Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
	Grade	10	9	8	7	6	5	4	3	2	1	0		4	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR = 1									
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0		3
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.30
													FCI = #/100	

I. HYDROLOGIC FUNCTIONS S10 Trib2 (0.5-2')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — S10 Trib2 (0.5-2')

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal: Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Suboptimal: Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Marginal: Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Poor: Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5	
												Avg.Score	5	
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal: Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Suboptimal: Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Marginal: Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.			Poor: Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score	0	
Enter Score for Only One Variable	**or** 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal: >50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			Suboptimal: 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			Marginal: 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a			Poor: Substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal: Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Suboptimal: Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Marginal: Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.			Poor: Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal: Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Suboptimal: Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Marginal: Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.			Poor: Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Enter Score for Only One Variable	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal: When present, aquatic vegetation consists of moss and patches of algae.			Suboptimal: Algae dominant in pools, larger plants along edge.			Marginal: Algal mats present, some larger plants, few mosses.			Poor: Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		8

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		5
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		5
											Avg.Score		5

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (left)	10	9	8	7	6	5	4	3	2	1	0		6
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		6
											Avg.Score		6

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		6
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		6
											Avg.Score		6

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

	Calculation of Function Capacity Index = Total Score/Total Possible Score	0.39
	FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS S10 Trib2 (0.5-2')

ITEM	VARIABLES	III. HABITAT FUNCTIONS	S10 Trib2 (0.5-2')											SCORE	Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)			Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.			
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal		Poor				*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.			
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.			
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
6	6	CHANNEL FLOW STATUS													*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
			Optimal			Suboptimal			Marginal		Poor				
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry				
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.			
		Grade	10	9	8	7	6	5	4	3	2	1	0	8	
8	8	CHANNEL SINUOSITY													
			Optimal			Suboptimal			Marginal		Poor				*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance			
		Grade	10	9	8	7	6	5	4	3	2	1	0	4	

9	9	BANK STABILITY (SCORE EACH BANK)														
			Optimal			Suboptimal			Marginal		Poor					
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk District*, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3	2	1	0	5		
		Grade	10	9	8	7	6	5	4	3	2	1	0	5		
													Avg.Score		5	
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)														
			Optimal			Suboptimal			Marginal		Poor					
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.			*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3	2	1	0	6		
		Grade	10	9	8	7	6	5	4	3	2	1	0	6		
													Avg.Score		6	
11	11	RIPARIAN ZONE (SCORE EACH BANK)														
			Optimal			Suboptimal			Marginal		Poor					
			Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	6		
		Grade	10	9	8	7	6	5	4	3	2	1	0	6		
													Avg.Score		6	
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)														
			Optimal			Suboptimal			Marginal		Poor					
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.			Norfolk SAAM Form 1 Field
		Grade	10	9	8	7	6	5	4	3	2	1	0			
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors 2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this. 3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.												Ensure the sums of %Riparian Blocks equal 100		
			Optimal			Suboptimal			Marginal		Poor					
		Right Bank %Riparian Area				100								100		
		Right Bank Score				7										
		Right Bank SubCI		0		7				0						
		Left Bank %Riparian Area				100								100		
		Left Bank Score				7										
		Left Bank SubCI		0		7				0			0			
													SubCI=(%RA*Scores*0.01)			
													Rt Bank CI>	7	**CI**	
													LT Bank CI>	7	7	
													Calculation of Function Capacity Index = Total Score/Total Possible Score		0.33	
														FCI = #/120		

Record of Functional Assessment Results

Stream Functional Capacity Calculation

S10 Trib2 (0.5-2')

Date:

Project: Lake Ralph Hall

Assessment Area:

Assessors:

Project Status: __X__Preproject ____Postproject

Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.30	1,705	E	0.00125	0.64
Water Quality Improvement	0.39	1,705	E	0.00125	0.83
Habitat	0.33	1,705	E	0.00125	0.69
Total	1.01	1,705			2.16

*Stream Length is the length of the Stream Assessment Reach (SAR)

**Multiplication Factors

Ephemeral = 0.00125

Intermittent = 0.0025

Perennial = 0.0038

S10 Trib2 (0.5-2') facing upstream. 5/18/2006

S10 Trib2 (0.5-2') facing downstream. 5/18/2006

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 2.5 TO 5.0’ PRE-PROJECT

- **S12**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

S12 (2.5-5')

1

PARAMETER												
	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
Grade	10	9	8	7	6	5	4	3	2	1	0	

Right bank- 15-10 meters to pasture, Left bank 50-60 meters to pasture. Park area surrounded by pasture.

WP 20
P59, 58

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS S12 (2.5-5')											SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8	
												Avg.Score	6.5	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	4	

	3b. Bottom Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal			Poor			
		Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable			Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal			Poor			
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category			Channel bottom includes <3 of the items listed in Optimal Category			
	Grade	10	9	8	7	6	5	4	3	2	1	0		2
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal			Poor			
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15			0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal			Poor			
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0			
	TLB =	10			BHR =	1								
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0		2
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal			Poor			
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.			Pools absent, or the entire bottom is discernible. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal			Poor			
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.			Very little water in channel and mostly present as standing pools. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.19
													FCI = #/100	

I. HYDROLOGIC FUNCTIONS S12 (2.5-5')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — S12 (2.5-5')

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal			Suboptimal			Marginal			Poor			
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8	
												Avg.Score	6.5	
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal			Suboptimal			Marginal			Poor			
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score		
Enter Score for Only One Variable	**or** 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal			Suboptimal			Marginal			Poor			
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a			Substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal			Suboptimal			Marginal			Poor			
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.			Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal			Suboptimal			Marginal			Poor			
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.			Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal			Suboptimal			Marginal			Poor			
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.			Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		7

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		3
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		3
												Avg.Score	3

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (left)	10	9	8	7	6	5	4	3	2	1	0		8
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		8
												Avg.Score	8

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		6
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		6
												Avg.Score	6

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.42
FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS S12 (2.5-5')

ITEM	VARIABLES	III. HABITAT FUNCTIONS	S12 (2.5-5')											SCORE	Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent			Ephemeral			*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal			Poor			
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)			Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.			*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal			Poor			
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.			Hard pan clay or bedrock; no root mat or submerged vegetation.			*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal			Poor			
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools			Majority of pools small-shallow or pools absent			*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal			Poor			
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.			More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.			*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
6	6	CHANNEL FLOW STATUS													*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
			Optimal			Suboptimal			Marginal			Poor			
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed			Very little water in the channel and mostly present in standing pools; or stream is dry			
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal			Poor			
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.			Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.			*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al.. 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	

8	8	CHANNEL SINUOSITY																
			Optimal			Suboptimal			Marginal			Poor						
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line			Channel straight; waterway has been channelized for a long distance					*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3		2	1	0			2	
9	9	BANK STABILITY (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3		2	1	0			5	
		Grade	10	9	8	7	6	5	4	3		2	1	0			8	
													Avg.Score				6.5	
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS ; *KDWP 2000* ; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3		2	1	0			6	
		Grade	10	9	8	7	6	5	4	3		2	1	0			6	
													Avg.Score				6	
11	11	RIPARIAN ZONE (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3		2	1	0			8	
		Grade	10	9	8	7	6	5	4	3		2	1	0			8	
													Avg.Score				8	
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						Norfolk SAAM Form 1 Field
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if >2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if >2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if >2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.					
		Grade	10	9	8	7	6	5	4	3		2	1	0			6	
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors															Ensure the sums of %Riparian Blocks equal 100	
		2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.																
		3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.																
			Optimal			Suboptimal			Marginal			Poor						
		%Riparian Area				100											100	
	Right Bank	Score				6												
		SubCI		0		6				0								
		%Riparian Area				100											100	
	Left Bank	Score				6												
		SubCI		0		6				0			0					
												SubCI=(%RA*Scores*0.01)						
												Rt Bank CI>					6	**CI**
												LT Bank CI>					6	6
																	Calculation of Function Capacity Index = Total Score/Total Possible Score	0.30
																	FCI = #/120	

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
S12 (2.5-5')					
Date:	5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 20				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject	____Postproject			
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.19	6,304	E	0.00125	1.46
Water Quality Improvement	0.42	6,304	E	0.00125	3.30
Habitat	0.30	6,304	E	0.00125	2.33
Total	0.90	6,304			7.09

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

Pasture outside of riparian zone. Rip zone 20m or less.

S12 (2.5-5') facing upstream.
5/19/2006

S12 (2.5-5') facing downstream.
5/19/2006

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 2.5 TO 5.0’ PRE-PROJECT

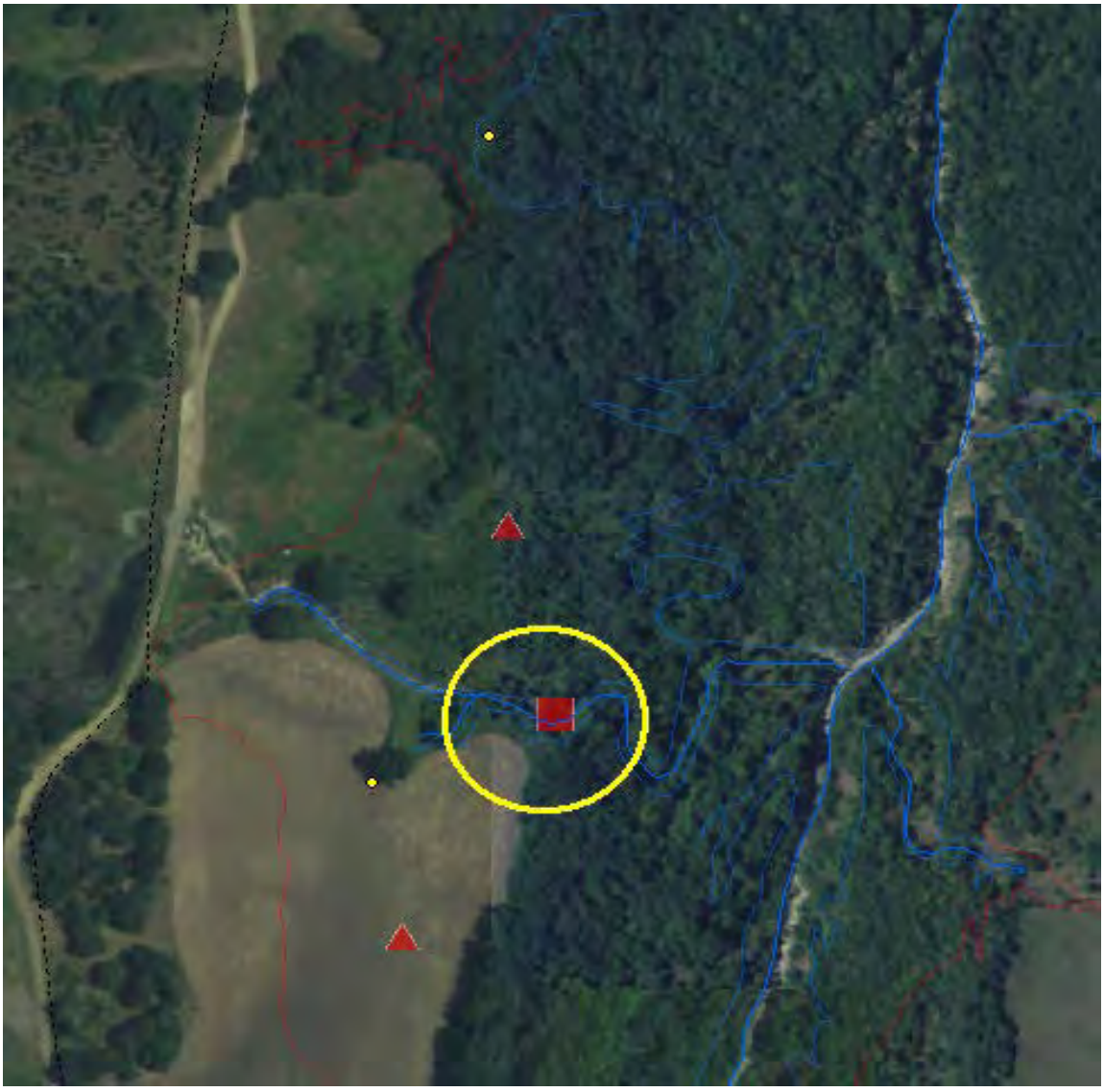
- **S16-TRIB4**

S16 TRIB 4 (2.5-5.0')

Site 7. Assessed 25 August 2009

1535 linear foot reach

Young tree and crops are the adjacent land use at and upstream of the SWAMPIM site, forest is the adjacent land use downstream of the site. Approximate 10 foot wooded riparian buffer between crops and stream



ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS S16-Trib4 (2.5-5.0')											SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.			Natural, active, downcutting.	
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (north)	10	9	8	7	6	5	4	3	2	1	0	2	
	Grade (south)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	3	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable														
	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	15			BHR =	3								
	BFD =	5												
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
												Calculation of Function Capacity Index = Total Score/Total Possible Score	0.10	
												FCI = #/100		

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS		S16-Trib4 (2.5-5.0')											
ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal			Suboptimal			Marginal			Poor			
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
	Grade (north)	10	9	8	7	6	5	4	3	2	1	0		2
	Grade (south)	10	9	8	7	6	5	4	3	2	1	0		2
												Avg.Score		2
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal			Suboptimal			Marginal			Poor			
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.			
	Grade (north)	10	9	8	7	6	5	4	3	2	1	0		2
	Grade (south)	10	9	8	7	6	5	4	3	2	1	0		2
												Avg.Score		2
Enter Score for Only One Variable	**or** 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal			Suboptimal			Marginal			Poor			
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a			Substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0		
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal			Suboptimal			Marginal			Poor			
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.			Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal			Suboptimal			Marginal			Poor			
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.			Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		
Enter Score for Only One Variable	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal			Suboptimal			Marginal			Poor			
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.			Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		1

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (north)	10	9	8	7	6	5	4	3	2	1	0		8
Grade (south)	10	9	8	7	6	5	4	3	2	1	0		8
											Avg.Score		8

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (north)	10	9	8	7	6	5	4	3	2	1	0		9
Grade (south)	10	9	8	7	6	5	4	3	2	1	0		7
											Avg.Score		8

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				
Grade (north)	10	9	8	7	6	5	4	3	2	1	0		2
Grade (south)	10	9	8	7	6	5	4	3	2	1	0		2
											Avg.Score		2

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.31
FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS S16-Trib4 (2.5-5.0')

ITEM		VARIABLES	III. HABITAT FUNCTIONS S16-Trib4 (2.5-5.0')												SCORE	Reference Source
1	1	FLOW REGIME														
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral					*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER														
			Optimal			Suboptimal			Marginal		Poor					
		Exposed roots but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization														
			Optimal			Suboptimal			Marginal		Poor					
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.					*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
4	4	POOL VARIABILITY														
			Optimal			Suboptimal			Marginal		Poor					
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent					*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
5	5	SEDIMENT DEPOSITION/SCOURING														
			Optimal			Suboptimal			Marginal		Poor					
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.					*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0		2	
6	6	CHANNEL FLOW STATUS														*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
			Optimal			Suboptimal			Marginal		Poor					
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry					
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
7	7	CHANNEL ALTERATION														
			Optimal			Suboptimal			Marginal		Poor					
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0		1	
8	8	CHANNEL SINUOSITY														
			Optimal			Suboptimal			Marginal		Poor					
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance					*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		3	

9	9	BANK STABILITY (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade (north)	10	9	8	7	6	5	4	3	2	1	0	2				
		Grade (south)	10	9	8	7	6	5	4	3	2	1	0	2				
													Avg.Score	2				
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
		Grade (north)	10	9	8	7	6	5	4	3	2	1	0	2				
		Grade (south)	10	9	8	7	6	5	4	3	2	1	0	2				
													Avg.Score	2				
11	11	RIPARIAN ZONE (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.						*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade (north)	10	9	8	7	6	5	4	3	2	1	0	9				
		Grade (south)	10	9	8	7	6	5	4	3	2	1	0	7				
													Avg.Score	8				
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)																Norfolk SAAM Form 1 Field
			Optimal			Suboptimal			Marginal			Poor						
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.					
		Grade	10	9	8	7	6	5	4	3	2	1	0					
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors												Ensure the sums of %Riparian Blocks equal 100				
		2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.																
		3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.																
			Optimal			Suboptimal			Marginal			Poor						
		%Riparian Area	50			50								100				
		North Bank Score	10			6												
		SubCl	5			3			0									
		%Riparian Area	50									50		100				
		South Bank Score	10									0						
		SubCl	5			0			0			0						
													SubCl=(%RA*Scores*0.01)					
													Rt Bank CI>	8	CI			
													LT Bank CI>	8	8			
													Calculation of Function Capacity Index = Total Score/Total Possible Score		0.26			
														FCI = #/120				

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	S16-Trib4 (2.5-5.0')				
Date:	8/25/2009				
Project:	Lake Ralph Hall				
Assessment Area:	WP 19				
Assessors:	Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.10	1,423	E	0.00125	0.18
Water Quality Improvement	0.31	1,423	E	0.00125	0.56
Habitat	0.26	1,423	E	0.00125	0.46
Total	0.67	1,423			1.19

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

S16 Trib4 (2.5-5.0')
Facing Downstream

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 6 TO 15’ PRE-PROJECT

- **S25**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

S25 (6-15')

1

PARAMETER											
	CONDITION CATEGORY GRADE or SCORE										
	Optimal			Suboptimal			Marginal		Poor		
Grade	10	9	8	7	6	5	4	3	2	1	0

Right bank- 15-100 meters North Sulphur, Left bank 15-100 meters to pasture. Sinuous, park area, trees before river and pasture.

WP 8
P 87, 86

I. HYDROLOGIC FUNCTIONS

ITEM	VARIABLES	S25 (6-15')											SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	4	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	8	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	

Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category			Pools but no flow	
	Grade	10	9	8	7	6	5	4	3	2	1	0		1	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR = 1									
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.			Pools but no flow	
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.18
													S25 FCI = #/100	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — S25 (6-15')

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal			Suboptimal			Marginal		Poor				
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	4	
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal			Suboptimal			Marginal		Poor				
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	2	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2	
	or 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal			Suboptimal			Marginal		Poor				
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal			Suboptimal			Marginal		Poor				
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal			Suboptimal			Marginal		Poor				
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal			Suboptimal			Marginal		Poor				
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		1

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		3
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		3
												Avg.Score	3

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (left)	10	9	8	7	6	5	4	3	2	1	0		5
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		5
												Avg.Score	5

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				Well covered, mostly herbaceous.
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		3
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		3
												Avg.Score	3

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.23
S25 FCI = #/80	

III. HABITAT FUNCTIONS

ITEM		VARIABLES	S25 (6-15')											SCORE	Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)			Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal		Poor				
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.				*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
6	6	CHANNEL FLOW STATUS													
			Optimal			Suboptimal			Marginal		Poor				
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry				*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.			Disturbed by stormwater.	*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
8	8	CHANNEL SINUOSITY													
			Optimal			Suboptimal			Marginal		Poor				
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance				*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	8	

9	9	BANK STABILITY (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric*t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3	2	1	0	5				
		Grade	10	9	8	7	6	5	4	3	2	1	0	3				
													Avg.Score		4			
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3	2	1	0	3				
		Grade	10	9	8	7	6	5	4	3	2	1	0	3				
													Avg.Score		3			
11	11	RIPARIAN ZONE (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.						*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	5				
		Grade	10	9	8	7	6	5	4	3	2	1	0	5				
													Avg.Score		5			
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)																Norfolk SAAM Form 1 Field
			Optimal			Suboptimal			Marginal			Poor						
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
		Grade	10	9	8	7	6	5	4	3	2	1	0					
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors													Ensure the sums of %Riparian Blocks equal 100			
		2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.																
		3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.																
			Optimal			Suboptimal			Marginal			Poor						
		%Riparian Area							100						100			
		Right Bank Score							3									
		SubCl		0			0		3									
		%Riparian Area							100						100			
		Left Bank Score							3									
		SubCl		0			0		3			0						
												SubCl=(%RA*Scores*0.01)						
												Rt Bank CI>			3	CI		
												LT Bank CI>			3	3		
												Calculation of Function Capacity Index = Total Score/Total Possible Score				0.24		
												S25 FCI = #/120						

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
S25 (6-15')					
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 8				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject	____Postproject			
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.18	2,772	E	0.00125	0.62
Water Quality Improvement	0.23	2,772	E	0.00125	0.78
Habitat	0.24	2,772	E	0.00125	0.84
Total	0.65	2,772			2.24

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

Pasture outside of riparian zone. Rip zone 20m or less.

S25 (6-15')
facing upstream. 5/17/2006

S25 (6-15')
facing upstream. 5/17/2006

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 16 TO >25’ PRE-PROJECT

- **S21**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

S21 (16-25')

1

PARAMETER												
	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
Grade	10	9	8	7	6	5	4	3	2	1	0	

Right bank- 15-10 meters to pasture, Left bank 15-30 meters to row crop. Few trees before pasture and crops.

WP 6
P 91, 90

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS	S21 (16-25')										SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	3	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	3	

	3b. Bottom Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal			Poor			
		Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable			Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1	
Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal			Poor			
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category			Channel bottom includes <3 of the items listed in Optimal Category			
	Grade	10	9	8	7	6	5	4	3	2	1	0		1	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal			Poor			
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15			0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal			Poor			
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0			
	TLB =	10			BHR =	1								
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0		2
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal			Poor			
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.			Pools absent, or the entire bottom is discernible. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal			Poor			
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.			Very little water in channel and mostly present as standing pools. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.11
													FCI = #/100	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — S21 (16-25')

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal			Suboptimal			Marginal		Poor				
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	3	
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal			Suboptimal			Marginal		Poor				
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score	0	
	or 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal			Suboptimal			Marginal		Poor				
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal			Suboptimal			Marginal		Poor				
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal			Suboptimal			Marginal		Poor				
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal			Suboptimal			Marginal		Poor				
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		2

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		4
												Avg.Score	3

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (left)	10	9	8	7	6	5	4	3	2	1	0		4
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		4
												Avg.Score	4

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		4
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		4
												Avg.Score	4

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.21
FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS S21 (16-25')

ITEM	VARIABLES	III. HABITAT FUNCTIONS	S21 (16-25')										SCORE	Source
1	1	FLOW REGIME												
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER												
			Optimal			Suboptimal			Marginal		Poor			
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)			Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.			*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization												
			Optimal			Suboptimal			Marginal		Poor			
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.			*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1
4	4	POOL VARIABILITY												
			Optimal			Suboptimal			Marginal		Poor			
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent			*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0
5	5	SEDIMENT DEPOSITION/SCOURING												
			Optimal			Suboptimal			Marginal		Poor			
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.			*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1
6	6	CHANNEL FLOW STATUS												
			Optimal			Suboptimal			Marginal		Poor			*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry			
		Grade	10	9	8	7	6	5	4	3	2	1	0	0
7	7	CHANNEL ALTERATION												
			Optimal			Suboptimal			Marginal		Poor			
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.			*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2
8	8	CHANNEL SINUOSITY												
			Optimal			Suboptimal			Marginal		Poor			
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance			*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	3

9	9	BANK STABILITY (SCORE EACH BANK)													
			Optimal			Suboptimal			Marginal			Poor			
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric*t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3	2	1	0	4	
		Grade	10	9	8	7	6	5	4	3	2	1	0	4	
													Avg.Score		4
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)													
			Optimal			Suboptimal			Marginal			Poor			
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.			*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3	2	1	0	3	
		Grade	10	9	8	7	6	5	4	3	2	1	0	3	
													Avg.Score		3
11	11	RIPARIAN ZONE (SCORE EACH BANK)													
			Optimal			Suboptimal			Marginal			Poor			
			Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.			*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	4	
		Grade	10	9	8	7	6	5	4	3	2	1	0	4	
													Avg.Score		4
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)													
			Optimal			Suboptimal			Marginal			Poor			
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.			Norfolk SAAM Form 1 Field
		Grade	10	9	8	7	6	5	4	3	2	1	0	3	
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors 2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this. 3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.											Ensure the sums of %Riparian Blocks equal 100		
			Optimal			Suboptimal			Marginal			Poor			
		Right Bank %Riparian Area							100				100		
		Right Bank Score							3						
		Right Bank SubCI	0			0			3						
		Left Bank %Riparian Area							100				100		
		Left Bank Score							3						
		Left Bank SubCI	0			0			3			0			
												SubCI=(%RA*Scores*0.01)			
												Rt Bank CI>	3	CI	
												LT Bank CI>	3	3	
												Calculation of Function Capacity Index = Total Score/Total Possible Score		0.18	
													FCI = #/120		

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
S21 (16-25')					
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 6				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject	____Postproject			
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.11	1,026	E	0.00125	0.14
Water Quality Improvement	0.21	1,026	E	0.00125	0.27
Habitat	0.18	1,026	E	0.00125	0.22
Total	0.50	1,026			0.64

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

Pasture outside of riparian zone. Rip zone 20m or less.

S21 (16-25') facing downstream.
5/17/2006

S21 (16-25' facing upstream.
5/17/2006

SWAMPIM DATASHEETS – NORTH SULPHUR RIVER PRE-PROJECT

- **NSR @ SH 34**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

05\05\2006 NSR @ Highway 34 Bridge

1

PARAMETER												
	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
Grade	10	9	8	7	6	5	4	3	2	1	0	

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS			NSR @ Highway 34 Bridge			05\05\2006					SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	4	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR = 1									
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.07
													FCI = #/100	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS		05\05\2006		NSR @ Highway 34 Bridge									
ITEM	VARIABLES												SCORE
	TYPE												
	NOTES												
1.	SEDIMENT TRANSPORT/DEPOSITION												
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0
												Avg.Score	0
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.			
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	1
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	1
												Avg.Score	1
	or 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable			
	Grade	10	9	8	7	6	5	4	3	2	1	0	
2	WATER APPEARANCE: Clarity or Visibility												
	Water Clarity	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	2
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage												
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1
	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	

Reference Source

Newton, et al., 1998 USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA

Galli, 1996 Wash-COG RSAT No. 1

Barbour, et al., 1999 ; Petersen, et al., 1992

Newton, et al., 1998 USDA/ NRCS SVAP page 11

Newton, et al., 1998 USDA/ NRCS SVAP page 12

Petersen, et al., 1992 RCE form No. 13

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring				
Grade	10	9	8	7	6	5	4	3	2	1	0		2

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		0
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		0
												Avg.Score	0

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.				
Grade (left)	10	9	8	7	6	5	4	3	2	1	0		2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		2
												Avg.Score	2

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness

	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		1
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		1
												Avg.Score	1

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.11
FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS 05\05\2006 NSR @ Highway 34 Bridge

ITEM	VARIABLES	III. HABITAT FUNCTIONS	05\05\2006	NSR @ Highway 34 Bridge	SCORE	Reference Source
1	1	FLOW REGIME				
		TYPE: Perennial (10, 9, 8) | Intermittent w/ Perennial Pools (7, 6, 5) | Intermittent (4, 3) | Ephemeral (2, 1, 0)			4	*KDWP, 2000*
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER				
		Optimal: Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization (10, 9, 8)	Suboptimal: Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.) (7, 6, 5)	Marginal: Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.) (4, 3)	Poor: Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat. (2, 1, 0)		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
		Optimal: Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common. (10, 9, 8)	Suboptimal: Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present. (7, 6, 5)	Marginal: All mud or clay or sand bottom; little or no root mat; no submerged vegetation. (4, 3)	Poor: Hard pan clay or bedrock; no root mat or submerged vegetation. (2, 1, 0)										*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
4	4	POOL VARIABILITY													
		Optimal: Even mix of large-shallow, large-deep, small-shallow, small-deep pools present (10, 9, 8)	Suboptimal: Majority of pools large-deep; very few shallow. (7, 6, 5)	Marginal: Shallow pools much more prevalent than deep pools (4, 3)	Poor: Majority of pools small-shallow or pools absent (2, 1, 0)										*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
5	5	SEDIMENT DEPOSITION/SCOURING													
		Optimal: <5% of channel bottom affected by scour or deposition. (10, 9, 8)	Suboptimal: 5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools (7, 6, 5)	Marginal: 30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. (4, 3)	Poor: More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring. (2, 1, 0)										*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
6	6	CHANNEL FLOW STATUS													*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
		Optimal: Water reaches the base of both lower banks; <5% of channel substrate is exposed (10, 9, 8)	Suboptimal: Water fills >75% of the channel; or <25% of channel substrate is exposed (7, 6, 5)	Marginal: Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed (4, 3)	Poor: Very little water in the channel and mostly present in standing pools; or stream is dry (2, 1, 0)										
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
7	7	CHANNEL ALTERATION													
		Optimal: Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal (10, 9, 8)	Suboptimal: Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs. (7, 6, 5)	Marginal: Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered. (4, 3)	Poor: Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered. (2, 1, 0)										*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	

8	8	CHANNEL SINUOSITY																
			Optimal			Suboptimal			Marginal			Poor						
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line			Channel straight; waterway has been channelized for a long distance					*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3		2	1	0			0	
9	9	BANK STABILITY (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3		2	1	0			0	
		Grade	10	9	8	7	6	5	4	3		2	1	0			0	
													Avg.Score				0	
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS ; *KDWP 2000* ; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3		2	1	0			1	
		Grade	10	9	8	7	6	5	4	3		2	1	0			1	
													Avg.Score				1	
11	11	RIPARIAN ZONE (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3		2	1	0			2	
		Grade	10	9	8	7	6	5	4	3		2	1	0			2	
													Avg.Score				2	
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)																Norfolk SAAM Form 1 Field
			Optimal			Suboptimal			Marginal			Poor						
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.					
		Grade	10	9	8	7	6	5	4	3		2	1	0			Below	
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors															Ensure the sums of	
		2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.															%Riparian Blocks	
		3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.															equal 100	
			Optimal			Suboptimal			Marginal			Poor						
		%Riparian Area										100						
		Right Bank Score										2						
		SubCI	0			0			0			2						
		%Riparian Area				60			40							100		
		Left Bank Score				5			3									
		SubCI	0			3			1.2			0						
												SubCI=(%RA*Scores*0.01)						
												Rt Bank CI>				2	CI	
												LT Bank CI>				4.2	3.1	
															Calculation of Function Capacity Index = Total Score/Total Possible Score		0.13	
															FCI = #/120			

Record of Functional Assessment Results

Stream Functional Capacity Calculation

Date:	5/5/2006
Project:	Lake Ralph Hall
Assessment Area:	Highway 34 bridge
Assessors:	Holmes, Voight, Capps
Project Status:	__X__Preproject ____Postproject

Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.07		I	0.0025	0.00
Water Quality Improvement	0.11		I	0.0025	0.00
Habitat	0.13		I	0.0025	0.00
Total	0.31	55,570*			0.00

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

*FCI scores for NSR (SH 34) and NSR (FM 2990) averaged then multiplied by linear feet of NSR impacted by conservation pool, dam, spillway:
(0.31 + 0.39)/2 = 0.35; 0.35 X 55,570 X 0.0025 = 48.62 FC

NSR Hwy 34 facing upstream. 5/05/2006

NSR Hwy 34 facing downstream. 5/05/2006

SWAMPIM DATASHEETS – NORTH SULPHUR RIVER PRE-PROJECT

- **NSR @ FM 2990**

ITEM	VARIABLE FUNCTION CATEGORY												SCORE	Reference Source
	NSR 2			05\10\2006			NSR @ Highway 2990 Bridge							
1	PARAMETER													
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal			Poor			
	Grade	10	9	8	7	6	5	4	3	2	1	0		

Active erosion
Channel width 50 meters
Waypoint 24
Pictures 39, 38

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS				NSR @ FM 2990		05\05\2006					SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	5	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR = 1									
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0		0
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		2
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		1
													Calculation of Function Capacity Index = Total Score/Total Possible Score	0.08
													FCI = #/100	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS 05\05\2006 NSR @ FM 2990

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
	1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Optimal			Suboptimal			Marginal		Poor				
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE												*Galli, 1996* Wash-COG RSAT No. 1
		Optimal			Suboptimal			Marginal		Poor				
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
	or 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		Optimal			Suboptimal			Marginal		Poor				
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
2	WATER APPEARANCE: Clarity or Visibility													
	Water Clarity	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Optimal			Suboptimal			Marginal		Poor				
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	6	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable	3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Optimal			Suboptimal			Marginal		Poor				
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		Optimal			Suboptimal			Marginal		Poor				
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
	Mainly consisting of leaves and wood without sediment.			Leaves and wood scarce; fine organic debris without sediment.			No leaves or woody debris; coarse and fine organic matter with sediment.		Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring			
Grade	10	9	8	7	6	5	4	3	2	1	0	0

Petersen, et al., 1992 RCE form No. 15

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.			Permanent pasture mixed with woodlots and swamps, few row crops			Mixed row crops and pasture; some wooded areas may be present but as isolated patches		Mainly row crops			
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2
											Avg.Score	2

Petersen, et al., 1992 RCE form No. 1

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

6a. Riparian Zone Width (from stream edge to field)	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
	Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.			
Grade (left)	10	9	8	7	6	5	4	3	2	1	0	2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2
											Avg.Score	2

Barbour, et al., RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/ NRCS

6b. Riparian Zone Vegetation Protection/ Completeness	CONDITION CATEGORY GRADE or SCORE											
	Optimal			Suboptimal			Marginal		Poor			
	>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/mowing minimal.			75-90% streambank vegetation, mixed young species along channel and mature trees behind; disruption evident with breaks occurring at intervals of >50 meters.			50-75% streambank vegetation of mixed grasses and sparse young tree or shrub species; breaks frequent with some gullies and scars every 50 meters.		Less than 50% streambank vegetation coverage consisting mostly of pasture grasses, few trees & shrubs; low plant density; bank deeply scarred with gullies all along its length.			
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	2
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2
											Avg.Score	2

Barbour, et al., 1999 RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.18
FCI = #/80	

ITEM	VARIABLES	III. HABITAT FUNCTIONS	05\05\2006	NSR @ FM 2990	SCORE	Reference Source
1	1 FLOW REGIME					

TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			
Grade	10	9	8	7	6	5	4	3	2	1	0	5

KDWP, 2000

2	2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER												
	Optimal			Suboptimal			Marginal			Poor			
	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.			
Grade	10	9	8	7	6	5	4	3	2	1	0	1

USACE Norfolk, 2004 SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS

3	3 STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization												
	Optimal			Suboptimal			Marginal			Poor			
	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.			Hard pan clay or bedrock; no root mat or submerged vegetation.			
Grade	10	9	8	7	6	5	4	3	2	1	0	1

Barbour, et al. 1999 RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS

4	4 POOL VARIABILITY												
	Optimal			Suboptimal			Marginal			Poor			
	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools			Majority of pools small-shallow or pools absent			
Grade	10	9	8	7	6	5	4	3	2	1	0	2

Barbour, et al. 1999 RBA #3b page 5-16; *Parsons, et al., 2001*

5	5 SEDIMENT DEPOSITION/SCOURING												
	Optimal			Suboptimal			Marginal			Poor			
	<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.			More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.			
Grade	10	9	8	7	6	5	4	3	2	1	0	1

Barbour, et al. 1999 RBA #4 page 5-17; *Parsons, et al., 2001*

6	6 CHANNEL FLOW STATUS												
	Optimal			Suboptimal			Marginal			Poor			
	Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed			Very little water in the channel and mostly present in standing pools; or stream is dry			
Grade	10	9	8	7	6	5	4	3	2	1	0	1

TCEQ, 1999 HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*

7	7 CHANNEL ALTERATION												
	Optimal			Suboptimal			Marginal			Poor			
	Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.			Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.			
Grade	10	9	8	7	6	5	4	3	2	1	0	0

USACE Norfolk District, 2004 SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001*

8	8	CHANNEL SINUOSITY																
			Optimal			Suboptimal			Marginal			Poor						
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line			Channel straight; waterway has been channelized for a long distance					*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0				
9	9	BANK STABILITY (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods			Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric*t, 2004 SAM #3; Scholz and Booth from Henshaw,
		Grade	10	9	8	7	6	5	4	3	2	1	0	0				
		Grade	10	9	8	7	6	5	4	3	2	1	0	0				
												Avg.Score		0				
10	10	VEGETATIVE PROTECTION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.					*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2				
		Grade	10	9	8	7	6	5	4	3	2	1	0	2				
												Avg.Score		2				
11	11	RIPARIAN ZONE (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.					*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	2				
		Grade	10	9	8	7	6	5	4	3	2	1	0	2				
												Avg.Score		2				
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)																
			Optimal			Suboptimal			Marginal			Poor						
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.			Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.					Norfolk SAAM Form 1 Field
		Grade	10	9	8	7	6	5	4	3	2	1	0	1				
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors 2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this. 3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.												Ensure the sums of %Riparian Blocks equal 100				
			Optimal			Suboptimal			Marginal			Poor						
		Right Bank %Riparian Area										100		100				
		Right Bank Score										2						
		Right Bank SubCI	0			0			0			1						
		Left Bank %Riparian Area										100		100				
		Left Bank Score										1						
		Left Bank SubCI	0			0			0			1						
												SubCI=(%RA*Scores*0.01)						
												Rt Bank CI>		1	**CI**			
												LT Bank CI>		1	1			
												Calculation of Function Capacity Index = Total Score/Total Possible Score			0.13			
														FCI = #/120				

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	NSR 2 (135)				
Date:	5/10/2006				
Project:	Lake Ralph Hall				
Assessment Area:	North Sulphur River, Approx 1/4 mile upstream of 2990 Bridge				
Assessors:	Holmes, Voight, Capps				
Project Status:	__X__Preproject	____Postproject			
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.08		I	0.0025	0.00
Water Quality Improvement	0.18		I	0.0025	0.00
Habitat	0.13		I	0.0025	0.00
Total	0.39	55,570*			0.00

*Stream Length is the length of the Stream Assessment Reach (SAR)
**Multiplication Factors
Ephemeral = 0.00125
Intermittent = 0.0025
Perennial = 0.0038

*FCI scores for NSR (SH 34) and NSR (FM 2990) averaged then multiplied by linear feet of NSR impacted by conservation pool, dam, spillway:
(0.31 + 0.39)/2 = 0.35; 0.35 X 55,570 X 0.0025 = 48.62 FC

NSR @ FM 2990
facing downstream. 5/10/2006

NSR @ FM 2990

IMPOUNDMENTS

SWAMPIM DATASHEETS

SWAMPIM DATASHEETS – PONDS PRE-PROJECT

Small Pond (On-channel) < 1 acre OCP-5

Impoundment Evaluation from Kansas Department of Wildlife and Parks, Subjective Evaluation of Aquatic Habitats
Developed by : Kansas Department of Wildlife & Parks, Environmental Services Section (Revised 2004)
with minor modifications to address conditions in North Central Texas

Impoundment Habitat Evaluation

OCP-5 (≤1 acre)

SCORE

A.	PHYSICAL HABITAT KEY												
	1.Shoreline Development	CONDITION CATEGORY GRADE or SCORE (perimeter of impoundment/perimeter of circle of equal area)											
		High > or = 2.5					Medium 1.5 - 2.4			Low 1.0-1.4			
	Grade	10	9	8	7	6	5	4	3	2	1	0	2
	2.Average Depth	CONDITION CATEGORY GRADE or SCORE											
		> 10 feet					3 - 10 feet			< 3 feet			
	Grade	10	9	8	7	6	5	4	3	2	1	0	
	3.Annual Storage Ratio	CONDITION CATEGORY GRADE or SCORE											2
		1 - 2			> 2			< 1					
	Grade	5			4		3		2		1	0	1
	4.Substrate	CONDITION CATEGORY GRADE or SCORE (select two predominant types in littoral zone and average the score)											
		Boulder/Cobble			Gravel		Sand (< 0.1")		Bedrock		Mud/Detritus/Muck		
	Grade	5			4		3		2		1	0	0
	5.Number of substrate types in littoral zone	CONDITION CATEGORY GRADE or SCORE											
		4 or more			3 types present				2 types present		1 type present		
	Grade	5			4		3		2		1	0	1
	6.Amount of Cover	CONDITION CATEGORY GRADE or SCORE (aquatic vegetation, flooded timber, woody debris, large boulders, rock outcrops, overhanging vegetation, man-made structures)											
		Extensive (>75%)		Abundant (50-75%)		Moderate (25-50%)		Sparse (5-25%)		Little or none (0-5%)			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1
	7.Native vegetation buffer	CONDITION CATEGORY GRADE or SCORE											
		> 50 meters		10 - 50 meters		5 - 10 meters		1 - 5 meters				None	
	Grade	5		4		3		2		1		0	0
	8.Bank erosion	CONDITION CATEGORY GRADE or SCORE											
		Stable banks w/little sloughing				Moderate erosion due to livestock				Severe active erosion along			
	Grade	5		4		3		2		1		0	3
	Total for the physical habitat components (max 54.5)												10
B.	WATERSHED LAND USE AND MANAGEMENT KEY												
	1.Management Strategies	CONDITION CATEGORY GRADE or SCORE											
		Fish fences		Livestock exclusion		Drawdowns		Downstream flow augmentation		Fish feeders		Other (I.e. harvest restrictions, nuisance species control, etc)	
	Grade	+1		+1		+1		+1		+1			0
	Total												
	2. Watershed Land Uses (Describe the extent of land use in the upstream watershed)												
	2a.Minimal impact land uses	CONDITION CATEGORY GRADE or SCORE (Ungrazed native vegetation (I.e. woodlands, native grass, wetlands), good grazing practices, cropland w/ good to excellent conservation											
		Entire		Abundant		Common		Moderate		Sparse		None	
	Grade	+5		+4		+3		+2		+1		0	3
	2b.Significant impact land uses	CONDITION CATEGORY GRADE or SCORE (Poor grazing practices, cropland w/ fair to poor conservation practices, urban, industrial, commercial, residential.											
		Entire		Abundant		Common		Moderate		Sparse		None	
	Grade	-5		-4		-3		-2		-1		0	0
	Total for the watershed/management (max 10)												3
C.	BIOLOGICAL COMPONENT KEY												
	1.Fish characteristics	CONDITION CATEGORY GRADE or SCORE (If problem or exotic fish dominant Score is -5)											
		High quality sport		Pan & predaceous		Minnows/panfish/roughfish				Minnows/roughfish		No fish	
	Grade	10	9	8	7	6	5	4	3	2	1	0	3

	2.Aquatic insects	CONDITION CATEGORY GRADE or SCORE						
		> 3 orders present		1 -3 orders present			None	
	Grade	5	4	3	2	1	0	3
	3.Mollusc/ Crayfish	CONDITION CATEGORY GRADE or SCORE						
		Common/Abundant		Sparse	None	Zebra mussels present		
	Grade	3	2	1	0	-5		1
	4.Other aquatic/semi-aquatic vertebrates	CONDITION CATEGORY GRADE or SCORE						
		Common/Abundant		Sparse	None	Nutria present		
	Grade	3	2	1	0	-5		1
	Total for the biological components (max 21)							8
D.	WATER QUALITY COMPONENT KEY							
	1.DO/BOD	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		2
	2.Nutrient enrichment	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		0
	3.Pesticides	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		3
	4.Turbidity	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		0
	5.Temperature	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		2
	6.Other (if applicable)	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		0
	Total for the water quality components (max 15)							7
TOTAL SCORE "RCI" = (PHYSICAL + WATERSHED/MANAGEMENT + BIOLOGICAL + WATER QUALITY)/100								0.28

Impoundment Habitat Evaluation OCP-5 (0.5-2), Small Pond

E. Impoundment Characterisics (attach to aquatic habitat summary):

Watershed Area = _____

Shoreline Perimeter: = 1,290 feet

Impoundment Area = 51,490 square feet
(permanent pool) 0.92 acres

SDI (shoreline dev. Ratio) = 1.603701

Project Comments: alternatives possible to accomplish project goals & lessen adverse impacts on habitat

Fish - If sampled check method: _____ seining; _____ dip-net; _____ electrofishing
Species

Other Aquatic/Semi-Aquatic Vertebrates:

Mussels:

T/E Species Known/Likely to Occur:

Record of Functional Assessment Results

Impoundments/Reservoir Functional Capacity Calculation					
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Location:	OCP-5 Small Pond, WP2 (≤ 1 acre)				
Circle One: Small Pond (≤1 acre) Pond (>1≤ 5 acres) Lake (>5 < 500 acres) Reservoir (>500 acres)					
Represented Acreage:	11.92 Total acreage of all impoundments represented by site				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject ____Postproject				
Major Function Categories	Score	RCI	Acreage	Multiplication Factor*	RC
Physical Habitat	10				
Watershed/Management	3				
Biological	8				
Water Quality	7				
Total Score	28	0.28	8.06	1.5	3.4
*Multiplication Factors	Ref: Table A-2 of SJD Report included in Mitigation Plan Appendix B				
Small Pond = 1.5	Note: OCP-5 is representative of 22 small ponds within conservation pool				
Pond = 1.3	of LRH totaling 8.06 acres plus 10 ponds outside conservation pool				
Lake = 1.1	totaling 3.86 acres; overall total of small ponds is 11.92 acres.				
Reservoir = 1.04	RCI Formula (Physical + Watershed/Management + Biological + Water Quality) / 100				
	RC = RCI X Acreage X Multiplication Factor				

Pasture outside of riparian zone. Rip zone 20m or less.

SWAMPIM DATASHEETS – PONDS PRE-PROJECT

Ponds (On-channel) >1 ≤5 acres: OCP10

Impoundment Evaluation from Kansas Department of Wildlife and Parks, Subjective Evaluation of Aquatic Habitats
Developed by : Kansas Department of Wildlife & Parks, Environmental Services Section (Revised 2004)
with minor modifications to address conditions in North Central Texas

OCP-10 2.89 acres

Impoundment Habitat Evaluation

Surrounded by pasture. Few trees. WP 15 P69, 68

													SCORE
A.	PHYSICAL HABITAT KEY												
	1.Shoreline Development	CONDITION CATEGORY GRADE or SCORE											
		(perimeter of impoundment/perimeter of circle of equal area)											
		High > or = 2.5					Medium 1.5 - 2.4			Low 1.0-1.4			
	Grade	10	9	8	7	6	5	4	3	2	1	0	2
	2.Average Depth	CONDITION CATEGORY GRADE or SCORE											
		> 10 feet					3 - 10 feet			< 3 feet			
	Grade	10	9	8	7	6	5	4	3	2	1	0	3
	3.Annual Storage Ratio	CONDITION CATEGORY GRADE or SCORE											
		1 - 2			> 2				< 1				
	Grade	5			4			3		2	1	0	2
	4.Substrate	CONDITION CATEGORY GRADE or SCORE											
		(select two predominant types in littoral zone and average the score)											
		Boulder/Cobble (>		Gravel			Sand (< 0.1")			Bedrock		Mud/Detritus/Muck	
	Grade	5			4			3		2	1	0	1
	5.Number of substrate types in littoral zone	CONDITION CATEGORY GRADE or SCORE											
		4 or more			3 types present				2 types present		1 type present		
	Grade	5			4			3		2	1	0	1
	6.Amount of Cover	CONDITION CATEGORY GRADE or SCORE											
		(aquatic vegetation, flooded timber, woody debris, large boulders, rock outcrops, overhanging vegetation, man-made structures)											
		Extensive (>75%)		Abundant (50-75%)			Moderate (25-50%)			Sparse (5-25%)		Little or none (0-5%)	
	Grade	10	9	8	7	6	5	4	3	2	1	0	3
	7.Native vegetation buffer	CONDITION CATEGORY GRADE or SCORE											
		> 50 meters		10 - 50 meters			5 - 10 meters			1 - 5 meters		None	
	Grade	5			4			3		2	1	0	3
	8.Bank erosion	CONDITION CATEGORY GRADE or SCORE											
		Stable banks w/little sloughing					Moderate erosion due to livestock			Severe active erosion along			
	Grade	5			4			3		2	1	0	3
	Total for the physical habitat components (max 54.5)												18
B.	WATERSHED LAND USE AND MANAGEMENT KEY												
	1.Management Strategies	CONDITION CATEGORY GRADE or SCORE											
		Fish fences		Livestock exclusion			Drawdowns			Downstream flow augmentation		Fish feeders	Other (I.e. harvest restrictions, nuisance species control, etc)
	Grade	+1			+1			+1		+1		+1	0
	Total												
	2. Watershed Land Uses (Describe the extent of land use in the upstream watershed)												
	2a.Minimal impact land uses	CONDITION CATEGORY GRADE or SCORE											
		Ungrazed native vegetation (I.e. woodlands, native grass, wetlands), good grazing practices, cropland w/ good to excellent conservation											
		Entire		Abundant			Common			Moderate		Sparse	None
	Grade	+5			+4			+3		+2		+1	0	2
	2b.Significant impact land uses	CONDITION CATEGORY GRADE or SCORE											
		Poor grazing practices, cropland w/ fair to poor conservation practices, urban, industrial, commercial, residential.											
		Entire		Abundant			Common			Moderate		Sparse	None
	Grade	-5			-4			-3		-2		-1	0	-3
	Total for the watershed/management (max 10)												-1
C.	BIOLOGICAL COMPONENT KEY												

	1.Fish characteristics	CONDITION CATEGORY GRADE or SCORE (If problem or exotic fish dominant Score is -5)											
		High quality sport		Pan & predaceous		Minnows/panfish/roughfish				Minnows/roughfish		No fish	
	Grade	10	9	8	7	6	5	4	3	2	1	0	7
	2.Aquatic insects	CONDITION CATEGORY GRADE or SCORE											
		> 3 orders present				1 -3 orders present						None	
	Grade	5		4		3		2		1		0	4
	3.Mollusc/ Crayfish	CONDITION CATEGORY GRADE or SCORE											
		Common/Abundant				Sparse		None		Zebra mussels present			
	Grade	3		2		1		0		-5			1
	4.Other aquatic/semi-aquatic vertebrates	CONDITION CATEGORY GRADE or SCORE											
		Common/Abundant				Sparse		None		Nutria present			
	Grade	3		2		1		0		-5			1
	Total for the biological components (max 21)												13
D.	WATER QUALITY COMPONENT KEY												
	1.DO/BOD	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	3
	2.Nutrient enrichment	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	2
	3.Pesticides	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	3
	4.Turbidity	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	3
	5.Temperature	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	3
	6.Other (if applicable)	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2				1		0	
	Total for the water quality components (max 15)												14
	TOTAL SCORE "RCI" = (PHYSICAL + WATERSHED/MANAGEMENT + BIOLOGICAL + WATER QUALITY)/100												0.44

OCP-10 (2.89 acres)

E. Impoundment Characterisics (attach to aquatic habitat summary):

Watershed Area = _____ Shoreline Perimeter: = 1,961 feet

Impoundment Area = 125,888 square feet SDI (shoreline dev. Ratio) = 1.559124
(permanent pool) 2.89 acres

Project Comments: alternatives possible to accomplish project goals & lessen adverse impacts on habitat

Fish - If sampled check method: _____ seining; _____ dip-net; _____ electrofishing

Species

Other Aquatic/Semi-Aquatic Vertebrates:

Mussels:

T/E Species Known/Likely to Occur:

Record of Functional Assessment Results

Impoundments/Reservoir Functional Capacity Calculation					
Date:	5/18/2006				
Project:	Lake Ralph Hall				
Location:	OCP-10 (2.89 acres)				
Circle One: Small Pond (≤1 acre) Pond (>1≤ 5 acres) Lake (>5 < 500 acres) Reservoir (>500 acres)					
Represented Acreage:	26.2 Total acreage of all impoundments represented by site				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject ____Postproject				
Major Function Categories	Score	RCI	Acreage	Multiplication Factor*	RC
Physical Habitat	18				
Watershed/Management	-1				
Biological	13				
Water Quality	14				
Total Score	44	0.44	16.36	1.3	9.4
*Multiplication Factors	Ref: Table A-2 of SJD Report included in Mitigation Plan Appendix B				
Small Pond = 1.5	Note: OCP-10 is one representative of 9 ponds within LRH conservation				
Pond = 1.3	pool totaling 16.36 acres plus 4 ponds outside conservation pool				
Lake = 1.1	totaling 9.84 acres; overall total of ponds is 26.2 acres.				
Reservoir = 1.04	RCI Formula (Physical + Watershed/Management + Biological + Water Quality) / 100				
	RC = RCI X Acreage X Multiplication Factor				

OCP-10. 5/19/2006

SWAMPIM DATASHEETS – PONDS PRE-PROJECT

Ponds (On-channel) >1 ≤5 acres: UP67

Impoundment Evaluation from Kansas Department of Wildlife and Parks, Subjective Evaluation of Aquatic Habitats
Developed by : Kansas Department of Wildlife & Parks, Environmental Services Section (Revised 2004)
with minor modifications to address conditions in North Central Texas

UP-67 (3.2 acres)

Impoundment Habitat Evaluation | Surrounded by pasture. Few trees. | WP 15 | P69, 68 | SCORE

A.	PHYSICAL HABITAT KEY											
	1.Shoreline Development	CONDITION CATEGORY GRADE or SCORE										
		(perimeter of impoundment/perimeter of circle of equal area)										
		High > or = 2.5					Medium 1.5 - 2.4			Low 1.0-1.4		
	Grade	10	9	8	7	6	5	4	3	2	1	0	2
	2.Average Depth	CONDITION CATEGORY GRADE or SCORE										
		> 10 feet					3 - 10 feet			< 3 feet		
	Grade	10	9	8	7	6	5	4	3	2	1	0	3
	3.Annual Storage Ratio	CONDITION CATEGORY GRADE or SCORE										
		1 - 2			> 2				< 1			
	Grade	5			4			3		2	1	0	2
	4.Substrate	CONDITION CATEGORY GRADE or SCORE										
		(select two predominant types in littoral zone and average the score)										
		Boulder/Cobble (>			Gravel		Sand (< 0.1")		Bedrock	Mud/Detritus/Muck		
	Grade	5			4		3		2	1	0	1
	5.Number of substrate types in littoral zone	CONDITION CATEGORY GRADE or SCORE										
		4 or more			3 types present				2 types present	1 type present		
	Grade	5			4		3		2	1	0	1
	6.Amount of Cover	CONDITION CATEGORY GRADE or SCORE										
		(aquatic vegetation, flooded timber, woody debris, large boulders, rock outcrops, overhanging vegetation, man-made structures)										
		Extensive (>75%)		Abundant (50-75%)		Moderate (25-50%)		Sparse (5-25%)		Little or none (0-5%)		
	Grade	10	9	8	7	6	5	4	3	2	1	0	0
	7.Native vegetation buffer	CONDITION CATEGORY GRADE or SCORE										
		> 50 meters		10 - 50 meters		5 - 10 meters		1 - 5 meters			None	
	Grade	5		4		3		2		1	0	0
	8.Bank erosion	CONDITION CATEGORY GRADE or SCORE										
		Stable banks w/little sloughing				Moderate erosion due to livestock				Severe active erosion along		
	Grade	5		4		3		2		1	0	0
	Total for the physical habitat components (max 54.5)											9
B.	WATERSHED LAND USE AND MANAGEMENT KEY											
	1.Management Strategies	CONDITION CATEGORY GRADE or SCORE										
		Fish fences		Livestock exclusion		Drawdowns		Downstream flow augmentation		Fish feeders	Other (I.e. harvest restrictions, nuisance species control, etc)	
	Grade	+1		+1		+1		+1		+1		0
	Total											
	2. Watershed Land Uses (Describe the extent of land use in the upstream watershed)											
	2a.Minimal impact land uses	CONDITION CATEGORY GRADE or SCORE										
		Ungrazed native vegetation (I.e. woodlands, native grass, wetlands), good grazing practices, cropland w/ good to excellent conservation										
		Entire		Abundant		Common		Moderate		Sparse	None	
	Grade	+5		+4		+3		+2		+1	0	0
	2b.Significant impact land uses	CONDITION CATEGORY GRADE or SCORE										
		Poor grazing practices, cropland w/ fair to poor conservation practices, urban, industrial, commercial, residential.										
		Entire		Abundant		Common		Moderate		Sparse	None	
	Grade	-5		-4		-3		-2		-1	0	-3
	Total for the watershed/management (max 10)											-3
C.	BIOLOGICAL COMPONENT KEY											

	1.Fish characteristics	CONDITION CATEGORY GRADE or SCORE (If problem or exotic fish dominant Score is -5)											
		High quality sport		Pan & predaceous		Minnows/panfish/roughfish				Minnows/roughfish		No fish	
	Grade	10	9	8	7	6	5	4	3	2	1	0	3
	2.Aquatic insects	CONDITION CATEGORY GRADE or SCORE											
		> 3 orders present				1 -3 orders present						None	
	Grade	5		4		3		2		1		0	1
	3.Mollusc/ Crayfish	CONDITION CATEGORY GRADE or SCORE											
		Common/Abundant				Sparse		None		Zebra mussels present			
	Grade	3		2		1		0		-5			1
	4.Other aquatic/semi-aquatic vertebrates	CONDITION CATEGORY GRADE or SCORE											
		Common/Abundant				Sparse		None		Nutria present			
	Grade	3		2		1		0		-5			1
	Total for the biological components (max 21)												6
D.	WATER QUALITY COMPONENT KEY												
	1.DO/BOD	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	0
	2.Nutrient enrichment	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	0
	3.Pesticides	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	3
	4.Turbidity	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	0
	5.Temperature	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	1
	6.Other (if applicable)	CONDITION CATEGORY GRADE or SCORE											
		Rarely Limiting				Occasionally Limiting						Frequently Limiting	
	Grade	3				2		1				0	
	Total for the water quality components (max 15)												4
TOTAL SCORE "RCI" = (PHYSICAL + WATERSHED/MANAGEMENT + BIOLOGICAL + WATER QUALITY)/100													0.16

E. Impoundment Characterisics (attach to aquatic habitat summary):

Watershed Area = _____ Shoreline Perimeter: = 1,610 feet

Impoundment Area = 139,392 square feet SDI (shoreline dev. Ratio) = 1.216472
(permanent pool) 3.2 acres

Project Comments: alternatives possible to accomplish project goals & lessen adverse impacts on habitat

Fish - If sampled check method: _____ seining; _____ dip-net; _____ electrofishing

Species

Other Aquatic/Semi-Aquatic Vertebrates:

Mussels:

T/E Species Known/Likely to Occur:

Record of Functional Assessment Results

Impoundments/Reservoir Functional Capacity Calculation

Date:	5/18/2006
Project:	Lake Ralph Hall
Location:	UP-67 (3.2 acres)
Circle One: Small Pond (≤1 acre) Pond (>1≤ 5 acres) Lake (>5 < 500 acres) Reservoir (>500 acres)	
Represented Acreage:	26.2 Total acreage of all impoundments represented by site
Assessors:	Holmes Voight Capps
Project Status:	__X__Preproject ____Postproject

Major Function Categories	Score	RCI	Acreage	Multiplication Factor*	RC
Physical Habitat	9				
Watershed/Management	-3				
Biological	6				
Water Quality	4				
Total Score	16	0.16	16.36	1.3	3.4

*Multiplication Factors
Small Pond = 1.5
Pond = 1.3
Lake = 1.1
Reservoir = 1.04

Ref: Table A-2 of SJD Report included in Mitigation Plan Appendix B
Note: UP-37 is one representative of 9 ponds within LRH conservation pool totaling 16.36 acres plus 4 ponds outside conservation pool totaling 9.84 acres; overall total of ponds is 26.2 acres.
RCI Formula (Physical + Watershed/Management + Biological + Water Quality) / 100
RC = RCI X Acreage X Multiplication Factor

UP-67 Holmes. 5/19/2006

UP-67 Holmes. 5/19/2006

SWAMPIM DATASHEETS – PONDS PRE-PROJECT

Lake (On-channel) >5 <500 acres: OCP17

Impoundment Evaluation from Kansas Department of Wildlife and Parks, Subjective Evaluation of Aquatic Habitats
Developed by : Kansas Department of Wildlife & Parks, Environmental Services Section (Revised 2004)
with minor modifications to address conditions in North Central Texas

Impoundment Habitat Evaluation OCP-17 (>5 <500 acres) SCORE

A.	PHYSICAL HABITAT KEY												
	1.Shoreline Development	CONDITION CATEGORY GRADE or SCORE											
		(perimeter of impoundment/perimeter of circle of equal area)											
		High > or = 2.5					Medium 1.5 - 2.4			Low 1.0-1.4			
	Grade	10	9	8	7	6	5	4	3	2	1	0	4
	2.Average Depth	CONDITION CATEGORY GRADE or SCORE											
		> 10 feet					3 - 10 feet			< 3 feet			
	Grade	10	9	8	7	6	5	4	3	2	1	0	9
	3.Annual Storage Ratio	CONDITION CATEGORY GRADE or SCORE											
		1 - 2			> 2			< 1					
	Grade	5			4			3		2		1	0	4
	4.Substrate	CONDITION CATEGORY GRADE or SCORE											
		(select two predominant types in littoral zone and average the score)											
		Boulder/Cobble		Gravel		Sand (< 0.1")		Bedrock		Mud/Detritus/Muck			
	Grade	5		4		3		2		1		0	1
	5.Number of substrate types in littoral zone	CONDITION CATEGORY GRADE or SCORE											
		4 or more		3 types present				2 types present		1 type present			
	Grade	5		4		3		2		1		0	1
	6.Amount of Cover	CONDITION CATEGORY GRADE or SCORE											
		(aquatic vegetation, flooded timber, woody debris, large boulders, rock outcrops, overhanging vegetation, man-made structures)											
		Extensive (>75%)		Abundant (50-75%)		Moderate (25-50%)		Sparse (5-25%)		Little or none (0-5%)			
	Grade	10	9	8	7	6	5	4	3	2	1	0	1
	7.Native vegetation buffer	CONDITION CATEGORY GRADE or SCORE											
		> 50 meters		10 - 50 meters		5 - 10 meters		1 - 5 meters				None	
	Grade	5		4		3		2		1		0	1
	8.Bank erosion	CONDITION CATEGORY GRADE or SCORE											
		Stable banks w/little sloughing				Moderate erosion due to livestock				Severe active erosion along			
	Grade	5		4		3		2		1		0	2
	Total for the physical habitat components (max 54.5)												23
B.	WATERSHED LAND USE AND MANAGEMENT KEY												
	1.Management Strategies	CONDITION CATEGORY GRADE or SCORE											
		Fish fences		Livestock exclusion		Drawdowns		Downstream flow augmentation		Fish feeders		Other (I.e. harvest restrictions, nuisance species control, etc)	
	Grade	+1		+1		+1		+1		+1			1
	Total												
	2. Watershed Land Uses (Describe the extent of land use in the upstream watershed)												
	2a.Minimal impact land uses	CONDITION CATEGORY GRADE or SCORE											
		Ungrazed native vegetation (I.e. woodlands, native grass, wetlands), good grazing practices, cropland w/ good to excellent conservation											
		Entire		Abundant		Common		Moderate		Sparse		None	
	Grade	+5		+4		+3		+2		+1		0	2
	2b.Significant impact land uses	CONDITION CATEGORY GRADE or SCORE											
		Poor grazing practices, cropland w/ fair to poor conservation practices, urban, industrial, commercial, residential.											
		Entire		Abundant		Common		Moderate		Sparse		None	
	Grade	-5		-4		-3		-2		-1		0	-5
	Total for the watershed/management (max 10)												-2
C.	BIOLOGICAL COMPONENT KEY												
	1.Fish characteristics	CONDITION CATEGORY GRADE or SCORE											
		(If problem or exotic fish dominant Score is -5)											
		High quality sport		Pan & predaceous		Minnows/panfish/roughfish				Minnows/roughfish		No fish	
	Grade	10	9	8	7	6	5	4	3	2	1	0	9

	2.Aquatic insects	CONDITION CATEGORY GRADE or SCORE						
		> 3 orders present		1 -3 orders present			None	
	Grade	5	4	3	2	1	0	5
	3.Mollusc/ Crayfish	CONDITION CATEGORY GRADE or SCORE						
		Common/Abundant		Sparse	None	Zebra mussels present		
	Grade	3	2	1	0	-5		3
	4.Other aquatic/semi-aquatic vertebrates	CONDITION CATEGORY GRADE or SCORE						
		Common/Abundant		Sparse	None	Nutria present		
	Grade	3	2	1	0	-5		1
	Total for the biological components (max 21)							18
D.	WATER QUALITY COMPONENT KEY							
	1.DO/BOD	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		3
	2.Nutrient enrichment	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		2
	3.Pesticides	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		3
	4.Turbidity	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		2
	5.Temperature	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		2
	6.Other (if applicable)	CONDITION CATEGORY GRADE or SCORE						
		Rarely Limiting		Occasionally Limiting		Frequently Limiting		
	Grade	3		2	1	0		3
	Total for the water quality components (max 15)							15
TOTAL SCORE "RCI" = (PHYSICAL + WATERSHED/MANAGEMENT + BIOLOGICAL + WATER QUALITY)/100								0.54

E. Impoundment Characterisics (attach to aquatic habitat summary):

Watershed Area = _____ Shoreline Perimeter: = 4,877 feet

Impoundment Area = 395,506 square feet SDI (shoreline dev. Ratio) = 2.187618
(permanent pool) 7.98 acres

Project Comments: alternatives possible to accomplish project goals & lessen adverse impacts on habitat

Fish - If sampled check method: _____ seining; _____ dip-net; _____ electrofishing
Species

Other Aquatic/Semi-Aquatic Vertebrates:

Mussels:

T/E Species Known/Likely to Occur:

Record of Functional Assessment Results

Impoundments/Reservoir Functional Capacity Calculation					
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Location:	OCP-17 (7.98 acres)				
Circle One: Small Pond (≤1 acre) Pond (>1≤ 5 acres) Lake (>5 < 500 acres) Reservoir (>500 acres)					
Represented Acreage:	31.78 Total acreage of all impoundments represented by site				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject ____Postproject				

Major Function Categories	Score	RCI	Acreage	Multiplication Factor*	RC
Physical Habitat	23				
Watershed/Management	-2				
Biological	18				
Water Quality	15				
Total Score	54	0.54	31.78	1.1	18.9

*Multiplication Factors
Small Pond = 1.5
Pond = 1.3
Lake = 1.1
Reservoir = 1.04

Ref: Table A-2 of SJD Report included in Mitigation Plan Appendix B
Note: OCP-17 is representative of 2 ponds within LRH conservation pool totaling 31.78 acres; no ponds outside conservation pool within this category; overall total of ponds is 31.78 acres.
RCI Formula (Physical + Watershed/Management + Biological + Water Quality) / 100
RC = RCI X Acreage X Multiplication Factor

OCP-17 5/19/2006

SWAMPIM DATASHEETS – PONDS PRE-PROJECT

No OCPs > 500 Acres

APPENDIX D

LETTER DATED MARCH 24, 2015
FROM EPA TO USACE
CONCURRING USE OF SWAMPIM AS FUNCTIONAL ASSESSMENT PROTOCOL FOR LAKE RALPH HALL

ENVIRONMENTAL PROTECTION AGENCY

Region 6, Dallas, Texas

March 24, 2015

Chandler Peter, Permits Section
Regulatory Branch
Fort Worth District
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102-0300

Dear Mr. Peter:

The Environmental Protection Agency (EPA) Region 6 has reviewed the February 9, 2015, Lake Ralph Hall Functional Assessment Comparisons Document. This document provides a comparison of two stream function assessment methods. These methods are the Texas Rapid Assessment Method, Wetlands and Streams Modules (TXRAM) and the StreamWatershed Assessment and Measurement Protocol Interaction Model for Streams and On-Channel Impoundements (SWAMPIM). Historically, the SWAMPIM method was used as a functional assessment protocol to quantify the potential impacts to unique aquatic systems affected by the proposed Lake Ralph Hall Project. At the time this was developed, there were no other functional assessment models. In October, 2010, the USACE Fort Worth District released the final draft of TXRAM. Based upon our review, EPA offers the following comment:

Both methods are comparable and examine essentially the same major and specific stream functions. The side-by-side comparison shows that the TXRAM and SWAMPIM Specific Stream Functions and Comparable Metrics overlap one another. However, the SWAMPIM functional assessment examines in more detail the stream conditions. Because SWAMPIM has already been used to assess the potential impacts to the Lake Ralph Hall Project, it is EPA's opinion that SWAMPIM should be used instead of TXRAM.

Thank you for the opportunity to comment on this document. If you have any questions regarding this comment, please contact me at 214-665-7576.

Sincerely,

Donna Mullins
Wetlands Section

Cc: Tom Heger, TPW
Sid Puder, USFW

Robert Hansen, TCEQ

APPENDIX E

DESCRIPTION OF TYPICAL IN-STREAM STRUCTURES

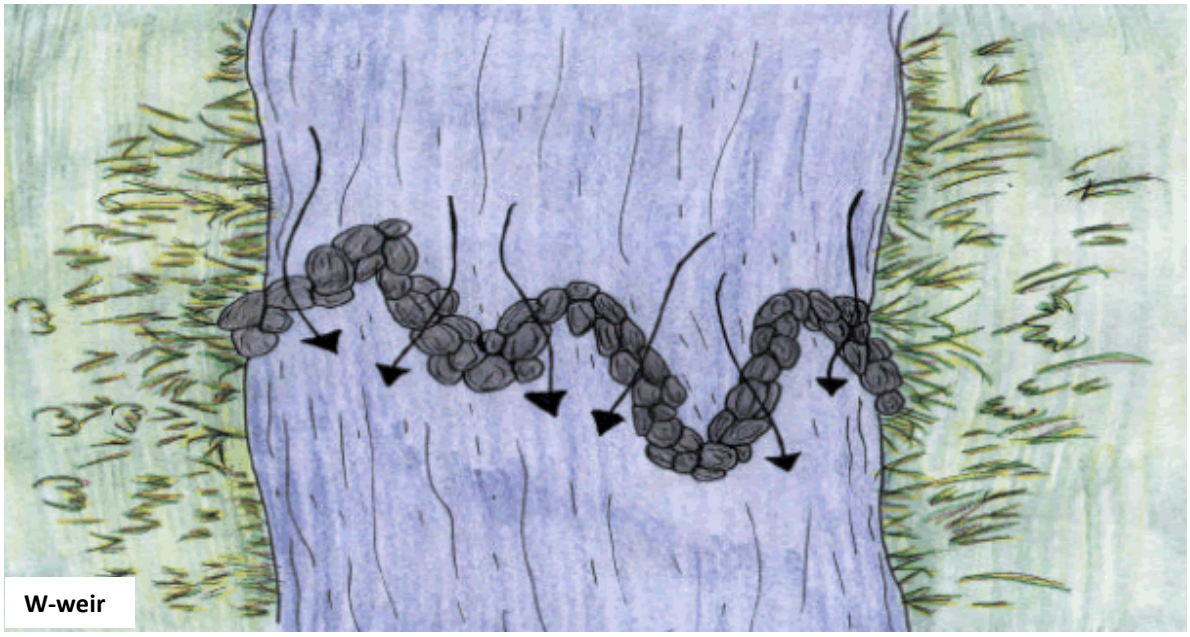
EXAMPLES OF TYPICAL IN-STREAM STRUCTURES

In-stream Structures – In-stream structures may be utilized to provide some reduction in hydraulic forces such as near-bank slope, velocity, velocity gradient, stream power, and shear stress, thus reducing erosion and providing some measure of stability. This reduction would enable the stream systems to create some variation in the channel bed form (i.e., diversify the substrate material) and induce depositional zones where natural recruitment of vegetation could occur. These structures would also provide instream habitat for aquatic organisms. Typical structures selected for use would include:

J-hook vanes: The J-hook vane is an upstream directed, sloping structure that can be composed of wood or rock material. J-hook vanes are buried in the outside bank to create a fixed point, and the vane and "hook" portion of the structure lie in the outer approximately two-thirds of the channel bed width. The structure is used as a method to reduce bank erosion by reducing the near-bank hydraulic forces and redirecting them to the center of the channel. Any J-hook vanes would be added in outside meander bends.

J-hook vane

W-weirs: The W-weir gets its name from the "W" shape it has when looking in planview in the downstream direction. Both sides of the W-weir are directed from the bank upstream toward the bed. The outside vane arms rise from the channel bottom to intercept the banks at the ordinary high water mark. The crest of the weir rises in the downstream direction to the center of the channel and occupies one-half the channel width; the outside arms occupy one-fourth of the channel width on either side of the crest. W-weirs force two scour pools inside the vane arms and reduce velocity in the near-bank areas. These structures are intended for straighter stream reaches in over-widened channel bottoms.



W-weir

Cross vanes: The cross vane is a grade control structure that also decreases near-bank hydraulic forces and increases the energy in the center of the channel, maintaining a scour pool. Cross vanes are built very similarly to W-weirs and used for the same purpose. W-weirs are better applied in wider river/stream cross sections; cross vanes are better applied in narrower cross sections.

Cross vane installed on the lower Blanco River, CO

Cross vane/step-pool on the East Fork Piedra River, CO

Cross vane structure with step on the East Fork Piedra River, CO

Cross vane/rootwad/log vane step-pool, converting a braided D4→C4 stream type on the East Fork Piedra River, CO

Rock/log vanes: Vanes made of natural material are used along streambanks for stabilization, shade, detritus, and other habitat benefits. They can also reduce erosion for transplanted vegetation up- and downstream of the structure.

Rock Vane

Log Vane

The structures would be constructed using locally available material to the extent available and practical, specifically using native bois d'arc trees and other woody material. The minimum diameter of tree desired for in-channel structures is 10 inches, although detailed design may result in a method that can incorporate numerous smaller trees in one structure. Structure length and spacing is based on appropriate pool-to-pool spacing, as structures tend to force pool creation.

Structure selection and placement within the stream channels located within the aquatic resources mitigation boundary would occur during detailed design.

APPENDIX F

ROBERT J. BRANDES CONSULTING

TECHNICAL MEMORANDUM: ANALYSIS OF FLOOD FLOWS FOR REVISED NORTH SULPHUR RIVER RESTORED CHANNEL

Robert J. Brandes Consulting

TECHNICAL MEMORANDUM

To: Loretta Mokry
Tim Noack
Alan Plummer Associates, Inc.

Copy: Ed Motley, P.E.
CH2M

Larry Patterson, Deputy Executive Director
Upper Trinity Regional Water District

From: Bob Brandes, P.E., Ph.D.
Michelle Evans, P.E.

Robert J. Brandes 8-11-17

Michelle R. Evans 8-11-17

Subject: Analysis of Flood Flows for Revised North Sulphur River Restored Channel

Date: August 11, 2017

As requested, to support the mitigation plan for the restored channel of the North Sulphur River that is to be located on the south floodplain downstream of Lake Ralph Hall dam, we have undertaken a hydrologic/hydraulic analysis of the revised alignment and geometry for the restored channel. This study has involved the determination of peak flood flows, depths and velocities at selected locations along the revised alignment of the restored channel for a range of flood events.

For this work, an initial design cross section for the restored channel was provided by Alan Plummer Associates (APA) along with details regarding the channel slope and grade breaks. The restored channel alignment and tributary routing used in this analysis were provided by APA electronically in GIS format on June 28, 2017. Additional information describing vegetative cover projected for the watershed of the restored channel was provided by APA on August 5, 2017, followed with updated tributary sub-basin boundaries and vegetative cover refinements that were finalized on August 8, 2017. It is recognized that based on the results from this study, APA may determine that modifications to the initial design cross section and channel grade or alignment may be required to more effectively achieve the operational goals for the aquatic and terrestrial ecosystems supported with the restored channel and that additional hydrologic/hydraulic analyses may be required.

While a similar flood flow analysis of the restored channel was performed back in 2008 based on the design and alignment envisioned at that time, the currently-revised restored channel requires updates and modifications for watershed delineations, drainage areas, and various hydrologic parameters needed to effectively model runoff and flood hydraulics. In this current study, the U.S Army Corps of Engineers (Corps) Hydrologic Modeling System (HMS) model has been used for performing the flood runoff and hydrograph simulations, and the Corps' unsteady HEC River

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Analysis System (RAS) model has been applied to route the HMS flood flows through the restored channel taking into account the attenuation effects of channel storage.

The development of the input parameters used in the hydrologic and hydraulic flood modeling and a summary of the flood modeling results are presented in the following sections.

HMS FLOOD FLOW MODELING

Drainage Areas

The revised alignment of the restored channel was segmented into reaches defined primarily by tributary inflow points. Sub-basin watersheds for each tributary and the intervening areas then were delineated using GIS procedures with the UTRWD's 2-foot digital elevation contours in the vicinity of the Lake Ralph Hall dam, recent aerial photographs of the project area, and U.S. Geological Survey (USGS) digital topographic maps. A total of 10 sub-basins have been delineated, identified either as "tributary" sub-basins associated with each of the four primary tributaries that discharge into the restored channel from the south or as "channel" sub-basins for the four intervening watersheds and the two terminal watersheds. These sub-basins are shown on the aerial map of the area in Exhibit 1 following this memo. Drainage areas for these sub-basins are listed in Table 1. As shown, a total of 1,976 acres contribute runoff and inflows to the more than 19,000 feet of the restored channel from its headwaters just below the Lake Ralph Hall dam downstream to its confluence with the North Sulphur River.

Table 1 – Sub-Basin Hydrologic Parameters

Sub-Basin	Drainage Area (acres)	Curve Number	Time of Concentration (hours)	Lag Time (hours)
Channel 1	39	79	1.48	0.89
Channel 2	85	61	1.07	0.64
Channel 3	42	75	1.39	0.83
Channel 4	27	79	1.63	0.98
Channel 5	19	79	0.91	0.54
Channel 6	85	78	1.22	0.73
Tributary 1	255	78	1.21	0.72
Tributary 2	520	77	1.01	0.60
Tributary 3	342	72	0.94	0.56
Tributary 4	494	80	0.78	0.47
Tributary 5	39	79	1.49	0.90
Tributary 6	29	79	1.45	0.87
Total	1,976	- -	- -	- -

SCS Curve Numbers

The curve number method developed by the U.S. Soil Conservation Service (SCS, now the Natural Resources Conservation Service, NRCS) was used to account for infiltration losses and surface retention associated with runoff from the sub-basin watersheds. For application of this method, information on soil runoff and infiltration characteristics and land cover is needed to establish the curve numbers that relate storm rainfall amount to runoff volume. Hydrologic soil types were determined for the entire drainage area of the restored channel using the NRCS soil classification database[1]. The hydrologic soil groups (HSGs) for the watershed are shown on the aerial in Exhibit 2. Projected land use or vegetative cover information for the entire drainage area of the restored channel and its tributaries was developed by APA through discussions with RJB personnel, and this information is shown on the map in Exhibit 3. An Excel spreadsheet procedure was used to perform the area-weighted calculations necessary to determine the overall curve number value for each of the sub-basins taking into account overlays of hydrologic soil types and vegetative cover.

In the previous 2008 study, a single curve number value of 79 corresponding to normal antecedent moisture conditions was used for modeling runoff from the entire restored channel watershed. For this current study, curve numbers have been determined for each sub-basin, providing a better representation of variations in runoff conditions. Table 1 includes these curve numbers for all of the sub-basins.

Times of Concentration

The time of concentration (t_c) for each sub-basin, which relates to the time for runoff to travel overland from the most-upstream point of a sub-basin to its most-downstream outlet, have been determined using the Kerby-Kirpich method. In the 2008 study, the time of concentration was calculated using the SCS TR-55 method; however, now the Texas Department of Transportation's hydraulic design manual recommends that the Kerby-Kirpich method be used for estimating the time of concentration for watersheds in rural areas. The manual notes that the Kerby-Kirpich method is preferable since it requires comparatively few input parameters and produces time of concentration estimates consistent with values derived from real-world storms and runoff hydrographs.

The lag time for each sub-basin was calculated by multiplying the time of concentration value by 0.6, a standard SCS procedure. The resulting values for the time of concentration and the corresponding lag times also are summarized in Table 1. An Excel spreadsheet procedure was used to perform the calculations of the time of concentration and lag time for each sub-basin.

Rainfall Distribution

As in the 2008 study, the frequency storm method available in the HMS model has been used to temporally distribute precipitation amounts over a specified storm duration. The frequency storm method uses statistical data to produce balanced storms with a specific exceedance probability. For the frequency storm method, an empirical factor is built in to the HMS model for converting

[1] https://websoilsurvey.sc.egov.usda.gov

partial-duration series to annual series for the 2-, 5- and 10-year storm events, but this factor is not included for the 1-year storm event. Therefore, the 2-year factor was also used for the 1-year storm event. For the 25-, 50-, and 100-year storm events, no conversion is needed.

Consistent with the analyses previously undertaken in 2008, the 3-hour storm duration has been used in this study for simulating watershed runoff and flood flows. Based on the times of concentration for the different sub-basins presented in Table 1 and normal channel velocities for the range of flood events being analyzed, the 3-hour duration has been determined to be appropriate. This duration is sufficiently long to allow peak flood flows to be generated for each of the sub-basins and for these flows to travel down the length of the restored channel. With an assumed channel velocity of 4 feet per second (fps), the time required for the peak flood flow to travel from the upstream end of the restored channel to its outlet at the confluence with the North Sulphur River is a little more than an hour. Hence, considering this travel time estimate together with the longest times of concentration for the sub-basins, the 3-hour storm duration is appropriate.

Rainfall Depths

For the 2008 study, rainfall depths were obtained from the U.S. Weather Bureau's Technical Paper No. 40 (TP-40) and from the National Oceanic and Atmospheric Administration's Technical Memorandum NWS HYDRO-35. Since then, revised precipitation depths have been developed for Texas and are provided in the USGS Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas – Scientific Investigations Report 2004-5041. This report contains rainfall depths for storm durations of 15 minutes and 1, 2, 3, 6, 12, and 24 hours for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events. Additional rainfall data for a 5-minute storm duration and a 1-year storm of 1, 2, 3, 6, 12, and 24-hour durations also were obtained from the HYDRO-35 and TP-40 reports, respectively. The rainfall depths compiled from these different sources for different storm durations and frequencies are summarized in Table 2.

Table 2 – Rainfall Depths for Different Storm Frequencies and Durations

Storm Frequency	Storm Duration							
	5-min.	15-min.	1-hour	2-hour	3-hour	6-hour	12-hour	24-hour
1-year	---	---	1.60	1.90	2.05	2.40	2.90	3.30
2-year	0.50	1.02	1.74	2.11	2.34	2.74	3.19	3.69
5-year	0.57	1.30	2.22	2.71	3.02	3.57	4.20	5.10
10-year	0.63	1.49	2.55	3.12	3.48	4.30	5.10	6.30
25-year	0.72	1.73	2.98	3.66	4.10	5.10	6.10	7.70
50-year	0.79	1.96	3.40	4.18	4.67	5.90	7.10	9.00
100-year	0.86	2.17	3.81	4.70	5.26	6.60	8.10	10.50

Runoff Hydrographs

As in the 2008 study, the Snyder Unit Hydrograph (SUH) method has been used to develop runoff hydrographs for specified rainfall events, thereby providing a common basis for comparison of results. The method was initially adopted because of its use by the Corps for developing flood inflow hydrographs for Lakes Jim Chapman and Wright Patman, both of which are located in the Sulphur Basin. The Snyder peaking coefficient C_p = 0.5469 was adopted from the earlier hydrologic analyses of sub-basins in the Lake Ralph Hall watershed. This value originated from analyses performed by the Corps during studies of Lake Jim Chapman.

HMS Peak Flood Flow Results

The resulting peak flood flows as simulated with the HMS model for each of the sub-basins and as combined at key junctions along the reach of the restored channel are summarized in Table 3 below for different flood frequencies, all for 3-hour storm durations. As expected, these peak flood flows increase from junction to junction in the downstream direction along the restored channel as flood inflows enter from adjacent sub-basins. As noted, for the 100-year flood event, the peak flood flow in the restored channel increases from about 140 cfs for the Channel 6 sub-basin at the upstream end to about 3,400 cfs at the downstream end at Junction 1.

Table 3 – Summary of 3-Hour Storm Peak Flood Flows for Different Flood Frequencies for Sub-basins and Junctions from HMS Model Simulations

HYDROLOGIC ELEMENT	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Channel 6	18	24	49	69	93	116	139
Tributary 4	167	215	436	596	796	981	1,169
Junction 6	183	234	474	650	871	1,075	1,285
Channel 5	5	7	14	20	26	32	39
Junction 5	188	241	487	669	897	1,107	1,323
Tributary 3	50	66	162	239	341	439	543
Channel 4	5	7	14	19	25	31	37
Junction 4	239	307	654	913	1,241	1,549	1,870
Tributary 2	118	152	327	460	627	784	947
Channel 3	6	8	19	27	37	47	57
Tributary 5	8	10	20	28	38	47	56
Junction 3	367	472	1,002	1,406	1,919	2,401	2,899
Tributary 1	55	71	149	207	281	350	421
Channel 2	2	4	15	26	41	57	75
Tributary 6	6	8	16	22	29	36	43
Junction 2	425	547	1,172	1,642	2,238	2,804	3,395
Channel 1	8	10	21	29	39	48	58
Junction 1	432	555	1,189	1,666	2,271	2,841	3,440

UNSTEADY RAS FLOOD ROUTING

Flood Routing Procedure

The individual flood hydrographs for each of the sub-basins simulated with the HMS model were input to the unsteady HEC-RAS model at their respective locations (channel sections) for routing and combining along the length of the restored channel and for calculating channel hydraulics. This procedure was used for each of the different flood events simulated with the HMS model. The unsteady RAS model is a dynamic wave model that accounts for flow attenuation due to channel storage as flood flows enter a watercourse and move downstream. For this application, the unsteady RAS model was operated for each flood event to simulate time-varying flows, depths and velocities at sequential cross sections located along the entire length of the restored channel.

Initial Design Cross Section

The flood routing approach used in the HEC-RAS modeling requires definition of the channel geometry along the entire length of the restored channel. For this purpose, it has been assumed that a single design cross section could be used to effectively represent the restored channel along its entire length. Even though APA's initial plans call for considerable variation in the geometry of the restored channel, including approximately 75 shallow pools with depths of ~3 feet and approximately 75 deeper pools with depths of ~7 feet, all connected with intervening shallow riffle reaches, it is anticipated that the deeper portions of these pools will not be particularly significant with regard to the conveyance of flood flows. The intervening shallow riffle reaches, being only a foot or so deep, will likely have a controlling influence on conveyance capacity. Hence, it is believed that assuming a single cross section configuration, tailored to generally represent the proposed channel conditions, for the entire restored channel should provide meaningful and realistic results in terms of channel hydraulics.

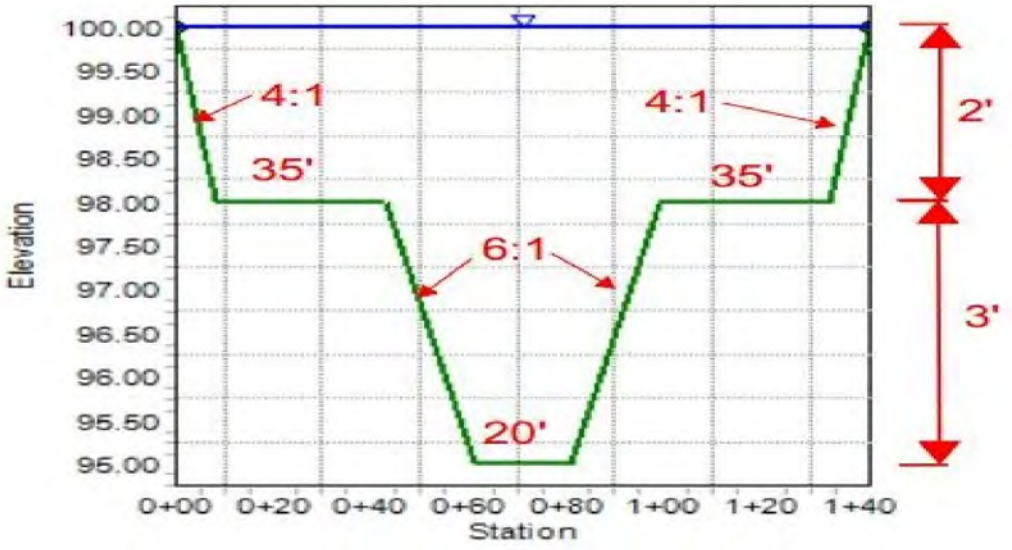
The initial design cross section for the restored stream channel as provided by APA is depicted in Figure 1. It includes a trapezoidal low-flow channel with a 20-foot bottom width, a 3-foot depth and 6:1 side slopes. For higher flows, there is an upper section with 35-foot horizontal overbanks on each side and 4:1 side slopes that extend high enough to contain the 100-year flood (even though the height of these side slopes as shown in Figure 1 is only 2.0 feet, they will be extended as necessary up to the 100-flood level).

According to APA, the proposed channel slope is to be 0.001 feet per foot, or 0.1 percent. As an initial design, the proposed flowline at the upstream end of the channel is set at elevation 498.0 feet[2], and the target elevation at the downstream end near the confluence with the North Sulphur River is set at 468.8 feet. The combination of the proposed channel slope and the terminal flowline elevations requires that grade control structures be installed at multiple locations along the length of the restored channel. Conceptually, these structures will be one-foot high hardened steps with a uniform 0.1-percent channel slope upstream and downstream. In order to reach the target flowline elevation of 468.8 feet at the downstream end of the restored channel, 10 one-foot drop

[2] The datum for these initial design elevations is approximately mean sea level; however, this will be verified with field measurements and elevations will be adjusted during final design.

structures have been included at specified locations along the length of the restored channel for purposes of applying the HEC-RAS model. The flowline of the most downstream section in the HEC-RAS model, which is upstream of the confluence with the North Sulphur River, is 468.9 feet. As noted earlier, results from this current study may require APA to make revisions to this initial channel configuration in order to achieve hydraulic conditions that effectively support the aquatic and terrestrial ecosystems envisioned for the restored channel.

Figure 1 – Initial Design Cross Section for Restored Channel



For the unsteady HEC-RAS flood routing, the initial design cross section was assigned at specific computational sections along the entire length of the restored channel, with section elevations uniformly reduced in the downstream direction at a constant slope of 0.001 feet per foot, except at the grade control structures where the channel flowline elevations were reduced by an even one foot. This overall channel slope generally conforms to the natural slope of the south floodplain of the North Sulphur River in this vicinity. The bottom elevation of the restored channel generally follows the existing bottom profile of the abandoned channel of the North Sulphur River. A total of 62 cross sections, including two cross sections at each grade control structure, have been defined along the length of the restored channel to facilitate the unsteady RAS flood routing calculations. The locations of these cross sections, along with the sub-basin delineations, are shown on the aerial map in Exhibit 4.

Considering that the conveyance capacity of the lower portions of the proposed pools along the length of the restored channel, even those with depths as shallow as 3 feet, will be limited due to the intervening shallow riffle reaches, it has been assumed for purposes of the flood routing calculations that only the upper 1.5 feet of the low-flow channel of the initial design cross section would be effective for conveying flood flows. Therefore, in the HEC-RAS model, the bottom elevation of each cross section has been raised to limit the depth of the low-flow channel to 1.5 feet, with its bottom assumed to be underlain with water. Hence, for representing overall channel roughness effects on flood flow conveyance, a composite Manning's "n" value has been calculated for the low-flow channel assuming the side slopes would be covered with grass and light vegetation (n=0.04) and the bottom of the channel would be occupied with water (n=0.02). The resulting

low-flow channel "n" value is 0.033. An "n" value of 0.12 has been specified for the higher horizontal overbanks and upper side slopes of the initial design cross section based on APA's projected vegetative condition of forest with a target density of 200 woody stems per acre with native prairie herbaceous species in the understory.

Unsteady RAS Flood Routing Results

The unsteady HEC-RAS flood routing model was run for the same 3-hour storms simulated with the HMS flood flow model. In these simulations, the flood hydrographs previously simulated for each of the sub-basins with the HMS model for each storm event were input to the HEC-RAS model and routed, and combined as appropriate, section by section downstream through the restored channel to produce final flood hydrographs at each of the computational sections and junctions.

The output from the unsteady RAS model provides a variety of information pertaining to the hydraulics of the simulated flood flows at each section, including the peak flood flow value, the corresponding water surface elevation and total depth, and flow velocities for the middle of the channel section and the overbank areas. These quantities are presented for each computational section for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year flood events in Tables 4 through 10, respectively.

As shown in each of these tables, and as expected, peak flood flows and water depths in the channel increase in the downstream direction as runoff enters the channel from adjacent sub-basins and accumulates along the channel. Channel and overbank velocities similarly increase. The peak flood flow for the 100-year flood event at the most downstream Section 36 is 2,382 cfs, which is somewhat less than the corresponding value of 3,440 cfs calculated at Junction 1 with the HMS model. This reduction is due to the attenuation effects of channel storage on flood flows as simulated with the HEC-RAS model. Average channel velocities range from about 2.5 fps for the 1-year storm event up to about 5.0 fps for the 100-year storm event. Overbank velocities are lower, ranging from about 0.3 fps to 1.0 fps. Maximum water depths in the lower reach of the restored channel range from about 4.0 feet for the 1-year storm event up to about 8.5 feet for the 100-year storm event.

Water surface profiles along the restored channel for the 2-year flood and the 100-year flood are plotted on the graph below along with the channel flowline as represented in the HEC-RAS model and the top of the low flow channel (~3 feet above the flowline).