
Total Watershed =	61.78	100.00%		4373
<b>Total Weighted CN =</b>				<b>71</b>



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<b>Checked By:</b>	DTB
<b>Date:</b>	November 23, 2009
<b>Revised Date:</b>	

**Assumptions:**

Runoff curve numbers for cover types as referenced from Table 2-2c USDA, 1986, Urban Hydrology for Small Watersheds: TR55.  
 Land cover types as referenced from recent aerial photography and site visits.  
 Soil types and hydrologic soil groups are referenced from the USDA RUSLE 2 related attributes for Somerset County Area and Parts of Franklin and Oxford Counties Maine Dated 11/28/06

**Determine the Pre-development weighted curve number (CN)**

**Watershed 2S - Sisk Mountain - Pre-development (Chain of Ponds Watershed)**

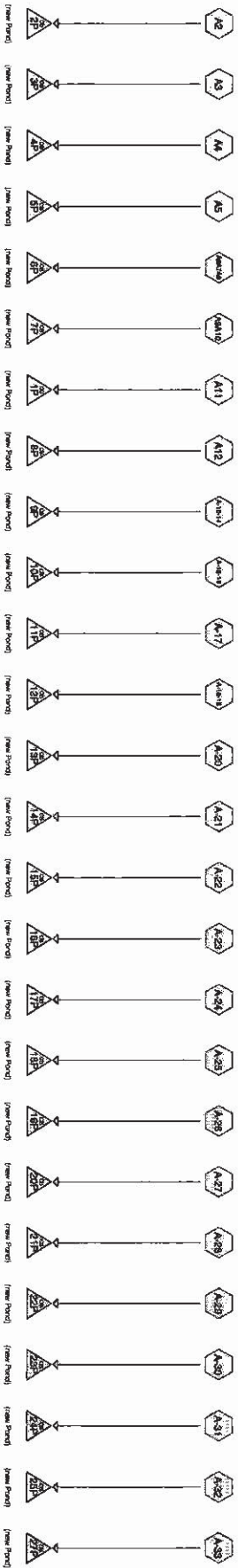
Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	108.1	26.35%	70	7567
Woods, Good, HSG D	302.09	73.65%	77	23261
Brush, Good, HSG C	0.00	0.00%	65	0
Brush, Good, HSG D	0.00	0.00%	73	0
Gravel Road, HSG C	0.00	0.00%	89	0
<b>Total Watershed =</b>	<b>410.19</b>	<b>100.00%</b>		<b>30828</b>
			<b>Total Weighted CN =</b>	<b>75</b>

**Watershed 2S - Sisk Mountain - Post-development (Chain of Ponds Watershed)**

Cover Description	Land Area (acres)	Land Area % of total	CN	Product of CN x Area
Woods, Good, HSG C	108.1	26.35%	70	7567
Woods, Good, HSG D	272.34	66.39%	77	20970
Brush, Good, HSG C	0.00	0.00%	65	0
Brush, Good, HSG D	24.00	5.85%	73	1752
Gravel Road, HSG D	4.40	1.07%	91	400
Turbine Pads	1.35	0.33%	91	123
<b>Total Watershed =</b>	<b>410.19</b>	<b>100.00%</b>		<b>30812</b>
			<b>Total Weighted CN =</b>	<b>75</b>

CULVERT SCHEDULE				
NUMBER	SIZE	LENGTH	INV. IN	INV. OUT
A-2	30" HDPE	40	2141.5	2138
A-3	30" HDPE	40	2127.3	2124
A-4	24" HDPE	40	2132	2121
A-5	18" HDPE	40	2118	2116
A-6	24" HDPE	40	2107	2105
A-7	24" HDPE	40	2105	2102
A-8	24" HDPE	40	2106	2104
A-9	36" HDPE	40	2106	2105
A-10	36" HDPE	40	2106	2105
A-11	(2)-36" HDPE	40	2117	2115
A-12	24" HDPE	40	2111	2108
A-13	49X33 CMP ARCH	40	2107	2105.5
A-14	49X33 CMP ARCH	40	2107	2105.5
A-15	64X43 CMP ARCH	50	2116	2114
A-16	64X43 CMP ARCH	50	2116	2114
A-17	36" HDPE	40	2146	2145
A-18	64X43 CMP ARCH	40	2145	2143
A-19	64X43 CMP ARCH	40	2145	2143
A-20	NOT REPLACING	EXISTING BRIDGE		
A-21	36" HDPE	40	2223	2221
A-22	18" HDPE	40	2237	2235
A-23	24" HDPE	40	2246	2245
A-24	30" HDPE	40	2287.5	2285
A-25	18" HDPE	40	2318	2316
A-26	18" HDPE	60	2324	2320
A-27	36" HDPE	40	2338.5	2338
A-28	18" HDPE	40	2388	2386
A-29	24" HDPE	40	2409	2400
A-30	18" HDPE	40	2450	2448
A-31	36" HDPE	40	2463	2462
A-32	18" HDPE	40	2523	2521
A-33	18" HDPE	40	2638	2636
A-36	30" HDPE	40	2856	2852
A-37	36" HDPE	40	2890	2878

CULVERT SCHEDULE				
NUMBER	SIZE	LENGTH	INV. IN	INV. OUT
R-38	18" HDPE	70	3186	3183
R-39	18" HDPE	50	3306	3305
R-40	18" HDPE	70	3265	3258
R-41	18" HDPE	70	3211	3194
R-43	18" HDPE	50	3180	3174
R-44	18" HDPE	50	3185	3178
R-45	24" HDPE	50	3198	3190
R-46	18" HDPE	50	3228	3220
R-47	18" HDPE	70	3261	3248
R-48	18" HDPE	70	3283	3272
R-49	18" HDPE	50	3270	3264
R-50	24" HDPE	50	3256	3246
R-51	24" HDPE	80	3266	3262
R-52	18" HDPE	60	3241	3232
R-53	18" HDPE	80	3135	3134
R-54	18" HDPE	70	2485	2970
R-55	24" HDPE	90	2970	2952
R-56	18" HDPE	80	2987	2986
R-57	18" HDPE	60	3047	3036
R-58	18" HDPE	60	3100	3098
R-59	18" HDPE	44	3320	3318
R-60	18" HDPE	50	3200	3272
R-61	24" HDPE	90	3137	3136
R-62	18" HDPE	50	3156.5	3152
R-63	18" HDPE	70	3340	3340
R-64	24" HDPE	50	3184	3182



5.1.1



**Drainage Diagram for Kibby Expansion Project - culvert sizing**  
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**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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Page 1

**Summary for Subcatchment A2:**

Runoff = 29.38 cfs @ 12.30 hrs, Volume= 2.816 af, Depth> 1.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
22.560	70	Woods, Good, HSG C
1.420	77	Woods, Good, HSG D
0.610	89	Gravel roads, HSG C
24.590	71	Weighted Average
24.590		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.6					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 2P: (new Pond)**

Inflow Area = 24.590 ac, 0.00% Impervious, Inflow Depth > 1.37" for 10-yr event  
 Inflow = 29.38 cfs @ 12.30 hrs, Volume= 2.816 af  
 Outflow = 29.38 cfs @ 12.30 hrs, Volume= 2.816 af, Atten= 0%, Lag= 0.0 min  
 Primary = 29.38 cfs @ 12.30 hrs, Volume= 2.816 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,145.23' @ 12.30 hrs

Flood Elev= 2,146.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,141.50'	<b>30.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,138.00' S= 0.0875 '/ Cc= 0.900 n= 0.012 Wood, planed

**Primary OutFlow Max=29.32 cfs @ 12.30 hrs HW=2,145.22' (Free Discharge)**↑**1=Culvert (Inlet Controls 29.32 cfs @ 5.97 fps)**

<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-2	<b>Date:</b>	April 17, 2009
		<b>PH 9</b>	<b>Revised:</b> November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
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**SHEET FLOW**

Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.2								
T <sub>i</sub> <sup>1</sup> , hr	0.360								0.3604

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

<b>Unpaved</b>									
Length, ft			4556						
Slope, ft/ft			0.185	850'/4600'					
Velocity <sup>4</sup> , ft/sec			6.939711						
T <sub>i</sub> <sup>3</sup> , hr			0.182						0.1824

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>6</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	0.543
<b>Min</b>	32.57

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A3:**

Runoff = 25.93 cfs @ 12.33 hrs, Volume= 2.647 af, Depth&gt; 1.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
18.730	70	Woods, Good, HSG C
4.250	77	Woods, Good, HSG D
0.170	89	Gravel roads, HSG C
23.150	71	Weighted Average
23.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.8					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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Printed 11/20/2009

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**Summary for Pond 3P: (new Pond)**

Inflow Area = 23.150 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-yr event  
 Inflow = 25.86 cfs @ 12.34 hrs, Volume= 2.957 af  
 Outflow = 25.86 cfs @ 12.34 hrs, Volume= 2.957 af, Atten= 0%, Lag= 0.0 min  
 Primary = 25.86 cfs @ 12.34 hrs, Volume= 2.957 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
 Peak Elev= 2,130.47' @ 12.34 hrs  
 Flood Elev= 2,131.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,127.30'	<b>30.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,124.00' S= 0.0825 '/ Cc= 0.900 n= 0.012

**Primary OutFlow Max=25.33 cfs @ 12.34 hrs HW=2,130.39' (Free Discharge)**  
 ↳1=Culvert (Inlet Controls 25.33 cfs @ 5.16 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-3</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>PH 9</b>	<b>Revised:</b>
			<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5				
<b>SHEET FLOW</b>									
Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.2								
T <sub>i</sub> <sup>1</sup> , hr	0.360								0.3604
<b>SHALLOW CONCENTRATED FLOW</b>									
<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000
<b>Unpaved</b>									
Length, ft			5800						
Slope, ft/ft			0.178	1030/5800'					
Velocity <sup>3</sup> , ft/sec			6.807153						
T <sub>i</sub> <sup>3</sup> , hr			0.237						0.2367
<b>CHANNEL FLOW</b>									
<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000
<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>6</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	<b>0.597</b>
<b>Min</b>	<b>35.83</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A4:**

Runoff = 14.71 cfs @ 12.27 hrs, Volume= 1.352 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
12.190	70	Woods, Good, HSG C
0.180	89	Gravel roads, HSG C
12.370	70	Weighted Average
12.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.4					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 4P: (new Pond)**

Inflow Area = 12.370 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-yr event  
 Inflow = 14.52 cfs @ 12.28 hrs, Volume= 1.510 af  
 Outflow = 14.52 cfs @ 12.28 hrs, Volume= 1.510 af, Atten= 0%, Lag= 0.0 min  
 Primary = 14.52 cfs @ 12.28 hrs, Volume= 1.510 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Peak Elev= 2,125.48' @ 12.28 hrs

Flood Elev= 2,126.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,123.00'	<b>24.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,121.00' S= 0.0500 '/ Cc= 0.900 n= 0.012 Wood, planed

**Primary OutFlow Max=14.28 cfs @ 12.28 hrs HW=2,125.43' (Free Discharge)**

↑1=Culvert (Inlet Controls 14.28 cfs @ 4.55 fps)



<b>PROJECT:</b>	Kibby Wind Expansion				<b>Calculated By:</b>	PGT	
<b>Proj:</b>	170019.0000.0000	PH 9		<b>Checked By:</b>	DTB		
<b>Watershed:</b>	A-4					<b>Date:</b>	April 17, 2009
						<b>Revised:</b>	November 20, 2009
<b>Time of Concentration Determination Worksheet, SCS Methods</b>							
	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
<b>SHEET FLOW</b>							
Manning's No.	0.8						
Length, ft	150						
P2, in	2.9						
Slope, ft/ft	0.166						
T <sub>i</sub> <sup>1</sup> , hr	0.388						0.3883
<b>SHALLOW CONCENTRATED FLOW</b>							
<b>Paved</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Unpaved</b>							
Length, ft			2650				
Slope, ft/ft			0.15	410/2650'			
Velocity <sup>4</sup> , ft/sec			6.248865				
T <sub>i</sub> <sup>3</sup> , hr			0.118				0.1178
<b>CHANNEL FLOW</b>							
<b>Waterways &amp; Swamps, No Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>5</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Grassed Waterways/Roadside Ditches</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>6</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Large Tributary</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>8</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Main River</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Culvert</b>							
Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>i</sub> , hr							0.0000
						<b>HR</b>	0.506
						<b>Min</b>	30.37

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A5:**

Runoff = 7.66 cfs @ 12.32 hrs, Volume= 0.766 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
6.900	70	Woods, Good, HSG C
0.120	89	Gravel roads, HSG C
7.020	70	Weighted Average
7.020		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.4					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 5P: (new Pond)**

Inflow Area = 7.020 ac, 0.00% Impervious, Inflow Depth > 1.31" for 10-yr event  
 Inflow = 7.66 cfs @ 12.32 hrs, Volume= 0.766 af  
 Outflow = 7.66 cfs @ 12.32 hrs, Volume= 0.766 af, Atten= 0%, Lag= 0.0 min  
 Primary = 7.66 cfs @ 12.32 hrs, Volume= 0.766 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,120.05' @ 12.32 hrs

Flood Elev= 2,120.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,118.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,116.00' S= 0.0500 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=7.62 cfs @ 12.32 hrs HW=2,120.04' (Free Discharge)

↳1=Culvert (Inlet Controls 7.62 cfs @ 4.31 fps)

<b>PROJECT:</b>	Kibby Wind Expansion		<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	PH 9	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-5		<b>Date:</b>	April 17, 2009
			<b>Revised:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5				
<b>SHEET FLOW</b>									
Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.11								
T <sub>i</sub> <sup>1</sup> , hr	0.458								0.4578
<b>SHALLOW CONCENTRATED FLOW</b>									
<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000
<b>Unpaved</b>									
Length, ft			2600						
Slope, ft/ft			0.151	394/2600'					
Velocity <sup>4</sup> , ft/sec			6.26966						
T <sub>i</sub> <sup>3</sup> , hr			0.115						0.1152
<b>CHANNEL FLOW</b>									
<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000
<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>6</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000
<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	0.573
<b>Min</b>	34.38

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A6A7A8:**

Runoff = 66.40 cfs @ 12.32 hrs, Volume= 6.661 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
60.680	70	Woods, Good, HSG C
0.390	89	Gravel roads, HSG C
61.070	70	Weighted Average
61.070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.6					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 6P: (new Pond)**

Inflow Area = 61.070 ac, 0.00% Impervious, Inflow Depth > 1.31" for 10-yr event  
 Inflow = 66.40 cfs @ 12.32 hrs, Volume= 6.661 af  
 Outflow = 66.40 cfs @ 12.32 hrs, Volume= 6.661 af, Atten= 0%, Lag= 0.0 min  
 Primary = 66.40 cfs @ 12.32 hrs, Volume= 6.661 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,110.43' @ 12.32 hrs

Flood Elev= 2,110.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,106.00'	<b>24.0" Round Culvert X 3.00</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,104.00' S= 0.0500 '/ Cc= 0.900 n= 0.012 Wood, planed

**Primary OutFlow Max=66.04 cfs @ 12.32 hrs HW=2,110.40' (Free Discharge)**↑**1=Culvert (Inlet Controls 66.04 cfs @ 7.01 fps)**

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-6-7-8</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>PH 9</b>	<b>Revised:</b>
			<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.23					
T <sub>i</sub> <sup>1</sup> , hr	0.341					0.3408
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			5470			
Slope, ft/ft			0.16	880/5470'		
Velocity <sup>4</sup> , ft/sec			6.4538			
T <sub>i</sub> <sup>3</sup> , hr			0.235			0.2354
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.576</b>
<b>Min</b>	<b>34.58</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A9A10:**

Runoff = 87.30 cfs @ 12.41 hrs, Volume= 9.920 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
90.920	70	Woods, Good, HSG C
0.320	89	Gravel roads, HSG C
91.240	70	Weighted Average
91.240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.4					Direct Entry, See spreadsheet



# Kibby Expansion Project - culvert sizing

Type II 24-hr 10-yr Rainfall=4.20"

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## Summary for Pond 7P: (new Pond)

Inflow Area = 91.240 ac, 0.00% Impervious, Inflow Depth > 1.30" for 10-yr event  
Inflow = 87.30 cfs @ 12.41 hrs, Volume= 9.920 af  
Outflow = 87.30 cfs @ 12.41 hrs, Volume= 9.920 af, Atten= 0%, Lag= 0.0 min  
Primary = 87.30 cfs @ 12.41 hrs, Volume= 9.920 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,110.14' @ 12.41 hrs

Flood Elev= 2,111.77'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,106.00'	<b>36.0" Round Culvert X 2.00</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,105.00' S= 0.0250 '/ Cc= 0.900 n= 0.012

Primary OutFlow Max=87.06 cfs @ 12.41 hrs HW=2,110.12' (Free Discharge)

↑1=Culvert (Inlet Controls 87.06 cfs @ 6.16 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-9-10</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>PH 9</b>	<b>Revised:</b>
			<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.2					
T <sub>i</sub> <sup>1</sup> , hr	0.360					0.3604
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			7340			
Slope, ft/ft			0.147	1080/7340'		
Velocity <sup>4</sup> , ft/sec			6.186061			
T <sub>i</sub> <sup>3</sup> , hr			0.330			0.3296
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.690</b>
<b>Min</b>	<b>41.40</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A11:**

Runoff = 65.51 cfs @ 12.45 hrs, Volume= 7.770 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
71.240	70	Woods, Good, HSG C
0.320	89	Gravel roads, HSG C
71.560	70	Weighted Average
71.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.0					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 1P: (new Pond)**

Inflow Area = 71.560 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-yr event  
 Inflow = 65.36 cfs @ 12.45 hrs, Volume= 8.735 af  
 Outflow = 65.36 cfs @ 12.45 hrs, Volume= 8.735 af, Atten= 0%, Lag= 0.0 min  
 Primary = 65.36 cfs @ 12.45 hrs, Volume= 8.735 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Peak Elev= 2,119.96' @ 12.45 hrs

Flood Elev= 2,121.87'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,117.00'	<b>36.0" Round Culvert X 2.00</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,115.00' S= 0.0500 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=64.39 cfs @ 12.45 hrs HW=2,119.92' (Free Discharge)

↑1=Culvert (Inlet Controls 64.39 cfs @ 4.59 fps)

<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-11	<b>Date:</b>	April 17, 2009
		<b>PH 9</b>	<b>Revised:</b> November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.1	15'/150'				
T <sub>i</sub> <sup>1</sup> , hr	0.476					0.4756
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft				4940		
Slope, ft/ft				0.109	540'/4940'	
Velocity <sup>4</sup> , ft/sec				5.32682906		
T <sub>i</sub> <sup>3</sup> , hr				0.258		0.2576
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	0.733
<b>Min</b>	43.99

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A12:**

Runoff = 12.67 cfs @ 12.47 hrs, Volume= 1.550 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
* 14.150	70	Woods, Good, HSG C
0.140	89	Gravel roads, HSG C
14.290	70	Weighted Average
14.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
46.1					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 8P: (new Pond)**

Inflow Area = 14.290 ac, 0.00% Impervious, Inflow Depth = 1.46" for 10-yr event  
 Inflow = 12.60 cfs @ 12.48 hrs, Volume= 1.744 af  
 Outflow = 12.60 cfs @ 12.48 hrs, Volume= 1.744 af, Atten= 0%, Lag= 0.0 min  
 Primary = 12.60 cfs @ 12.48 hrs, Volume= 1.744 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Peak Elev= 2,113.11' @ 12.48 hrs

Flood Elev= 2,114.22'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,111.00'	<b>24.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,108.00' S= 0.0750 '/ Cc= 0.900 n= 0.012 Wood, planed

**Primary OutFlow** Max=12.51 cfs @ 12.48 hrs HW=2,113.10' (Free Discharge)↑**1=Culvert** (Inlet Controls 12.51 cfs @ 3.98 fps)

<b>PROJECT:</b>	Kibby Wind Expansion				<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	PH 9		<b>Checked By:</b>	DTB	
<b>Watershed:</b>	A-12	<b>Date:</b> April 17, 2009				
					<b>Revised:</b>	November 20, 2009
<b>Time of Concentration Determination Worksheet, SCS Methods</b>						
	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.05	10'/200'				
T <sub>i</sub> <sup>1</sup> , hr	0.628					0.6276
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			2950			
Slope, ft/ft			0.131	387.5'/2950'		
Velocity <sup>4</sup> , ft/sec			5.839708			
T <sub>i</sub> <sup>3</sup> , hr			0.140			0.1403
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000
						HR
						0.768
						Min
						48.07



**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-13-14:**

Runoff = 131.43 cfs @ 12.45 hrs, Volume= 15.626 af, Depth&gt; 1.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
141.940	70	Woods, Good, HSG C
0.330	77	Woods, Good, HSG D
1.660	89	Gravel roads, HSG C
143.930	70	Weighted Average
143.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.2					Direct Entry, See spreadsheet

# Kibby Expansion Project - culvert sizing

Prepared by TRC Environmental Corp

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Type II 24-hr 10-yr Rainfall=4.20"

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## Summary for Pond 9P: (new Pond)

Inflow Area = 143.930 ac, 0.00% Impervious, Inflow Depth > 1.30" for 10-yr event  
Inflow = 131.43 cfs @ 12.45 hrs, Volume= 15.626 af  
Outflow = 131.43 cfs @ 12.45 hrs, Volume= 15.626 af, Atten= 0%, Lag= 0.0 min  
Primary = 131.43 cfs @ 12.45 hrs, Volume= 15.626 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,111.98' @ 12.45 hrs

Flood Elev= 2,112.47'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,107.00'	42.0" Round Culvert X 2.00 L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,105.50' S= 0.0375 ' Cc= 0.900 n= 0.024

*Use 44" x 33" Pipe Drum (2 required)*

Primary OutFlow Max=131.39 cfs @ 12.45 hrs HW=2,111.98' (Free Discharge)

↑1=Culvert (Inlet Controls 131.39 cfs @ 6.83 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-13-14-15	<b>Date:</b>	April 17, 2009
		<b>PH 9</b>	<b>Revised:</b> November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8							
Length, ft	150							
P2, in	2.9							
Slope, ft/ft	0.07	10'/130'						
T <sub>t</sub> <sup>1</sup> , hr	0.549							0.5485

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>2</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000
<b>Unpaved</b>								
Length, ft			3675					
Slope, ft/ft			0.113	417'/3675'				
Velocity <sup>4</sup> , ft/sec			5.423688					
T <sub>t</sub> <sup>3</sup> , hr			0.188					0.1882

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>5</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000

<b>Grassed Waterways/Roadside Ditches</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>6</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Small Tributary &amp; Swamp w/Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>7</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Large Tributary</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>8</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Main River</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>9</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Culvert</b>								
Diameter, ft								
Area, ft <sup>2</sup>								
Wetted Perimeter, ft								
Hydraulic Radius, R, ft								
Slope, ft/ft								
Manning's No.								
Velocity <sup>10</sup> , ft/sec								
Length, L, ft								
T <sub>t</sub> , hr								0.0000

<b>HR</b>	0.737
<b>Min</b>	44.21

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-15-16:**

Runoff = 194.45 cfs @ 12.43 hrs, Volume= 22.569 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
113.400	70	Woods, Good, HSG C
67.290	77	Woods, Good, HSG D
180.690	73	Weighted Average
180.690		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.8					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Pond 10P: (new Pond)**

Inflow Area = 180.690 ac, 0.00% Impervious, Inflow Depth > 1.50" for 10-yr event  
 Inflow = 194.45 cfs @ 12.43 hrs, Volume= 22.569 af  
 Outflow = 194.45 cfs @ 12.43 hrs, Volume= 22.569 af, Atten= 0%, Lag= 0.0 min  
 Primary = 194.45 cfs @ 12.43 hrs, Volume= 22.569 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 2,120.84' @ 12.43 hrs  
 Flood Elev= 2,122.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,116.00'	54.0" Round Culvert X 2.00' <i>USE 64" x 43" PIPE ARCH (2-REVISION)</i> L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,114.00' S= 0.0400 '/ Cc= 0.900 n= 0.024

Primary OutFlow Max=193.97 cfs @ 12.43 hrs HW=2,120.82' (Free Discharge)  
 ↑1=Culvert (Inlet Controls 193.97 cfs @ 6.10 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-16</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>PH 9</b>	<b>Revised:</b>
			<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
<b>SHEET FLOW</b>							
Manning's No.	0.8		0.8				
Length, ft	120		30				
P2, in	2.9		2.9				
Slope, ft/ft	0.083	10'/120'	0.166	10'/60'			
T <sub>i</sub> <sup>1</sup> , hr	0.429		0.107				0.5358
<b>SHALLOW CONCENTRATED FLOW</b>							
<b>Paved</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Unpaved</b>							
Length, ft			4660				
Slope, ft/ft			0.17	797'/4660'			
Velocity <sup>3</sup> , ft/sec			6.652425				
T <sub>i</sub> <sup>3</sup> , hr			0.195				0.1946
<b>CHANNEL FLOW</b>							
<b>Waterways &amp; Swamps, No Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>5</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Grassed Waterways/Roadside Ditches</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>5</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Large Tributary</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>8</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Main River</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Culvert</b>							
Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>i</sub> , hr							0.0000
						<b>HR</b>	0.730
						<b>Min</b>	43.82

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-17:**

Runoff = 36.85 cfs @ 12.31 hrs, Volume= 3.625 af, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
1.720	77	Woods, Good, HSG D
31.500	70	Woods, Good, HSG C
33.220	70	Weighted Average
33.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.6					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 11P: (new Pond)**

Inflow Area = 33.220 ac, 0.00% Impervious, Inflow Depth > 1.31" for 10-yr event  
 Inflow = 36.85 cfs @ 12.31 hrs, Volume= 3.625 af  
 Outflow = 36.85 cfs @ 12.31 hrs, Volume= 3.625 af, Atten= 0%, Lag= 0.0 min  
 Primary = 36.85 cfs @ 12.31 hrs, Volume= 3.625 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,149.38' @ 12.31 hrs

Flood Elev= 2,150.75'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,146.00'	<b>36.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,145.00' S= 0.0250 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=36.71 cfs @ 12.31 hrs HW=2,149.37' (Free Discharge)↑**1=Culvert** (Inlet Controls 36.71 cfs @ 5.19 fps)



<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-17	<b>Date:</b>	April 17, 2009
		<b>Revised:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.1					
T <sub>t</sub> <sup>1</sup> , hr	0.476					0.4756
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>t</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft		2350				
Slope, ft/ft		0.23	555'/2350'			
Velocity <sup>4</sup> , ft/sec		7.737834				
T <sub>t</sub> <sup>3</sup> , hr		0.084				0.0844
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>t</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>4</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>t</sub> , hr						0.0000

<b>HR</b>	0.560
<b>Min</b>	33.60

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A-18-19:**

Runoff = 227.13 cfs @ 12.41 hrs, Volume= 25.671 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
105.680	70	Woods, Good, HSG C
99.690	77	Woods, Good, HSG D
205.370	73	Weighted Average
205.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.2					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 12P: (new Pond)**

Inflow Area = 205.370 ac, 0.00% Impervious, Inflow Depth > 1.50" for 10-yr event  
 Inflow = 227.13 cfs @ 12.41 hrs, Volume= 25.671 af  
 Outflow = 227.13 cfs @ 12.41 hrs, Volume= 25.671 af, Atten= 0%, Lag= 0.0 min  
 Primary = 227.13 cfs @ 12.41 hrs, Volume= 25.671 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 2,150.78' @ 12.41 hrs  
 Flood Elev= 2,151.45'

Device	Routing	Invert	Outlet Devices	
#1	Primary	2,145.00'	<b>54.0" Round Culvert X 2.00</b>	<i>64" x 43" Pipe Area (2 hrs' D)</i>
			L= 40.0' CMP, projecting, no headwall, Ke= 0.900	
			Outlet Invert= 2,142.00' S= 0.0750 '/' Cc= 0.900 n= 0.024	

**Primary OutFlow** Max=226.44 cfs @ 12.41 hrs HW=2,150.76' (Free Discharge)  
 ↑1=Culvert (Inlet Controls 226.44 cfs @ 7.12 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-18-19</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8	0.8						
Length, ft	100	50						
P2, in	2.9	2.9						
Slope, ft/ft	0.1	0.166	10'/60'					
T <sub>1</sub> <sup>1</sup> , hr	0.344	0.161						0.5051

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft								
Slope, ft/ft								
Velocity <sup>2</sup> , ft/sec								
T <sub>1</sub> <sup>3</sup> , hr								0.0000

**Unpaved**

Length, ft		5300						
Slope, ft/ft		0.21	1147'/5300'					
Velocity <sup>4</sup> , ft/sec		7.393757						
T <sub>1</sub> <sup>3</sup> , hr		0.199						0.1991

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft								
Slope, ft/ft								
Velocity <sup>5</sup> , ft/sec								
T <sub>1</sub> <sup>3</sup> , hr								0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft								
Slope, ft/ft								
Velocity <sup>6</sup> , ft/sec								
T <sub>1</sub> , hr								0.0000

**Small Tributary & Swamp w/Channels**

Length, ft								
Slope, ft/ft								
Velocity <sup>7</sup> , ft/sec								
T <sub>1</sub> , hr								0.0000

**Large Tributary**

Length, ft								
Slope, ft/ft								
Velocity <sup>8</sup> , ft/sec								
T <sub>1</sub> , hr								0.0000

**Main River**

Length, ft								
Slope, ft/ft								
Velocity <sup>9</sup> , ft/sec								
T <sub>1</sub> , hr								0.0000

**Culvert**

Diameter, ft								
Area, ft <sup>2</sup>								
Wetted Perimeter, ft								
Hydraulic Radius, R, ft								
Slope, ft/ft								
Manning's No.								
Velocity <sup>10</sup> , ft/sec								
Length, L, ft								
T <sub>1</sub> , hr								0.0000

<b>HR</b>	<b>0.704</b>
<b>Min</b>	<b>42.25</b>

**Kibby Expansion Project - culvert sizing**

Prepared by TRC Environmental Corp  
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**Summary for Subcatchment A-20: TO REMAIN**

Runoff = 241.24 cfs @ 12.50 hrs, Volume= 30.000 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
74.340	70	Woods, Good, HSG C
146.120	77	Woods, Good, HSG D
220.460	75	Weighted Average
220.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.0					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 13P: (new Pond)**

Inflow Area = 220.460 ac, 0.00% Impervious, Inflow Depth > 1.63" for 10-yr event  
Inflow = 241.24 cfs @ 12.50 hrs, Volume= 30.000 af  
Outflow = 241.24 cfs @ 12.50 hrs, Volume= 30.000 af, Atten= 0%, Lag= 0.0 min  
Primary = 241.24 cfs @ 12.50 hrs, Volume= 30.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,182.69' @ 12.50 hrs

Flood Elev= 2,185.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,178.60'	<b>144.0" W x 84.0" H Box Culvert</b> L= 15.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet Invert= 2,178.60' S= 0.0000 '/' Cc= 0.900 n= 0.014

**Primary OutFlow Max=241.09 cfs @ 12.50 hrs HW=2,182.69' (Free Discharge)**

↳ **1=Culvert (Barrel Controls 241.09 cfs @ 6.55 fps)**

<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-20	<b>Date:</b>	April 17, 2009
		<b>Revised:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.057	10'/175'				
T <sub>1</sub> <sup>1</sup> , hr	0.596					0.5955
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft		5750				
Slope, ft/ft		0.2	1176'/5750'			
Velocity <sup>4</sup> , ft/sec		7.215568				
T <sub>1</sub> <sup>3</sup> , hr		0.221				0.2214
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>1</sub> , hr						0.0000

<b>HR</b>	0.817
<b>Min</b>	49.01

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-21:**

Runoff = 50.92 cfs @ 12.41 hrs, Volume= 5.740 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
21.470	70	Woods, Good, HSG C
22.460	77	Woods, Good, HSG D
43.930	74	Weighted Average
43.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.4					Direct Entry, See spreadsheet



**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 14P: (new Pond)**

Inflow Area = 43.930 ac, 0.00% Impervious, Inflow Depth > 1.57" for 10-yr event  
 Inflow = 50.92 cfs @ 12.41 hrs, Volume= 5.740 af  
 Outflow = 50.92 cfs @ 12.41 hrs, Volume= 5.740 af, Atten= 0%, Lag= 0.0 min  
 Primary = 50.92 cfs @ 12.41 hrs, Volume= 5.740 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,228.09' @ 12.41 hrs

Flood Elev= 2,228.17'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,223.00'	<b>36.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,221.00' S= 0.0500 '/' Cc= 0.900 n= 0.012

**Primary OutFlow Max=50.76 cfs @ 12.41 hrs HW=2,228.07' (Free Discharge)****↑1=Culvert (Inlet Controls 50.76 cfs @ 7.18 fps)**

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-21</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	100	50				
P2, in	2.9	2.9				
Slope, ft/ft	0.05	0.1	10'/100'			
T <sub>i</sub> <sup>1</sup> , hr	0.454	0.197				0.6512
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft		1160				
Slope, ft/ft		0.133	155'/1160'			
Velocity <sup>4</sup> , ft/sec		5.884117				
T <sub>i</sub> <sup>3</sup> , hr		0.055				0.0548
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000
						<b>HR</b>
						<b>0.706</b>
						<b>Min</b>
						<b>42.36</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A-22:**

Runoff = 7.53 cfs @ 12.16 hrs, Volume= 0.563 af, Depth&gt; 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
5.130	70	Woods, Good, HSG C
5.130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.1					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 15P: (new Pond)**

Inflow Area = 5.130 ac, 0.00% Impervious, Inflow Depth > 1.32" for 10-yr event  
 Inflow = 7.53 cfs @ 12.16 hrs, Volume= 0.563 af  
 Outflow = 7.53 cfs @ 12.16 hrs, Volume= 0.563 af, Atten= 0%, Lag= 0.0 min  
 Primary = 7.53 cfs @ 12.16 hrs, Volume= 0.563 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,239.01' @ 12.16 hrs

Flood Elev= 2,240.42'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,237.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,235.00' S= 0.0500 '/' Cc= 0.900 n= 0.012

**Primary OutFlow Max=7.45 cfs @ 12.16 hrs HW=2,238.98' (Free Discharge)**  
 ↑**1=Culvert (Inlet Controls 7.45 cfs @ 4.21 fps)**

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-22</b>	<b>Date:</b>	<b>April 17, 2009</b>
	<b>PH 9</b>	<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.266					
T <sub>i</sub> <sup>1</sup> , hr	0.322					0.3216
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft		1450				
Slope, ft/ft		0.179	260'/1450'			
Velocity <sup>2</sup> , ft/sec		8.600534				
T <sub>i</sub> <sup>3</sup> , hr		0.047				0.0468
<b>Unpaved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>4</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000
						<b>HR</b>
						<b>0.368</b>
						<b>Min</b>
						<b>22.10</b>

**Kibby Expansion Project - culvert sizing**

Prepared by TRC Environmental Corp

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Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-23:**

Runoff = 20.40 cfs @ 12.17 hrs, Volume= 1.548 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
14.110	70	Woods, Good, HSG C
14.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.6					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 16P: (new Pond)**

Inflow Area = 14.110 ac, 0.00% Impervious, Inflow Depth > 1.32" for 10-yr event  
 Inflow = 20.40 cfs @ 12.17 hrs, Volume= 1.548 af  
 Outflow = 20.40 cfs @ 12.17 hrs, Volume= 1.548 af, Atten= 0%, Lag= 0.0 min  
 Primary = 20.40 cfs @ 12.17 hrs, Volume= 1.548 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,249.91' @ 12.17 hrs

Flood Elev= 2,250.17'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,246.00'	<b>24.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,245.00' S= 0.0250 '/ Cc= 0.900 n= 0.012

Primary OutFlow Max=20.15 cfs @ 12.17 hrs HW=2,249.85' (Free Discharge)

↑1=Culvert (Inlet Controls 20.15 cfs @ 6.41 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-23</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.266					
T <sub>i</sub> <sup>1</sup> , hr	0.322					0.3216
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft				1500		
Slope, ft/ft				0.216	325/1500	
Velocity <sup>4</sup> , ft/sec				7.498638		
T <sub>i</sub> <sup>3</sup> , hr				0.056		0.0556
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.377</b>
<b>Min</b>	<b>22.63</b>



**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-24:**

Runoff = 33.56 cfs @ 12.37 hrs, Volume= 3.575 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
15.940	70	Woods, Good, HSG C
12.620	77	Woods, Good, HSG D
28.560	73	Weighted Average
28.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.8					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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Printed 11/20/2009

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**Summary for Pond 17P: (new Pond)**

Inflow Area = 28.560 ac, 0.00% Impervious, Inflow Depth = 1.67" for 10-yr event  
 Inflow = 33.30 cfs @ 12.37 hrs, Volume= 3.981 af  
 Outflow = 33.30 cfs @ 12.37 hrs, Volume= 3.981 af, Atten= 0%, Lag= 0.0 min  
 Primary = 33.30 cfs @ 12.37 hrs, Volume= 3.981 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Peak Elev= 2,291.93' @ 12.38 hrs

Flood Elev= 2,292.28'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,287.50'	<b>30.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,285.00' S= 0.0625 ' S Cc= 0.900 n= 0.012

**Primary OutFlow** Max=32.93 cfs @ 12.37 hrs HW=2,291.86' (Free Discharge)

↑1=Culvert (Inlet Controls 32.93 cfs @ 6.71 fps)

<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000 PH 9	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-24	<b>Date:</b>	April 17, 2009
		<b>Revised:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	100	50				
P2, in	2.9	2.9				
Slope, ft/ft	0.05	0.2				
T <sub>i</sub> <sup>1</sup> , hr	0.454	0.150				0.6034
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft					1250	
Slope, ft/ft					0.248	310'/1250'
Velocity <sup>4</sup> , ft/sec					8.034916	
T <sub>i</sub> <sup>3</sup> , hr					0.043	0.0432
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	0.647
<b>Min</b>	38.80

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-25:**

Runoff = 5.91 cfs @ 12.10 hrs, Volume= 0.376 af, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
2.160	70	Woods, Good, HSG C
0.950	77	Woods, Good, HSG D
3.110	72	Weighted Average
3.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 18P: (new Pond)**

Inflow Area = 3.110 ac, 0.00% Impervious, Inflow Depth = 1.60" for 10-yr event  
 Inflow = 5.80 cfs @ 12.10 hrs, Volume= 0.415 af  
 Outflow = 5.80 cfs @ 12.10 hrs, Volume= 0.415 af, Atten= 0%, Lag= 0.0 min  
 Primary = 5.80 cfs @ 12.10 hrs, Volume= 0.415 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
 Peak Elev= 2,319.49' @ 12.10 hrs  
 Flood Elev= 2,320.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,318.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,316.00' S= 0.0500 ' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=5.76 cfs @ 12.10 hrs HW=2,319.48' (Free Discharge)  
 ↳1=Culvert (Inlet Controls 5.76 cfs @ 3.27 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000 PH 9</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-25</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.53					
T <sub>i</sub> <sup>1</sup> , hr	0.244					0.2441
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			1370			
Slope, ft/ft			0.383	525'/1370'		
Velocity <sup>4</sup> , ft/sec			9.985157			
T <sub>i</sub> <sup>3</sup> , hr			0.038			0.0381
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.282</b>
<b>Min</b>	<b>16.93</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-26:**

Runoff = 8.65 cfs @ 12.16 hrs, Volume= 0.634 af, Depth&gt; 1.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
3.900	70	Woods, Good, HSG C
1.360	77	Woods, Good, HSG D
5.260	72	Weighted Average
5.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 19P: (new Pond)**

Inflow Area = 5.260 ac, 0.00% Impervious, Inflow Depth > 1.45" for 10-yr event  
 Inflow = 8.65 cfs @ 12.16 hrs, Volume= 0.634 af  
 Outflow = 8.65 cfs @ 12.16 hrs, Volume= 0.634 af, Atten= 0%, Lag= 0.0 min  
 Primary = 8.65 cfs @ 12.16 hrs, Volume= 0.634 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,326.41' @ 12.16 hrs

Flood Elev= 2,327.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,324.00'	<b>18.0" Round Culvert</b> L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,320.00' S= 0.0667 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=8.59 cfs @ 12.16 hrs HW=2,326.39' (Free Discharge)

↑1=Culvert (Inlet Controls 8.59 cfs @ 4.86 fps)



<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-26</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.266					
T <sub>i</sub> <sup>1</sup> , hr	0.322					0.3216
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			1450			
Slope, ft/ft			0.4	580'/1450'		
Velocity <sup>4</sup> , ft/sec			10.20435			
T <sub>i</sub> <sup>3</sup> , hr			0.039			0.0395
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Cuvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	0.361
<b>Min</b>	21.66

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-27:**

Runoff = 36.12 cfs @ 12.25 hrs, Volume= 3.223 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
15.320	70	Woods, Good, HSG C
10.320	77	Woods, Good, HSG D
25.640	73	Weighted Average
25.640		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.8					Direct Entry, See Spreatsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 20P: (new Pond)**

Inflow Area = 25.640 ac, 0.00% Impervious, Inflow Depth > 1.51" for 10-yr event  
 Inflow = 36.12 cfs @ 12.25 hrs, Volume= 3.223 af  
 Outflow = 36.12 cfs @ 12.25 hrs, Volume= 3.223 af, Atten= 0%, Lag= 0.0 min  
 Primary = 36.12 cfs @ 12.25 hrs, Volume= 3.223 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,341.81' @ 12.25 hrs

Flood Elev= 2,343.29'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,338.50'	<b>36.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,338.00' S= 0.0125 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=36.03 cfs @ 12.25 hrs HW=2,341.80' (Free Discharge)

↑1=Culvert (Inlet Controls 36.03 cfs @ 5.10 fps)

**PROJECT:** Kibby Wind Expansion **Calculated By:** PGT  
**Checked By:** DTB  
**Proj:** 170019.0000.0000 **PH 9** **Date:** April 17, 2009  
**Watershed:** A-27 **Revised:** November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8	0.8			
Length, ft	50	70	30			
P2, in	2.9	2.9	2.9			
Slope, ft/ft	0.2	0.14	0.33			
$T_t^1$ , hr	0.150	0.226	0.081			0.4570
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
$T_t^3$ , hr						0.0000
<b>Unpaved</b>						
Length, ft			1500			
Slope, ft/ft			0.42	630'/1500'		
Velocity <sup>4</sup> , ft/sec			10.45635			
$T_t^3$ , hr			0.040			0.0398
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
$T_t^3$ , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
$T_t$ , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
$T_t$ , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
$T_t$ , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
$T_t$ , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
$T_t$ , hr						0.0000

<b>HR</b>	0.497
<b>Min</b>	<b>29.81</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Subcatchment A-28:**

Runoff = 11.53 cfs @ 12.09 hrs, Volume= 0.717 af, Depth&gt; 1.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
3.990	70	Woods, Good, HSG C
1.940	77	Woods, Good, HSG D
5.930	72	Weighted Average
5.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.2					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 21P: (new Pond)**

Inflow Area = 5.930 ac, 0.00% Impervious, Inflow Depth > 1.45" for 10-yr event  
Inflow = 11.53 cfs @ 12.09 hrs, Volume= 0.717 af  
Outflow = 11.53 cfs @ 12.09 hrs, Volume= 0.717 af, Atten= 0%, Lag= 0.0 min  
Primary = 11.53 cfs @ 12.09 hrs, Volume= 0.717 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,391.70' @ 12.09 hrs

Flood Elev= 2,391.79'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,388.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,386.00' S= 0.0500 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=11.43 cfs @ 12.09 hrs HW=2,391.65' (Free Discharge)

↑**1=Culvert** (Inlet Controls 11.43 cfs @ 6.47 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-28</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.6					
$T_1^1$ , hr	0.232					0.2323
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
$T_1^3$ , hr						0.0000
<b>Unpaved</b>						
Length, ft			1360			
Slope, ft/ft			0.39	530'/1360'		
Velocity <sup>4</sup> , ft/sec			10.07599			
$T_1^3$ , hr			0.037			0.0375
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
$T_1^3$ , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
$T_1$ , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
$T_1$ , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
$T_1$ , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
$T_1$ , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
$T_1$ , hr						0.0000

<b>HR</b>	0.270
<b>Min</b>	16.19

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A-29:**

Runoff = 14.87 cfs @ 12.27 hrs, Volume= 1.365 af, Depth&gt; 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
6.080	70	Woods, Good, HSG C
4.790	77	Woods, Good, HSG D
10.870	73	Weighted Average
10.870		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.2					Direct Entry, See spreadsheet



**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

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**Summary for Pond 22P: (new Pond)**

Inflow Area = 10.870 ac, 0.00% Impervious, Inflow Depth > 1.51" for 10-yr event  
 Inflow = 14.87 cfs @ 12.27 hrs, Volume= 1.365 af  
 Outflow = 14.87 cfs @ 12.27 hrs, Volume= 1.365 af, Atten= 0%, Lag= 0.0 min  
 Primary = 14.87 cfs @ 12.27 hrs, Volume= 1.365 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,411.55' @ 12.27 hrs

Flood Elev= 2,412.72'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,409.00'	<b>24.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,400.00' S= 0.2250 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=14.76 cfs @ 12.27 hrs HW=2,411.53' (Free Discharge)

↑1=Culvert (Inlet Controls 14.76 cfs @ 4.70 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-29</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.1					
T <sub>1</sub> <sup>1</sup> , hr	0.476					0.4756
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			1580			
Slope, ft/ft			0.379	600'/1580'		
Velocity <sup>4</sup> , ft/sec			9.932878			
T <sub>1</sub> <sup>3</sup> , hr			0.044			0.0442
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>3</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>1</sub> , hr						0.0000

<b>HR</b>	0.520
<b>Min</b>	31.19

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-30:**

Runoff = 9.80 cfs @ 12.10 hrs, Volume= 0.613 af, Depth> 1.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
3.100	70	Woods, Good, HSG C
1.750	77	Woods, Good, HSG D
4.850	73	Weighted Average
4.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 23P: (new Pond)**

Inflow Area = 4.850 ac, 0.00% Impervious, Inflow Depth > 1.52" for 10-yr event  
Inflow = 9.80 cfs @ 12.10 hrs, Volume= 0.613 af  
Outflow = 9.80 cfs @ 12.10 hrs, Volume= 0.613 af, Atten= 0%, Lag= 0.0 min  
Primary = 9.80 cfs @ 12.10 hrs, Volume= 0.613 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Peak Elev= 2,452.88' @ 12.10 hrs  
Flood Elev= 2,453.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,450.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,448.00' S= 0.0500 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=9.75 cfs @ 12.10 hrs HW=2,452.86' (Free Discharge)  
↑**1=Culvert** (Inlet Controls 9.75 cfs @ 5.52 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-30</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.6					
T <sub>i</sub> <sup>1</sup> , hr	0.232					0.2323
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			1400			
Slope, ft/ft			0.328	460'/1400'		
Velocity <sup>4</sup> , ft/sec			9.240435			
T <sub>i</sub> <sup>3</sup> , hr			0.042			0.0421
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.274</b>
<b>Min</b>	<b>16.46</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-31:**

Runoff = 50.77 cfs @ 12.42 hrs, Volume= 5.766 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
0.960	89	Gravel roads, HSG C
11.000	70	Woods, Good, HSG C
30.300	77	Woods, Good, HSG D
42.260	75	Weighted Average
42.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.0					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 24P: (new Pond)**

Inflow Area = 42.260 ac, 0.00% Impervious, Inflow Depth > 1.64" for 10-yr event  
 Inflow = 50.77 cfs @ 12.42 hrs, Volume= 5.766 af  
 Outflow = 50.77 cfs @ 12.42 hrs, Volume= 5.766 af, Atten= 0%, Lag= 0.0 min  
 Primary = 50.77 cfs @ 12.42 hrs, Volume= 5.766 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,468.07' @ 12.42 hrs

Flood Elev= 2,468.64'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,463.00'	<b>36.0" Round Culvert</b> L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,462.00' S= 0.0250 '/ Cc= 0.900 n= 0.024

**Primary OutFlow** Max=50.59 cfs @ 12.42 hrs HW=2,468.05' (Free Discharge)

↑1=Culvert (Inlet Controls 50.59 cfs @ 7.16 fps)

<b>PROJECT:</b>	Kibby Wind Expansion	<b>Calculated By:</b>	PGT
<b>Proj:</b>	170019.0000.0000 PH 9	<b>Checked By:</b>	DTB
<b>Watershed:</b>	A-31	<b>Date:</b>	April 17, 2009
		<b>Revised:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	120	30				
P2, in	2.9	2.9				
Slope, ft/ft	0.041	0.33				
T <sub>i</sub> <sup>1</sup> , hr	0.568	0.081				0.6497
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			2100			
Slope, ft/ft			0.285	600'/2100'		
Velocity <sup>4</sup> , ft/sec			8.613466			
T <sub>i</sub> <sup>3</sup> , hr			0.068			0.0677
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	0.717
<b>Min</b>	43.05



**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment A-32:**

Runoff = 9.73 cfs @ 12.15 hrs, Volume= 0.702 af, Depth&gt; 1.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
5.200	70	Woods, Good, HSG C
0.900	77	Woods, Good, HSG D
6.100	71	Weighted Average
6.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0					Direct Entry, See spreadsheet

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Pond 25P: (new Pond)**

Inflow Area = 6.100 ac, 0.00% Impervious, Inflow Depth > 1.38" for 10-yr event  
 Inflow = 9.73 cfs @ 12.15 hrs, Volume= 0.702 af  
 Outflow = 9.73 cfs @ 12.15 hrs, Volume= 0.702 af, Atten= 0%, Lag= 0.0 min  
 Primary = 9.73 cfs @ 12.15 hrs, Volume= 0.702 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Peak Elev= 2,525.85' @ 12.15 hrs

Flood Elev= 2,526.32'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,523.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,521.00' S= 0.0500 '/ Cc= 0.900 n= 0.012

**Primary OutFlow Max=9.72 cfs @ 12.15 hrs HW=2,525.84' (Free Discharge)**

↑**1=Culvert (Inlet Controls 9.72 cfs @ 5.50 fps)**

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-32</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>Revised:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.26					
T <sub>i</sub> <sup>1</sup> , hr	0.325					0.3245
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			760			
Slope, ft/ft			0.256	195/760'		
Velocity <sup>4</sup> , ft/sec			8.163483			
T <sub>i</sub> <sup>3</sup> , hr			0.026			0.0259
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.350</b>
<b>Min</b>	<b>21.02</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/23/2009

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**Summary for Subcatchment A-33:**

Runoff = 2.20 cfs @ 12.18 hrs, Volume= 0.188 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10-yr Rainfall=4.20"

Area (ac)	CN	Description
1.210	70	Woods, Good, HSG C
0.260	77	Woods, Good, HSG D
1.470	71	Weighted Average
1.470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.5					<b>Direct Entry, See spreadsheet</b>

**Kibby Expansion Project - culvert sizing**

Type II 24-hr 10-yr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/23/2009

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**Summary for Pond 27P: (new Pond)**

Inflow Area = 1.470 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-yr event  
 Inflow = 2.20 cfs @ 12.18 hrs, Volume= 0.188 af  
 Outflow = 2.20 cfs @ 12.18 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min  
 Primary = 2.20 cfs @ 12.18 hrs, Volume= 0.188 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
 Peak Elev= 2,638.78' @ 12.18 hrs  
 Flood Elev= 2,640.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,638.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,636.00' S= 0.0500 '/ Cc= 0.900 n= 0.012

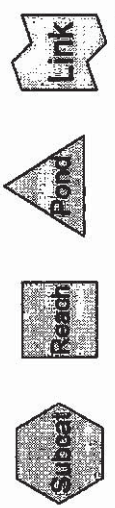
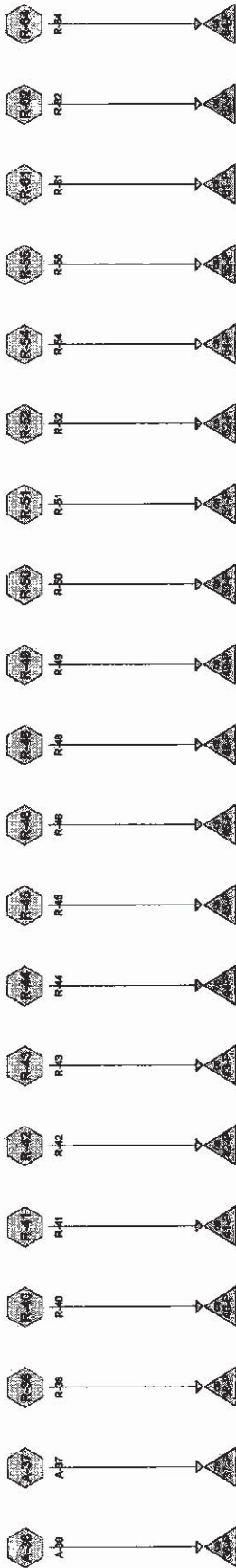
**Primary OutFlow** Max=2.14 cfs @ 12.18 hrs HW=2,638.77' (Free Discharge)  
 ↑**1=Culvert** (Inlet Controls 2.14 cfs @ 2.35 fps)

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	<b>PGT</b>
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>A-33</b>	<b>Date:</b>	<b>April 17, 2009</b>
		<b>PH 9</b>	<b>Revised:</b>
			<b>November 23, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.2					
T <sub>i</sub> <sup>1</sup> , hr	0.360					0.3604
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			350			
Slope, ft/ft			0.17	60/360'		
Velocity <sup>4</sup> , ft/sec			6.652425			
T <sub>i</sub> <sup>3</sup> , hr			0.015			0.0146
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.375</b>
<b>Min</b>	<b>22.50</b>



**Drainage Diagram for Kibby Expansion Project Ridge Swale Sizing**  
 Prepared by TRC Environmental Corp, Printed 11/20/2009  
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# Kibby Expansion Project Ridge Swale Sizing

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

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## Summary for Subcatchment A-36: A-36

Runoff = 23.78 cfs @ 12.11 hrs, Volume= 1.722 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.780	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
9.310	77	Woods, Good, HSG D
10.090	78	Weighted Average
10.090		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					Direct Entry, See Spreadshet



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 36-P:**

Inflow Area = 10.090 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 23.78 cfs @ 12.11 hrs, Volume= 1.722 af  
 Outflow = 23.78 cfs @ 12.11 hrs, Volume= 1.722 af, Atten= 0%, Lag= 0.0 min  
 Primary = 23.78 cfs @ 12.11 hrs, Volume= 1.722 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 2,858.87' @ 12.11 hrs

Flood Elev= 2,859.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,856.00'	<b>30.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,852.00' S= 0.1000 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=23.32 cfs @ 12.11 hrs HW=2,858.81' (Free Discharge)

↑1=Culvert (Inlet Controls 23.32 cfs @ 4.75 fps)

<b>PROJECT:</b>	Kibby Expansion	<b>Calculated By:</b>	DTB
		<b>Checked By:</b>	DTB
<b>Proj:</b>	170019	<b>Date:</b>	November 20, 2009
<b>Watershed:</b>	A-36 (SF in R-62)		

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
--	-------	-------	-------	-------	-------	--

SHEET FLOW							
Manning's No.	0.8						
Length, ft	150						
P2, in	2.9						
Slope, ft/ft	0.4						
T <sub>t</sub> <sup>1</sup> , hr	0.273						0.2732

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>t</sub> <sup>3</sup> , hr							0.0000
<b>Unpaved</b>							
Length, ft		200	800				
Slope, ft/ft		0.5	0.4	320'/800'			
Velocity <sup>4</sup> , ft/sec		11.40881	10.20435				
T <sub>t</sub> <sup>5</sup> , hr		0.005	0.022				0.0266

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>6</sup> , ft/sec							
T <sub>t</sub> <sup>3</sup> , hr							0.0000
<b>Grassed Waterways/Roadside Ditches</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>6</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Large Tributary</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>8</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Main River</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Culvert</b>							
Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>t</sub> , hr							0.0000

<b>HR</b>	0.300
<b>Min</b>	17.99

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment A-37: A-37**

Runoff = 33.37 cfs @ 12.45 hrs, Volume= 4.339 af, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 2.830	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
21.650	77	Woods, Good, HSG D
24.480	79	Weighted Average
24.480		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.9					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Pond 37-P:**

Inflow Area = 24.480 ac, 0.00% Impervious, Inflow Depth = 2.13" for 10Yr-24Hr event  
 Inflow = 33.37 cfs @ 12.45 hrs, Volume= 4.339 af  
 Outflow = 33.37 cfs @ 12.45 hrs, Volume= 4.339 af, Atten= 0%, Lag= 0.0 min  
 Primary = 33.37 cfs @ 12.45 hrs, Volume= 4.339 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 2,893.04' @ 12.45 hrs

Flood Elev= 2,893.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,890.00'	<b>36.0" Round Culvert</b> L= 40.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,878.00' S= 0.3000 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=32.89 cfs @ 12.45 hrs HW=2,893.00' (Free Discharge)

↑1=Culvert (Inlet Controls 32.89 cfs @ 4.65 fps)

<b>PROJECT:</b>	<b>Kibby Expansion</b>					<b>Calculated By:</b>	DTB
<b>Proj:</b>	<b>170019</b>					<b>Checked By:</b>	DTB
<b>Watershed:</b>	<b>A-37 (SF in R-60--see R-61)</b>					<b>Date:</b>	November 20, 2009
<b>Time of Concentration Determination Worksheet, SCS Methods</b>							
	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>		
<b>SHEET FLOW</b>							
Manning's No.	0.8						
Length, ft	150						
P2, in	2.9						
Slope, ft/ft	0.04	10'/250'					
T <sub>i</sub> <sup>1</sup> , hr	0.686						0.6862
<b>SHALLOW CONCENTRATED FLOW</b>							
<b>Paved</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Unpaved</b>							
Length, ft		350		650			
Slope, ft/ft		0.233	112'/480'	0.46	300'/650'		
Velocity <sup>4</sup> , ft/sec		7.788		10.943			
T <sub>i</sub> <sup>5</sup> , hr		0.012		0.016			0.0290
<b>CHANNEL FLOW</b>							
<b>Waterways &amp; Swamps, No Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>6</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000
<b>Grassed Waterways/Roadside Ditches</b>							
Length, ft			850				
Slope, ft/ft			0.1				
Velocity <sup>8</sup> , ft/sec			4.743				
T <sub>i</sub> , hr			0.050				0.0498
<b>Small Tributary &amp; Swamp w/Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Large Tributary</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Main River</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000
<b>Culvert</b>							
Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>i</sub> , hr							0.0000
						<b>HR</b>	0.765
						<b>Min</b>	46.89

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-38: R-38**

Runoff = 9.26 cfs @ 12.20 hrs, Volume= 0.808 af, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.560	91	Gravel roads/riprap slopes, HSG D
4.000	77	Woods, Good, HSG D
4.560	79	Weighted Average
4.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.1					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 38-P:**

Inflow Area = 4.560 ac, 0.00% Impervious, Inflow Depth = 2.13" for 10Yr-24Hr event  
 Inflow = 9.26 cfs @ 12.20 hrs, Volume= 0.808 af  
 Outflow = 9.26 cfs @ 12.20 hrs, Volume= 0.808 af, Atten= 0%, Lag= 0.0 min  
 Primary = 9.26 cfs @ 12.20 hrs, Volume= 0.808 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2  
 Peak Elev= 3,188.65' @ 12.20 hrs  
 Flood Elev= 3,192.67'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,186.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,183.00' S= 0.0429 '/ Cc= 0.900 n= 0.012

**Primary OutFlow Max=9.22 cfs @ 12.20 hrs HW=3,188.63' (Free Discharge)**  
 ↑=Culvert (Inlet Controls 9.22 cfs @ 5.22 fps)



**PROJECT:** Kibby Expansion **Calculated By:** DTB  
**Proj:** 170019 **Checked By:** DTB  
**Watershed:** R-38 **Date:** November 20, 2009

**Time of Concentration Determination Worksheet SCS Methods**

Seg 1
Seg 2
Seg 3
Seg 4
Seg 5

SHEET FLOW								
Manning's No.	0.8							
Length, ft	150							
P2, in	2.9							
Slope, ft/ft	0.1667	30'/180'						
T <sub>t</sub> <sup>1</sup> , hr	0.388							0.3877

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>2</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000
<b>Unpaved</b>								
Length, ft		680						
Slope, ft/ft		0.1985	135'/680'					
Velocity <sup>4</sup> , ft/sec		7.188458						
T <sub>t</sub> <sup>3</sup> , hr		0.026						0.0263

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>5</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000

<b>Grassed Waterways/Roadside Ditches</b>								
Length, ft				80				
Slope, ft/ft				0.12				
Velocity <sup>6</sup> , ft/sec				5.196				
T <sub>t</sub> , hr				0.004				0.0043

<b>Small Tributary &amp; Swamp w/Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>7</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Large Tributary</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>8</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Main River</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>9</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Culvert</b>								
Diameter, ft								
Area, ft <sup>2</sup>								
Wetted Perimeter, ft								
Hydraulic Radius, R, ft								
Slope, ft/ft								
Manning's No.								
Velocity <sup>10</sup> , ft/sec								
Length, L, ft								
T <sub>t</sub> , hr								0.0000

<b>HR</b>	0.418
<b>Min</b>	25.09



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-40: R-40**

Runoff = 7.19 cfs @ 12.28 hrs, Volume= 0.732 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.840	91	Gravel roads/reveg turbine site/riprap slopes, HSG D
3.140	77	Woods, Good, HSG D
3.980	80	Weighted Average
3.980		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Pond 40-P:**

Inflow Area = 3.980 ac, 0.00% Impervious, Inflow Depth = 2.21" for 10Yr-24Hr event  
 Inflow = 7.19 cfs @ 12.28 hrs, Volume= 0.732 af  
 Outflow = 7.19 cfs @ 12.28 hrs, Volume= 0.732 af, Atten= 0%, Lag= 0.0 min  
 Primary = 7.19 cfs @ 12.28 hrs, Volume= 0.732 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,266.89' @ 12.28 hrs

Flood Elev= 3,267.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,265.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,258.00' S= 0.1000 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=7.09 cfs @ 12.28 hrs HW=3,266.86' (Free Discharge)

↑1=Culvert (Inlet Controls 7.09 cfs @ 4.01 fps)

**PROJECT:** Kibby Expansion **Calculated By:** DTB  
**Checked By:** DTB  
**Proj:** 170019 **Date:** November 20, 2009  
**Watershed:** R-40

**Time of Concentration Determination Worksheet, SCS Methods**

Seg 1      Seg 2      Seg 3      Seg 4      Seg 5

**SHEET FLOW**

Manning's No.	0.8	0.8							
Length, ft	100	50							
P2, in	2.9	2.9							
Slope, ft/ft	0.1	0.143							
T <sub>i</sub> <sup>1</sup> , hr	0.344	0.171							0.5150

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Unpaved**

Length, ft			200						
Slope, ft/ft			0.275						
Velocity <sup>4</sup> , ft/sec			8.481003						
T <sub>i</sub> <sup>3</sup> , hr			0.007						0.0066

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft			180						
Slope, ft/ft			0.08						
Velocity <sup>6</sup> , ft/sec			4.243						
T <sub>i</sub> , hr			0.012						0.0118

**Small Tributary & Swamp w/Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Large Tributary**

Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Main River**

Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Culvert**

Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	0.533
<b>Min</b>	32.00

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-41: R-41**

Runoff = 11.44 cfs @ 12.26 hrs, Volume= 1.138 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.530	91	Gravel roads/ reveg turbine sites/riprap slopes, HSG D
6.140	77	Woods, Good, HSG D
6.670	78	Weighted Average
6.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.5					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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Printed 11/20/2009

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**Summary for Pond 41-P:**

Inflow Area = 6.670 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 11.44 cfs @ 12.26 hrs, Volume= 1.138 af  
 Outflow = 11.44 cfs @ 12.26 hrs, Volume= 1.138 af, Atten= 0%, Lag= 0.0 min  
 Primary = 11.44 cfs @ 12.26 hrs, Volume= 1.138 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,214.64' @ 12.26 hrs

Flood Elev= 3,215.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,211.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,194.00' S= 0.2429 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=11.21 cfs @ 12.26 hrs HW=3,214.54' (Free Discharge)

↑1=Culvert (Inlet Controls 11.21 cfs @ 6.34 fps)

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-41</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8	0.8					
Length, ft	30	120					
P2, in	2.9	2.9					
Slope, ft/ft	0.1667	0.4					
T <sub>i</sub> <sup>1</sup> , hr	0.107	0.375					0.4820

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000

**Unpaved**

Length, ft			470				
Slope, ft/ft			0.163	85/520'			
Velocity <sup>4</sup> , ft/sec			6.514023				
T <sub>i</sub> <sup>3</sup> , hr			0.020				0.0200

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft							
Slope, ft/ft							
Velocity <sup>5</sup> , ft/sec							
T <sub>i</sub> <sup>3</sup> , hr							0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft				100			
Slope, ft/ft				0.08			
Velocity <sup>6</sup> , ft/sec				4.243			
T <sub>i</sub> , hr				0.007			0.0065

**Small Tributary & Swamp w/Channels**

Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000

**Large Tributary**

Length, ft							
Slope, ft/ft							
Velocity <sup>8</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000

**Main River**

Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>i</sub> , hr							0.0000

**Culvert**

Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>i</sub> , hr							0.0000

<b>HR</b>	0.509
<b>Min</b>	30.51

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-42: R-42**

Runoff = 11.12 cfs @ 12.32 hrs, Volume= 1.211 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.400	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
6.700	77	Woods, Good, HSG D
7.100	78	Weighted Average
7.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.4					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 42-P:**

Inflow Area = 7.100 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 11.12 cfs @ 12.32 hrs, Volume= 1.211 af  
 Outflow = 11.12 cfs @ 12.32 hrs, Volume= 1.211 af, Atten= 0%, Lag= 0.0 min  
 Primary = 11.12 cfs @ 12.32 hrs, Volume= 1.211 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,188.49' @ 12.32 hrs

Flood Elev= 3,188.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,185.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,176.00' S= 0.1286 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=10.96 cfs @ 12.32 hrs HW=3,188.41' (Free Discharge)

↑1=Culvert (Inlet Controls 10.96 cfs @ 6.20 fps)



<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	DTB
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	DTB
<b>Watershed:</b>	<b>R-42</b>	<b>Date:</b>	November 20, 2009

**Time of Concentration Determination Worksheet SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	80	70				
P2, in	2.9	2.9				
Slope, ft/ft	0.0625	0.142				
T <sub>c</sub> <sup>1</sup> , hr	0.347	0.225				0.5718
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>c</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			600			
Slope, ft/ft			0.308	185'/600'		
Velocity <sup>4</sup> , ft/sec			8.954284			
T <sub>c</sub> <sup>3</sup> , hr			0.019			0.0186
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>c</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>c</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>c</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>c</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>c</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>c</sub> , hr						0.0000

<b>HR</b>	0.590
<b>Min</b>	35.42

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment R-43: R-43**

Runoff = 8.26 cfs @ 12.34 hrs, Volume= 0.928 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.510	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
4.930	77	Woods, Good, HSG D
5.440	78	Weighted Average
5.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.1					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 43-P:**

Inflow Area = 5.440 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 8.26 cfs @ 12.34 hrs, Volume= 0.928 af  
 Outflow = 8.26 cfs @ 12.34 hrs, Volume= 0.928 af, Atten= 0%, Lag= 0.0 min  
 Primary = 8.26 cfs @ 12.34 hrs, Volume= 0.928 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,182.26' @ 12.34 hrs

Flood Elev= 3,182.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,180.00'	<b>18.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,174.00' S= 0.1200 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=8.09 cfs @ 12.34 hrs HW=3,182.20' (Free Discharge)

↑1=Culvert (Inlet Controls 8.09 cfs @ 4.58 fps)

<b>PROJECT:</b>	Kibby Expansion	<b>Calculated By:</b>	DTB
		<b>Checked By:</b>	DTB
<b>Proj:</b>	170019	<b>Date:</b>	November 20, 2009
<b>Watershed:</b>	R-43		

**Time of Concentration Determination Worksheet, SCS Methods**

<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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SHEET FLOW					
Manning's No.	0.8	0.8			
Length, ft	100	50			
P2, in	2.9	2.9			
Slope, ft/ft	0.05	0.2			
T <sub>c</sub> <sup>1</sup> , hr	0.454	0.150			0.6034

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>2</sup> , ft/sec					
T <sub>c</sub> <sup>3</sup> , hr					0.0000
<b>Unpaved</b>					
Length, ft			530		
Slope, ft/ft			0.339	180'/530'	
Velocity <sup>4</sup> , ft/sec			9.394104		
T <sub>c</sub> <sup>3</sup> , hr			0.016		0.0157

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>5</sup> , ft/sec					
T <sub>c</sub> <sup>3</sup> , hr					0.0000
<b>Grassed Waterways/Roadside Ditches</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>6</sup> , ft/sec					
T <sub>c</sub> , hr					0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>7</sup> , ft/sec					
T <sub>c</sub> , hr					0.0000
<b>Large Tributary</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>8</sup> , ft/sec					
T <sub>c</sub> , hr					0.0000
<b>Main River</b>					
Length, ft					
Slope, ft/ft					
Velocity <sup>9</sup> , ft/sec					
T <sub>c</sub> , hr					0.0000
<b>Culvert</b>					
Diameter, ft					
Area, ft <sup>2</sup>					
Wetted Perimeter, ft					
Hydraulic Radius, R, ft					
Slope, ft/ft					
Manning's No.					
Velocity <sup>10</sup> , ft/sec					
Length, L, ft					
T <sub>c</sub> , hr					0.0000

<b>HR</b>	0.619
<b>Min</b>	37.14

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment R-44: R-44**

Runoff = 5.72 cfs @ 12.32 hrs, Volume= 0.623 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.330	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
3.320	77	Woods, Good, HSG D
3.650	78	Weighted Average
3.650		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.4					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Pond 44-P:**

Inflow Area = 3.650 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 5.72 cfs @ 12.32 hrs, Volume= 0.623 af  
 Outflow = 5.72 cfs @ 12.32 hrs, Volume= 0.623 af, Atten= 0%, Lag= 0.0 min  
 Primary = 5.72 cfs @ 12.32 hrs, Volume= 0.623 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,186.46' @ 12.32 hrs

Flood Elev= 3,188.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,185.00'	<b>18.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,178.00' S= 0.1400 ' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=5.64 cfs @ 12.32 hrs HW=3,186.44' (Free Discharge)

↑1=Culvert (Inlet Controls 5.64 cfs @ 3.23 fps)

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-44</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	70	80				
P2, in	2.9	2.9				
Slope, ft/ft	0.142	0.0625				
T <sub>1</sub> <sup>1</sup> , hr	0.225	0.347				0.5718
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			600			
Slope, ft/ft			0.308	185'/600'		
Velocity <sup>4</sup> , ft/sec			8.954284			
T <sub>1</sub> <sup>3</sup> , hr			0.019			0.0186
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>1</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>1</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>1</sub> , hr						0.0000

<b>HR</b>	<b>0.590</b>
<b>Min</b>	<b>35.42</b>

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

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**Summary for Subcatchment R-45: R-45**

Runoff = 11.66 cfs @ 12.21 hrs, Volume= 1.054 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.280	91	Gravel roads/revveg turbine sites/riprap slopes, HSG D
5.900	77	Woods, Good, HSG D
6.180	78	Weighted Average
6.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.6					Direct Entry, See Spreadsheet



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 45-P:**

Inflow Area = 6.180 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 11.66 cfs @ 12.21 hrs, Volume= 1.054 af  
 Outflow = 11.66 cfs @ 12.21 hrs, Volume= 1.054 af, Atten= 0%, Lag= 0.0 min  
 Primary = 11.66 cfs @ 12.21 hrs, Volume= 1.054 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2  
 Peak Elev= 3,199.94' @ 12.21 hrs  
 Flood Elev= 3,201.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,198.00'	<b>24.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,190.00' S= 0.1600 ' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=11.49 cfs @ 12.21 hrs HW=3,199.91' (Free Discharge)  
 ↳1=Culvert (Inlet Controls 11.49 cfs @ 3.72 fps)

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-45</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8	0.8						
Length, ft	50	100						
P2, in	2.9	2.9						
Slope, ft/ft	0.1	0.3						
T <sub>i</sub> <sup>1</sup> , hr	0.197	0.222						0.4191

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft								
Slope, ft/ft								
Velocity <sup>2</sup> , ft/sec								
T <sub>i</sub> <sup>2</sup> , hr								0.0000

**Unpaved**

Length, ft			600					
Slope, ft/ft			0.183	110'/600'				
Velocity <sup>4</sup> , ft/sec			6.902097					
T <sub>i</sub> <sup>3</sup> , hr			0.024					0.0241

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft								
Slope, ft/ft								
Velocity <sup>5</sup> , ft/sec								
T <sub>i</sub> <sup>3</sup> , hr								0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft								
Slope, ft/ft								
Velocity <sup>6</sup> , ft/sec								
T <sub>i</sub> , hr								0.0000

**Small Tributary & Swamp w/Channels**

Length, ft								
Slope, ft/ft								
Velocity <sup>7</sup> , ft/sec								
T <sub>i</sub> , hr								0.0000

**Large Tributary**

Length, ft								
Slope, ft/ft								
Velocity <sup>8</sup> , ft/sec								
T <sub>i</sub> , hr								0.0000

**Main River**

Length, ft								
Slope, ft/ft								
Velocity <sup>9</sup> , ft/sec								
T <sub>i</sub> , hr								0.0000

**Culvert**

Diameter, ft								
Area, ft <sup>2</sup>								
Wetted Perimeter, ft								
Hydraulic Radius, R, ft								
Slope, ft/ft								
Manning's No.								
Velocity <sup>10</sup> , ft/sec								
Length, L, ft								
T <sub>i</sub> , hr								0.0000

<b>HR</b>	0.443
<b>Min</b>	26.59

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment R-46: R-46**

Runoff = 8.00 cfs @ 12.21 hrs, Volume= 0.716 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 1.520	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
1.970	77	Woods, Good, HSG D
3.490	83	Weighted Average
3.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4					Direct Entry, See Spreadsheet

# Kibby Expansion Project Ridge Swale Sizing

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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## Summary for Pond 46-P:

Inflow Area = 3.490 ac, 0.00% Impervious, Inflow Depth = 2.46" for 10Yr-24Hr event  
Inflow = 8.00 cfs @ 12.21 hrs, Volume= 0.716 af  
Outflow = 8.00 cfs @ 12.21 hrs, Volume= 0.716 af, Atten= 0%, Lag= 0.0 min  
Primary = 8.00 cfs @ 12.21 hrs, Volume= 0.716 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,230.17' @ 12.21 hrs

Flood Elev= 3,231.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,228.00'	<b>18.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,220.00' S= 0.1600 ' Cc= 0.900 n= 0.012

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**Primary OutFlow** Max=7.94 cfs @ 12.21 hrs HW=3,230.15' (Free Discharge)

↑=Culvert (Inlet Controls 7.94 cfs @ 4.50 fps)

**PROJECT:** Kibby Expansion **Calculated By:** DTB  
**Checked By:** DTB  
**Proj:** 170019 **Date:** November 20, 2009  
**Watershed:** R-46 (SF in R-58)

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8	0.8				
Length, ft	50	100				
P2, in	2.9	2.9				
Slope, ft/ft	0.1	0.3				
T <sub>r</sub> <sup>1</sup> , hr	0.197	0.222				0.4191
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>r</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			250			
Slope, ft/ft			0.42	105'/250'		
Velocity <sup>4</sup> , ft/sec			10.45635			
T <sub>r</sub> <sup>3</sup> , hr			0.007			0.0066
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>r</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft				250		
Slope, ft/ft				0.1		
Velocity <sup>6</sup> , ft/sec				4.743		
T <sub>r</sub> , hr				0.015		0.0146
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>r</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>r</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>r</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>c</sub> , hr						0.0000

**HR** 0.440  
**Min** 26.42

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 48-P:**

Inflow Area = 3.590 ac, 0.00% Impervious, Inflow Depth = 2.13" for 10Yr-24Hr event  
 Inflow = 6.14 cfs @ 12.29 hrs, Volume= 0.636 af  
 Outflow = 6.14 cfs @ 12.29 hrs, Volume= 0.636 af, Atten= 0%, Lag= 0.0 min  
 Primary = 6.14 cfs @ 12.29 hrs, Volume= 0.636 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,284.59' @ 12.29 hrs

Flood Elev= 3,286.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,283.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,272.00' S= 0.1571 ' /' Cc= 0.900 n= 0.012

Primary OutFlow Max=6.09 cfs @ 12.29 hrs HW=3,284.57' (Free Discharge)

↑1=Culvert (Inlet Controls 6.09 cfs @ 3.45 fps)

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment R-48: R-48**

Runoff = 6.14 cfs @ 12.29 hrs, Volume= 0.636 af, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.540	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
3.050	77	Woods, Good, HSG D
3.590	79	Weighted Average
3.590		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.8					Direct Entry, See Spreadsheet

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-48</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8	0.8						
Length, ft	100	50						
P2, in	2.9	2.9						
Slope, ft/ft	0.08	0.2						
T <sub>t</sub> <sup>1</sup> , hr	0.376	0.150						0.5256

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>2</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000

<b>Unpaved</b>								
Length, ft			250					
Slope, ft/ft			0.32	80'/250'				
Velocity <sup>4</sup> , ft/sec			9.127051					
T <sub>t</sub> <sup>3</sup> , hr			0.008					0.0076

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>5</sup> , ft/sec								
T <sub>t</sub> <sup>3</sup> , hr								0.0000

<b>Grassed Waterways/Roadside Ditches</b>								
Length, ft				100				
Slope, ft/ft				0.02				
Velocity <sup>6</sup> , ft/sec				2.121				
T <sub>t</sub> , hr				0.013				0.0131

<b>Small Tributary &amp; Swamp w/Channels</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>7</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Large Tributary</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>8</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Main River</b>								
Length, ft								
Slope, ft/ft								
Velocity <sup>9</sup> , ft/sec								
T <sub>t</sub> , hr								0.0000

<b>Culvert</b>								
Diameter, ft								
Area, ft <sup>2</sup>								
Wetted Perimeter, ft								
Hydraulic Radius, R, ft								
Slope, ft/ft								
Manning's No.								
Velocity <sup>10</sup> , ft/sec								
Length, L, ft								
T <sub>t</sub> , hr								0.0000

<b>HR</b>	0.546
<b>Min</b>	32.78



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment R-49: R-49**

Runoff = 2.91 cfs @ 12.25 hrs, Volume= 0.287 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.100	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
1.580	77	Woods, Good, HSG D
1.680	78	Weighted Average
1.680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Pond 49-P:**

Inflow Area = 1.680 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 2.91 cfs @ 12.25 hrs, Volume= 0.287 af  
 Outflow = 2.91 cfs @ 12.25 hrs, Volume= 0.287 af, Atten= 0%, Lag= 0.0 min  
 Primary = 2.91 cfs @ 12.25 hrs, Volume= 0.287 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,270.92' @ 12.25 hrs

Flood Elev= 3,272.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,270.00'	<b>18.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,264.00' S= 0.1200 ' Cc= 0.900 n= 0.012

**Primary OutFlow Max=2.85 cfs @ 12.25 hrs HW=3,270.91' (Free Discharge)****↑1=Culvert (Inlet Controls 2.85 cfs @ 2.56 fps)**

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	DTB
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	DTB
<b>Watershed:</b>	<b>R-49</b>	<b>Date:</b>	November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.1					
T <sub>t</sub> <sup>1</sup> , hr	0.476					0.4756
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>t</sub> <sup>3</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft			320			
Slope, ft/ft			0.3125	100'/320'		
Velocity <sup>4</sup> , ft/sec			9.01946			
T <sub>t</sub> <sup>3</sup> , hr			0.010			0.0099
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft				140		
Slope, ft/ft				0.05		
Velocity <sup>5</sup> , ft/sec				2.663		
T <sub>t</sub> <sup>3</sup> , hr				0.014		0.0145
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>t</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>c</sub> , hr						0.0000

<b>HR</b>	0.500
<b>Min</b>	30.00

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-50: R-50**

Runoff = 11.21 cfs @ 12.29 hrs, Volume= 1.169 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.300	91	Gravel roads/reveg turbine sites/riprap slopes, HAG D
6.550	77	Woods, Good, HSG D
6.850	78	Weighted Average
6.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.0					Direct Entry, See Spreadsheet

# Kibby Expansion Project Ridge Swale Sizing

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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## Summary for Pond 50-P:

Inflow Area = 6.850 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
Inflow = 11.21 cfs @ 12.29 hrs, Volume= 1.169 af  
Outflow = 11.21 cfs @ 12.29 hrs, Volume= 1.169 af, Atten= 0%, Lag= 0.0 min  
Primary = 11.21 cfs @ 12.29 hrs, Volume= 1.169 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,257.87' @ 12.29 hrs

Flood Elev= 3,259.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,256.00'	<b>24.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,246.00' S= 0.2000 '/ Cc= 0.900 n= 0.012

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**Primary OutFlow** Max=11.16 cfs @ 12.29 hrs HW=3,257.86' (Free Discharge)

↳ **1=Culvert** (Inlet Controls 11.16 cfs @ 3.66 fps)

<b>PROJECT:</b>	Kibby Expansion	<b>Calculated By:</b>	DTB
		<b>Checked By:</b>	DTB
<b>Proj:</b>	170019	<b>Date:</b>	November 20, 2009
<b>Watershed:</b>	R-50		

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
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**SHEET FLOW**

Manning's No.	0.8	0.8	0.8			
Length, ft	50	50	50			
P2, in	2.9	2.9	2.9			
Slope, ft/ft	0.1	0.2	0.142	10'/70'		
T <sub>i</sub> <sup>1</sup> , hr	0.197	0.150	0.172			0.5188

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000

<b>Unpaved</b>						
Length, ft				350		
Slope, ft/ft				0.29	102'/350'	
Velocity <sup>4</sup> , ft/sec				8.689		
T <sub>i</sub> <sup>3</sup> , hr				0.011		0.0112

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000

<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft				250		
Slope, ft/ft				0.05		
Velocity <sup>6</sup> , ft/sec				3.354		
T <sub>i</sub> , hr				0.021		0.0207

<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000

<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000

<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000

<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>c</sub> , hr						0.0000

<b>HR</b>	0.551
<b>Min</b>	33.04

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-51: R-51**

Runoff = 12.40 cfs @ 12.27 hrs, Volume= 1.244 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 1.600	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
5.160	77	Woods, Good, HSG D
6.760	80	Weighted Average
6.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.2					Direct Entry, See Spreadsheet

# Kibby Expansion Project Ridge Swale Sizing

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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## Summary for Pond 51-P:

Inflow Area = 6.760 ac, 0.00% Impervious, Inflow Depth = 2.21" for 10Yr-24Hr event  
Inflow = 12.40 cfs @ 12.27 hrs, Volume= 1.244 af  
Outflow = 12.40 cfs @ 12.27 hrs, Volume= 1.244 af, Atten= 0%, Lag= 0.0 min  
Primary = 12.40 cfs @ 12.27 hrs, Volume= 1.244 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,268.08' @ 12.27 hrs

Flood Elev= 3,269.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,266.00'	<b>24.0" Round Culvert</b> L= 80.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,262.00' S= 0.0500 '/ Cc= 0.900 n= 0.012

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**Primary OutFlow** Max=12.17 cfs @ 12.27 hrs HW=3,268.04' (Free Discharge)

↑1=Culvert (Inlet Controls 12.17 cfs @ 3.87 fps)



**PROJECT:** Kibby Expansion **Calculated By:** DTB  
**Proj:** 170019 **Checked By:** DTB  
**Watershed:** R-51 (SF in R-59) **Date:** November 20, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

Seg 1
Seg 2
Seg 3
Seg 4
Seg 5

**SHEET FLOW**

Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.1	15'/150'							
T <sub>i</sub> <sup>1</sup> , hr	0.476								0.4756

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Unpaved**

Length, ft		300							
Slope, ft/ft		0.066	20'/300'						
Velocity <sup>4</sup> , ft/sec		4.145							
T <sub>i</sub> <sup>3</sup> , hr		0.020							0.0201

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft				450					
Slope, ft/ft				0.12					
Velocity <sup>6</sup> , ft/sec				5.196					
T <sub>i</sub> , hr				0.024					0.0241

**Small Tributary & Swamp w/Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Large Tributary**

Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Main River**

Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Culvert**

Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	0.520
<b>Min</b>	31.19

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-52: R-52**

Runoff = 5.20 cfs @ 12.11 hrs, Volume= 0.372 af, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.280	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
1.820	77	Woods, Good, HSG D
2.100	79	Weighted Average
2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6					Direct Entry, See spreadsheet

# Kibby Expansion Project Ridge Swale Sizing

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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## Summary for Pond 52-P:

Inflow Area = 2.100 ac, 0.00% Impervious, Inflow Depth = 2.13" for 10Yr-24Hr event  
Inflow = 5.20 cfs @ 12.11 hrs, Volume= 0.372 af  
Outflow = 5.20 cfs @ 12.11 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.0 min  
Primary = 5.20 cfs @ 12.11 hrs, Volume= 0.372 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,242.34' @ 12.11 hrs

Flood Elev= 3,244.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,241.00'	<b>18.0" Round Culvert</b> L= 60.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,232.00' S= 0.1500 '/ Cc= 0.900 n= 0.012

**Primary OutFlow** Max=5.15 cfs @ 12.11 hrs HW=3,242.33' (Free Discharge)

↑1=Culvert (Inlet Controls 5.15 cfs @ 3.10 fps)

<b>PROJECT:</b>	Kibby Expansion	<b>Calculated By:</b>	DTB
		<b>Checked By:</b>	DTB
<b>Proj:</b>	170019	<b>Date:</b>	November 20, 2009
<b>Watershed:</b>	R-52		

**Time of Concentration Determination Worksheet, SCS Methods**

Seg 1	Seg 2	Seg 3	Seg 4	Seg 5
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**SHEET FLOW**

Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.4								
T <sub>i</sub> <sup>1</sup> , hr	0.273								0.2732

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>2</sup> , hr									0.0000

<b>Unpaved</b>									
Length, ft		50							
Slope, ft/ft		0.4	20'/50'						
Velocity <sup>4</sup> , ft/sec		10.204							
T <sub>i</sub> <sup>3</sup> , hr		0.001							0.0014

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft				200					
Slope, ft/ft				0.04					
Velocity <sup>6</sup> , ft/sec				3.000					
T <sub>i</sub> , hr				0.019					0.0185

<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	0.293
<b>Min</b>	17.58

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-54: R-54**

Runoff = 4.97 cfs @ 12.24 hrs, Volume= 0.471 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.750	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
1.720	77	Woods, Good, HSG D
2.470	81	Weighted Average
2.470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.0					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Pond 54-P:**

Inflow Area = 2.470 ac, 0.00% Impervious, Inflow Depth = 2.29" for 10Yr-24Hr event  
 Inflow = 4.97 cfs @ 12.24 hrs, Volume= 0.471 af  
 Outflow = 4.97 cfs @ 12.24 hrs, Volume= 0.471 af, Atten= 0%, Lag= 0.0 min  
 Primary = 4.97 cfs @ 12.24 hrs, Volume= 0.471 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 2,986.30' @ 12.24 hrs

Flood Elev= 2,987.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,985.00'	<b>18.0" Round Culvert</b> L= 70.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,970.00' S= 0.2143 '/ Cc= 0.900 n= 0.012

**Primary OutFlow Max=4.84 cfs @ 12.24 hrs HW=2,986.27' (Free Discharge)****↳1=Culvert (Inlet Controls 4.84 cfs @ 3.03 fps)**

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-54</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>
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**SHEET FLOW**

Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.1								
T <sub>t</sub> <sup>1</sup> , hr	0.476								0.4756

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000

**Unpaved**

Length, ft		140							
Slope, ft/ft		0.107	15'/140'						
Velocity <sup>4</sup> , ft/sec		5.278							
T <sub>t</sub> <sup>3</sup> , hr		0.007							0.0074

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft									
Slope, ft/ft									
Velocity <sup>6</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

**Small Tributary & Swamp w/Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

**Large Tributary**

Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

**Main River**

Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

**Culvert**

Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>t</sub> , hr									0.0000

<b>HR</b>	0.483
<b>Min</b>	28.98

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Subcatchment R-55: R-55**

Runoff = 14.99 cfs @ 12.23 hrs, Volume= 1.397 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 1.880	91	Gravel roads/revveg turbine sites/riprap slopes, HSG D
5.440	77	Woods, Good, HSG D
7.320	81	Weighted Average
7.320		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.2					Direct Entry, See Spreadsheet



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 55-P:**

Inflow Area = 7.320 ac, 0.00% Impervious, Inflow Depth = 2.29" for 10Yr-24Hr event  
 Inflow = 14.99 cfs @ 12.23 hrs, Volume= 1.397 af  
 Outflow = 14.99 cfs @ 12.23 hrs, Volume= 1.397 af, Atten= 0%, Lag= 0.0 min  
 Primary = 14.99 cfs @ 12.23 hrs, Volume= 1.397 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 2,972.57' @ 12.23 hrs

Flood Elev= 2,973.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	2,970.00'	<b>24.0" Round Culvert</b> L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 2,952.00' S= 0.2000 ' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=14.63 cfs @ 12.23 hrs HW=2,972.50' (Free Discharge)

↑1=Culvert (Inlet Controls 14.63 cfs @ 4.66 fps)

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-55</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	
<b>SHEET FLOW</b>						
Manning's No.	0.8					
Length, ft	150					
P2, in	2.9					
Slope, ft/ft	0.133					
T <sub>i</sub> <sup>1</sup> , hr	0.424					0.4243
<b>SHALLOW CONCENTRATED FLOW</b>						
<b>Paved</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>2</sup> , ft/sec						
T <sub>i</sub> <sup>2</sup> , hr						0.0000
<b>Unpaved</b>						
Length, ft		750				
Slope, ft/ft		0.08	60'/750'			
Velocity <sup>4</sup> , ft/sec		4.564				
T <sub>i</sub> <sup>3</sup> , hr		0.046				0.0457
<b>CHANNEL FLOW</b>						
<b>Waterways &amp; Swamps, No Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>5</sup> , ft/sec						
T <sub>i</sub> <sup>3</sup> , hr						0.0000
<b>Grassed Waterways/Roadside Ditches</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>6</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Small Tributary &amp; Swamp w/Channels</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>7</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Large Tributary</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>8</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Main River</b>						
Length, ft						
Slope, ft/ft						
Velocity <sup>9</sup> , ft/sec						
T <sub>i</sub> , hr						0.0000
<b>Culvert</b>						
Diameter, ft						
Area, ft <sup>2</sup>						
Wetted Perimeter, ft						
Hydraulic Radius, R, ft						
Slope, ft/ft						
Manning's No.						
Velocity <sup>10</sup> , ft/sec						
Length, L, ft						
T <sub>i</sub> , hr						0.0000

<b>HR</b>	<b>0.470</b>
<b>Min</b>	<b>28.20</b>

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-61: R-61**

Runoff = 17.69 cfs @ 12.44 hrs, Volume= 2.269 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 1.030	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
12.270	77	Woods, Good, HSG D
13.300	78	Weighted Average
13.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.9					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 61-P:**

Inflow Area = 13.300 ac, 0.00% Impervious, Inflow Depth = 2.05" for 10Yr-24Hr event  
 Inflow = 17.69 cfs @ 12.44 hrs, Volume= 2.269 af  
 Outflow = 17.69 cfs @ 12.44 hrs, Volume= 2.269 af, Atten= 0%, Lag= 0.0 min  
 Primary = 17.69 cfs @ 12.44 hrs, Volume= 2.269 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,140.19' @ 12.44 hrs

Flood Elev= 3,140.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,137.00'	<b>24.0" Round Culvert</b> L= 90.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,136.00' S= 0.0111 ' /' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=17.45 cfs @ 12.44 hrs HW=3,140.13' (Free Discharge)

↑1=Culvert (Inlet Controls 17.45 cfs @ 5.55 fps)

**PROJECT:** Kibby Expansion **Calculated By:** DTB  
**Checked By:** DTB  
**Proj:** 170019 **Date:** November 20, 2009  
**Watershed:** R-61 (SF in R-60)

**Time of Concentration Determination Worksheet, SCS Methods**

Seg 1    Seg 2    Seg 3    Seg 4    Seg 5

SHEET FLOW									
Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.04	10'/250'							
T <sub>t</sub> <sup>1</sup> , hr	0.686								0.6862

**SHALLOW CONCENTRATED FLOW**

<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000
<b>Unpaved</b>									
Length, ft		350							
Slope, ft/ft		0.233	112'/480'						
Velocity <sup>4</sup> , ft/sec		7.788							
T <sub>t</sub> <sup>3</sup> , hr		0.012							0.0125

**CHANNEL FLOW**

<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000

<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft				850					
Slope, ft/ft				0.1					
Velocity <sup>6</sup> , ft/sec				4.743					
T <sub>t</sub> , hr				0.050					0.0498

<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000

<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>t</sub> , hr									0.0000

<b>HR</b>	0.748
<b>Min</b>	44.90

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-62: R-62**

Runoff = 5.33 cfs @ 12.10 hrs, Volume= 0.372 af, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 0.300	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
1.800	77	Woods, Good, HSG D
2.100	79	Weighted Average
2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7					Direct Entry, See Spreadsheets

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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Printed 11/20/2009

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**Summary for Pond 62-P:**

Inflow Area = 2.100 ac, 0.00% Impervious, Inflow Depth = 2.13" for 10Yr-24Hr event  
 Inflow = 5.33 cfs @ 12.10 hrs, Volume= 0.372 af  
 Outflow = 5.33 cfs @ 12.10 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.0 min  
 Primary = 5.33 cfs @ 12.10 hrs, Volume= 0.372 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,157.87' @ 12.10 hrs

Flood Elev= 3,159.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,156.50'	<b>18.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,152.00' S= 0.0900 ' Cc= 0.900 n= 0.012

**Primary OutFlow Max=5.30 cfs @ 12.10 hrs HW=3,157.86' (Free Discharge)****↑1=Culvert (Inlet Controls 5.30 cfs @ 3.14 fps)**

<b>PROJECT:</b>	<b>Kibby Expansion</b>	<b>Calculated By:</b>	<b>DTB</b>
<b>Proj:</b>	<b>170019</b>	<b>Checked By:</b>	<b>DTB</b>
<b>Watershed:</b>	<b>R-62</b>	<b>Date:</b>	<b>November 20, 2009</b>

**Time of Concentration Determination Worksheet, SCS Methods**

	<b>Seg 1</b>	<b>Seg 2</b>	<b>Seg 3</b>	<b>Seg 4</b>	<b>Seg 5</b>	
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**SHEET FLOW**

Manning's No.	0.8								
Length, ft	150								
P2, in	2.9								
Slope, ft/ft	0.4								
T <sub>i</sub> <sup>1</sup> , hr	0.273								0.2732

**SHALLOW CONCENTRATED FLOW**

**Paved**

Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Unpaved**

Length, ft		200							
Slope, ft/ft		0.5							
Velocity <sup>4</sup> , ft/sec		11.40881							
T <sub>i</sub> <sup>3</sup> , hr		0.005							0.0049

**CHANNEL FLOW**

**Waterways & Swamps, No Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>i</sub> <sup>3</sup> , hr									0.0000

**Grassed Waterways/Roadside Ditches**

Length, ft									
Slope, ft/ft									
Velocity <sup>6</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Small Tributary & Swamp w/Channels**

Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Large Tributary**

Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Main River**

Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>i</sub> , hr									0.0000

**Culvert**

Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>i</sub> , hr									0.0000

<b>HR</b>	<b>0.278</b>
<b>Min</b>	<b>16.68</b>



**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

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**Summary for Subcatchment R-64: R-64**

Runoff = 10.53 cfs @ 12.13 hrs, Volume= 0.819 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs  
Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Area (ac)	CN	Description
* 1.210	91	Gravel roads/reveg turbine sites/riprap slopes, HSG D
3.080	77	Woods, Good, HSG D
4.290	81	Weighted Average
4.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5					Direct Entry, See Spreadsheet

**Kibby Expansion Project Ridge Swale Sizing**

Type II 24-hr 10Yr-24Hr Rainfall=4.20"

Prepared by TRC Environmental Corp

Printed 11/20/2009

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**Summary for Pond 64-P:**

Inflow Area = 4.290 ac, 0.00% Impervious, Inflow Depth = 2.29" for 10Yr-24Hr event  
 Inflow = 10.53 cfs @ 12.13 hrs, Volume= 0.819 af  
 Outflow = 10.53 cfs @ 12.13 hrs, Volume= 0.819 af, Atten= 0%, Lag= 0.0 min  
 Primary = 10.53 cfs @ 12.13 hrs, Volume= 0.819 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2

Peak Elev= 3,185.77' @ 12.13 hrs

Flood Elev= 3,187.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	3,184.00'	<b>24.0" Round Culvert</b> L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3,182.00' S= 0.0400 ' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=10.11 cfs @ 12.13 hrs HW=3,185.72' (Free Discharge)

↑1=Culvert (Inlet Controls 10.11 cfs @ 3.52 fps)









### Triangular Channel - 2%

#### Project Description

Friction Method	Manning Formula
Solve For	Discharge

#### Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02000	ft/ft
Normal Depth	2.00	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)

#### Results

Discharge	39.02	ft <sup>3</sup> /s
Flow Area	8.00	ft <sup>2</sup>
Wetted Perimeter	8.94	ft
Top Width	8.00	ft
Critical Depth	1.88	ft
Critical Slope	0.02761	ft/ft
Velocity	4.88	ft/s
Velocity Head	0.37	ft
Specific Energy	2.37	ft
Froude Number	0.86	
Flow Type	Subcritical	

< D<sub>50</sub> = 6" maybe allowable

#### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

#### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.88	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.02761	ft/ft

## Triangular Channel - 12%

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.040	
Channel Slope	0.12000 ft/ft	← MAX PITCH
Left Side Slope	2.00 ft/ft (H:V)	
Right Side Slope	2.00 ft/ft (H:V)	
Discharge	17.00 ft <sup>3</sup> /s	← MAX VOLUME ON RIDGE

### Results

Normal Depth	1.05 ft	
Flow Area	2.19 ft <sup>2</sup>	
Wetted Perimeter	4.68 ft	
Top Width	4.19 ft	
Critical Depth	1.35 ft	
Critical Slope	0.03084 ft/ft	
Velocity	7.76 ft/s	≈ D <sub>50</sub> = 6" RYPRAP ANCHORAGE
Velocity Head	0.94 ft	
Specific Energy	1.98 ft	
Froude Number	1.89	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.05 ft
Critical Depth	1.35 ft
Channel Slope	0.12000 ft/ft
Critical Slope	0.03084 ft/ft



## Trapazoidal Channel - Sta -29+00 to 37+00 RT

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.12000	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	1.29	ft <sup>3</sup> /s

### Results

Normal Depth	0.11	ft
Flow Area	0.35	ft <sup>2</sup>
Wetted Perimeter	3.39	ft
Top Width	3.33	ft
Critical Depth	0.17	ft
Critical Slope	0.02507	ft/ft
Velocity	3.74	ft/s
Velocity Head	0.22	ft
Specific Energy	0.33	ft
Froude Number	2.05	
Flow Type	Supercritical	

*RIP DAP REQUIMED*

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.11	ft
Critical Depth	0.17	ft
Channel Slope	0.12000	ft/ft
Critical Slope	0.02507	ft/ft

## Worksheet for Trapezoidal Channel - A-8 to A-9

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	96.03	ft <sup>3</sup> /s

### Results

Normal Depth	2.83	ft
Flow Area	20.46	ft <sup>2</sup>
Wetted Perimeter	13.19	ft
Top Width	11.48	ft
Critical Depth	2.22	ft
Critical Slope	0.01377	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	3.17	ft
Froude Number	0.62	
Flow Type	Subcritical	

*RIP RAP REQUIRED*

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.83	ft
Critical Depth	2.22	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01377	ft/ft

## Worksheet for Trapezoidal Channel - A-5 to A-8

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	36.00	ft <sup>3</sup> /s

### Results

Normal Depth	1.23	ft
Flow Area	5.96	ft <sup>2</sup>
Wetted Perimeter	7.43	ft
Top Width	6.69	ft
Critical Depth	1.32	ft
Critical Slope	0.01546	ft/ft
Velocity	6.04	ft/s <i>RIP MAP REQUIRED</i>
Velocity Head	0.57	ft
Specific Energy	1.80	ft
Froude Number	1.13	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.23	ft
Critical Depth	1.32	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01546	ft/ft

## Worksheet for Trapezoidal Channel - A-4 to A-5

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	8.43	ft <sup>3</sup> /s

### Results

Normal Depth	0.55	ft
Flow Area	2.13	ft <sup>2</sup>
Wetted Perimeter	5.00	ft
Top Width	4.66	ft
Critical Depth	0.57	ft
Critical Slope	0.01861	ft/ft
Velocity	3.96	ft/s <i>RIP RAP REQUIRED</i>
Velocity Head	0.24	ft
Specific Energy	0.80	ft
Froude Number	1.03	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.57	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01861	ft/ft

## Worksheet for Copy of Trapezoidal Channel - A-3 to A-4

### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	16.18	ft <sup>3</sup> /s

### Results

Normal Depth	0.80	ft
Flow Area	3.36	ft <sup>2</sup>
Wetted Perimeter	5.88	ft
Top Width	5.40	ft
Critical Depth	0.83	ft
Critical Slope	0.01707	ft/ft
Velocity	4.82	ft/s <i>RIP RAP REQUIRED</i>
Velocity Head	0.36	ft
Specific Energy	1.16	ft
Froude Number	1.08	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.80	ft
Critical Depth	0.83	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01707	ft/ft

## Worksheet for Trapezoidal Channel - A-2 to A-3

### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.03000	ft/ft
Left Side Slope	1.50	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	28.52	ft <sup>3</sup> /s

### Results

Normal Depth	0.98	ft
Flow Area	4.35	ft <sup>2</sup>
Wetted Perimeter	6.52	ft
Top Width	5.93	ft
Critical Depth	1.16	ft
Critical Slope	0.01590	ft/ft
Velocity	6.55	ft/s <i>RIP MAP ASSIGNED</i>
Velocity Head	0.67	ft
Specific Energy	1.64	ft
Froude Number	1.35	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.98	ft
Critical Depth	1.16	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.01590	ft/ft

## Worksheet for Trapezoidal Channel - Sta 106+00 -113+00 LT

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030
Channel Slope	0.06000 ft/ft
Left Side Slope	1.50 ft/ft (H:V)
Right Side Slope	1.50 ft/ft (H:V)
Bottom Width	3.00 ft
Discharge	36.12 ft <sup>3</sup> /s

### Results

Normal Depth	0.92 ft
Flow Area	4.02 ft <sup>2</sup>
Wetted Perimeter	6.31 ft
Top Width	5.76 ft
Critical Depth	1.32 ft
Critical Slope	0.01546 ft/ft
Velocity	8.98 ft/s <b>RIP RAP NEEDED.</b>
Velocity Head	1.25 ft
Specific Energy	2.17 ft
Froude Number	1.89
Flow Type	Supercritical

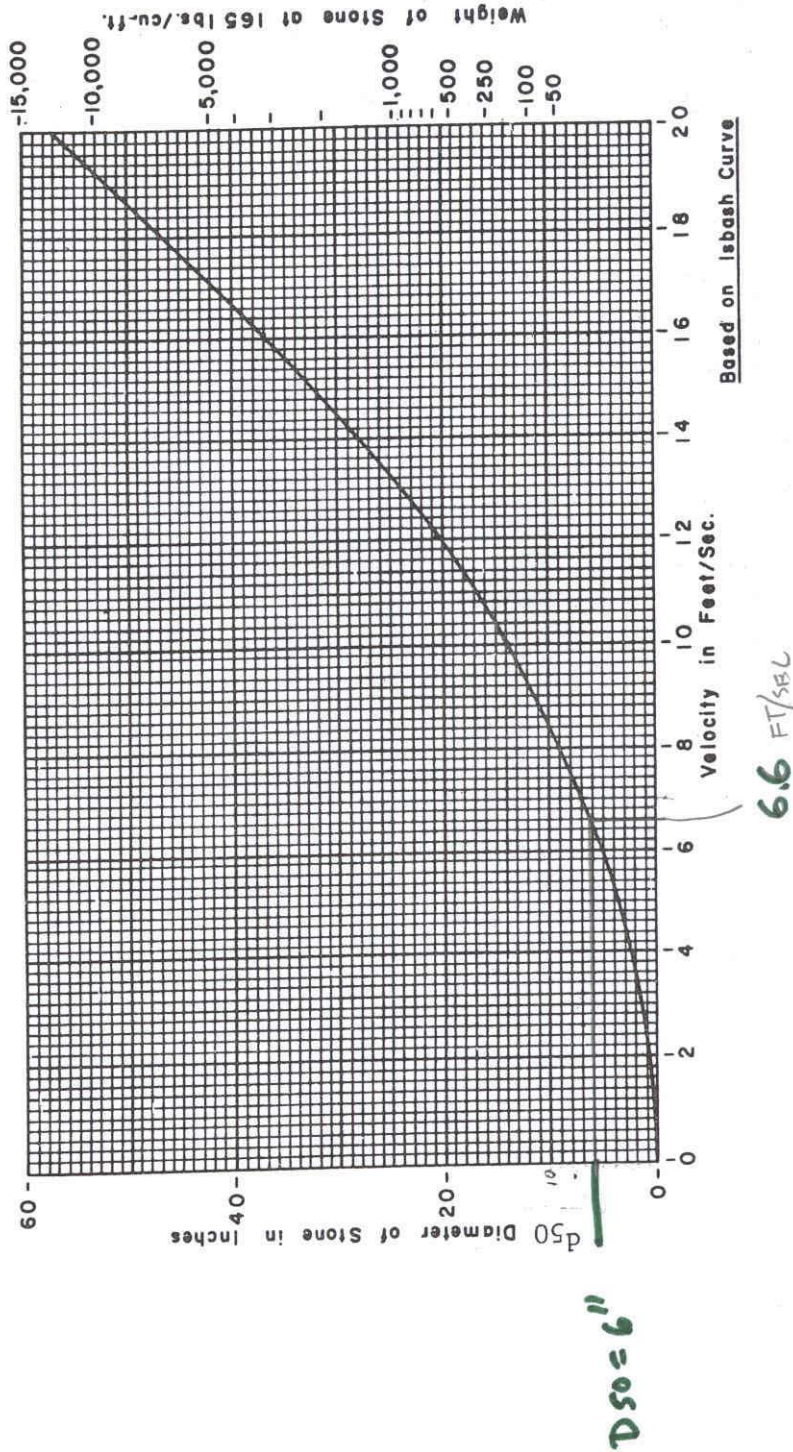
### GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.92 ft
Critical Depth	1.32 ft
Channel Slope	0.06000 ft/ft
Critical Slope	0.01546 ft/ft

Figure 70.1 STONE SIZE FOR RIPRAP (USDA Soil Conservation Service)





# Kibby Expansion Project SS Swale Sizing

Prepared by TRC Environmental Corp

HydroCAD® 9.00 s/n 01824 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr 25-yr Rainfall=4.90"

Printed 11/17/2009

## Summary for Subcatchment 1SW: (Watershed 2S)

Runoff = 6.23 cfs @ 12.27 hrs, Volume= 0.636 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Type II 24-hr 25-yr Rainfall=4.90"

Area (ac)	CN	Description
0.750	65	Brush, Good, HSG C
2.280	70	Woods, Good, HSG C
* 0.400	98	Riprap
* 0.310	55	Substation C soil
3.740	71	Weighted Average
3.340		89.30% Pervious Area
0.400		10.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.5					Direct Entry, See spreadsheet

ADD FOR SEEPAGE : 25%  
 $6.23 \times 1.25 = 7.79 \text{ cfs}$

# Kibby Expansion Project SS Swale Sizing

Prepared by TRC Environmental Corp

HydroCAD® 9.00 s/n 01824 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr 25-yr Rainfall=4.90"

Printed 11/17/2009

## Summary for Subcatchment 2SW: (Watershed 3S)

Runoff = 10.43 cfs @ 12.27 hrs, Volume= 1.067 af, Depth= 2.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs  
Type II 24-hr 25-yr Rainfall=4.90"

Area (ac)	CN	Description
* 0.180	55	Substation
4.360	70	Woods, Good, HSG C
1.070	65	Brush, Good, HSG C
* 0.540	98	Riprap
0.120	89	Gravel roads, HSG C
6.270	71	Weighted Average
5.730		91.39% Pervious Area
0.540		8.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.6					Direct Entry, See spreadsheet

ADD FOR SEEPAGE: 25%

$$10.43 \times 1.25 = 13.04 \text{ cfs}$$

## Substation 7.8cfs@1.25%

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.030  
Channel Slope                                0.01250    ft/ft  
Left Side Slope                              2.00    ft/ft (H:V)  
Right Side Slope                             2.00    ft/ft (H:V)  
Bottom Width                                3.00    ft  
Discharge                                    7.80    ft<sup>3</sup>/s

### Results

Normal Depth                                0.59    ft  
Flow Area                                    2.45    ft<sup>2</sup>  
Wetted Perimeter                            5.63    ft  
Top Width                                    5.35    ft  
Critical Depth                                0.53    ft  
Critical Slope                                0.01870    ft/ft  
Velocity                                    3.18    ft/s *< 4.0 - No Riprap Req'd*  
Velocity Head                                0.16    ft  
Specific Energy                              0.74    ft  
Froude Number                                0.83  
Flow Type                                    Subcritical

### GVF Input Data

Downstream Depth                            0.00    ft  
Length                                      0.00    ft  
Number Of Steps                              0

### GVF Output Data

Upstream Depth                              0.00    ft  
Profile Description  
Profile Headloss                              0.00    ft  
Downstream Velocity                            Infinity    ft/s  
Upstream Velocity                              Infinity    ft/s  
Normal Depth                                0.59    ft  
Critical Depth                                0.53    ft  
Channel Slope                                0.01250    ft/ft  
Critical Slope                                0.01870    ft/ft

## Substation 7.8cfs@11%

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.11000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	7.80	ft <sup>3</sup> /s ←

### Results

Normal Depth	0.32	ft
Flow Area	1.16	ft <sup>2</sup>
Wetted Perimeter	4.43	ft
Top Width	4.28	ft
Critical Depth	0.53	ft
Critical Slope	0.01870	ft/ft
Velocity	6.73	ft/s ← > 4.0 - Riprap req'd
Velocity Head	0.70	ft
Specific Energy	1.02	ft
Froude Number	2.28	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.53	ft
Channel Slope	0.11000	ft/ft
Critical Slope	0.01870	ft/ft

## Substation 13.04cfs@3.33%

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient	0.030	
Channel Slope	0.03300	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	13.04	ft <sup>3</sup> /s

### Results

Normal Depth	0.60	ft
Flow Area	2.50	ft <sup>2</sup>
Wetted Perimeter	5.67	ft
Top Width	5.39	ft
Critical Depth	0.71	ft
Critical Slope	0.01738	ft/ft
Velocity	5.22	ft/s
Velocity Head	0.42	ft
Specific Energy	1.02	ft
Froude Number	1.35	
Flow Type	Supercritical	

← 4.0 Riprap Needed

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.60	ft
Critical Depth	0.71	ft
Channel Slope	0.03300	ft/ft
Critical Slope	0.01738	ft/ft

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	PGT
<b>Proj:</b>	<b>170019.0000.0000</b>	<b>Checked By:</b>	DTB
<b>Watershed:</b>	<b>1SW - Swale Sizing</b>	<b>Date:</b>	April 17, 2009
	<b>PH 9</b>	<b>Revised:</b>	November 17, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5		
<b>SHEET FLOW</b>							
Manning's No.	0.8	0.8	0.8				
Length, ft	53	57	40				
P2, in	2.9	2.9	2.9				
Slope, ft/ft	0.1887	0.175	0.23				
T <sub>t</sub> <sup>1</sup> , hr	0.161	0.175	0.118				0.4542
<b>SHALLOW CONCENTRATED FLOW</b>							
<b>Paved</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>2</sup> , ft/sec							
T <sub>t</sub> <sup>3</sup> , hr							0.0000
<b>Unpaved</b>							
Length, ft				1225	65		
Slope, ft/ft			240.8/1225'	0.197	0.500		
Velocity <sup>4</sup> , ft/sec				7.161247	11.40881		
T <sub>t</sub> <sup>3</sup> , hr				0.048	0.002		0.0491
<b>CHANNEL FLOW</b>							
<b>Waterways &amp; Swamps, No Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>5</sup> , ft/sec							
T <sub>t</sub> <sup>3</sup> , hr							0.0000
<b>Grassed Waterways/Roadside Ditches</b>							
Length, ft					270		
Slope, ft/ft					0.055	15'/270'	
Velocity <sup>6</sup> , ft/sec					3.518		
T <sub>t</sub> , hr					0.021		0.0213
<b>Small Tributary &amp; Swamp w/Channels</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>7</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Large Tributary</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>8</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Main River</b>							
Length, ft							
Slope, ft/ft							
Velocity <sup>9</sup> , ft/sec							
T <sub>t</sub> , hr							0.0000
<b>Culvert</b>							
Diameter, ft							
Area, ft <sup>2</sup>							
Wetted Perimeter, ft							
Hydraulic Radius, R, ft							
Slope, ft/ft							
Manning's No.							
Velocity <sup>10</sup> , ft/sec							
Length, L, ft							
T <sub>t</sub> , hr							0.0000

<b>HR</b>	0.525
<b>Min</b>	31.48

OK DTB 11/17/09

<b>PROJECT:</b>	<b>Kibby Wind Expansion</b>	<b>Calculated By:</b>	PGT
<b>Proj:</b>	<b>170019.0000.0000 PH 9</b>	<b>Checked By:</b>	DTB
<b>Watershed:</b>	<b>2SW -Swale Sizing</b>	<b>Date:</b>	April 17, 2009
		<b>Revised:</b>	November 17, 2009

**Time of Concentration Determination Worksheet, SCS Methods**

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5				
<b>SHEET FLOW</b>									
Manning's No.	0.8	0.8	0.8	0.8	0.8				
Length, ft	32	22	26	40	30				
P2, in	2.9	2.9	2.9	2.9	2.9				
Slope, ft/ft	0.312	0.45	0.38	0.25	0.238				
T <sub>t</sub> <sup>1</sup> , hr	0.088	0.056	0.069	0.115	0.093				0.4197
<b>SHALLOW CONCENTRATED FLOW</b>									
<b>Paved</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>2</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000
<b>Unpaved</b>									
Length, ft				1565	65				
Slope, ft/ft			312.8/1565'	0.200	0.500				
Velocity <sup>4</sup> , ft/sec				7.220977	11.40881				
T <sub>t</sub> <sup>3</sup> , hr				0.060	0.002				0.0618
<b>CHANNEL FLOW</b>									
<b>Waterways &amp; Swamps, No Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>5</sup> , ft/sec									
T <sub>t</sub> <sup>3</sup> , hr									0.0000
<b>Grassed Waterways/Roadside Ditches</b>									
Length, ft						305			
Slope, ft/ft						0.016	5/305'		
Velocity <sup>6</sup> , ft/sec						1.897			
T <sub>t</sub> , hr						0.045			0.0447
<b>Small Tributary &amp; Swamp w/Channels</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>7</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000
<b>Large Tributary</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>8</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000
<b>Main River</b>									
Length, ft									
Slope, ft/ft									
Velocity <sup>9</sup> , ft/sec									
T <sub>t</sub> , hr									0.0000
<b>Culvert</b>									
Diameter, ft									
Area, ft <sup>2</sup>									
Wetted Perimeter, ft									
Hydraulic Radius, R, ft									
Slope, ft/ft									
Manning's No.									
Velocity <sup>10</sup> , ft/sec									
Length, L, ft									
T <sub>t</sub> , hr									0.0000

<b>HR</b>	0.526
<b>Min</b>	31.57

*ok DMS 11/17/09*





## Worksheet 1 PPB calculations

Project name: Kibby Wind Power Expansion Project

Lake name: Flagstaff Lake

Town name: Kibby Township

### Standard Calculation

Watershed per acre phosphorus budget (Appendix C):	<b>PAPB</b>	<u>0.045</u>	lbs P / acre / year
Total acreage of development parcel:	<b>TA</b>	<u>116.23</u>	acres
Existing impervious area (Pre 1980)	<b>EIA<sub>B</sub></b>	<u>0</u>	acres
Existing impervious area (post 1980)	<b>EIA<sub>A</sub></b>	<u>0</u>	acres
NWI wetland acreage:	<b>WA</b>	<u>1.15</u>	acres
Steep slope acreage: (Greater than 25%)	<b>SA</b>	<u>73.32</u>	acres
Project acreage: $A = TA - (WA + SA + EIA_B + EIA_A)$	<b>A</b>	<u>41.76</u>	acres

**Project Phosphorus Budget:**  $PPB = P \times A$

<b>PPB</b>	<u>1.879</u>	lbs P/year
------------	--------------	------------

### (N/A = Project acreage is less than Small Watershed Threshold) Small Watershed Adjustment

If Project Acreage (A) is greater than the threshold acreage for the small watershed threshold (SWT, from pertinent lake and town info in the table in Appendix C), calculate an alternative PPB using the analysis below and use this value if it is less than the the Standard Calculation PPB.

Small Watershed Threshold (Appendix C):	<b>SWT</b>	<u>N/A</u>	acres
Project acreage:	<b>A</b>	<u>                    </u>	acres
Allowable increase in town's share of annual phosphorus load to lake (Appendix C):	<b>FC</b>	<u>                    </u>	lbs P/year
Area available for development (Appendix C):	<b>AAD</b>	<u>                    </u>	acres
Ratio of A to AAD	<b>R</b>	<u>                    </u>	

**If  $R < 0.5$ , Project Phosphorus Budget**  
 $PPB = [(FC \times R)/2] + [FC/4]$

<b>PPB</b>	<u>                    </u>	lbs P/year
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**If  $R > 0.5$ , Project Phosphorus Budget**  
 $PPB = FC \times R$

<b>PPB</b>	<u>NA</u>	lbs P/year
------------	-----------	------------



## Worksheet 4 Project Phosphorus Export Summary

Summarizing the project's algal available phosphorus export (PPE)

**Project name:** Kibby Wind Power Expansion Project

<b>Project Phosphorus Budget</b>	Worksheet 1	<b>PPB</b>	<u>1.87920</u>	lbs P / year
<b>Mitigation Credit -</b>	Source Elimination Credit	<b>SEC</b>	<u>                    </u>	lbs P / year
	Source Treatment Credit	<b>STC</b>	<u>                    </u>	lbs P / year
<b>Total Phosphorus Mitigation Credit</b>	(SWC + STC)	<b>TMC</b>	<u>0.00</u>	lbs P / year

### Pre-treatment phosphorus export - Worksheet 2

Sheet 1 -----	-	<u>                    </u>	lbs P / year	
Sheet 2 -----		<u>                    </u>	lbs P / year	
Sheet 3 -----		<u>                    </u>	lbs P / year	
<b>Total Pre-treatment phosphorus export</b>	(add all worksheet 2)	<b>Pre-PPE</b>	<u>1.2975</u>	lbs P / year

### Post-treatment phosphorus export - Worksheet 2

Sheet 1 -----		<u>                    </u>	lbs P / year	
Sheet 2 -----		<u>                    </u>	lbs P / year	
Sheet 3 -----		<u>                    </u>	lbs P / year	
<b>Total Post-treatment phosphorus export</b>	(add all worksheet 2)	<b>Post-PPE</b>	<u>1.2975</u>	lbs P / year
<b>Project Phosphorus Export</b>	(Post-PPE - TMC)	<b>PPE</b>	<u>1.2975</u>	lbs P / year

If PPE is less than or equal to PPB, the project meets its phosphorus budget (Therefore project meets budget)

If PPE is more than PPB, more reduction in phosphorus export is required, or, if further reduction is not feasible and Post-PPE is less than one half the Pre-PPE, a compensation fee may be appropriate at the cost of \$10,000 per pound of phosphorus over the PPB

                      
AMOUNT

## Worksheet 1 PPB calculations

Project name: Kibby Wind Power Expansion Project

Lake name: Lower Pond

Town name: Chain of Ponds Township

### Standard Calculation

Watershed per acre phosphorus budget (Appendix C):	<b>PAPB</b>	<u>0.062</u>	lbs P / acre / year
Total acreage of development parcel:	<b>TA</b>	<u>399</u>	acres
Existing impervious area (Pre 1980)	<b>EIA<sub>B</sub></b>	<u>0</u>	acres
Existing impervious area (post 1980)	<b>EIA<sub>A</sub></b>	<u>0</u>	acres
NWI wetland acreage:	<b>WA</b>	<u>0</u>	acres
Steep slope acreage: (Greater than 25%)	<b>SA</b>	<u>280.3</u>	acres
Project acreage: $A = TA - (WA + SA + EIA_B + EIA_A)$	<b>A</b>	<u>118.7</u>	acres

**Project Phosphorus Budget:**  $PPB = P \times A$

<b>PPB</b>	<u>7.3594</u>	lbs P/year
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### (N/A = Project acreage is less than Small Watershed Threshold) Small Watershed Adjustment

If Project Acreage (A) is greater than the threshold acreage for the small watershed threshold (SWT, from pertinent lake and town info in the table in Appendix C), calculate an alternative PPB using the analysis below and use this value if it is less than the the Standard Calculation PPB.

Small Watershed Threshold (Appendix C):	<b>SWT</b>	<u>N/A</u>	acres
Project acreage:	<b>A</b>	<u>                    </u>	acres
Allowable increase in town's share of annual phosphorus load to lake (Appendix C):	<b>FC</b>	<u>                    </u>	lbs P/year
Area available for development (Appendix C):	<b>AAD</b>	<u>                    </u>	acres
Ratio of A to AAD	<b>R</b>	<u>                    </u>	

**If  $R < 0.5$ , Project Phosphorus Budget**  
 $PPB = [(FC \times R)/2] + [FC/4]$

<b>PPB</b>	<u>                    </u>	lbs P/year
------------	-----------------------------	------------

**If  $R > 0.5$ , Project Phosphorus Budget**  
 $PPB = FC \times R$

<b>PPB</b>	<u>NA</u>	lbs P/year
------------	-----------	------------



## Worksheet 4 Project Phosphorus Export Summary

Summarizing the project's algal available phosphorus export (PPE)

**Project name:** Kibby Wind Power Expansion Project

<b>Project Phosphorus Budget</b>	Worksheet 1	<b>PPB</b>	<u>7.35940</u>	lbs P / year
<b>Mitigation Credit -</b>	Source Elimination Credit	<b>SEC</b>	<u>                    </u>	lbs P / year
	Source Treatment Credit	<b>STC</b>	<u>                    </u>	lbs P / year
<b>Total Phosphorus Mitigation Credit</b>	(SWC + STC)	<b>TMC</b>	<u>0.00</u>	lbs P / year

### Pre-treatment phosphorus export - Worksheet 2

Sheet 1 -----	-	<u>                    </u>	lbs P / year	
Sheet 2 -----		<u>                    </u>	lbs P / year	
Sheet 3 -----		<u>                    </u>	lbs P / year	
<b>Total Pre-treatment phosphorus export</b>	(add all worksheet 2)	<b>Pre-PPE</b>	<u>7.2900</u>	lbs P / year

### Post-treatment phosphorus export - Worksheet 2

Sheet 1 -----		<u>                    </u>	lbs P / year	
Sheet 2 -----		<u>                    </u>	lbs P / year	
Sheet 3 -----		<u>                    </u>	lbs P / year	
<b>Total Post-treatment phosphorus export</b>	(add all worksheet 2)	<b>Post-PPE</b>	<u>7.2900</u>	lbs P / year

<b>Project Phosphorus Export</b>	(Post-PPE - TMC)	<b>PPE</b>	<u>7.2900</u>	lbs P / year
----------------------------------	------------------	------------	---------------	--------------

If PPE is less than or equal to PPB, the project meets its phosphorus budget (Therefore project meets budget)

If PPE is more than PPB, more reduction in phosphorus export is required, or, if further reduction is not feasible and Post-PPE is less than one half the Pre-PPE, a compensation fee may be appropriate at the cost of \$10,000 per pound of phosphorus over the PPB

                      
AMOUNT