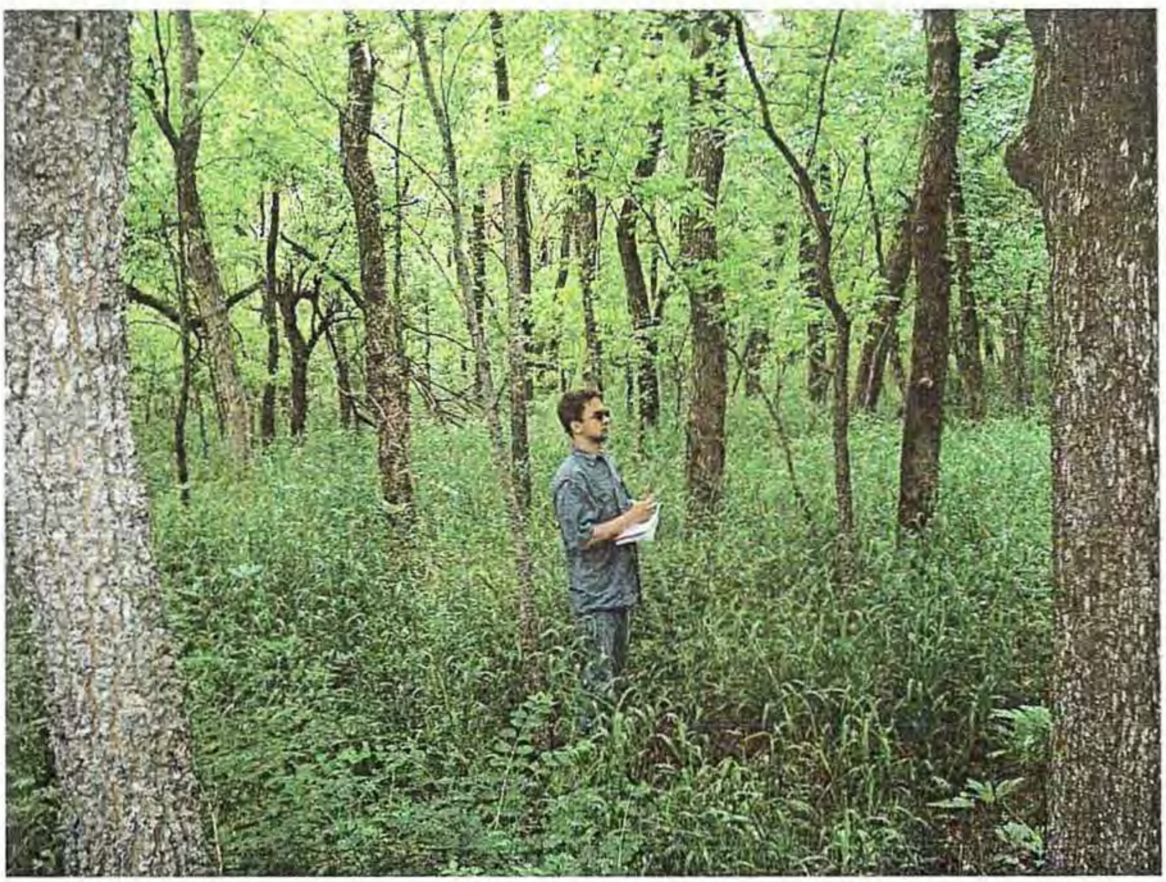
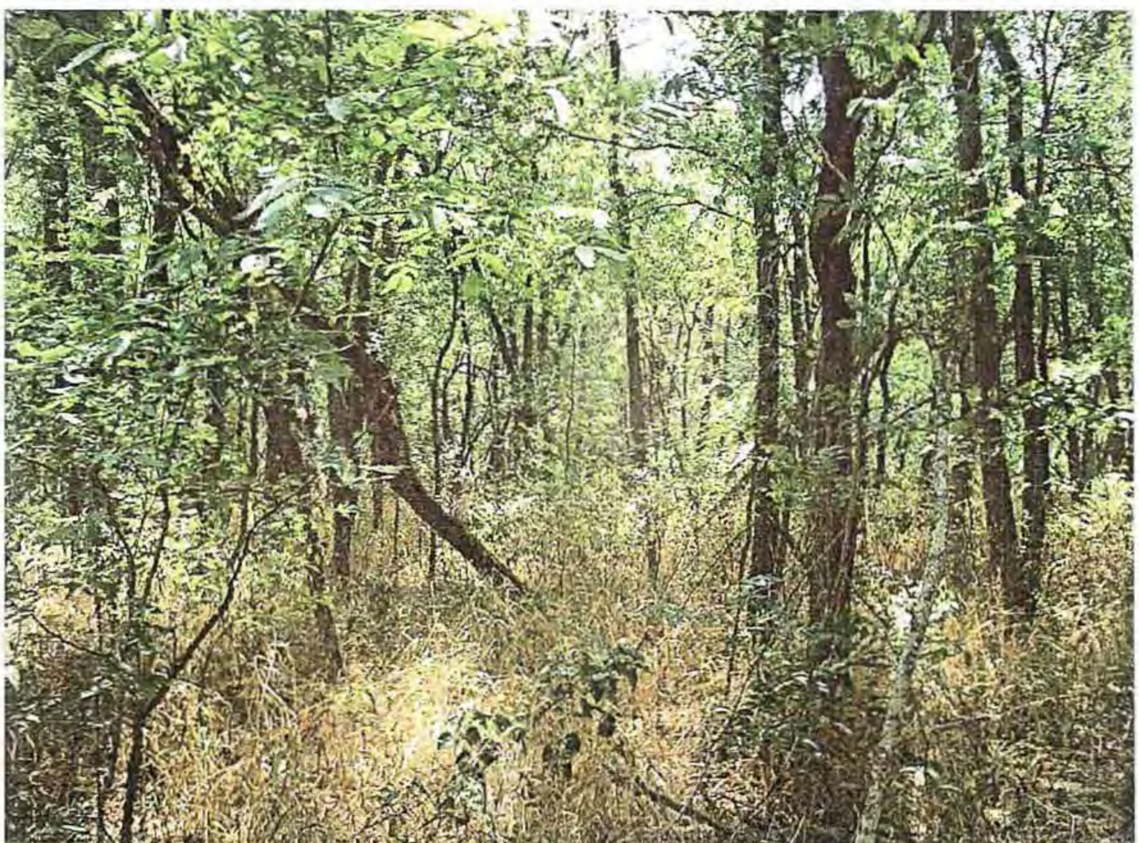
Forested area identified from 2004 aerial photograph where clearing activity had recently been conducted. Classification changed to Parks.

REPRESENTATIVE PHOTOGRAPHS OF YOUNG FOREST

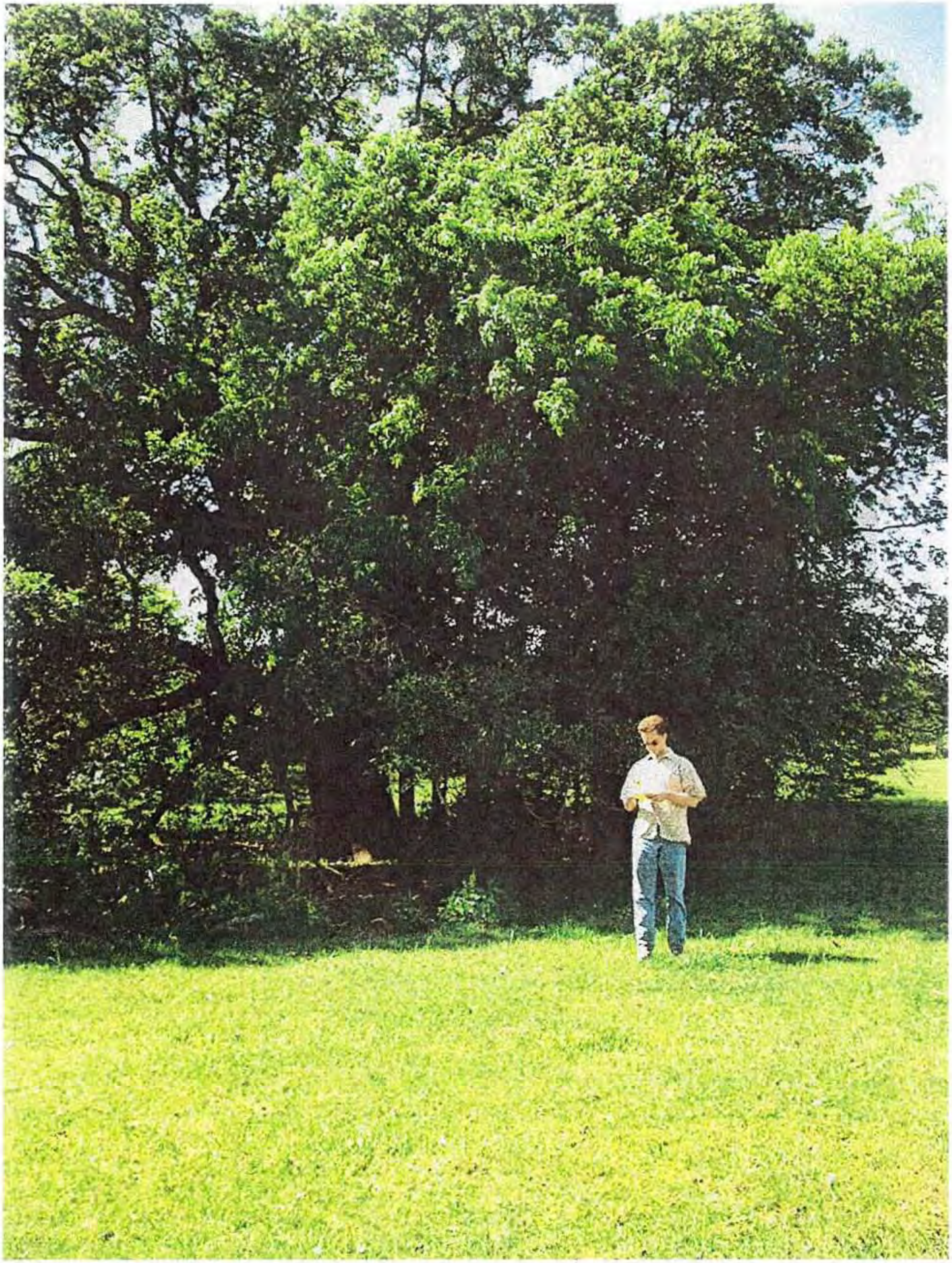
REPRESENTATIVE PHOTOGRAPHS OF YOUNG FOREST

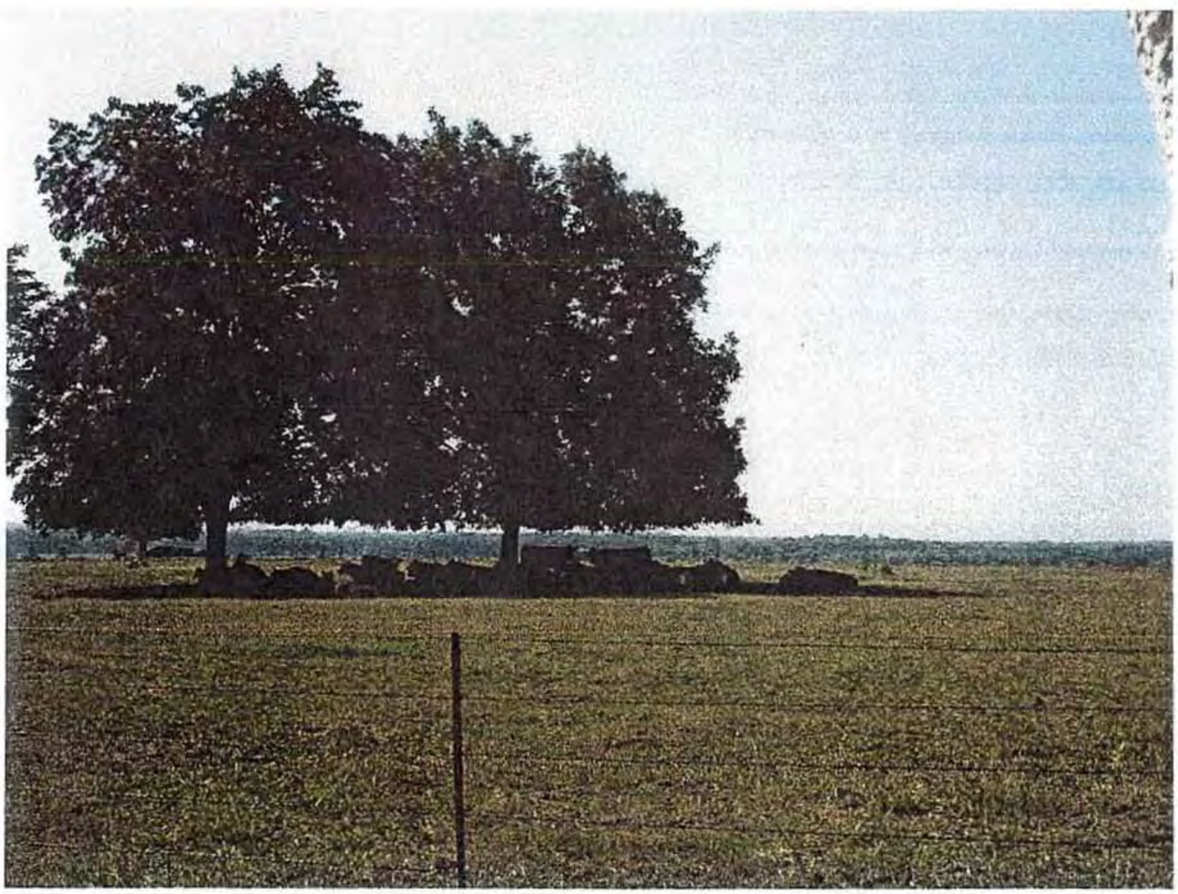




REPRESENTATIVE PHOTOGRAPHS OF PARTIALLY WOODED AREAS

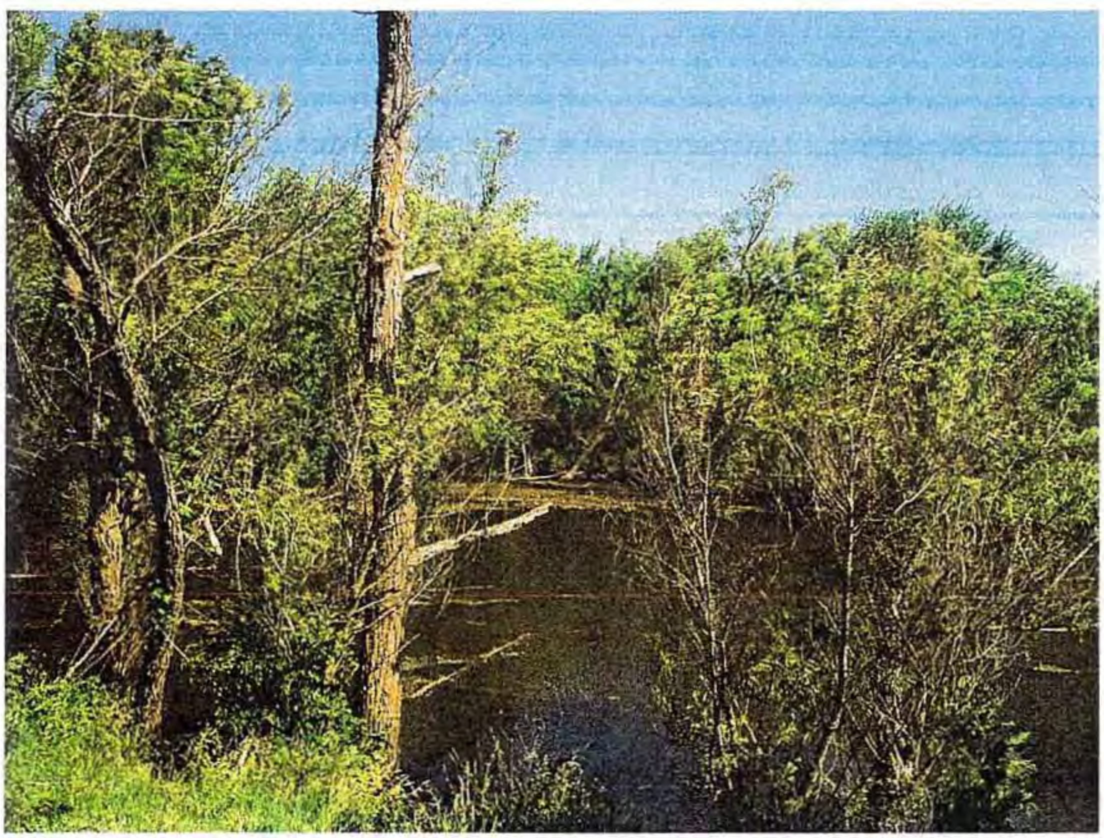
REPRESENTATIVE PHOTOGRAPHS OF PARTIALLY WOODED AREAS

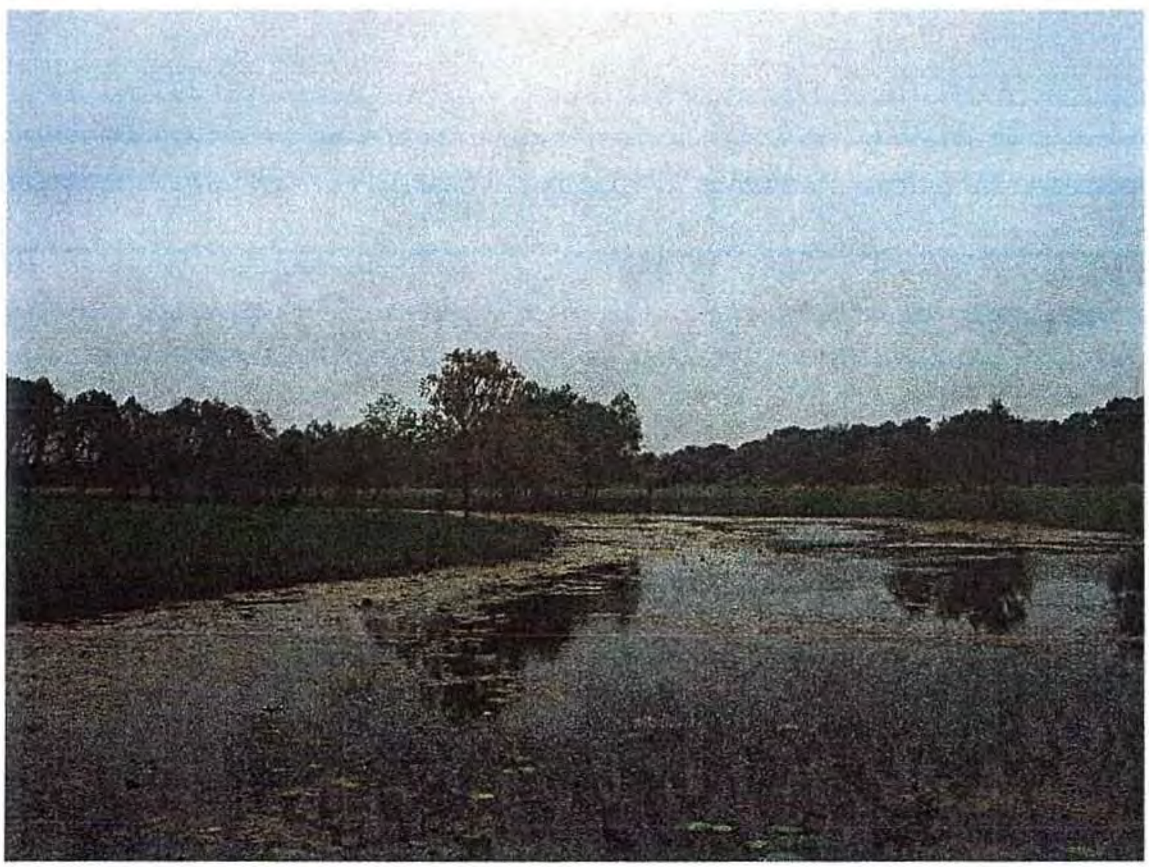




REPRESENTATIVE PHOTOGRAPHS
OF
PONDS

REPRESENTATIVE PHOTOGRAPHS OF PONDS





BIOLOGICAL HABITAT COMPONENTS EVALUATION KEY

Biological Habitat Components Evaluation Key

Component 1 - Site Potential

Evaluate for all cover types.

Criteria [2]	Value
Substrate is composed or exhibits one or more of the following: 1) at least periodically supports predomi- nately hydrophytic vegetation; 2) is predominately undrained hydric soil and supports or is capable of supporting hydrophytic vegetation; 3) is saturated with water or covered by shallow water during 1-2 months during the growing season of each year (swamps, bogs, marshes, and hardwood bottomlands exhibiting a high frequency of flooding).	25
Alluvial substrate although less hydric than above; only temporarily or intermittently inundated or saturated for short periods (higher terraces of hard-wood bottoms, riparian drainages).	20
Uplands with thick surface layer (generally greater than or equal to 10 inches) consisting of unrestricted loam (including sandy loam) or dark well structured (granulated) clay (including sandy clay).	12
Uplands with shallow surface layer (generally less than 10 inches) consisting of shallow soil over restrictive layer (rock, gravel, claypan, etc.) or deep, leached, droughty sand or, relatively light colored, poorly structured clay or gravelly/stony sand or clay.	7
Organic matter minimal or absent at the surface. (Includes undrained or saturated hydric soils not supporting vegetation i.e., mud flats).	3
Surface contains chemical compounds which would potentially limit growth of primary producers (salt, mine overburden containing heavy metals or acid compounds, surface pollution).	1

Component 2 - Temporal Development of Existing Successional Stage

Determine currently existing successional stage (Criteria A); evaluate for all cover types except marshes. For this habitat type use Criteria B.

Criteria A [3]	Value
Old timber (100 or more years, trees >25 inches*)	20
Mature timber, old brush, climax prairie (40-99 years, trees 12-25 inches)	12
Pole and young timber, mature brush (11-39 years, trees <12 inches)	6
Grasslands in grazing disclimax** or early and mid- successional perennial grasses and forbs, hay meadows	5
Seedlings, saplings, young brush (3-10 years)	3
Annual native or introduced grasses, forbs, crops	1

* Diameter at breast height (DBH)
** Example: Texas wintergrass-silver bluestem grasslands

Criteria B

(Marsh wetlands)	Value
Established mature communities within or adjacent to an enclosed coastal water	20

body with a free connection to the sea and a measurable quantity of salt in its waters but with abundant or semi-abundant freshwater inflow (estuarine areas).

Established mature communities or intermediate to well advanced successional stages occurring in fresh, brackish, or saline environments; freshwater inflow limited to generally small tributaries and localized runoff or overflow from flood conditions.	10
Aquatic or semi-aquatic communities occurring in generally early to intermediate successional stages as a result of periodic changes in moisture gradients; highly dependent on seasonal weather conditions.	5

Component 3 - Uniqueness and Relative Abundance

1. Evaluate the habitat within the site according to the categories below.

Category	Value
Highly valuable for wildlife and is very uncommon, unique or irreplaceable (USFWS Mitigation Resource Category 1)	20
Highly valuable for wildlife but is relatively scarce or becoming scarce (USFWS Mitigation Resource Category 2)	15
Exhibits high to medium value for wildlife and is relatively abundant (USFWS Mitigation Resource Category 3)	10
Exhibits medium to low value for wildlife and is relatively abundant (USFWS Mitigation Resource Category 4)	5
Exhibits very low wildlife value regardless of abundance or scarcity	0

Component 4 - Vegetation Species Diversity

Criteria A

Diversity of Woody Species

Evaluate the composition of readily observable woody species in the overstory, midstory, and understory by determining the number of species groups as represented by the following categories. Evaluate for all cover types except Swamps (Criteria C) and Marsh wetlands (Criteria D). Worksheet for Criteria A&B provided on page 25.

Species Group[4]	Examples
Berry/Drupe	hackberry, mulberry, paw paw, hawthorn, winterberry, black haw, soapberry, persimmon, choke cherry, yaupon, dogwood, Am. beautyberry, greenbriar, dewberry, poison ivy, rattan vine, blackgum, grape, mulberry, holly, bumelia, huckleberry, sumac, Virginia creeper, sassafras, prickly ash, chinaberry, crab apple, agarito, lotebush, ivy tree vine, palmetto, peppervine; wax myrtle
Legume/Pod	mesquite, locust, redbud, Acacia spp., Eve's necklace, Sesbania spp.
Acorn	white oak, red oak, live oak, water oak, willow oak, post oak, bur oak
Nut/Nutlike	hickory, pecan, walnut, water elm, buttonbush,

	ephidra,bitternut, hornbean
Samara (Winged Fruit)	elm, ash, box elder, maple
Cone	pine, cypress, juniper
Achene	sycamore, Baccharis spp., sandsage, Clematis spp., salt bush
All others(capsules, follicles, burrs, hairy seeds)	willow, cottonwood, sweetgum, salt cedar, yucca, cactus, buttonbush, sweetgum, bois d'arc, creosotebush, Chinese tallow-tree

Value assigned is equivalent to the number of groups represented (Maximum=8, If none is represented then value is 0)

Criteria B
Total Number of Occurring Woody Species

Determine the total number of readily observable woody species and assign value according to the following categories. Do not use for Swamps (Criteria C) or Marsh wetlands (Criteria D)

	Value
15 or more species	7
10-14 species	5
5-9 species	3
1-4 species	1
None occurring	0

Criteria C
Diversity of Vegetation in Swamps
Evaluate swamp areas according to the following categories:[5]

	Value
Seasonally flooded mixed bottomland hardwoods; inundation resulting from freshwater inflow	15
Seasonally flooded vegetation dominated by cypress-tupelo; inundation resulting from freshwater inflow	10
Continually flooded or infrequent, abrasively flooded vegetation comprised of one or more species; inundation resulting from freshwater, brackish or saline inflow	6
Continually flooded vegetation; inundation resulting from stagnant or impounded freshwater, brackish, or saline water conditions	2

Criteria D
Diversity of Vegetation in Marshes and other similar wetland areas

Determine the major types of wetland vegetation present according to the following categories: rooted emergent vegetation, rooted submergent vegetation, rooted vegetation with floating leaves, algal mat communities (microalgae), benthic or drifting seaweeds (macroalgae).

	Value
High - includes three or more of above categories.	20
Medium - includes two of the above categories.	15
Low - includes one of the above categories.	5

Component 5 - Vertical Vegetation Stratification[6]

Evaluate canopy coverage of the following three categories of vegetation for all cover types except crops and marsh wetlands.

Categories:
1. Vegetation greater than 12 feet high
2. Vegetation 3-12 feet high
3. Vegetation less than 3 feet high

Criteria	Value
All three categories present, each accounting for at least 25 percent of ground cover	5
Any two of the above categories present, each accounting for at least 25 percent of ground cover	4
Only one of the above categories present and accounting for at least 25 percent of ground cover	3
None of the categories together account for more than 25 percent of ground cover	1

Component 6- Additional Structural Diversity Components

Evaluate for all cover types except crops. Determine the presence of brush piles, rock piles, rocky crevices, snags, fallen logs, thick grass cover, brambles or thickets according to the following categories.

Criteria	Value
Abundant - Three or more of the above components readily apparent and observable from most locations with the site	5
Moderate - Any of the above components present, and observable with very little search effort	3
Sparse - Any of the above components present, but occurring infrequently or requiring significant search effort to locate	1
Absent - None of the above components observed	0

Component 7 - Condition of Existing Vegetation - Other

Use: Criteria A&B for cover types (other than crops and marsh wetlands) containing woody and/or herbaceous vegetation.
Criteria C for cropland only.
Criteria D for marsh wetlands.

Criteria A
Degree of utilization of woody vegetation by vertebrates and invertebrates

	Value
Not evident - little or no evidence of plant utilization	5
Moderate - plant utilization observable with minimal damage to leaves and/or stems	3
Severe - damage to leaves and/or stems readily observable	1
No woody vegetation present	0

Criteria B
Availability of Herbaceous Vegetation. Do not evaluate for Crops (Criteria C) or Marsh Wetlands (Criteria D)

	Value
Good - Eight or more combined species of grasses and forbs readily observable.	5
Fair - Four to seven combined species of grasses and forbs readily observable	3
Poor - One to three combined species of grasses and forbs readily observable	1
None - Herbaceous vegetation lacking or absent	0

Criteria C
Available Biomass (Evaluate for croplands only)

	Value
High- Biomass removed periodically, although not necessarily annually; removed biomass supplanted by other vegetation resulting from natural succession of invading species or overseeding of introduced species; (Ex. Rice or other crop on multi-year rotational system allowing for additional biomass accumulations between harvests).	10
Moderate - Most biomass removed annually or semi-annually but with some residual amount remaining during portions of the rotational period. Minimal bare ground conditions (Hay operations, crops grown for pasture or grazing, chiseled crops).	5
Low - Most biomass removed annually due to clean farming practices creating significant bare ground conditions (intensive row crop farming).	1

Criteria D
Condition of Marsh Wetlands

	Value
Unaltered - Quality of water and/or associated vegetation good, no foreseeable danger of environmental intrusion including pollution, contamination,	10

sedimentation, or stagnation.

Stable - Quality of water and/or associated vegetation good, although evidence exists that pollution, contamination sedimentation or stagnation could occur in the future or has occurred in the past. 5

Degraded - Degraded - Quality of water and/or associated vegetation poor or declining or degradation imminent. 1

WILDLIFE HABITAT APPRAISAL PROCEDURE FIELD EVALUATION FORMS

TABLE F-1

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Cropland

Habitat Components	Components Points (From Key)							
Site No.	179	458	434	127	546	32	543	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	1	7
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	0	0	0	0	0	0	0	0
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	NA	NA	NA	NA	NA	NA	NA	NA
6. Additional Structural Diversity Components	0	0	0	0	0	0	0	0
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B (Herbaceous Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Croplands Only)	1	1	3	1	1	1	1	9
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.09

TABLE F-2

SPECIES LIST FOR CROP COVER TYPE

Common Name	Scientific Name	Group	Layer
Bermuda grass	*Cynodon dactylon*	Caryopsis	herbaceous
Foxtail grass	*Setaria italica*	Caryopsis	herbaceous
Giant Ragweed	*Ambrosia trifida*	Achene	herbaceous
Japanese brome	*Bromus japonicus*	Caryopsis	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Perennial ryegrass	*Lolium perenne*	Caryopsis	herbaceous
Prairie Peppergrass	*Lepidium densiflorum*	Silique	herbaceous
Southern Crabgrass	*Digitaria ciliaris*	Caryopsis	Herbaceous
White Clover	*Trifolium repens*	Legume/Pod	herbaceous
Wild Rye	*Elymus sp.*	Caryopsis	herbaceous

TABLE F-3

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Pasture

Habitat Components	Components Points (From Key)							
Site No.	458	23	108	131	520	742	38	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	1	7
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	5	5	5	5	5	5	5	35
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	3	3	3	3	3	3	21
6. Additional Structural Diversity Components	0	0	0	0	0	0	0	0
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B (Herbaceous Vegetation)	5	5	1	5	3	5	3	27
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.20

TABLE F-4

SPECIES LIST FOR PASTURE COVER TYPE

Common Name	Scientific Name	Group	Layer
Bermuda	*Cynodon dactylon*	Caryopsis	herbaceous
Buttercup	*Ranunculus sp.*	Achene	herbaceous
Cocklebur	*Xanthium sp.*	Achene	herbaceous
Curly Dock	*Rumex crispus*	Achene	herbaceous
Dewberry	*Rubus trivialis*	Berry/Drupe	herbaceous
Dotted Blue-eyed Grass	*Sisyrinchium langloisii*	Capsule	herbaceous
Fescue	*Festuca arundinacea*	Caryopsis	herbaceous
Fiddle Dock	*Rumex pulcher*	Achene	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Prairie Phlox	*Phlox pilosa*	Capsule	herbaceous
Purple Threeawn	*Aristida purpurea*	Caryopsis	herbaceous
Showey Evening Primrose	*Oenothera speciosa*	Capsule	herbaceous
Spurred Butterfly Pea	*Centrosema virginianum*	Legume/Pod	herbaceous
Texas Prairie Parsley	*Polytaenia texana*	Schizocarp	herbaceous
Texas Toadflax	*Nuttallanthus texanus*	Capsule	herbaceous
Texas Vervain	*Verbena halei*	Nut/Nutlike	herbaceous
Trumpet Creeper	*Campsis radicans*	Capsule	herbaceous
Vetch	*Vicia sp.*	Legume/Pod	herbaceous
Violet	*Viola sp.*	Capsule	herbaceous
White Clover	*Trifolium repens*	Legume/Pod	herbaceous
Wild Onion	*Allium canadense*	Capsule	herbaceous
Woodsorrell	*Oxalis sp.*	Capsule	herbaceous
Yellow Thistle	*Cirsium horridulum*	Achene	herbaceous

TABLE F-5

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Grasses

Habitat Components	Components Points (From Key)							
Site No.	510	330	321	577	535	683	53	Total
1. Site Potential	7	7	7	7	7	7	7	49
2. Temporal Development								
Criteria A	1	1	1	1	1	1	5	11
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	5	5	5	10	10	10	10	55
4. Vegetation Species Diversity								
Criteria A	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B	NA	NA	NA	NA	NA	NA	NA	NA
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	3	3	3	3	3	3	21
6. Additional Structural Diversity Components	1	0	1	1	0	0	1	4
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria B (Herbaceous Vegetation)	5	3	5	5	5	5	5	33
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.25

TABLE F-6

SPECIES LIST FOR GRASSES COVER TYPE

Common Name	Scientific Name	Group	Layer
Annual Ragweed	*Ambrosia artemisiifolia*	Achene	herbaceous
Beaked Cornsalad	*Valerianella radiata*	Achene	herbaceous
Bermuda	*Cynodon dactylon*	Caryopsis	herbaceous
Big Bluestem	*Andropogon gerardii*	Achene	herbaceous
Japanese Brome	*Bromus japonicus*	Caryopsis	herbaceous
Bushy Bluestem	*Andropogon glomeratus*	Achene	herbaceous
Buttercup	*Ranunculus sp.*	Achene	herbaceous
Catchweed Bedstraw	*Galium aparine*	Schizocarp	herbaceous
Clasping Venus' Looking-glass	*Triodanis perfoliata*	Capsule	herbaceous
Common Selfheal	*Prunella vulgaris*	Nut/Nutlike	herbaceous
Common Sunflower	*Helianthus annuus*	Achene	herbaceous
Common Yarrow	*Achillea millefolium*	Achene	herbaceous
Cross-vine	*Bignonia capreolata*	Capsule	herbaceous
Curly Dock	*Rumex crispus*	Achene	herbaceous
Dewberry	*Rubus trivialis*	Berry/Drupe	herbaceous
Dill Family	*Anethum sp.*	Schizocarp	herbaceous
Dotted Blue-eyed Grass	*Sisyrinchium langloisii*	Capsule	herbaceous
Fiddle Dock	*Rumex pulcher*	Achene	herbaceous
Flameleaf Sumac	*Rhus copallinum*	Berry/Drupe	herbaceous
Flax	*Linum sp.*	Capsule	herbaceous
Foxtail Grass	*Setaria sp.*	Caryopsis	herbaceous
Giant Ragweed	*Ambrosia trifida*	Achene	herbaceous
Goldenrod	*Solidago sp.*	Achene	herbaceous
Green Wild Indigo	*Baptisia sphaerocarpa*	Legume/Pod	herbaceous
Greenbriar	*Smilax bona-nox*	Berry/Drupe	herbaceous
Henbit	*Lamium amplexicaule*	Nut/Nutlike	herbaceous
Illinois Bundleflower	*Desmanthus illinoensis*	Legume/Pod	herbaceous
Indian paintbrush	*Castilleja sp.*	Capsule	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Little Bluestem	*Schizachyrium scoparium*	Achene	herbaceous
Milkweed	*Asclepias sp.*	Follicle	herbaceous
Nettle Family		Achene	herbaceous
Nightshade	*Solanum sp.*	Berry/Drupe	herbaceous
Pigweed	*Amaranthus sp.*	Utricle	herbaceous
Prairie Peppergrass	*Lepidium densiflorum*	Silique	herbaceous
Prairie Plantain	*Plantago elongata*	Capsule	herbaceous
Prickly Pear Cactus	*Opuntia sp.*	Berry/Drupe	herbaceous
Purple Threeawn	*Aristida purpurea*	Caryopsis	herbaceous
Quakinggrass	*Briza minor*	Caryopsis	herbaceous
Ryegrass	*Lolium perenne*	Caryopsis	herbaceous
Sensitive Briar	*Schrankia spp.*	Legume/Pod	herbaceous
Showy Evening Primrose	*Oenothera speciosa*	Capsule	herbaceous
Spurge Family		Capsule	herbaceous
Spurred Butterfly Pea	*Centrosema virginianum*	Legume/Pod	herbaceous
Sunflower Family	*Aster sp.*	Achene	herbaceous
Texas Dandelion	*Pyrrhopappus carolinianus*	Achene	herbaceous
Texas Prairie Parsley	*Polytaenia texana*	Schizocarp	herbaceous
Texas Vervain	*Verbena halei*	Nut/Nutlike	herbaceous
Trumpet Creeper	*Campsis radicans*	Capsule	herbaceous

TABLE F-6

SPECIES LIST FOR GRASSES COVER TYPE

Vetch	*Vicia sp.*	Legume/Pod	herbaceous
Virginia Creeper	*Parthenocissus quinquefoli*	Berry/Drupe	herbaceous
White Clover	*Trifolium repens*	Legume/Pod	herbaceous
Wild Geranium	*Geranium caroliniuanum*	Legume/Pod	herbaceous
Wild Onion	*Allium canadense*	Capsule	herbaceous
Wild Petunia	*Ruellia sp.*	Capsule	herbaceous
Yellow Sweet Clover	*Melilotus indicus*	Legume/Pod	herbaceous
Yellow Thistle	*Cirsium horridulum*	Achene	herbaceous

TABLE F-7

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Forest

Habitat Components	Components Points (From Key)							
Site No.	684	510	706	330	518	539	742	Total
1. Site Potential	12	12	12	7	7	12	12	74
2. Temporal Development								
Criteria A	6	12	12	12	12	12	12	78
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	15	15	15	15	10	10	15	95
4. Vegetation Species Diversity								
Criteria A	7	8	7	6	5	4	8	45
Criteria B	7	7	7	7	5	3	5	41
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	4	5	4	5	5	4	4	31
6. Additional Structural Diversity Components	5	1	3	1	3	3	1	17
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	1	5	5	5	5	5	5	31
Criteria B (Herbaceous Vegetation)	5	5	5	5	5	3	5	33
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.64

TABLE F-8

SPECIES LIST FOR FOREST COVER TYPE

Common Name	Scientific Name	Group	Layer
American Elm	*Ulmus americana*	Samara	canopy
Black Willow	*Salix nigra*	Capsule	canopy
Blackjack Oak	*Quercus marilandica*	Acorn	canopy
Bois d' Arc	*Maclura pomifera*	Achene	canopy
Box Elder	*Acer negundo*	Samara	canopy
Bur Oak	*Quercus macrocarpa*	Acorn	canopy
Cedar Elm	*Ulmus crassifolia*	Samara	canopy
Cottonwood	*Populus deltoides*	Berry/Drupe	canopy
Eastern Red Cedar	*Juniperus virginiana*	Cone	canopy
Green Ash	*Fraxinus pennsylvanica*	Samara	canopy
Hackberry	*Celtis laevigata*	Berry/Drupe	canopy
Hawthorn	*Crataegus texana*	Berry/Drupe	canopy
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	canopy
Pecan	*Carya illinoensis*	Nut/Nutlike	canopy
Post Oak	*Quercus stellata*	Acorn	canopy
Red Oak	*Quercus texana*	Acorn	canopy
Texas ash	*Fraxinus texensis*	Berry/Drupe	canopy
White Ash	*Fraxinus americana*	Samara	canopy
Winged Elm	*Ulmus alata*	Samara	canopy
American Elm	*Ulmus americana*	Samara	understory
Bamboo	*Phyllostachys sp.*	Other	understory
Black Willow	*Salix nigra*	Capsule	understory
Bois d' Arc	*Maclura pomifera*	Achene	understory
Box Elder	*Acer negundo*	Samara	understory
Cedar Elm	*Ulmus crassifolia*	Samara	understory
Chickasaw plum	*Prunus angustifolia*	Berry/Drupe	understory
Chinaberry	*Melia azedarach*	Berry/Drupe	understory
Chinese privet	*Ligustrum sinese*	Berry/Drupe	understory
Chinquapin Oak	*Quercus muehlenbergii*	Acorn	understory
Cottonwood	*Populus deltoides*	Berry/Drupe	understory
Deciduous Holly	*Ilex decidua*	Berry/Drupe	understory
Eastern Red Cedar	*Juniperus virginiana*	Cone	understory
Eve's Necklace	*Sophora affinis*	Legume/Pod	understory
Green Ash	*Fraxinus pennsylvanica*	Samara	understory
Gum Bumelia	*Bumelia lanuginosum*	Berry/Drupe	understory
Hackberry	*Celtis laevigata*	Berry/Drupe	understory
Hawthorn	*Crataegus texana*	Berry/Drupe	understory
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	understory
Mexican Plum	*Prunus mexicana*	Berry/Drupe	understory
Pecan	*Carya illinoensis*	Nut/Nutlike	understory
Post Oak	*Quercus stellata*	Acorn	understory
Rattlebush	*Sesbania drummondii*	Legume/Pod	understory
Red Oak	*Quercus shumardii*	Acorn	understory
Redbud	*Cercis canadensis*	Legume/Pod	understory
Roughleaf Dogwood	*Cornus drummondii*	Berry/Drupe	understory
Sassafras	*Sassafras albidum*	Berry/Drupe	understory
Soapberry	*Sapindus drummondii*	Berry/Drupe	understory
Toothache Tree	*Zanthoxylum clava-herculis*	Berry/Drupe	understory
Wild Rose Bush	*Rosa sp.*	Achene	understory

TABLE F-8

SPECIES LIST FOR FOREST COVER TYPE

Annual Ragweed	*Ambrosia artemisiifolia*	Achene	herbaceous
Beaked Cornsalad	*Valerianella radiata*	Achene	herbaceous
Bermuda	*Cynodon dactylon*	Caryopsis	herbaceous
Browneyed Susan	*Rudbeckia triloba*	Achene	herbaceous
Bushy Bluestem	*Andropogon glomeratus*	Achene	herbaceous
Buttercup	*Ranunculus sp.*	Achene	herbaceous
Catchweed Bedstraw	*Galium aparine*	Schizocarp	herbaceous
Cocklebur	*Xanthium sp.*	Achene	herbaceous
Common Selfheal	*Prunella vulgaris*	Nut/Nutlike	herbaceous
Common Yarrow	*Achillea millefolium*	Achene	herbaceous
Coral Honeysuckle	*Lonicera sempervirens*	Berry/Drupe	herbaceous
Coralberry	*Symphoricarpos orbiculatus*	Berry/Drupe	herbaceous
Cross-vine	*Bignonia capreolata*	Capsule	herbaceous
Curly Dock	*Rumex crispus*	Achene	herbaceous
Dewberry	*Rubus trivialis*	Berry/Drupe	herbaceous
False Indigo	*Amorpha fruticosa*	Legume/Pod	herbaceous
Flameleaf Sumac	*Rhus copallinum*	Berry/Drupe	herbaceous
Foxtail Grass	*Setaria italica*	Caryopsis	herbaceous
Giant Ragweed	*Ambrosia trifida*	Achene	herbaceous
Giant Reed	*Arundo donax*	Caryopsis	herbaceous
Goldenrod	*Solidago sp.*	Achene	herbaceous
Grapevine	*Vitis sp.*	Berry/Drupe	herbaceous
Green Wild Indigo	*Baptisia sphaerocarpa*	Legume/Pod	herbaceous
Greenbriar	*Smilax bona-nox*	Berry/Drupe	herbaceous
Heavenly Bamboo	*Nandina domestica*	Berry/Drupe	herbaceous
Hedgenettle	*Stachys sp.*		herbaceous
Illinois Bundleflower	*Desmanthus illinoensis*	Legume/Pod	herbaceous
Indian Paintbrush	*Castilleja sp.*	Capsule	herbaceous
Inland Sea Oats	*Chasmanthium latifolium*	Achene	herbaceous
Japanese Honeysuckle	*Lonicera japonica*	Berry/Drupe	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Little Bluestem	*Schizachyrium scoparium*	Achene	herbaceous
Lizard's Tail	*Saururus cernuus*	Capsule	herbaceous
May Apple	*Podophyllum peltatum*	Berry/Drupe	herbaceous
Milkweed	*Asclepias sp.*	Follicle	herbaceous
Mint Family		Nut/Nutlike	herbaceous
Mulberry	*Morus sp.*	Achene	herbaceous
Mustang Grape	*Vitis mustangensis*	Berry/Drupe	herbaceous
Mustard Family		Silique	herbaceous
Perennial Ryegrass	*Lolium perenne*	Caryopsis	herbaceous
Plantain	*Plantago sp.*	Capsule	herbaceous
Poison Ivy	*Toxicodendron radicans*	Berry/Drupe	herbaceous
Prairie Plantain	*Plantago elongata*	Capsule	herbaceous
Prickly Pear Cactus	*Opuntia sp.*	Berry/Drupe	herbaceous
Quakinggrass	*Briza minor*	Caryopsis	herbaceous
Queen Anne's Lace	*Daucus carota*	Schizocarp	herbaceous
Sedge	*Carex sp.*	Achene	herbaceous
Showy Evening Primrose	*Oenothera speciosa*	Capsule	herbaceous
Slender Fimbry	*Fimbristylis autumnalis*	Achene	herbaceous
Spurred Butterfly Pea	*Centrosema virginianum*	Legume/Pod	herbaceous

TABLE F-8

SPECIES LIST FOR FOREST COVER TYPE

Sunflower Family	*Aster sp.*	Achene	herbaceous
Texas Dandelion	*Pyrrhopappus carolinianus*	Achene	herbaceous
Texas Prairie Parsley	*Polytaenia texana*	Schizocarp	herbaceous
Texas Vervain	*Verbena halei*	Nut/Nutlike	herbaceous
Trumpet Creeper	*Campsis radicans*	Capsule	herbaceous
Vetch	*Vicia sp.*	Legume/Pod	herbaceous
Violet	*Viola sp.*	Capsule	herbaceous
Virginia Creeper	*Parthenocissus quinquefolia*	Berry/Drupe	herbaceous
Virginia Wildrye	*Elymus virginicus*	Caryopsis	herbaceous
White Clover	*Trifolium repens*	Legume/Pod	herbaceous
Wild Onion	*Allium canadense*	Capsule	herbaceous
Woodsorrel	*Oxalis sp.*	Capsule	herbaceous

TABLE F-9

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Young Forest

Habitat Components	Components Points (From Key)							
Site No.	167	127	108	519	325	520	749	Total
1. Site Potential	12	12	7	7	7	7	7	59
2. Temporal Development								
Criteria A	6	6	6	6	6	6	6	42
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	10	10	10	10	10	10	10	70
4. Vegetation Species Diversity								
Criteria A	5	7	7	4	3	8	5	39
Criteria B	3	5	5	5	3	7	3	31
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	4	4	4	4	4	4	4	28
6. Additional Structural Diversity Components	1	3	3	1	1	1	1	11
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	5	5	5	5	5	5	35
Criteria B (Herbaceous Vegetation)	5	5	1	5	5	3	1	25
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.49

TABLE F-10

SPECIES LIST FOR YOUNG FOREST COVER TYPE

Common Name	*Scientific Name*	Group	Layer
American Elm	*Ulmus americana*	Samara	canopy
Black Willow	*Salix nigra*	Capsule	canopy
Bois d' Arc	*Maclura pomifera*	Achene	canopy
Box Elder	*Acer negundo*	Samara	canopy
Bur Oak	*Quercus macrocarpa*	Acorn	canopy
Cedar Elm	*Ulmus crassifolia*	Samara	canopy
Cottonwood	*Populus deltoides*	Berry/Drupe	canopy
Eastern Red Cedar	*Juniperus virginiana*	Cone	canopy
Green Ash	*Fraxinus pennsylvanica*	Samara	canopy
Hackberry	*Celtis laevigata*	Berry/Drupe	canopy
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	canopy
Pecan	*Carya illinoensis*	Nut/Nutlike	canopy
Post Oak	*Quercus stellata*	Acorn	canopy
Red Oak	*Quercus shumardii*	Acorn	canopy
Toothache Tree	*Zanthoxylum clava-herculis*	Berry/Drupe	canopy
Black Willow	*Salix nigra*	Capsule	understory
Bois d' Arc	*Maclura pomifera*	Achene	understory
Cedar Elm	*Ulmus crassifolia*	Samara	understory
Chickasaw plum	*Prunus angustifolia*	Berry/Drupe	understory
Chinese Privet	*Ligustrum sinese*	Berry/Drupe	understory
Deciduous Holly	*Ilex decidua*	Berry/Drupe	understory
Eastern Red Cedar	*Juniperus virginiana*	Cone	understory
Eve's Necklace	*Sophora affinis*	Legume/Pod	understory
Green Ash	*Fraxinus pennsylvanica*	Samara	understory
Gum Bumelia	*Bumelia lanuginosum*	Berry/Drupe	understory
Hackberry	*Celtis laevigata*	Berry/Drupe	understory
Hawthorn	*Crataegus texana*	Berry/Drupe	understory
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	understory
Mesquite	*Prosopis glandulosa*	Legume/Pod	understory
Mexican Plum	*Prunus mexicana*	Berry/Drupe	understory
Rattlebush	*Sesbania drummondii*	Legume/Pod	understory
Redbud	*Cercis canadensis*	Legume/Pod	understory
Soapberry	*Sapindus drummondii*	Berry/Drupe	understory
Toothache Tree	*Zanthoxylum clava-herculis*	Berry/Drupe	understory
Wild Rose Bush	*Rosa sp.*	Achene	understory
American Pokeweed	*Phytolacca americana*	Berry/Drupe	herbaceous
Annual Ragweed	*Ambrosia artemisiifolia*	Achene	herbaceous
Bermuda	*Cynodon dactylon*	Caryopsis	herbaceous
Japanese Brome	*Bromus japonicus*	Caryopsis	herbaceous
Bushy Bluestem	*Andropogon glomeratus*	Achene	herbaceous
Buttercup	*Ranunculus sp.*	Achene	herbaceous
Catchweed Bedstraw	*Galium aparine*	Schizocarp	herbaceous
Coralberry	*Symphoricarpos orbiculatus*	Berry/Drupe	herbaceous
Curly Dock	*Rumex crispus*	Achene	herbaceous
False Garlic	*Nothoscordum bivalve*	Achene	herbaceous
Giant Ragweed	*Ambrosia trifida*	Achene	herbaceous
Greenbriar	*Smilax bona-nox*	Berry/Drupe	herbaceous
Henbit	*Lamium amplexicaule*	Nut/Nutlike	herbaceous
Inland Sea Oats	*Chasmanthium latifolium*	Achene	herbaceous

TABLE F-10

SPECIES LIST FOR YOUNG FOREST COVER TYPE

Japanese Honeysuckle	*Lonicera japonica*	Berry/Drupe	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Mulberry	*Morus sp.*	Achene	herbaceous
Mustard Family		Silique	herbaceous
Perennial Ryegrass	*Lolium perenne*	Caryopsis	herbaceous
Poison Hemlock	*Conium maculatum*	Schizocarp	herbaceous
Poison Ivy	*Toxicodendron radicans*	Berry/Drupe	herbaceous
Prickly Pear Cactus	*Opuntia sp.*	Berry/Drupe	herbaceous
Sedge	*Carex sp.*	Achene	herbaceous
Spurge Family		Capsule	herbaceous
Sunflower Family	*Aster sp.*	Achene	herbaceous
Texas Prairie Parsley	*Polytaenia texana*	Schizocarp	herbaceous
Trumpet Creeper	*Campsis radicans*	Capsule	herbaceous
Virginia Wildrye	*Elymus virginicus*	Caryopsis	herbaceous

TABLE F-11

WHAP
Biological Components
Field Evaluation Form

Project Proposed Lake Ralph Hall Date: 2005
Cover Type or Plant Association Parks

Habitat Components	Components Points (From Key)							
Site No.	534	701	749	321	126	535	706	Total
1. Site Potential	7	12	7	7	7	7	12	59
2. Temporal Development								
Criteria A	6	6	6	6	6	6	6	42
Criteria B (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
3. Uniqueness and Relative Abundance	5	5	5	5	5	5	5	35
4. Vegetation Species Diversity								
Criteria A	6	6	3	4	2	8	7	36
Criteria B	3	3	1	1	1	7	5	21
Criteria C (Swamps Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA
5. Vertical Stratification	3	4	3	4	3	4	3	24
6. Additional Structural Diversity Components	0	1	0	1	3	1	1	7
7. Condition of Existing Vegetation								
Criteria A (Woody Vegetation)	5	5	5	5	5	5	5	35
Criteria B (Herbaceous Vegetation)	5	5	1	3	3	5	5	27
Criteria C (Croplands Only)	NA	NA	NA	NA	NA	NA	NA	NA
Criteria D (Marsh Wetlands Only)	NA	NA	NA	NA	NA	NA	NA	NA

Average Habitat Quality Score for all sites within this cover type = $\frac{\text{Total Points}}{\text{Total number of sites}} \times \frac{1}{100} =$ 0.41

TABLE F-12

SPECIES LIST FOR PARKS COVER TYPE

Common Name	Scientific Name	Group	Layer
American elm	*Ulmus americana*	Samara	canopy
Bois d' Arc	*Maclura pomifera*	Achene	canopy
Catalpa (cigar tree)	*Catalpa speciosa*	Capsule	canopy
Cedar Elm	*Ulmus crassifolia*	Samara	canopy
Green Ash	*Fraxinus pennsylvanica*	Samara	canopy
Hackberry	*Celtis laevigata*	Berry/Drupe	canopy
Pecan	*Carya illinoensis*	Nut/Nutlike	canopy
Post Oak	*Quercus stellata*	Acorn	canopy
Red Oak	*Quercus shumardii*	Acorn	canopy
Black Willow	*Salix nigra*	Capsule	understory
Bois d' Arc	*Maclura pomifera*	Achene	understory
Cedar Elm	*Ulmus crassifolia*	Samara	understory
Chickasaw plum	*Prunus angustifolia*	Berry/Drupe	understory
Chinese Privet	*Ligustrum sinese*	Berry/Drupe	understory
Chinquapin Oak	*Quercus muehlenbergii*	Acorn	understory
Deciduous Holly	*Ilex decidua*	Berry/Drupe	understory
Eastern Red Cedar	*Juniperus virginiana*	Cone	understory
Eve's Necklace	*Sophora affinis*	Legume/Pod	understory
Green Ash	*Fraxinus pennsylvanica*	Samara	understory
Gum Bumelia	*Bumelia lanuginosum*	Berry/Drupe	understory
Hackberry	*Celtis laevigata*	Berry/Drupe	understory
Hawthorn	*Crataegus texana*	Berry/Drupe	understory
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	understory
Mesquite	*Prosopis glandulosa*	Legume/Pod	understory
Mexican Plum	*Prunus mexicana*	Berry/Drupe	understory
Post Oak	*Quercus stellata*	Acorn	understory
Rattlebush	*Sesbania drummondii*	Legume/Pod	understory
Roughleaf Dogwood	*Cornus drummondii*	Berry/Drupe	understory
Soapberry	*Sapindus drummondii*	Berry/Drupe	understory
Wild Rose Bush	*Rosa sp.*	Achene	understory
Annual Ragweed	*Ambrosia artemisiifolia*	Achene	herbaceous
Beaked Cornsalad	*Valerianella radiata*	Achene	herbaceous
Bermuda	*Cynodon dactylon*	Caryopsis	herbaceous
Big Bluestem	*Andropogon gerardii*	Achene	herbaceous
Japanese Brome	*Bromus japonicus*	Caryopsis	herbaceous
Bull Nettle	*Cnidoscolus texanus*	Capsule	herbaceous
Bushy Bluestem	*Andropogon glomeratus*	Achene	herbaceous
Buttercup	*Ranunculus sp.*	Achene	herbaceous
Catchweed Bedstraw	*Galium aparine*	Schizocarp	herbaceous
Clasping Venus' Looking-glass	*Triodanis perfoliata*	Capsule	herbaceous
Clover (yellow)	*Meliotus indicus*	Legume/Pod	herbaceous
Cockspur Grass	*Echinochloa crus-pavonis*	Caryopsis	herbaceous
Common Selfheal	*Prunella vulgaris*	Nut/Nutlike	herbaceous
Common Sunflower	*Helianthus annuus*	Achene	herbaceous
Common Yarrow	*Achillea millefolium*	Achene	herbaceous
Coral Honeysuckle	*Lonicera sempervirens*	Berry/Drupe	herbaceous
Coralberry	*Symphoricarpos orbiculatus*	Berry/Drupe	herbaceous
Cross-vine	*Bignonia capreolata*	Capsule	herbaceous
Curly Dock	*Rumex crispus*	Achene	herbaceous

TABLE F-12

SPECIES LIST FOR PARKS COVER TYPE

Dewberry	*Rubus trivialis*	Berry/Drupe	herbaceous
Dotted Blue-eyed Grass	*Sisyrinchium langloisii*	Capsule	herbaceous
False Garlic	*Nothoscordum bivalve*	Achene	herbaceous
Fern		Other	herbaceous
Fiddle Dock	*Rumex pulcher*	Achene	herbaceous
Flameleaf Sumac	*Rhus copallinum*	Berry/Drupe	herbaceous
Flax	*Linum sp.*	Capsule	herbaceous
Foxtail Grass	*Setaria sp.*	Caryopsis	herbaceous
Giant Ragweed	*Ambrosia trifida*	Achene	herbaceous
Goldenrod	*Solidago sp.*	Achene	herbaceous
Green Wild Indigo	*Baptisia sphaerocarpa*	Legume/Pod	herbaceous
Greenbriar	*Smilax bona-nox*	Berry/Drupe	herbaceous
Honey Locust	*Gleditsia triacanthos*	Legume/Pod	herbaceous
Illinois Bundleflower	*Desmanthus illinoensis*	Legume/Pod	herbaceous
Indian Paintbrush	*Castilleja sp.*	Capsule	herbaceous
Johnson Grass	*Sorghum halepense*	Caryopsis	herbaceous
Little Bluestem	*Schizachyrium scoparium*	Achene	herbaceous
Lyreleaf Sage	*Salvia lyrata*	Nut/Nutlike	herbaceous
Milkweed	*Asclepias sp.*	Follicle	herbaceous
Nettle		Achene	herbaceous
Nightshade	*Solanum sp.*	Berry/Drupe	herbaceous
Poison Hemlock	*Conium maculatum*	Schizocarp	herbaceous
Poison Ivy	*Toxicodendron radicans*	Berry/Drupe	herbaceous
Prairie Peppergrass	*Lepidium densiflorum*	Silique	herbaceous
Prickly Pear Cactus	*Opuntia sp.*	Berry/Drupe	herbaceous
Purple Threeawn	*Aristida purpurea*	Caryopsis	herbaceous
Quakinggrass	*Briza minor*	Caryopsis	herbaceous
Sensitive-briar	*Mimosa sp.*	Legume/Pod	herbaceous
Showy Evening Primrose	*Oenothera speciosa*	Capsule	herbaceous
Spurred Butterfly Pea	*Centrosema virginianum*	Legume/Pod	herbaceous
Sunflower Family	*Aster sp.*	Achene	herbaceous
Texas Prairie Parsley	*Polytaenia texana*	Schizocarp	herbaceous
Texas Vervain	*Verbena halei*	Nut/Nutlike	herbaceous
Trumpet Creeper	*Campsis radicans*	Capsule	herbaceous
Vervain Family		Nut/Nutlike	herbaceous
Vetch	*Vicia sp.*	Legume/Pod	herbaceous
Virginia Creeper	*Parthenocissus quinquefolia*	Berry/Drupe	herbaceous
Virginia Wildrye	*Elymus virginicus*	Caryopsis	herbaceous
White Clover	*Trifolium repens*	Legume/Pod	herbaceous
Wild Onion	*Allium canadense*	Capsule	herbaceous
Yellow Thistle	*Cirsium horridulum*	Achene	herbaceous

LAND COVER ASSESSMENT MAP

ALAN PLUMMER ASSOCIATES, INC.

ENVIRONMENTAL ENGINEERS · DESIGNERS · SCIENTISTS

Figure G-1
Upper Trinity Regional Water District
Lake Ralph Hall Drainage Basin
Land Cover Assessment Map

F-2: Summary of SWAMPIM and WHAP Memorandum

MEMORANDUM

Date: November 10, 2009

To: Mary Verwers, United States Army Corps of Engineers

From: Jason Voight, Alan Plummer Associates, Inc.
Loretta Mokry, Alan Plummer Associates, Inc.

Cc: Larry Patterson, P.E., Upper Trinity Regional Water District
Edward Motley, P.E., CH2MHill
File 0346-004-03

Subject: USACE Project Number 2003-00336
Summary of SWAMPIM and WHAP Data Sets and Reports for the Proposed Lake Ralph Hall Project Site

Background

To date numerous reports and subsequent reports have been produced for the Lake Ralph Hall project documenting efforts conducted to assess aquatic resource functions as well as habitat quality. The following is a brief synopsis of the effort to date.

- August 2005 – a draft Lake Ralph Hall Preliminary Habitat Assessment report documenting assessment of habitat and land cover within the project area using the Texas Parks and Wildlife Department's (TPWD) Wildlife Habitat Appraisal Procedure (WHAP) was circulated to the United States Army Corps of Engineers (USACE), U.S. Fish and Wildlife Department (USFWS), U.S. Environmental Protection Agency (USEPA), and the TPWD for review. During a project review meeting with Presley Hatcher (USACE Permits Chief) and Brent Jasper (USACE Project Manager for this project 2005-2008), the USACE provided a directive to use a functions based analysis rather than areal based analysis for developing appropriate mitigation for impacts associated with the project.

- January 2006 – a project meeting was held with Presley Hatcher and Brent Jasper to discuss the outline for functions based analysis of Lake Ralph Hall. Comments were received from the USACE and incorporated into a draft Stream Watershed Assessment and Measurement Protocol Interaction Model (SWAMPIM) protocol for functional assessment of the Lake Ralph Hall project area.

- March 2006 – the draft SWAMPIM protocol was submitted to the USACE for their review and comment; review comments were discussed at a project meeting with the USACE (Presley Hatcher and Brent Jasper).

- October 30, 2006 – an application for a Section 404 permit was submitted to the Fort Worth District, USACE. The application included the Lake Ralph Hall Preliminary

Habitat Assessment dated December 6, 2005, the Biological Assessment of the North Sulphur River dated June 15, 2006, and the Draft Mitigation Plan dated October 26, 2006. The SWAMPIM protocol was used in the development of the mitigation plan to determine the existing aquatic resource functions of the project area and to project aquatic resource functions based on the mitigation proposal. A balance between pre- and post-project aquatic functions was shown to be obtainable within the proposed project boundary.

- February 4, 2009 – an interagency meeting was hosted at the Lake Belton USACE office. At this meeting, a presentation was provided to the team to discuss the development of the SWAMPIM protocol and its application for assessing existing and post-project aquatic resources, which was used as the basis for the proposed draft mitigation plan. The interagency review team agreed to the use of the SWAMPIM and WHAP protocols for aquatic resource function and habitat assessment respectively within the Lake Ralph Hall project area. During the meeting, the agencies requested assessment of additional sampling points within the proposed mitigation areas along the upper reaches of tributaries to the North Sulphur River and within the Ladonia Unit of the Caddo National Grasslands. Attendees included representatives from the USACE, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, the U.S. Forest Service, Upper Trinity Regional Water District, CPYI, CH2MHill, and Alan Plummer Associates, Inc.

- July 2009 – USACE agreed to the proposed additional sampling points for SWAMPIM and WHAP assessment.

- August 24-29, 2009 – representatives from APAI assessed the additional sampling points using SWAMPIM for the stream channels and WHAP for terrestrial habitat.

- September 16, 2009 – the interagency review team participated in a field review of the additional sampling points. Based on the input received from the interagency review team during the on-site field review, the data sheets were revised for the additional sampling points. Attendees included representatives from the USACE, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, Upper Trinity Regional Water District, CPYI, CH2MHill, and Alan Plummer Associates, Inc.

A general location map is provided as Figure 1.

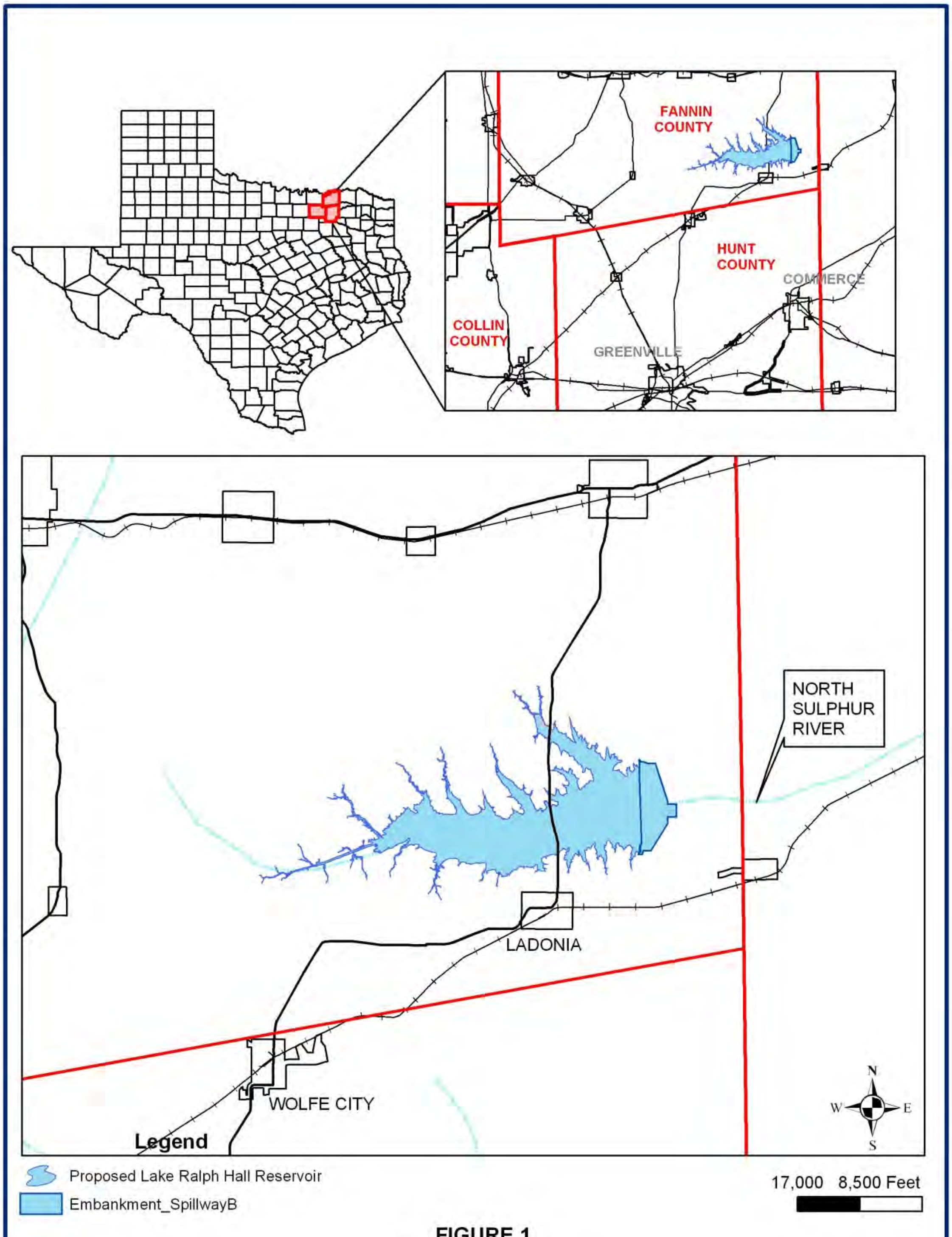


FIGURE 1
LAKE RALPH HALL
GENERAL LOCATION MAP

Discussion of the Data within the Draft Mitigation Plan (dated October 26, 2006) to the Data Reassessed After 2009 Agency Review

Wildlife Habitat Appraisal Procedure (WHAP)

On-site observations conducted during spring and summer 2005 were used to assess habitat quality and desktop analysis of a 2003 aerial photograph was used to quantify the areal extent of specific land cover categories within the proposed Lake Ralph Hall project area. The following table (Table 1) details the data presented in the draft mitigation plan dated October 26, 2006. As of the time of the mitigation submittal, the project area, excluding aquatic resources, consisted of 22 percent cropland, 19 percent grasses, 28 percent pasture, 7 percent partially wooded grassland (parklike), 8 percent forest, and 16 percent young forest. The two forested communities displayed the highest habitat quality scores.

Table 1: Wildlife Habitat Appraisal Procedure Data As Presented in the Draft Mitigation Plan

Cover-type Category	Average Habitat Quality Score (HQ)	Total Area (Acres)	Habitat Units (HQxArea)
Cropland	0.09	1,720	154.8
Grasses	0.25	1,435	358.75
Pasture	0.2	2,192	438.4
Partially Wooded Grassland	0.41	516	211.56
Forest	0.59	602	355.18
Young Forest	0.44	1,299	571.56
Total		**7,764**	**2,090.25**

During the September 16, 2009 agency review, not all habitat cover-types were included in the assessment of additional sampling points. Only cropland, pasture, forest, and young forest cover types were reassessed during the September 2009 interagency site field review. Of the habitat cover types that were assessed in 2009, habitat quality scores were adjusted both upwards and downwards from the comments received. The following illustrates the habitat quality scoring for data gathered at the additional sampling points pre- and post-agency review.

Site	Pre-Agency Visit	Post-Agency Visit
Cropland	0.15	0.20
Pasture	0.18	0.17
Forest	0.44	0.44
Young Forest	0.53	0.48

Scores for cropland improved, forest remained unchanged, but both pasture and young forest were downgraded slightly. All in all, there was less than one percent change downward from the pre-agency field review to the post-agency field review when all scores were summed (1.3 pre-agency review compared to 1.29 post-agency review).

When the scores for the additional sampling points are included with the original data for habitat assessment for the entire project area, the habitat quality scores decreased slightly from the values presented in the draft mitigation plan from 2,090.25 to 2,083.81, as shown in Table 2.

Table 2: Wildlife Habitat Appraisal Procedure Following September 2009 Agency Review Incorporated into the Entire Habitat Assessment

Cover-type Category	Average Habitat Quality Score (HQ)	Total Area (Acres)	Habitat Units (HQxArea)
Cropland	0.12	1,720	206.4
*Grasses**	*0.25*	*1,435*	*358.75*
Pasture	0.19	2,192	416.48
*Partially Wooded Grassland**	*0.41*	*516*	*211.56*
Forest	0.53	602	319.06
Young Forest	0.44	1,299	571.56
Total		**7,764**	**2,083.81**

**Represents data used from the mitigation plan assessment*

As illustrated above, the WHAP data used in the draft mitigation plan is consistent with the post-agency field review data. Figure A-1 in Attachment A illustrates the WHAP data points for all assessments. The WHAP protocol and all WHAP data sheets are included in Attachment A.

Stream Watershed Assessment and Measu rement Protocol Interaction Model (SWAMPIM)

The primary goal of the draft mitigation plan is to provide compensation to existing aquatic resource functions and terrestrial habitats impacted by the construction of the Lake Ralph Hall project on a watershed basis rather than on an areal basis. The SWAMPIM protocol was developed to facilitate development of a functions based mitigation plan by assessing existing conditions and functions capacity and projecting future functions capacity of the project area with the proposed Lake Ralph Hall in place. The SWAMPIM protocol accounts for functions and watershed interactions of both streams and impoundments. The following table (Table 3) summarizes the results of the pre- and post-project functional capacities for streams and impoundments as outlined in the draft mitigation plan.

Table 3: Functional Capacities for Streams and Impoundments as Outlined in the Draft Mitigation Plan dated October 26, 2006

STREAMS	**Pre-Project**		**Post-Project**	
	Linear Feet of Stream	Functional Capacity	Linear Feet of Stream	Functional Capacity
Within Conservation Pool	589,066	532.98	74,546	361.11
Outside of Conservation Pool	113,111	94.43	113,111	165.94
Former NSR	11,020	22.59	--	--
Restored NSR	--	--	14,500	125.08
Total	**124,131**	**650.0**	**202,157**	**652.13**
IMPOUNDMENTS	**Pre-Project**		**Post-Project**	
	Area (Acres)	Resource Capacity	Area (Acres)	Resource Capacity
Within Conservation Pool	72.5	30.83	7,566	5,783.5
Outside of Conservation Pool	40.7	16.58	40.7	16.58
Total	**113.2**	**47.41**	**7,606.7**	**5,800.08**

Streams

The North Sulphur River and its tributaries within the proposed Lake Ralph Hall project area are characterized as intermittent (North Sulphur River) and ephemeral (tributaries) which do not retain water in perennial pools during periods of insufficient rainfall. Based on observations of this character during field work conducted in 2006 and for the additional sampling points in August 2009, the SWAMPIM scoring for some functional parameters was zero. During the interagency field review, some agency team members expressed the opinion that the scoring of zero for these parameters based on no flow observed was unduly penalizing ephemeral streams. Based on the input received during the field review, data for the additional sampling points were upgraded for the various parameters that dealt with no water in the channel. The comparison of the pre-agency to post-agency field review functional capacity scores for the additional sampling points is as follows:

Site #	Pre-Agency Visit FC	Post-Agency Visit FC
N6	11.1	12.4
N16	11.1	11.0
N21	17.7	17.0
N21-Trib 18	1.4	1.3
N27	5.7	7.3
S52	12.4	14.3
S52-Trib 6	1.0	0.75
S56	7.0	6.8
S61	6.8	9.1

The data obtained from the post-agency field review was incorporated into the overall functional capacity data outlined in the draft mitigation plan. As shown in Table 4 when incorporating the post-agency reassessment data, the pre-project functional capacity within conservation pool decreased slightly whereas the outside of conservation pool functional capacity increased slightly.

Table 4: Comparison of Functional Capacity Scores from the Mitigation Plan and the 2009 Reassessment

Pre-Project Streams	Linear Feet of Stream	Mitigation Plan	2009 Reassessment
		Functional Capacity	Functional Capacity
Within Conservation Pool	589,066	532.98	519.30
Outside of Conservation Pool	113,111	94.43	95.69
Former NSR	11,020	22.59	22.59
Total	**124,131**	**650.0**	**637.58**

The summary tables for the 2006 and 2009 pre- and post-project stream functional capacity calculations are included in Attachment B. These tables provide the linear feet and functional capacity index score for the stream channel categories identified by channel widths and the corresponding functional capacity score for each category. As presented, the functional capacity indices outlined in the draft mitigation plan provided a more conservative picture of the aquatic resource functions within the proposed Lake Ralph Hall project area.

On-channel Impoundments

No changes were made to on-channel impoundments from what was presented in the draft mitigation plan. The interagency review team did not express any comments or concerns regarding the functional capacity scores presented for the impoundments. However, it should be noted that the pre-project resource capacity for existing impoundments scored a 47.41 whereas the post-project resource capacity with the construction of Lake Ralph Hall scored 5,800.08. Lake Ralph Hall grossly improves the post-project impoundment aquatic resource.

Figure B-1 in Attachment B illustrates the SWAMPIM data points used during the original assessments and the additional sampling points for the assessed in August 2009. The SWAMPIM protocol and all SWAMPIM data sheets are included in Attachment B.

Summary

Based on the mitigation proposal, a functional capacity score of 652.21 was primarily obtained through increased habitat potential, development of perennial pools within channels upstream of the conservation pool of the reservoir, and a decrease in erosion due to the curbing of current on-going head cutting. In keeping with the USACE's directive of mitigating this project through a functions based assessment, both the 2006 and 2009 pre-project functional capacity scores of 650.0 and 637.58 respectively are at or below the projected functional capacity improvements to the project area.

F-3: Biological Assessment of the North Sulphur River

ATTACHMENT 5

ATTACHMENT 5
BIOLOGICAL ASSESSMENT
OF NORTH SULPHUR RIVER

PREPARED BY
ALAN PLUMMER ASSOCIATES, INC.

UPPER TRINITY
REGIONAL WATER DISTRICT

R. J. BRANDES COMPANY
Consulting in Water Resources

MEMO

TO: Chris Loft
Texas Commission on Environmental Quality

FROM: Bob Brandes

DATE: October 30, 2006

SUBJECT: Biological Sampling of the North Sulphur River and Instream Flow Requirements for Lake Ralph Hall

As we have discussed on several occasions, development of appropriate instream flow requirements for the proposed Lake Ralph Hall on the North Sulphur River is a challenge because of the unique eroded nature of the river channel, the occurrence of significant river flows in the vicinity of the dam site only immediately after substantial rainfall events, the absence of any significant habitat within the river channel to support a viable aquatic ecosystem, and the fact that biological organisms often are not found in the river at all because its channel is essentially dry. To document these conditions and obtain site-specific data in the vicinity of the proposed dam site, the Upper Trinity Regional Water District (UTRWD), the project sponsor, commissioned Alan Plummer Associates, Inc. (APAI) to undertake a biological sampling program on the river earlier this year. These sampling efforts and their results are described in two letters from APAI dated June 15, 2006 and August 28, 2006, both of which are attached hereto as Attachments A and B, respectively.

It is apparent from the results from these field studies that the biological resources of this reach of the North Sulphur River are fairly limited, even with pools of water in the river channel following a series of small rainfall events as occurred prior to and during the May 5th sampling activity[1]. Only of a small variety of freshwater invertebrates were collected from the pools, with no fish species observed. Again, without rainfall, the channel of the river is essentially dry. As observed during the August 24th and 25th sampling event when no rainfall had previously occurred, there was no water present in the river channel and no biological activity.

Based on the results from the sampling that has been conducted by APAI, it is apparent that there is no significant existing biological community or aquatic ecosystem within the river channel that is sustained by the ephemeral flows that periodically occur in the river. At best, as described by APAI, the organisms that do occur are "opportunists" that are temporarily sustained by the occasional pools of water that occur after rainfall events and the temporary habitat that these

[1] About 1.5 inches of precipitation fell in the vicinity of the proposed Lake Ralph Hall dam site during the two weeks prior to the May 5th sampling event.

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pools provide. For this reason, it would appear that the development of some form of instream flow regime to attempt to mimic what occurs, or doesn't occur, naturally in the river under existing conditions would be difficult at best and may not be warranted. Instead, it might be more productive from a biological standpoint to utilize a portion of the inflows to Lake Ralph Hall, or some of the stored water in Lake Ralph Hall, to support a more viable ecosystem such as that being proposed by the UTRWD for restoration along a segment of the abandoned original channel of the North Sulphur River immediately below the dam.

As you know, we originally included in our water availability and yield analysis of Lake Ralph Hall a set of monthly instream flow requirements as a placeholder pending the development of more appropriate and meaningful information. These earlier instream flow requirements were derived using the Lyons desktop method applied to historical daily flow records from the existing streamflow gage on the North Sulphur River near Cooper. These calculations are summarized in the table included herewith as Attachment C, and as shown, even these estimated instream flow needs exhibit essentially zero values for four months of the year, i.e., July through October. Based on actual observations of the river flow in the vicinity of the dam site, it is obvious that the flows in the other eight months of the year certainly are not sustained at the levels indicated in the table, but rather are also zero the vast majority of the time when it is not raining in the river's upper watershed.

There is geologic evidence that there are certain formations along the channel of the North Sulphur River downstream of the dam site and closer to the streamflow gage near Cooper that potentially support sustained spring discharges, or at least seeps, for prolonged periods following rainfall events. Particularly, the Wolfe City and Pecan Gap sands are known to be characterized by such discharges. There is the possibility that it is the discharges from these formations that account for some of the observed river flows at the streamflow gage on the North Sulphur River near Cooper during the December-through-June period that result in the corresponding higher instream flow values derived with the Lyons method. It may be that this lower reach of the river in the vicinity of the gage simply has higher base flows than the reach upstream of the proposed Lake Ralph Hall dam site, and that the use of these flows to establish instream flow requirements for Lake Ralph Hall is not appropriate.

Enclosed with this memo is a copy of a video taken from a helicopter on October 11, 2005 of the reach of the North Sulphur River from the State Highway 24 crossing about 20 miles downstream of the proposed Lake Ralph Hall dam site (where the streamflow gage near Cooper is located) upstream to State Highway 68, which is about ten miles above the proposed Lake Ralph Hall dam site. This video clearly shows essentially no water in the river for about ten miles upstream and ten miles downstream of the proposed the Lake Ralph Hall dam site, but it does indicate the presence of isolated shallow pools of water along the lower segment of the river upstream of the streamflow gage near Cooper at the State Highway 24 crossing. Rainfall records for the area indicate that about one-half inch of precipitation fell in the watershed above the dam site on September 24th, followed by a few tenths of an inch of rainfall on September 28th and traces of rainfall on several days in early October. On the watershed below the dam site, over an inch of rain fell on September 24th, with another half inch on September 28th, thus contributing to the pools of water shown in the river channel above the gage.

As an alternative approach for providing for environmental flows, the UTRWD proposes to make all of the low-flow releases from Lake Ralph Hall, to the extent possible, through an outlet that contributes flows directly to the proposed restoration segment of the abandoned channel of the North Sulphur River located immediately below the dam in the south floodplain of the river. The balance of these flows not consumed within the restored segment of the abandoned river channel would be discharged back into the existing river channel through a controlled outlet structure, thus providing some sustained flow in the river for a short distance. While the design of the channel restoration project is still in progress, the low-flow releases from the reservoir to the restored channel will provide the necessary flow regime required to maintain the restored wetland area, with only part of this flow actually being consumed within the restored channel itself. Current plans for the project call for approximately 14,500 linear feet of the abandoned river channel on the south floodplain of the river to be excavated and restored, with plantings for creation and enhancement of riparian zones, wetlands, and corridors connecting to adjacent terrestrial habitat. In a river bottom area void of such conditions, this seems to be a much more appropriate and productive use of water from the river for environmental purposes than simply passing it downstream to flow through the existing barren and eroded channel of the river with no sustained habitat or biological resources.

In summary, the UTRWD is requesting that you give serious consideration to the approach described herein for providing appropriate environmental flows and for meeting the TCEQ's obligations for assuring that the proposed Lake Ralph Hall project will not adversely impact instream uses or water quality. We believe that the proposed approach will be an effective means for restoring riverine habitat in the area. As plans for the proposed river channel restoration project continue to evolve, we will keep you apprised of how the project will be configured and operated, and we would welcome any suggestions you might have for its improvement. In the meantime, if you have questions regarding what is being proposed, we will be glad to discuss them with you. Or if you want to visit the site and see firsthand the segment of the abandoned river channel that is being proposed for restoration, please let us know and we will be happy to arrange such a trip.

We appreciate your help with this effort and look forward to your comments regarding the approach being proposed by the UTRWD.

ATTACHMENT A

**Letter Dated June 15, 2006 from Alan Plummer Associates, Inc.
to Edward Motley, Chiang, Patel and Yerby, Inc.**

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS • DESIGNERS • SCIENTISTS

JAMES L. ALTSTAETTER, P.E.
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RICHARD H. SMITH, P.E.
ALAN R. TUCKER, P.E.

346-0402

June 15, 2006

Mr. Edward Motley, P.E.
Chiang, Patel, and Yerby, Inc.
1820 Regal Row, Suite 200
Dallas, Texas 75235

RE: Biological Assessment of the Aquatic Community of the North Sulphur River

Dear Mr. Motley:

Samplings for the biological assessment study were conducted on May 5 and 10, 2006 to determine the type and extent of aquatic biological resources at three sampling locations within the North Sulphur River in the vicinity of the proposed Lake Ralph Hall dam site. The sampling locations were selected based on accessibility and their relationship to the proposed dam location to provide insight as to the degree of environmental flows required to support the existing aquatic ecosystem downstream of the dam. Prior to the on-site investigation, a procedure was developed based on existing sampling protocols, specifically the United States Environmental Protection Agency's Rapid Bioassessment Protocol for Streams and Wadeable Rivers (second edition) and the Texas Commission on Environmental Quality's (TCEQ) Surface Water Quality Monitoring Program, Habitat Assessment.

The locations of the three sampling stations are shown on Figure A-1, included in Attachment A. The three sampling stations were located upstream of the State Highway (SH) 34 Bridge, downstream of the Farm to Market Road (FM) 904 Bridge, and downstream of the SH 38 Bridge. The SH 34 site is located approximately 2.5 upstream of the proposed dam, and the most downstream site at SH 38 is about 7.5 miles below the dam. The FM 904 site is only about 1.5 miles downstream of the proposed dam site. Photographs from the on-site investigations of the sampling locations are also included in Attachment A.

At each of the three sampling locations, six pools were identified in the field to collect samples using three sampling techniques for each identified pool: 1) D-frame aquatic dip net for invertebrates, fish, and amphibians; 2) the Surber Stream Sampler for benthic invertebrates; and 3) a kick net for collecting large and small organisms in open water. The Surber Sampler is primarily used in flowing streams where the substrate is stirred allowing invertebrates to dislodge and flow downstream into the sampling net. However, due to the fact that there was not flow in the North Sulphur River at the time of the on-site investigations, samples from the Surber did not fully represent the community within the selected pool. The protocol for kick net sampling consists of sampling for a pre-determined time using a hand-held

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rectangular net. The collector stirs the substrate within the pool for five minutes while an assistant holds the net downstream and collects the sample. Since there was a lack of discernable flow and due to the shallow depths of the selected pools within the North Sulphur River, a field determination was made to use the D-frame aquatic dip net in lieu of the kick net. The collector walked in a clockwise direction in front of the D-frame aquatic dip net stirring the substrate within the pool for a total five minutes. The resulting D-frame samples provided a more detailed cross-section of the representative community within the various pools. Since a greater quantity of biota was collected with the D-frame, those samples were preserved and processed in the lab whereas the Surber samples were processed in the field.

In conjunction with the biological assessment, at each sampling location, a score was generated for the North Sulphur River's Functional Condition Index.[1] The data sheets from that assessment are included in Attachment B. Lastly, TCEQ's Surface Water Quality Monitoring Habitat Assessment was performed for each the three sampling locations. The descriptions of the physical parameters observed and the resulting scores from the habitat assessment are as follows:

SH 34

The pools sampled averaged approximately 20 meters by 15 meters with depths ranging from five to ten centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 6, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.31 out of a total possible score of 3.0.

FM 904

The pools sampled averaged approximately 15 meters by 10 meters with depths ranging from five to 22 centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 4, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.53 out of a total possible score of 3.0.

SH 38

[1] The Functional Condition Index is a score based on a proposed method for evaluating stream functions. The proposed system is based on protocols used elsewhere in the United States. The proposed functional assessment protocol has not been approved by the USACE or any other regulatory agency.

The pools sampled averaged approximately 40 meters by 25 meters with depths ranging from five to 15 centimeters. The substrate consisted of clayey shale with some gravels intermixed. The shale observed was exposed bedrock. No discernable flow was observed and the water clarity was good. No rooted vegetation was observed. However, some detritus and filamentous algae were observed. The data collected were compiled into TCEQ's habitat assessment worksheet and the sampling location scored a 7, which is a habitat quality index of limited (poor). As an independent measure of the functional value of this location, the functional condition index for this sampling location is 0.47 out of a total possible score of 3.0.

From the three sampling locations, a variety of freshwater invertebrates were collected utilizing the aforementioned sampling techniques. The following table summarizes the total number of specimens collected for each sampling technique at each location. These numbers represent the total number of species identified at each of the six pools within the three sampling locations.

Family	Common Name	Hwy 38 Bridge		Hwy 904 Bridge		Hwy 34 Bridge	
		Surber	D-Frame Dip Net	Surber	D-Frame Dip Net	Surber	D-Frame Dip Net
Amphipoda	Scuds	0	1	2	0	0	6
Baetidae	Mayflies	0	6	0	4	1	23
Caenidae	Mayflies	38	361	155	811	41	425
Cambaridae	Crayfish	0	0	0	0	0	1
Ceratopogonidae	Flies and Midges	0	21	2	13	0	22
Chironomidae	Flies and Midges	84	591	92	288	75	934
Cladocera	Water Fleas	0	0	0	0	284	56
Coenagrionidae	Damselflies	0	0	0	2	0	0
Collembula	Spring Tails	0	0	0	0	0	1
Copepoda	Tiny Crustaceans	0	3	0	0	0	7
Corixidae	Aquatic and Semi-Aquatic Bugs	71	136	3	3	4	53
Culicidae	Mosquitoes	2	50	17	19	1	38
Dolichopodidae	Flies and Midges	0	0	0	0	2	3
Gyrinidae	Water Beetles	0	8	0	0	2	5
Haliplidae	Water Beetles	0	0	0	0	0	4
Heptageniidae	Mayflies	0	0	1	1	0	0
Hydracarina	Water Mites	0	2	6	0	0	1
Hydrophilidae	Water Beetles	0	14	5	15	5	25
Libellulidae	Dragonflies	3	12	8	24	3	55
Ostracoda	Seed Shrimp	0	38	0	0	0	48
Planorbidae	Freshwater Snail	0	0	0	0	0	1

Descriptions of the ecology for the identified species are included in Attachment C.

SUMMARY

The two most abundant families of invertebrates identified include Caenidae and Chironomidae at 39 and 44 percent, respectively. Both of these families are more tolerant of degraded streams and low dissolved oxygen conditions. It should be noted that all of the aforementioned invertebrates occur in areas typically found along the North Sulphur River including ponds, stock tanks, and ephemeral tributaries. During the on-site investigation, there were areas within the sampling locations where algae were colonizing thereby providing some habitat for the aforementioned species. Furthermore, detritus, decomposing shale sediment, and rooted terrestrial vegetation (e.g., Johnsongrass and rattlebush) were observed within the channel. This accumulation of sediment and rooted vegetation is most likely a product of the recent deficit of significant rainfall events in the area due to the extended drought conditions. Observations of the river channel in 2004 during a more normal rainfall period indicated that the channel is routinely scoured by flow resulting from typical rain events. This scouring includes removal of the oxidized shale in the river bottom, precluding any vegetative growth including algae. It should also be noted that the sampling was scheduled during spring rain events to ideally provide information when hopefully there was flow in the North Sulphur River. A rainfall event did occur on the morning of May 5th. However, this rain did not produce any detectable flow in the river. The limited pools within the river channel appeared to form more from seepage from small impoundments within the watershed, which enters the river channel along the shale bedrock layer.

The invertebrates identified during the sampling studies are common and abundant throughout the area and would be expected to colonize ephemeral to intermittent pools within the North Sulphur River even in the absence of river flow. The fact that flow in the river occurs only in response to rain events, leaving the bed of the river essentially dry the vast majority of the time would strongly suggest that a sustainable community of aquatic organisms (including invertebrates) cannot and does not exist within the river channel. The organisms observed are opportunists, temporarily sustained by the ephemeral pools and the limited temporal habitat these pools provide.

Should you have comments or questions, please feel free to phone either Loretta Mokry or myself at (817) 806-1700.

Sincerely,

ALAN PLUMMER ASSOCIATES, INC.

Jason Voight

Attachments

ATTACHMENT A

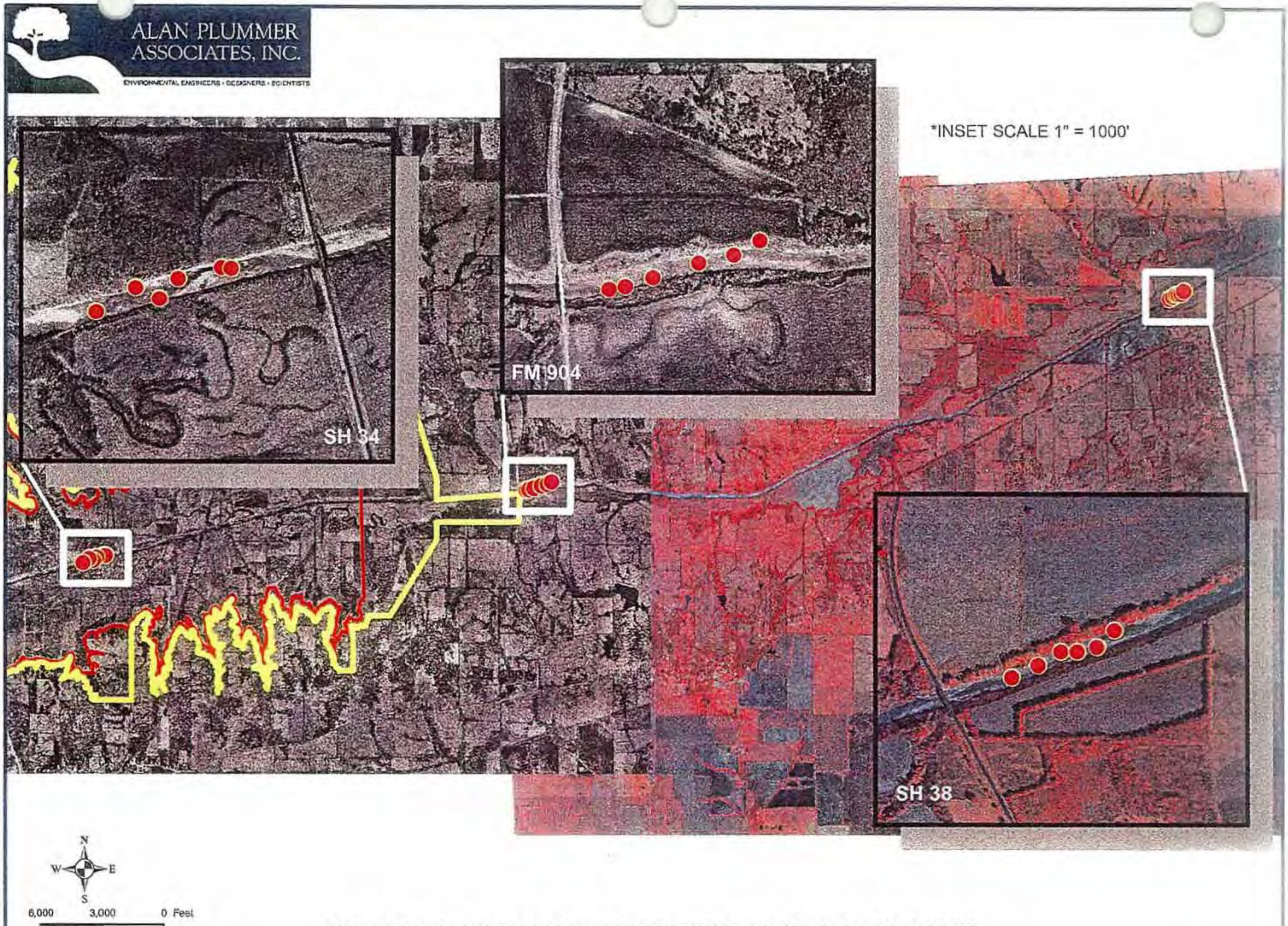


FIGURE A-1 - BIOLOGICAL ASSESSMENT SAMPLING LOCATIONS

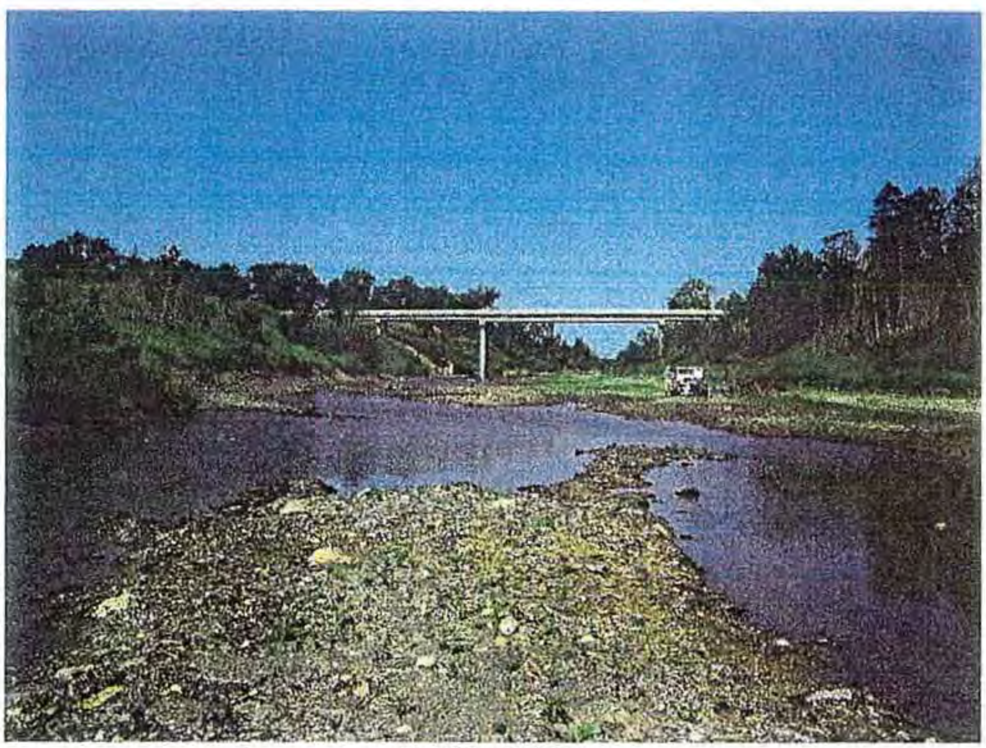
HWY 34 Bridge

HWY 34 Bridge

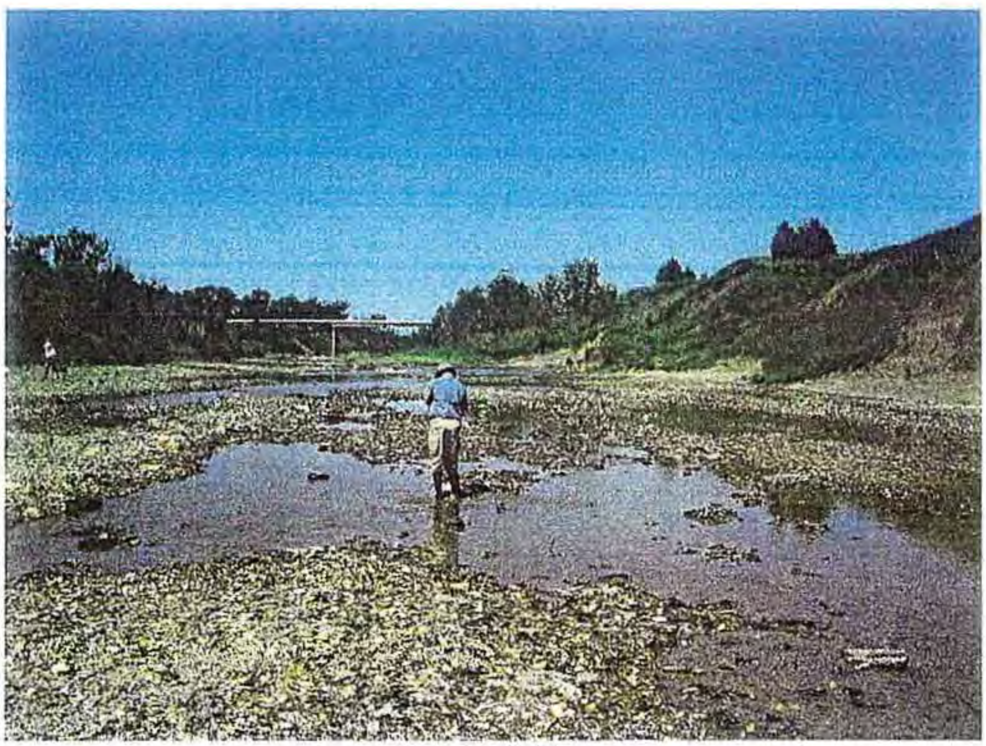
HWY 34 Bridge

HWY 34 Bridge


FM 904 Bridge


FM 904 Bridge

FM 904 Bridge



FM 904 Bridge


HWY 38 Bridge


HWY 38 Bridge

HWY 38 Bridge

HWY 38 Bridge

ATTACHMENT B

I. HYDROLOGIC FUNCTIONS

ITEM VARIABLES 05\05\2006 Highway 34 Bridge

ITEM	VARIABLES	10	9	8	7	6	5	4	3	2	1	0	SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas Subjective
	Grade	10	9	8	7	6	5	4	3	2	1	0	4	
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												
		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.				*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												
		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				w/ assistance and input from Dr. Mike Harvey and Stu Travant
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												
		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.				*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
	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												
		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 ≤1.0				*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												
		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				*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

	Variable	Optimal	Suboptimal	Marginal	Poor	Score	Reference
Enter Score for Only One Variable		CONDITION CATEGORY GRADE or SCORE					
	3c. Instream Bottom Topography	Optimal	Suboptimal	Marginal	Poor		*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		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	CONDITION CATEGORY GRADE or SCORE					
	3c. Manning's n	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		
		CONDITION CATEGORY GRADE or SCORE					
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	Optimal	Suboptimal	Marginal	Poor		*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		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						
		CONDITION CATEGORY GRADE or SCORE					
	4a.Pools (abundant, present or absent)	Optimal	Suboptimal	Marginal	Poor		*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		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	
		CONDITION CATEGORY GRADE or SCORE					
	4b. Channel Flow Status (degree to which channel is filled)	Optimal	Suboptimal	Marginal	Poor		*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		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 Highway 34 Bridge

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	1a. Bank Stability (score each bank, left or right facing downstream)	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.				*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
	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		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	1b. Channel Bottom Bank Stability	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.				*Galli, 1996* Wash-COG RSAT No. 1
	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	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	1c. Channel Sediments or Substrate Composition	>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				*Barbour, et al., 1999 ; Petersen, et al., 1992*
	Grade	10	9	8	7	6	5	4	3	2	1	0		
2	WATER APPEARANCE: Clarity or Visibility													
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	Water Clarity	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				*Newton, et al., 1998* USDA/ NRCS SVAP page 11
	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		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	3a. Nutrient Enrichment	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.				*Newton, et al., 1998* USDA/ NRCS SVAP page 12
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	or	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	3b. Aquatic Vegetation	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.				*Petersen, et al., 1992* RCE form No. 13
	Grade	10	9	8	7	6	5	4	3	2	1	0		

4	COMPOSITION OF ORGANIC MATTER: Detritus.													
		CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 15
		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	
5	LAND USE PATTERN: Beyond Immediate Riparian Zone													
		CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 1
		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	
6	RIPARIAN ZONE WIDTH AND CONTINUITY:													
	6a. Riparian Zone Width (from stream edge to field)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al.*, RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/
		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	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	3	
	6b. Riparian Zone Vegetation Protection/ Completeness	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4
		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	
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.125	
												FCI = #/80		

III. HABITAT FUNCTIONS

ITEM	VARIABLES				05\05\2006			Highway 34 Bridge					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	4	*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.				*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													
		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*
	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	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 District*, 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,*
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	

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	Below	

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	
	Score				2		
	SubCI	0	0	0	2		
Left Bank	%Riparian Area		60	40		100	
	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 0.1175

FCI = #/120

I. HYDROLOGIC FUNCTIONS

ITEM VARIABLES 05\10\2006 Highway 904 Bridge SCORE | Reference Source

1. FLOW REGIME:

TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			SCORE	Reference Source
Grade	10	9	8	7	6	5	4	3	2	1	0	4	*KDWP 2000* Kansas Subjective

2. CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions

CONDITION CATEGORY GRADE or SCORE

Variable	Optimal	Suboptimal	Marginal	Poor	Reference Source
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.	*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7

Grade	10	9	8	7	6	5	4	3	2	1	0	SCORE
2a	10	9	8	7	6	5	4	3	2	1	0	0

CONDITION CATEGORY GRADE or SCORE

Variable	Optimal	Suboptimal	Marginal	Poor	Reference Source
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	w/ assistance and input from Dr. Mike Harvey and Stu Travant

Grade	10	9	8	7	6	5	4	3	2	1	0	SCORE
2b	10	9	8	7	6	5	4	3	2	1	0	0

CONDITION CATEGORY GRADE or SCORE

Variable	Optimal	Suboptimal	Marginal	Poor	Reference Source
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.	*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*

Grade	10	9	8	7	6	5	4	3	2	1	0	SCORE
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

3 CHANNEL ROUGHNESS FACTORS

CONDITION CATEGORY GRADE or SCORE

Variable	Optimal	Suboptimal	Marginal	Poor	Reference Source
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 ≤1.0	*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*

Grade	10	9	8	7	6	5	4	3	2	1	0	SCORE
3a	10	9	8	7	6	5	4	3	2	1	0	2

CONDITION CATEGORY GRADE or SCORE

Variable	Optimal	Suboptimal	Marginal	Poor	Reference Source
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	*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats

Grade	10	9	8	7	6	5	4	3	2	1	0	SCORE
3b	10	9	8	7	6	5	4	3	2	1	0	0

Enter Score for Only One Variable	Variable	10	9	8	7	6	5	4	3	2	1	0	Score	Reference
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
	3c. Instream Bottom Topography	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	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	3c. Manning's n	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		
		CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	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													
		CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
	4a.Pools (abundant, present or absent)	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	3	
		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				
	4b. Channel Flow Status (degree to which channel is filled)	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	2	
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.15	
	FCI = #/100													

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS 05\10\2006 Highway 904 Bridge

ITEM VARIABLES — SCORE — Reference Source

TYPE

NOTES

1. SEDIMENT TRANSPORT/DEPOSITION

Enter Score for Only One Variable

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
1a. Bank Stability (score each bank, left or right facing downstream)	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.		*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
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	

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
1b. Channel Bottom Bank Stability	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.		*Galli, 1996* Wash-COG RSAT No. 1
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

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
1c. Channel Sediments or Substrate Composition	>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		*Barbour, et al., 1999 ; Petersen, et al., 1992*
Grade	10 9 8	7 6 5	4 3	2 1 0	2	

2 WATER APPEARANCE: Clarity or Visibility

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
Water Clarity	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.		*Newton, et al., 1998* USDA/ NRCS SVAP page 11
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

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
3a. Nutrient Enrichment	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.		*Newton, et al., 1998* USDA/ NRCS SVAP page 12
Grade	10 9 8	7 6 5	4 3	2 1 0		

or

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
3b. Aquatic Vegetation	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.		*Petersen, et al., 1992* RCE form No. 13
Grade	10 9 8	7 6 5	4 3	2 1 0	1	

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*Petersen, et al., 1992* RCE form No. 15
		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

5	LAND USE PATTERN: Beyond Immediate Riparian Zone													
		CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 1
		Optimal			Suboptimal			Marginal		Poor				
		Undisturbed, consisting of forest, pristine native prairie, and/or natura 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	1	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	2	

6	RIPARIAN ZONE WIDTH AND CONTINUITY:													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, et al.*, RBA # 10; *Petersen, et al., 1992* RCE # 2; USDA/
	6a. Riparian Zone Width (from stream edge to field)	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	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	1	
												Avg.Score	2	
		CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4
	6b. Riparian Zone Vegetation Protection/ Completeness	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	
		Calculation of Function Capacity Index = Total Score/Total Possible Score											0.1875	
												FCI = #/80		

III. HABITAT FUNCTIONS

ITEM VARIABLES 05\10\2006 Highway 904 Bridge SCORE Reference Source

1 1 FLOW REGIME

TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			SCORE	Reference Source
Grade	10	9	8	7	6	5	4	3	2	1	0	4	*KDWP, 2000*

2 2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER

	Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
	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	2	

3 3 STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization

	Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
	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 vegetation 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	SCORE	Reference Source
	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	SCORE	Reference Source
	<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	SCORE	Reference Source
	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*
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

7 7 CHANNEL ALTERATION

	Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
	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	SCORE	Reference Source

	Optimal	Suboptimal	Marginal	Poor		Reference
	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		Reference
	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,
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	

10

10 VEGETATIVE PROTECTION (SCORE EACH BANK)	Optimal	Suboptimal	Marginal	Poor		Reference
	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,*
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		Reference
	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	3	
Grade	10 9 8	7 6 5	4 3	2 1 0	3	
				Avg.Score	3	

12

12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)	Optimal	Suboptimal	Marginal	Poor		Reference
	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 addnional 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	Below	

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			25	75	100	
	Score			3	2		
	SubCI	0	0	0.75	1.5		
Left Bank	%Riparian Area		60	40		100	
	Score		5	3			
	SubCI	0	3	1.2	0		
					SubCI=(%RA*Scores*0.01)		
					RI Bank CI>	2.25	CI
					LT Bank CI>	4.2	3.225

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.193542

FCI = #/120

I. HYDROLOGIC FUNCTIONS

ITEM VARIABLES 05\05\2006 Highway 38 Bridge SCORE | Reference Source

1. FLOW REGIME:

TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			SCORE	Reference Source
Grade	10	9	8	7	6	5	4	3	2	1	0	4	*KDWP 2000* Kansas Subjective

2. CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
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.		*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
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		w/ assistance and input from Dr. Mike Harvey and Stu Travant
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
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.		*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
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	

3 CHANNEL ROUGHNESS FACTORS

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
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 ≤1.0		*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

Variable	CONDITION CATEGORY GRADE or SCORE: Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
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		*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	3	

Enter Score for Only One Variable

Variable	Optimal	Suboptimal	Marginal	Poor	Score	Reference
	CONDITION CATEGORY GRADE or SCORE					
3c. Instream Bottom Topography	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		*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
or	CONDITION CATEGORY GRADE or SCORE					
3c. Manning's n	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		
	CONDITION CATEGORY GRADE or SCORE					
3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	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		*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
TLB =	10	BHR = 1				
BFD =	10					
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
4 DYNAMIC SURFACE WATER STORAGE						
	CONDITION CATEGORY GRADE or SCORE					
4a.Pools (abundant, present or absent)	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.		*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	2	
	CONDITION CATEGORY GRADE or SCORE					
4b. Channel Flow Status (degree to which channel is filled)	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.		*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
Calculation of Function Capacity Index = Total Score/Total Possible Score					0.12	
FCI = #/100						

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS 05\05\2006 Highway 36 Bridge

ITEM	VARIABLES	Optimal	Suboptimal	Marginal	Poor	SCORE	Reference Source
	TYPE						
	NOTES						
1.	SEDIMENT TRANSPORT/DEPOSITION						
		CONDITION CATEGORY GRADE or SCORE					
	1a. Bank Stability (score each bank, left or right facing downstream)	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.		*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
	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	
		CONDITION CATEGORY GRADE or SCORE					
Enter Score for Only One Variable	1b. Channel Bottom Bank Stability	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.		*Galli, 1996* Wash-COG RSAT No. 1
	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	
		CONDITION CATEGORY GRADE or SCORE					
	or 1c. Channel Sediments or Substrate Composition	>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		*Barbour, et al., 1999 ; Petersen, et al., 1992*
	Grade	10 9 8	7 6 5	4 3	2 1 0	3	
2	WATER APPEARANCE: Clarity or Visibility						
		CONDITION CATEGORY GRADE or SCORE					
	Water Clarity	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.		*Newton, et al., 1998* USDA/NRCS SVAP page 11
	Grade	10 9 8	7 6 5	4 3	2 1 0	1	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage						
		CONDITION CATEGORY GRADE or SCORE					
Enter Score for Only One Variable	3a. Nutrient Enrichment	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.		*Newton, et al., 1998* USDA/NRCS SVAP page 12
	Grade	10 9 8	7 6 5	4 3	2 1 0	1	
		CONDITION CATEGORY GRADE or SCORE					
	or 3b. Aquatic Vegetation	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.		*Petersen, et al., 1992* RCE form No. 13
	Grade	10 9 8	7 6 5	4 3	2 1 0		

4	COMPOSITION OF ORGANIC MATTER: Detritus.													
		CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 15
		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	

5	LAND USE PATTERN: Beyond Immediate Riparian Zone													
		CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 1
		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	1	
												Avg.Score	1.5	

6	RIPARIAN ZONE WIDTH AND CONTINUITY:													
	6a. Riparian Zone Width (from stream edge to field)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al.*, RBA # 10; *Petersen, et al., 1992* RCE # 2: USDA/
		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	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	1	
												Avg.Score	2	
	6b. Riparian Zone Vegetation Protection/ Completeness	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* RBA #9; *Petersen, et al., 1992* RCE form # 3 and 4
		Optimal			Suboptimal			Marginal		Poor				
		>90% plant density of mature trees or shrubs, prairie grasses, or marsh plants, riparian zone intact or disruption from grazing/moving 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	3	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2.5	

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.1875
FCI = #/80	

III. HABITAT FUNCTIONS

ITEM VARIABLES 05\05\2006 Highway 38 Bridge SCORE Reference Source

1 1 FLOW REGIME

TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			SCORE	Reference Source
Grade	10	9	8	7	6	5	4	3	2	1	0	4	*KDWP, 2000*

2 2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER

	Optimal			Suboptimal			Marginal		Poor			SCORE	Reference Source
	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			SCORE	Reference Source
	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 vegetation 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			SCORE	Reference Source
	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			SCORE	Reference Source
	<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			SCORE	Reference Source
	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*
Grade	10	9	8	7	6	5	4	3	2	1	0	1	

7 7 CHANNEL ALTERATION

	Optimal			Suboptimal			Marginal		Poor			SCORE	Reference Source
	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		

	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 District*, 2004 SAM #3; Scholz and Booth from Henshaw,
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	1	
				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,*
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	1	
				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	3	
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
				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	Below	

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	
	Score				2		
	SubCI	0	0	0	2		
Left Bank	%Riparian Area		60	40		100	
	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		0.159167
						FCI = #/120	

ATTACHMENT C

BRIEF DESCRIPTION OF THE ECOLOGY FOR THE IDENTIFIED SPECIES

INSECTS

Mayflies (Ephemeropterans) (all larvae identified)

Baetidae are widespread and abundant occurring in a variety of streams and also in permanent and temporary ponds or littoral zones (areas of shallow water where light penetrates to the bottom allowing for rooted plant growth) of lakes.

Caenidae are widespread and common in a variety of lotic (running or flowing streams) and lentic (standing water) habitats, including slow-moving streams of all sizes, spring seeps, marshes, swamps, ponds, and lakes. They frequent sediments and often are partially covered with silt. They are generally more tolerant of lower levels of dissolved oxygen.

Heptageniidae are widespread and abundant in streams, wave-swept shorelines of lakes, or in vernal (in the Spring) ponds adjacent to streams. They typically inhabit rocks, wood, debris, and other strata to which they cling.

Flies, midges, and mosquitoes (Dipterans) (all larvae identified)

Ceratopogonidae or biting midges typically live in moist terrestrial habitats; however, many species do occur in aquatic habitats that include marshes, swamps, ponds, lakes, and streams.

Chironomidae or midges are the largest family of aquatic insects. They inhabit all types of permanent and temporary aquatic habitats. Larvae are an extremely important part of the aquatic ecosystem serving as prey for other organisms. Larvae are quite tolerant of lowered levels of dissolved oxygen including some species surviving in areas where oxygen levels are undetectable (blood worms – which were identified at all sampling locations). The larvae are primarily herbivores and detritivores feeding on fine bottom particles.

Culicidae or mosquitoes are common and widespread usually occurring in shallow, non-flowing or semi-flowing habitats such as swamps, shallow temporary or permanent ponds and marshes, and heavily vegetated margins of lakes and streams. They are not found in moving water or water subjected to wave action. The reason for this is that they obtain oxygen from use of breathing tubes at the water surface and wave action and current disrupt the water surface inhibiting their ability to obtain oxygen. Mosquitoes often dominate the insect community of temporary ponds and marshes, especially those that flood in spring and summer. The mosquito larvae feed on organic debris and microorganisms.

Dolicopodidae or long-legged flies develop in a wide variety of lotic and lentic habitats. Little information is available for this family.