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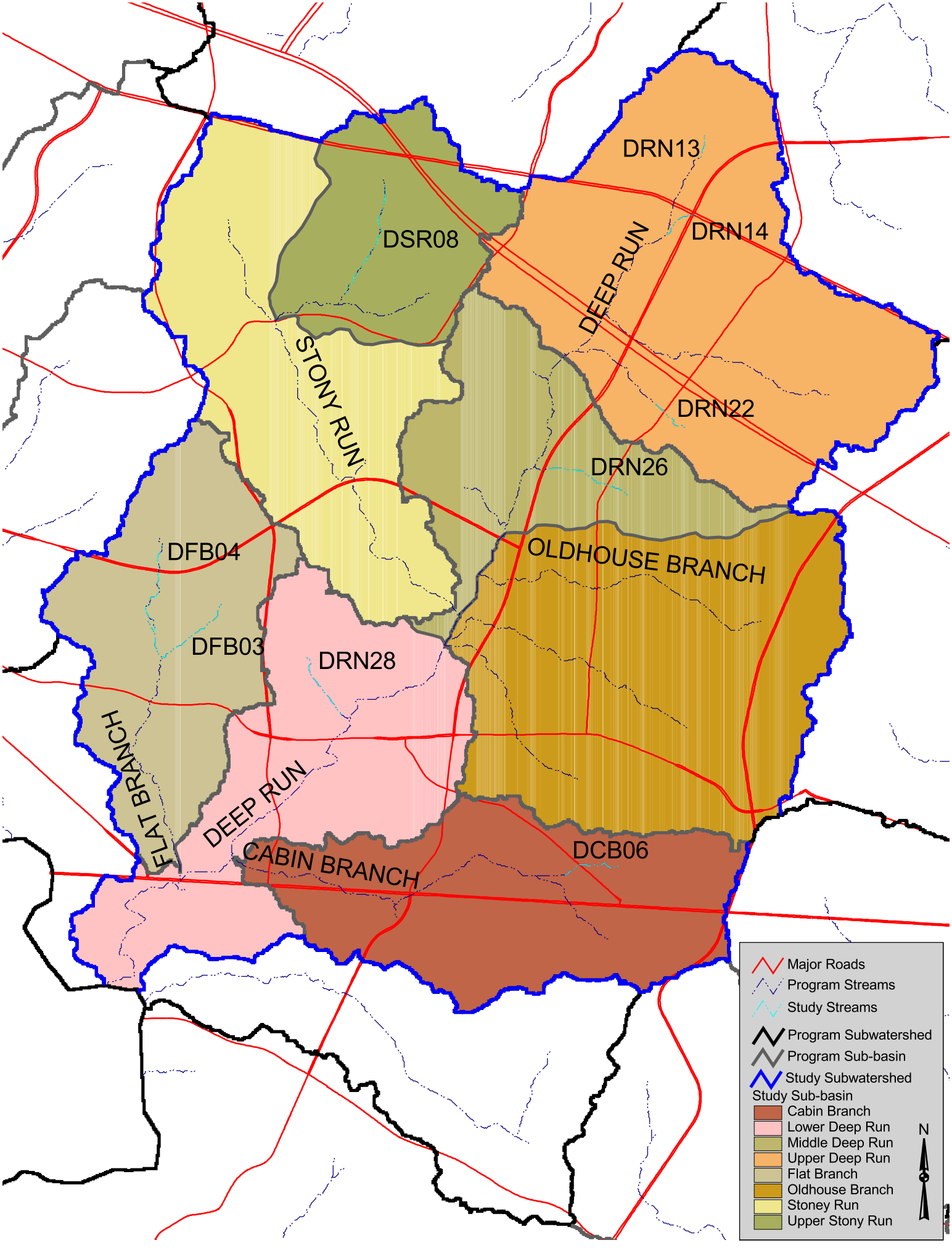
Appendix A: Study Streams and Watersheds


DRN13
DSR08
DEEP RUN
DRN14
STONY RUN
DRN22
DRN26
DFB04
OLDHOUSE BRANCH
DFB03
DRN28
FLAT BRANCH
DEEP RUN
CABIN BRANCH
DCB06
Major Roads
Program Streams
Study Streams
Program Subwatershed
Program Sub-basin
Study Subwatershed
Study Sub-basin
Cabin Branch
Lower Deep Run
Middle Deep Run
Upper Deep Run
Flat Branch
Oldhouse Branch
Stoney Run
Upper Stony Run
N

Appendix B: Stream Bank Erosion Rate

REACH ID: dfb03

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 14.20-7.14	2.6	1412	0.065	0.17	238.63	8.84
BB 7.14-5.50	2.6	328	0.065	0.17	55.43	2.05
BB 7.14-1.70	2.6	1088	0.18	0.47	509.18	18.86
BB 1.70-0.85	2.6	170	0.065	0.17	28.73	1.06
BB 0.85-0.00	2.6	170	0.3	0.78	132.60	4.91
REACH TOTAL		3168			964.57	35.72
LINEAR FOOT					0.30	0.01

REACH ID: dfb04

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 11.80-10.80	1.5	200	0.18	0.27	54.00	2.00
BB 9.70-8.00	3	60	0.3	0.90	54.00	2.00
BB 8.00-6.58	1.8	284	0.18	0.32	92.02	3.41
BB 6.58-2.50	2.6	816	0.3	0.78	636.48	23.57
BB 2.50-1.30	2.1	240	0.065	0.14	32.76	1.21
BB 1.30-0.00	3.7	260	0.065	0.24	62.53	2.32
REACH TOTAL		1860			931.79	34.51
LINEAR FOOT					0.50	0.02

REACH ID: dcb06

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
LB 8.85-7.81	2.8	104	0.3	0.84	87.36	3.24
RB 8.85-7.81	4.02	104	0.065	0.26	27.18	1.01
LB 7.81-6.90	2.6	91	0.065	0.17	15.38	0.57
RB 7.81-6.91	2.6	91	0.065	0.17	15.38	0.57
LB 6.90-6.40	5	50	0.065	0.33	16.25	0.60
RB 6.90-6.40	4	50	0.3	1.20	60.00	2.22
LB 6.40-5.65	4	75	0.065	0.26	19.50	0.72
RB 6.40-5.65	4.4	75	0.3	1.32	99.00	3.67
LB 5.65-5.04	3.6	61	0.18	0.65	39.53	1.46
RB 5.65-5.04	5	61	0.3	1.50	91.50	3.39
LB 5.04-4.20	8	84	0.3	2.40	201.60	7.47
LB 5.04-4.20	4.9	84	0.18	0.88	74.09	2.74
LB 3.35-0.00	5.4	335	0.18	0.97	325.62	12.06
RB 3.35-0.00	3	335	0.065	0.20	65.33	2.42
REACH TOTAL		1600			1137.70	42.14
LINEAR FOOT					0.71	0.03

REACH ID: drn13

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
LB 6.00-0.00	2.6	600	0.065	0.17	101.40	3.76
RB 6.00-0.00	2.6	600	0.18	0.47	280.80	10.40
REACH TOTAL		1200			382.20	14.16
LINEAR FOOT					0.32	0.01

REACH ID: drn14

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
LB 5.00-1.00	2.7	400	0.065	0.18	70.20	2.60
RB 5.00-1.00	3.2	400	0.065	0.21	83.20	3.08
LB 1.00-0.00	4.06	100	0.065	0.26	26.39	0.98
RB 1.00-0.00	3.2	100	0.18	0.58	57.60	2.13
REACH TOTAL		800			237.39	8.79
LINEAR FOOT					0.30	0.01

REACH ID: drn22

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 5.23-3.80	3.2	286	0.065	0.21	59.49	2.20
BB 3.80-1.89	3.7	382	0.065	0.24	91.87	3.40
BB 1.89-0.00	5.7	378	0.3	1.71	646.38	23.94
REACH TOTAL		1046			797.74	29.55
LINEAR FOOT					0.76	0.03

REACH ID: drn26

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 16.00-12.80	2.4	640	0.065	0.16	99.84	3.70
LB 12.80-11.80	3	100	0.18	0.54	54.00	2.00
RB 12.80-11.80	2.5	100	0.065	0.16	16.25	0.60
LB 10.80-9.30	2.1	150	0.065	0.14	20.48	0.76
RB 10.80-9.30	8	150	0.065	0.52	78.00	2.89
LB 9.30-8.40	7	90	0.18	1.26	113.40	4.20
RB 9.30-8.40	3.8	90	0.3	1.14	102.60	3.80
BB 8.40-6.15	3.2	450	0.065	0.21	93.60	3.47
BB 6.15-4.75	2.2	280	0.065	0.14	40.04	1.48
BB 4.75-2.50	3.1	350	0.065	0.20	70.53	2.61
BB 2.50-0.00	2	500	0.065	0.13	65.00	2.41
REACH TOTAL		2900			753.73	27.92
LINEAR FOOT					0.26	0.01

REACH ID: drn28

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 17.00-16.00	3.1	200	0.065	0.20	40.30	1.49
BB 16.00-15.00	3.1	200	0.18	0.56	111.60	4.13
BB 15.00-13.50	3.9	300	0.18	0.70	210.60	7.80
BB 13.50-12.00	2.9	300	0.18	0.52	156.60	5.80
BB 12.00-10.50	2	300	0.18	0.36	108.00	4.00
BB10.50-7.70	7	560	0.065	0.46	254.80	9.44
BB 7.70-5.25	4.4	490	0.065	0.29	140.14	5.19
BB 5.25-3.80	3.2	260	0.065	0.21	54.08	2.00
BB 3.80-1.89	3.7	582	0.065	0.24	139.97	5.18
LB 1.89-0.00	3.7	189	0.065	0.24	45.45	1.68
RB 1.89-0.00	5.7	189	0.3	1.71	323.19	11.97
REACH TOTAL		3570			1584.74	58.69
LINEAR FOOT					0.44	0.02

REACH ID: dsr08

STATIONING	BANK HEIGHT	BANK LENGTH	EROSION RATE	SQ. FT/FT	CU. FT/REACH	CU. YARD
BB 7.27-4.16	2.17	622	0.065	0.14	87.73	3.25
BB 4.16-3.01	3	230	0.18	0.54	124.20	4.60
LB 3.01-1.25	12	176	0.18	2.16	380.16	14.08
RB 3.01-1.25	2.6	176	0.18	0.47	82.37	3.05
BB 1.25-0.00	14	250	0.18	2.52	630.00	23.33
REACH TOTAL		1454			1304.46	48.31
LINEAR FOOT					0.90	0.03

HENRICO COUNTY *BEHI* FORM

REACH ID	DFB03	**INVESTIGATORS**		Dan Sweet			**DATE**	7.20.2002						
bank	both	**segment length**		706 and 164	**stationing**	14.20-7.14	and 7.14-5.50							
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1	1	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	40	5.1	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	26	2.24	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		11.24		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	**segment length**		544	**stationing**	7.14-1.70								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1	4	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	70	4.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		23.52		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	**segment length**		85	**stationing**	1.70-0.85								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.2	1	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	70	4.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	30	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		13.6		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	**segment length**		85	**stationing**	0.85-0.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.2	4	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	69	4.8	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	10	9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		30.14		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme

HENRICO COUNTY *BEHI* FORM														
REACH ID	DFB04	INVESTIGATORS		Dan Sweet			DATE	7.13.2002						
bank	both	segment length		100	stationing	11.80 -10.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.5	5.9	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.466667	4.24	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	90	7.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		24.25		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		30	stationing	9.70-8.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.578947	6	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.3	5.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	15	7.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	41	2.97	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	10	9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		31.77		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme
bank	both	segment length		142	stationing	8.00-6.58								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.285714	4.57	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.666667	3.12	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	90	7.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	30	5.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		28.71		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		408	stationing	6.58-2.50								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.625	6.12	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.692308	2.97	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	47	3.26	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	5	10	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		30.79		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme

bank	both	segment length		120	stationing	2.50-1.30								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.4	5.26	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.761905	2.63	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	74	5.3	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		17.8		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		130	stationing	1.30-0.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.3	4.63	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.837838	2.29	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	60	3.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		14.17		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme

HENRICO COUNTY *BEHI* FORM														
REACH ID	DCB06	INVESTIGATORS		Dan Sweet			DATE	7.20.2002						
bank	left	segment length		104	stationing	8.85-7.81								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.217391	4.06	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.535714	3.71	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	38	2.83	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		15.21		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		104	stationing	8.85-7.81								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.73913	6.67	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.95	1.45	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	40	2.92	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		14.39		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	left	segment length		91	stationing	7.81-6.90								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.083333	1.72	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.923077	1.72	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	76	5.5	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		13.55		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		91	stationing	7.81-6.90								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.541667	6	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	9.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	57	3.75	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	15	8	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		28.19		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

bank	left	segment length		50	stationing	6.90-6.40								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.25	4.32	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.8	2.44	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	60	3.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		16.87		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		50	stationing	6.90-6.40								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2	7.9	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.325	5.65	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	5	9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	67	4.6	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	15	8	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		35.15		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme
bank	left	segment length		75	stationing	6.40-5.65								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.666667	6.29	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.95	1.41	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	38	2.83	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		17.56		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		75	stationing	6.40-5.65								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.833333	6.95	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0	10	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	45	3.17	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		35.78		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme

bank	left	segment length		61	stationing	5.65-5.04								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.5	6	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	59	3.85	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		19.97		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	right	segment length		61	stationing	5.65-5.04								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.083333	8	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	58	5.27	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	10	9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		34.61		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme
bank	left	segment length		84	stationing	5.04-4.20								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	3.333333	10	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	70	2.71	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	10	9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		34.05		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme
bank	right	segment length		84	stationing	5.04-4.20								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.041667	8	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.489796	4	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	65	3.11	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		22.93		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

bank	left	segment length		85	stationing	4.20-3.35								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.272727	8.24	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	55	3.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		19.35		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		85	stationing	4.20-3.35								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.375	5.07	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.69697	2.92	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	35	5.5	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		21.31		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	left	segment length		335	stationing	3.35-0.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.25	8.21	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.941176	1.54	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	30	5.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	50	3.41	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	40	5.11	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		24.17		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	right	segment length		335	stationing	3.35-0.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.25	4.32	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.666667	3.12	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	60	3.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
		17.55		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme

HENRICO COUNTY *BEHI* FORM														
REACH ID	DRN13	INVESTIGATORS		Dan Sweet			DATE	June 13th, 2002						
bank	left	segment length		600	stationing									
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.65	6.24	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	3.19	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	43	3.07	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	75	2.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS		15.82												
				5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		600	stationing									
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.8	6.95	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	35	5.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	28	2.34	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	50	4.31	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS		20.1												
				5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

REACH ID	DRN14	INVESTIGATORS		Dan Sweet			DATE	6.12.2002						
bank	left	segment length		400	stationing	1.00-5.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.285714	4.57	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	70	4.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		13.82		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		400	stationing	1.00 - 5.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.52381	5.9	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	67	4.6	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		14.85		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	left	segment length		100	stationing	0.00 - 1.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.933333	7.57	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	2.388235	4.7	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	25	6.54	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	60	3.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	25	6.54.	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		22.71		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		100	stationing	0.00 - 1.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.52381	5.9	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.375	5.15	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	15	7.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	65	4.4	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	30	5.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		29.25		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

REACH ID	DRN22	INVESTIGATORS		Dan Sweet			DATE	7.20.2002						
bank	both	segment length		143	stationing	5.23-3.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.391304	5.27	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.90625	1.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	67	4.6	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		15.12		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		191	stationing	3.80-1.89								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.48	5.77	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.72973	2.78	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	55	3.66	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		18.42		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		189	stationing	1.89-0.00								
	left same as above													
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.28	8.25	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.54386	3.71	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.4	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	57	3.75	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		31.33		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme

REACH ID	DRN26	INVESTIGATORS		Dan Sweet			DATE	7.20.2002						
bank	both	segment length		320	stationing	16.00-12.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.263158	4.38	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.916667	1.72	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	50	3.4	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		14.11		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	left	segment length		100	stationing	12.80-11.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.764706	6.76	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.8	2.44	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	40	2.93	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	25	6.54	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		27.11		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	right	segment length		100	stationing	12.80-11.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.470588	5.71	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	48	3.3	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		15.41		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		100	stationing	11.80-10.80								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.105263	2.21	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.904762	1.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	25	2.19	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		9.65		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		very low		very low		low		moderate		high		very high		extreme

bank	left	segment length		150	stationing	10.80-9.30								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	4.705882	10	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	50	3.41	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		17.76		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		150	stationing	10.80-9.30								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.294118	8.27	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.933333	1.63	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	40	5.11	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	45	3.17	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		14.23		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		low		very low		low								
bank	left	segment length		90	stationing	9.30-840								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	4.117647	10	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.714286	2.88	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	37	2.78	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		20.27		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		moderate		very low		low								
bank	right	segment length		90	stationing	9.30-8.40								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	2.235294	8.2	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	65	4.4	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		32.16		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		high		very low		low								

bank	both	segment length		225	stationing	8.40-6.15								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	1.882353	7.33	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.875	2.07	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	55	3.66	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		17.67		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		low		very low		low								
bank	both	segment length		140	stationing	6.15-4.75								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	1.294118	4.57	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.954545	1.45	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	38	2.83	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	90	1.46	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		12.21		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		low		very low		low								
bank	both	segment length		175	stationing	4.75-2.50								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	1.823529	7.05	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.83871	2.24	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	40	2.93	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		18.43		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		low		very low		low								
bank	both	segment length		250	stationing	2.50-0.00								
							value	index	value	index	value	index	value	index
CRITERIA	field value	index	value	index	value	index	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
bank ht/bkf ht	1.176471	3.69	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root depth/bank ht	0.9	1.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
bank angle (degrees)	58	3.8	0-20	1.0-1.9	21-60	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9								
TOTALS								20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		14		5.0-9.5		10.0-19.5		moderate		high		very high		extreme
		low		very low		low								

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bank	both	segment length		100	stationing	17.00-16.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1	1	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.65	3.17	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	55	3.66	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		11.18		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		100	stationing	16.00-15.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.24	4.25	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.548387	3.66	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	70	4.9	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	4.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS		1.9												
		22.32		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		150	stationing	15.00-13.50								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.95	7.66	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	3.9/3.9	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	72	5.1	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		19.97		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		150	stationing	13.50-12.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.363636	5.01	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.966667	1.36	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	95	7.96	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.7	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		20.53		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

bank	both	segment length		150	stationing	12.00-10.50								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.318182	4.7	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.5	3.9	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	68	4.7	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	15	7.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		28.42		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		280	stationing	10.50-7.70								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1	1	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.85	2.19	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	95	8.14	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		15.94		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		245	stationing	7.70-5.25								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.466667	5.2	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.909091	1.81	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	72	4.6	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		14.96		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		130	stationing	5.25-380								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.391304	5.65	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.90625	1.81	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	67	5.1	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		18.77		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		291	stationing	3.80-1.89								

CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.48	5.77	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.72973	2.78	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	55	3.66	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		18.42		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	right	segment length		189	stationing	1.89-0.00								
	left same as above													
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	2.28	8.26	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.54386	3.7	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	10	8.44	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	57	3.75	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	20	7.22	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		31.37		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		high		very low		low		moderate		high		very high		extreme

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bank	both	segment length		311	stationing	7.27-4.16								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.235294	4.25	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	80	1.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	50	3.41	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	90	1.45	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		12.01		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		low		very low		low		moderate		high		very high		extreme
bank	both	segment length		115	stationing	4.16-3.01								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.304348	4.63	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.733333	2.78	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	70	2.71	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	75	5.4	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		19.84		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	left	segment length		176	stationing	3.01-1.25								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	3.1	10	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.791667	2.78	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	30	5.9	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	55	3.66	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		26.66		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

bank	right	segment length		176	stationing	3.01-1.25								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	1.625	6.14	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	1	1	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	40	5.09	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	75	5.4	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		21.95		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme
bank	both	segment length		125	stationing	1.25-0.00								
CRITERIA	field value	index	value	index	value	index	value	index	value	index	value	index	value	index
bank ht/bkf ht	8.235294	10	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
root depth/bank ht	0.95	1.45	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	0.29-0.15	6.0-7.9	0.14-.05	8.0-9.0	<.05	10
root density (%)	50	4.32	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10
bank angle (degrees)	75	5.4	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10
surface protection (%)	60	3.5	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10
TOTALS														
		24.67		5.0-9.5		10.0-19.5		20.0-29.5		30.0-39.5		40.0-49.5		46.0-50
		moderate		very low		low		moderate		high		very high		extreme

Appendix C: Channel Stability

Scoring Tool For Channel Stability

Aggrading — Dynamic Equilibrium/Stable State — Degrading

Not Functioning	Functioning at Risk	Proper Functioning Condition	Functioning at Risk	Not Functioning
Disconnected from Floodplain		Connected to Floodplain		Disconnected from Floodplain
channel filled		sedimentation/deposition consistent with stability	mid channel bars/transverse bars	no thalweg

Stream Evolution By Type

~D	~D	~D>C/E	C/E (D)	C/E (B)	F> C/E	F	G>F	G

Channel Evolution Model

				Stable	Narrowing	Aggrading/ Widening	Degrading/ Widening	Degrading
1	2	3	4	5	4	3	2	1

SCORE		1	2	3	4	5	4	3	2	1
LANES BALANCE DIAGRAM		aggrading	aggrading	aggrading	aggrading	equlibruim	aggrading	aggrading	degrading	degrading
CHANNEL EVOLUTION MODEL						stable	narrowing	V agg/wid	IV deg/wide	III degradation
PROPER FUNCTIONING CONDITION		NFC	NFC	FAR	FAR	PFC	FAR	FAR	NFC	NFC
STREAM TYPE SCENARIO		~D	~D	~D>C/E	C/E (D*)	C/E (B)	F>C/E	F	G>F	G
reach	length									
DFB03	1420		2							
DFB04(1)	50				4					
DFB04(2)	850								2	
DFB04(3)	330		2							
DFB04(W)	2.08									
DCB06	504							3		
DRN13	600							3		
DRN14	500							3		
DRN22(1)	130						2			
DRN22(2)	90							3		
DRN22(3)	350						2			
DRN22(4)	88								4	
DRN22(w)	2.40									
DRN26(1)	150						4			
DRN26(1)	455							3		
DRN26(1)	225				4					
DRN26(1)	250							3		
DRN26(W)	3.35									
DRN28(1)	523						4			
DRN28(2)	1177							3		
DRN28(3)	100				4					
DRN28(W)	3.35									
DSR08(1)	416									1
DSR08(2)	311	1								
DSR08(W)	1.00									

Appendix D: Ownership

REACH	PUBLIC(1)	NPO/HOA(1.25)	BUSINESS(1.5)	MF/DVLP(1.75)	OWN/OCC(2)	TOTAL	WEIGHTED TOTAL
DBF03	0	0	0	0	28	28	56
DBF04	0	0	0	0	25	25	50
DCB06	1	1	0	0	12	14	26.25
DRN13	0	0	1	0	1	2	3.5
DRN14	0	0	1	0	0	1	1.5
DRN22		0	0	0	1	1	2
DRN26	1	1	0	0	26	28	54.25
DRN28	0	1	0	1	5	7	13
DSR08	0	2	0	2	0	4	6

Appendix E: Prioritization Tool

REACH: DBF03									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.3	4.24	*0.9*	*0.16*	*0.74*	*4*	*9*	1
IMPROVE	CHANNEL STABILITY	2	2.00	5	1	4	4	N/A	1
IMPROVE	STORMWATER	0	5.00	7	0	7	4	9	1
IMPROVE	BUFFERS	1950	1.00	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	2	1.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	56	5.00	56	1	55	4	9	1
TOTAL			21.24						21.24
IMP TOTAL			12.24						12.24
IMP RATIO			0.48						
CON TOTAL			9.00						9.00
CON RATIO			0.50						
IMP:CON			0.97						
REACH: DBF04									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.76	1.76	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	2.08	2.08	5	1	4	4	N/A	1
IMPROVE	STORMWATER	3	3.29	7	0	7	4	9	1
IMPROVE	BUFFERS	0	5.00	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	50	4.56	56	1	55	4	9	1
TOTAL			22.69						22.69
IMP TOTAL			12.12						12.12
IMP RATIO			0.49						
CON TOTAL			10.56						10.56
CON RATIO			0.63						
IMP:CON			0.78						

REACH: DCB06									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.71	2.03	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	3	3.00	5	1	4	4	N/A	1
IMPROVE	STORMWATER	7	1.00	7	0	7	4	9	1
IMPROVE	BUFFERS	700	3.56	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	2	1.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	26.25	2.84	56	1	55	4	9	1
TOTAL			16.43						16.43
IMP TOTAL			9.59						9.59
IMP RATIO			0.65						
CON TOTAL			6.84						6.84
CON RATIO			0.32						
IMP:CON			2.03						
REACH: DRN13									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.32	4.14	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	3	3.00	5	1	4	4	N/A	1
IMPROVE	STORMWATER	2	3.86	7	0	7	4	9	1
IMPROVE	BUFFERS	0	5.00	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	1	1.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	0	5.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	3.5	1.18	56	1	55	4	9	1
TOTAL			23.17						23.17
IMP TOTAL			15.99						15.99
IMP RATIO			0.25						
CON TOTAL			7.18						7.18
CON RATIO			0.35						
IMP:CON			0.72						

REACH: DRN14									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.3	4.24	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	3	3.00	5	1	4	4	N/A	1
IMPROVE	STORMWATER	2	3.86	7	0	7	4	9	1
IMPROVE	BUFFERS	100	4.79	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	1	1.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	1.5	1.04	56	1	55	4	9	1
TOTAL			20.93						20.93
IMP TOTAL			15.90						15.90
IMP RATIO			0.26						
CON TOTAL			5.04						5.04
CON RATIO			0.17						
IMP:CON			1.51						
REACH: DRN22									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.76	1.76	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	2.4	2.40	5	1	4	4	N/A	1
IMPROVE	STORMWATER	6	1.57	7	0	7	4	9	1
IMPROVE	BUFFERS	1240	2.46	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	2	1.07	56	1	55	4	9	1
TOTAL			15.26						15.26
IMP TOTAL			8.18						8.18
IMP RATIO			0.74						
CON TOTAL			7.07						7.07
CON RATIO			0.34						
IMP:CON			2.18						

REACH: DRN26									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.26	4.46	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	3.35	3.35	5	1	4	4	N/A	1
IMPROVE	STORMWATER	7	1.00	7	0	7	4	9	1
IMPROVE	BUFFERS	1660	1.59	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	54.25	4.87	56	1	55	4	9	1
TOTAL			21.28						21.28
IMP TOTAL			10.40						10.40
IMP RATIO			0.60						
CON TOTAL			10.87						10.87
CON RATIO			0.66	0.2					
IMP:CON			0.91						
REACH: DRN28									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.44	3.49	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	3.35	3.35	5	1	4	4	N/A	1
IMPROVE	STORMWATER	4	2.71	7	0	7	4	9	1
IMPROVE	BUFFERS	700	3.56	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	13	1.87	56	1	55	4	9	1
TOTAL			20.99						20.99
IMP TOTAL			13.11						13.11
IMP RATIO			0.43						
CON TOTAL			7.87						7.87
CON RATIO			0.41						
IMP:CON			1.06						

REACH: DSR08									
CATEGORY	**CRITERIA**	**VALUE**	**INDEX**	**HIGH VALUE**	**LOW VALUE**	**VALUE RANGE**	**INDEX RANGE**	**SAMPLE SIZE**	**WEIGHT**
IMPROVE	BANK EROSION	0.9	1.00	*0.9*	*0.16*	0.74	4	9	1
IMPROVE	CHANNEL STABILITY	1	1.00	5	1	4	4	N/A	1
IMPROVE	STORMWATER	2	3.86	7	0	7	4	9	1
IMPROVE	BUFFERS	1700	1.51	1950	0	1950	4	9	1
FEASIBILITY	PERMITTING	2	3.00	3	1	2	4	N/A	1
FEASIBILITY	ACCESS	1	3.00	2	0	2	4	9	1
FEASIBILITY	OWNERSHIP	6	1.36	56	1	55	4	9	1
TOTAL			14.73						14.73
IMP TOTAL			7.37						7.37
IMP RATIO			0.79						
CON TOTAL			7.36						7.36
CON RATIO			0.36						
IMP:CON			2.17						

Appendix F: Mitigation Calculators

Executive Summary

Over the past several years, the scientific community, government agencies, and the general public have become increasingly aware of the role headwater streams play in maintaining environmental quality. This awareness has lead to expanded efforts in the stewardship and management of headwater resources and increased research into critical headwater stream processes. The Clean Water Act (33 U.S.C. 1344) plays a significant role in regulating impacts to headwater streams at the national scale. Section 404 of the Act directs the U.S. Army Corps of Engineers (Corps), in cooperation with the U.S. Environmental Protection Agency (EPA), to administer the 404 Regulatory Program (404) for permitting the discharge of dredged or fill material in "waters of the United States" which, by definition, include headwater streams that are part of a tributary system encompassing navigable waters. Application requests for Nationwide permit authorization to discharge dredged or fill material in waters of the United States undergo a review that includes assessing the impact of the proposed project on the functions and values of the aquatic environment. Results of the assessment are a component of the evaluation in verifying a Nationwide permit decision.

An interagency team including members from the U.S. Army Corps of Engineers (COE), the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (USFWS), the Kentucky Division of Water (KDOW), and the Kentucky Department of Fish and Wildlife Resources (KDFWR) was assembled to address the needs for a headwater stream assessment procedure that would accommodate the 404 programmatic requirements in the eastern Kentucky Coalfield Region. The team considered a variety of methods that have been developed to assess stream quality. However, none have received wide spread use or acceptance in 404 because of a failure to satisfy one or more technical or programmatic requirements. One of the most constraining considerations for an assessment procedure to be useful within the 404 program is an ability to assess stream functions accurately and efficiently within the limited time and resources available. EPA's Rapid Bioassessment Protocol (RBP) (Barbour *et al.*, 1999) was the assessment procedure singled out by the interagency team as having the greatest utility for the program's needs. This protocol has undergone extensive peer review and is based on sound ecological principles. The procedure also aims to be rapid and, thus, accommodates the time and resource limitations of the 404 program. This document outlines an approach for using the RBP in a manner that assesses overall stream ecosystem integrity and also satisfies the technical and programmatic requirements of the 404 program.

The headwater stream ecosystem may be thought of as being composed of two gross compartments: 1) the abiotic compartment and 2) the biotic compartment. These two components are interdependent and interact to perform a number of ecological processes or functions within the landscape. These, often ephemeral or intermittent, streams are the key interface between the surrounding landscape and larger waterbodies. Healthy headwater streams provide habitat to relatively distinct and diverse invertebrate assemblages, and by assimilating nutrients, organic matter, and sediments, they export

high quality water and provide goods and services (e.g., water supply, recreation, waste assimilation, flood control, and ecological values) important to the public interest. To assess the integrity of the stream ecosystem and, thus, its capacity to provide goods and services, one must address both the abiotic and biotic components of the system. The estimate of overall ecological integrity for the stream ecosystem would be a net result of the combined abiotic integrity and the biological integrity characterizing the entire system.

The approach recommended in this document will incorporate a body of data gathered by the Kentucky Division of Water (KDOW) (Pond & McMurray 2002, in prep) with some assistance by the Louisville District COE. In 2000, 43 sites were sampled (25 reference, 18 non-reference, or test) distributed throughout the Kentucky portion of ecoregions 68 (Southwestern Appalachians), 69 (Central Appalachians), and 70 (Western Allegheny Plateau), collectively known as the Eastern Coalfield Region. Another 13 sites (10 reference, 3 test) were collected in spring 2001 for validation purposes. Two other streams were sampled in 1998 and 1999 (CA ecoregion) and used as validation sites. All reference (least disturbed) streams were located in highly forested, undisturbed areas, whereas impaired or degraded sites ranged from slightly to severely impacted by a variety of regional land uses.

Macroinvertebrates and physical habitat data were sampled in the spring index period (mid-February to late-May) from 58 sites. These data were utilized to calibrate regional expectation criteria for benthic invertebrate communities and habitat conditions for small headwater streams (1^{st}–2^{nd} order). Sites were chosen using Arcview GIS software (e.g., topographic maps, aerial photos, and land use) and field reconnaissance. A reference site was determined adequate if it was primarily vegetated with relatively mature native forest, little or no residential development, and there were no permitted discharges (coal mining, oil/gas extraction, or sewage treatment plant). Non-reference, or test sites, were chosen to span a range of observed human impacts to the watershed, stream, or individual reach.

This data and subsequent analyses were used as a basis to compose and calibrate recommended headwater stream assessment model(s) applicable to the Eastern Kentucky Coalfield Region. The most robust form of these models includes variables representing both the biotic component and the abiotic component shown to be statistically significant for these headwater stream ecosystems and will, thus, collectively provide an index of ecological integrity. In exceptional circumstances, such as an absence of comparable biotic data or when there is a lack of time, one could rely on a less robust form of the model that includes only significant abiotic habitat parameters. Confidence in less robust forms of the model is supported by an analysis of the above referenced data, which revealed a moderately strong correlation between the integrity of the biotic communities and the habitat variables chosen to represent the abiotic component of the stream ecosystem. All of these models serve to provide an estimate of the ecological integrity of a headwater stream ecosystem relative to the reference (i.e., least disturbed) stream conditions in the same region. The output of the models range from 0 – 1, and is calibrated such that a score of 1.0 is given for stream conditions indicative of least

disturbed or reference streams in the region. The models were developed with 404 program limitations in mind as well as the data requirements that may be incurred by applicants seeking a 404 permit. An effort was made to minimize the burden on the regulated public while at the same time ensuring that meaningful data was obtained. This allows for good decision making, effective administration of the 404 permitting program, and fair, reasonable, and timely responses to customers while also adequately protecting the aquatic environment.

Biotic Integrity

Thirty-one (31) macroinvertebrate biological attributes (biometrics) were calculated and evaluated for discrimination efficiency, sensitivity, redundancy, and variability. Effort was given to include metrics covering a wide scope of ecological attributes (e.g., structure, tolerance, habit, and function). Five metrics (**taxa richness, EPT richness, mHBI, %Ephemeroptera, and %Chironomidae+Oligochaeta**) were selected for use in a Macroinvertebrate Bioassessment Index (MBI). Data analysis also revealed that the output of the MBI model using family level taxonomy and sampling only the riffle habitats was highly correlated with the output derived from using genus and species level taxonomy and sampling multiple habitats. The use of family level taxonomy and the sampling of a single habitat would reduce the time and effort required to glean useful data in certain situations (e.g., pre-application consultations and project/mitigation site screening) and also eliminate noise and improve the quality of data submitted with 404 applications. The approach recommended by the interagency team incorporates the MBI model to serve as the indicator for the integrity of the biotic component for the overall headwater stream ecosystem within the reference domain.

Abiotic Integrity

The assessment protocol was validated in selected sites with catchment areas ranging from 50 to 2000 acres. Reference and test stream data sets did not differ significantly in mean catchment area, riffle substrate size, stream width, elevation, slope, and distance-to-source (Mann-Whitney, $p>0.1$). In contrast, the two data sets differed significantly in mean riffle embeddedness, riparian width, canopy score, conductivity, and temperature ($p<0.01$). Both stepwise discriminant function analysis (DFA) and principal components analysis (PCA) showed that **conductivity**, **riparian width**, **canopy**, and **embeddedness** best separated reference (least disturbed) and test (degraded) sites. In addition, cluster analyses and box and whisker plots also indicated that EPA **RBP habitat scores** successfully distinguished reference from test sites. These physical habitat parameters which proved to provide the best discriminatory power between least disturbed streams and those that were degraded serve as the variables used to assess for the abiotic integrity of the stream ecosystem.

The recommended assessment procedure includes a characterization, assessment, and analysis component. The characterization is largely embodied by the current requirements of the EPAs RBP and involves using a checklist and describing the physical

characteristics of the headwater stream ecosystem and the surrounding landscape. However, for 404 purposes one must also include a characterization of the proposed project and its potential consequences on the aquatic environment. Assessment involves the application of the developed models and the calculation of ecological integrity indices for a defined headwater stream ecosystem under existing (i.e., preproject) conditions, and if appropriate, predicted (postproject) conditions. Analysis involves the application of the assessment results to the following: 1) description of the potential impacts of a proposed project, 2) description of the actual impacts of a completed project, 3) identification of ways to avoid and minimize impact of a proposed project, 4) determination of the least damaging alternative for a proposed project, 5) determination of compensatory mitigation needs for a proposed project, 6) determination of restoration potential for headwater streams, 7) development of design criteria for stream restoration projects, 8) planning, monitoring and managing stream mitigation or restoration projects, 9) evaluation of performance standards or success criteria for headwater stream mitigation efforts, 10) comparison of stream management alternatives or results, 11) determination of appropriate in-lieu-fee ratios, and 12) identifying priorities for in-lieu-fee mitigation projects.

The strengths of the recommended approach are that it promotes an ecosystem approach based on accepted methodologies and real data calibrated to the existing gradient of conditions found within a specific region. In addition, it takes advantage of information and data that is currently being supplied by applicants to the 404 program and thus imparts little additional burden to the regulated public. The limitations of the assessment procedure should also be identified at the outset. In order for the MBI scores to be effective, adherence to sampling procedures and sample index period is important. Recommended time frames for sampling headwater streams ranges from mid-February to late-May. Samples collected before or after these dates may give inaccurate results and caution should be used when interpreting benthic data. In addition, the tool may only be applied to headwater streams in the region from which the reference data was collected. In addition to these ecological integrity assessment models, one should also take into consideration sound geomorphological principles when assessing for stable stream morphology. The last potential limitation is that the ecological integrity indices developed under this approach do not assign value to stream ecosystems. The ecological integrity indices derived from the models may serve as a type of environmental "currency" and can be used to estimate a stream's functional capacity or relative quality. They may also predict the amount of loss or gain of stream function(s). However, they cannot be used to assign the value of benefits, goods, and services resulting from a proposed project. This requires other methods designed specifically for the purpose of assigning value, and is beyond the scope or intent of the stream assessment protocol.

Stream Compensation Ratio Calculator Version 3.3

Inputs

Time Horizon: 75 yrs
Discount Rate: 0.00 %

Function Name	Relative Importance (e.g., 0 to 10)	Impacted Site: Ecological Integrity Index Pre-Impact	Impacted Site: Ecological Integrity Index Post-Impact	Impact Year	Mitigation Site: Mitigation Work Timing & Risk Year Started	Year Matured	Failure Risk	Mitigation Site: Ecological Integrity Index Pre-Work	Immediately After Work	At Maturity
Ecological Integrity	1.0	0.75	0.00	2000	2000	2035	20 %	0.10	0.40	0.75

Outputs

Function-for-Function Compensation Ratios

Function Name	Impact Site Per-linear foot Loss	Mitigation Site Per-linear foot Gain	Ratio (mitigation site feet per impact site feet)	
Ecological Integrity	56.25	38.60	>=	1.46

Overall Ratio with Trade-Offs Among Importance-Weighted Functions

Impact Site Per-Linear foot Loss	Mitigation Site Per-Linear foot Gain	Net Surplus or (Deficit) (@ mitigation site Overall-Ratio feet per impact site foot)
56.25	38.60	(0.00)
56.25	38.60	0.00

Overall Ratio with Trade-offs = 1.46

Compensatory Stream Mitigation
Definitions of Factors

Bankfull Discharge: The bankfull discharge is the flow at which channel maintenance is most effective. It is the discharge that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels (Dunne and Leopold 1978). The bankfull stage is the point at which water begins to overflow onto a floodplain. Bankfull may not be at the top of the streambank in incised or entrenched streams.

Bankfull width is the width of the stream channel at bankfull measured in a riffle section.

Buffer Calculations: The **minimum buffer width** for which mitigation credit will be earned is 50 feet. The buffer width will be measured from the top of the stream bank, perpendicular to the channel. If a stream buffer has more than a 2% slope, 2 additional feet of buffer width are required for every additional percent of slope (e.g., minimum width of a 50' buffer with a +10% slope is 70'). Buffer slope will be determined in 50' increments, beginning at the stream and moving away from the stream. No additional buffer width will be required for negative slopes. For the segment of stream being buffered, degree of slope will be determined at 100' intervals, and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

Channel Dimension: The dimension of a stream is its crossectional area (bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the stream bed and bank materials.

Channel Features: Natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A **riffle** is a bed feature with gravel or larger size particles where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. Pools are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average depth. Step/pool sequences are found in high gradient streams. Steps are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.

Control:

Conservancy means a conservation easement held by a non-profit conservation organization or government agency with natural resource or environmental responsibilities/functions.
POA-CE means the mitigation site is protected by a conservation easement held by a property owners association or other formally chartered non-profit organization.
POA-RC means the mitigation site is protected by a restrictive covenant held by a property owners association or other formally chartered non-profit organization.
Private-CE means the mitigation site is protected by a conservation easement held by a private citizen or business enterprise.
Private-RC means the mitigation site is protected by a restrictive covenant held by a private citizen or business enterprise.

Compensatory Stream Mitigation
Definitions of Factors

Subdivided means the mitigation site is protected by a restrictive covenant and different portions of the mitigation site are owned by different citizens or business enterprises.

Types ofCompensatory Mitigation:

Stream restoration means actions taken to correct previous alterations that have destroyed, diminished, or impaired the character and function of riverine systems. Restoration is the process of converting an unstable, altered, or degraded stream channel to its natural or referenced stable condition, considering recent and future watershed conditions. This process may include restoration of the stream's geomorphic dimension, pattern and profile and/or biological and chemical integrity, including transport of water and sediment produced by the streams' watershed in order to achieve dynamic equilibrium.

Riparian buffer restoration means implementing stream rehabilitation practices within a riparian buffer zone to improve water quality and/or ecological function. Buffer restoration may include increasing or improving upland buffers or wetlands within or adjacent to riverine systems.

Stream Relocation means moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed in the stream's former location. Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions and have at least a 25' buffer from each bank of the stream in order to receive mitigation credit. This 25' buffer will not receive riparian buffer restoration credit.

Preservation means the conservation, in its naturally occurring or present condition, of a stream, its banks, and riparian buffers, in perpetuity, to prevent their destruction, degradation, or alteration in any manner not authorized by the governing authority. Channel preservation alone will not be accepted without inclusion of a 25' buffer.

Conservation Easement: Conservation Easement means a legally binding, recorded instrument, approved by the Department of the Army's Office of Counsel, that conserves a site in perpetuity.

Credits: **For Non-Banks**:
S***chedule 1*** : All mitigation is completed before the impacts occur.
Schedule 2: A majority of the mitigation is completed before the impacts, and the remainder is completed concurrent with or after the impacts occur.
Schedule 3: A majority of the mitigation is completed concurrent with the impacts, and the remainder is completed after the impacts occur.
Schedule 4: A majority of the mitigation is initiated after the impacts occur.
Schedule 5: Mitigation will be completed significantly after the impacts occur.

For Stream Mitigation Banks: Release of credits for stream mitigation banks will be determined by the Mitigation Bank Review Team on a case-by-case basis.

Dominant Impact: Dominant impact is the type of impact proposed that will diminish the functional integrity of the riparian system.

Fill means permanent fill of a stream channel.

Compensatory Stream Mitigation
Definitions of Factors

Morphologic alteration means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

Impound means to dam a stream or otherwise convert it to a lentic state. Installation of sediment control structures that modify the stream to facilitate sediment control and/or stormwater management is considered impoundment.

Culvert means to route a stream through pipes, box culverts, or other enclosed structures for <100 feet.

Enhanced culverts are structures that approximate the stream's width/depth ratio at bankfull discharge and that minimize potential impacts to aquatic fauna movement. Floodplains, if present, should be adequately culverted at an elevation equal to or greater than bankfull to pass flows.

Standard Culverts are structures of appropriate size to pass bankfull discharge but that are not specifically designed to approximate the stream's width/depth ratio at bankfull discharge or to minimize potential impacts to fish movements.

Armor means to rip-rap, bulkhead, or use other rigid methods to contain stream channels.

Shading and clearing means activities, such as bridging or streambank vegetation clearing, that reduce or eliminate the quality and functions of the vegetation within the riparian habitat without disturbing the existing topography or soil stratigraphy. Although these impacts may not be directly regulated, mitigation for these impacts may be required if the impact occurs as a result of, or in association with, an activity requiring a permit.

Utility crossings means open cut construction or other pipeline/utility line installation methods that require disturbance of the streambed.

Duration: Duration is the amount of time the adverse impacts are expected to last.

Seasonal means impacts will be limited to times outside of breeding and growth periods for applicable species (Federally listed species and Species of Management Concern, State Species of Concern, and trout).
0 -1 year means impacts will occur within a period of up to one year and recovery of most system integrity will follow the cessation of permitted activity.
Greater than 1 year means project impacts will be permanent for most types of construction activities.

Entrenchment Ratio: The entrenchment ratio is an index value used to describe the degree of vertical containment of a river channel. It is the ratio of the width of the flood-prone area divided by bankfull width.

Existing Condition: The functional state of a stream before any pre-project/project impacts. This is a measure of the stream's natural stability and resilience relative to the physical, chemical and biological integrity of the system.

Fully functional means that the physical geomorphology of the reach is stable and is representative of an appropriate stream hydrograph for the topographical setting. The biological community is diverse and

unimpaired by excessive anthropogenic inputs. For purposes of this SOP, a fully functional stream is one that has not been channelized; has no culverts, pipes, impoundments, or other instream manmade structures on site; has 3 or less stream reaches within 0.5 miles upstream that have been culverted, piped, impounded, or otherwise modified by manmade structures; has an appropriate entrenchment ratio and width/depth ratio at bankfull discharge relative to unimpaired stream condition; shows little evidence of human-induced sedimentation; and has a wide riparian buffer of deep-rooted vegetation (>50').

Somewhat Impaired means that stability and resilience of the stream or river reach has been compromised, to a limited degree, through partial loss of one or more of the integrity functions (chemical, physical, biological). System recovery has a moderate probability of occurring naturally. For purposes of this SOP, a stream is considered somewhat impaired if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream condition; human-induced sedimentation is moderate; a moderate riparian buffer of deep-rooted vegetation is present (minimum of 25 feet); and/or 3-5 reaches within 0.5 miles upstream have been culverted, piped, impounded, or otherwise modified by manmade structures.

Impaired means that there is a very high loss of system stability and resilience characterized by loss of one or more integrity functions. Recovery is unlikely to occur naturally without further damage, unless restoration is undertaken. For purposes of this SOP, a stream is considered impaired if the reach has been channelized or if the entrenchment ratio and/or width/depth ratio at bankfull discharge is inappropriate relative to unimpaired stream condition; has extensive human-induced sedimentation; has little or no riparian buffer with deep-rooted vegetation (<25'); has banks that are extensively eroded or unstable; and/or >5 reaches within 0.5 miles upstream have been culverted, piped, impounded, or otherwise modified by manmade structures.

Flood-prone Area Width: The width of the flood-prone area is measured in the field at an elevation twice-maximum depth at bankfull. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section.

Kind: In-kind mitigation means the lost functions of the impacted stream will be mitigated through restoration or preservation of a stream of the same general order and/or morphological classification. Out-of-kind mitigation means the lost functions of the impacted stream will be mitigated through restoration or preservation of a stream with a different morphological classification or order (> 2 stream order difference).

~~**Location:**~~
Location is a factor used to compare the relative location of the mitigation site to the impact site. For Stream Mitigation Banks, Location will be defined for the bank after an assessment of the banking proposal. For mitigation proposals not involving mitigation banks, location categories are as shown below.

Onsite means within ½ mile up or downstream of the impact.

Offsite means greater than ½ mile from the impact site, and within the watershed (8-digit HUC as mapped by USGS).

Outside Watershed means the mitigation site is not within the same watershed as the impacts

Compensatory Stream Mitigation
Definitions of Factors

Lost Type:

First and Second Order Perennial Streams
Greater than Second Order Perennial Streams
Intermittent Streams

Mean Depth at Bankfull: Mean depth at bankfull is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

Monitoring and Contingencies: Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include contingency actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period.

Vegetation monitoring includes measurement of vegetation survival and growth (height, diameter at breast height, or other biomass measure). **Physical parameters** to be monitored include water temperature, DO, turbidity, pH, substrate characteristics, streambank erosion patterns, and longitudinal and cross sectional profiles at sites above, within, and below the stream mitigation project. **Biological parameters** to be monitored include density and diversity of mammals, birds, reptiles, amphibians, fish, macroinvertebrates and other fauna at sites within the stream mitigation project.

Minimum Level M&C:
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in preserved/restored/relocated streams.

Moderate Level M&C Plans (not applicable to preservation/relocation):
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in restored streams.
Snapshop data on physical parameters in the restored stream or riparian buffer before mitigation is implemented.

Substantial Level M&C:
At least 5 years of vegetation monitoring in restored riparian buffers.
At least 5 years of monitoring physical parameters in preserved/restored/relocated streams.
Snapshot baseline data on physical parameters in the restored stream or riparian buffer before the mitigation is implemented.
At least 5 years of monitoring biological parameters in preserved/restored/relocated streams.
Simultaneous collection of baseline data on physical and biological parameters in a reference site for 5 years.

Excellent Level M&C:
At least 7 years of vegetation monitoring in restored riparian buffers.
At least 7 years of monitoring physical parameters in preserved/restored/relocated streams.
Snapshop baseline data on physical parameters in the restored stream or riparian buffer before the mitigation is implemented.
At least 7 years of monitoring biological parameters in preserved/restored/relocated streams.
Simultaneous collection of baseline data on physical and biological parameters in a reference site for 7 years.

Compensatory Stream Mitigation
Definitions of Factors

Net Benefit: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, and maintenance of the chemical, biological, and physical integrity of the Nation's waters. Stream mitigation within 100' of a culvert, dam, or other project impact to waters of the United States generally will generate only the minimal level of restoration or preservation credit due to upstream and downstream impacts associated with these structures. NOTE: Calculating credit for installation of restorat5ion structures will be based on 3X the length of the appropirate size structure (e.g., 600' for 200' of tree revetment).

Excellent stream restoration actions include:
Removing stream impoundments and restoring stream channels to referenced, stable morphologic patterns
Restoring appropriate bankfull discharge width, stream sinuosity, entrenchment ratio, and width/depth ratio to referenced morphologic patterns
Creating floodplains of appropriate dimensions adjacent to streams with inappropriately low width/depth ratios at bankfull discharge.
Construction of off-channel stormwater detention facilities in areas where runoff is accelerating streambank erosion. Off-channel stormwater detention facilities should not be placed in jurisdictional wetlands, forested floodplains, or riparian buffer zones.
Watershed improvement actions, such as sediment reduction (i.e., paving dirt roads sloping to a stream), contaminant reduction, and stormwater surcharge reduction.
Restoring channels for piped or culverted streams (i.e., daylighting) to referenced, stable morphologic patterns
Implementing restoration activities that will improve water quality or reduce sedimentation in State of Georgia primary trout streams or waters with Federal or State listed endangered or threatened species

Good stream restoration actions include:
Restoring streambank stability using non-rigid methods in highly eroded areas
Restoring natural channel features (i.e., riffle/run/pool/glide habitat) using methodology appropriate to stream type
Reducing nonpoint pollution sources by methods other than buffering
Implementing restoration activities that will improve water quality or reduce sedimentation in State of Georgia secondary trout streams or waters with Federal Species of Management Concern or State listed rare or uncommon species

Moderate stream restoration actions include:
Restoring streambank stability in moderately eroded areas
Constructing fish ladders, where appropriate
Culverting floodplains at existing road crossings to allow more natural flood flows
Adding woody debris to create fish habitat, where appropriate to stream type
Replacing inappropriately sized/designed culverts
Removing checkdams, weirs, and other manmade instream structures where these structures are contributing to bank erosion or scour

Excellent riparian restoration actions include:
Restoring vegetated riparian buffers at least 3X as wide as the minimum buffer width on both sides of a stream
Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species

Fencing livestock from a riparian buffer at least 75' wide on both sides of a stream, if one or more livestock crossings are planned, or from a buffer 50' wide on both sides of a stream if no livestock crossings are planned

Good riparian restoration actions include:
Restoring vegetated riparian buffers at least 4X as wide as the minimum buffer width on one side of a stream or 2X as wide as the minimum width on both sides of a stream
Restoring a vegetated riparian buffer of at least minimum buffer width on both sides or at least 2X minimal buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 50' wide on both sides of a stream, if one or more livestock crossings are planned, or from a buffer 25' wide on both sides of a stream if no livestock crossings are planned

Moderate riparian restoration actions include:
Restoring vegetated riparian buffers at least 3X as wide as the minimum buffer width on one side of a stream or 1X as wide as the minimum buffer width on both sides of a stream
Restoring a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Restoring vegetated riparian buffers of at least minimal buffer width on both sides or at least 2X minimal width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 25' wide on both sides of a stream (with livestock crossings planned) or 75' wide on one side of a stream (no livestock crossings planned)

Low riparian restoration actions include:
Restoring vegetated riparian buffers at least 2X as wide as the minimum buffer width on one side of a stream.
Restoring a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species
Fencing livestock from a riparian buffer at least 75' wide on one side of a stream, if one or more livestock crossings are planned, or from a buffer 50' wide on one side of a stream if no livestock crossings are planned

Minimal riparian restoration actions include:
Restoring vegetated riparian buffers of at least minimum buffer width on one side of a stream.
Fencing livestock from a riparian buffer at least 50' wide on one side of a stream, if one or more livestock crossings are planned, or from a buffer 25' wide on one side of a stream if no livestock crossings are planned

A well-designed relocated stream has an appropriate geomorphic dimension, pattern and profile, maintains the capacity to transport bedload sediment, and is constructed with at least a 25' riparian buffer on each side of the stream.

Compensatory Stream Mitigation
Definitions of Factors

A minimally-designed relocated stream has an appropriate geomorphic dimension, pattern, and profile and the streambanks are stabilized with tree revetments, willow plantings, or other non-rigid measures. **No mitigation credit is generated for relocated streams that are riprapped, constructed with concrete, or serve as stormwater conduits.**

Excellent preservation actions include:
Preserving vegetated riparian buffers at least 3X as wide as the minimum buffer width on both sides of a stream
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species

Good preservation actions include:
Preserving vegetated riparian buffers at least 4X as wide as the minimum buffer width on one side of a stream or 2X as wide as the minimum buffer width on both sides of a stream
Preserving a vegetated riparian buffer of at least minimum buffer width on both sides or at least 2X minimal buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on both sides of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

Moderate preservation actions include:
Preserving vegetated riparian buffers at least 3X as wide as the minimum buffer width on one side of a stream or 1X as wide as the minimum buffer width on both sides of a stream
Preserving a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia primary trout stream or a stream with Federal or State listed endangered or threatened species
Preserving vegetated riparian buffers of at least minimal buffer width on both sides or at least 2X minimal width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

Low preservation actions include:
Preserving vegetated riparian buffers at least 2X as wide as the minimum buffer width on one side of a stream.
Preserving a vegetated riparian buffer of at least minimum buffer width on one side of a State of Georgia secondary trout stream or a stream with Federal Species of Management Concern or State listed rare or uncommon species

Minimal preservation actions include:
Preserving vegetated riparian buffers of at least minimum buffer width on one side of a stream.
Preserving stream channel, with at least 25' buffers on both sides of stream. No credit for channel preservation if only one bank of the stream has a 25' buffer.

Non-profit Organization: Non-profit organization means an entity recognized and operating under the rules of the Internal Revenue Services for non-profit purposes.

Compensatory Stream Mitigation
Definitions of Factors

Priority Areas: These are stream and riverine systems with various levels of functional attributes that contribute to their existing physical, chemical and biological state. They may be systems that also have a high social, cultural, or economic component.

Primary Priority*:* These areas provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these areas should be rigorously avoided or minimized. Compensation for impacts in these areas should emphasize replacement nearby and in the same immediate 8-digit watershed. Designated **primary priority** areas include:

National Estuarine Research Reserves
Wild and Scenic Rivers
Designated shellfish grounds
Outstanding Resource Waters
Essential Fish Habitat
Waters on the 303(d) list
Primary trout streams
Federal or State listed threatened or endangered species waters
Streams in greenways corridors
Anadromous fish spawning habitat
State Heritage Trust Preserves
Waters adjacent to Federal or State protected areas or other mitigation sites
Waters officially designated by State or Federal agencies as high priority

Secondary Priority: Secondary priority areas include:

Waters with Federal Species of Management Concern or State listed rare or uncommon species
Secondary trout streams
Stream and river reaches within 0.5 mile upstream or downstream of primary priority reaches
Stream or river reaches within high growth areas that aren't ranked as primary priority systems
Stream or river reaches within 0.5 miles of a groundwater recharge area
Stream or river reaches within 0.5 miles of a drinking water withdrawal site

Tertiary Priority: These areas include all other freshwater or tidally influenced lotic systems not ranked as primary or secondary priority.

Size of Impact: Cumulative impact means the total linear feet of stream impacted by the project.

Stable Stream: A naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not degrade or aggrade. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Instability occurs when scouring causes the channel to incise (degrade) or when excessive deposition causes the channel bed to rise (aggrade).

Sinuosity and Stream Pattern: Stream pattern describes the view of a stream channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, streamflow, and the bed and bank materials.

Stream Profile: The profile of a stream refers to its longitudinal slope. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in streamflow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosities and flat streams have high sinuosities.

Threat: Threat is an assessment of the level of imminent risk of loss or damage to a system.

Width/Depth Ratio: The width/depth ratio is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

STREAM MITIGATION WORKSHEETS

ADVERSE IMPACT TABLE

Factors	Options								
Lost Type	Intermittent 0.3			>2nd Order Perennial Stream 0.5			1st or 2nd Order Perennial Stream 0.7		
Priority Area	Tertiary 0.1			Secondary 0.2			Primary 0.4		
Existing Condition	Impaired 0.1			Somewhat Impaired..... 0.5			Fully Functional 0.8		
Duration	Seasonal 0.05			0-1 Year 0.1			> 1 Year 0.2		
Dominant Impact	Shade/ Clear 0.05	Utility X-ing 0.1	Armor 0.15	Deten-tion (weir) 0.75	Road X-ing 1.0	Im-pound (dam) 1.5	Morpho-logic 2.0	Pipe 2.5	Fill 3.0
Linear Distance	<100 0	100-200 0.05	201-500 0.1	501-1000 0.2	1001-2000 0.4	2001-3000 0.6	3001-4000 0.8	4001-5000 1.0	>5000 N/A

Factor	Area 1	Area 2	Area 3	Area 4	Area 5
Lost Type					
Priority Area					
Existing Condition					
Duration					
Dominant Impact					
Linear Distance					
Sum of Factors	M =				
Linear Feet Impact	A=				
M X A					

Total Mitigation Credits Required = (M X A) = _____

STREAM AND RIPARIAN RESTORATION MITIGATION FACTORS FOR RIVERINE SYSTEMS

Factors	Options							
Net Benefit	Riparian Restoration					Stream Restoration		
	Min-imal 1.2	Low 1.3	Mod-erate 1.4	Good 1.7	Ex-cellent 1.9	Mod-erate 1.6	Good 2.0	Excellent 3.0
Monitoring/ Contingency	Minimal 0.1		Moderate 0.2		Substantial 0.3		Excellent 0.4	
Priority Area	Tertiary 0.05			Secondary 0.1			Primary 0.15	
Location	Outside Watershed 0.1			Offsite 0.5			Onsite 1.0	
Control	Sub-divided 0	Private-RC 0.05		Private -CE 0.1	POA-RC 0.1		POA-CE 0.15	Conservancy 0.2
Kind	Out-of-Kind 0					In-Kind 0.1		
Credits	Schedule 5 0		Schedule 4 0.02		Schedule 3 0.05		Schedule 2 0.08	Schedule 1 0.1

Factors	Area 1	Area 2	Area 3	Area 4	Area 5
Net Benefit					
Monitoring/ Contingency					
Priority Area					
Location					
Control					
Kind					
Credits					
Sum Factors	M =				
Linear Feet	A =				
M X A =					

Total Restoration Credits = (M X A) = _____

PRESERVATION AND RELOCATION MITIGATION FACTORS FOR RIVERINE SYSTEMS

Factors	Options							
Net Benefit	Stream Relocation		Stream/Riparian Preservation					
	Min-imum 0.1	Opti-mal 0.6	Min-imal 0.2	Low 0.3	Mod-erate 0.4	Good 0.5	Excellent 0.6	
Monitoring/ Contingency	Minimal 0.01		Substantial 0.05		Excellent 0.15			
Priority Area	Tertiary 0.01			Secondary 0.05			Primary 0.1	
Location	Outside Watershed 0.01			Offsite 0.05			Onsite 0.1	
Control	Sub-divided 0	Private-RC 0.02		Private-CE 0.05	POA-RC 0.05		POA-CE 0.1	Conservancy 0.15
Kind	Out-of-Kind 0.01					In-Kind 0.05		
Threat	Low 0.01		Moderate 0.03		High 0.04		Imminent 0.05	

Preservation credits cannot exceed 80% of the total mitigation credits required.

Factors	Area 1	Area 2	Area 3	Area 4	Area 5
Net Benefit					
Monitoring/ Contingency					
Priority Area					
Location					
Control					
Kind					
Threat					
Sum Factors	M =				
Linear Feet	A =				
M X A =					

Total Preservation/Relocation Credits = (M X A) = _____

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