UP168. WP6 Upland Pond. 5/31/2017.

UP207. WP713 Upland. 5/31/2017.

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

July 27, 2017

Regulatory Division

SUBJECT: SWF-2003-00336, Lake Ralph Hall, Upper Trinity Regional Water District

Mr. Larry Patterson
Upper Trinity Regional Water District
900 N. Kealy
P.O. Drawer 305
Lewisville, Texas 75067

Dear Mr. Patterson:

This letter is in regard to your request for an approved jurisdictional determination information received March 29, 2017, and additional information received June 22 and July 5, 2017, concerning the proposed Lake Ralph Hall Reservoir project located in Fannin County, Texas. The study area for the approved jurisdictional determination encompasses approximately 13,100 acres.

We have reviewed the site in question in accordance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Under Section 404, the USACE regulates the discharge of dredged and fill material into waters of the United States, including wetlands. Our responsibility under Section 10 is to regulate any work in, or affecting, navigable waters of the United States.

Based on the Supplemental Report in Support for AJD for proposed Lake Ralph Hall project, dated June 21, 2017, multiple previous site visits associated with the ongoing development of the Environmental Impact Statement associated with the permit application, and other information available to us, waters of the United States under Section 404 do exist in the study area. We concur with the delineation of waters of the United States as shown on the 11 maps sheets included in the referenced report identified as Aquatic Resources Proposed Lake Ralph Hall Supplemental Jurisdictional Determination. This approved jurisdictional determination (JD) is valid for a period of no more than five (5) years from the date of this letter unless new information warrants revision of the delineation before the expiration date. A copy of the Approved Jurisdictional Determination form supporting this determination is enclosed for your information.

This determination does not convey any property rights, either in real estate or material or any exclusive privileges, nor does it authorize any injury to property or invasion of rights or Federal, State, or local laws or regulations. This determination does not eliminate the requirements to obtain State or local permits or approvals as needed.

Department of the Army authorization would be required for the discharge of dredged or fill material into any areas identified as waters of the United States, unless otherwise exempted. If you anticipate a discharge, please provide us with a detailed description of the proposed project, a suitable map of the proposed project area showing the location of proposed discharges, the type and amount of material (temporary or permanent), if any, to be discharged, and plan and cross-section views of the proposed project. Please note that it is unlawful to start work without a Department of the Army permit if one is required.

The Applicant may accept or appeal this approved JD or provide new information in accordance with the enclosed Notification of Administration Appeal Options and Process and Request for Appeal (NAAOP-RFA). If the Applicant elects to appeal this approved JD, the Applicant must complete Section II (Request for Appeal or Objections to an Initial Proffered Permit) of the enclosure and return it to the Division Engineer, ATTN: CESWD-PD-O Appeals Review Officer, U.S. Army Corps of Engineers, 1100 Commerce Street, Dallas, Suite 831, Texas 75242-0216 within 60 days of the date of this notice. Failure to notify the USACE within 60 days of the date of this notice means you accept the approved JD in its entirety and waive all rights to appeal the approved JD.

Thank you for your interest in our nation's water resources. If you have any questions concerning this matter please contact Mr. Chandler Peter at (817) 886-1736. Other information concern our regulatory program is at http://www.swf.usace.army.mil/Missions/Regulatory.

Please help the regulatory program improve its service by completing the survey on the following website: http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey

Sincerely,

Stephen Brooks
Chief, Regulatory Division

Enclosures:

Appeals Form
Approved Jurisdictional Determination Form

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Upper Trinity Regional Water District		File Number: 2003-00336	Date: 7/24/2017
Attached is:			See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)		A
	PROFFERED PERMIT (Standard Permit or Letter of permission)		B
	PERMIT DENIAL		C
X	APPROVED JURISDICTIONAL DETERMINATION		D
	PRELIMINARY JURISDICTIONAL DETERMINATION		E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/appeals.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact: Mr. Elliott Carman Administrative Appeals Review Officer (CESWD-PD-O) U.S. Army Corps of Engineers 1100 Commerce Street, Suite 831 Dallas, Texas 75242-1317 469-487-7061

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

Signature of appellant or agent.	Date:	Telephone number:

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): 26 June 2017

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Fort Worth District, Lake Ralph Hall, SWF-2003-00336

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State: Texas County/parish/borough: Fannin City: Ladonia
Center coordinates of site (lat/long in degree decimal format): Lat. 33.46302° **N**, Long. 95.90102° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: North Sulphur River
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Sulphur River
Name of watershed or Hydrologic Unit Code (HUC): 8 - 11140301

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc...) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: June 26, 2017
☒ Field Determination. Date(s): Specific field investigation to develop data to produce PJD dated October 26, 2006 were conducted by applicant August-September, 2005. USACE and cooperating agencies conducted numerous site visits to portions of project area from 2002 through 2015 associated with jurisdictional determination and resource assessments associated with development of Environmental Impact Statement for proposed project.

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
      ☐ TNWs, including territorial seas
      ☐ Wetlands adjacent to TNWs
      ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
      ☒ Non-RPWs that flow directly or indirectly into TNWs
      ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
      ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
      ☒ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
      ☒ Impoundments of jurisdictional waters
      ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
      Stream (non-wetland) waters: linear feet: 690,918 acreage: 387.14 (streams)
      Other open waters: acres: 59.89 (on channel ponds)
      Wetlands: 10.0 acres (PEM lacustrine fringe around on-channel ponds).

   c. **Limits (boundaries) of jurisdiction** based on: **1987 Delineation Manual and Great Plains Delineation Supplement**
      Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

☒ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **212 open water stock tanks constructed in uplands occur within the study area totaling 83 acres (Table A-3 of Appendix A). Additionally, there are 3.8 acres (comprised of 26 features – Table A-4 of Appendix A) of forested wetlands associated with remnant channels of the North Sulphur River. Due to historic channelization and significant channel degradation, the 100 year flood of the North Sulphur River is contained in its existing channel banks. No hydrologic connection/significant nexus exists between the remnant channels and the North Sulphur River.**

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: No TNWs are in assessment area. The nearest USACE designated navigable water is the segment of the Sulphur River downstream of Wright Patman Dam to the Texas/Arkansas state border. See section B.1.ii below for distance.

   Summarize rationale supporting determination:

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

   (i) General Area Conditions:
   Watershed size: 100 square miles
   Drainage area: 467 square miles
   Average annual rainfall: 33 inches
   Average annual snowfall: 3 inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☒ Ephemeral tributaries flow through 2 and the North Sulphur River flows through 1 tributary before entering TNW.

   Project waters are more than 100 river miles from TNW.

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

Project waters are more than 30 river miles from RPW.
Project waters are 105 aerial (straight) miles from TNW.
Project waters are 37 aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: Named (see item b below) and unnamed tributaries flow into North Sulphur River which flows into to Sulphur River (starting at confluence with South Sulphur River which becomes navigable approximately 105 miles downstream.
Tributary stream order, if known: Varies.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural. Explain:
☐ Artificial (man-made). Explain:
☒ Manipulated (man-altered). Explain: North Sulphur River and named (Merrill, Bralley Pool, Leggets Branch, Davis, Pickle, Pot, Brushy, Bear, Allen, Long and Headrick Branch Creeks) and unnamed tributries to it are natural channels but modified due to headcuts. North Sulphur River channelized in 1930s. Unique soil properties continue to erode and channel as well as tributaries continue to degrade. Headcuts occur to all tributaries in the study area.

Tributary properties with respect to top of bank (estimate):
Average width: 150 feet
Average depth: 45 feet
Average side slopes: **2:1.**

Primary tributary substrate composition (check all that apply):

☒ Silts	☐ Sands	☐ Concrete
☐ Cobbles	☐ Gravel	☐ Muck
☒ Bedrock	☐ Vegetation. Type/% cover:	

☐ Other. Explain: Bedrock is decomposing soft shale.

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: highly eroding, sloughing banks with channel eroded into underlying shale bedrock; delamination of the shale results in average channel down-cutting at a rate of 2 inches/year and channel widening of 4 inches/year as side slopes are destabilized and slough.

Presence of run/riffle/pool complexes. Explain: No riffle pool complexes exist.
Tributary geometry: **Relatively straight**
Tributary gradient (approximate average slope): Dependent on tributary, North Sulphur River is 0.1 %

(c) Flow:
Tributary provides for: **Intermittent but not seasonal flow** **Other tributaries are epemeral.**
Estimate average number of flow events in review area/year: **6-10**
Describe flow regime: Channel flow is extremely flashy with high flows immediately following significant rain events rapidly reducing to a trickle unless subsequent rainfall experienced in the watershed. Channel is frequently dry in most locations with variable to non-existent pooling.
Other information on duration and volume: Stage discharge and rating curves are provided in the geomorphological evaluation and hydraulic and hydrologic analyses.

Surface flow is: **Discrete and confined.** Characteristics: Flashy -- immediate peak with rapidly diminishing flows.

Subsurface flow: **Unknown.** Explain findings: No groundwater discharges documented in hydrologic analysis.
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☒ Bed and banks
☒ OHWM[6] (check all indicators that apply):

☐ clear, natural line impressed on the bank	☐ the presence of litter and debris
☐ changes in the character of soil	☒ destruction of terrestrial vegetation
☐ shelving	☐ the presence of wrack line
☐ vegetation matted down, bent, or absent	☐ sediment sorting
☐ leaf litter disturbed or washed away	☒ scour
☐ sediment deposition	☒ multiple observed or predicted flow events
☐ water staining	☐ abrupt change in plant community

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.
[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.

☐ other (list):

☐ Discontinuous OHWM.[7] Explain:

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):

☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) **Chemical Characteristics:**

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: Turbid during flow events but clearer during lower flows

Identify specific pollutants, if known: Suspended solids.

(iv) **Biological Characteristics. Channel supports (check all that apply):**

☐ Riparian corridor. Characteristics (type, average width):
☒ Wetland fringe. Characteristics: Emergent wetland occurs on fringes of on-channel stock tanks.
☐ Habitat for:
☐ Federally Listed species. Explain findings:
☐ Fish/spawn areas. Explain findings:
☐ Other environmentally-sensitive species. Explain findings:
☒ Aquatic/wildlife diversity. Explain findings: Limited invertebrate and songbird utilization.

2. **Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW**

(i) **Physical Characteristics:**

(a) General Wetland Characteristics:

Properties: PEM fringes associated with on channel ponds

Wetland size: 10 acres

Wetland type. Explain: Wetlands confined to on channel ponds

Wetland quality. Explain: Detailed functional assessment of the wetlands not accomplished. Vegetation in wetland areas are typically desirable and include Typha, Eleocharis, Polyuganum, Carex, Juncus, Sagittaria, Ludwigia, Potamigeton and Ranunculus species. Hydrilla was also documented in some assessed areas. Wetlands are expected to rate as low to average quality based on geomorphic and vegetation type, density as well as agricultural activities and grazing adjacent and in the wetland areas. Wetlands provide soil rentention and protection at pond edges.

Project wetlands cross or serve as state boundaries. N/A

(b) General Flow Relationship with Non-TNW:

Flow is: **Ephemeral flow.** Explain: Wetlands are associated with on-channel pond construction. Outlets exist and/or spills occur during precipitation events from ponds into connecting named and unnamed tributaries to the North Sulphur River.

Surface flow is: **Confined**

Characteristics:

Subsurface flow: **Unknown.** Explain findings:

☐ Dye (or other) test performed:

(c) Wetland Adjacency Determination with Non-TNW:

☒ Directly abutting – wetlands are created by and connected to pond pool elevations.
☐ Not directly abutting
☐ Discrete wetland hydrologic connection. Explain:
☐ Ecological connection. Explain:
☐ Separated by berm/barrier. Explain: There is an earthen berm east of the wetland.

(d) Proximity (Relationship) to TNW

Project wetlands are **30 (or more)** river miles from TNW.
Project waters are **30 (or more)** aerial (straight) miles from TNW.
Flow is from: **Wetland to navigable waters.**
Estimate approximate location of wetland as within the **2-year or less** floodplain.

(ii) **Chemical Characteristics:**

[7] Ibid.

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: Herbaceous fringe varying in widths from 1 to more than 20 feet as part of 27 on-channel ponds. Wetlands perform water quality functions from overland flow to waters via filtration and sediment trapping, retention and nutrient transformation. Nutrient transformation from stream flow into ponds also accomplished.
Identify specific pollutants, if known: unknown.

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☒ Vegetation type/percent cover. Explain: Eleocharis, Typha,
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☒ Aquatic/wildlife diversity. Explain findings: Variation in vegetation communities compared to upland vegetation can provide minor habitat for occasional use of wetland and water dependent species.

3. Characteristics of all wetlands adjacent to tributaries (if any)

All wetland(s) being considered in the cumulative analysis: 25-30

Approximately 10 acres in total are being considered in the cumulative analysis as identified in the delineation report at 27 on-channel ponds. Off-site desk top estimation was used to identify wetland fringes occurring with on-channel ponds. The higher resolution aerial photographs from 2014-2016 compared to those used in the 2006 PJD report facilitated in refinements of the previously identified (delineated) aquatic resources as well as identification in modifications to aquatic resources within the project area (erosional features, impoundments, etc.). These refinements to the delineated aquatic resources were performed as a "desktop" evaluation. To ground-truth observations from the desktop evaluation, field investigations were performed May 30 through June 2, 2017 to assess a representative sample area of portions of the 13,094-acre assessment area. These "on the ground" assessments aided in verification of identified aquatic resources from the desktop evaluation as well as to map the limits of potential waters of the U.S. identified both from the desktop evaluation and in the field. As an example, 14 of the 47 mapped on-channel ponds within the assessment area representing approximately 29.7 percent were investigated in the field. Lacustrine "fringe" wetland areas associated with the 14 on-channel ponds assessed in the field were observed and recorded in the field. The lacustrine wetlands, predominantly herbaceous emergent wetlands, represented approximately 3.4 acres of the 23.8 acres of the 14 on-channel ponds assessed or approximately 14.3 percent of the assessed on-channel pond acreage. This percentage of fringe wetlands was used to estimate the lacustrine wetland area associated with the total delineated area of on-channel impoundments within the assessment area that would be considered as hydraulically and hydrologically connected to waters of the U.S. Calculation of area of Lacustrine Fringe Wetlands (emergent) totaled 3.4 acres identified for 23.8 acres of 14 on-channel ponds that were field assessed. This equated to 14.3 percent of 69.9 acres of 47 on-channel ponds within assessment area resulting in the determination that slightly less than 10 acres of on-channel fringe wetlands exist.

Summarize overall biological, chemical and physical functions being performed: See descriptions above.

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: The North Sulphur River totals 65,646 linear feet in the study area and is intermittent. Additionally, numerous ephemeral tributaries totaling 625,272 lineal feet have continuous ordinary high water marks that feed into the North Sulphur River. On said tributaries are 47 on channel ponds totaling 59.89 acres of open water. Wetland fringes associated with the ponds total 10 acres. All streams flow during and shortly after precipitation events allowing for biological and chemical contributions to the North Sulphur River which flows into Relatively Permanent Flow portions of the channel and eventually into the Sulphur River which is a TNW. Sediment, biota (including fish from on channel stock tanks) and organic matter are contributed to the North Sulphur River. Tributaries can also act as refugia during high flow events in the North Sulphur River. The tributaries and on channel wetlands also contribute as well as carry pollutants and flood waters to TNWs, can reduce amount of pollutants or flood water reaching a TNW, and transfer nutrients and organic carbon downstream.

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D:.

D. **DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):**

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☒ Tributary waters: 690,918 linear feet and up to 45 width (ft).
   ☒ Other non-wetland waters: 59.89 acres of on channel ponds.
   Identify type(s) of waters: On channel ponds.

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☒ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

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[8]See Footnote # 3.

Provide acreage estimates for jurisdictional wetlands in the review area: 10 acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   - ☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.**[9]
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   - ☒ Demonstrate that impoundment was created from "waters of the U.S.," (see 69.89 acres of on-channel ponds and associated fringe wetlands as detailed in this form), or
   - ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   - ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]
- ☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
- ☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
- ☐ which are or could be used for industrial purposes by industries in interstate commerce.
- ☐ Interstate isolated waters. Explain: .
- ☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
- ☐ Tributary waters: linear feet width (ft).
- ☐ Other non-wetland waters: acres.
  Identify type(s) of waters: .
- ☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
- ☒ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and Great Plains Regional Supplement.
- ☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  - ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- ☒ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: Numerous stock tanks constructed in uplands exist as well as stock tanks that are not connected to tributaries to the North Sulphur River. Isolated forested wetlands also exist which are not adjacent due to significant channel degradation of North Sulphur River and are no longer connected to or have interaction with the river.
- ☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
- ☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
- ☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- ☒ Lakes/ponds: 83 acres upland ponds/stock tanks.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☒ Wetlands: 3.8 acres.

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[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: .
☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  ☒ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☒ U.S. Geological Survey Hydrologic Atlas: .
  ☐ USGS NHD data.
  ☒ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: Greenville NW, Celeste, Pike, Wolfe City, Gober, Ladonia, Honey Grove and Dodd City.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Fannin.
☒ National wetlands inventory map(s). Cite name: See USGS quad map names.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): 2003-2005 and 2014-2016 FSA NAIP and 2015 Texas Ortho-imagery Project.
  or ☒ Other (Name & Date): On site photos from 2006 delineation report and 2017 supplment.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .

APPENDIX C - 1

SWAMPIM ASSESSMENT PROTOCOL DOCUMENTATION

Stream Watershed Assessment and Measurement Protocol Interaction Model (SWAMPIM)
for Streams and On-Channel Impoundments
Prepared for Lake Ralph Hall Environmental Assessment

1.0 Introduction

1.1 General Notes and Information

Recognizing that streams provide many functions and that the interaction of streams with their respective watersheds is key to the quantity and quality of functions provided, various stream assessment protocols have been developed for use across the country (Somerville and Pruitt 2004). The breadth and scope of stream assessments are as varied as the reasons for undertaking them. The SWAMPIM provides an assessment tool based primarily on geological and morphological habitat characteristics, floodplain and riparian condition, and water quality. It was developed based on existing protocols in use that have been extensively peer reviewed and field-tested across a wide variety of environmental settings. The evaluation used in this protocol can reasonably evaluate the aquatic resources within a project area through assessing the condition level of selected variables related to each function such that a holistic evaluation of the physical, biological, and chemical parameters of the aquatic system is accomplished within the context of its watershed.

The SWAMPIM was developed to provide an assessment tool for quantifying impacts on streams and impoundments within the U.S. Army Corps of Engineers (USACE), Fort Worth District, especially within the north central and east Texas area (refer to Figure 1). Information gathered using the SWAMPIM can be used to determine the appropriate amount of compensatory mitigation required for permitted impacts. The SWAMPIM is not intended to replace other decision-making tools, but to be used to develop relative assessments of environmental functions in the pre- and post-project phase, and provide a realistic basis for determining mitigation needs.

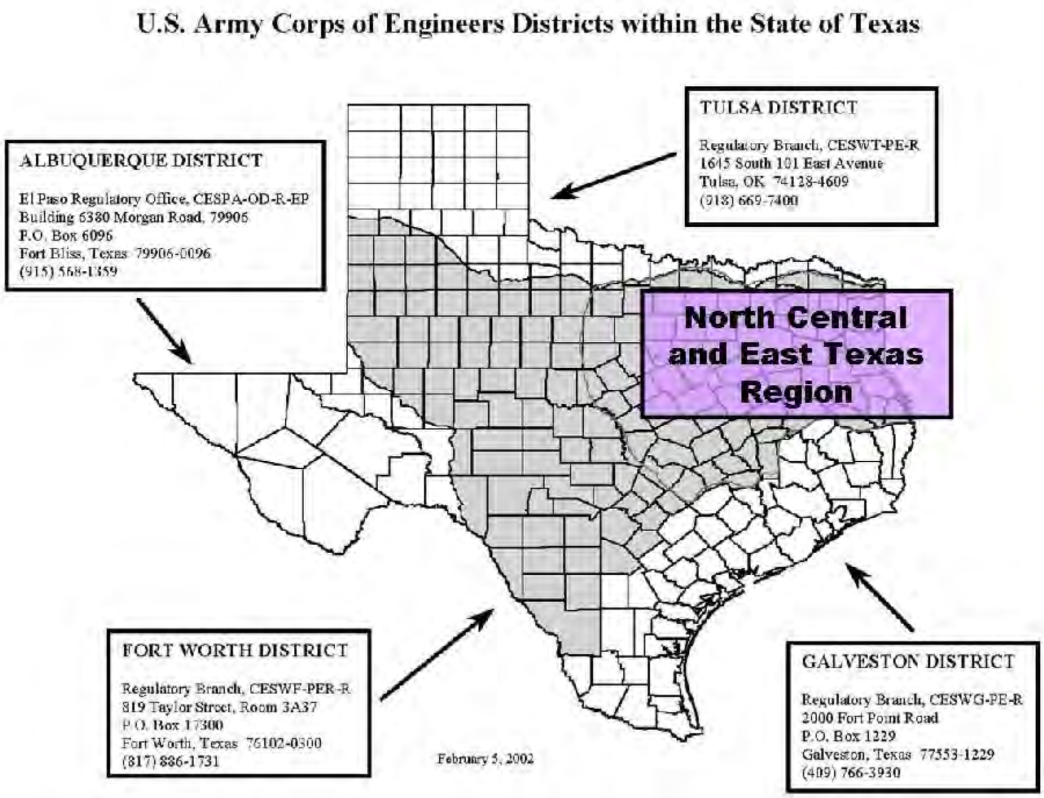


Figure 1. USACE Fort Worth District, north central and east Texas region

1.2 SWAMPIM Overview

Figure 2 (following this section) shows an overview of the SWAMPIM process. Functional capacity of aquatic resources on a watershed basis is evaluated using the SWAMPIM by defining stream assessment reaches based on geomorphic characteristics of stream size, valley characteristics, and underlying geology. Specific characteristics used in defining assessment reaches may include valley width, stream width, valley slope, geologic materials, and tributary influence. Representative reaches are then selected for evaluation for the identified stream assessment reaches. Section 2 of this document provides a detailed description of the SWAMPIM process for streams and rivers.

On-channel impoundments are characterized by relative impoundment size and representatives of each impoundment size category are selected for evaluation. The data collected at the representative reaches and impoundments are used to determine overall quality on a relative basis for the aquatic resources in a project area. Section 4 describes the SWAMPIM process for impoundments.

Due to the complex and dynamic conditions within stream channels and based on the proposed use of the data collected, assessment protocols have been developed that range from subjective, visual-based assessment protocols that are rapid and relatively easy-to-use to objective, quantitative assessments that are usually labor intensive, time consuming, and costly. Selected stream assessment and mitigation protocols were reviewed and summarized (Somerville and Pruitt, 2004) in an effort to recommend components to best assess and document physical stream conditions pertinent to the Clean Water Act (CWA) Section 404 regulatory program. Five suggestions for programmatically complete stream assessment protocols were developed for use in the regulatory program.

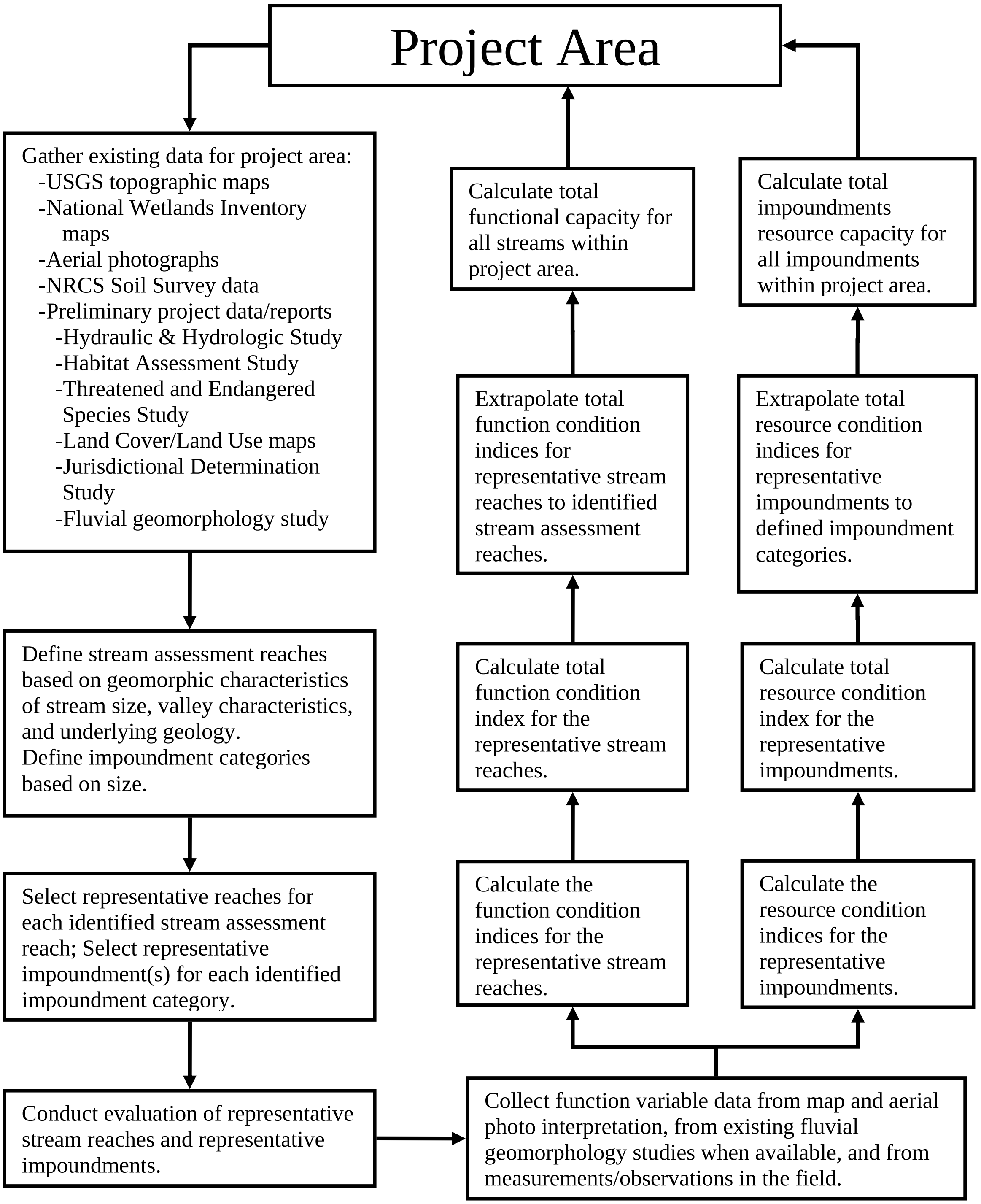
1) Classification: Stream assessment should be preceded by classification to narrow the natural variability of physical stream variables.
2) Objectivity: The assessment procedure should remove as much observer bias as possible by providing well-defined procedures for objective measures of explicitly defined stream variables.

3) Quantitative Methods: The assessment procedure should utilize quantitative measures of stream variables to the maximum extent practicable.
4) Fluvial Geomorphological Emphasis: Stream assessments undertaken to prioritize watersheds or stream reaches for management or aid the design of stream enhancement or restoration projects should be based on fluvial geomorphic principles.
5) Data Management: Data from stream assessments should be catalogued by designated entities in each region of the country. This is especially true of reference data.

Although most states, including Texas, include biological assessment as part of their water quality programs, biological variables tend to be seasonally variable and labor intensive to sample. Physical stream features are relatively stable over short-time frames in most stream environments, are relatively easy to measure in the field, and provide a tangible resource for decision making, management, and restoration plans. (Somerville and Pruitt, 2004). Habitat assessment is a nearly ubiquitous component of all stream assessment protocols. Geomorphological data is also increasingly being included. Evaluation of the parameters related to physical and geomorphological habitat allows the development of direct and indirect inference of functional capacity of the assessed stream for each of the functions identified in Table 1. This protocol utilizes measures of defined stream variables to quantify to the degree practicable the relative condition of the assessed stream.

The impoundment evaluation is designed to provide a qualitative assessment of the lentic habitat provided by these aquatic resources. The assessment, as with the stream assessment, incorporates geological and morphological habitat characteristics, riparian and watershed condition, biological components, and water chemistry into the protocol. The merging of these variable characteristics of an impoundment into an assessment provides a means to rapidly produce a reproducible, consistent, quality determination of habitat characteristics and ecological conditions based on observations and measurements taken at a single point in time.

Figure 2. SWAMPIM OVERVIEW



2.0 Streams and Rivers

Stream functions and interactions within a watershed basis were divided into three major function categories: hydrologic, water quality improvement/biogeochemical, and habitat. Table 1 provides a listing of the three major function categories and the individual functions identified within each major category.

TABLE 1. STREAM FUNCTIONS

Major Categories	Functions
1. Hydrologic	A. Groundwater Interactions – discharge/recharge
	B. Channel Condition and Energy Dissipation
	C. Flood Capacity/Flow Conveyance
	D. Flow Attenuation and Desynchronization of Peak Flows
	E. Dynamic surface water storage
2. Water Quality Improvement/Biogeochemical	A. Sediment Transport/Deposition
	B. Nutrient cycling/Assimilation
	C. Removal/Assimilation of Imported Contaminants
3. Habitat	A. Maintains Spatial Structure of Habitat
	B. Maintains Distribution and Abundance of Vertebrates
	C. Maintains Distribution and Abundance of Invertebrates
	D. Production of Allochthonous Materials
	E. Supports Riparian Vegetation
	F. Maintains Interspersion and Connectivity with Terrestrial Habitats/supports Biological Diversity

SWAMPIM uses variables that are easily identified and evaluated in the field or with the use of mapping resources to determine the level of functions provided. Evaluation of these parameters allows the development of direct and indirect inference of functional capacity of the assessed stream reach for each of the function categories identified in Table 1. Selection of the function variables used in SWAMPIM was based primarily on physical criteria that were derived from existing peer-reviewed and field-tested protocols that assess stream and impoundment functions within a watershed context. Detailed descriptions of the function variables for assessment of streams and rivers are provided in Section 3 of this document.

2.1 Reach Length Determinations

Several protocols for rapid assessment of biological habitat such as the U.S. Environmental Protection Agency's (EPA) *Rapid Bioassessment Protocols for Use In Streams and Rivers, Benthic Macroinvertebrates and Fish* were designed and tested in wadeable fresh-water streams, rather than large rivers (Plafkin, et al., 1989). However, the fundamental approach was deemed applicable to large rivers as well, and portions of the Rapid Bioassessment Protocols were validated for both freshwater streams and large rivers. Assessment of stream classification should be conducted prior to determination of appropriate stream reaches to be evaluated. The stream reach encompasses the biological and chemical collection areas and includes as many different geomorphic channel units as possible. Examples of geomorphic units include riffles, runs, glides, and pools. Note that some of these geomorphic units may not be found in some streams.

Streams are considered wadeable if most of the stream channel is accessible by wading during normal flow conditions. Generally, these streams are third order or less based on a Strahler (1957) classification. Pool areas or high-flow conditions may cause the stream to be inaccessible to wading in certain places or at certain times; however, the stream would still be considered wadeable in determining reach length. A length of a Reference Reach (RR) should be about 40 times the average stream width in wadeable streams, but with a minimum of 150 m (492 feet). The maximum reach length for wadeable streams is 500 m (1640.5 feet) (TCEQ 2005).

Streams are considered non-wadeable if water depth in the stream channel prohibits wading and requires use of a floatation device (boat or tube) during normal flow conditions. Generally, these are fourth order streams or larger and are usually considered rivers. Riffle areas or low-flow conditions may cause the stream to be accessible to wading in certain places or at certain times; however, the stream would still be considered non-wadeable in determining reach length. The reach length of a non-wadeable stream is based on incorporating one full meander of the stream channel, if possible, and includes two examples of at least two types of geomorphic channel units. The minimum reach length for a non-wadeable stream is 500 m (1640.5 feet). The maximum length is 1 km (3,281 feet) (TCEQ 2005). On some rivers, one full meander may be longer than 1 km. In other rivers, the channel may be dominated by only one geomorphic unit, such as a glide. In these cases, limit the reach length to 1 km with as many different types of geomorphic units represented as possible (TCEQ 2005).

Variation in results of stream order classification occurs when small scale maps are used (USGS 1:100,000 map) as opposed to larger scale maps (USGS 1:24,000 map) and use of actual channels mapped on ground results in larger stream orders due to identification of small ephemeral streams not typically identified on maps (Leopold 1994). *[Since the majority of stream channels identified within the Lake Ralph Hall project area are ephemeral headwater streams, which are not typically considered in habitat assessment protocols, but which are considered jurisdictional under the Clean Water Act and require assessment under Section 404 permit review, the Strahler stream classification system was not used for this assessment. Instead, delineated stream channels are classified as ephemeral or intermittent. No perennial streams are located within the Lake Ralph Hall reservoir project area.]*

2.2 General Instructions for Streams and Rivers Assessment Using SWAMPIM

A. Determine the Stream Assessment Reach(s) (SAR) within the proposed project area. The SAR is the linear feet of stream channel of like characterization (i.e., ephemeral, intermittent, 1st order, 2nd order, major tributary, river channel) within the proposed project impact area. All stream reaches within the project area should be included in appropriate SARs.

B. Determine Reference Reaches (RR) for each identified SAR. Number of RRs to be assessed for each identified SAR should be based on the quantity and variability of quality within the SAR as determined during initial reconnaissance so that all conditions within a SAR are adequately represented.

C. Complete Stream Functions Assessment Forms for each major functions category based on measurements and assessment of conditions within all identified RRs. Certain variables (e.g., sinuosity, riparian continuity, land use) may be evaluated first through review of topographic maps and recent aerial photographs with subsequent verification based on field observations. The classification of variables based on map or aerial photograph interpretation may be done on a SAR basis with the score applied to each RR within the SAR.

D. Calculate the Function Condition Index (FCI) for each function category based on the scoring of variables for each RR. The scores for the variables for each Stream Function Category (e.g., hydrologic, water quality/biogeochemical, and habitat) are summed and divided by the highest total possible score to determine the FCI for each category. If multiple RRs are identified within a SAR, the FCIs for each function category for each RR are totaled and divided by the total number of RRs to determine the average FCI for each Stream Function Category for the SAR. Based on a total maximum FCI of 1.0 for each major Functions Category, the maximum Total FCI for the SAR is 3.0.

E. The FCIs determined for the SAR are then multiplied by the linear feet of stream channel in the SAR and by a multiplication factor determined by the stream characterization (i.e., ephemeral, intermittent, or perennial) to determine the Functional Capacity (FC) for the SAR. The multiplication factor incorporates a typical width of stream channel and appropriate riparian buffer for each stream type so that when multiplied by the linear feet of stream channel, the result or FC represents an area comparable to acres. The typical width of stream channel and appropriate riparian buffer for each stream type used in determining the multiplication factors is comparable to those used for the Trinity River Mitigation Bank (Fort Worth, Texas) credit calculations for stream channels (i.e., ephemeral = 5-foot wide channel with 25-foot wide riparian buffers each side; intermittent = 10-foot wide channel with 50-foot wide riparian buffers each side; and perennial = 15-foot wide channel with 75-foot wide riparian buffers each side). The resulting calculation for FC is as follows:

FC = FCI * (Linear Feet of SAR) * Multiplication Factor

The Total FC for each SAR is the sum of the FCs for the three Stream Function Categories.

F. The Project FC for streams and rivers is the summation of the Total FCs for all the identified SARs within the defined project area.

G. Post-project FC for stream and rivers is determined by the same process as for the existing conditions within the project area except scoring of variables for each of the function categories is based on projections of changes in condition relative to proposed project activities, including compensatory mitigation activities, or resulting impacts of the proposed project.

3.0 Description of Function Category Variables for Streams and Rivers

3.1 Hydrologic Function Variables

3.1.1. Flow Regime. The stream flow regime identified by this variable indicates the importance of the stream to the aquatic community. Although ephemeral and intermittent drainages are essential to the function of a watershed, they are not as valuable as perennial streams due to the fact that they typically do not provide year-round habitat for aquatic organisms. Evaluators should take into account regional and site-specific climatic conditions (i.e., extended drought, recent heavy rains, etc.) when determining the flow characteristics of a stream. A scoring range is provided for various stream types to efficiently characterize differences in quality within stream types. For example, some intermittent streams have groundwater input that sustains flow at a higher rate and for a longer period of time than other streams. The evaluator may choose to provide a higher score within the stream type for this system.

Ephemeral stream – A drainageway that may or may not have a well-defined channel that carries flow only during periods of surface runoff. These drainages are not hydrologically connected to subsurface inputs (i.e., springs, subterranean flow, etc.) and often lack a well-defined channel with easily identifiable bed and banks.

Intermittent stream – A drainageway with a well-defined channel that generally flows only during a part of the year. It continues to flow after cessation of surface runoff, but effluent groundwater (springs/subterranean flow) will not sustain flows through moderate periods of little or no precipitation. It may contain reaches of perennial flow or have permanent pools that support aquatic wildlife. Some special conditions, such as the discharge from a wastewater treatment plant or irrigation flows, can cause portions of an intermittent stream to have qualities of a perennial stream.

Perennial stream – A drainageway with a well-defined channel in which perennial flow persists throughout the length of the drainage during normal climate conditions. The permanency of flow is usually attributable to groundwater effluent.

Selected References: KDWP 2000

3.1.2. Channel Condition and Energy Dissipation

3.1.2a. Channel Condition/Alteration (natural, altered, or downcutting).

Stream meandering generally increases as the gradient of the surrounding valley decreases. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control or irrigation purposes. These changes in turn may affect stream functions, such as transport of sediment and the development and maintenance of habitat for fish, aquatic insects, and aquatic plants. Some modifications to stream channels have more impact on stream health than others. For example channelization and dams affect a stream more than the presence of pilings or other supports for road crossings. Signs of channelization or straightening of a stream may include an unnaturally straight section of the stream, high banks, dikes or berms, lack of flow diversity, and uniform-sized bed materials. Newly channelized reaches may have vegetation missing or vegetation different from reaches that were not channelized. Older channelized reaches may also have little or no vegetation or have grasses instead of woody vegetation. Drop structures (such as check dams), irrigation diversions, culverts, bridge abutments, and riprap also indicate changes to the stream channel.

Active downcutting and excessive lateral cutting are serious impairments to stream function. Both conditions are indicative of an unstable stream channel. Indicators of downcutting in the stream channel include nickpoints associated with headcuts in the stream bottom and exposure of cultural features, such as pipelines that were initially buried under the stream. Exposed footings in bridges and culvert outlets that are higher than the water surface during low flows are other examples. A lack of sediment depositional features, such as regularly spaced point bars, is normally an indicator of incision. A low vertical scarp at the toe of the streambank may indicate downcutting, especially if the scarp occurs on the inside of a meander. Excessive bank erosion is indicated by raw banks in areas of the stream where they are not normally found, such as straight sections between meanders or on the inside of curves.

Selected References: Newton, et al., 1998; Barbour, et al., 1999

3.1.2b. Channel Capacity to Flow Frequency Ratio (for 2-year peak flow). Channel capacity is the maximum flow that a given channel is capable of conveying without overtopping its banks. For evaluation purposes, the 2-year flow is considered the base condition for bankfull capacity when projected based on hydrological modeling of stream flow from watershed runoff. Optimal conditions fall within a 1.5 to 2.5 year frequency of storm events which causes flow to exceed bankfull stream capacity providing overflows into adjacent wetlands and floodplains. This frequency can be expressed as a ratio related to the 2 year flow as 0.75 to 1.25. Suboptimal conditions would have overbank flow events on a more frequent basis than every 1.5 years (ratios <0.75) or less frequent than 2.5 years (ratios >1.25). Conditions are considered marginal if overbank flow events are more frequent than every year (ratios <0.5) or less frequent than every 5 years (ratios >2.5). Conditions are considered poor if overbank flow events are more frequent than every ½ year (ratios <0.25) or less frequent than every 10 years (>5).

Selected References: Dr. Mike Harvey and Stu Travant, 2005

3.1.2c. Channel Bank Stability. This parameter evaluates the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. This parameter measures active stream bank erosion. Signs of erosion include raw, exposed soil on banks, or banks that are sloughing, crumbling, or otherwise unstable. Some banks may exhibit exposed soil, but are "crusted/healed over" and are not actively eroding. Such banks may exhibit early signs of stabilizing that include colonization by lichens and mosses, herbaceous vegetation establishing at the toe of the bank, etc. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately and the average score (left and right) is used for this parameter. For convention, right and left banks are determined when facing downstream.

Selected References: Newton, et al., 1998; Barbour, et al., 1999, USACE, Norfolk District, 2004

3.1.3. Channel Roughness Factors

3.1.3a. Channel Sinuosity. This parameter evaluates the meandering or sinuosity of the stream Sinuosity is used as an indication of how a river has adjusted to the slope of its valley (Rosgen, 1996) and is measured as Channel Length divided by Valley Length. The degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials. A sinuosity of 1 indicates the stream is flowing in a straight line and would typically be indicative of some anthropogenic activity such as channelization. Most low-gradient streams that are functioning efficiently in transportation of bedload will have a sinuosity value of 1.5 or greater (Rosgen, 1996; Cole, 1994; Gordon, et al., 1992).

A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when the stream flow fluctuates as a result of storms. The absorption of stream flow energy by bends protects the stream from excessive erosion and flooding and provides refugia for benthic invertebrates and fish during storm events. To gain an appreciation of this parameter in low gradient streams, a longer segment or reach than that designated as a reference reach (RR) may be incorporated into the evaluation. In some situations, this parameter may be rated on a macro-scale by evaluation of the SAR by interpretation of accurate topographical maps or aerial photographs and application of the results to all RRs within the SAR. The “sequencing” pattern of the stream morphology is important in rating this parameter (Barbour, et al., 1999). In “oxbow” streams of coastal areas and deltas, meanders are highly exaggerated and transient. Natural conditions in these streams are shifting channels and bends, and alteration is usually in the form of flow regulation and diversion.

Selected References: Barbour, et al., 1999; KDWP, 1996

3.1.3b. Substrate Composition. Substrate can vary significantly in a stream, horizontally, vertically, and lengthwise throughout a reach, with frequent changes relating to fluctuations in flow regimes. Both inorganic and organic materials are included in substrate composition, and will vary spatially and temporally. Vertical variations may occur seasonally as with the presence of leaf litter in the late fall through the spring, covering gravel or cobble substrates that would be visible in the summer. In addition, temporal variability related to sediment deposition and accumulation of detritus during periods when spates have been absent (i.e., no “flush” effect) may influence the evaluator’s perception of substrate composition.

The deposition of substrate, and its composition can affect the hydrology of a stream. Sediment accumulation can lead to channel enlargement or division. Further, unstable substrates can lead to sediment accumulation downstream. The evaluator should note any changes in stream hydrology based on the deposition or instability of a stream’s substrate.

Selected References: KDWP, 1996

3.1.3c. Instream Bottom Topography or Manning’s n. Instream structure or channel bottom topography influences flow within the channel by increasing roughness and thereby, turbulence. Turbulent areas improve aeration and influence other water quality parameters as well as provide habitat features. Structural elements within a stream also impact water flow direction, which in turn influences erosional patterns that shape the channel. Instream bottom topography includes occurrence of deep pools, riffle zones, boulders/gravel, in-channel sediment bars, logs or large woody debris, backwater areas, connecting oxbows or other side-channel pools, overhanging vegetation, vegetated shallows, rootwads, or undercut banks. Manning's n is a roughness coefficient used as a factor in hydrologic and hydraulic modeling. The U.S. Geological Survey (USGS) has developed a guide for selecting Manning's n coefficients for natural channels and floodplains that is available at the following web address:

http://www.fhwa.dot.gov/bridge/wsp2339.pdf

In the event that Manning's n roughness coefficients are not available from hydrologic modeling conducted for the SAR or cannot be estimated using the USGS guidance, professional judgment from site evaluation of observed structural elements within the stream as described under the category conditions for instream bottom topography should be used to estimate the roughness coefficient of a RR based on observations of RR and comparison to described ranges for Manning's n.

Selected References: KDWP, 1996; Newton et al., 1998

3.1.3d. Channel I ncision. The degree of channel incision is evaluated by determining the Bank Height Ratio (BHR) of a representative section of the RR. The BHR is calculated by dividing the Top of Lowest Bank (TOLB) by the Maximum Bankfull Depth (BFD). Both the TOLB and BFD are measured in a riffle, from the thalweg, and at the same cross-section. The lowest bank refers to the lower of the left or right bank (where the bank intersects the floodplain or terrace) on any given cross-section, and is not a low bank or bar within the channel cross-section. There may be instances whereby an incised stream has reestablished a stable pattern, profile and dimension at a lower elevation and stable bankfull benches are apparent. In these instances, the bankfull bench should be considered as the new TOLB. Bankfull discharge is the discharge that fills a stable alluvial channel to the elevation of the active floodplain.

This discharge is morphologically significant because it identifies the point where the active channel stops and the floodplain begins. The height of water, or stage, during bankfull flow is the point at which flooding occurs on the floodplain. This may or may not be the top of the streambank. If the stream has downcut due to changes in the watershed or streamside vegetation, the floodplain stage indicator may be a small bench or scour line on the streambank. The top of the bank, which was formerly the floodplain, is called a terrace in this case. A stream with a terrace near the top of the banks is an incised, or entrenched, stream.

For actively incising streams, where BFD is difficult to locate, make your best estimate of bankfull based upon watershed size and condition, and in stream features. The Bank Full Depth is the average depth measured during a dominant channel forming flow with a recurrence interval averaging approximately 1.5 years. A good bankfull indicator is the uppermost scour line. Other bankfull indicators include the back of a point bar, the upper break in slope of the bank, and occasionally the top of the bank. Often, there is another prominent feature known as the inner berm. The Army Corps of Engineers refers to the inner berm as the mean high water mark. This feature is usually identified as a scour line or small bench halfway between the low flow water surface and the bankfull stage. Streams with large watersheds will have bankfull stage indicators at a higher elevation on the bank than streams with smaller watersheds. If necessary, walk upstream and downstream of the SAR and locate other indicators of bankfull stage.

Values will always be greater than or equal to one. A BHR ratio equal to 1 indicates a stream is not incised. Ratios greater than 1 indicate a stream is incised.

Additional guidance regarding the identification of field indicators of bankfull stage is found in Appendix 2 of the USACE, Norfolk District Stream Attribute Assessment Methodology Instruction Manual (2004).

Figures below are from the USACE, Norfolk District Stream Attribute Assessment Methodology Instruction Manual (2004)

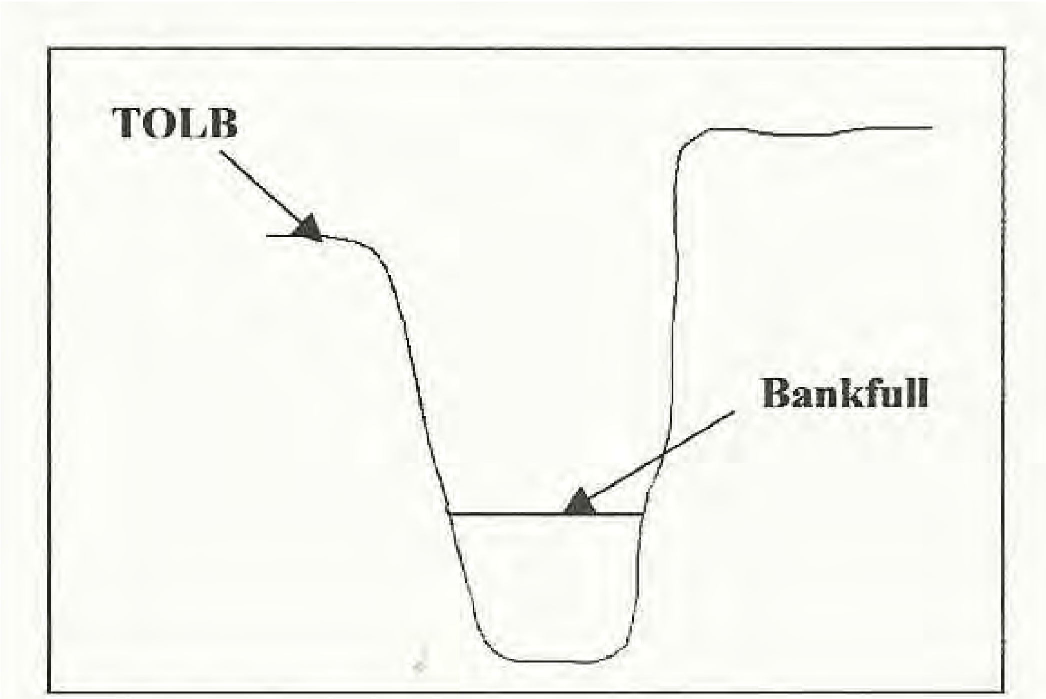


Figure 2. Relationship between Bankfull and TOLB in an incised channel without a bankfull bench.

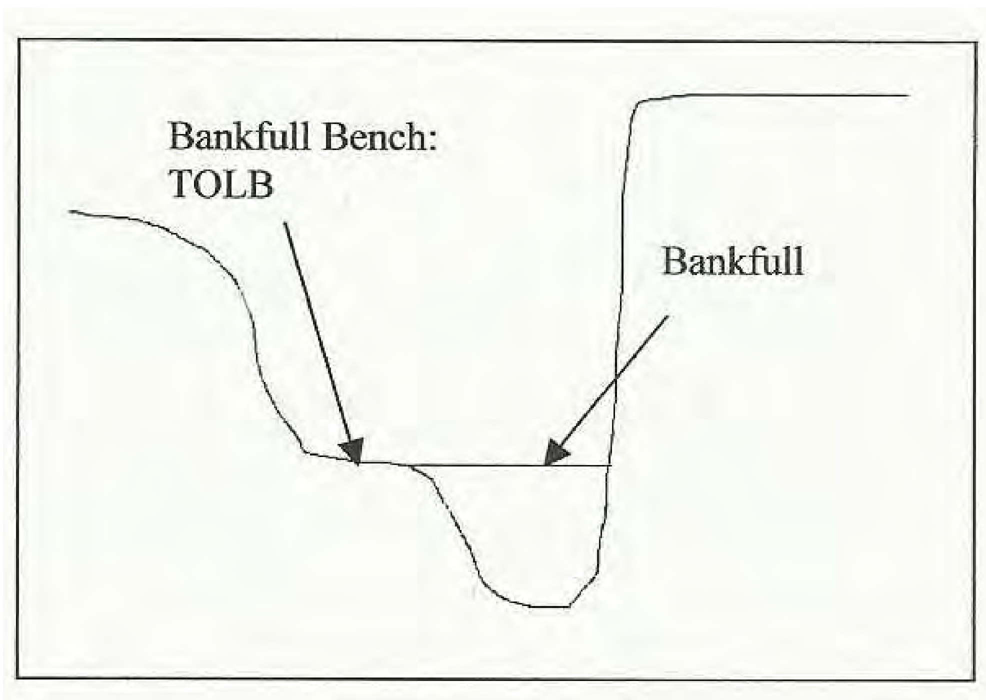


Figure 3. Relationship between Bankfull and TOLB in an incised channel with a bankfull bench.

Figure 4. Channel Incision: without bankfull bench - TOLB -

Figure 5. Channel Incision: Early channel evolution of bankfull bench within incised channel

Figure 6. Channel Incision: Channel has stabilized at a new base-elevation with an established bankfull bench

Figure 7. Channel Incision: Change in BHR due to head-cut

Figure 8. Looking upstream and downstream to establish bankfull stage from field indicators

Selected References: USACE Norfolk, 2004, Kline, et al., 2005.

3.1.4. Dynamic Surface Water Storage

3.1.4a. Pools. Pools are important resting and feeding sites for fish. A healthy stream has a mix of shallow and deep pools. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. A deep pool is 1.6 to 2 times deeper than the prevailing depth, while a shallow pool is less than 1.5 times deeper than the prevailing depth. Pools are abundant if a deep pool is in each of the meander bends in the reach being assessed. Generally, only 1 or 2 pools would typically form within a reach as long as 12 active channel widths. In low order, high gradient streams, pools are abundant if there is more than one pool every 4-channel widths.

Pool diversity and abundance are estimated based on walking the stream or probing from the streambank. You should find deep pools on the outside of meander bends. In shallow, clear streams a visual inspection may provide an accurate estimate.

Selected References: Newton, et al., 1998; Barbour, et al., 1999

3.1.4b. Channel Flow Status. Channel flow status is the degree to which water covers the entire available channel substrate, from bank to bank. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversion for irrigation, or drought. When water does not cover much of the streambed, the amount of suitable substrate for aquatic organisms is limited. In high-gradient streams, riffles and cobble substrate are exposed; in low-gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat. Channel flow is especially useful for interpreting biological condition under abnormal or lowered flow conditions. This parameter becomes important when more than one biological index period is used for surveys or the timing of sampling is inconsistent among sites or annual periodicity.

When measuring this parameter you should consider the area from the toe of the streambank to the toe of the opposite streambank. Whether due to natural runoff patterns or human-induced impacts, streams have different flow characteristics ranging from intermittent, to perennial. A stream that is naturally intermittent is more likely to exhibit poorer channel flow status condition than a perennial stream. Evaluation of channel flow status should be made based on normal flow within a stream channel. Best professional judgment should be used to determine normal flow conditions. Review of climatic data for the local area of the stream assessment can provide indication of rainfall patterns prior to the field assessment work. Field indicators would include water levels relative to Ordinary High Water Mark (OHWM) for the stream channel.

Selected References: Barbour, et al., 1999; TCEQ 1999; Vermont Agency of Natural Resources, 2005.

3.2 Water Quality/Biogeochemical Function Variables

3.2.1. Sediment Transport/Deposition

3.2.1a. Channel Bank Erosion. As with channel bank stability (#2c variable under Hydrologic Functions), this parameter evaluates the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. Stream channels with poor riparian vegetation are subjected to accelerated streambank erosion and corresponding channel adjustments leading to instability and increased sedimentation within the channel, both at the point of bank erosion and downstream (Rosgen, 2001). Steep banks are more susceptible to collapse and suffer from erosion more than gently sloping banks, and are therefore considered to be unstable. A healthy riparian corridor with a vegetated floodplain contributes to bank stability. The roots of perennial grasses or small woody vegetation typically extend to the baseflow elevation of water in streams that have bank heights of 6 feet or less. Mature tree roots typically extend to deeper depths. The root masses help hold the bank soils together and physically protect the bank from scour during bankfull and flooding events.

Signs of erosion include crumbling, unvegetated banks, bank sloughing/slumping, recently exposed non-woody tree roots (e.g., fine hair-like roots and or smaller lateral roots less than 0.5 inch in diameter), the general absence of any vegetation within the lower one-third portion of the bank, recent tree falls, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately and the average score (left and right) is used for this parameter. For convention, right and left banks are determined when facing downstream.

Selected References: Newton et al., 1998; Barbour, et al., 1999, Rosgen, 2001; Galli, 1996

3.2.1b. Channel Bottom Bank Stability. This parameter is a subset of Channel Bank Stability and the existence of or the potential for erosion of the lower stream bank and its movement into the stream. Resistant plant or soil material will prevent frequent compromise of the bank, increased erosion, or shifting of channel morphology. However, vegetation seldom becomes established below the elevation of the bankfull surface because of the frequency of inundation and the unstable bottom conditions as the stream moves its bedload, which facilitates the erosion of the bottom of the stream's bank. The more stable the channel bottom is the greater ability of the stream to provide or develop physical aquatic habitat.

Selected References: Galli, 1996

3.2.1c. Substrate Composition or Channel Sediments. Silt deposition may influence substrate composition and water quality and biogeochemical functions, if significant high-flow events have been absent during drought periods to provide a "flush" effect on the site. This often leads to deposition of fine sediments that become embedded within the interstitial spaces between substrate particles; thereby depleting the hyporheic zone of subsurface flow of oxygen-containing water through the interstitial spaces beneath the stream bed (Alan, 1995). This variable is evaluated by taking into consideration the amount of substrates that create interstitial spaces on the streambed suitable for colonization by macroinvertebrates, and the amount of sediment that is present in the streambed that may impact the availability of this habitat.

Selected References: Barbour, et al., 1999, Petersen, 1992.

3.2.2. Water Clarity. The clarity of water is evaluated by turbidity. The deeper an object can be seen, the lower the amount of turbidity. This variable is determined from color, clarity, and any other visual characteristics, such as oil sheen.. Soil or organic matter in the stream may increase turbidity. Water may be colorless or naturally colored (brown or green) due to the natural setting of the stream. Heavy sediment loads or algae may affect water color and clarity. Other visual characteristics may be present from pollutants, submerged objects, watershed usage or discharges.

Selected References: Newton et al., 1998

3.2.3. Presence of Aquatic Vegetation

3.2.3a. Nutrient Enrichment. Nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients promote an overabundance of algae and floating and rooted macrophytes. The presence of some aquatic vegetation is normal in streams and beneficial for most stream life. Nutrient enrichment in excess, however, is not beneficial to most stream life. Plant respiration and decomposition of vegetation consume dissolved oxygen in the water. Lack of dissolved oxygen creates stress for all aquatic organisms and can result in fish kills.

Healthy streams may have some aquatic vegetation including rooted macrophytes, floating plants, and algae attached to substrates. Excess nutrients can cause excessive growth of algae and macrophytes, which can create a greenish color to the water. More intense nutrient loads lead to lusher aquatic vegetation and deeper green color. Intense algal blooms, thick mats of algae, or dense stands of macrophytes degrade water quality and habitat. Clear water and a diverse aquatic plant community without dense plant populations are optimal for this parameter.

Selected References: Newton et al., 1998

3.2.3b. Aquatic Vegetation. This variable is similar to Nutrient Enrichment, but is a quick look measure of the amount of aquatic vegetation and algae present. The intensity of vegetation and algae cover is scored based on presence and abundance of aquatic vegetation.

Selected References: Petersen, et al., 1992

3.2.4. Composition of Organic Matter. The detritus present in streams affects water quality. Detritus may consist of wood, leaves, organic debris, and sediment. The size and amount of the detritus affects water quality by filling the channel, floating in the stream, and causing the water to be more turbid. Excessive fine organic matter may further degrade the water quality by consuming oxygen and causing anaerobic conditions in the stream.

Selected References: Petersen, et al., 1992

3.2.5. Land Use Pattern. The land beyond the immediate riparian zone can affect water quality based on its usage. If the land consists of forest or wetlands, the riparian zone would be buffered against excessive runoff and sediment loads. If the land is used for pasture or agriculture, the riparian zone and the stream may be required to absorb or be impacted by nutrient, pollutant, or sediment laden inputs that can degrade water quality. A stream with undisturbed or natural lands outside the immediate riparian zone is better able to support an aquatic community and maintain more stable natural conditions.

Selected References: Petersen, et al., 1992

3.2.6. Riparian Zone Width and Continuity

3.2.6a. Riparian Zone Width. This variable measures the width of natural vegetation from the edge of the stream bank out through the riparian zone. The riparian vegetation zone provides a buffer from pollutants or sediment entering a stream from runoff, helps control erosion, dissipates energy during floods, provides habitat, and nutrients to the stream. An undisturbed and wider riparian zone that has not been impacted by human activities is optimal. Riparian zones may be impacted by human activities including roads, fields, lawns, bare soil, buildings, residential developments, golf courses, and rangeland.

The width of the riparian zone can determine the amount of buffer provided although depending on the size of the stream a specific width for one riparian zone on a stream may or may not be sufficient for another stream with larger or smaller dimensions and flow. The width specified under each condition category should be evaluated relative to the width of the stream within the RR first, but riparian zone width should be no less than 50 feet (each side) for streams characterized as intermittent for optimal condition. Optimal conditions for streams characterized as perennial should be at least 100-150 feet (each side). Each bank is evaluated separately. Score for this variable is calculated as an average of the scores for each bank.

Selected References: Barbour, et al., 1999, Petersen, et al., 1992, Newton, et al., 1999.

3.2.6b. Riparian Zone Vegetation Protection/Completeness. This variable measures the amount of vegetation protection along the stream banks. Banks with full native vegetation growth are best for water quality and habitat. The type of vegetation is also an important component when measuring the completeness of vegetative protection. Vegetation protection is important because root systems of plants hold soil in place reducing the amount of erosion that may occur along the bank and also providing buffering from anthropogenic activities outside the riparian zone.

Is the vegetation natural and diverse, and does it consist of all structural components appropriate for the locale? If exotics are present or have replaced native species, do they support the habitat structure and protect water quality? What activities are occurring outside the riparian zone and does the riparian zone buffer these activities or do these activities impact the riparian zone? If activities are impacting the riparian zone, the zone may need to be wider to provide protection. How complete is the vegetation zone along each bank? Each bank is evaluated as both sides will be affected and are important for the health of the stream. Score for this variable is calculated as an average of the scores for each bank.

Selected References: Barbour, et al., 1999, Petersen, et al., 1992.

3.3 Habitat Function Variables

3.3.1. Flow Regime. The stream flow regime identified by this variable indicates the importance of the stream to the aquatic community. Although ephemeral and intermittent drainages are essential to the function of a watershed, they are not provided a point value equal to perennial streams due to the fact that they typically do not provide year-round habitat for aquatic organisms. Evaluators should take into account regional and site-specific climatic conditions (i.e., extended drought, recent heavy rains, etc.) when determining the flow characteristics of a stream. A range of point values is provided for various stream types to efficiently characterize differences in quality within that stream type. For example, some intermittent streams have groundwater input that sustains flow at a higher rate and for a longer period of time than other streams. The evaluator may choose to provide a higher score within the stream type for this system.

Ephemeral stream – A drainageway that may or may not have a well-defined channel that carries flow only during periods of surface runoff. These drainages are not hydrologically connected to subsurface inputs (i.e., springs, subterranean flow, etc.) and often lack a well-defined channel with easily identifiable bed and banks.

Intermittent stream – A drainageway with a well-defined channel that generally flows only during a part of the year. It continues to flow after cessation of surface runoff, but effluent groundwater (springs/subterranean flow) will not sustain flows through moderate periods of little or no precipitation. It may contain reaches of perennial flow or have permanent pools that support aquatic wildlife. Some special conditions, such as the discharge from a wastewater treatment plant or irrigation flows, can cause portions of an intermittent stream to have qualities of a perennial stream.

Perennial stream – A drainageway with a well-defined channel in which perennial flow persists throughout the length of the drainage during normal climate conditions. The permanency of flow is usually attributable to groundwater effluent. Some streams considered perennial may cease surface flow during periods of seasonal drought.

Selected References: KDWP 2000.

3.3.2. Epifaunal Substrate/Available Cover. Substrate and available cover refer to the relative quantity and variety of natural structures in the stream, such as cobble, large rocks, fallen trees, logs and branches, persistent leaf packs, and undercut banks, available to aquatic habitat for hiding, feeding, spawning and nursery functions. A wide variety of substrate provides macroinvertebrates and fish with a large number of niches, thus increasing habitat diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Riffles and runs are critical for maintaining a variety and abundance of insects and serving as spawning and feeding refugia for certain fish. Riffles and runs offer a diversity of habitat through variety of particle size. Less variety or scarcity of substrate leads to less diversity of aquatic species. Also, sedimentation in the stream channel can lead to decreased condition of the habitat. Snags and submerged logs are among the most productive habitat structure for macroinvertebrate colonization and fish populations in low-gradient streams. However, “new fall” will not yet be suitable for colonization.

The variable score is determined by visual observation of percent of substrate and features present. When evaluating epifaunal substrate and available cover look at the relative quantity and variety of natural structures in the stream. In general, consider the entire bankfull area of the channel, but give greater weight to the area of the channel that remains wetted during lower flow conditions (such as those during late summer).

Selected References: USACE Norfolk, 2004, Barbour, et al, 1999, Parsons, et al, 2001.

3.3.3. Stream Bottom Substrate. The type and condition of the substrate found in the pools of the channel is a factor in determining if the pools can support organisms. Firmer substrate (gravel and sand) and rooted aquatic plants provide better substrate than mud or bedrock with no plants. Also, more variety of substrate typically supports a more diverse community of organisms. Visual observance of the substrate materials in pools is used to determine the score. The evaluator should consider these variables and use professional judgment when scoring the components related to substrate.

Waters (1995) reports on several studies that have demonstrated that substrate and biological diversity are often correlated, with substrates having greater surface area and interstitial space (i.e., gravel, cobble) indicative of greater aquatic macroinvertebrate and vertebrate diversity. These habitats are particularly productive in riffles where numerous benthic macroinvertebrates inhabit these areas and require substrates unimpeded by excessive sedimentation. At sediment embeddedness levels greater than one-third (i.e., more than 33% of the substrate fixed by surrounding sediment) oxygen flow decreases and insect abundance can decline by approximately 50% for riffle inhabiting taxa.

In cases where a stream's substrate is monotypic, but not indicative of less-than-optimal habitat, the evaluator should provide a score that reflects the site's substrate quality in relation to the geographical region in which the evaluation is being performed. The evaluator should consider if the lack of substrate diversity is hindering the habitat quality of the stream for the geographical area the site is located in. If not, then exceptions can be made and appropriate points provided along with a brief explanation. Best professional judgment on the substrate parameters should address these dynamic circumstances to provide the optimal score the habitat provides for aquatic organisms on a consistent basis.

Selected References: Barbour, et al, 1999, Parsons, et al, 2001, Petersen, 1992.

3.3.4. Pool Variability. For low gradient streams, this variable rates the overall mixture of pool types found in streams, according to size and depth. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. General guidelines for determining large or small pools are any pool dimension (ie., length, width, oblique) greater than half the cross section of the stream qualifies as a large pool. In wadeable streams, a deep pool is 1.5 to 2 times deeper than the prevailing depth, while a shallow pool is less than 1.5 times deeper than the prevailing depth.

Selected References: Barbour, et al., 1999, Parsons, et al., 2001.

3.3.5. Sediment Deposition. Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition. Deposition occurs from large-scale movement of sediment. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow velocity decreases, such as bends. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms.

Selected References: Barbour, et al., 1999, Parsons, et al., 2001, USACE Norfolk, 2004.

3.3.6. Channel Flow Status. Channel flow status is the degree to which water covers the entire available channel substrate, from bank to bank. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) or as flow decreases as a result of dams and other obstructions, diversion for irrigation, or drought. When water does not cover much of the streambed, the amount of suitable substrate for aquatic organisms is limited. In high-gradient streams, riffles and cobble substrate are exposed; in low-gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat. Channel flow is especially useful for interpreting biological condition under abnormal or lowered flow conditions. This parameter becomes important when more than one biological index period is used for surveys or the timing of sampling is inconsistent among sites or annual periodicity.

When measuring this parameter you should consider the area from the toe of the stream bank to the toe of the opposite stream bank. Whether due to natural runoff patterns or human-induced impacts, streams have different flow characteristics. A stream that is naturally intermittent is more likely to exhibit poorer channel flow status condition than a perennial stream. Evaluation of channel flow status should be made based on normal flow within a stream channel. Best professional judgment should be used to determine normal flow conditions. Review of climatic data for the local area of the stream assessment can provide indication of rainfall patterns prior to the field assessment work. Field indicators would include water levels relative to ordinary high water mark (OHWM) for the stream channel.

Selected References: TCEQ, 1999, Barbour, et al., 1999, Parsons, et al., 2001; Vermont Agency of Natural Resources, 2005.

3.3.7. Channel Alteration. Channel alteration is a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control or irrigation purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred. Scouring is often associated with channel alteration.

Selected References: USACE Norfolk, 2004, Barbour, et al., 1999, Parsons, et al., 2001.

<u>3.3.8. Channel Sinuosity</u>. Evaluates the meandering or sinuosity of the stream. A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when the stream fluctuates as a result of storms. The absorption of stream flow energy by bends protects the stream from excessive downstream erosion and flooding and provides refugia for benthic invertebrates and fish during storm events. To gain an appreciation of this parameter in low gradient streams, a longer segment or reach than that designated for sampling may be incorporated into the evaluation. In some situations, this parameter may be rated from viewing accurate topographical maps or aerial photographs. The "sequencing" pattern of the stream morphology is important in rating this parameter. In "oxbow" streams of coastal areas and deltas, meanders are highly exaggerated and transient. Natural conditions in these streams are shifting channels and bends, and alteration is usually in the form of flow regulation and diversion. A stable channel is one that does not exhibit progressive changes in slope, shape, or dimensions, although short-term variations may occur during floods (Gordon et al. 1992).

Selected References: Barbour, et al., 1999, Parsons, et al., 2001.

<u>3.3.9. Bank Stability</u>. Measures whether the stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks, and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.

Selected References: Barbour, et al., 1999, Parsons, et al., 2001, USACE Norfolk, 2004.

3.3.10. Vegetation Protection. Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of in-stream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap. This parameter is made more effective by defining the native vegetation for the region and stream type (i.e., shrubs, trees, etc.). In some regions, the introduction of exotics has virtually replaced all native vegetation. The value of exotic vegetation to the quality of the habitat structure and contribution to the stream ecosystem must be considered in this parameter. In areas of high grazing pressure from livestock (or from uncontrolled wildlife populations) or where residential and urban development activities disrupt the riparian zone, the growth of a natural plant community is impeded and can extend to the bank vegetative protection zone. Damage may also result from exotic animals (e.g., nutria) that forage on both herbaceous and small diameter woody vegetation as well as burrow into banks. Each bank is evaluated separately and the average score (right and left) is used for this parameter.

Selected References: Barbour, et al., 1999, Parsons, et al., 2001, KDWP, 2000, Petersen, et al., 1992.

3.3.11. Riparian Zone Width. Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic degradation of riparian zone. Conversely, the presence of “old field” (i.e., a previously developed field not currently in use), paths, and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to altering the riparian zone and may be given relatively high scores. For variable size streams, the specified width of a desirable riparian zone may also be variable and may be best determined by some multiple of stream width (e.g., 4X wetted stream width). The riparian zone is influenced by the depth to groundwater, and is related to the interaction of the stream and groundwater. As one moves landward, the groundwater may become deeper beneath the surface. At some point, the groundwater is of sufficient depth below the surface that it is not a source of water for trees. This point is the natural demarcation that defines the extent of the riparian zone. Since it is usually impractical to make this determination, default values of 25-foot wide buffers fro ephemeral streams, 50-foot buffers for intermittent streams, or 75-150-foot wide buffers for perennial stream are often used to evaluate this variable. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.

Selected References: Barbour, et al., 1999, Parsons, et al., 2001.

3.3.12. Riparian Habitat Condition. Evaluate the riparian area condition within a 25-foot wide buffer for ephemeral streams, a 50-foot buffer for intermittent streams, or a 75-150 foot wide buffer for perennial streams. The buffer should be evaluated from the top of each bank and to the appropriate buffer width for the stream flow regime along the entire length of the SAR. The SAR Area may be homogeneous (for example: all pasture land on both banks) or heterogeneous (example: 33% forested, 33% cropland, and 33% pavement). It is possible that the SAR could contain multiple condition categories; each with one or more scores. In that case, each condition category present within the SAR is scored and weighted by the percent it occupies within the SAR.

Land use cover data from aerial photographs and other sources should be used to determine the land use cover within buffer zones of the SARs. Each Riparian Area condition category (Optimal, Suboptimal, Marginal, Poor) present should be categorized and scored accordingly, based upon the condition description in the Riparian Areas variable. An estimate of the condition categories may be made from aerial photographs and land use maps, but visual verification of conditions based on observations during field investigations for Reference Reaches should be made.

The score is calculated as a weighted Sub-Condition Index (SCI) for each bank and then total Riparian Area Condition Index (CI) for the SAR. Percentages and scores are determined separately for Right and Left banks. For example: Suboptimal comprises 30% of the Right Bank SAR and its score is 7; Marginal comprises the other 70% of the Right Bank SAR and its score is 3. A weighted SCI for each bank is calculated by multiplying the percentage by the score. Summing the SCI scores provides the CI for the bank. The left and right bank CI are averaged together to obtain the CI for the entire SAR. From the above example: (0.3 x 7) + (0.7 x 0.3) = SCI 4.2

Selected References: USACE Norfolk, 2004.

4.0 Impoundments

Impoundments in Texas are man-made structures used for water supply, recreational, agricultural, or flood-control and grade stabilization purposes. These structures may be constructed to capture sheet runoff from the watershed (upland ponds) or as on-channel impoundments. On-channel impoundments are considered jurisdictional waters of the U.S. where the impoundment expands the breadth of ordinary high water mark (OHWM) of a defined stream and therefore, are protected under the Clean Water Act. Impacts to on-channel impoundments require a Section 404 permit, and potentially, compensatory mitigation since these structures provide a number of benefits to wildlife adapted to lentic habitat types. The parameters included in the SWAMPIM for on-channel impoundments are adapted from a similar evaluation system utilized by the Kansas Department of Wildlife and Parks (KDWP 2000). The impoundment evaluation is designed to provide a qualitative assessment of the habitat available to species, as well as water quality conditions. The impoundment assessment, as with the stream assessment, incorporates geological and morphological habitat characteristics, riparian and watershed condition, biological components, and water chemistry into the protocol. The merging of these variable characteristics of an impoundment into an assessment protocol provides a means to rapidly produce a quality determination of habitat characteristics and ecological conditions based on observations and measurements taken at a single point in time.

Although on-channel impoundments are jurisdictional waters of the U.S., they function differently within a watershed than a stream. Therefore, evaluation of impoundments should be related to the aquatic functions provided in these lentic environments. Especially in areas dominated by ephemeral and intermittent streams, the more perennial nature provided by the pool of an on-channel impoundment increases both habitat availability and diversity, provides flood storage, captures sediment load, provides capture and degradation of organic loads from the watershed, and many of the other functions also related to streams. Detailed descriptions of the variables for assessment of impoundments are provided in Section 5 of this document.

4.1 Size Categories

Four size categories were identified for on-channel impoundments for this evaluation:

- Small ponds ($\leq$1 acre);
- Ponds (>1 acre $\leq$ 5 acres);
- Lakes (>5 acres $\leq$ 500 acres); and
- Reservoirs (>500 acres)

For calculation of the Resource Capacity (RC) (similar to Functional Capacity (FC) for Streams and Rivers), a multiplication factor was developed for each impoundment size category to reflect the corresponding increase in overall habitat area provided with the addition of a representative buffer zone along the impoundment shoreline. The multiplication factor was determined by calculating the habitat area increase based on the increased radius provided by a buffer zone of 25 feet for a small pond, 25 feet for a pond, 100 feet for a lake, and 150 feet for a reservoir based on a hypothetical circular impoundment of median size for each category (i.e., 0.5 acre for small pond, 2.5 acres for pond, 250 acres for lake, and 5,000 acres for reservoir). The impoundment plus buffer zone area was divided by the impoundment area to determine the multiplication factor for each category.

4.2 General Instructions for Impoundments Assessment Using SWAMPIM

A. Determine the On-Channel Impoundments present within the proposed project area. Categorize all identified on-channel impoundments based on the size categories listed in Section 4.1.

B. Determine representative impoundments to be assessed within each category based on the quantity and variability of quality of the identified impoundments within each category (based on initial reconnaissance and studies).

C. Complete Impoundment Resource Assessment Forms for each representative impoundment based on measurements and assessment of conditions. Certain variables (e.g. shoreline development, watershed land use) may be evaluated first through review of topographic maps and recent aerial photographs with subsequent verification based on field observations.

D. Total the scores for physical, watershed/management, biological, and water quality variables.

D. Calculate the Resource Condition Index (RCI) for each representative impoundment based on the total score for the impoundment divided by 100 (the maximum total score possible).

E. If multiple representative impoundments are assessed for a category, add the RCIs calculated for all representative impoundments in the category and divide by the number of impoundments assessed to determine an average RCI score.

F. The RCIs determined for the impoundment category are then multiplied by the total acreage of all impoundments within each category then multiplied by the multiplication factor (described in Section 4.1) for the specific category represented to determine the total Resource Capacity (RC) for the category.

The resulting calculation for RC is as follows:

RC = RCI * (Total Acreage of All Impoundments In Category) * Multiplication Factor

G. The Project RC for impoundments is the summation of the total RCs for all Impoundment Categories within the defined project area.

H. Post-project RC for impoundments is determined by the same process as for the existing conditions within the project area except scoring of physical, watershed/management, biological, and water quality variables for each impoundment category is based on projections of changes in condition relative to proposed project activities, including compensatory mitigation activities, or resulting impacts of the proposed project.

5.0 Description of Resource Variables for Impoundments

5.1 Physical Habitat

5.1.1 Shoreline Development. The Shoreline Development Index (SDI) is a common morphometric measurement used to calculate the amount of littoral zone present on a water body (McMahon et al., 1996). The littoral zone of a water body provides spawning and nursery habitat for the majority of lentic fish species, as well as being the area of greatest biological productivity and habitat use by other aquatic and semi-aquatic wildlife. The SDI incorporates the area of the impoundment and shoreline length, and is calculated from the following equation:

$$\text{SDI} = \frac{L}{(2)\sqrt{A\pi}}$$

Where L = shoreline length (feet) and A = surface area of the impoundment (square feet). The SDI represents the ratio of the circumference of an impoundment compared to a circle of the same area. A circular shaped impoundment would have an SDI of 1, offering the minimal amount of littoral zone compared to the surface area of the water body. Circumference and area measurements of an impoundment can be obtained from aerial photographs, topographical maps, or Global Positioning Systems (GPS).

5.1.2 Average Depth. Average depth of small impoundments can be estimated with the use of a weighted bobber with incremental depths identified or by measuring the depth with a depth stick. Increased average depth provides critical refugia during drought as water pools shrink as well as for various aquatic species that prefer deep-water areas.

5.1.3 Annual Storage Ratio. The annual storage ratio is a hydrodynamic variable commonly used to describe the rate at which water moves through an impoundment (McMahon et al. 1996). It is synonymous with other calculations such as flushing rate and turnover time, which describe water transport through impoundments. Storage ratio is measured as:

$$\text{Storage Ratio} = \frac{\text{Storage Volume (Acre feet)}}{\text{Annual discharge rate (Acre feet)}}$$

For example, if the evaluator is calculating the storage ratio for the 3 acre impoundment listed above, and it is estimated the average depth is 5 feet, the impoundment would have a storage volume of 15 acre feet. If the average annual discharge is estimated at 0.01 cfs (approximately 5 gallons/minute), the annual discharge rate could be calculated as:

$$\begin{aligned} \textit{Annual Discharge} &= 0.01\frac{\text{ft}^3}{\text{second}} \times 60\frac{\text{seconds}}{\text{minute}} \times 60\frac{\text{minutes}}{\text{hour}} \times 24\frac{\text{hours}}{\text{day}} \times 365\frac{\text{days}}{\text{year}} \times \frac{1}{43560}\frac{\text{acre}\cdot\text{ft}}{\text{ft}^3} \\ &= 7.28\frac{\text{acre}\cdot\text{ft}}{\text{year}} \end{aligned}$$

Thus, storage ratio would be equal to 2.1(15 ÷ 7.2) and would receive a score of "3" on the evaluation form. Studies have indicated that there is an optimal rate of water movement through an impoundment that reduces the number of fish lost through discharge events (Willis and Stephen, 1987).

The following table will help describe discharge amounts when estimating storage ratio:

Average discharge Gallons/minute	**CFS**	**Annual discharge rate (acre-feet)**
4.5	0.01	7.2
45	0.1	72
450	1	720

Note: For impoundments that do not normally have a discharge except for short periods following substantial rainfall events that result in capture of sufficient water to allow variable spillage, this parameter can be deleted from the assessment with the corresponding adjustment to the calculation for RCI. Impoundments such as the ones within the Lake Ralph Hall project area which are sited on streams characterized as ephemeral would be in this category.

5.1.4-6. Substrate, Number of Substrate Types, and Amount of Cover. As in streams, substrate diversity is correlated to biological diversity and is an important habitat characteristic. When estimating the amount of cover for component #6 (Amount of Cover), the percentage of available cover should be estimated from the littoral zone, not the water body as a whole.

5.1.7. Native Vegetative Buffer. Native vegetation adjacent to the water body provides similar benefits to an impoundment as does a riparian zone along a stream. Benefits include protection against bank erosion, water quality benefits to surface runoff, aquatic habitat and nutrient input to the impoundment, and habitat to terrestrial species that may in turn provide resources to the aquatic community (i.e., terrestrial insects).

5.1.8. Bank erosion. Erosion of banks through sloughing from wave action and livestock trampling can degrade water quality and habitat for aquatic species, and decrease the sediment storage for the impoundment.

5.2. Watershed Land Use And Impoundment Management

5.2.1. Impoundment Management. Various strategies can be implemented to provide benefits to the aquatic habitat of an impoundment as well as enhancement of adjacent riparian habitat. Drawdowns in water elevation allows for areas in the littoral zone that are typically inundated to colonize with vegetation and invertebrates, thus providing excellent food resources and nursery habitat for fish species following subsequent inundation. Management of water levels can be implemented with draw-down valves and can be coupled with flow-augmentation for the downstream channel, thus reducing de-watering effects downstream or enhancing flow regimes for ephemeral or intermittent downstream waters. Fish fences around spillways prevent the escape of impoundment fishes and reduce their influence on stream fish communities. Excluding livestock from the impoundment will improve water quality and protect banks from trampling effects. Fish feeders can increase growth and vigor of many sport fishes, and along with supplemental stockings and managed harvest rates, the quality of the fishery can be improved and overpopulations and growth stunting reduced. Other management strategies that maintain a quality sport fishery such as following strict harvest guidelines for large predators (i.e., Bass, Crappie, Catfish) and preventing the introduction of nuisance fish. Also, management strategies that control introduction of nuisance exotic species, including plant species, and enhance native habitat features should be awarded points when applicable.

5.2.2. Watershed Land Uses . Poorly implemented agricultural activities and human settlement are the two most influential factors that lead to degradation of an impoundment primarily by increasing sedimentation and degrading water quality. The evaluator should estimate the extent of minimal and significant impact land uses in the upstream watershed, as described in the stream evaluation guidelines, and provide the appropriate points.

5.3. Biological Diversity and Abundance

5.3.1. Fishery Characteristics. Impoundments are virtually all man-made structures in Texas, and as such, their fishery components typically consist of sport fishes stocked for recreational purposes. This fact is recognized in this component, and provides a higher habitat value to an impoundment that provides high-quality recreational fishing opportunities. In addition, most high-quality sport fisheries are an indication of a well-managed facility and upstream watershed, and can be considered an indicator of overall biological health for the aquatic community. Occasionally, exotic fish may be a detriment to the fishery potential of an impoundment. In these instances, the evaluator may deduct 5 points for this component. The negative aspects of impoundments on native stream fish communities are not considered in this component, but are addressed in the stream evaluation.

5.3.2. Aquatic Insects . Aquatic insects are imperative to the overall aquatic community of lentic systems. Since most aquatic insects native to the central plains evolved in streams, much of the habitat these organisms require does not exist in impoundments; therefore, macroinvertebrate assemblages found in lentic environments will differ from those found in lotic (swift flowing water) environments. This component of the impoundment evaluation addresses species richness (i.e., number of species) of

Phylogenetic Orders of macroinvertebrates, rather than the presence/absence of species indicative of antropogenic (habitat destruction, water quality impairment, etc.).

<u>5.3.3-4. Mollusc/Crayfish and Aqua tic and Semi-Aquatic V ertebrates</u>. These two components provide an estimation of various aquatic and semi-aquatic organisms that may exist in impoundments. As with aquatic insects, most of these organisms evolved in streams, and the majority of species that exist in impoundments evolved in lentic habitat types that exist in slow-moving streams, back-water oxbows, or wetlands. The evaluator should account for live or recently dead individuals to estimate existing populations for mussels and crayfish. Evaluators should check for the presence of nuisance exotic organisms (i.e., Zebra mussels (*Dreissena polymorpha*) or nutria (*Myocastor coypus*)) in or around the impoundment and deduct 5 points from the score if present. Other aquatic vertebrates may include amphibians, reptiles, birds, and mammals that live or breed in or near impoundments.

5.4. Water Quality

Water quality will affect an impoundment's ability to support aquatic life. Five main parameters (DO/BOD, Nutrient Enrichment, Pesticides, Turbidity, and Temperature) have been selected for the evaluator to assess based upon the effects degradation of these components can have on aquatic organisms; however, if it is determined other parameters are influencing aquatic life, those should be included along with a narrative description identifying their importance. The evaluator should determine if the parameter is frequently, occasionally, or rarely limiting aquatic life in the impoundment. Best professional judgment should be used when making this determination.

5.5. Impoundment Characteristics, Project Comments, and Species Information

This section is not included in the qualitative score for the impoundment, but rather allows the evaluator to provide data on physical characteristics, species observed during the evaluation, and any comments related to specific components that the evaluator modified during the assessment.

6.0 Glossary of Terms

Bankfull Depth (BFD): Maximum water depth as measured from the bottom of the channel in the thalweg (see below) portion of a riffle (that portion of the channel between an upstream pool and the next downstream pool) to bankfull stage elevation (Note: Measures of BFD should never be taken in a stream's pool zone).

Bank Height Ratio (BHR): The relationship between the top of the lowest bank (TOLB) and maximum bankfull depth (see above). Bank Height Ratio is a measure of channel incision (see below). Bank Height Ratio is determined by dividing the TOLB height by the maximum bankfull depth.

Bankfull Stage (BFS): A physical and/or biological indicator on the stream bank or in the stream channel that marks the elevation of ordinary high flows. These flows generally have a re-occurrence interval of 1.5 to 1.8 years and are the primary channel-forming flows. Bankfull Stage can be determined by such features as the elevation associated with the highest point bars/mid-channel bars, break in slope on the banks, particle size distribution (finer material that is associated with over-flow rather than more coarse material deposited in the active channel), water staining on rocks, trees, bridge abutments, exposed root hairs below an intact soil layer, the lower limit of woody vegetation on the channel banks, shelving, etc.

Base flow: The sustained portion of stream discharge that is drawn from natural storage sources, and not affected by human activity or regulation.

Bed load: Sediment moving on or near the streambed and transported by jumping, rolling, or sliding on the bed layer of a stream.

Bed material: The sediment mixture that a streambed is composed of.

Benthic invertebrates: Aquatic animals without backbones that dwell on or in the bottom sediments of fresh or salt water. Examples: clams, crayfish, insect larvae, and worms.

Berms: Mounds of dirt, earth, gravel, or other fill built parallel to the stream banks designed to keep flood flows from entering the adjacent floodplain.

Biota: All living organisms of a region, as in a stream or other body of water.

Buffer strip: A barrier of permanent vegetation, either forest or other vegetation, between waterways and land uses such as agriculture or urban development, designed to intercept and filter out pollution before it reaches the surface water resource.

Channel: An area that contains continuously or periodically flowing water that is confined by banks and a streambed.

Channel Incision: The extent that a stream channel has down-cut through its floodplain. Bank Height Ratio, as described above, is a measure of channel incision. A BHR greater than 1 generally indicates that a stream has some degree of incision and that storm events in excess of 1.5 to 1.8 year events are necessary before the stream overtops its banks onto the floodplain.

Channelization: The process of artificially straightening a stream channel by using equipment to cut a new channel thereby eliminating a stream's natural meanders, or containing a stream by streambank filling or hardening. In some circumstances, channelized streams, over time, equilibrate to a new base elevation and re-establish stable dimension, pattern, and profile. As this occurs, new floodplains can evolve within the incised channel. While it may be evident that some streams were channelized in the past, they may not be considered channelized if they have evolved a new stable meander pattern and floodplain within a historic channelized section.

Contiguous Habitat: Habitat suitable to support the life needs of a species that is distributed continuously or nearly continuously across the landscape.

Detritus: Organic material such as leaves, twigs, and other dead plant matter, that collects on the stream bottom. It may occur in clumps, such as leaf packs at the bottom of a pool, or as single pieces, such as a fallen tree branch.

Epifaunal: "Epi" means surface, and "fauna" means animals. Thus "epifaunal substrate" is structures in the stream (on the stream bed) that provide surfaces on which animals can live. Animals such as aquatic invertebrates live on or under cobbles, boulders, logs, snags, and in cracks and crevices found in these structures.

Ephemeral Streams: Streams that flow only in direct response to precipitation and whose channel is at all times above the water table.

Eutrophication: A process through which excessive plant growth, typically algae, induced by excess nutrients is followed by the decomposition of vegetative material and the depletion of the water's oxygen supply.

Floodplain: The portion of the river valley adjacent to the active channel that is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages.

Function Capacity Index (FCI): A numerical value representing the quantity and quality of a function present in a Reference Reach (RR). FCI is the sum of variable scores from the parameters of each function category divided by the maximum possible score for each function category. Where multiple RRs are evaluated for a SAR, the FCI for each function category is calculated as the average of the FCIs for the function category calculated for each RR.

Functional Capacity (FC): A numerical value that represents the quality and quantity of functional area (comparable to acres of stream and associated riparian corridor) affected by a project. The FC is derived from the FCI which qualitatively measures hydrological, water quality/biogeochemical, and habitat functions.

Function Variables: Stream Function Variables are physical, biological, and geomorphologic parameters selected to enable collection of uniform, consistent data when evaluating different aquatic resources (i.e. ephemeral vs. intermittent vs. perennial; small impoundments vs. large lakes) to provide a qualitative and quantitative value of Stream.

Geomorphology: The science that treats the general configuration of the earth's surface, including the classification, description, nature, origin, and development of landforms and their functional relationships to underlying structures.

Glide: A section of stream that has little or no turbulence.

Gradient: Vertical drop per unit of horizontal distance.

Incised River: A river that erodes its channel by the process of degradation to a lower base level than existed previously or is consistent with the current hydrology.

Instream Cover: The layers of vegetation, like trees, shrubs, and overhanging vegetation, that are in the stream or immediately adjacent to the wetted channel.

Intermittent Stream: Any nonpermanent flowing drainage feature having a definable channel and evidence of scour or deposition, but where evidence of groundwater inflows can be discerned along the stream bank.

Large Woody Debris (LWD): Pieces of wood at least 6 feet long and 1 foot diameter (at the large end) contained, at least partially, within the bankfull channel.

Left Bank/Right Bank: Left Bank and Right Bank designations are always determined while facing downstream.

Littoral Zone: Shallow area along or near a shoreline.

Low Gradient: Streams typically appear slow moving and winding and have poorly defined riffles and pools. Low gradient streams have wider and less rugged valleys, with a tendency for the stream to meander. These are older streams, in geological time.

Nutrients: The elements required to support the bodily structure and metabolism of biological organisms. These elements include nitrogen and phosphorus, which can become pollutants if present in excessive quantities or result in the generation of adverse secondary effects, such as eutrophication in slow moving or standing water.

Perennial Stream: A stream that flows continuously throughout the year.

Pond: A body of water smaller than a lake, often artificially formed.

Pool: A reach of stream that is characterized by deep, low-velicity water and a smooth surface river (normally found in the bends of the stream or river).

Reach: An uninterrupted length of stream channel with similar physical characteristics, including discharge conveyance capacity, cross section geometry, and slope.

Reference Reach (RR): Reference reaches are segments of a Stream Assessment Reach (SAR) that are deemed representative of the entire Stream Assessment Reach so that evaluation of the Reference Reach is used to characterize the conditions for the Stream Assessment Reach. A Reference Reach should be 40 times the average stream width in wadeable streams with a minimum length of 150 m (492 feet) and maximum length of 500 m (1640.5 feet).

Reference Impoundment: An impoundment in the project area that is considered representative of other impoundments of like size and type within the project area.

Riffle: Riffles are the topographic highs between an upstream pool and a downstream pool generally characterized by "rapids" in a stream or river where shallow water flows swiftly over a rough or rocky surface.

Riparian Area: An area of land and vegetation adjacent to a stream that has a direct effect on the stream. This includes woodlands, other vegetation, and floodplains.

Riparian Buffer: The width of naturally vegetated land adjacent to the stream between the top of the bank (or top of slope, depending on site characteristics) and the edge of other land uses. A buffer is largely undisturbed and consists of the trees, shrubs, groundcover plants, duff layer, and naturally uneven ground surface, which serve to protect the water body from the impacts of adjacent land uses.

Riparian Corridor: Includes lands defined by the lateral extent of a stream's meanders necessary to maintain a stable stream dimension, pattern, profile, and sediment regime. In addition, the riparian corridor typically corresponds to the land area surrounding and including the stream that supports (or could support if unimpacted) a distinct ecosystem, generally with abundant and diverse plant and animal communities (as compared with upland communities).

Riparian: Located on the banks of a stream or other body of water.

Roughness: Features that create resistance to the downstream movement of water in a channel. The features may include sediment particles, sediment deposits, bank irregularities, the type, amount, and distribution of living and dead vegetation, and other obstructions to flow. The term is modified to "relative roughness" when the scale of the roughness elements to the water depth is considered. Streambed roughness is commonly expresses as a Manning's "n" value.

Run (in stream or river): A reach of stream characterized by fast-flowing, low-turbulence water.

Runoff: Water that flows over the ground and reaches a stream as a result of rainfall (or other precipitation).

Sediment: Solid, fragmented material that is transported and deposited by wind, water, or ice, chemically precipitated from solution, or secreted by an organism, that forms in layers or a loose unconsolidated form.

Sinuosity: The amount of curvature in a channel defined as the ratio of the active channel length to the valley length.

Stream Assessment Reach (SAR) : Stream Assessment Reaches are stream systems of like characteristics within a project area. While many stream projects may be evaluated with one

Stream Assessment Reach being assessed, some projects may need to be split into several Stream Assessment Reaches depending on the differing stream characteristics within the project area.

Stream Gradient: The ratio of drop in a stream per unit distance, usually expressed as feet per mile or meters per kilometer.

Thalweg: The general meander line of deepest water in a stream when viewed from above. The thalweg is normally associated with the zone of greatest velocity and flow.

Top of Lowest Bank (TOLB): Bank height as measured from the bottom of the channel in the thalweg portion of a riffle (that portion of the channel between an upstream pool and the next downstream pool) to the top of the lowest bank. Top of Lowest Bank measurements in the stream channel are made at the same location in the thalweg as the Maximum Bankfull Depth. However, the location on the banks being measured may vary short distances up or down stream of the thalweg measurement location. The TOLB and the MBD are used to determine the bank height ratio; the BHR is a measure of channel incision as described above.

Watershed: The land area that drains water, sediment, and dissolved materials to a common outlet. The term is synonymous with drainage basin and catchment.

Wetland: Term used to describe areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions, including swamps, marshes, bogs, and other similar areas.

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APPENDIX A

FIELD FORMS FOR ASSESSMENT OF STREAMS AND RIVERS

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

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

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

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		
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 (East)	10	9	8	7	6	5	4	3	2	1	0		Forest in upper reaches; pasture/hay
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score		
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 (East)	10	9	8	7	6	5	4	3	2	1	0		
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score		
	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 (East)	10	9	8	7	6	5	4	3	2	1	0		
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score		
		Calculation of Function Capacity Index = Total Score/Total Possible Score											0	
												FCI = #/80		
	II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS													

III. HABITAT FUNCTIONS

ITEM	VARIABLES		10	9	8	7	6	5	4	3	2	1	0	SCORE	Reference Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				Kansas Subjective
		Grade	10	9	8	7	6	5	4	3	2	1	0		
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				Norfolk SAAM Form 1 (page 2); EPA RBA; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal		Poor				
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.				RBA #2b page 5-14; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		
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				RBA #3b page 5-16; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				RBA #4 page 5-17; AUSRIVAS; USACE Norfolk No. 5; Pfankuch
		Grade	10	9	8	7	6	5	4	3	2	1	0		
6	6	CHANNEL FLOW STATUS													
			Optimal			Suboptimal			Marginal		Poor				
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry				TCEQ HAP Wrksheet; RBA #5 page 5-19; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				Norfolk District SAAM Form 1 (Field) page 2; RBA #6; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	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 length 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance				RBA #7b; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	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.				RBA #8; AUSRIVAS; Norfolk District SAAM #3; Scholz and Booth from Henshaw, 1999)
		Grade	10	9	8	7	6	5	4	3	2	1	0		
		Grade	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score			
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.				RBA #9; AUSRIVAS; KDWP; RCE
		Grade	10	9	8	7	6	5	4	3	2	1	0		
		Grade	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score			
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.				RBA #10; AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0		
		Grade	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score			
12	12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)													Norfolk SAAM Form 1 Field
			Optimal			Suboptimal			Marginal		Poor				
			Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
		Grade	10	9	8	7	6	5	4	3	2	1	0		
		1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors 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		
		Right Bank	%Riparian Area												
			Score												
		Left Bank	%Riparian Area												
			Score												
											CI=(Sum%RA*Scores*0.001)/2				
											Rt Bank CI>			**CI**	
											LT Bank CI>				
							Calculation of Function Capacity Index = Total Score/Total Possible Score								
													FCI = #/120		

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
Date:					
Project:					
Assessment Area:					
Assessors:					
Project Status:	____Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic					0
Water Quality Improvement					0
Habitat					0
Total					0

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

**Multiplication Factors

Ephemeral = 0.00125

Intermittent = 0.0025

Perennial = 0.0038

APPENDIX B

FIELD FORMS FOR ASSESSMENT
OF
ON-CHANNEL IMPOUNDMENTS

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

Impoundment Habitat Evaluation SCORE

A. PHYSICAL HABITAT KEY

1.Shoreline Development	CONDITION CATEGORY GRADE or SCORE											SCORE
	(perimeter of impoundment/perimeter of circle of equal area)											
	High > or = 2.5					Medium 1.5 - 2.4			Low 1.0-1.4			
Grade	10	9	8	7	6	5	4	3	2	1	0	

2.Average Depth	CONDITION CATEGORY GRADE or SCORE											SCORE
	> 10 feet					3 - 10 feet			< 3 feet			
Grade	10	9	8	7	6	5	4	3	2	1	0	

3.Annual Storage Ratio	CONDITION CATEGORY GRADE or SCORE						SCORE
	1 - 2	> 2		< 1			
Grade	5	4	3	2	1	0	

4.Substrate	CONDITION CATEGORY GRADE or SCORE						SCORE
	(select two predominant types in littoral zone and average the score)						
	Boulder/Cobble	Gravel	Sand (< 0.1")	Bedrock	Mud/Detritus/Muck		
Grade	5	4	3	2	1	0	

5.Number of substrate types in	CONDITION CATEGORY GRADE or SCORE						SCORE
	4 or more	3 types present		2 types present	1 type present		
Grade	5	4	3	2	1	0	

6.Amount of Cover	CONDITION CATEGORY GRADE or SCORE											SCORE
	(aquatic vegetation, flooded timber, woody debris, large boulders, rock outcrops, overhanging vegetation, man-made structures)											
	Extensive (>75%)		Abundant (50-75%)		Moderate (25-50%)		Sparse (5-25%)		Little or none (0-5%)			
Grade	10	9	8	7	6	5	4	3	2	1	0	

7.Native vegetation buffer	CONDITION CATEGORY GRADE or SCORE						SCORE
	> 50 meters	10 - 50 meters	5 - 10 meters	1 - 5 meters		None	
Grade	5	4	3	2	1	0	

8.Bank erosion	CONDITION CATEGORY GRADE or SCORE						SCORE
	Stable banks w/little sloughing		Moderate erosion due to livestock		Severe active erosion along		
Grade	5	4	3	2	1	0	

Total for the physical habitat components (max 55)

B. WATERSHED LAND USE AND MANAGEMENT KEY

1.Management Strategies	CONDITION CATEGORY GRADE or SCORE						SCORE
	Fish fences	Livestock exclusion	Drawdowns	Downstream flow augmentation	Fish feeders	Other (I.e. harvest restrictions, nuisance species control, etc)	
Grade	+1	+1	+1	+1	+1		
Total							

2. Watershed Land Uses (Describe the extent of land use in the upstream watershed)

2a.Minimal impact land uses	CONDITION CATEGORY GRADE or SCORE						SCORE
	practices.						
	Entire	Abundant	Common	Moderate	Sparse	None	
Grade	+5	+4	+3	+2	+1	0	

2b.Significant impact land uses	CONDITION CATEGORY GRADE or SCORE						SCORE
	Poor grazing practices, cropland w/ fair to poor conservation practices, urban, industrial, commercial, residential.						
	Entire	Abundant	Common	Moderate	Sparse	None	
Grade	-5	-4	-3	-2	-1	0	

Total for the watershed/management (max 10)												
C. BIOLOGICAL COMPONENT KEY												
1.Fish characteristics	CONDITION CATEGORY GRADE or SCORE											
	(If problem or exotic fish dominant Score is -5)											
	High quality sport		Pan & predaceous		Minnows/panfish/roughfish				Minnows/roughfish		No fish	
Grade	10	9	8	7	6	5	4	3	2	1	0	
2.Aquatic insects	CONDITION CATEGORY GRADE or SCORE											
	> 3 orders present				1 -3 orders present						None	
Grade	5		4		3		2		1		0	
3.Mollusc/ Crayfish	CONDITION CATEGORY GRADE or SCORE											
	Common/Abundant				Sparse		None		Zebra mussels present			
Grade	3		2		1		0		-5			
4.Other aquatic/semi-aquatic vertebrates	CONDITION CATEGORY GRADE or SCORE											
	Common/Abundant				Sparse		None		Nutria present			
Grade	3		2		1		0		-5			
Total for the biological components (max 20)												
D. WATER QUALITY COMPONENT KEY												
1.DO/BOD	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade	3			2			1			0		
2.Nutrient enrichment	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade	3			2			1			0		
3.Pesticides	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade	3			2			1			0		
4.Turbidity	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade	3			2			1			0		
5.Temperature	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade	3			2			1			0		
6.Other (if applicable)	CONDITION CATEGORY GRADE or SCORE											
	Rarely Limiting			Occasionally Limiting						Frequently Limiting		
Grade												
Total for the water quality components (max 15)												

TOTAL SCORE "RCI" = (PHYSICAL + WATERSHED/MANAGEMENT + BIOLOGICAL + WATER QUALITY)/100

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

Watershed Area = ______________________ Shoreline Perimeter: =______________________

Impoundment Area = ______________________ SDI (shoreline dev. Ratio) = ______________________
(permanent pool)

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

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

Other Aquatic/Semi-Aquatic Vertebrates:

Mussels:

T/E Species Known/Likely to Occur:

Impoundments/Reservoir Resource Capacity Calculation					
Date:					
Project:					
Location:					
Circle One: Small Pond (≤1 acre) Pond (>1≤ 5 acres) Lake (>5 < 500 acres) Reservoir (>500 acres)					
Represented Acreage:		Total acreage of all impoundments represented by site			
Assessors:					
Project Status:	____Preproject		____Postproject		
Major Function Categories	Score	RCI	Acreage	Multiplication Factor*	RC
Physical Habitat					
Watershed/Management					
Biological					
Water Quality					
Total Score		0			0

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

APPENDIX C-2

SWAMPIM DATA TABLES AND DATASHEETS

Note: For consistency, the following data tables and datasheets have been updated to reflect the stream and pond nomenclature presented in the SJD report dated June 21, 2017 which was approved by the USACE on July 27, 2017. The data were collected by APAI in 2006 and 2009, and data for representative locations were reviewed on September 16, 2009 by representatives from the agencies including: Ms. Mary Verwers, USACE; Mr. Sid Puder, USFWS; Ms. Donna Mullins, USEPA; Mr. Raul Gutierrez, USEPA; Ms. Beth Bendik, TPWD; Ms. Karen Hardin, TPWD; and Mr. John Trevino, TCEQ.

Based on the input received from the review team, upgrades and downgrades to various metrics were incorporated into the SWAMPIM datasheets. A summary of the input from the review team and data changes made in response to this input was submitted to the USACE in a technical memorandum dated November 10, 2009 which also included the revised SWAMPIM datasheets.

TABLE C-1

Streams Within Conservation Pool, Embankment, Spillway of LRH - Pre-Project FCI

North Ephemeral 0.5 to 2.0' Pre-Project FCI

		Stream Channels					
		N8 Trib 9	N6 Trib1 A3	N15 Trib 1	N11	N1 Trib 2	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	2	0	2	0	0	0.8
Hydrology Function	2a. Channel Condition/ Alteration	1	0	8	8	2	3.8
Hydrology Function	2b. Channel Capacity to Flow Frequency	0	0	8	0	0	1.6
Hydrology Function	2c. Channel Bank Stability	0	1	9	0	0	2.0
Hydrology Function	3a. Channel Sinuosity	2	2	3	5	4	3.2
Hydrology Function	3b. Bottom Substrate Composition	3	0	2	2	0	1.4
Hydrology Function	3c. In stream Bottom Topography **OR** Manning's Number	1	1	4	3	1	2.0
Hydrology Function	3d. Channel Incision	1	1	8	2	0	2.4
Hydrology Function	4a. Pools	0	0	0	0	0	0.0
Hydrology Function	4b. Channel Flow Status	0	0	0	0	0	0.0
Hydrology Function	**TOTAL**	10	5	44	20	7	17
Hydrology Function	**TOTAL/100**	**0.10**	**0.05**	**0.44**	**0.20**	**0.07**	**0.17**
Water Quality Function	1a. Bank Stability	0	1	9	0	0	2.0
Water Quality Function	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	1	0	2	0	1	0.8
Water Quality Function	2. Water Clarity	0	0	0	0	0	0.0
Water Quality Function	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0	0	0	0	0	0.0
Water Quality Function	4. Composition of Organic Matter	5	0	8	5	0	3.6
Water Quality Function	5. Land Use Pattern Beyond Immediate Riparian Zone	5	3	4	5	3	4.0
Water Quality Function	6a. Riparian Zone Width (from stream edge to field)	7	1	9	8	8	6.6
Water Quality Function	6b. Riparian Zone Vegetation Protection/ Completeness	6	2	8	5	4	5.0
Water Quality Function	**TOTAL**	24	7	40	23	16	22
Water Quality Function	**TOTAL/80**	**0.30**	**0.09**	**0.50**	**0.29**	**0.20**	**0.28**
Habitat Function	1. Flow Regime	2	0	2	0	0	0.8
Habitat Function	2. Epifaunal Sustrate and Available Cover	0	0	0	0	2	0.4
Habitat Function	3. Stream Bottom Substrate	2	0	2	2	0	1.2
Habitat Function	4. Pool Variability	0	0	0	0	0	0.0
Habitat Function	5. Sediment Deposition and Scouring	2	0	7	2	0	2.2
Habitat Function	6. Channel Flow Status	0	0	0	0	0	0.0
Habitat Function	7. Channel Alteration	1	1	9	5	5	4.2
Habitat Function	8. Channel Sinuosity	2	0	3	5	3	2.6
Habitat Function	9. Bank Stability	0	1	9	0	0	2.0
Habitat Function	10. Vegetative Protection	6	2	8	5	4	5.0
Habitat Function	11. Riparian Zone	7	1	9	8	8	6.6
Habitat Function	12. Riparian Habitat Condition	5	2	9	7	5	5.6
Habitat Function	**TOTAL**	27	7	58	34	27	31
Habitat Function	**TOTAL/120**	**0.23**	**0.06**	**0.48**	**0.28**	**0.23**	**0.26**
							Final FCI Score
GRAND TOTAL-FCI		**0.63**	**0.20**	**1.42**	**0.77**	**0.50**	**0.70**
Detailed SWAMPIM datasheets on pgs		**10-19**	**20-29**	**30-39**	**40-49**	**50-59**	

North Ephemeral 2.5 to 5.0' Pre-Project FCI

		Stream Channels		
		N10	N5	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	2	0	1.0
Hydrology Function	2a. Channel Condition/ Alteration	2	8	5.0
Hydrology Function	2b. Channel Capacity to Flow Frequency	7	0	3.5
Hydrology Function	2c. Channel Bank Stability	7	5	6.0
Hydrology Function	3a. Channel Sinuosity	3	7	5.0
Hydrology Function	3b. Bottom Substrate Composition	2	2	2.0
Hydrology Function	3c. In stream Bottom Topography **OR** Manning's Number	2	2	2.0
Hydrology Function	3d. Channel Incision	4	1	2.5
Hydrology Function	4a. Pools	1	0	0.5
Hydrology Function	4b. Channel Flow Status	1	0	0.5
Hydrology Function	**TOTAL**	31	25	28
Hydrology Function	**TOTAL/100**	**0.31**	**0.25**	**0.28**
Water Quality Function	1a. Bank Stability	7	5	6.0
Water Quality Function	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	7	2	4.5
Water Quality Function	2. Water Clarity	1	0	0.5
Water Quality Function	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0	0	0.0
Water Quality Function	4. Composition of Organic Matter	0	2	1.0
Water Quality Function	5. Land Use Pattern Beyond Immediate Riparian Zone	7	4	5.5
Water Quality Function	6a. Riparian Zone Width (from stream edge to field)	7	2	4.5
Water Quality Function	6b. Riparian Zone Vegetation Protection/ Completeness	7	2	4.5
Water Quality Function	**TOTAL**	36	17	27
Water Quality Function	**TOTAL/80**	**0.45**	**0.21**	**0.33**
Habitat Function	1. Flow Regime	2	0	1.0
Habitat Function	2. Epifaunal Sustrate and Available Cover	4	2	3.0
Habitat Function	3. Stream Bottom Substrate	2	1	1.5
Habitat Function	4. Pool Variability	1	0	0.5
Habitat Function	5. Sediment Deposition and Scouring	2	2	2.0
Habitat Function	6. Channel Flow Status	2	0	1.0
Habitat Function	7. Channel Alteration	5	8	6.5
Habitat Function	8. Channel Sinuosity	3	7	5.0
Habitat Function	9. Bank Stability	7	5	6.0
Habitat Function	10. Vegetative Protection	7	2	4.5
Habitat Function	11. Riparian Zone	7	2	4.5
Habitat Function	12. Riparian Habitat Condition	7	4	5.5
Habitat Function	**TOTAL**	49	33	41
Habitat Function	**TOTAL/120**	**0.41**	**0.28**	**0.34**
				Final FCI Score
GRAND TOTAL		**1.17**	**0.74**	**0.95**
		60-69	**70-79**	

Notes for Summary Tables and SWAMPIM datasheets:

(1) Stream identification corresponds to nomenclature used in Table A-1 of the SJD Report; (Ref: SJD Report included in Mitigation Plan, Appendix B)

(2) Stream nomenclature abbreviations: "N" indicates northern tributary, "S" indicates southern tributary, "Trib" indicates tributary, NSR indicates North Sulphur River.

(3) Calculation of Totals for each Function Category equals total # divided by maximum possible total #; for Hydrology (#/100), for Water Quality (#/80), for Habitat (#/120); GRAND TOTAL equals the sum of Hydrology Total, Water Quality Total, and Habitat Total; Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted under GRAND TOTAL-FCI.

TABLE C-1
Streams Within Conservation Pool, Embankment, Spillway of LRH - Pre-Project FCI

North Ephemeral 6 to 15' Pre-Project FCI

		Stream Channels			
		N6-TRIB1	N22 Trib 2	N20	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	1	2	2	1.7
	2a. Channel Condition/ Alteration	1	1	0	0.7
	2b. Channel Capacity to Flow Frequency	0	0	0	0.0
	2c. Channel Bank Stability	2	0	2	1.2
	3a. Channel Sinuosity	2	3	3	2.7
	3b. Bottom Substrate Composition	0	0	1	0.3
	3c. In stream Bottom Topography **OR** Manning's Number	2	0	2	1.3
	3d. Channel Incision	2	0	3	1.7
	4a. Pools	0	0	0	0.0
	4b. Channel Flow Status	0	0	0	0.0
	TOTAL	10	6	13	10
	TOTAL/100	**0.10**	**0.06**	**0.13**	**0.10**
Water Quality Function	1a. Bank Stability	2	0	2	1.2
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	0	0	1	0.3
	2. Water Clarity	0	0	0	0.0
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0	0	0	0.0
	4. Composition of Organic Matter	0	0	8	2.7
	5. Land Use Pattern Beyond Immediate Riparian Zone	3	3	3	3.0
	6a. Riparian Zone Width (from stream edge to field)	4	3	8	5.0
	6b. Riparian Zone Vegetation Protection/ Completeness	4	1	5	3.3
	TOTAL	13	7	27	16
	TOTAL/80	**0.16**	**0.09**	**0.33**	**0.19**
Habitat Function	1. Flow Regime	1	2	2	1.7
	2. Epifaunal Sustrate and Available Cover	0	0	0	0.0
	3. Stream Bottom Substrate	0	0	0	0.0
	4. Pool Variability	0	0	1	0.3
	5. Sediment Deposition and Scouring	0	0	0	0.0
	6. Channel Flow Status	0	0	0	0.0
	7. Channel Alteration	1	1	0	0.7
	8. Channel Sinuosity	2	3	3	2.7
	9. Bank Stability	2	0	1.5	1.2
	10. Vegetative Protection	4	1	5	3.3
	11. Riparian Zone	4	3	8	5.0
	12. Riparian Habitat Condition	4	2	6.5	4.2
	TOTAL	18	12	27	19
	TOTAL/120	**0.15**	**0.10**	**0.23**	**0.16**
					Final FCI Score
GRAND TOTAL		**0.41**	**0.25**	**0.68**	**0.45**
Detailed SWAMPIM datasheets on pgs		**80-89**	**90-99**	**100-109**	

North Ephemeral >16' Pre-Project FCI

		Stream Channels			
		N12	N1	N18	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	2	1	1	1.3
	2a. Channel Condition/ Alteration	0	0	1	0.3
	2b. Channel Capacity to Flow Frequency	0	0	0	0.0
	2c. Channel Bank Stability	4	2	2	2.7
	3a. Channel Sinuosity	1	1	4	2.0
	3b. Bottom Substrate Composition	0	2	1	1.0
	3c. In stream Bottom Topography **OR** Manning's Number	3	5	1	3.0
	3d. Channel Incision	2	0	0	0.7
	4a. Pools	1	1	1	1.0
	4b. Channel Flow Status	1	0	1	0.7
	TOTAL	14	12	12	13
	TOTAL/100	**0.14**	**0.12**	**0.12**	**0.1**
Water Quality Function	1a. Bank Stability	4	2	2	2.7
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	0	2	1	1.0
	2. Water Clarity	2	1	1	1.3
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0	1	1	0.7
	4. Composition of Organic Matter	0	1	1	0.7
	5. Land Use Pattern Beyond Immediate Riparian Zone	3	4	4	3.7
	6a. Riparian Zone Width (from stream edge to field)	5	7	3	5.0
	6b. Riparian Zone Vegetation Protection/ Completeness	5	1	2	2.7
	TOTAL	19	19	15	18
	TOTAL/80	**0.24**	**0.24**	**0.19**	**0.22**
Habitat Function	1. Flow Regime	2	1	1	1.3
	2. Epifaunal Sustrate and Available Cover	1	1	1	1.0
	3. Stream Bottom Substrate	1	1	1	1.0
	4. Pool Variability	1	1	1	1.0
	5. Sediment Deposition and Scouring	1	1	1	1.0
	6. Channel Flow Status	0	1	1	0.7
	7. Channel Alteration	0	0	2	0.7
	8. Channel Sinuosity	1	1	4	2.0
	9. Bank Stability	4	2	2	2.7
	10. Vegetative Protection	5.5	1	3	3.2
	11. Riparian Zone	5	7	3	5.0
	12. Riparian Habitat Condition	7	4.8	3	4.9
	TOTAL	28.5	21.8	23.0	24
	TOTAL/120	**0.24**	**0.18**	**0.19**	**0.20**
					Final FCI Score
GRAND TOTAL		**0.62**	**0.54**	**0.50**	**0.55**
		110-119	**120-129**	**130-139**	

Notes for Summary Tables and SWAMPIM datasheets:

(1) Stream identification corresponds to nomenclature used in Table A-1 of the SJD Report; (Ref: SJD Report included in Mitigation Plan, Appendix B)

(2) Stream nomenclature abbreviations: "N" indicates northern tributary, "S" indicates southern tributary, "Trib" indicates tributary, NSR indicates North Sulphur River.

(3) Calculation of Totals for each Function Category equals total # divided by maximum possible total #; for Hydrology (#/100), for Water Quality (#/80), for Habitat (#/120); GRAND TOTAL equals the sum of Hydrology Total, Water Quality Total, and Habitat Total; Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted under GRAND TOTAL-FCI.

TABLE C-1
Streams Within Conservation Pool, Embankment, Spillway of LRH - Pre-Project FCI

South Ephemeral 0.5 to 2.0' Pre-Project FCI

		Stream Channels		
		S8 Trib 2	S10 Trib 2	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	2	0	1.0
	2a. Channel Condition/ Alteration	0	8	4.0
	2b. Channel Capacity to Flow Frequency	0	5	2.5
	2c. Channel Bank Stability	0	5	2.5
	3a. Channel Sinuosity	2	4	3.0
	3b. Bottom Substrate Composition	0	1	0.5
	3c. In stream Bottom Topography **OR** Manning's Number	0	4	2.0
	3d. Channel Incision	0	3	1.5
	4a. Pools	0	0	0.0
	4b. Channel Flow Status	0	0	0.0
	TOTAL	4	30	17
	TOTAL/100	**0.04**	**0.30**	**0.17**
Water Quality Function	1a. Bank Stability	0	5	2.5
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	0	1	0.5
	2. Water Clarity	0	0	0.0
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0	0	0.0
	4. Composition of Organic Matter	0	8	4.0
	5. Land Use Pattern Beyond Immediate Riparian Zone	4	5	4.5
	6a. Riparian Zone Width (from stream edge to field)	3	6	4.5
	6b. Riparian Zone Vegetation Protection/ Completeness	0	6	3.0
	TOTAL	7	31	19
	TOTAL/80	**0.09**	**0.39**	**0.24**
Habitat Function	1. Flow Regime	2	0	1.0
	2. Epifaunal Sustrate and Available Cover	0	0	0.0
	3. Stream Bottom Substrate	0	1	0.5
	4. Pool Variability	0	0	0.0
	5. Sediment Deposition and Scouring	0	2	1.0
	6. Channel Flow Status	0	0	0.0
	7. Channel Alteration	0	8	4.0
	8. Channel Sinuosity	2	4	3.0
	9. Bank Stability	0	5	2.5
	10. Vegetative Protection	0	6	3.0
	11. Riparian Zone	3	6	4.5
	12. Riparian Habitat Condition	4	7	5.5
	TOTAL	11	39	25
	TOTAL/120	**0.09**	**0.33**	**0.21**
				Final FCI Score
GRAND TOTAL		**0.22**	**1.01**	**0.62**
Detailed SWAMPIM datasheets on pgs		**140-149**	**150-159**	

South Ephemeral 2.5 to 5.0' Pre-Project FCI

		Stream Channels		
		S12	S16-TRIB4	AVERAGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	1	1	1.0
	2a. Channel Condition/ Alteration	1	1	1.0
	2b. Channel Capacity to Flow Frequency	0	0	0.0
	2c. Channel Bank Stability	6.5	2	4.3
	3a. Channel Sinuosity	4	3	3.5
	3b. Bottom Substrate Composition	1	0	0.5
	3c. In stream Bottom Topography **OR** Manning's Number	2	1	1.5
	3d. Channel Incision	2	0	1.0
	4a. Pools	1	1	1.0
	4b. Channel Flow Status	0	1	0.5
	TOTAL	19	10	14
	TOTAL/100	**0.19**	**0.10**	**0.14**
Water Quality Function	1a. Bank Stability	6.5	2.0	4.3
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	1	2	1.5
	2. Water Clarity	1	1	1.0
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	1	1	1.0
	4. Composition of Organic Matter	7	1	4.0
	5. Land Use Pattern Beyond Immediate Riparian Zone	3	8	5.5
	6a. Riparian Zone Width (from stream edge to field)	8	8	8.0
	6b. Riparian Zone Vegetation Protection/ Completeness	6	2	4.0
	TOTAL	34	25	29
	TOTAL/80	**0.42**	**0.31**	**0.37**
Habitat Function	1. Flow Regime	1	1	1.0
	2. Epifaunal Sustrate and Available Cover	1	1	1.0
	3. Stream Bottom Substrate	1	1	1.0
	4. Pool Variability	1	1	1.0
	5. Sediment Deposition and Scouring	1	2	1.5
	6. Channel Flow Status	0	1	0.5
	7. Channel Alteration	2	1	1.5
	8. Channel Sinuosity	2	3	2.5
	9. Bank Stability	6.5	2.0	4.3
	10. Vegetative Protection	6	2	4.0
	11. Riparian Zone	8	8	8.0
	12. Riparian Habitat Condition	6	8	7.0
	TOTAL	36	31	33
	TOTAL/120	**0.30**	**0.26**	**0.28**
				Final FCI Score
GRAND TOTAL		**0.90**	**0.67**	**0.79**
		160-169	**170-179**	

Notes for Summary Tables and SWAMPIM datasheets:

(1) Stream identification corresponds to nomenclature used in Table A-1 of the SJD Report; (Ref: SJD Report included in Mitigation Plan, Appendix B)

(2) Stream nomenclature abbreviations: "N" indicates northern tributary, "S" indicates southern tributary, "Trib" indicates tributary, NSR indicates North Sulphur River.

(3) Calculation of Totals for each Function Category equals total # divided by maximum possible total #; for Hydrology (#/100), for Water Quality (#/80), for Habitat (#/120); GRAND TOTAL equals the sum of Hydrology Total, Water Quality Total, and Habitat Total; Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted under GRAND TOTAL-FCI.

TABLE C-1

Streams Within Conservation Pool, Embankment, Spillway of LRH - Pre-Project FCI

South Ephemeral 6 to 15.0' Pre-Project FCI

		Stream Channel
		S25
Hydrology Function	1. Flow Regime and Groundwater Interactions	1
	2a. Channel Condition/ Alteration	0
	2b. Channel Capacity to Flow Frequency	0
	2c. Channel Bank Stability	4
	3a. Channel Sinuosity	8
	3b. Bottom Substrate Composition	2
	3c. In stream Bottom Topography **OR** Manning's Number	1
	3d. Channel Incision	1
	4a. Pools	1
	4b. Channel Flow Status	0
	TOTAL	18
	TOTAL/100	**0.18**
Water Quality Function	1a. Bank Stability	4
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	2
	2. Water Clarity	0
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0
	4. Composition of Organic Matter	1
	5. Land Use Pattern Beyond Immediate Riparian Zone	3
	6a. Riparian Zone Width (from stream edge to field)	5
	6b. Riparian Zone Vegetation Protection/ Completeness	3
	TOTAL	18
	TOTAL/80	**0.23**
Habitat Function	1. Flow Regime	1
	2. Epifaunal Sustrate and Available Cover	0
	3. Stream Bottom Substrate	2
	4. Pool Variability	1
	5. Sediment Deposition and Scouring	0
	6. Channel Flow Status	0
	7. Channel Alteration	2
	8. Channel Sinuosity	8
	9. Bank Stability	4
	10. Vegetative Protection	3
	11. Riparian Zone	5
	12. Riparian Habitat Condition	3
	TOTAL	29
	TOTAL/120	**0.24**
		Final FCI Score
GRAND TOTAL		**0.65**
Detailed SWAMPIM datasheets on pgs		**180-189**

South Ephemeral >16' Pre-Project FCI

		Stream Channel
		S21
Hydrology Function	1. Flow Regime and Groundwater Interactions	0
	2a. Channel Condition/ Alteration	1
	2b. Channel Capacity to Flow Frequency	0
	2c. Channel Bank Stability	3
	3a. Channel Sinuosity	3
	3b. Bottom Substrate Composition	1
	3c. In stream Bottom Topography **OR** Manning's Number	1
	3d. Channel Incision	2
	4a. Pools	0
	4b. Channel Flow Status	0
	TOTAL	11
	TOTAL/100	**0.11**
Water Quality Function	1a. Bank Stability	3
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	1
	2. Water Clarity	0
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	0
	4. Composition of Organic Matter	2
	5. Land Use Pattern Beyond Immediate Riparian Zone	3
	6a. Riparian Zone Width (from stream edge to field)	4
	6b. Riparian Zone Vegetation Protection/ Completeness	4
	TOTAL	17
	TOTAL/80	**0.21**
Habitat Function	1. Flow Regime	0
	2. Epifaunal Sustrate and Available Cover	0
	3. Stream Bottom Substrate	1
	4. Pool Variability	0
	5. Sediment Deposition and Scouring	1
	6. Channel Flow Status	0
	7. Channel Alteration	2
	8. Channel Sinuosity	3
	9. Bank Stability	4
	10. Vegetative Protection	3
	11. Riparian Zone	4
	12. Riparian Habitat Condition	3
	TOTAL	21
	TOTAL/120	**0.18**
		Final FCI Score
GRAND TOTAL		**0.50**
		190-199

North Sulphur River Intermittent Pre-Project FCI

		Stream Channel
		HWY 34 BRIDGE
Hydrology Function	1. Flow Regime and Groundwater Interactions	4
	2a. Channel Condition/ Alteration	0
	2b. Channel Capacity to Flow Frequency	0
	2c. Channel Bank Stability	0
	3a. Channel Sinuosity	0
	3b. Bottom Substrate Composition	0
	3c. In stream Bottom Topography **OR** Manning's Number	1
	3d. Channel Incision	0
	4a. Pools	1
	4b. Channel Flow Status	1
	TOTAL	7
	TOTAL/100	**0.07**
Water Quality Function	1a. Bank Stability	0
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	1
	2. Water Clarity	2
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	1
	4. Composition of Organic Matter	2
	5. Land Use Pattern Beyond Immediate Riparian Zone	0
	6a. Riparian Zone Width (from stream edge to field)	2
	6b. Riparian Zone Vegetation Protection/ Completeness	1
	TOTAL	9
	TOTAL/80	**0.11**
Habitat Function	1. Flow Regime	4
	2. Epifaunal Sustrate and Available Cover	1
	3. Stream Bottom Substrate	1
	4. Pool Variability	1
	5. Sediment Deposition and Scouring	1
	6. Channel Flow Status	1
	7. Channel Alteration	0
	8. Channel Sinuosity	0
	9. Bank Stability	0
	10. Vegetative Protection	1
	11. Riparian Zone	2
	12. Riparian Habitat Condition	3
	TOTAL	15
	TOTAL/120	**0.13**
		Final FCI Score
GRAND TOTAL		**0.31**
		200-209

North Sulphur River Intermittent Pre-Project FCI

		Stream Channel
		FM 2990
Hydrology Function	1. Flow Regime and Groundwater Interactions	5
	2a. Channel Condition/ Alteration	0
	2b. Channel Capacity to Flow Frequency	0
	2c. Channel Bank Stability	0
	3a. Channel Sinuosity	0
	3b. Bottom Substrate Composition	0
	3c. In stream Bottom Topography **OR** Manning's Number	0
	3d. Channel Incision	0
	4a. Pools	2
	4b. Channel Flow Status	1
	TOTAL	8
	TOTAL/100	**0.08**
Water Quality Function	1a. Bank Stability	0
	1b. Channel Bottom Bank Stability **OR** Channel Sediments or Substrate Composition	0
	2. Water Clarity	6
	3a. Nutrient Enrichment **OR** Presence of Aquatic Vegetation	2
	4. Composition of Organic Matter	0
	5. Land Use Pattern Beyond Immediate Riparian Zone	2
	6a. Riparian Zone Width (from stream edge to field)	2
	6b. Riparian Zone Vegetation Protection/ Completeness	2
	TOTAL	14
	TOTAL/80	**0.18**
Habitat Function	1. Flow Regime	5
	2. Epifaunal Sustrate and Available Cover	1
	3. Stream Bottom Substrate	1
	4. Pool Variability	2
	5. Sediment Deposition and Scouring	1
	6. Channel Flow Status	1
	7. Channel Alteration	0
	8. Channel Sinuosity	0
	9. Bank Stability	0
	10. Vegetative Protection	2
	11. Riparian Zone	2
	12. Riparian Habitat Condition	1
	TOTAL	16
	TOTAL/120	**0.13**
		Final FCI Score
GRAND TOTAL		**0.39**
		210-219

Notes for Summary Tables and SWAMPIM datasheets:

(1) Stream identification corresponds to nomenclature used in Table A-1 of the SJD Report; (Ref: SJD Report included in Mitigation Plan, Appendix B)

(2) Stream nomenclature abbreviations: "N" indicates northern tributary, "S" indicates southern tributary, "Trib" indicates tributary, NSR indicates North Sulphur River.

(3) Calculation of Totals for each Function Category equals total # divided by maximum possible total #; for Hydrology (#/100), for Water Quality (#/80), for Habitat (#/120);
GRAND TOTAL equals the sum of Hydrology Total, Water Quality Total, and Habitat Total; Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1
Detailed SWAMPIM datasheets following summary tables on pages noted under GRAND TOTAL-FCI.

TABLE C-2

Impoundment Resource Capacity Index Calculations for both within and above Conservation Pool

Small Pond (On-channel) $\leq$ 1 acre

Parameter	Key	OCP 5 Score
Physical Habitat	Shoreline Development	2
	Average Depth	2
	Annual Storage Ratio	1
	Substrate	0
	Number of Substrate Types in Littoral Zone	1
	Amount of Cover	1
	Native Vegetation Buffer	0
	Bank Erosion	3
	Total (max 54)	**10**
Watershed Use and Mgmt	Management Strategies	0
	Watershed Land Uses	3
	Total (max 10)	**3**
Biological Component	Fish Characteristics	3
	Aquatic Insects	3
	Molluscs/Crayfish	1
	Other aquatic/semi-aquatic vertebrates	1
	Total (max 21)	**8**
Water Quality Component	Dissolved Oxygen/Biological Oxygen Demand	2
	Nutrient Enrichment	0
	Pesticides	3
	Turbidity	0
	Temperature	2
	Other (If Applicable)	0
	Total (max 15)	**7**
Total Sum (max 100)		**28**

RCI Formula (Physical + Watershed/Management + Biological + Water Quality) / 100

RCI Score **0.28**

Open Water Area (Acres) **8.06 within CP** **3.86 outside CP**

Detailed SWAMPIM datasheets on pages: **221-225**

Notes for Summary Tables and SWAMPIM datasheets:

(1) Pond Nomenclature corresponds to nomenclature used in Table A-2 of the SJD Report; (Ref: SJD Report included in

(2) Pond Nomenclature abbreviations: "OCP" indicates on-channel pond; "UP" indicates upland pond

(3) Resource Capacity Index calculated as total sum of Physical Habitat Score, Water Use and Management Score, Biological Component, and Water Quality Component divided by the maximum possible sum of 100. Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted above.

TABLE C-2

Impoundment Resource Capacity Index Calculations for both within and above Conservation Pool

Pond (On-channel) >1 ≤5 acres

Parameter	Key	OCP 10 Score	UP-67 Score
Physical Habitat	Shoreline Development	2	2
	Average Depth	3	3
	Annual Storage Ratio	2	2
	Substrate	1	1
	Number of Substrate Types in Littoral Zone	1	1
	Amount of Cover	3	0
	Native Vegetation Buffer	3	0
	Bank Erosion	3	0
	Total (max 54)	**18**	**9**
Watershed Use and Mgmt	Management Strategies	0	0
	Watershed Land Uses	-1	-3
	Total (max 10)	**-1**	**-3**
Biological Component	Fish Characteristics	7	3
	Aquatic Insects	4	1
	Molluscs/Crayfish	1	1
	Other aquatic/semi-aquatic vertebrates	1	1
	Total (max 21)	**13**	**6**
Water Quality Component	Dissolved Oxygen/Biological Oxygen Demand	3	0
	Nutrient Enrichment	2	0
	Pesticides	3	3
	Turbidity	3	0
	Temperature	3	1
	Other (If Applicable)	0	0
	Total (max 15)	**14**	**4**
Total Sum (max 100)		**44**	**16**

Total RCI Score (Physical + Watershed/Management + Biological + Water Quality) / 100

RCI Scores **0.44** **0.16**

Average RCI Score **0.3**

Open Water Area (Acres) **16.36 within CP** **9.84 outside CP**

Detailed SWAMPIM datasheets on pages: **226-231** **232-237**

Notes for Summary Tables and SWAMPIM datasheets:

(1) Pond Nomenclature corresponds to nomenclature used in Table A-2 of the SJD Report; (Ref: SJD Report included in

(2) Pond Nomenclature abbreviations: "OCP" indicates on-channel pond; "UP" indicates upland pond

(3) Resource Capacity Index calculated as total sum of Physical Habitat Score, Water Use and Management Score, Biological Component, and Water Quality Component divided by the maximum possible sum of 100. Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted above.

TABLE C-2

Impoundment Resource Capacity Index Calculations for both within and above Conservation Pool

Lake (On-channel) >5 <500 acres

OCP 17

Parameter	Key	Score
Physical Habitat	Shoreline Development	4
	Average Depth	9
	Annual Storage Ratio	4
	Substrate	1
	Number of Substrate Types in Littoral Zone	1
	Amount of Cover	1
	Native Vegetation Buffer	1
	Bank Erosion	2
	Total (max 54)	**23**
Watershed Use and Mgmt	Management Strategies	1
	Watershed Land Uses	-3
	Total (max 10)	**-2**
Biological Component	Fish Characteristics	9
	Aquatic Insects	5
	Molluscs/Crayfish	3
	Other aquatic/semi-aquatic vertebrates	1
	Total (max 21)	**18**
Water Quality Component	Dissolved Oxygen/Biological Oxygen Demand	3
	Nutrient Enrichment	2
	Pesticides	3
	Turbidity	2
	Temperature	2
	Other (If Applicable)	3
	Total (max 15)	**15**
Total Sum (max 100)		**54**

Reservoir

No OCPs > 500 Acres

Total RCI Score (Physical + Watershed/Management + Biological + Water Quality) / 100

RCI Score **0.54**

Open Water Area (Acres) **31.78 within CP** **0 outside CP**

Detailed SWAMPIM datasheets on pages: **238-243** **244**

Notes for Summary Tables and SWAMPIM datasheets:

(1) Pond Nomenclature corresponds to nomenclature used in Table A-2 of the SJD Report; (Ref: SJD Report

(2) Pond Nomenclature abbreviations: "OCP" indicates on-channel pond; "UP" indicates upland pond

(3) Resource Capacity Index calculated as total sum of Physical Habitat Score, Water Use and Management Score, Biological Component, and Water Quality Component divided by the maximum possible sum of 100. Ref: SWAMPIM Documentation provided in Mitigation Plan, Appendix C-1

Detailed SWAMPIM datasheets following summary tables on pages noted above.

STREAM CHANNELS

SWAMPIM DATASHEETS

SWAMPIM DATASHEETS – NORTH EPHEMERAL 0.5 TO 2.0' PRE-PROJECT

- **N8-TRIB9**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N8-TRIB9

1

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

Right bank- Park area, Left bank leads directly to pasture, no trees.Reach crosses under road.
Reach surrounded by pasture and road.
Riparian zone is 0 on left bank and 70 m on right bank.

I. HYDROLOGIC FUNCTIONS

N8-TRIB9

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

Enter Score for Only One Variable

Variable	Optimal			Suboptimal			Marginal		Poor			Score	Reference
	CONDITION CATEGORY GRADE or SCORE												
	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				*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
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												
	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				*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	1	

4 DYNAMIC SURFACE WATER STORAGE

Variable	Optimal			Suboptimal			Marginal		Poor			Score	Reference
	CONDITION CATEGORY GRADE or SCORE												
	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.				*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	0	
	CONDITION CATEGORY GRADE or SCORE												
	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.				*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	0	
Calculation of Function Capacity Index = Total Score/Total Possible Score												0.1	
FCI = #/100													

N8-TRIB9 I. HYDROLOGIC FUNCTIONS

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N8-TRIB9

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

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	5
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	5
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5
												Avg.Score	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/ NRCS
		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	7
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7
												Avg.Score	7
	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	6
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	6
												Avg.Score	6
												Calculation of Function Capacity Index = Total Score/Total Possible Score	0.3
												FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N8-TRIB9

III. HABITAT FUNCTIONS

ITEM VARIABLES

N8-TRIB9

SCORE | Source

1 1 FLOW REGIME

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

2 2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER

	Optimal	Suboptimal	Marginal	Poor	SCORE	Source
Some features present but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

3 3 STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization

	Optimal	Suboptimal	Marginal	Poor	SCORE	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 vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	2	

4 4 POOL VARIABILITY

	Optimal	Suboptimal	Marginal	Poor	SCORE	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* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

5 5 SEDIMENT DEPOSITION/SCOURING

	Optimal	Suboptimal	Marginal	Poor	SCORE	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* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	2	

6 6 CHANNEL FLOW STATUS

	Optimal	Suboptimal	Marginal	Poor	SCORE	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 al., 2001* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	

7 7 CHANNEL ALTERATION

	Optimal	Suboptimal	Marginal	Poor	SCORE	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* AUSRIVAS
Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	

		Optimal			Suboptimal			Marginal		Poor			Score	Reference
8	8 CHANNEL SINUOSITY													
		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)													
		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 undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw,
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
											Avg.Score		0	
10	10 VEGETATIVE PROTECTION (SCORE EACH BANK)													
		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	6	
	Grade	10	9	8	7	6	5	4	3	2	1	0	6	
											Avg.Score		6	
11	11 RIPARIAN ZONE (SCORE EACH BANK)													
		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	7	
	Grade	10	9	8	7	6	5	4	3	2	1	0	7	
											Avg.Score		7	
12	12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)													Norfolk SAAM Form 1 Field
		Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if $\geq$2 additional layers are present. Score at low end if $\leq$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 $\geq$2 additional forest layers are present. Score at low end if $\leq$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 $\geq$2 additional layers are present. Score at low end if $\leq$1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
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		5				
	SubCI	0	5	0			
Left Bank	%Riparian Area		100			100	
	Score		5				
	SubCI	0	5	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	5	**CI**
					LT Bank CI>	5	5

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.23

FCI = #/120

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N8-TRIB9				
Date:	5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 18				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.1	935	E	0.00125	0.12
Water Quality Improvement	0.3	935	E	0.00125	0.35
Habitat	0.23	935	E	0.00125	0.27
Total	0.63	935			0.74

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

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

N8 Trib 9 (0.5-2.0') facing upstream. 5/19/2006

N8 Trib 9 (0.5-2.0') facing downstream. 5/19/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 0.5 TO 2.0’ PRE-PROJECT

- **N6-TRIB1-A3**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N6-TRIB1-A3 (N1-TRIB1-A3)

1

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

Pasture outside of riparian zone. Rip zone 5 to 10 meters or less. Some trees.
WP 17

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS N6-TRIB1-A3 (N1-TRIB1-A3)											SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE											Natural, active, downcutting.	
		Optimal			Suboptimal			Marginal		Poor				*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	1	
												Avg.Score	1	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable

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

I. HYDROLOGIC FUNCTIONS N6-TRIB1-A3 (N1-Trib1-A3) (0.5-2)

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — N6-TRIB1-A3 (N1-TRIB1-A3)

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

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	0
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	3
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3
												Avg.Score	3
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/ NRCS
		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	1
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	1
												Avg.Score	1
	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	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												0.09
												FCI = #/80	
	II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS							N6-TRIB1-A3 (N1-Trib1-A3) (0.5-2)					

ITEM	VARIABLES	III. HABITAT FUNCTIONS	N6-TRIB1-A3 (N1-TRIB1-A3)			SCORE	Reference Source
1	1	FLOW REGIME					
	TYPE	Perennial	Intermittent w/ Perennial Pools	Intermittent	Ephemeral		*KDWP, 2000*
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER					
		Optimal	Suboptimal	Marginal	Poor		
	Exposed roots but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization					
		Optimal	Suboptimal	Marginal	Poor		
		Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
4	4	POOL VARIABILITY					
		Optimal	Suboptimal	Marginal	Poor		
		Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent		*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
5	5	SEDIMENT DEPOSITION/SCOURING					
		Optimal	Suboptimal	Marginal	Poor		
		<5% of channel bottom affected by scour or deposition.	5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools	30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.		*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
6	6	CHANNEL FLOW STATUS					
		Optimal	Suboptimal	Marginal	Poor		
		Water reaches the base of both lower banks; <5% of channel substrate is exposed	Water fills >75% of the channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in the channel and mostly present in standing pools; or stream is dry		*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	0	
7	7	CHANNEL ALTERATION					
		Optimal	Suboptimal	Marginal	Poor		
		Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal	Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.	Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.	Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.		*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	

#		Optimal			Suboptimal			Marginal		Poor			Score	Reference
8	8 CHANNEL SINUOSITY													
		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	

#		Optimal			Suboptimal			Marginal		Poor			Score	Reference
9	9 BANK STABILITY (SCORE EACH BANK)													
		Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
											Avg.Score		1	

#		Optimal			Suboptimal			Marginal		Poor			Score	Reference
10	10 VEGETATIVE PROTECTION (SCORE EACH BANK)													
		More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS ; *KDWP 2000* ; *Petersen, et al., 1992* RCE
	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	

#		Optimal			Suboptimal			Marginal		Poor			Score	Reference
11	11 RIPARIAN ZONE (SCORE EACH BANK)													
		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	1	
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
											Avg.Score		1	

#		Optimal			Suboptimal			Marginal		Poor			Score	Reference
12	12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)													Norfolk SAAM Form 1 Field
		Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		

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	2			
Left Bank	%Riparian Area			100		100	
	Score			2			
	SubCI	0	0	2	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	2	**CI**
					LT Bank CI>	2	2
					Calculation of Function Capacity Index = Total Score/Total Possible Score		0.06
					FCI = #/120		

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N6-TRIB1-A3 (N1-Trib1-A3) (0.5-2)				
Date:	5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 17				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.05	3015	E	0.00125	0.1884375
Water Quality Improvement	0.09	3015	E	0.00125	0.3391875
Habitat	0.06	3015	E	0.00125	0.226125
Total	0.20				0.75375

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

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

N6-TRIB1-A3 (N1 Trib 1 A3)
(0.5-2) facing upstream.
5/19/2006

N6-TRIB1-A3 (N1 Trib 1 A3)
(0.5-2) facing downstream.
5/19/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 0.5 TO 2.0' PRE-PROJECT

- **N15-TRIB1**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N15-TRIB1

1

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

Right bank- 10-15 meters of trees before row crops, Left bank10-15 meters of trees to pasture.
Reach surrounded by pasture and row crops.
WP 10
P 86, 85

I. HYDROLOGIC FUNCTIONS

N15-TRIB1

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

Enter Score for Only One Variable													
3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
	Optimal			Suboptimal			Marginal		Poor				
	Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
Grade	10	9	8	7	6	5	4	3	2	1	0	4	
or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
	Optimal			Suboptimal			Marginal		Poor				
	Incision ratio >1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope <2%; Entrenchment ratio >2.0			Incision ratio >1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope <2%, Entrenchment ratio >2.0			Incision ratio > 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope <2%, Entrenchment ratio >2.0		Incision ratio >2.0 **and** Where channel slope >2%, Entrenchment ratio <1.4; Where channel slope <2%, Entrenchment ratio <2.0				
TLB =	10			BHR =	1								
BFD =	10												
Grade	10	9	8	7	6	5	4	3	2	1	0	8	

4 DYNAMIC SURFACE WATER STORAGE

4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
	Optimal			Suboptimal			Marginal		Poor				
	Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
	Optimal			Suboptimal			Marginal		Poor				
	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	Calculation of Function Capacity Index = Total Score/Total Possible Score											0.44	
	FCI = #/100												

I. HYDROLOGIC FUNCTIONS N15 Trib 1 (.5-2)

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N15-TRIB1

ITEM	VARIABLES					SCORE	Reference Source
	TYPE						
	NOTES						
1.	SEDIMENT TRANSPORT/DEPOSITION						

Enter Score for Only One Variable

1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	9	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	9	
											Avg.Score	9	

1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Galli, 1996* Wash-COG RSAT No. 1
	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
											Avg.Score	0	

or 1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Barbour, et al., 1999 ; Petersen, et al., 1992*
	>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
Grade	10	9	8	7	6	5	4	3	2	1	0	2	

2	WATER APPEARANCE: Clarity or Visibility

Water Clarity	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/ NRCS SVAP page 11
	Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	

3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage

Enter Score for Only One Variable

3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/ NRCS SVAP page 12
	Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

or 3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Petersen, et al., 1992* RCE form No. 13
	When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	8
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	4
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
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/ NRCS
		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	9
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	9
												Avg.Score	9
	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	8
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8
												Avg.Score	8
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.5
												FCI = #/80	
	II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS N15 Trib 1 (.5-2)												

III. HABITAT FUNCTIONS N15 Trib1 (.5-2)

ITEM	VARIABLES		N15-TRIB1											SCORE	Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP,*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	*2000*
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				
		Features present but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal		Poor				
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.				*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	AUSRIVAS
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	7	
6	6	CHANNEL FLOW STATUS													*TCEQ, 1999* HAP Wrksheet;
			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				*Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				*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	9	

8 8 CHANNEL SINUOSITY

	Optimal			Suboptimal			Marginal		Poor			Score	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	3	

9 9 BANK STABILITY (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score	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 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	9	
Grade	10	9	8	7	6	5	4	3	2	1	0	9	
										Avg.Score		9	

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score	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	8	
Grade	10	9	8	7	6	5	4	3	2	1	0	8	
										Avg.Score		8	

11 11 RIPARIAN ZONE (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score	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	9	
Grade	10	9	8	7	6	5	4	3	2	1	0	9	
										Avg.Score		9	

12 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score	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 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	9	

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	9					
	SubCI	9	0	0			
Left Bank	%Riparian Area	100				100	
	Score	9					
	SubCI	9	0	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	9	CI
					LT Bank CI>	9	9
				Calculation of Function Capacity Index = Total Score/Total Possible Score			0.48
						FCI = #/120	

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N15-TRIB1				
Date:	5/18/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 10				
Assessors:	Holmes Voight capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.44	3,696	E	0.00125	2.03
Water Quality Improvement	0.5	3,696	E	0.00125	2.31
Habitat	0.48	3,696	E	0.00125	2.22
Total	1.42	3,696			6.56

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

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

N15 Trib1 (0.5-2) facing upstream. 5/18/2006

N15 Trib1 (0.5-2) facing downstream. 5/18/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 0.5 TO 2.0’ PRE-PROJECT

- **N11**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N11(0.5-2.0')

1

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

Park area, surrounded by pastures. Riparian zone is 100+ m.
WP 4
P 95, 94

I. HYDROLOGIC FUNCTIONS

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS N11(0.5-2.0')											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	0	
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	8	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	5	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	

Enter Score for Only One Variable

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	3	
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	2	
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	0	
4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
	Optimal			Suboptimal			Marginal		Poor				
	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	Calculation of Function Capacity Index = Total Score/Total Possible Score											0.20	
	FCI = #/100												

I. HYDROLOGIC FUNCTIONS N11(0.5-2.0')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N11(0.5-2.0')

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													
		CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		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.				
	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												*Galli, 1996* Wash-COG RSAT No. 1
		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.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score	0	
	or	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999 ; Petersen, et al., 1992*
		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				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	WATER APPEARANCE: Clarity or Visibility													
		CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 11
		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.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
Enter Score for Only One Variable		CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/NRCS SVAP page 12
		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.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	or	CONDITION CATEGORY GRADE or SCORE												*Petersen, et al., 1992* RCE form No. 13
		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.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	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	5

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	5
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5
											Avg.Score	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	8
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8
											Avg.Score	8
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	5
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5
											Avg.Score	5

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.29

FCI = #/80

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N11(0.5-2.0')

III. HABITAT FUNCTIONS

ITEM VARIABLES III. HABITAT FUNCTIONS N20(0.5-2.0') SCORE Source

1 1 FLOW REGIME

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

2 2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER

	Optimal	Suboptimal	Marginal	Poor	SCORE	Source
Habitat features present but no water so 0.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
Grade	10 9 8	7 6 5	4 3	2 1 0	0	

3 3 STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization

	Optimal	Suboptimal	Marginal	Poor	SCORE	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 vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
Grade	10 9 8	7 6 5	4 3	2 1 0	2	

4 4 POOL VARIABILITY

	Optimal	Suboptimal	Marginal	Poor	SCORE	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	0	

5 5 SEDIMENT DEPOSITION/SCOURING

	Optimal	Suboptimal	Marginal	Poor	SCORE	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	2	

6 6 CHANNEL FLOW STATUS

	Optimal	Suboptimal	Marginal	Poor	SCORE	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	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	5	

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	5	

9 9 BANK STABILITY (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric*t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
										Avg.Score		0	

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
										Avg.Score		5	

11 11 RIPARIAN ZONE (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.				*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
Grade	10	9	8	7	6	5	4	3	2	1	0	8	
Grade	10	9	8	7	6	5	4	3	2	1	0	8	
										Avg.Score		8	

12 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥ 2 additional layers are present. Score at low end if ≤ 1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥ 2 additional forest layers are present. Score at low end if ≤ 1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥ 2 additional layers are present. Score at low end if ≤ 1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				Norfolk SAAM Form 1 Field
Grade	10	9	8	7	6	5	4	3	2	1	0		

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.
3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.

Ensure the sums of %Riparian Blocks equal 100

		Optimal	Suboptimal	Marginal	Poor		
Right Bank	%Riparian Area		100			100	
	Score		7				
	SubCI	0	7	0			
Left Bank	%Riparian Area		100			100	
	Score		7				
	SubCI	0	7	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	7	CI
					LT Bank CI>	7	7

Calculation of Function Capacity Index = Total Score/Total Possible Score	0.28
FCI = #/120	

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N11(0.5-2.0')				
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 4				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.20	3,470	E	0.00125	0.87
Water Quality Improvement	0.29	3,470	E	0.00125	1.26
Habitat	0.28	3,470	E	0.00125	1.23
Total	0.77	3,470			3.35

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

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

N11 (0.5-2) facing upstream.
5/17/2006

N11 (0.5-2) facing downstream.
5/17/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 0.5 TO 2.0' PRE-PROJECT

- **N1-TRIB2**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

N1-Trib2 (0.5-2)

1

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

Pasture outside of riparian zone. Rip zone 20 to 30m or less. Few trees.
WP 1
P 98, 97

Young trees, Burr Oak, Elm, Red Cedar, Green Ash, Hackberry

ITEM	VARIABLES												SCORE	Reference Source
		I. HYDROLOGIC FUNCTIONS				N1-Trib2 (0.5-2)								
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	0	
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	4	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				

	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Enter Score for Only One Variable		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	
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
	or 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	0	
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	0	
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
	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	0	
		Calculation of Function Capacity Index = Total Score/Total Possible Score											0.07	
		FCI = #/100												

I. HYDROLOGIC FUNCTIONS N1-Trib2 (0.5-2)

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS								N1-Trib2 (0.5-2)						
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	0	
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		
		CONDITION CATEGORY GRADE or SCORE												
	or	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	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	0
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	3
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3
												Avg.Score	3
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/ NRCS
		Optimal			Suboptimal			Marginal		Poor			
		Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.			
	Grade (left)	10	9	8	7	6	5	4	3	2	1	0	8
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8
												Avg.Score	8
	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	4
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.20
												FCI = #/80	
	II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS							N1-Trib2 (0.5-2)					

ITEM	VARIABLES					III. HABITAT FUNCTIONS		N1-Trib2 (0.5-2)						SCORE	Reference Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
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	0	
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
6	6	CHANNEL FLOW STATUS													
			Optimal			Suboptimal			Marginal		Poor				
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry				*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et*
		Grade	10	9	8	7	6	5	4	3	2	1	0	5	

8

8	CHANNEL SINUOSITY												
		Optimal			Suboptimal			Marginal		Poor			
		The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).			The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.			The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line		Channel straight; waterway has been channelized for a long distance			*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
	Grade	10	9	8	7	6	5	4	3	2	1	0	3

9

9	BANK STABILITY (SCORE EACH BANK)												
		Optimal			Suboptimal			Marginal		Poor			
		Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.			*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk District*, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
	Grade	10	9	8	7	6	5	4	3	2	1	0	0
	Grade	10	9	8	7	6	5	4	3	2	1	0	0
											Avg.Score		0

10

10	VEGETATIVE PROTECTION (SCORE EACH BANK)												
		Optimal			Suboptimal			Marginal		Poor			
		More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.			*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992* RCE
	Grade	10	9	8	7	6	5	4	3	2	1	0	4
	Grade	10	9	8	7	6	5	4	3	2	1	0	4
											Avg.Score		4

11

11	RIPARIAN ZONE (SCORE EACH BANK)												
		Optimal			Suboptimal			Marginal		Poor			
		Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.			*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
	Grade	10	9	8	7	6	5	4	3	2	1	0	8
	Grade	10	9	8	7	6	5	4	3	2	1	0	8
											Avg.Score		8

12

12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)												Norfolk SAAM Form 1 Field
		Optimal			Suboptimal			Marginal		Poor			
		Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
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		5				
	SubCI	0	5	0			
Left Bank	%Riparian Area		100			100	
	Score		5				
	SubCI	0	5	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	5	CI
					LT Bank CI>	5	5
Calculation of Function Capacity Index = Total Score/Total Possible Score							0.23
						FCI = #/120	

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
Date:	N1-Trib2 (0.5-2) 5/17/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 1				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.07	793	E	0.00125	0.07
Water Quality Improvement	0.20	793	E	0.00125	0.20
Habitat	0.23	793	E	0.00125	0.22
Total	0.50	793			0.49

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

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


N1-TRIB2 (0.5-2) facing upstream.
5/17/2006


N1 TRIB2 (0.5-2) facing
downstream. 5/17/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 2.5 TO 5.0' PRE-PROJECT

- **N10**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

N10 (2.5-5)

1

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

Park area, surrounded by pasture and roads. Reach crosses under road. Riparian zone is 15 to 100m depending on proximity to road.

East 2990
P61, 60

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS			N10 (2.5-5)								SCORE	Reference Source
1.	FLOW REGIME:													*KDWP 2000* Kansas Subjective
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	7	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	7	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7	
												Avg.Score	7	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	3	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	

Enter Score for Only One Variable

Variable	Optimal			Suboptimal			Marginal		Poor			Score	Reference
3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*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	2	
or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
	0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
Grade	10	9	8	7	6	5	4	3	2	1	0		
3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
	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	4	

Variable	Optimal			Suboptimal			Marginal		Poor			Score	Reference
4 DYNAMIC SURFACE WATER STORAGE													
4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
	Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	1	
4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
	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												0.31	
FCI = #/100													

I. HYDROLOGIC FUNCTIONS N10 (2.5-5)

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N10 (2.5-5)

ITEM	VARIABLES												SCORE	Reference Source
	TYPE													
	NOTES													
1.	SEDIMENT TRANSPORT/DEPOSITION													

Enter Score for Only One Variable (1b or 1c)

Variable												SCORE	Reference Source
	CONDITION CATEGORY GRADE or SCORE												
1a. Bank Stability (score each bank, left or right facing downstream)	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	7	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7	
											Avg.Score	7	
	CONDITION CATEGORY GRADE or SCORE												
1b. Channel Bottom Bank Stability	Optimal			Suboptimal			Marginal		Poor				*Galli, 1996* Wash-COG RSAT No. 1
	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	7	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7	
											Avg.Score	7	
or	CONDITION CATEGORY GRADE or SCORE												
1c. Channel Sediments or Substrate Composition	Optimal			Suboptimal			Marginal		Poor				*Barbour, et al., 1999 ; Petersen, et al., 1992*
	>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
Grade	10	9	8	7	6	5	4	3	2	1	0		

2 WATER APPEARANCE: Clarity or Visibility

Variable												SCORE	Reference Source
	CONDITION CATEGORY GRADE or SCORE												
Water Clarity	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/ NRCS SVAP page 11
	Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	1	

3 PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage

Enter Score for Only One Variable

Variable												SCORE	Reference Source
	CONDITION CATEGORY GRADE or SCORE												
3a. Nutrient Enrichment	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/ NRCS SVAP page 12
	Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0		
or	CONDITION CATEGORY GRADE or SCORE												
3b. Aquatic Vegetation	Optimal			Suboptimal			Marginal		Poor				*Petersen, et al., 1992* RCE form No. 13
	When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	0
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	7
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7
												Avg.Score	7
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/ NRCS
		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	7
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7
												Avg.Score	7
	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	7
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	7
												Avg.Score	7
												Calculation of Function Capacity Index = Total Score/Total Possible Score	0.45
												FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N10 (2.5-5)

III. HABITAT FUNCTIONS

ITEM		VARIABLES											SCORE	Source
		III. HABITAT FUNCTIONS N10 (2.5-5)												
1	1	FLOW REGIME												
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				KDWP,
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	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	4	
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
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	AUSRIVAS
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				Barbour, et al. 1999 RBA #3b page 5-16; Parsons, et al., 2001
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				Barbour, et al. 1999 RBA #4 page 5-17; Parsons, et al., 2001
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
6	6	CHANNEL FLOW STATUS													
			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,
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
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,
		Grade	10	9	8	7	6	5	4	3	2	1	0	5	

8

8 CHANNEL SINUOSITY	Optimal	Suboptimal	Marginal	Poor		
	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line	Channel straight; waterway has been channelized for a long distance		*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS

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

9

9 BANK STABILITY (SCORE EACH BANK)	Optimal	Suboptimal	Marginal	Poor		
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.	Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods	Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw,

Grade	10	9	8	7	6	5	4	3	2	1	0	7
Grade	10	9	8	7	6	5	4	3	2	1	0	7
										Avg.Score		7

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	7
Grade	10	9	8	7	6	5	4	3	2	1	0	7
										Avg.Score		7

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	7
Grade	10	9	8	7	6	5	4	3	2	1	0	7
										Avg.Score		7

12

12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)	Optimal	Suboptimal	Marginal	Poor		
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.	Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.	Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.	Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.		Norfolk SAAM Form 1 Field

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

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.
3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.

Ensure the sums of %Riparian Blocks equal 100

		Optimal	Suboptimal	Marginal	Poor		
Right Bank	%Riparian Area	100				100	
	Score	8					
	SubCI	8	0	0			
Left Bank	%Riparian Area	100				100	
	Score	8					
	SubCI	8	0	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	7	CI
					LT Bank CI>	7	7

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.41

FCI = #/120

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N10 (2.5-5)				
Date:	5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	East 2990				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.31	5,632	E	0.00125	2.18
Water Quality Improvement	0.45	5,632	E	0.00125	3.17
Habitat	0.41	5,632	E	0.00125	2.87
Total	1.17	5,632			8.23

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

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

N10 Facing downstream.
5/19/2006

N10 Facing upstream.
5/19/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 2.5 TO 5.0' PRE-PROJECT

- **N5**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

N5 (2.5-5)

1

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

Park area, surrounded by pasture. Trees present, riparian zone 10-30m, mostly trees in zone, several bends.

WP3
P97,96

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS						N5 (2.5-5)					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	0	
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	8	
		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	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5	
												Avg.Score	5	
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	7	
		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	2	

Enter Score for Only One Variable	Variable	Optimal			Suboptimal			Marginal		Poor			Score	Reference
	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*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	2	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR = 1									
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.25	
	FCI = #/100													

I. HYDROLOGIC FUNCTIONS N5 (2.5-5)

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N5 (2.5-5)

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	5	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5	
												Avg.Score	5	
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	2	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2	
	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	0	
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		
	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	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	4
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
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/ NRCS
		Optimal			Suboptimal			Marginal		Poor			
		Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.			
	Grade (left)	10	9	8	7	6	5	4	3	2	1	0	2
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2
												Avg.Score	2
	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	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												0.21
												FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N5 (2.5-5)

ITEM	VARIABLES	III. HABITAT FUNCTIONS			N5 (2.5-5)								SCORE	Source
1	1	FLOW REGIME												
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral			*KDWP,*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	*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	2	
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*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	AUSRIVAS
4	4	POOL VARIABILITY												
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
5	5	SEDIMENT DEPOSITION/SCOURING												
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	2	
6	6	CHANNEL FLOW STATUS													*TCEQ, 1999* HAP Wrksheet;
			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				*Barbour, et al. 1999* RBA #5 page 5-19; *Parsons,*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION												
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons,*
		Grade	10	9	8	7	6	5	4	3	2	1	0	8	

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	7

9 9 BANK STABILITY (SCORE EACH BANK)

	Optimal	Suboptimal	Marginal	Poor		
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.	Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods	Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw,

Grade	10	9	8	7	6	5	4	3	2	1	0	5
Grade	10	9	8	7	6	5	4	3	2	1	0	5
										Avg.Score		5

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal	Suboptimal	Marginal	Poor		
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS ; *KDWP 2000* ; *Petersen,*

Grade	10	9	8	7	6	5	4	3	2	1	0	2
Grade	10	9	8	7	6	5	4	3	2	1	0	2
										Avg.Score		2

11 11 RIPARIAN ZONE (SCORE EACH BANK)

	Optimal	Suboptimal	Marginal	Poor		
	Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.		*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS

Grade	10	9	8	7	6	5	4	3	2	1	0	2
Grade	10	9	8	7	6	5	4	3	2	1	0	2
										Avg.Score		2

12 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	Optimal	Suboptimal	Marginal	Poor		
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.	Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.	Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.	Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.		Norfolk SAAM Form 1 Field

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

1. 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			4			
	SubCI	0	0	4			
Left Bank	%Riparian Area			100		100	
	Score			4			
	SubCI	0	0	4	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	4	**CI**
					LT Bank CI>	4	4

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.28

FCI = #/120

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N5 (2.5-5)				
Date:	5/17/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP3				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.25	2,840	E	0.00125	0.89
Water Quality Improvement	0.21	2,840	E	0.00125	0.75
Habitat	0.28	2,840	E	0.00125	0.98
Total	0.74	2,840			2.62

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

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

N5 (2.5-5) facing upstream.
5/17/2006

N5 (2.5-5) facing downstream.
5/17/2006

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

- **N6-TRIB1**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N6-TRIB1

1

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

Surrounded by pasture, 10-20 meters of riparian. Few trees.

WP 13
P72, 71

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS N6-TRIB1											SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.			Active downcut, no human alteration.	
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	2	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length ≤ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable

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

I. HYDROLOGIC FUNCTIONS N6-TRIB1

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS N6-TRIB1

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

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	0
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	3
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3
												Avg.Score	3
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/ NRCS
		Optimal			Suboptimal			Marginal		Poor			
		Width of riparian zone >18 meters (1-2 channel widths with trees, shrubs, or tall grasses), human activities have not impacted zone.			Width of riparian zone 12-18 meters (1/2-1 active channel width w/trees, shrubs, or grasses), human activities have minimally impacted zone.			Width of riparian zone 6-12 meters (1/3-1/2 active channel width vegetated), impacted by human activities.		Width of riparian zone < 6 meters (natural vegation less than 1/3 active channel width), little riparian vegetation due to human activities.			
	Grade (left)	10	9	8	7	6	5	4	3	2	1	0	4
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
	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	4
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.16
												FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS N6-TRIB1

ITEM	VARIABLES	III. HABITAT FUNCTIONS					N6-TRIB1							SCORE	Reference Source
1	1	FLOW REGIME													
		TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP, 2000*
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER													
			Optimal			Suboptimal			Marginal		Poor				
			Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization			Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)			Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)		Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.				*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization													
			Optimal			Suboptimal			Marginal		Poor				
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.			Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.			All mud or clay or sand bottom; little or no root mat; no submerged vegetation.		Hard pan clay or bedrock; no root mat or submerged vegetation.				*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4	4	POOL VARIABILITY													
			Optimal			Suboptimal			Marginal		Poor				
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present			Majority of pools large-deep; very few shallow.			Shallow pools much more prevalent than deep pools		Majority of pools small-shallow or pools absent				*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
5	5	SEDIMENT DEPOSITION/SCOURING													
			Optimal			Suboptimal			Marginal		Poor				
			<5% of channel bottom affected by scour or deposition.			5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools			30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.		More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.				*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
6	6	CHANNEL FLOW STATUS													
			Optimal			Suboptimal			Marginal		Poor				
			Water reaches the base of both lower banks; <5% of channel substrate is exposed			Water fills >75% of the channel; or <25% of channel substrate is exposed			Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed		Very little water in the channel and mostly present in standing pools; or stream is dry				*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et*
		Grade	10	9	8	7	6	5	4	3	2	1	0	0	
7	7	CHANNEL ALTERATION													
			Optimal			Suboptimal			Marginal		Poor				
			Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal			Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.			Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.		Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.				*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al., 2001* AUSRIVAS
		Grade	10	9	8	7	6	5	4	3	2	1	0	1	

8 8 CHANNEL SINUOSITY

	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	1
Grade	10	9	8	7	6	5	4	3	2	1	0	3
										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, et al., 1992*

Grade	10	9	8	7	6	5	4	3	2	1	0	4
Grade	10	9	8	7	6	5	4	3	2	1	0	4
										Avg.Score		4

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	4
Grade	10	9	8	7	6	5	4	3	2	1	0	4
										Avg.Score		4

12 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	Optimal	Suboptimal	Marginal	Poor	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 additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.	Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.	Norfolk SAAM Form 1 Field

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

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.
3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.

Ensure the sums of %Riparian Blocks equal 100

		Optimal	Suboptimal	Marginal	Poor		
Right Bank	%Riparian Area			100		100	
	Score			4			
	SubCI	0	0	4			
Left Bank	%Riparian Area			100		100	
	Score			4			
	SubCI	0	0	4	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	4	CI
					LT Bank CI>	4	4

Calculation of Function Capacity Index = Total Score/Total Possible Score | 0.15

FCI = #/120

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
Date:	N 6-TRIB1 5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 14				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.10	1,356	E	0.00125	0.17
Water Quality Improvement	0.16	1,356	E	0.00125	0.28
Habitat	0.15	1,356	E	0.00125	0.25
Total	0.41	1,356			0.70

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

**Multiplication Factors

Ephemeral = 0.00125

Intermittent = 0.0025

Perennial = 0.0038

N6-TRIB1 (6-15') facing

N6-TRIB1 (6-15') facing upstream.

SWAMPIM DATASHEETS – NORTH EPHEMERAL 6 TO 15' PRE-PROJECT

- **N22-TRIB2**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N22 Trib2 (6-15')

1

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

Right bank- 20-25 meters before pasture, Left bank 50 meters to pasture.
Riparian zone 10 m, few trees.

WP7
P 89,88

ITEM	VARIABLES					I. HYDROLOGIC FUNCTIONS N22 Trib2 (6-15')							SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length $\leq$ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	3	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable: 3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
	Optimal			Suboptimal			Marginal		Poor				
	Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
	Optimal			Suboptimal			Marginal		Poor				
	0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
Grade	10	9	8	7	6	5	4	3	2	1	0		
3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
	Optimal			Suboptimal			Marginal		Poor				
	Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
TLB =	10			BHR = 1									
BFD =	10												
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4 DYNAMIC SURFACE WATER STORAGE													
4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
	Optimal			Suboptimal			Marginal		Poor				
	Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
	Optimal			Suboptimal			Marginal		Poor				
	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Calculation of Function Capacity Index = Total Score/Total Possible Score												0.06	
FCI = #/100													

I. HYDROLOGIC FUNCTIONS N22 Trib2 (6-15')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N22 Trib2 (6-15')

ITEM	VARIABLES												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)	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	0	

Enter Score for Only One Variable

													SCORE	Reference Source
		CONDITION CATEGORY GRADE or SCORE												
	1b. Channel Bottom Bank Stability	Optimal			Suboptimal			Marginal		Poor				*Galli, 1996* Wash-COG RSAT No. 1
		Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0		
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
												Avg.Score		
	or	CONDITION CATEGORY GRADE or SCORE												
	1c. Channel Sediments or Substrate Composition	Optimal			Suboptimal			Marginal		Poor				*Barbour, et al., 1999 ; Petersen, et al., 1992*
		>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

													SCORE	Reference Source
2	WATER APPEARANCE: Clarity or Visibility													
		CONDITION CATEGORY GRADE or SCORE												
	Water Clarity	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 11
		Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

Enter Score for Only One Variable

													SCORE	Reference Source
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
		CONDITION CATEGORY GRADE or SCORE												
	3a. Nutrient Enrichment	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 12
		Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
		CONDITION CATEGORY GRADE or SCORE												
	or 3b. Aquatic Vegetation	Optimal			Suboptimal			Marginal		Poor				*Petersen, et al., 1992* RCE form No. 13
		When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	

4	COMPOSITION OF ORGANIC MATTER: Detritus.												
		CONDITION CATEGORY GRADE or SCORE											*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	0
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	3
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3
												Avg.Score	3
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/ NRCS
		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												0.09
												FCI = #/80	

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N22Trib2 (6-15')

ITEM	VARIABLES	III. HABITAT FUNCTIONS	N22 Trib2 (6-15')			SCORE	Source

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

2	2 EPIFAUNAL SUBSTRATE/AVAILABLE COVER						
		Optimal	Suboptimal	Marginal	Poor		
		Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 9 8	7 6 5	4 3	2 1 0	0	

3	3 STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization						
		Optimal	Suboptimal	Marginal	Poor		
		Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 9 8	7 6 5	4 3	2 1 0	0	

4	4 POOL VARIABILITY						
		Optimal	Suboptimal	Marginal	Poor		
		Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent		*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
	Grade	10 9 8	7 6 5	4 3	2 1 0	0	

5	5 SEDIMENT DEPOSITION/SCOURING						
		Optimal	Suboptimal	Marginal	Poor		
		<5% of channel bottom affected by scour or deposition.	5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools	30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.		*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
	Grade	10 9 8	7 6 5	4 3	2 1 0	0	

6	6 CHANNEL FLOW STATUS						
		Optimal	Suboptimal	Marginal	Poor		
		Water reaches the base of both lower banks; <5% of channel substrate is exposed	Water fills >75% of the channel; or <25% of channel substrate is exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in the channel and mostly present in standing pools; or stream is dry		*TCEQ, 1999* HAP Wrksheet; *Barbour, et al. 1999* RBA #5 page 5-19; *Parsons, et al., 2001*
	Grade	10 9 8	7 6 5	4 3	2 1 0	0	

7	7 CHANNEL ALTERATION						
		Optimal	Suboptimal	Marginal	Poor		
		Channelization, alteration, or dredging absent or minimal; normal and stable stream meander pattern. Alteration by stormwater inputs absent or minimal	Some alteration or channelization present, usually adjacent to structures, (such as bridge abutments or culverts); evidence of past alteration, (I.e., channelization) may be present, but stream pattern and stability have recovered; recent alteration is not present. Minor alteration from stormwater or other inputs.	Alteration or channelization may be extensive; embankments (including spoil piles) or shoring structures present on both banks; normal stable stream meander pattern has not recovered. Alteration from stormwater inputs may be extensive. 40-80% of stream reach altered.	Banks shored with gabion, riprap, or concrete. Concrete or riprap lined channels. Instream habitat significantly altered by stormwater or other inputs. Over 80% of the stream reach altered.		*USACE Norfolk District, 2004* SAAM Form 1 (Field) page 2; *Barbour, et al. 1999* RBA #6; *Parsons, et al.. 2001*
	Grade	10 9 8	7 6 5	4 3	2 1 0	1	

8	8 CHANNEL SINUOSITY						
		Optimal	Suboptimal	Marginal	Poor		
		The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line	Channel straight; waterway has been channelized for a long distance		*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
	Grade	10 9 8	7 6 5	4 3	2 1 0	3	

9

9	BANK STABILITY (SCORE EACH BANK)												
	Optimal			Suboptimal			Marginal		Poor				
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS ; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
										Avg.Score		0	

10

10	VEGETATIVE PROTECTION (SCORE EACH BANK)												
	Optimal			Suboptimal			Marginal		Poor				
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS ; *KDWP 2000* ; *Petersen, et al., 1992*
Grade	10	9	8	7	6	5	4	3	2	1	0	1	
Grade	10	9	8	7	6	5	4	3	2	1	0	1	
										Avg.Score		1	

11

11	RIPARIAN ZONE (SCORE EACH BANK)												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.				*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
Grade	10	9	8	7	6	5	4	3	2	1	0	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)												Norfolk SAAM Form 1 Field
	Optimal			Suboptimal			Marginal		Poor				
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
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				100	100	
	Score				2		
	SubCI	0	0	0	2		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	2	**CI**
					LT Bank CI>	2	2
	Calculation of Function Capacity Index = Total Score/Total Possible Score						0.10
						FCI = #/120	

Record of Functional Assessment Results

Stream Functional Capacity Calculation

N22 Trib2 (6-15')

Date:	5/17/2005
Project:	Lake Ralph Hall
Assessment Area:	WP 7
Assessors:	Holmes Voight Capps
Project Status:	__X__Preproject ____Postproject

Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.06	1,676	E	0.00125	0.13
Water Quality Improvement	0.09	1,676	E	0.00125	0.18
Habitat	0.10	1,676	E	0.00125	0.21
Total	0.25	1,676			0.52

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

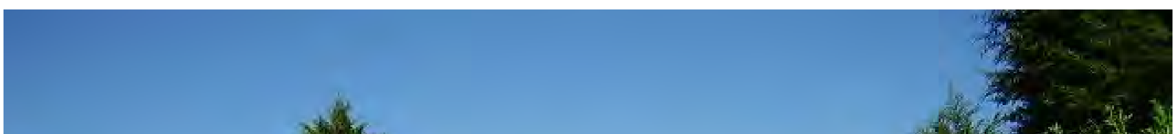
**Multiplication Factors

Ephemeral = 0.00125

Intermittent = 0.0025

Perennial = 0.0038

N22-TRIB2 (6-15) facing upstream. 5/17/2006



N22-TRIB2 (6-15) facing downstream. 5/17/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 6 TO 15' PRE-PROJECT

- **N20**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

N20 (6-15')

1

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

Right bank- 50 meters of trees before pasture, Left bank 50-20 meters of trees to row crops.
Park area, left bank row crops beyond trees, right bank pasture beyond trees.

WP 5
P 92, 93

I. HYDROLOGIC FUNCTIONS

ITEM	VARIABLES						I. HYDROLOGIC FUNCTIONS N20 (6-15')						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	2	
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	1	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	1.5	
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 $\leq$ 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	3	
		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	1	

Enter Score for Only One Variable													
	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE											*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor			
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category			
	Grade	10	9	8	7	6	5	4	3	2	1	0	2
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE											
		Optimal			Suboptimal			Marginal		Poor			
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE											*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor			
		Incision ratio $\geq$1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope $\leq$2%; Entrenchment ratio >2.0			Incision ratio $\geq$1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope $\leq$2%, Entrenchment ratio >2.0			Incision ratio $\geq$ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope $\leq$2%, Entrenchment ratio >2.0		Incision ratio $\geq$2.0 **and** Where channel slope >2%, Entrenchment ratio $\leq$1.4; Where channel slope $\leq$2%, Entrenchment ratio $\leq$2.0			
	TLB =	10			BHR = 1								
	BFD =	10											
	Grade	10	9	8	7	6	5	4	3	2	1	0	3
4	DYNAMIC SURFACE WATER STORAGE												
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE											*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor			
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	0
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE											*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor			
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.			
	Grade	10	9	8	7	6	5	4	3	2	1	0	0
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.13
	FCI = #/100												

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N20 (6-15')

ITEM VARIABLES — SCORE — Reference Source

TYPE	
NOTES	

Enter Score for Only One Variable (1b or 1c)

1. SEDIMENT TRANSPORT/DEPOSITION

1a. Bank Stability (score each bank, left or right facing downstream)	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 10; *Barbour, et al., 1999* EPA
	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.		Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	1	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	2	
											Avg.Score	1.5	

1b. Channel Bottom Bank Stability	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Galli, 1996* Wash-COG RSAT No. 1
	Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally resistant plant/soil matrix or material.			Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix compromised.		Bottom 1/3 of bank is generally highly erodible material; plant/soil matrix severely compromised.				
Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	0	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
											Avg.Score	0	

or

1c. Channel Sediments or Substrate Composition	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Barbour, et al., 1999 ; Petersen, et al., 1992*
	>50% gravel or larger substrate; gravel, cobble boulders; dominant substrate type is gravel or larger; stable			30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments; moderately stable			10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a		Substrate is uniform sand, silt, clay, or bedrock; unstable				
Grade	10	9	8	7	6	5	4	3	2	1	0	1	

2 WATER APPEARANCE: Clarity or Visibility

Water Clarity	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 11
	Very clear, or clear but tea-colored; objects visible at depth 3-6 feet (less if slightly colored); no oil sheen on surface;no noticeable film on submerged objects or rocks.			Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5-3 ft; may have slightly green color; no oil sheen on water surface.			Considerable cloudiness most of the time; objects visible to depth 0.5-1.5 ft; slow sections may appear pea-green; bottom rocks or sumerged objected covered with film.		Very turbid or muddy appearance most the time; objects visible to depth <0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	

3 PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage

Enter Score for Only One Variable (3a or 3b)

3a. Nutrient Enrichment	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Newton, et al., 1998* USDA/NRCS SVAP page 12
	Clear water along entire reach; diverse aquatic plant community includes low quantaties of many species of macrophytes; little algal growth present.			Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.			Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.		Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

or

3b. Aquatic Vegetation	CONDITION CATEGORY GRADE or SCORE											SCORE	Reference Source
	Optimal			Suboptimal			Marginal		Poor				*Petersen, et al., 1992* RCE form No. 13
	When present, aquatic vegetation consists of moss and patches of algae.			Algae dominant in pools, larger plants along edge.			Algal mats present, some larger plants, few mosses.		Algal mats cover bottom, larger plants dominate the channel or NO algae present due to unstable substrate. No water = zero.				
Grade	10	9	8	7	6	5	4	3	2	1	0	0	

4 COMPOSITION OF ORGANIC MATTER: Detritus.

	10	9	8	7	6	5	4	3	2	1	0	Score	Reference
	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	8	

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

	10	9	8	7	6	5	4	3	2	1	0	Score	Reference
	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	3	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3	
											Avg.Score	3	

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

	10	9	8	7	6	5	4	3	2	1	0	Score	Reference
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	8	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	8	
											Avg.Score	8	
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	5	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	5	
											Avg.Score	5	

Calculation of Function Capacity Index = Total Score/Total Possible Score: 0.33

FCI = #/80

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N20 (6-15')

III. HABITAT FUNCTIONS

ITEM VARIABLES III. HABITAT FUNCTIONS N20 (6-15') SCORE Source

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

9 | 9 BANK STABILITY (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)
Grade	10	9	8	7	6	5	4	3	2	1	0	1	
Grade	10	9	8	7	6	5	4	3	2	1	0	2	
										Avg.Score		1.5	

10 | 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
										Avg.Score		5	

11 | 11 RIPARIAN ZONE (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.				*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
Grade	10	9	8	7	6	5	4	3	2	1	0	8	
Grade	10	9	8	7	6	5	4	3	2	1	0	8	
										Avg.Score		8	

12 | 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor				
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				Norfolk SAAM Form 1 Field
Grade	10	9	8	7	6	5	4	3	2	1	0		

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
2. Determine square footage for each by measuring or estimating length and width. Land Use GIS maps may be used for this.
3. Enter the %Riparian Area (or for field purposes, enter length and width) and Score for each riparian category in the blocks below.

Ensure the sums of %Riparian Blocks equal 100

		Optimal	Suboptimal	Marginal	Poor		
Right Bank	%Riparian Area		100			100	
	Score		7				
	SubCI	0	7	0			
Left Bank	%Riparian Area		100			100	
	Score		6				
	SubCI	0	6	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	7	**CI**
					LT Bank CI>	6	6.5

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.23

FCI = #/120

III. HABITAT FUNCTIONS N20 (6-15')

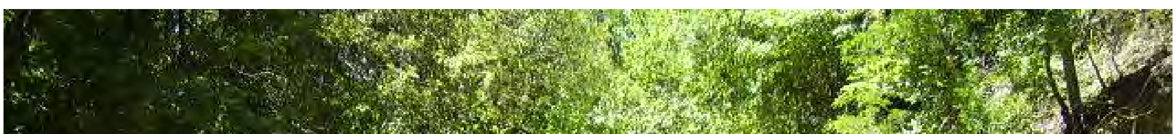
Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N20 (6-15')				
Date:	5/17/2005				
Project:	Lake Ralph Hall				
Assessment Area:	WP 5				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.13	6,084	E	0.00125	0.95
Water Quality Improvement	0.33	6,084	E	0.00125	2.52
Habitat	0.23	6,084	E	0.00125	1.71
Total	0.68	6,084			5.18

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

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

N20 (6-15') facing downstream.
5/17/2006



N20 (6-15') facing downstream.
5/17/2006

SWAMPIM DATASHEETS – NORTH EPHEMERAL 16 TO >25' PRE-PROJECT

- **N12**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

N12 (16-25')

1

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

Park area, surrounded by pasture and road. Reach crosses under road. Riparian zone is 0 to 100+ meters depending on proximity to road.

WP19
P 62, 61

ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS				N12 (16-25')							SCORE	Reference Source
1.	FLOW REGIME:													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	Subjective
2.	CHANNEL CONDITION: Measurement or Observation of Stream Channel Conditions													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA page 5-21; *Newton, 1998* USDA/ NRCS SVAP page 7
		Optimal			Suboptimal			Marginal		Poor				
	2a.Channel Condition/Alteration (natural, altered, or downcutting)	Natural channel; no structures or channelization minimal. No evidence of downcutting or excessive lateral cutting. Normal frequency of hydrological connection between channel and floodplain.			Some channelization (usually in bridge areas) or past channel alteration, but with significant recovery of channel bed and banks. Acceptable frequency of overbank flows onto floodplain.			Altered channel; 40-80% of the reach channelized or disrupted. Excess aggradation; braided channel with excessive frequency of overbank flows onto the floodplain. Historical incision,dikes or levees restrict floodplain.		Channel is actively downcutting or widening. >80% of the reach riprap or channnelized. Degradation,dikes or levees prevent access to the floodplain.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common;		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (Left)	10	9	8	7	6	5	4	3	2	1	0	8	
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0	
												Avg.Score	4	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length ≤ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	

	Parameter												Score	Reference
	3b. Bottom Substrate Composition	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
		Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
Enter Score for Only One Variable	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
	Grade	10	9	8	7	6	5	4	3	2	1	0	3	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR =	1								
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		Calculation of Function Capacity Index = Total Score/Total Possible Score											0.14	
		FCI = #/100												

I. HYDROLOGIC FUNCTIONS N12 (16-25')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N12 (16-25')

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

4	COMPOSITION OF ORGANIC MATTER: Detritus.											
		CONDITION CATEGORY GRADE or SCORE										*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	0

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	3
	Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	3
												Avg.Score	3

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

Calculation of Function Capacity Index = Total Score/Total Possible Score | 0.24

FCI = #/80

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

N12 (16-25')

ITEM VARIABLES III. HABITAT FUNCTIONS N12 (16-25') SCORE Source

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

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	8	
Grade	10	9	8	7	6	5	4	3	2	1	0	0	
										Avg.Score		4	

10

10	VEGETATIVE PROTECTION (SCORE EACH BANK)												
	Optimal			Suboptimal			Marginal		Poor				
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992* RCE
Grade	10	9	8	7	6	5	4	3	2	1	0	6	
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
										Avg.Score		5.5	

11

11	RIPARIAN ZONE (SCORE EACH BANK)												
	Optimal			Suboptimal			Marginal		Poor				
	Width of riparian zone >18 meters; human activities (I.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally).			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.		Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.				*Barbour, et al., 1999* RBA #10; *Parsons, et al., 2001* AUSRIVAS
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
Grade	10	9	8	7	6	5	4	3	2	1	0	5	
										Avg.Score		5	

12

12	RIPARIAN HABITAT CONDITION (SCORE EACH BANK)												Norfolk SAAM Form 1 Field
	Optimal			Suboptimal			Marginal		Poor				
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥ 2 additional layers are present. Score at low end if ≤ 1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥ 2 additional forest layers are present. Score at low end if ≤ 1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥ 2 additional layers are present. Score at low end if ≤ 1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

1. Delineate riparian areas along each stream bank into Condition Categories and Condition Scores using the above descriptors
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		7				
	SubCI	0	7	0			
Left Bank	%Riparian Area		100			100	
	Score		7				
	SubCI	0	7	0	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	7	CI
					LT Bank CI>	7	7

Calculation of Function Capacity Index = Total Score/Total Possible Score | 0.24

FCI = #/120

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N12 (16-25')				
Date:	5/19/2006				
Project:	Lake Ralph Hall				
Assessment Area:	WP 19				
Assessors:	Holmes Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.14	5,435	E	0.00125	0.95
Water Quality Improvement	0.24	5,435	E	0.00125	1.61
Habitat	0.24	5,435	E	0.00125	1.61
Total	0.62	5,435			4.18

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

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

N12 (16-25') facing
upstream. 5/19/2006

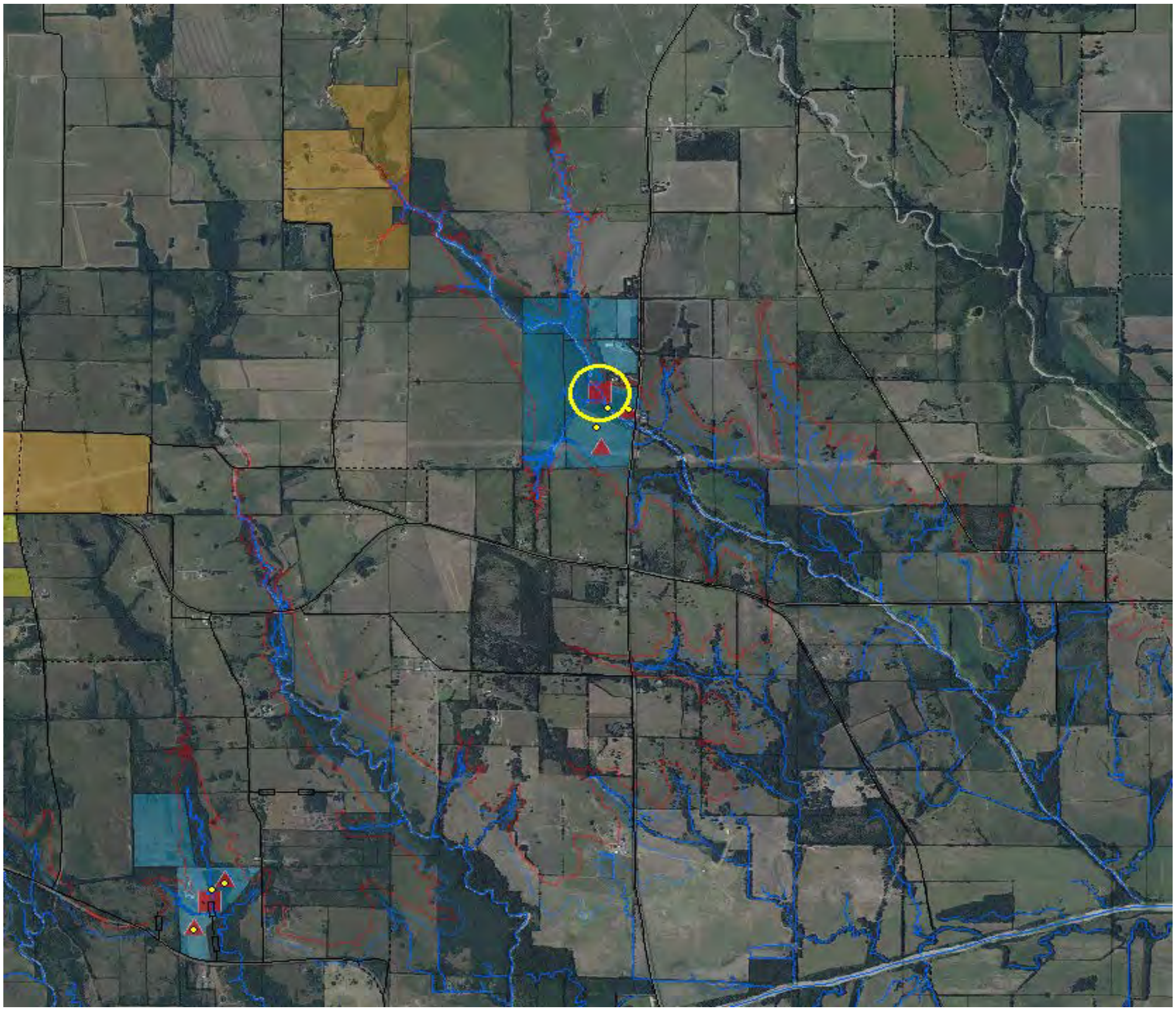
SWAMPIM DATASHEETS – NORTH EPHEMERAL 16 TO >25' PRE-PROJECT

- **N1**

N1 (16 - >25')
Site 4. Assessed 26 August 2009

24,578 linear foot reach

Forested riparian buffer on either side of reach, tapering to young forest on the west bank as the reach nears the NSR
Standing water from recent rain (8-24-2009 AM rain shower)



ITEM	VARIABLES	I. HYDROLOGIC FUNCTIONS	N1 (16 - >25')										SCORE	Reference Source
1.	FLOW REGIME: Standing water from recent rain (8-24-2009 AM rain shower)													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas Subjective
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
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.			Natural, active, downcutting.	*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												w/ assistance and input from Dr. Mike Harvey and Stu Travant
		Optimal			Suboptimal			Marginal		Poor				
	2b.Channel Capacity to Flow Frequency Ratio (for 2-year peak flow)	Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events occur at a 1.25 to 2.5 year frequency. 0.75-1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every 1.25 years or less frequent than every 2.5 years. <0.75 or >1.25			Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every year or less frequent than every 5 years. < 0.5 or >1.5		Channel Capacity to Flow Frequency Ratio is such that bank overflow from storm events are more frequent than every half year or less frequent than every 10 years. <0.24 or >2				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
		CONDITION CATEGORY GRADE or SCORE												*Newton, 1998* USDA/ NRCS SVAP page 10; *Barbour, et al., 1999* EPA RBA page 5-26; *USACE, Norfolk District, 2004*
		Optimal			Suboptimal			Marginal		Poor				
	2c.Channel Bank Stability (score each bank, left or right facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	Grade (East)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	2	
3	CHANNEL ROUGHNESS FACTORS													
		CONDITION CATEGORY GRADE or SCORE												*Barbour, 1999* EPA RBA Chapter 5 page 5-25; *KDWP, 1996*
		Optimal			Suboptimal			Marginal		Poor				
	3a.Channel Sinuosity (bends in low gradient stream)	The bends in the stream increase the stream length 2.5 to 4 times longer than if it was straight. Channel length/valley length at least >1.5.			The bends in the stream increase the stream length 1.5 to 2.5 times longer than if it was a straight line. Channel length/valley length 1.2 to 1.5			The bends in the stream increase the stream length 1 to 1.5 times longer than if it was a straight line. Channel length/valley length 1.0 to 1.2.		Channel straight; waterway has been channelized for a long distance. Channel length/valley length ≤ 1.0				
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
		CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996* Kansas Subjective Evaluation of Aquatic Habitats
		Optimal			Suboptimal			Marginal		Poor				
	3b. Bottom Substrate Composition	Little or no channel enlargement resulting from sediment accumulation; channel is stable			Some gravel bars of coarse stones and well-washed debris present, little silt; moderately stable			Sediment bars of rocks, sands, and silt common; moderately unstable		Channel divided into braids or stream is channelized; substrate is uniform sand, silt, clay, or bedrock; unstable				
	Grade	10	9	8	7	6	5	4	3	2	1	0	2	

Enter Score for Only One Variable

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	5	

or

Variable	Optimal	Suboptimal	Marginal	Poor	Score
	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	

Variable	Optimal	Suboptimal	Marginal	Poor	Score	Reference
	CONDITION CATEGORY GRADE or SCORE					
3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	Incision ratio $\geq$1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope $\leq$2%; Entrenchment ratio >2.0	Incision ratio $\geq$1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope $\leq$2%, Entrenchment ratio >2.0	Incision ratio $\geq$ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope $\leq$2%, Entrenchment ratio >2.0	Incision ratio $\geq$2.0 **and** Where channel slope >2%, Entrenchment ratio $\leq$1.4; Where channel slope $\leq$2%, Entrenchment ratio $\leq$2.0		*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
TLB =	15	BHR = 3				
BFD =	5					
Grade	10 9 8	7 6 5	4 3	2 1 0	0	

4 DYNAMIC SURFACE WATER STORAGE

Variable	Optimal	Suboptimal	Marginal	Poor	Score	Reference
	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	1	
	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	0	

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.12

FCI = #/100

I. HYDROLOGIC FUNCTIONS N1 (16 - >25')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS N1 (16 - >25')

ITEM	VARIABLES												SCORE	Reference Source
	Standing water from recent rain (8-24-2009 AM rain shower)													
	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 (East)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	2	
	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 (East)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	3	
												Avg.Score	2	
	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	1	
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		
		CONDITION CATEGORY GRADE or SCORE												
	or	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	1	

4 COMPOSITION OF ORGANIC MATTER: Detritus.

CONDITION CATEGORY GRADE or SCORE				
	Optimal	Suboptimal	Marginal	Poor
	Mainly consisting of leaves and wood without sediment.	Leaves and wood scarce; fine organic debris without sediment.	No leaves or woody debris; coarse and fine organic matter with sediment.	Fine organic sediment - black in color and foul odor (anaerobic) or no sediment present due to excessive scouring

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

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

5 LAND USE PATTERN: Beyond Immediate Riparian Zone

Wide riparian zone of forest at ass't site, pasture and crops beyond. Narrower riparian zones typical downstream of ass't site.

CONDITION CATEGORY GRADE or SCORE				
	Optimal	Suboptimal	Marginal	Poor
	Undisturbed, consisting of forest, pristine native prairie, and/or natural wetlands.	Permanent pasture mixed with woodlots and swamps, few row crops	Mixed row crops and pasture; some wooded areas may be present but as isolated patches	Mainly row crops

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

Grade (East)	10	9	8	7	6	5	4	3	2	1	0	4	Forest in upper reaches; pasture/hay
Grade (West)	10	9	8	7	6	5	4	3	2	1	0	4	
											Avg.Score	4	

6 RIPARIAN ZONE WIDTH AND CONTINUITY:

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

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

Grade (East)	10	9	8	7	6	5	4	3	2	1	0	7
Grade (West)	10	9	8	7	6	5	4	3	2	1	0	7
											Avg.Score	7

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

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

Grade (East)	10	9	8	7	6	5	4	3	2	1	0	1
Grade (West)	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 0.24

FCI = #/80

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS N1 (16 - >25')

ITEM	VARIABLES	III. HABITAT FUNCTIONS N1 (16 - >25')					SCORE	Reference Source
1	1	FLOW REGIME	Standing water from recent rain (8-24-2009 AM rain shower)					
		TYPE	Perennial	Intermittent w/ Perennial Pools	Intermittent	Ephemeral		*KDWP, 2000*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER						
			Optimal	Suboptimal	Marginal	Poor		
		Exposed roots but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization						
			Optimal	Suboptimal	Marginal	Poor		
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
4	4	POOL VARIABILITY						
			Optimal	Suboptimal	Marginal	Poor		
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent		*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
5	5	SEDIMENT DEPOSITION/SCOURING						
			Optimal	Suboptimal	Marginal	Poor		
			<5% of channel bottom affected by scour or deposition.	5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools	30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.		*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	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 al., 2001*
		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	1	

9 9 BANK STABILITY (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score
	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.			
Grade (East)	10	9	8	7	6	5	4	3	2	1	0	1
Grade (West	10	9	8	7	6	5	4	3	2	1	0	3
										Avg.Score		2

Barbour, et al. 1999 RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw, 1999)

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score
	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.			
Grade (East)	10	9	8	7	6	5	4	3	2	1	0	1
Grade (West	10	9	8	7	6	5	4	3	2	1	0	1
										Avg.Score		1

Barbour, et al. 1999 RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*

11 11 RIPARIAN ZONE (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score
	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.			
Grade (East)	10	9	8	7	6	5	4	3	2	1	0	7
Grade (West	10	9	8	7	6	5	4	3	2	1	0	7
										Avg.Score		7

Barbour, et al., 1999 RBA #10; *Parsons, et al., 2001* AUSRIVAS

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

Norfolk SAAM Form 1 Field

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		
East Bank	%Riparian Area	30		40	30	100	
	Score	10		4	1		
	SubCI	3	0	1.6			
West Bank	%Riparian Area	30		40	30	100	
	Score	10		4	1		
	SubCI	3	0	1.6	0.3		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	4.6	**CI**
					LT Bank CI>	4.9	4.75

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.18

FCI = #/120

III. HABITAT FUNCTIONS N1 (16 - >25')

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
Date:	N1 (16 - >25') 8/26/2009				
Project:	Lake Ralph Hall				
Assessment Area:	WP 23				
Assessors:	Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.12	24,057	E	0.00125	3.61
Water Quality Improvement	0.24	24,057	E	0.00125	7.14
Habitat	0.18	24,057	E	0.00125	5.45
Total	0.54	24,057			16.20

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

Standing water from recent rain (8-24-2009 AM rain shower)

N1 (Merrill Creek)
(16 to >25'), Looking
Downstream

N1, (Merrill Creek)
(16 - >25')
Looking Upstream

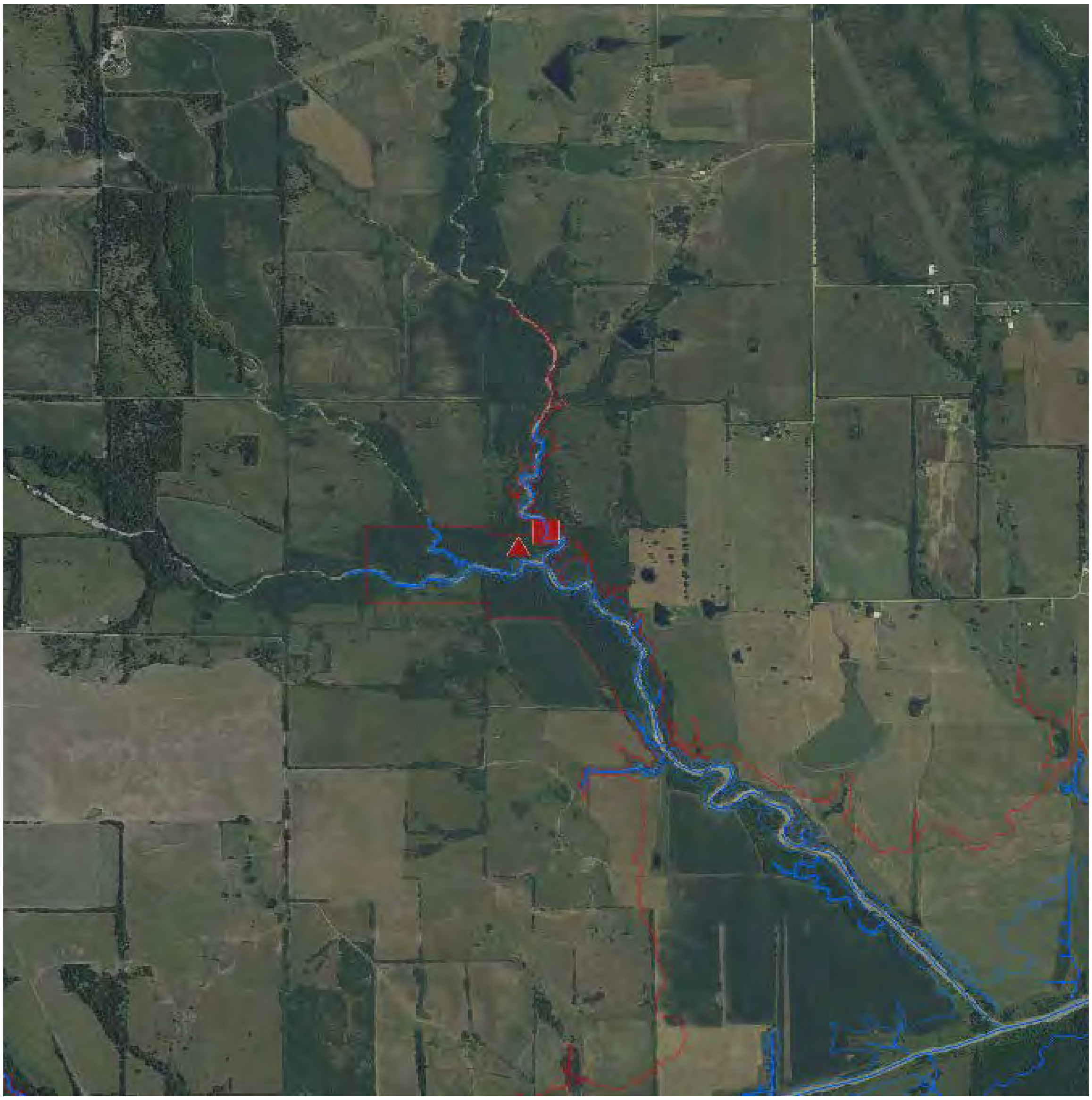
SWAMPIM DATASHEETS – NORTH EPHEMERAL 16 TO >25' PRE-PROJECT

- **N18**

N18 (18') (16 - >25')
Site 5. Assessed 25 August 2009

15,660 linear foot reach

Forested riparian buffer on either side of reach, tapering to young forest on the west bank as the reach nears the NSR
Standing water from recent rain (8-24-2009 AM rain shower)



ITEM	VARIABLES						I. HYDROLOGIC FUNCTIONS N18 (16 - >25')						SCORE	Reference Source
1.	FLOW REGIME: Standing water from recent rain (8-24-2009 AM rain shower)													
	TYPE	Perennial			Intermittent w/ Perennial Pools			Intermittent		Ephemeral				*KDWP 2000* Kansas Subjective
	Grade	10	9	8	7	6	5	4	3	2	1	0	1	
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.			Natural, active, downcutting.	*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	1	
		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 (East)	10	9	8	7	6	5	4	3	2	1	0	2	
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2	
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	4	
		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	1	

Enter Score for Only One Variable	Variable												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 =	20			BHR =	4								
	BFD =	5												
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
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	1	
		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	1	
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.12	
	FCI = #/100													

I. HYDROLOGIC FUNCTIONS N18 (16 - >25')

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS — N18 (16 - >25')

ITEM	VARIABLES												SCORE	Reference Source
	Standing water from recent rain (8-24-2009 AM rain shower)													
	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 (East)	10	9	8	7	6	5	4	3	2	1	0	2	
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	2	
												Avg.Score	2	
		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 (East)	10	9	8	7	6	5	4	3	2	1	0	1	
	Grade (West)	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	1	
3	PRESENCE OF AQUATIC VEGETATION: Presence and Percent Coverage													
		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		
		CONDITION CATEGORY GRADE or SCORE												
	or	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	1	

Enter Score for Only One Variable

Enter Score for Only One Variable

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 (East)	10	9	8	7	6	5	4	3	2	1	0	4 Forest in upper reaches; pasture/hay
	Grade (West)	10	9	8	7	6	5	4	3	2	1	0	4
												Avg.Score	4
6	RIPARIAN ZONE WIDTH AND CONTINUITY:												
		Riparian zone wider and more wooded in upper reach, becomes thinner to non-existant as it nears the NSR											
	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/ NRCS
		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 (East)	10	9	8	7	6	5	4	3	2	1	0	3
	Grade (West)	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 (East)	10	9	8	7	6	5	4	3	2	1	0	2
	Grade (West)	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											0.19
												FCI = #/80	
	II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS							N18 (16 - >25")					

ITEM VARIABLES III. HABITAT FUNCTIONS N18 (16 - >25') SCORE Reference Source

ITEM		VARIABLES					SCORE	Reference Source
1	1	FLOW REGIME Standing water from recent rain (8-24-2009 AM rain shower)						
		TYPE	Perennial	Intermittent w/ Perennial Pools	Intermittent	Ephemeral		*KDWP, 2000*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
2	2	EPIFAUNAL SUBSTRATE/AVAILABLE COVER	Optimal	Suboptimal	Marginal	Poor		
		Exposed roots but no water.	Within stream bed, greater than 50% coverage by stable habitat features, favorable for stream faunal colonization and/or fish/amphibian cover. Most habitat features non transient. Features may include snags, submerged logs, undercut banks, roots, cobble, rocks, persistent leaf packs, pools and glides, or other stable habitat at a stage to allow colonization	Within stream bed, 30-50% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover. Many habitat features not transient. (See Excellent Category for habitat feature components.)	Within stream bed, 10-30% coverage by stable habitat features favorable for stream faunal colonization and/or fish/amphibian cover; habitat availability may be less than desirable, substrate may be frequently disturbed. (See Excellent Category for habitat feature components.)	Less than 10% habitat features present; lack of habitat is obvious; substrate unstable or lacking; concrete lined channels. Habitat features and pools buried or lacking, channel bottom may be flat.		*USACE Norfolk, 2004* SAAM Form 1 (page 2); *Barbour, et al. 1999* EPA RBA; *Parsons, et al., 2001* AUSRIVAS
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
3	3	STREAM BOTTOM SUBSTRATE: Pool Substrate Characterization	Optimal	Suboptimal	Marginal	Poor		
			Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegatation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard pan clay or bedrock; no root mat or submerged vegetation.		*Barbour, et al. 1999* RBA #2b page 5-14; *Parsons, et al., 2001* AUSRIVAS
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
4	4	POOL VARIABILITY	Optimal	Suboptimal	Marginal	Poor		
			Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent		*Barbour, et al. 1999* RBA #3b page 5-16; *Parsons, et al., 2001*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	1	
5	5	SEDIMENT DEPOSITION/SCOURING	Optimal	Suboptimal	Marginal	Poor		
			<5% of channel bottom affected by scour or deposition.	5-30% affected by scour or deposition; Scour at constrictions and wehre grades steepen. Some deposition in pools	30-50% affected by scour or deposition. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	More than 50% of the bottom in a state of flux or change nearly yearlong. Pools minimal or absent due to heavy deposition or excessive scouring.		*Barbour, et al. 1999* RBA #4 page 5-17; *Parsons, et al., 2001*
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	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 al., 2001*
		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	2	
8	8	CHANNEL SINUOSITY	Optimal	Suboptimal	Marginal	Poor		
			The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line	Channel straight; waterway has been channelized for a long distance		*Barbour, et al. 1999* RBA #7b; *Parsons, et al., 2001* AUSRIVAS
		Grade	10 / 9 / 8	7 / 6 / 5	4 / 3	2 / 1 / 0	4	

9 9 BANK STABILITY (SCORE EACH BANK)

	10	9	8	7	6	5	4	3	2	1	0		
	Optimal			Suboptimal			Marginal		Poor				
	Banks stable; evidence of erosion or bank failure absent or minimal; (<5% of bank affected), perennial vegetation to waterline; no raw or undercut banks (some erosion on outside of meander bends O.K.); no recently exposed roots; no recent tree falls;			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of minor erosion and/or bank undercutting; perennial vegetation to waterline in most places; recently exposed tree roots rare but present.			Moderately unstable; perennial vegetation to waterline sparse (mainly scoured or stripped by lateral erosion), bank held by hard points (trees, rock outcrops) and eroded back elsewhere; 30-60% of bank in reach has areas of erosion and bank undercutting; recently exposed tree roots and fine root hairs common; high erosion potential during floods		Unstable; no perennial vegetation at waterline; severe erosion of both banks; recently exposed tree roots common; tree falls and/or severely undercut trees common; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				*Barbour, et al. 1999* RBA #8; *Parsons, et al., 2001* AUSRIVAS; *USACE Norfolk Distric* t, 2004 SAM #3; Scholz and Booth from Henshaw,
Grade (East)	10	9	8	7	6	5	4	3	2	1	0	2	
Grade (West	10	9	8	7	6	5	4	3	2	1	0	2	
										Avg.Score		2	

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	10	9	8	7	6	5	4	3	2	1	0		
	Optimal			Suboptimal			Marginal		Poor				
	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.		Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				*Barbour, et al. 1999* RBA #9; *Parsons, et al., 2001* AUSRIVAS; *KDWP 2000*; *Petersen, et al., 1992*
Grade (East)	10	9	8	7	6	5	4	3	2	1	0	3	
Grade (West	10	9	8	7	6	5	4	3	2	1	0	3	
										Avg.Score		3	

11 11 RIPARIAN ZONE (SCORE EACH BANK)

	10	9	8	7	6	5	4	3	2	1	0		
	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 (East)	10	9	8	7	6	5	4	3	2	1	0	3	
Grade (West	10	9	8	7	6	5	4	3	2	1	0	3	
										Avg.Score		3	

12 12 RIPARIAN HABITAT CONDITION (SCORE EACH BANK)

	10	9	8	7	6	5	4	3	2	1	0		
	Optimal			Suboptimal			Marginal		Poor				Norfolk SAAM Form 1 Field
	Tree stratum (dbh>3 inches) present, with >60% tree canopy cover. (Additional forest layers may include: sapling, shrub, herbaceous, and leaf litter including mosses/lichens and woody debris.) Score at the high end of Excellent range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present.			Tree stratum (dbh>3 inches) present, with 30% to 60% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Good range if ≥2 additional forest layers are present. Score at low end if ≤1 additional forest layers are present. **OR** cutover areas with stumps remaining.			Tree stratum (dbh>3 inches) present, with <30% tree canopy cover. (See Excellent Category for examples of additional forest layers.) Score at the high end of Fair range if ≥2 additional layers are present. Score at low end if ≤1 additional layers are present. **OR** area consists of non-maintained and naturalized dense herbaceous and/or woody vegetation.		Tree stratum absent; impervious surfaces, croplands, mine spoil lands, culverted streams, mowed and maintained herbaceous areas, denuded surfaces, actively grazed pasture, and etc.				
Grade	10	9	8	7	6	5	4	3	2	1	0		

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			
East Bank	%Riparian Area			40			20		40		100	
	Score			6			3		0			
	SubCI	0		2.4			0.6		0			
West Bank	%Riparian Area			40			20		40		100	
	Score			6			3		0			
	SubCI	0		2.4			0.6		0			
									SubCI=(%RA*Scores*0.01)			
									Rt Bank CI>		3	CI
									LT Bank CI>		3	3
									Calculation of Function Capacity Index = Total Score/Total Possible Score			0.19
											FCI = #/120	

III. HABITAT FUNCTIONS N18 (16 - >25")

Record of Functional Assessment Results

Stream Functional Capacity Calculation					
	N18 (16 - >25')				
Date:	8/26/2009				
Project:	Lake Ralph Hall				
Assessment Area:	WP 30				
Assessors:	Voight Capps				
Project Status:	__X__Preproject		____Postproject		
Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.12	12,086	E	0.00125	1.81
Water Quality Improvement	0.19	12,086	E	0.00125	2.83
Habitat	0.19	12,086	E	0.00125	2.90
Total	0.50	12,086			7.54

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

Standing water from recent rain (8-24-2009 AM rain shower)


N18 (16 - >25'),
Looking Upstream


N18 (16 - >25'),
Looking Downstream

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 0.5 TO 2.0' PRE-PROJECT

- **S8-TRIB2**

ITEM VARIABLE FUNCTION CATEGORY SCORE Reference Source

S8 Trib2 (0.5-2')

1

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

Right bank- 5-10 meters to pasture, Left bank 5 to 0 meters to pasture. Small park area surrounded by pasture is downstream.
No cover
WP 12
P 80, 79

I. HYDROLOGIC FUNCTIONS

S8 Trib2 (0.5-2')

ITEM	VARIABLES												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	2	
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 $\leq$ 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	2	
		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	

Enter Score for Only One Variable														
	3c. Instream Bottom Topography	CONDITION CATEGORY GRADE or SCORE												*KDWP, 1996; Newton et al., 1998* USDA/NRCS SVAP page 13/
		Optimal			Suboptimal			Marginal		Poor				
		Diverse bottom topography including >7 of the following: deep pools, boulders/gravel, logs/large woody debris, backwaters/oxbows, overhanging vegetation, riffles, vegetated shallows, rootwads, undercut banks, or side channel pools			Channel bottom includes 5-7 of the items listed in Optimal Category			Channel bottom includes < 5 of the items listed in Optimal Category		Channel bottom includes <3 of the items listed in Optimal Category				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	or 3c. Manning's n	CONDITION CATEGORY GRADE or SCORE												
		Optimal			Suboptimal			Marginal		Poor				
		0.05 to 0.099			0.035 to 0.05			0.021 to 0.03 or >0.10 to 0.15		0.16 to 0.20 due to excessive obstruction to flow or 0.01 to 0.02 due to channelization and clean, smooth channel.				
	Grade	10	9	8	7	6	5	4	3	2	1	0		
	3d. Channel Incision (TLB/BFD=BHR; 1/BHR*Adj Factor =CI)	CONDITION CATEGORY GRADE or SCORE												*USACE, Norfolk District, 2004* SAAM Form 1 #1 and VT Stream Geomorphic Assessment Phase 2
		Optimal			Suboptimal			Marginal		Poor				
		Incision ratio ≥1.0 <1.2 **and** Where channel slope >2%; Entrenchment ratio >1.4; Where channel slope ≤2%; Entrenchment ratio >2.0			Incision ratio ≥1.2 <1.4 **and** Where channel slope >2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0			Incision ratio ≥ 1.4 < 2.0 **and** Where channel slope > 2%, Entrenchment ratio >1.4; Where channel slope ≤2%, Entrenchment ratio >2.0		Incision ratio ≥2.0 **and** Where channel slope >2%, Entrenchment ratio ≤1.4; Where channel slope ≤2%, Entrenchment ratio ≤2.0				
	TLB =	10			BHR =	1								
	BFD =	10												
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
4	DYNAMIC SURFACE WATER STORAGE													
	4a.Pools (abundant, present or absent)	CONDITION CATEGORY GRADE or SCORE												*Newton, et al., 1998* USDA/ NRCS SVAP page 14; *Barbour, et al., 1999*
		Optimal			Suboptimal			Marginal		Poor				
		Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or pools are at least 5 feet deep.			Pools present, but not abundant; from 10-30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.			Pools present, but shallow; from 5-10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.		Pools absent, or the entire bottom is discernible. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	4b. Channel Flow Status (degree to which channel is filled)	CONDITION CATEGORY GRADE or SCORE												*Barbour, et al., 1999* EPA RBA page 5-19 /A-9#5; *TCEQ 1999; VANR, 2005*
		Optimal			Suboptimal			Marginal		Poor				
		Water reaches base of both lower banks and minimal amount of channel substrate is exposed.			Water fills >75% of the available channel; or <25% of channel substrate is exposed.			Water fills 25-75% of the available channel, and /or riffle substrates are mostly exposed.		Very little water in channel and mostly present as standing pools. No water = zero.				
	Grade	10	9	8	7	6	5	4	3	2	1	0	0	
	Calculation of Function Capacity Index = Total Score/Total Possible Score												0.04	
	S8 Trib2 (0.5-2') FCI = #/100													

II. WATER QUALITY/BIOGEOCHEMICAL FUNCTIONS

S8 Trib2 (0.5-2')

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	0	
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0		
											Avg.Score	0	
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	0	

ITEM	VARIABLES												SCORE	Reference Source
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	0	
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		
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	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	0
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	4
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	4
											Avg.Score	4
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/ NRCS
	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	0
Grade (Right)	10	9	8	7	6	5	4	3	2	1	0	0
											Avg.Score	0
	Calculation of Function Capacity Index = Total Score/Total Possible Score											0.09
											FCI = #/80	
S8 Trib2 (0.5-2')												

III. HABITAT FUNCTIONS

ITEM VARIABLES

S8 Trib2 (0.5-2')

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

10 10 VEGETATIVE PROTECTION (SCORE EACH BANK)

	Optimal			Suboptimal			Marginal		Poor			Score	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, et al., 1992*
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			Score	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			Score	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 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	4	

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			4			
	SubCI	0	0	4			
Left Bank	%Riparian Area			100		100	
	Score			4			
	SubCI	0	0	4	0		
					SubCI=(%RA*Scores*0.01)		
					Rt Bank CI>	4	CI
					LT Bank CI>	4	4

Calculation of Function Capacity Index = Total Score/Total Possible Score 0.09

FCI = #/120

S8 Trib2 (0.5-2')

Record of Functional Assessment Results

Stream Functional Capacity Calculation

S8 Trib2 (0.5-2')

Date:	8/18/2006
Project:	Lake Ralph Hall
Assessment Area:	WP 12
Assessors:	Holmes Voight Capps
Project Status:	__X__Preproject ____Postproject

Major Function Categories	FCI	Stream Length (LF)*	Stream Characterization	Multiplication Factor**	FC
Hydrologic	0.04	602	E	0.00125	0.03
Water Quality Improvement	0.09	602	E	0.00125	0.07
Habitat	0.09	602	E	0.00125	0.07
Total	0.22	602			0.16

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

**Multiplication Factors

Ephemeral = 0.00125

Intermittent = 0.0025

Perennial = 0.0038

S8 Trib2 (0.5-2') facing upstream. 5/18/2006

S8 Trib2 (0.5-2') facing downstream. 5/18/2006

SWAMPIM DATASHEETS – SOUTH EPHEMERAL 0.5 TO 2.0' PRE-PROJECT

- **S10-TRIB2**

ITEM	VARIABLE FUNCTION CATEGORY	SCORE	Reference Source

S10 Trib2 (0.5-2')

1

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

Right bank- 15 meters to pasture, Left bank 15 meters to pasture. Small park area surrounded by pasture. Left bank has more trees.

WP 11
P 83, 82

20% canopy cover

S10 Trib2 (0.5-2')

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