

**D'OLIVE WATERSHED MONITORING STUDY
AND
DEVELOPMENT OF A WATERSHED CONDITION FRAMEWORK**



Prepared for

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1.0 INTRODUCTION

The Mobile Bay National Estuary Program (MBNEP) funded the project entitled, “D’Olive Watershed Monitoring Study and Development of a Watershed Condition Framework”, through an Alabama Department of Environmental Management (ADEM) EPA Section 319 (non-point source) funding grant. This report presents an evaluation of trends in biological condition and water quality related to D’Olive Watershed restoration management activities, and analyzes the cost-effectiveness and efficiency of the pre- and post-restoration monitoring performed to date. The goals of this project are:

1. To use a Biological Condition Gradient (BCG) framework to measure the ecological benefits of the D’Olive Watershed restoration program;
2. To develop a Watershed Condition Framework (WCF) to measure restoration success and management effectiveness; and
3. To determine the most cost-effective metrics and efficient methods for evaluating trends in habitat condition related to MBNEP watershed management efforts.

The D’Olive Bay Watershed has a drainage area of approximately 7,700 acres encompassing parts of the cities of Daphne and Spanish Fort as well as unincorporated Baldwin County, Alabama. Development in upland areas of the Watershed has resulted in an increased volume of stormwater runoff from impermeable surfaces; flashy hydrology; loss of natural wetlands and riparian areas; inadequate natural floodplains; and threats to aquatic and wildlife species survival and habitat. This change in land use has increased volume and velocity of urban stormwater flows which has resulted in severe downstream channel degradation in D’Olive Creek, Tiawasee Creek, Joe’s Branch, and their tributaries. Due to a combination of steep slopes and highly erodible soils coupled with intensive residential and commercial development, the natural systems of creeks and streams used to convey stormwater runoff are severely degraded. The sediment generated during this process deposits in wetlands located in downstream floodplains, resulting in alterations to stream morphology and hydrologic function; destruction of native vegetation and wildlife habitat in the area; and the proliferation of invasive plant species. As a result, the three primary streams in the watershed are currently on the State of Alabama’s Section 303(d) List of Impaired Waters, indicating they do not meet their designated use for propagation of fish and wildlife.

This report presents an evaluation of the success of the D’Olive Watershed Restoration Program, through an analysis of the quality of wetlands, streams, and riparian buffers at the restored sites and their adjacent areas, and throughout the broader watershed. This effort is intended to serve as a template for using biological condition, measures of management effectiveness, and cost-effective monitoring to evaluate delivery of ecosystem services in coastal Alabama watersheds.

2.0 BACKGROUND

2.1 D’Olive Watershed Restoration Projects

In 2010, the MBNEP and project partners developed a comprehensive watershed management plan (WMP) with the primary goals of: reducing sediment inputs into the Lake Forest Lake/D’Olive/Tiawasee system; reducing outgoing sediments loads into D’Olive Bay and the Mobile Bay estuary; remediating and restoring past effects of these sediment loads; and mitigating future impacts of development in the watershed (TET, 2010). Among the recommended management measures was implementation of a programmatic stream restoration approach for a sustained effort to halt the active head-cutting and channel erosion processes. The first funded project in Joes Branch

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was approved in 2012 and completed in 2013. MBNEP began restoration activities throughout the entire D'Olive Watershed with the planning and design of NFWF-funded projects in 2014, with construction beginning in 2015. The first of these was completed in late 2016 and the last in early 2019. Table 1-1 summarizes the project metrics. Project locations are presented in Figure 1-1.

The Program to date includes restoration/stabilization of 11,283 linear feet of streams with an associated 27.6 acres of riparian area. The projects have also restored 3.1 acres of wetlands (not including wetlands incidental to stream restoration). Additionally, stormwater (SWMF) facilities associated with the projects have increased retention/detention capacity of 123,900 cubic feet (not including the capacity added by stream restoration itself).

Table 1-1. Summary of D'Olive Watershed restoration projects and specifications.						
Project Name	Construction Start	Construction Substantial Completion	Stream Restoration Length (linear ft)	Floodplain Riparian Area (acres)	Wetlands Restored (acres)	SWMF Area (acres)/ Volume (ft ³)
Joe's Branch Phase 1	Oct. 2012	Apr. 2013	1,000	2.2	0.5	
Joe's Branch Phase 2	Apr. 2015	Nov. 2016	3,300	7.0		
J-SWMF						0.4/35,000
JB-SWMF						0.5/53,400
D4-D6	May 2016	Sep. 2016	2,714	9.0		
DA3	Oct. 2016	Feb. 2017	1,100	2.2	1.6	
DAE	Apr. 2017	Sep. 2017	420	1.2		
DAF, DAF1	Jan. 2019	Mar. 2019	535	0.5		
DAF-1A (Melanie Loop)	Apr. 2018	May 2018	490	1.6		
TC1-TC2, TC2 Trib.	Jan. 2016	Sep. 2017	1,724	3.9	1.0	0.3/35,500
<i>Restoration Projects Totals</i>			<i>11,283</i>	<i>27.6</i>	<i>3.1</i>	<i>1.2/123,900</i>

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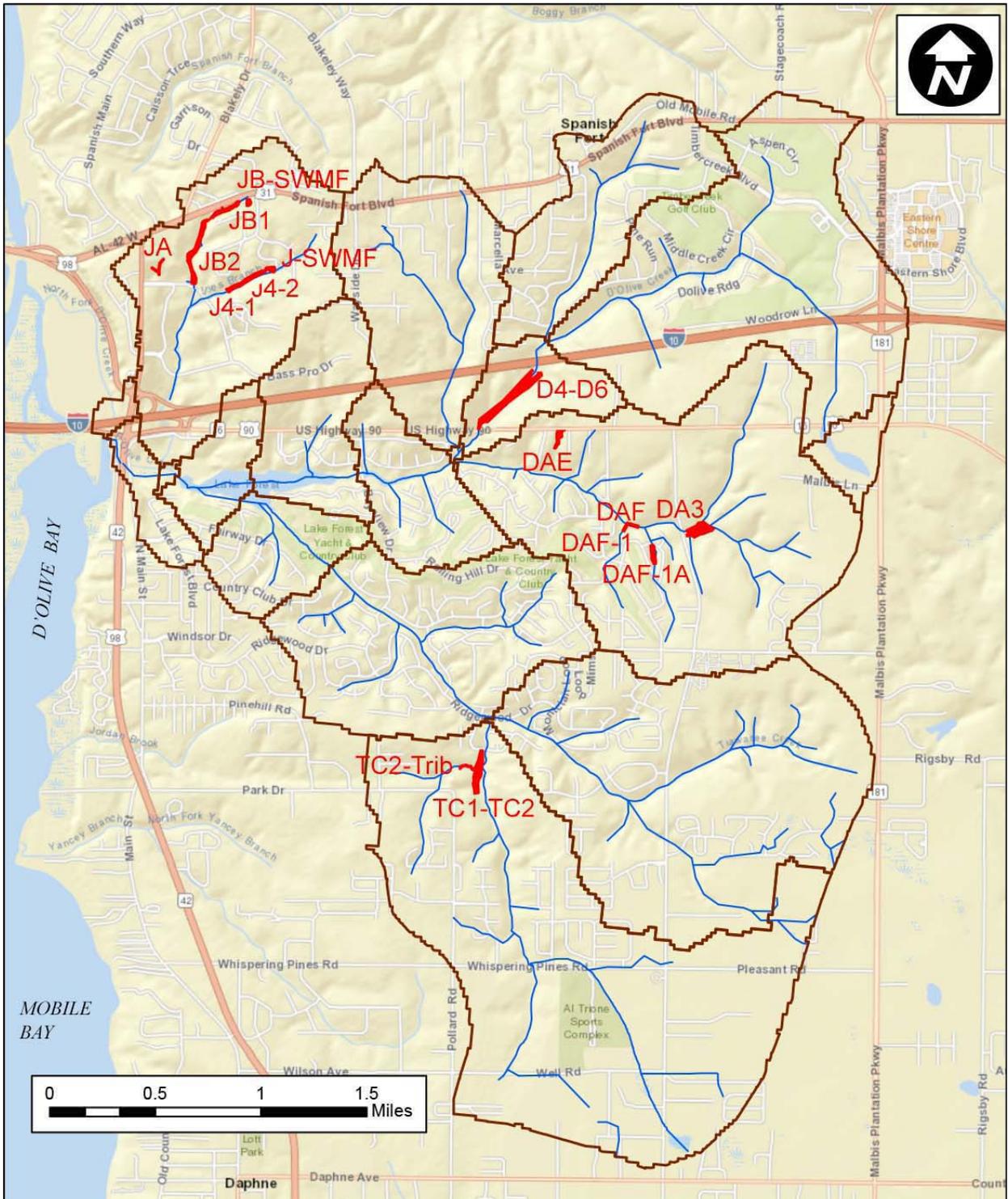


Figure 1-1. D'Olive Watershed restoration projects in Joes Branch (J), D'Olive Creek (D), and Tiawasse Creek (TC) sub-watersheds.

2.2 Developing a Watershed Condition Framework

A Watershed Condition Framework (WCF) can be used to track results and measure the success of management and restoration activities undertaken to improve the environmental condition of a priority watershed. The 2010 WMP classified the condition of the primary D'Olive stream systems as undergoing severe degradation due to development in upland areas of the watershed. A programmatic stream restoration approach first prioritized and then implemented integrated restoration projects in the Joes Branch, D'Olive Creek, and Tiawasse Creek sub-watersheds, for targeted improvement of stormwater management, water quality, and natural ecosystem function.

The United States Forest Service (USFS, 2011) developed a WCF approach describing three watershed condition classes that are directly related to the degree or level of watershed functionality or integrity, as follows:

- Class 1 = Functioning Properly.
- Class 2 = Functioning at Risk.
- Class 3 = Impaired Function.

A watershed in good condition is characterized as one that is functioning in a manner similar to natural conditions. The success of restoration on a whole-watershed scale can be assessed by a WCF, though demonstration of positive change in watershed classification moving from a degraded state to an improved condition, or higher quality watershed class (USFS, 2011). A watershed is considered to be functioning properly if the physical attributes are appropriate to maintain or improve biological integrity.

The MBNEP underwent a multi-year process developing environmental indicators to track management effectiveness and gauge progress toward meeting objectives and goals in its Comprehensive Conservation Management Plan. Toward that effort, the MBNEP Science Advisory Committee (SAC) developed a Biological Condition Gradient (BCG) framework of environmental assessment for evaluating and reporting on estuarine status and trends. The BCG framework describes the biological condition of priority coastal habitats along a continuum of stress, particularly impacts related habitat destruction and alteration. The SAC ranked the impacts of environmental stressors on the capacity of priority habitats to provide ecosystem services, which are broadly defined as benefits people receive from the natural environment. The evaluation determined that stressors having the most impact on the Alabama estuarine condition are land use, habitat fragmentation, dredging and filling, and sedimentation. The most imperiled habitats, based on stressor impacts on habitat function and the delivery of ecosystem services, are freshwater wetlands, tidal marshes and flats, and streams, rivers, and their riparian buffers.

The conceptual framework for the BCG is based on the relative proportion of Good (Tier 1), Fair (Tier 2), and Poor (Tier 3) conditions for a watershed, sub-watershed, habitat type, or stream reach of interest. The framework is focused on the ecological quality of wetlands, streams, and riparian buffers, which affect the estuarine condition through hydrologic and structural connectivity with receiving bays and bayous. BCG tiers are classified as follows:

- Tier 1 - Natural structure and function of biotic community maintained
- Tier 2 - Moderate impairments in structure and function
- Tier 3 - Major impairments in structure and function

Restoration of priority habitats requires monitoring the linkages between the restoration activities and the effect they have on aquatic habitat condition. The biological condition of wetlands, riparian buffers, and streams is typically measured using rapid assessment methods, which generate numeric expressions of habitat quality for comparison with calibrated reference standards. Using habitat quality indicators, the BCG framework has potential to be applied as a consistent approach for classifying habitat condition and tracking the effectiveness of environmental management. Successful restoration can be considered to have occurred when a biological condition tier is improved or maintained.

The BCG may be used in a WCF to determine if management activities in priority watersheds result in demonstrated improvement to stream and aquatic habitat conditions. A WCF may also be informed by measurable improvements in the physical aspects of restoration, such as more effective stormwater management or reductions in sediment loading.

3.0 METHODS

A tiered approach was used to assess the ecological condition of streamside wetlands and riparian buffers in the watershed, using landscape-scale (Level 1) and ground-level (Level 2) assessments. Level 1 assessment considers linkages among landscape components, such as land cover type and proximity to habitats and the restoration sites. Wetland and stream conditions were classified through field assessment and landscape analysis. For inaccessible locations and other areas not inspected in the field, assessment of stream and wetland locations and conditions were made through evaluation of adjacent land cover, prior observations, and best professional judgment.

3.1 Wetland and Stream Mapping

Baldwin County produced a wetland map in 2005 called the Wetland Advanced Identification Map, or ADID (Baldwin County Planning and Zoning Department, 2005), a modified USFWS National Wetland Inventory (NWI) map. For the D'Olive Watershed, the ADID wetland map was used for this study as a starting condition and updated using recent aerial imagery, 2011 LiDAR contour data, and field assessment to delineate wetland-upland boundaries. National Hydrology Dataset (NHD) catchments (i.e., sub-watersheds) and flowlines were used in the mapping assessment. Flowlines were modified in areas where LiDAR indicated an inaccurate horizontal location. Digital spatial data were analyzed in ArcGIS 10.3.7.

3.2 Field Assessment

Field surveys conducted by Vittor & Associates assessed the condition of streams, riparian buffers, and wetlands using rapid assessment methods. The surveys were focused on the Joes Branch, Tiawasse Creek, and D'Olive Creek sub-watersheds, principally at the restoration sites and along stream reaches upstream and downstream. Opportunistic observations and field assessments at accessible sites included reconnaissance of previously impacted wetland and riparian buffer habitats, including some locations that were evaluated during the 2010 WMP process.

Wetlands

Wetland Resources Environmental Consulting (2017) performed functional assessments of wetlands during the initial stages of D'Olive restoration monitoring (2015 to 2017). The assessments used the Wetland Rapid Assessment Procedure (WRAP) and a Floristic Quality Index (FQI) to measure

wetland quality at key sites in the watershed. Most of these sites were re-visited in 2018 and 2019 to generate field data for this study.

Wetland Rapid Assessment Procedure (WRAP) is a Level 2 assessment method used by the Mobile District Corps of Engineers for wetland permitting and mitigation in the Alabama coastal area. WRAP assesses six functional wetland values, including wetland hydrology, water quality input and treatment, wetland vegetation ground cover, wetland overstory/shrub canopy, adjacent upland buffer, and wildlife utilization. Each function is scored based on the field assessment, and a cumulative value for the condition of each wetland assessment area is generated. A variable score of 3 is considered the best a system can function and a 0 is for a system that is severely impacted and is exhibiting negligible attributes. The overall score is expressed as a percentage, ranging from 0% - 100%. Within the Mobile District wetland regulatory realm, WRAP scores of 0-50% (0.0 to 0.50) are considered Poor (low quality) wetlands; 51-75% (0.51 to 0.75) are Fair (medium quality); and greater than 75% (0.76 to 1.0) are Good (high quality). WRAP data sheets for the 2018 and 2019 field assessment sites are included in Appendix A.

The FQI employs a measure of conservatism (Coefficient of Conservatism) along with richness of a plant community to derive an estimate of habitat quality (Wilhelm & Ladd 1988, Lopez & Fennessy 2002). Coefficients of Conservatism (C values) for each plant species follow the wetland FQI for the Southeastern U.S. developed by the Southeast Wetlands Workgroup (Gianopulos 2014). A C value ranging from 0 to 10 is assigned *a priori* to individual wetland plant species by the Southeast Wetlands Workgroup to reflect tolerance to disturbance and fidelity to a particular habitat type or range of conditions. Native obligate wetland species are generally assigned higher C values, whereas plants with broad tolerances have lower values. Invasive species are assigned a C value of 0.

The FQI was performed at two locations. Compared to the WRAP, the FQI is a time-consuming method prone to generating inconsistent results, partly due to variable taxonomic expertise among field personnel. Moreover, the amount of time expended generating a plant species inventory for an assessment site, and hence the number of identified species, is not only time consuming but often generates lower scores due to a diversity bias inherent in the method. FQI scores at the two locations assessed with FQI in 2019 were similar to those generated in 2016 and 2017. FQI results for the field assessment sites are contained in Appendix A. The FQI assessment scores are presented in the following table.

Site	2016 FQI	2017 FQI	2019 FQI
JA	17.92	17.32	29.23
DA3	23.95	29.80	32.52

Rapid Stream Assessment

Vittor & Associates was tasked with researching and developing an approach to stream assessment that would allow monitoring personnel to make sound, but rapid judgments of general stream condition over time, specifically in relation to the restored areas of streams in the D'Olive watershed. A Rapid Stream Assessment (RSA) method was used to measure D'Olive stream condition, combining elements of established State-specific habitat assessments (HA), the Riparian Habitat Health Level Evaluation (RipHLE), Wetland Rapid Assessment Procedure (WRAP), and field biological observations. Most states have calibrated indexes of biological integrity (IBI) for assessing stream biological communities. The use of IBIs involves intensive macroinvertebrate sampling and

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time-consuming laboratory and data analysis. While complete bioassessment is probably the most effective method for assessing stream health in most situations, it can be cost-prohibitive.

Unlike an IBI, the RSA used for assessment of D'Olive streams does not determine a specific value by which stream health is compared to a pristine system. Rather, it is designed to relate conditions of specific stream reaches to other reaches in the same system, such as a restored stream reach and areas above and below the restoration. Applied consistently, it can be used to measure the relative condition of stream reaches through time.

ADEM (Alabama), FDEP (Florida), and MDEQ (Mississippi) have established procedures for stream habitat assessment. Methods differ among the states, but all generally score the same physical and biological aspects of a stream reach of interest. These aspects include available structure/habitat, characterizations of pools, sediments, stream channel, bank stability, and riparian buffer width and condition. The RSA used for this assessment focuses on stream condition as it is affected by channel alteration, sedimentation, habitat smothering, and stream flow velocity, since amelioration of these stressors is among the primary goals of D'Olive restoration management.

Most of the metrics included in the RSA are taken from typical stream assessment attributes, and have some overlap with the RipHLE and WRAP parameters. The RipHLE is a multi-metric approach, designed specifically for use in riparian forests in urban watersheds, using primarily vegetative biological indicators to establish riparian health. RipHLE results in the D'Olive monitoring were somewhat inconclusive for the relatively short study period (2 years), and some of the metrics utilized were deemed redundant by the author. While not all of the land surrounding the D'Olive Watershed streams is comprised of wetlands, the WRAP contains parameters that are useful in the development of this method for assessing overall stream and riparian conditions.

Table 3-1 presents a list of the metrics included in the RSA, and how they overlap with other multi-metric approaches to riparian zone and stream assessments. Table 3-2 presents the RSA attributes and their scoring criteria. The RSA is a combination of metrics taken directly from the other methods, primarily state-specific HAS.

Table 3-1. Metrics included in the Rapid Stream Assessment method (RSA) and overlap with the RipHLE and WRAP methods.			
Metric	RipHLE	HAS	WRAP
Riparian Buffer Width	*	*	
Riparian Vegetative Quality	* (Non-native Species)		*
Canopy Cover	*	*	
Local Watershed Erosion		*	
Sediment Deposition		*	
Habitat Availability		*	
Habitat Smothering		*	
Channel Alteration		*	
Channel Sinuosity		*	
Bank Stability	* (BEHI)	*	
Bank Vegetative Protection	* (BEHI)	*	
Macroinvertebrates			

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Table 3-2. Rapid stream assessment (RSA) metric and scoring criteria for the D'Olive watershed sampling stations, Spring 2019.			
Metric	Score Criteria		
Riparian Zone Width	Poor (0-9 m) +0	Moderate (9-18 m) +2	Good (>18 m) +4
Riparian Vegetative Quality	Poor (0-25% Native) +0	Moderate (25-75% Native) +2	Good (>75% Native) +4
Canopy Cover	Poor (<30%, 89-100%) +0	Moderate (30-50%) +2	Good (51-88%) +4
Local Watershed Erosion	Heavy +0	Moderate +2	Light +4
Sediment Deposition	Poor (>75% of bottom affected) +0	Moderate (25-75% of bottom affected) +2	Good (<25% of bottom affected) +4
Habitat Availability	Poor (<10% stable habitat) +0	Moderate (10-50% stable habitat) +2	Good (>50% stable habitat) +4
Habitat Smothering	Poor (>75% of habitat affected) +0	Moderate (25-75% of habitat affected) +2	Good (<25% of habitat affected) +4
Channel Alteration	Poor (Extensive channelization evident) +0	Moderate (Some channelization evident) +2	Good (No channelization evident) +4
Channel Sinuosity	Poor (Straight channel) +0	Moderate (Some bends in channel) +2	Good (Extensive bends in channel) +4
Bank Stability	Poor (>60% of banks unstable/eroding) +0	Moderate (30-60% of banks unstable/eroding) +2	Good (<30% of banks unstable/eroding) +4
Bank Vegetative Protection	Poor (<50% of streambank with vegetation) +0	Moderate (50-75% of streambank with vegetation) +2	Good (>75% of streambank with vegetation) +4
Macroinvertebrates Present	No +0	Yes +2	Yes +2
Identified Taxa*	Pollution Tolerant Taxa -2	Moderately Pollution Sensitive Taxa +2	Pollution Sensitive Taxa +4
*Taxa Examples	Midge Larvae Midge Pupae Black Fly Rat-tailed Maggot	Caddisfly Damsel fly Dragonfly Amphipods	Water Penny Stonefly Mayfly Riffle Beetle Dobson Fly

In some cases multiple metrics from the other methods are combined into single metrics in the RSA. The RipHLE includes the metric “Bank Erosion Hazard Index” (BEHI), which is a composite of several measurements of bank stability. Two of the metrics included in the RSA (Bank Stability and Bank Vegetative Protection) are similar to measurements found within the BEHI. In a natural system,

bank vegetative protection is an integral part of bank stability, so the two attributes are in general positively associated. The restored stream reaches in the D'Olive Watershed have been artificially created and recent, without well-developed vegetative cover, and the RSA distinguishes between bank cover and stability.

Several vegetative metrics from the WRAP are combined into the single metric of "Riparian Vegetative Quality", with a single estimate of percent native species. Instead of a larger range of numbers (0-20) usually used in stream habitat assessment, RSA attributes are scored as Poor (+0), Moderate (+2), or Good (+4), and the points summed and reported as a proportion of a 50-point maximum.

The RSA method includes qualitative, in-field assessment of stream biota. Stream macroinvertebrate communities can be extremely diverse with genera within the same family indicative of both healthy and degraded/polluted systems. There are certain families of macroinvertebrates that are generally all pollution sensitive (or moderately so), or pollution tolerant, and easy to identify. At each assessed stream reach, standard rapid bioassessment (RBA) methods were used to collect macroinvertebrates (e.g., using D-frame net sweeps), and the following parameters noted:

- Presence/absence of macroinvertebrates
- List of any pollution sensitive organisms
- List of any moderately pollution sensitive organisms
- List of pollution tolerant organisms

The RSA method is not designed to compare stream conditions to a calibrated standard, as in traditional habitat assessments and IBIs. Macroinvertebrate attributes were score based on presence (+2) or absence (+0), and if present scored as Poor (-2), Moderate (+2), or Good (+4) based on sensitivity to pollution (Table 3-2).

Streams assessment reaches were 100 meters long, except in cases where streams were constrained by roads or other impediments. The RSA results were compared to the Alabama Department of Environmental Management (ADEM) habitat assessment (HA) method, which was simultaneously performed at each stream assessment location. Figure 3-1 presents a comparison of the RSA and ADEM HA scoring, each scaled to their maximum achievable point total. The RSA and ADEM HA methods give similar results in terms of relative scores for different sites. Differences are due in part to a larger range of possible scores in the HA metric (up to 20) compared to the RSA (up to 4), because certain HA attributes were combined for the RSA methods, and due to inclusion of metrics found only in the RSA (e.g., macroinvertebrate criteria).

RSA and ADEM habitat assessment field data sheets are included in Appendix B. Photographs of the stream sampling sites are included in Appendix C.

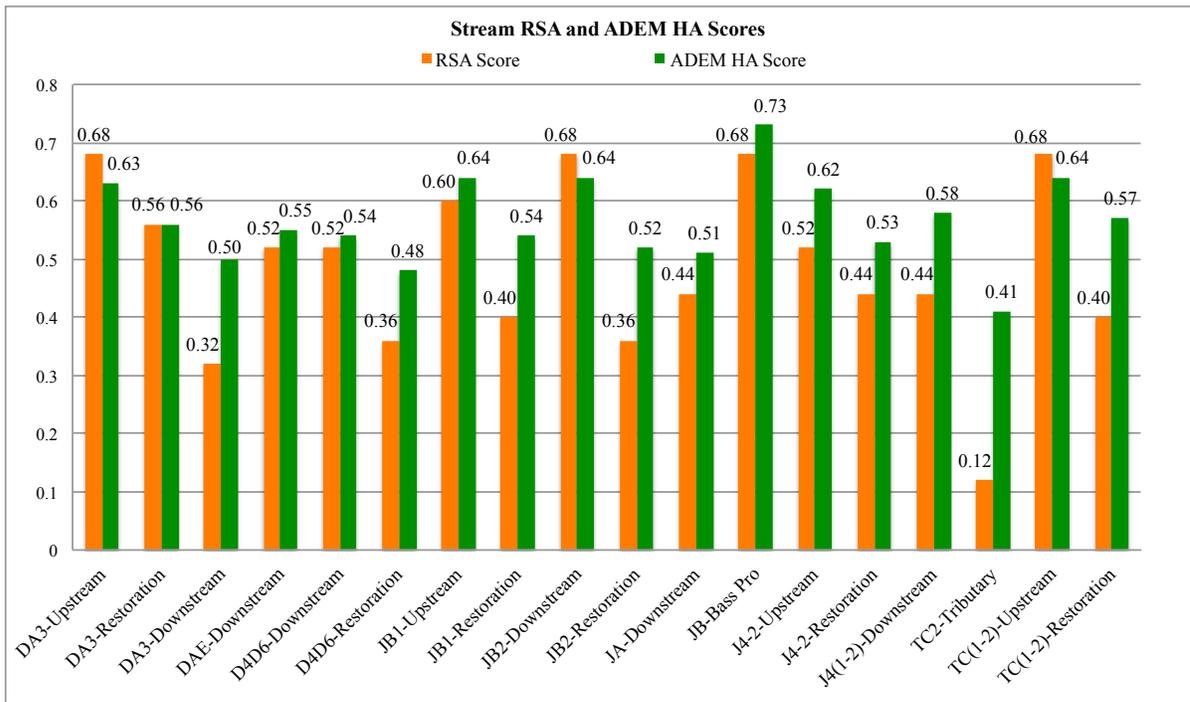


Figure 3-1. A comparison of the RSA and ADEM HA scores generated during 2019 D'Olive stream surveys.

3.3 Establishing a Baseline Ecosystem Condition

The 2010 D'Olive WMP (TET, 2010) presented information on the pre-restoration condition of streams, riparian areas, and wetlands at key locations in the watershed, including site photographs and observations, measurements, and narrative descriptions of ecosystem conditions. The Tetra Tech stream analysis included mapped locations where head-cutting, channel erosion, and sedimentation were occurring. Vittor & Associates generated a qualitative map of wetland condition based on site-specific information in the watershed. The WMP information was used to establish theoretical baseline scores in order to facilitate a condition trend analysis.

Baseline scores for the stream restoration sites were estimated using the TC2-Tributary restoration site as a model. This site scored lowest of all stream assessment locations in 2019, largely due to poor bank stability, bank vegetative protection, habitat availability, sediment deposition, and habitat smothering (Figure 3-2). The D'Olive restoration sites likely exhibited similar impairments prior to restoration efforts. The low RSA score observed at the TC2-Tributary site represents a good estimate of theoretical pre-restoration conditions.

Estimating baseline scores for the downstream sampling sites was more complicated without a clear surrogate. Based on the available information in the WMP, stream baseline scores were given lower scores for riparian buffer zone width, riparian vegetative quality, and canopy cover. These scores were based on pre-restoration observations that suggested that severe sediment deposition and habitat smothering had negative impacts on the plant communities in the riparian zone. Additionally, baseline scores for downstream sampling sites were given low ("poor") scores for local watershed erosion, sediment deposition, habitat availability, and habitat smothering.

Categories such as bank stability, bank vegetative protection, and channel sinuosity were less likely to be negatively impacted by the sedimentation issues addressed by restoration activities. For the purposes of baseline estimates, these scores were left unchanged from baseline to current (2019) scores. Upstream sites were unlikely to be impacted by restoration activities, and their baseline scores are presumed to be equivalent to the 2019 field-assessed scores, for both streams and wetlands. It is probable that macroinvertebrates were present during the pre-restoration, but no specific taxa (good or bad) were designated for the baseline scoring.



Figure 3-2. Restoration maintenance problems at the TC2-Tributary restoration site, Spring 2019.

Developing a baseline condition for wetlands is problematic because no good pre-restoration data are available for the D'Olive projects, including formal wetland delineations. The pre-restoration information for wetlands is largely qualitative. Site-specific WRAP and FQI assessments conducted as part of the restoration Program are relatively small-scale. The site-specific wetland data are not usable in developing condition baselines across broader areas, including at a sub-watershed level.

4.0 RESULTS

4.1 Wetland Assessment

Tables 4-1 through 4-3 presents WRAP scores by restoration sub-watershed. Figures 4-1 through 4-3 present wetland distributions and the locations of the field sites assessed for wetland quality. The highest quality wetlands in the watershed generally are associated with headwater areas on Malbis

Plantation properties above DA3 and on the main tributary to Tiawassee Creek, and the area upstream of the TC restoration site.

In the Joes Branch sub-watershed, highest quality wetlands are associated with Site J4, areas upstream and downstream of JB, and along the main stem of Joes Branch to the west of the Spanish Fort Town Center development. At J4, wetlands scored high for water quality input and treatment and upland buffers at the downstream end (J4), and for all six functional wetland values at the upstream end (J4-2). Upstream of JB, the headwater slope wetland scored highest for high quality ground cover, had a healthy overstory, and high quality wildlife habitat. Downstream of JB, the wetland scored highest for water quality input and treatment and relatively low for upland buffer condition.

Low WRAP scores in the Joes Branch sub-watershed are associated with restoration sites JA and JB. At JA, non-native exotics, including Chinese tallowtree, are present in both the canopy and subcanopy, and hydrology has been altered by commercial development and road construction. At JB, approximately 70% of the groundcover consists of exotics and transitional upland species. The canopy is immature, but has potential for good development, and several species of planted trees are still alive. Both JA and JB are just below the threshold for a condition class of Fair.

Sampling Station	2019 WRAP Score	Condition
JA-Restoration	0.49	Poor
JB-Upstream	0.83	Good
JB-Restoration	0.48	Poor
JB-Downstream	0.64	Fair
J4-Upstream	0.83	Good
J4-Downstream	0.71	Fair
JB-Bass Pro Shop	0.68	Fair

In the D'Olive Creek sub-watershed, the highest quality wetlands are associated with Malbis Plantation property upstream from the restoration site DA3. These wetlands scored high for vegetation quality and wildlife habitat, and have forested upland buffers providing good pre-treatment of water entering the system.

Site DA3 wetlands are classified as Fair (0.54), and scored highest for water quality input and treatment, and field hydrology. Because this site is recently restored, wildlife habitat is marginal due to limited canopy cover, and wetland ground cover is sparse compared to high quality wetlands.

Downstream at Acorn Knoll and Deciduous Court, fair quality wetlands occur at a drainageway leading to the DA tributary of D'Olive Creek. These wetlands scored high for wetland canopy and ground cover, and field hydrology. Human disturbance, vehicle traffic and barriers such as silt fence negatively affect wildlife utilization. A large portion of its drainage area has been removed by residential development, and has a low score for water quality input and treatment.

Restoration sites DAE and D4D6 have poor quality wetlands, though only marginally, with WRAP scores of 0.48 and 0.45, respectively. While both sites have little to no canopy cover, the planted trees at D4D6 have good potential for future condition improvement. D4D6 has a low functional value for ground cover, whereas DAE has a moderate ground cover score. With continued maturation, ground cover values at D4D6 are expected to improve. Both DAE and D4D6 have moderate scores for field

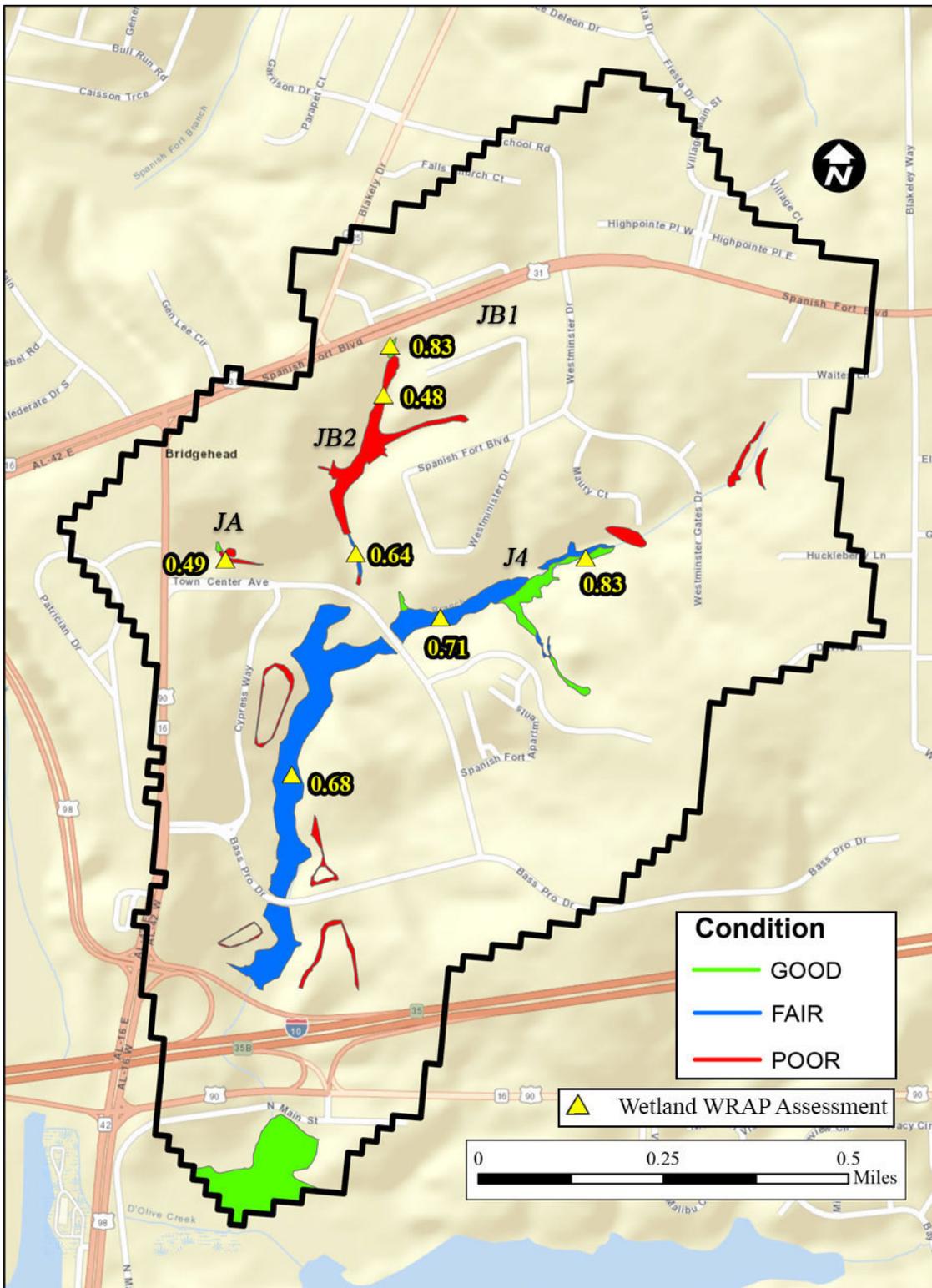


Figure 4-1. Wetland quality and WRAP scores in the Joes Branch sub-watershed.

hydrology and water quality input and treatment. The highest functional value at D4D6 is provided by its adjacent upland buffer, which is forested. The recently restored sites DAF, DAF1, DAF-1A were

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not inspected for this study. Predicted wetland conditions are Fair to Good for DAF and DAF1. The DAF-1A (Melanie Loop) site has wetlands predicted to be in Fair condition (Figure 4-1).

Sampling Station	2019 WRAP Score	Condition
D4D6-Restoration	0.45	Poor
DAE-Restoration	0.48	Poor
DA3-Restoration	0.54	Fair
Acorn Knoll at Deciduous Ct	0.67	Fair
MP-WRAP 6	0.88	Good
MP-WRAP 4	0.82	Good
MP-WRAP 3	0.63	Fair
MP-WRAP 1	0.96	Good
MP-WRAP 2	0.38	Poor

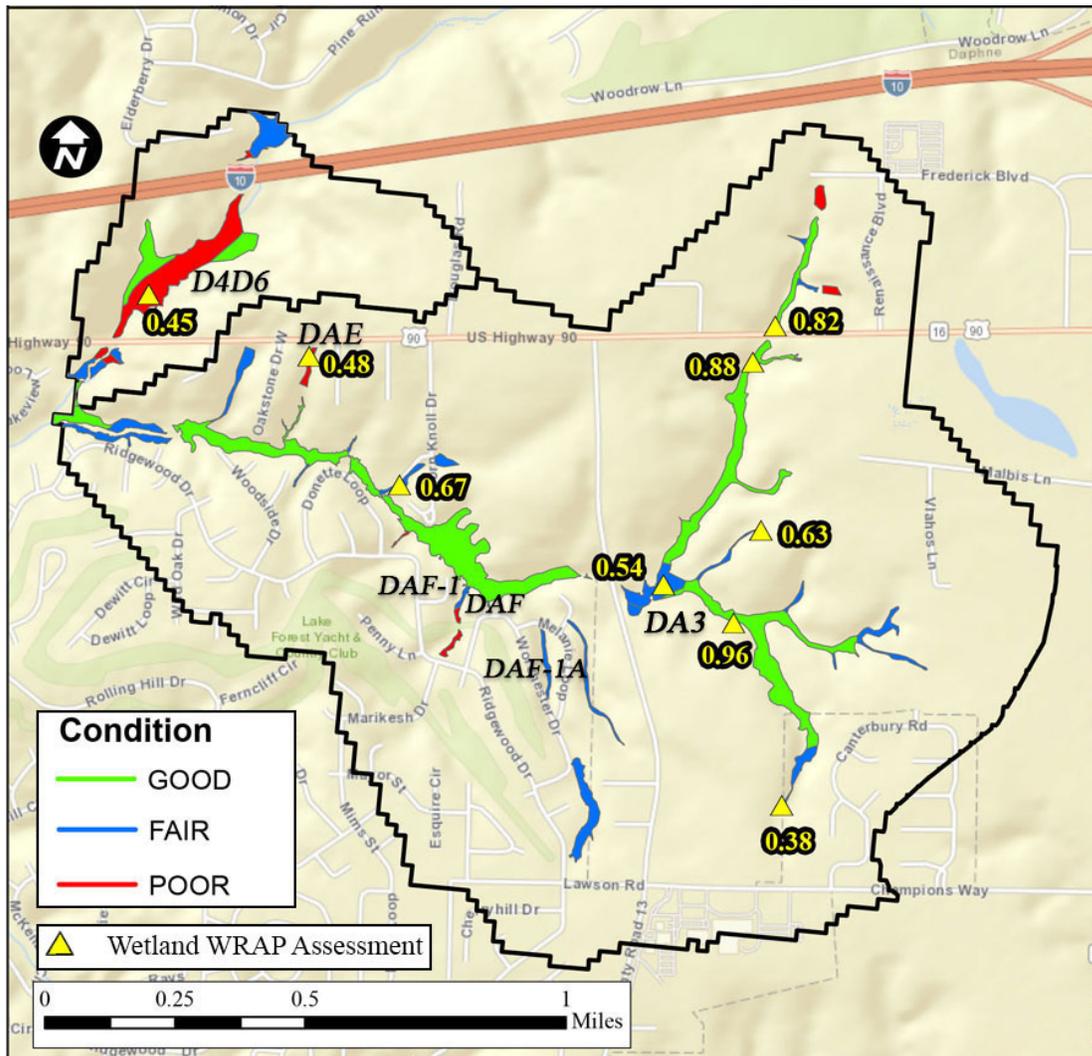


Figure 4-2. Wetland quality and WRAP scores in the D'Olive Creek sub-watersheds.

Restoration site TC1-TC2 wetlands are classified as Fair (0.61), and scored highest for upland buffer quality and water quality input and treatment. Wildlife habitat is marginal due to limited canopy cover, and wetland ground cover is sparse compared to high quality wetlands. With continued maturation, canopy and ground cover values at TC1-TC2 are expected to improve. The wetlands immediately upstream of TC1-TC2 are high quality, scoring high in all six WRAP functional values. The TC2-Tributary restoration site was inspected and its associated wetlands determined to have Poor condition.

Sampling Station	2019 WRAP Score	Condition
TC1-TC2-Restoration	0.61	Fair
TC1-TC2-Upstream	0.92	Good
TC2 Tributary-Restoration	N/A	Poor

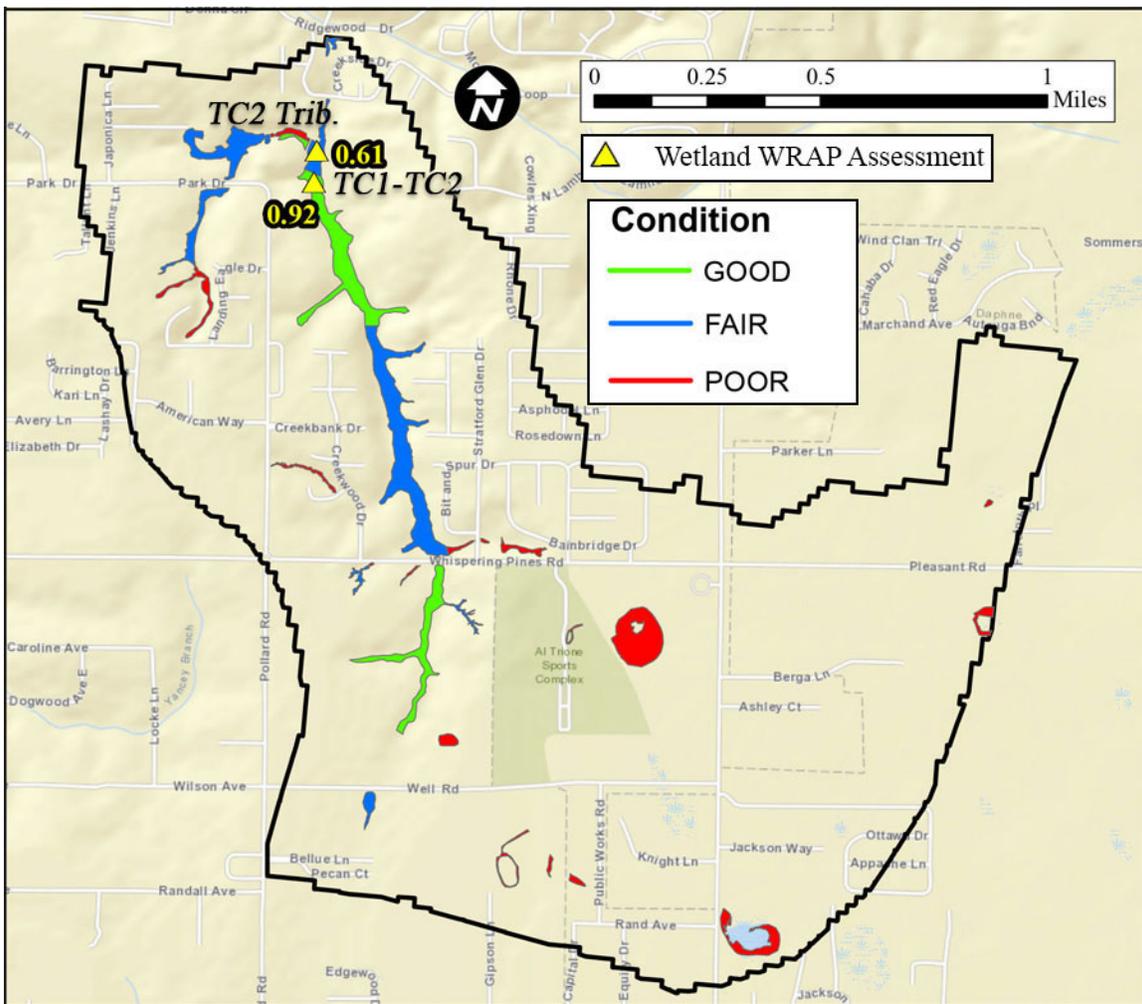


Figure 4-3. Wetland quality and WRAP scores in the Tiawasse Creek sub-watershed.

4.2 Stream Assessment

Tables 4-4 through 4-6 presents RSA scores by sub-watershed. Summary tables for the RSA results are provided in Appendix B. Figures 4-4 through 4-6 shows the locations of the field sites assessed for stream quality. In the Joes Branch sub-watershed, highest quality streams are associated with downstream areas of JB2 and along the main stem of Joes Branch to the west of the Town Center development (Table 4-4). These stream reaches scored “good” for riparian zone width, canopy cover, and channel alteration. The Bass Pro reach also scored “good” for channel sinuosity and habitat smothering.

Table 4-4. Stream RSA scores at sites in the Joes Branch sub-watershed.		
Sampling Station	2019 RSA Score	Condition
JB1-Upstream	0.60	Fair
JB1-Restoration	0.40	Poor
JB2-Downstream	0.68	Fair
JB2-Restoration	0.36	Poor
JA-Downstream	0.44	Poor
JB-Bass Pro Shop	0.68	Fair
J4-Upstream	0.52	Fair
J4-Restoration	0.44	Poor
J4-Downstream	0.44	Poor

The restoration sites in the Joes Branch sub-watershed had Poor stream conditions, including at JB1 (RSA=0.40), JB2 (0.36), and J4 (0.44). All three sites had “poor” scores for canopy cover and riparian zone width. The JB2 site had “poor” scores for channel alteration and sinuosity, whereas JB1 and JB4 had “moderate” scores for these two metrics. All three sites had “moderate” scores for sediment deposition and habitat smothering. The JA Downstream site is essentially a drainage ditch with good riparian buffer width and canopy cover, but received “poor” scores for channel sinuosity, habitat availability and smothering, and sediment deposition. Two upstream sites in Joes Branch, at JB1 and J4, are in Fair condition, with RSA scores of 0.60 and 0.52, respectively.

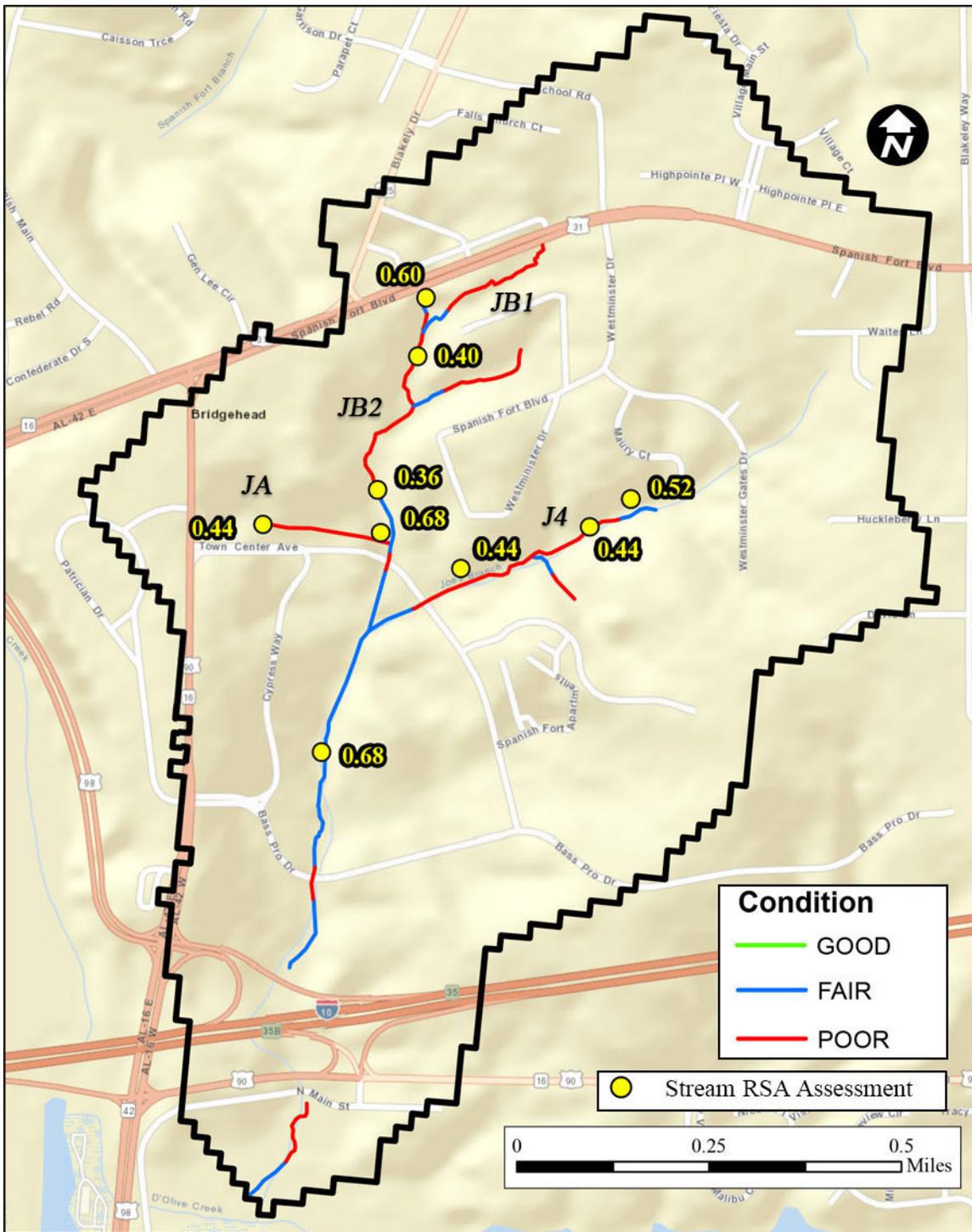


Figure 4-4. Stream quality and RSA scores at sites in the Joes Branch sub-watershed.

In the D'Olive Creek DA Tributary sub-watershed, highest quality streams are associated with Malbis Plantation property upstream from restoration site DA3. The DA3 Upstream location scored “good” for riparian zone width, vegetative quality, canopy cover, channel alteration, and habitat smothering (Table B).

The condition of Site DA3 is classified as Fair (0.54), and scored “good” for sediment deposition and habitat smothering. DA3 scores poorly for canopy cover and riparian zone width, reflecting its recent construction and initial stage of development. Stonefly and caddisfly larvae, insects with high pollution sensitivity and moderate pollution sensitivity, respectively, were collected at DA3, improving its condition score.

West of CR13, the DA3 downstream site scored poorly in several categories, including for channel sinuosity, bank stability, bank vegetative protection, sediment deposition, and habitat smothering. A 250-ft (76-m) reach of this portion of the DA Tributary does not have associated wetlands.

Sampling Station	2019 RSA Score	Condition
DA3-Upstream	0.68	Fair
DA3-Restoration	0.56	Fair
DA3-Downstream	0.32	Poor
DAE-Downstream	0.52	Fair
D4D6-Restoration	0.36	Poor
D4D6-Downstream	0.52	Fair

Downstream of restoration site DAE, the stream has a Fair condition (0.52), with “good” scoring for riparian zone width, vegetative quality, and canopy cover. The site scored poorly for habitat availability and sediment deposition, and “moderate” for bank vegetative protection and habitat smothering. The D4D6 downstream site also scored Fair (0.52), and was similar to DAE downstream with respect to sediment deposition (“poor”), but has better stream habitat availability and yielded two macroinvertebrate taxa (damselfly and dragonfly) with moderate pollution sensitivity, increasing its overall condition score.

The D4D6 restoration site has poor stream quality, with “poor” conditions for bank vegetative protection, canopy cover, and riparian zone width, reflecting the recent construction of the site. D4D6 is rated “good” for stream bank stability, and receives “moderate” scores for channel sinuosity, channel alteration, bank vegetative protection, habitat availability, and habitat smothering.

Restoration Sites DAF, DAF-1, AND DAF-1A were not field-inspected. Stream condition is predicted to be Fair at DAF and DAF-1A (Melanie Loop). DAF-1 is assigned a condition of Poor.

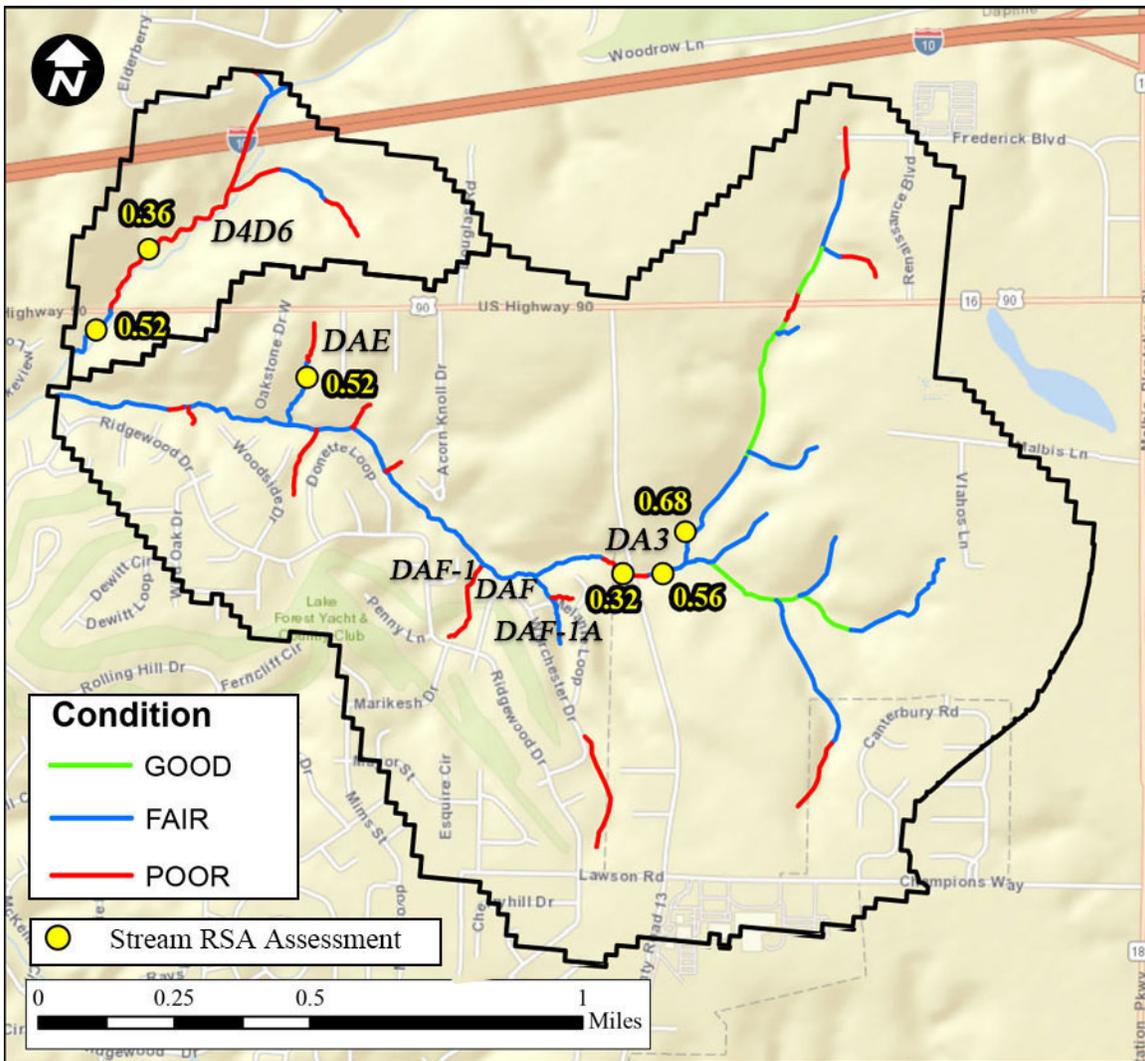


Figure 4-5. Stream quality and RSA scores at sites in the D'Olive Creek sub-watersheds.

The TC1-TC2 restoration site is classified as Poor (0.40), primarily due to “poor” scores for riparian zone width, canopy cover, and channel alteration. The site receives a “good” score for bank stability, and “moderate” scores for sediment deposition, habitat smothering, habitat availability, channel sinuosity, and bank vegetative protection. The reach upstream of TC1-TC2 is classified as Fair quality (0.68), scoring high for riparian zone width, canopy cover, and macroinvertebrate taxa.

The TC2-Tributary restoration site scored lowest of all stream assessment locations in 2019, largely due to poor bank stability, bank vegetative protection, habitat availability, sediment deposition, and habitat smothering.

Sampling Station	2019 RSA Score	Condition
TC1-TC2 -Upstream	0.68	Fair
TC1-TC2 -Restoration	0.40	Poor
TC2-Tributary Restoration	0.12	Poor

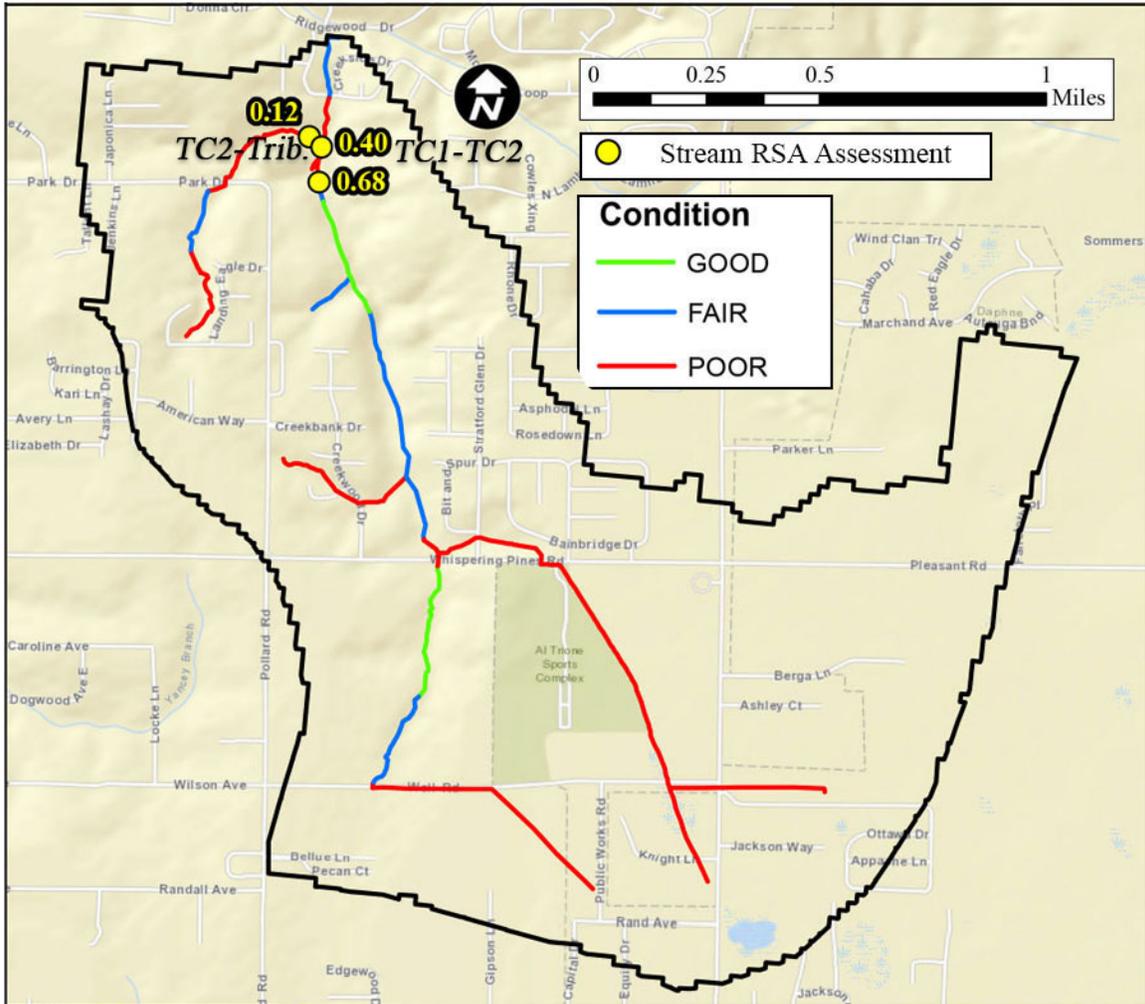


Figure 4-6. Stream quality and RSA scores at sites in the Tiawasse Creek sub-watersheds.

Table 4-7 summarizes the stream fauna sampling results for all RSA stations. Moderately pollution sensitive macroinvertebrates were collected at restoration sites JB2, J4, DA3, and TC1-TC2, indicating good benthic community development since the sites were completed. Macroinvertebrate community observations were variable at downstream sampling sites, with some sites having very few, stress-tolerant invertebrates collected, and others having a more diverse invertebrate community that included more sensitive species.

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Table 4-7. Stream fauna collected or observed at RSA sampling locations.

Sampling Station	Macroinvertebrates			Crayfish, Vertebrates
	Pollution Tolerant	Mod. Pollution Sensitive	Pollution Sensitive	
JB1-Upstream				
JB1-Restoration	√			
JB2-Downstream		√		√
JB2-Restoration	√	√		
JA-Downstream		√		
J4-Upstream	√	√		
J4-Restoration	√	√		
J4-Downstream	√	√		
JB-Bass Pro Shop				
DA3-Upstream				√
DA3-Restoration	√	√	√	
DA3-Downstream	√			
DAE-Downstream	√			
D4D6-Restoration	√			
D4D6-Downstream		√		
TC-Trib. Restoration	√			
TC-Upstream		√		√
TC1-TC2- Restoration	√	√		

4.3 Trend Analysis

Wetlands

Table 4-8 presents the WRAP scores generated since 2016 at and near the D'Olive restoration sites. The measured wetland qualities are relatively stable throughout the assessment period. Scores at Site J4 in Joes Branch, downstream from the J4-1 and J4-2 restorations, show consistently fair quality. These wetlands were identified in the 2010 WMP as being associated with a stream segment with high potential for future degradation. The J4-1 and J4-2 restorations appear to have stabilized this location.

Table 4-8. WRAP scores generated since 2016 at and near the D'Olive restoration sites.

Assessment Location	2016 WRAP	2017 WRAP	2019 WRAP	% Change
J4-1-2	0.72	0.72	0.71	-1.4 %
JA	0.44	0.44	0.49	+11.4 %
JB	0.39	0.42	0.48	+23.1 %
DA3	0.66	0.60	0.54	-18.2 %
D4-D6	0.42	0.53	0.45	+7.1 %
TC1-TC2	0.61	0.64	0.61	-

Restoration Sites JA and JA, also in Joes Branch, still have poor quality, but both show an upward trend in WRAP scoring. Both JA and JB are just below the threshold for a condition class of Fair.

Much of the groundcover at JB consists of invasive exotic species, and the canopy is immature, but with additional management and maturation the site has good potential for improved condition.

Site DA3 has shown a consistently fair condition, with some measured deterioration since 2016. With further maturation this site should improve in the quality of its canopy, ground cover, and wildlife habitat. Site D4D6 has poor quality wetlands, though only marginally, with a current WRAP score of 0.45. This site presently has little to no canopy cover, but its planted trees and expected natural recruitment, including for ground cover, should result in future condition improvement.

In the assessment for the 2010 WMP, the Joes Branch wetland adjacent to the Bass Pro Shop at Spanish Fort Town Center was among the most degraded areas in the entire D'Olive Watershed. This section of Joes Branch was severely impacted by sedimentation, with approximately 50% of the mature, native canopy trees are dead or dying, and the understory dominated by exotic species. The habitat provided very little cover for any endemic species, due to the extreme amount of silt accumulation and subsequent denuding of the lower vegetative strata. Review of available aerial imagery shows large areas of bare sediment and mostly dead canopy trees as recently as 2013.

Based on the 2009-2010 field surveys, and subsequent reconnaissance of the site, a baseline WRAP score of 0.32 (Poor) was developed for the Bass Pro Shop wetlands. In comparison, the 2019 field assessment generated a WRAP score of 0.68 (Fair) (Table 4-1). Large increases have occurred in the functional values for this wetland. While there remains a high prevalence of exotics like Chinese tallowtree and privet seedlings, approximately 65% of the current groundcover is comprised of native wetland species. The native wetland canopy trees still show signs of past siltation, but around 75% of canopy cover is made up of native wetland species, although not fully mature. There remains some competition from exotics such as Chinese tallowtree at the site.

At a sub-watershed scale, the proportion of good, fair, and poor wetland conditions was calculated based on the total acreage for each 2019 condition class (Table 4-9). D'Olive Creek (DA Tributary) has the best overall wetland conditions at 0.88 (Good). D'Olive Creek (D4D6) has the lowest overall quality, at 0.57 (Fair).

Sub-Watershed	2019 Condition ¹
Joes Branch	0.70
D'Olive Creek	0.57
D'Olive Creek (DA)	0.88
Tiawasse Creek	0.66

¹0.51 to 0.75=Fair quality; 0.76 to 1.0=Good.

Streams

Figure 4-7 presents the baseline RSA and 2019 RSA scores for the assessed stream reaches. Appendix B includes the complete per-category breakdown for the RSA scores. Compared to the 2019 RSA, baseline conditions for the restoration sites were generally given higher scores for riparian buffer zone width and canopy cover, but low for local watershed erosion, sediment deposition, habitat availability, habitat smothering, bank stability and bank vegetative protection. Baseline scores for the restoration sites averaged 12 points (ranging from 8 to 20 points) below the 2019 site scores.

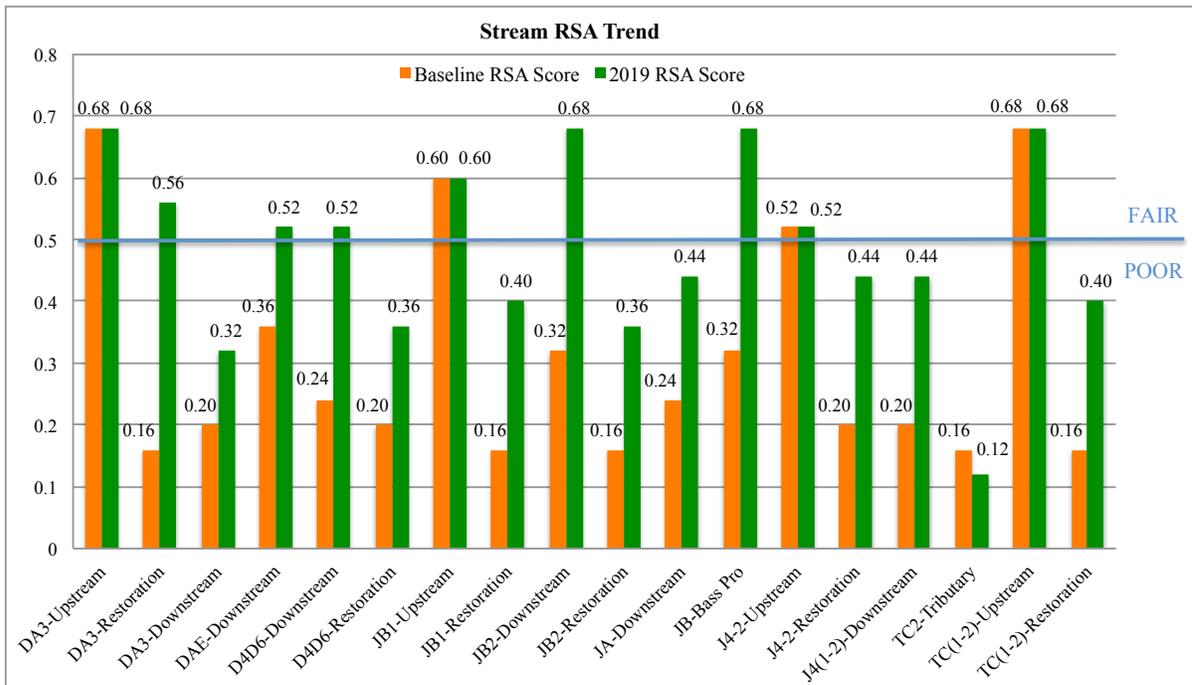


Figure 4-7. Comparison of baseline and 2019 RSA scores.

One restoration site (DA3), two downstream reaches in Joes Branch (JB2, Bass Pro) and two downstream reaches in the D'Olive subwatersheds (DAE, D4D6), are improved from baseline Poor to restored Fair classification. Site DA3 had the greatest overall increase in condition. The increase in stream reach quality at these sites suggests that restoration activities have resulted in measurable decreases in sediment loads being transported downstream, with corresponding improvements in habitat condition.

The JB Bass Pro Shop site scored well in terms of current stream condition and improvement relative to the other sampling sites. The large decrease in sediment loading originating upstream of this reach (Cook, 2019) has resulted in large improvements to stream habitat (Figure 4-8). The site scored well (“moderate” to “good”) in the categories of habitat availability, sediment deposition, habitat smothering, and bank stability. The favorable scores for these categories, compared to previous observations, show a clear link between restoration efforts upstream, and improved downstream condition.



Figure 4-8. Joes Branch stream and wetland habitat at Bass Pro Shop.

At a sub-watershed scale, the proportion of good, fair, and poor stream conditions was calculated based on the total stream feet for each condition class, for both baseline and 2019 conditions. Overall stream condition has improved on a sub-watershed scale only in the Joes Branch catchment, largely due to the improvement in the Bass Pro Shop reach (Table 4-10). The other restoration sub-watersheds have not to date shown a condition class increase, though the DA tributary of D'Olive Creek, which includes multiple restoration sites, is currently in fair condition.

Much of the upper portions of Tiawassee Creek sub-watershed include poor quality stream reaches that traverse developed areas and farm fields. If these areas were removed from consideration of overall stream quality, the overall Tiawassee sub-watershed condition score would be improved.

Table 4-10. Stream condition at a sub-watershed scale, based on the proportion of Good, Fair, and Poor stream reach conditions.				
Sub-Watershed	Baseline Score	2019 Score	Change	Condition ¹ Class Increase
Joes Branch	0.38	0.51	+0.13	√
D'Olive Creek (D4D6)	0.41	0.44	+0.03	
D'Olive Creek (DA)	0.59	0.63	+0.04	
Tiawassee Creek	0.49	0.49	-	

¹0.0 to 0.50=Poor quality; 0.51 to 0.75=Fair quality.

5.0 MEASURING RESTORATION SUCCESS

A primary objective of the D'Olive Restoration Program is to improve watershed habitats that had been adversely impacted or were threatened by future stream erosion and altered hydrology. The Program was implemented to halt the impairment and destruction of these natural areas, to maintain their provision of environmental services and benefits.

Streams in the Joes Branch sub-watershed have improved to a BCG Tier 2 (Fair) condition from a pre-restoration Tier 3 (Poor) condition. The large reductions in sediment loading provided by the Joes Branch restoration projects documented by Cook (2019) has led to improvements in downstream habitat quality. Wetland quality has been improved in some areas (e.g., Bass Pro Shop) and maintained in others (e.g., J4). For Joes Branch, a Watershed Condition Framework (WCF) classification is improved from Class 3 (Impaired Function) to Class 2 (Functioning at Risk), based on the BCG tier improvement, the amelioration of erosion and sedimentation, and improved stormwater management. Continued risk is due to anticipated future development in the Joes Branch sub-watershed.

Wetlands in the D'Olive Tributary DA sub-watershed are in good condition overall (0.88). Stream condition is Fair (0.63). Of the restoration sites, DA3 is in Fair biological condition. The site is expected to improve in quality as it matures. DA3 has also halted two active head-cuts, maintaining and protecting higher quality habitat upstream. Stream conditions below DAE are classified as Fair. While some of the DA Tributary projects are in an early restoration maintenance phase, all projects are complete and the habitat trajectory is positive. A WCF classification in this sub-watershed is maintained at Class 2.

Site D4D6 has poor quality wetlands, though only marginally. The D4D6 stream condition is classified as Poor (0.44). Both wetland and stream conditions at D4D6 are expected to improve as the site matures. With the continued condition improvement anticipated for Site D4D6, the WCF classification for the D'Olive Creek sub-watershed has been maintained at a WCF Class 2 as a result of the restoration.

The T1-T2 restoration stream reach currently has Poor quality (0.40) and its associated wetland area is classified as Fair (0.61). The stream condition is improved compared to the pre-restoration condition. Stream and wetland conditions at T1-T2 are expected to continue to improve through time. Due to the T1-T2 restoration, the upstream reach of Tiawasse Creek and its associated good quality wetlands are being protected and maintained. The TC Tributary restoration site has some maintenance issues that need to be addressed, but the size of the deteriorated area is relatively small. On a watershed scale, the WCF classification for the Tiawasse Creek sub-watershed has been maintained at Class 2.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In general, stream reaches assessed upstream of the restoration sites scored higher than the restoration sites themselves or their immediate downstream reaches. Upstream reaches generally had “moderate” to “good” riparian buffer zone widths, riparian vegetative quality, channel sinuosity, bank stability, and bank vegetative protection. Restored stream reaches overall had relatively poor scores for riparian buffer zone width and canopy cover, and in some for instances for channel alteration and bank vegetative protection. Plant community attributes are expected to improve in condition as the restoration sites develop and mature.

Results for downstream reaches were variable, but their overall RSA scores were similar to or higher than the restoration areas. This was generally due to greater riparian buffer zone width and canopy cover along the downstream reaches. Scores for sediment deposition were generally poor at downstream sites, but most have moderate scores for habitat smothering, suggesting that active sedimentation that was occurring pre-restoration has decreased and new habitat is developing.

Macroinvertebrates in stream restoration reaches reflected generally good water quality and habitat availability. Restoration activities (placement of logs, rocks, step pools) appear to have enhanced bank stability to provide habitat for a range of species. The presence of moderately pollution tolerant macroinvertebrates at four of the restoration sites suggests improvement compared to pre-restoration conditions.

The Rapid Stream Assessment method was designed to provide a measure of the relative condition among restoration sites and their upstream and downstream areas, and assess condition changes through time. For the D'Olive Program, metrics were chosen based on the goals of restoration to focus primarily on erosion, sediment deposition, and habitat smothering. The initial results suggest the RSA can provide a sound method of estimating and comparing stream conditions without the use of time-consuming, costly assessment techniques. Future assessments at the D'Olive restoration sites have potential to better determine the efficacy of the RSA method in detecting temporal changes in stream condition.

The D'Olive restoration projects were designed primarily to accommodate increased stormwater volume and slow runoff velocity, and halt head-cutting and erosional process, not to necessarily return the restoration streams to a natural state. Multiple locations show apparent improvement in downstream condition, especially in the Joes Branch sub-watershed. Halting the pre-restoration erosion and sedimentation has allowed the downstream reach and wetlands in Joes Branch to begin restoring naturally the highly degraded habitats that occurred prior to project implementation.

In the D'Olive Creek sub-watershed, which encompasses Site D4D6, broad-scale improvement to watershed wetland and stream condition is likely to lag the completion of the restoration by several years. More recent restoration projects at DAF, DAF1, and DAF-1A are still in an early post-construction maintenance period. These sites were not inspected as part of this study, and inspections during the maintenance period should include at least qualitative assessment of habitat condition, if not RSA and WRAP/FQI assessments.

Many of the restoration sites are heavily overgrown with blackberries, greenbriers, and other shrubs that make detection of herbaceous groundcover difficult. Species diversity was also extremely high in these areas, with numerous weedy (often non-native) early colonizing winter annuals characteristic of disturbed sites. The large number of species makes the recording of all species present very difficult over large areas, rendering the FQI method difficult and time-consuming. For plant community monitoring, consideration should be made for establishing permanent sampling plots for restoration sites and other monitored locations.

The removal of vegetation and the resulting bare ground at the restoration sites has allowed for rapid colonization by invasive exotic species, which are spreading into the adjacent natural areas both up and down stream. Several areas bordering the restoration sites are forested seepage slope wetlands with very good groundcover and a healthy canopy of healthy large trees, including locally uncommon species such as American Beech at JB1 and JB2. An invasive plant management program should be considered for implementation in the D'Olive Watershed.

7.0 REFERENCES CITED

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APPENDIX A - Wetland Rapid Assessment Procedure (WRAP) Data Sheets

WRAP ID

JA - WRAP 15

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (April, 2019), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forested Land), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (1.5), Wetland Canopy (O/S) (0.5), Wetland Ground Cover (1.5)

Habitat Support Buffer table, Field Hydrology (HYD) (2), WQ Input & Treatment* (1.5)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals

Pretreatment Category (PT) table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals

WRAP Score

0.49

Field Notes:

Field Notes sections: Wildlife Utilization (WU), Wetland Canopy (O/S), Wetland Ground Cover, Habitat Support/Buffer, Field Hydrology (HYD), WQ Input & Treatment

WRAP ID

JB 1 - Upstream

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Undeveloped Forested), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (2.5), Wetland Canopy (O/S) (2.5), Wetland Ground Cover (3)

Habitat Support Buffer table, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (1.875)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.83

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID

JB - WRAP 13

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (April, 2019), Evaluator (David Knowles), Wetland Type (PSS - Headwater Slope)

Land Use (Stream Restoration Site), Description/Notes (Phase I of Upper Joe's Branch Tributary), Wetland Acreage

Wildlife Utilization (WU) (1.5), Wetland Canopy (O/S) (1.5), Wetland Ground Cover (0.5)

Habitat Support Buffer table, Field Hydrology (HYD) (1.5), WQ Input & Treatment* (2.125)

Habitat Support Buffer table with columns: Buffer Type, (Score) X, area(0-1.0), Sub Totals

Total 1.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals

Pretreatment Category (PT) table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals

WRAP Score 0.48

Field Notes:

Field Notes table with sections: Wildlife Utilization (WU), Wetland Canopy (O/S), Wetland Ground Cover, Habitat Support/Buffer, Field Hydrology (HYD), WQ Input & Treatment

WRAP ID

J4 Downstream - WRAP 17

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (April, 2019), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes (Contains Perennial Stream), Wetland Acreage

Wildlife Utilization (WU) (2), Wetland Canopy (O/S) (2), Wetland Ground Cover (2)

Habitat Support Buffer, Field Hydrology (HYD) (2), WQ Input & Treatment* (2.5)

Table with columns: Buffer Type, (Score) X, area(0-1.0), Sub Totals. Rows include >300ft of, forested upland buffer, Residential, and Total (2.25).

Table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals. Rows include Silviculture, Detention, Pond, and LU Total (2.25).

Table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals. Rows include Nat Undev., Wet Detention, and PT Total (2.75).

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

WRAP Score

0.71

Field Notes:

Wildlife Utilization (WU)
Wetland is utilized by fauna of several different Phylum and Class. The wetland and buffers to North, west and south provide high quality habitat. The stream running thru the wetland offers habitat for aquatic species. There is a subdivision located east of the wetland which detracts slightly from its utility for wildlife. Corridors are cut off by the busy roadway to the SE.

Wetland Canopy (O/S)
The wetland canopy/shrub strata provides cover for wildlife, is healthy, but is somewhat immature and contains Chinese tallowtree.

Wetland Ground Cover
Ground cover is mostly appropriate for the system being evaluated (several species of OBL ferns); however, there were fairly significant numbers of exotic species seedlings emerging on the forest floor, and other non-native ferns are present as well.

Habitat Support/Buffer
The upland buffers (300+ ft wide on three sides) provide good support to wildlife and act as a decent buffer to the wetlands (slowing runoff).

Field Hydrology (HYD)
It is a groundwater driven system, and there is hydrology to support some wetland vegetation. Hydrology has been altered by changes in the drainage area.

WQ Input & Treatment
Surrounding landuse provides for decent pre-treatment of water entering the wetland system (forested, sandy hillslopes and wet detention up-stream).

WRAP ID

J4 Upstream - WRAP 16

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (April, 2019), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes (Contains Perennial Stream), Wetland Acreage

Wildlife Utilization (WU) (2.5), Wetland Canopy (O/S) (2.5), Wetland Ground Cover (2.5)

Habitat Support Buffer, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (2.625)

Table with columns: Buffer Type, (Score) X, area(0-1.0), Sub Totals. Rows include >300ft of, forested upland buffer, Residential.

Total 2.25

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals. Rows include Silviculture, LU Total 2.50

Table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals. Rows include Nat Undev., Wet Detention, PT Total 2.75

WRAP Score

0.83

Field Notes:

Wildlife Utilization (WU)
Wetland is utilized by fauna of many different Phylum and Class. The wetland and buffers to North, west and south provide high quality habitat.

Wetland Canopy (O/S)
The wetland canopy/shrub strata provides cover for wildlife, is healthy, shows signs of natural re-gen.

Wetland Ground Cover
Ground cover is mostly appropriate for the system being evaluated (several species of OBL ferns).

Habitat Support/Buffer
The upland buffers (300+ ft wide on three sides) provide good support to wildlife and act as a decent buffer to the wetlands (slowing runoff).

Field Hydrology (HYD)
It is a groundwater driven system, and there is adequate hydrology to support wetland vegetation.

WQ Input & Treatment
Surrounding landuse provides for decent pre-treatment of water entering the wetland system (forested, sandy hillslopes and wet detention up-stream).

WRAP ID

JB Bass Pro - WRAP 20

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location
West of Cypress Way and
Adjacent to Bass Pro Shop
Development.

Application Number, Project Name (NEP - D'Olive Creek), Date (6/19/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Natural Forested), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (2), Wetland Canopy (O/S) (2), Wetland Ground Cover (2)

Habitat Support Buffer table, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (1.775)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score (0.68)

Field Notes: Wildlife Utilization (WU), Wetland Canopy (O/S), Wetland Ground Cover, Habitat Support/Buffer, Field Hydrology (HYD), WQ Input & Treatment

WRAP ID

DA-3 WRAP

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (4/17/19), Evaluator (David Knowles), Wetland Type (PSS - Headwater Slope)

Land Use (Stream Restoration Site), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (1.5), Wetland Canopy (O/S) (0.5), Wetland Ground Cover (1.5)

Habitat Support Buffer table, Field Hydrology (HYD) (2), WQ Input & Treatment* (2.25)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.54

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID

DAE - WRAP 21

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
 √ Current Conditions
 Proposed Conditions

WRAP Location

Application Number	Project Name	Date	Evaluator	Wetland Type
	NEP - D'Olive Creek	April, 2019	David Knowles	Detention Basin

Land Use	Description/Notes	Wetland Acreage
Forested Land		

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover
1.5	0.5	1.5

Habitat Support Buffer	Field Hydrology (HYD)	WQ Input & Treatment *
	1.5	1.5625

Buffer Type	(Score) X	area(0-1.0)	Sub Totals
			0
>30<300	2	1	2
			0
			0
Total			2

Total
2

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)			
LU Category	(Score) X	area(0-1.0)	Sub Totals
Forested Land	2	0.5	1
Roadways	1	0.25	0.25
Residential	1.5	0.25	0.375
			0
LU Total			1.63

Pretreatment Category (PT)			
PT Category	(Score) X	area(0-1.0)	Sub Totals
Forested land	2	0.5	1
Runoff from			0
Stormwatr			0
Runoff	1	0.5	0.5
PT Total			1.5

WRAP Score

0.48

Field Notes:

Wildlife Utilization (WU)	Wetland provides limited cover and food source for wildlife. The site acts more as a detention area and can be utilized by species like frogs, turtles, reptiles, med-small mammals, and birds. There is human disturbance in the form of constant traffic; connected to corridor to south.
Wetland Canopy (O/S)	Wetland canopy is absent, however, planted trees have some potential for future support. <10 cover by exotics at the time of survey.
Wetland Ground Cover	Newly planted mitigation site, cover impacted by stream restoration project.
Habitat Support/Buffer	Buffers average between 100 and 180ft (cut off by residential properties) and consist of forested land. We considered the residential properties and the highway to the north as breaks in the buffer.
Field Hydrology (HYD)	Hydrology is adequate to support some hydrophytic vegetation; however, the water budget comes from north of the highway and is sporadic. Transition to upland species was also observed.
WQ Input & Treatment	A portion of the Surrounding landuse provides for moderate levels of pre-treatment of water entering the wetland system (forested, sandy hillslopes), and the remainder comes from runoff during rainfall events.

WRAP ID

D 4-D6 - WRAP 22

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location
South of, and Abutting
Interstate 10

Application Number, Project Name (NEP - D'Olive Creek), Date (April, 2019), Evaluator (Howard Horne), Wetland Type (Riparian Restoration Site)

Land Use (Forested Land), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (1), Wetland Canopy (O/S) (0.5), Wetland Ground Cover (0.5)

Habitat Support Buffer, Field Hydrology (HYD) (2), WQ Input & Treatment* (1.5625)

Table with columns: Buffer Type, (Score) X, area(0-1.0), Sub Totals. Rows include >300 and Total (2.5).

Table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals. Rows include Forested Land, Roadways, Residential, and LU Total (1.63).

Table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals. Rows include Forested land, Runoff from, Stormwatr, Runoff, and PT Total (1.5).

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

WRAP Score

0.45

Field Notes:

Field Notes section containing text for Wildlife Utilization (WU), Wetland Canopy (O/S), Wetland Ground Cover, Habitat Support/Buffer, Field Hydrology (HYD), and WQ Input & Treatment.

WRAP ID

MP - WRAP 1 (above DA3)

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (3), Wetland Canopy (O/S) (3), Wetland Ground Cover (3)

Habitat Support Buffer, Field Hydrology (HYD) (3), WQ Input & Treatment* (2.75)

Table with columns: Buffer Type, (Score) X, area(0-1.0), Sub Totals. Rows include >300ft of HQ and a Total row.

Total 2.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Table with columns: LU Category, (Score) X, area(0-1.0), Sub Totals. Rows include Silviculture and a LU Total row.

Table with columns: PT Category, (Score) X, area(0-1.0), Sub Totals. Rows include Nat Undev. and a PT Total row.

WRAP Score

0.96

Field Notes:

Wildlife Utilization (WU)
Wetland is utilized by fauna of many different Phylum and Class. The wetland and surrounding buffers offer high quality habitat. The stream running thru the wetland is relatively undisturbed and offers great habitat for aquatic species.

Wetland Canopy (O/S)
The wetland canopy provides cover for wildlife, is very healthy, shows signs of natural regen., and is free of exotics. The shrub later contains many different species, and several that we generally find in high quality wetlands of this type.

Wetland Ground Cover
Ground cover is appropriate for the system being evaluated (several species of OBL ferns), especially given the amount of shade due to a healthy overstory.

Habitat Support/Buffer
While the upland buffers have been cut over in recent years, they were not clear-cut (selective cut) and still provide good support to wildlife and act as a decent buffer to the wetlands (slowing runoff).

Field Hydrology (HYD)
It is a groundwater driven system and there are no known impediments to hydrology.

WQ Input & Treatment
Surrounding landuse provides for good pre-treatment of water entering the wetland system (forested, sandy hillslopes).

WRAP ID

MP - WRAP 3 (above DA3)

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes, Wetland Acreage

Wildlife Utilization (WU) (1.5), Wetland Canopy (O/S) (1.5), Wetland Ground Cover (1.5)

Habitat Support Buffer table, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (2.25)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.63

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID

MP - WRAP 4 (above DA3)

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes (Contains Perennial Stream), Wetland Acreage

Wildlife Utilization (WU) (2), Wetland Canopy (O/S) (2.5), Wetland Ground Cover (2.5)

Habitat Support Buffer table, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (2.75)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.82

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID

MP - WRAP 5 (above DA3)

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes (Contains Perennial Stream), Wetland Acreage

Wildlife Utilization (WU) (2), Wetland Canopy (O/S) (2.5), Wetland Ground Cover (2.5)

Habitat Support Buffer table, Field Hydrology (HYD) (2.5), WQ Input & Treatment* (2.75)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.82

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID

MP - WRAP 6 (above DA3)

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
√ Current Conditions
Proposed Conditions

WRAP Location

Application Number, Project Name (NEP - D'Olive Creek), Date (5/8/19), Evaluator (David Knowles), Wetland Type (PFO - Headwater Slope)

Land Use (Forestry), Description/Notes (Contains Perennial Stream), Wetland Acreage

Wildlife Utilization (WU) (2.5), Wetland Canopy (O/S) (2.5), Wetland Ground Cover (2.5)

Habitat Support Buffer table, Field Hydrology (HYD) (3), WQ Input & Treatment* (2.75)

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU) table, Pretreatment Category (PT) table

WRAP Score

0.88

Field Notes:

Wildlife Utilization (WU) notes, Wetland Canopy (O/S) notes, Wetland Ground Cover notes, Habitat Support/Buffer notes, Field Hydrology (HYD) notes, WQ Input & Treatment notes

WRAP ID
TC1-TC2 WRAP

Wetland Rapid Assessment Procedure (WRAP)
 Check One
 Current Conditions
 Proposed Conditions

WRAP Location

Application Number	Project Name	Date	Evaluator	Wetland Type
	NEP - D'Olive Creek	4/17/19	Matt Stowe and Howard Horne	PSS - Headwater Slope

Land Use	Description/Notes	Wetland Acreage
Stream Restoration Site		

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover
2	0.5	1.5

Habitat Support Buffer	Field Hydrology (HYD)	WQ Input & Treatment *
	2	2.5

Buffer Type	(Score) X	area(0-1.0)	Sub Totals
>300ft and comprised of mixed hardwood & pine forest	2.5	1	2.5
			0
			0
			0
Total			2.5

Total
2.5

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)			
LU Category	(Score) X	area(0-1.0)	Sub Totals
Secondary	2.5	1	2.5
Forest, likely			0
Silviculture Lands			0
			0
LU Total			2.50

Pretreatment Category (PT)			
PT Category	(Score) X	area(0-1.0)	Sub Totals
Mixed Pine & Hardwoods	2.5	1	2.5
			0
			0
			0
PT Total			2.5

WRAP Score
0.61

Field Notes:	
Wildlife Utilization (WU)	Wetland provides limited protective cover for larger wildlife species. There is cover for small mammals, and the stream offers some habitat for aquatic species and amphibians and reptiles. Adjacent upland buffer offers some cover, and only moderate food source. To some extent the wetland is connected to off-site corridors, but there are many road crossings and other disturbances along the Creek's course thru residential areas.
Wetland Canopy (O/S)	Site was re-planted after construction of step pool complex. There are some appropriate living saplings which offer some potential for future forestation.
Wetland Ground Cover	There are plenty non-natives and invasive exotics in the herbaceous layer. There were also several transitional/upland species noted amongst the native hydrophytic vegetation. Some of the wetter portions of the wetland area assessed had higher percentages of desirable wetland species.
Habitat Support/Buffer	Buffers are greater than 300ft on average, although the quality of the vegetation is not great. Upland buffer does contain some exotic species and will likely contain larger numbers of them in the near future when surrounding uplands are again harvested of the planted pine.
Field Hydrology (HYD)	Between the stream restoration work and the past heavy siltation there are definitely issues related to hydrology to support hydrophytic plant species.
WQ Input & Treatment	Surrounding upland forestry land is providing decent pre-treatment of water entering the wetland system (forested/scrub shrub hillslopes).

WRAP ID

TC1-TC2 Upstream - WRAP 19

Wetland Rapid Assessment Procedure (WRAP)

√ Check One
 √ Current Conditions
 Proposed Conditions

WRAP Location

East of Park Ave and Pollard Road and south of Restoration Site

Application Number	Project Name	Date	Evaluator	Wetland Type
	NEP - D'Olive Creek	April, 2019	David Knowles	PSS - Headwater Slope

Land Use	Description/Notes	Wetland Acreage
Forestry	Contains Perennial Stream	

Wildlife Utilization (WU)	Wetland Canopy (O/S)	Wetland Ground Cover
2.5	3	3

Habitat Support Buffer				Field Hydrology (HYD)	WQ Input & Treatment *
Buffer Type	(Score) X	area(0-1.0)	Sub Totals		
>300ft of forested upland buffer	2.5	1	2.5	3	2.625
			0		
			0		
			0		
			Total		
			2.5		

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)				Pretreatment Category (PT)			
LU Category	(Score) X	area(0-1.0)	Sub Totals	PT Category	(Score) X	area(0-1.0)	Sub Totals
Silviculture	2.5	1	2.5	Nat Undev.	3	0.5	1.5
			0	Wet Detention	2.5	0.5	1.25
			0				0
			0				0
			0				0
			LU Total				PT Total
			2.50				2.75

WRAP Score

0.92

Field Notes:

Wildlife Utilization (WU)	Habitat provides good cover for any endemic species. Corridors are somewhat fragmented due to the way the wetland is surrounded by residences and road crossings.
Wetland Canopy (O/S)	Large, mature canopy trees are present, very little pressure from non-natives.
Wetland Ground Cover	While there were a few occurrences of chinese privet saplings, for the most part the ground cover is in excellent shape, comprised of a large number of species that we typically associate with high quality headwater wetlands.
Habitat Support/Buffer	The upland buffers (300+ ft wide on all sides) provide good support to wildlife and act as a decent buffer for the wetlands (slowing runoff).
Field Hydrology (HYD)	It is a groundwater driven system, and there is adequate hydrology to support wetland vegetation.
WQ Input & Treatment	Surrounding landuse provides for good pre-treatment of water entering the wetland system (forested, sandy hillslopes and wet detention up-stream).

APPENDIX B - Rapid Stream Assessment (RSA) and Habitat Assessment (HA) Data Sheets

Table B. RSA scores for the D'Olive watershed sampling sites, Spring 2019.

Metric	DA3 - U	DA3 - R	DA3 - D	DAE - D	D4-D6 - D	D4-D6 - R
Riparian Zone Width	4	0	4	4	2	0
Riparian Vegetative Quality	4	2	4	4	2	2
Canopy Cover	4	0	4	4	4	0
Local Watershed Erosion	2	2	0	2	2	2
Sediment Deposition	2	4	0	0	0	2
Habitat Availability	2	2	0	0	2	2
Habitat Smothering	4	4	2	2	2	2
Channel Alteration	4	2	2	4	2	2
Channel Sinuosity	2	2	0	2	2	2
Bank Stability	2	2	0	2	2	4
Bank Vegetative Protection	2	2	0	2	0	0
Macroinvertebrates Present	2	2	2	2	2	2
Identified Taxa*	0	4	-2	-2	4	-2
<hr/>						
*Specific Taxa		Stonefly (+4)	Midge (-2)	Midge (-2)	Damselfly (+2)	Midge (-2)
		Caddisfly (+2)			Dragonfly (+2)	
		Midge (-2)				
<hr/>						
Total:	34	28	16	26	26	18

Table B-2. RSA scores for the D'Olive watershed sampling sites, Spring 2019, continued.

Metric	JB1 - U	JB1 - R	JB2 - D	JB2 - R	JA-D	JB Bass Pro
Riparian Zone Width	4	0	4	0	4	4
Riparian Vegetative Quality	2	2	2	2	2	2
Canopy Cover	4	0	4	0	4	4
Local Watershed Erosion	2	2	2	2	2	2
Sediment Deposition	2	2	2	2	0	2
Habitat Availability	4	4	2	2	0	4
Habitat Smothering	2	2	2	2	0	4
Channel Alteration	4	2	4	0	2	4
Channel Sinuosity	2	2	2	0	0	4
Bank Stability	2	2	2	4	2	2
Bank Vegetative Protection	2	2	2	2	2	2
Macroinvertebrates Present	0	2	2	2	2	2
Identified Taxa*	0	-2	4	0	2	-2
<hr/>						
*Specific Taxa		Midge (-2)	Caddisfly (+2) Damsel fly (+2)	Caddisfly (+2) Midge (-2)	Damsel fly (+2) Dragonfly (+2)	Midge (-2)
<hr/>						
Total:	30	20	34	18	22	34

Table B-3. RSA scores for the D'Olive watershed sampling sites, Spring 2019, continued.

Metric	J42 - U	J42 - R	J4(1-2) - D	TC2 Trib.	TC(1-2) - U	TC(1-2) - R
Riparian Zone Width	4	0	4	0	4	0
Riparian Vegetative Quality	2	2	2	2	2	2
Canopy Cover	4	0	4	0	4	0
Local Watershed Erosion	2	2	2	0	2	2
Sediment Deposition	0	2	0	0	2	2
Habitat Availability	2	2	2	0	2	2
Habitat Smothering	0	2	2	0	2	2
Channel Alteration	4	2	2	2	4	0
Channel Sinuosity	2	2	2	2	2	2
Bank Stability	2	2	0	0	2	4
Bank Vegetative Protection	2	2	0	0	2	2
Macroinvertebrates Present	2	2	2	2	2	2
Identified Taxa*	0	2	0	-2	4	0
<hr/>						
*Specific Taxa	Midge (-2) Damselfly (+2)	Midge (-2) Caddisfly (+2) Damselfly (+2)	Midge (-2) Damselfly (+2)	Midge (-2)	Caddisfly (+2) Damselfly (+2)	Midge (-2) Damselfly (+2)
<hr/>						
Total:	26	22	22	6	34	20

D'Olive Creek Watershed Data Sheet

Station Name/Number DAS - upstream Date 4/17/19 - 0930 - 1000

Field Personnel J. O'Neal Weather Sunny - 68°

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) _____ Good (>75% Native) X

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor _____ Moderate X Good _____

Habitat Availability: Poor _____ Moderate X Good _____

Habitat Smothering: Poor _____ Moderate _____ Good X

Channel Alteration (Artificial Channelization): Poor _____ Moderate _____ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: velocity Crawfish, salamanders - fish observed
- stream type (ephemeral, perennial etc...)

D'Olive Creek Watershed Data Sheet

Station Name/Number DA3 - Restoration Date 4/17/19 10:00-

Field Personnel J. O'Neil Weather Sunny - 70°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other Power line / Restoration Area

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate _____ Good

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate _____ Good

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor _____ Moderate Good _____

Bank Veg. Protection: Poor _____ Moderate Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
<u>Stonefly</u>
Mayfly
Rifle Beetle
Dobson fly

Mod. Pollution Sensitive
<u>Caddisfly</u>
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: Rocky steepdowns. All surfaces covered with periphyton

D'Olive Creek Watershed Data Sheet

Station Name/Number DAB-Down Date 4/17/19 1130

Field Personnel J. O'Neil Weather Sunny - 75°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) _____ Good (>75% Native) X

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate _____ Heavy X

Sediment Deposition: Poor X Moderate _____ Good _____

Habitat Availability: Poor X Moderate _____ Good _____

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate X Good _____

Channel Sinuosity: Poor X Moderate _____ Good _____

Bank Stability: Poor X Moderate _____ Good _____

Bank Veg. Protection: Poor X Moderate _____ Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number DAE - Downstream Date 4/17/19 1230 - 1300

Field Personnel J. O'Neil Weather Sunny - 80°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) _____ Good (>75% Native) X

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential X
 Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor X Moderate _____ Good _____

Habitat Availability: Poor X Moderate _____ Good _____

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate _____ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: No sample-able reach upstream. Restoration Area dry. water reaches stream via underground culverts

D'Olive Creek Watershed Data Sheet

Station Name/Number D4-D6 - Downstream Date 4/17/19 1310-

Field Personnel J. O'Neal Weather SP. cloudy 80°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial _____ Other Powerline Corridor

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%)

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor Moderate _____ Good _____

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor _____ Moderate Good _____

Bank Veg. Protection: Poor Moderate _____ Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
<u>Damselfly</u>
<u>Dragonfly</u>
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number D4-D6-Restoration Date 4/17/19 1340 - 1400

Field Personnel J. O'Neil Weather p. cloudy 80°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial _____ Other Restoration

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate Good

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate Good

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor Moderate _____ Good - riprap

Bank Veg. Protection: Poor Moderate _____ Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number JR1 - Upstream Date 4/23/19 0940-

Field Personnel J. O'Neal Weather Sunny - 68°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor _____ Moderate X Good _____

Habitat Availability: Poor _____ Moderate _____ Good X

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate _____ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes _____ No X

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number JBI-Restoration Date 4/23/19 10/0-

Field Personnel J. O'Neil Weather _____

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate Good _____

Habitat Availability: Poor _____ Moderate _____ Good

Habitat Smothering: Poor _____ Moderate Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor _____ Moderate Good _____

Bank Veg. Protection: Poor _____ Moderate Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number JB2 - Downstream Date 7/23/19 1125

Field Personnel J. O'Neal Weather Sunny - 75°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor _____ Moderate X Good _____

Habitat Availability: Poor _____ Moderate X Good _____

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate _____ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
<u>Caddisfly</u>
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: Salamander collected

D'Olive Creek Watershed Data Sheet

Station Name/Number JB 2 - Restoration Date 4/23/19 1205

Field Personnel J. O'Neal Weather sunny 78°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate Good _____

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate Good _____

Channel Alteration (Artificial Channelization): Poor Moderate _____ Good _____

Channel Sinuosity: Poor Moderate _____ Good _____

Bank Stability: Poor _____ Moderate _____ Good

Bank Veg. Protection: Poor _____ Moderate Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
<u>Caddisfly</u>
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number JA - Down stream Date 4/23/19 1345

Field Personnel J. O'Neil Weather Sunny 80°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) X Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other ~~_____~~

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor X Moderate _____ Good _____

Habitat Availability: Poor X Moderate _____ Good _____

Habitat Smothering: Poor X Moderate ~~X~~ Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate X Good ~~X~~

Channel Sinuosity: Poor X Moderate X Good _____ Banked

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number J4-2- upstream Date 4/24/19 1050-1105

Field Personnel J. O'Neal Weather overcast 70°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor X Moderate _____ Good _____

Habitat Availability: Poor _____ Moderate X Good _____

Habitat Smothering: Poor X Moderate _____ Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate ~~X~~ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number 042-Restoration Date 4/24/19 1115-

Field Personnel J. O'Neal Weather overcast 70°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial Other Powerline Corridor

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate Good _____

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor _____ Moderate Good _____

Bank Veg. Protection: Poor _____ Moderate Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
○ Caddisfly ○
○ Damselfly ○
Dragonfly
Amphipods

Pollution Tolerant
○ Midge Larvae ○
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number J4¹² - Downstream Date 4/24/19 1250

Field Personnel JD/HH/DK Weather overcast 75°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor X Moderate _____ Good _____

Habitat Availability: Poor _____ Moderate X Good _____

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate X Good _____

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor X Moderate _____ Good _____

Bank Veg. Protection: Poor X Moderate _____ Good _____

Macroinvertebrates Present: Yes X No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number TC2 Trib Date 4/24/19 1400

Field Personnel JO/HA/AK Weather Overcast 78°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest _____ Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate _____ Heavy

Sediment Deposition: Poor Moderate _____ Good _____

Habitat Availability: Poor Moderate _____ Good _____

Habitat Smothering: Poor Moderate _____ Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor Moderate _____ Good _____

Bank Veg. Protection: Poor Moderate _____ Good _____

Macroinvertebrates Present: Yes No _____

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
Damselfly
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: _____

D'Olive Creek Watershed Data Sheet

Station Name/Number TCF2 up Date 4/24/19 1425

Field Personnel JO/HH/DK Weather ☁ overcast 78°F

Riparian Zone Width: Poor (0-9m) _____ Moderate (9-18m) _____ Good (>18m) X

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) X Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest X Field/Pasture _____ Agriculture _____ Residential _____
Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) _____ Moderate (30-50%) _____ Good (51-88%) X

Local Watershed Erosion: None _____ Light _____ Moderate X Heavy _____

Sediment Deposition: Poor _____ Moderate X Good _____

Habitat Availability: Poor _____ Moderate X Good _____

Habitat Smothering: Poor _____ Moderate X Good _____

Channel Alteration (Artificial Channelization): Poor _____ Moderate _____ Good X

Channel Sinuosity: Poor _____ Moderate X Good _____

Bank Stability: Poor _____ Moderate X Good _____

Bank Veg. Protection: Poor _____ Moderate X Good _____

Macroinvertebrates Present: Yes X No _____ (common)

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
<u>Caddisfly</u>
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
Midge Larvae
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: Interesting fish - picture

D'Olive Creek Watershed Data Sheet

Station Name/Number TCI Restoration Date 4/21/19 1950

Field Personnel JH/HA/DK Weather Sunny 80°F

Riparian Zone Width: Poor (0-9m) Moderate (9-18m) _____ Good (>18m) _____

Riparian Veg. Quality: Poor (0-25% Native) _____ Moderate (25-75% Native) Good (>75% Native) _____

Water Quality: Water Temp (°C) _____ Cond. (µmohs/cm) _____ Sal. (ppt) _____ pH _____

DO (mg/L) _____ DO (%) _____ Turbidity (NTU) _____

Dominant Watershed Land Use: Forest Field/Pasture _____ Agriculture _____ Residential _____

Commercial _____ Industrial _____ Other _____

Canopy Cover: Poor (<30%, 89-100%) Moderate (30-50%) _____ Good (51-88%) _____

Local Watershed Erosion: None _____ Light _____ Moderate Heavy _____

Sediment Deposition: Poor _____ Moderate Good _____

Habitat Availability: Poor _____ Moderate Good _____

Habitat Smothering: Poor _____ Moderate Good _____

Channel Alteration (Artificial Channelization): Poor Moderate _____ Good _____

Channel Sinuosity: Poor _____ Moderate Good _____

Bank Stability: Poor _____ Moderate _____ Good

Bank Veg. Protection: Poor _____ Moderate Good _____

Macroinvertebrates Present: Yes No _____ (common)

Circle Identified Taxa (refer to attached ID guide)

Pollution Sensitive
Water Penny
Stonefly
Mayfly
Riffle Beetle
Dobson fly

Mod. Pollution Sensitive
Caddisfly
<u>Damselfly</u>
Dragonfly
Amphipods

Pollution Tolerant
<u>Midge Larvae</u>
Midge Pupae
Black Fly
Rat-tailed Maggot

Notes: Crawfish, same fish present

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody Station Number

DAB-UP

Date: 11/17/19 0930

Investigators J. ONCE

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 7	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 12	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 16	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.
4 Channel Alteration Score 17	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 11	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 13	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 8	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 7	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 9 Score (RB) 9	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 9 Score (RB) 9	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

DAB Restoration

Investigators

J. O'Neil

Date: 4/17/19 1000-

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 18	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 3	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 16	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.
4 Channel Alteration Score 10	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 18	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 10	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 13	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 14	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over, 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 5 Score (RB) 5	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 5 Score (RB) 3	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 1 Score (RB) 1	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

DAB Down

Date: 4/17/19

Investigators J. O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score <u>5</u>	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score <u>6</u>	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score <u>11</u>	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.
4 Channel Alteration Score <u>13</u>	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score <u>11</u>	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score <u>9</u>	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score <u>10</u>	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score <u>4</u>	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) <u>1</u> Score (RB) <u>1</u>	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) <u>10</u> Score (RB) <u>10</u>	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) <u>10</u> Score (RB) <u>10</u>	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

DAE-Downstream

Date: 4/17/19

Investigators

S. O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 6	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 6	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 11	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.
4 Channel Alteration Score 17	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 11	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 10	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 6	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 7	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 4 Score (RB) 4	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 9 Score (RB) 9	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

D4-D6

Date: 4/17/19

Investigators J. O'Neal

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 11	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 6	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 11	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.
4 Channel Alteration Score 11	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 6	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 7	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 9	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 9	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over, 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 5 Score (RB) 3	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 9 Score (RB) 9	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

04-36

Restoration

Date: 4/17/19

Investigators

J. O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score	16			
2 Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score	6			
3 Pool Variability	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.
Score	11			
4 Channel Alteration	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score	11			
5 Sediment Deposition	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score	11			
6 Channel Sinuosity	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score	9			
7 Channel flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
Score	10			
8 Condition of Banks	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score	15			
9 Bank Vegetative Protection (each bank)	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB)	3			
Score (RB)	5			
10 Grazing or other disruptive pressure (each bank)	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB)	5			
Score (RB)	5			
11 Riparian vegetative zone Width (each bank)	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB)	0			
Score (RB)	0			

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

JBI - upstream

Date: 4/23/19

Investigators J. O. Neal

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 Pool Variability	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.
Score 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 Channel Alteration	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 Sediment Deposition	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6 Channel Sinuosity	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 Channel flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
Score 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 Condition of Banks	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bands; on side slopes, 60-100% of bank has erosional scars.
Score 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 Bank Vegetative Protection (each bank)	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB) 5	10 9 8	7 6	5 4 3	2 1 0
Score (RB) 5	10 9 8	7 6	5 4 3	2 1 0
10 Grazing or other disruptive pressure (each bank)	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB) 10	10 9 8	7 6	5 4 3	2 1 0
Score (RB) 10	10 9 8	7 6	5 4 3	2 1 0
11 Riparian vegetative zone Width (each bank)	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB) 10	10 9 8	7 6	5 4 3	2 1 0
Score (RB) 10	10 9 8	7 6	5 4 3	2 1 0

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

JBI-Restoration

Investigators

J. O'Neal

Date: 4/23/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 15	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 11	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 11	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.
4 Channel Alteration Score 9	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 12	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 10	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 9	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 13	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 6 Score (RB) 10	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 6 Score (RB) 6	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 2 Score (RB) 2	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

JB2-Dou

Date: 4/23/19

Investigators

J. O'Neal

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 Pool Variability	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.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 Channel Alteration	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 Sediment Deposition	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6 Channel Sinuosity	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 Channel flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 Condition of Banks	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 Bank Vegetative Protection (each bank)	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB)	10 9 8	7 6	5 4 3	2 1 0
Score (RB)	10 9 8	7 6	5 4 3	2 1 0
10 Grazing or other disruptive pressures (each bank)	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB)	10 9 8	7 6	5 4 3	2 1 0
Score (RB)	10 9 8	7 6	5 4 3	2 1 0
11 Riparian vegetative zone Width (each bank)	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB)	10 9 8	7 6	5 4 3	2 1 0
Score (RB)	10 9 8	7 6	5 4 3	2 1 0

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

JB2 - Restoration

Date: 7/23/19

Investigators J. O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score	11			
2 Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score	16			
3 Pool Variability	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.
Score	10			
4 Channel Alteration	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score	6			
5 Sediment Deposition	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score	11			
6 Channel Sinuosity	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score	5			
7 Channel flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
Score	9			
8 Condition of Banks	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score	17			
9 Bank Vegetative Protection (each bank)	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB)	6			
Score (RB)	6			
10 Grazing or other disruptive pressure (each bank)	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB)	7			
Score (RB)	7			
11 Riparian vegetative zone Width (each bank)	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB)	2			
Score (RB)	2			

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

JA

Investigators

J. O'Neil

Date: 4/23/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 7	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 11	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 6	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.
4 Channel Alteration Score 6	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 10	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 5	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 8	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 10	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 5 Score (RB) 5	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 10 Score (RB) 10	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

J-2-ups

Date: 4/24/19

Investigators J. O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 12	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 6	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 10	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.
4 Channel Alteration Score 16	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 6	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 15	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 10	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 11	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bands; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 6 Score (RB) 12	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 9 Score (RB) 7	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

J42 Restoration

Date: 4/24/19

Investigators T O'Neil

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score <u>13</u>	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score <u>11</u>	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score <u>14</u>	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.
4 Channel Alteration Score <u>6</u>	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score <u>11</u>	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score <u>9</u>	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score <u>10</u>	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score <u>14</u>	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) <u>6</u> Score (RB) <u>10</u>	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) <u>6</u> Score (RB) <u>6</u>	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) <u>3</u> Score (RB) <u>10</u>	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 50 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

J4-Darwin

Investigators

J. O'Neil

Date: 4/24/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 11	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 7	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 10	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.
4 Channel Alteration Score 17	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 10	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 11	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 8	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 6	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 4 Score (RB) 4	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 10 Score (RB) 10	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 10 Score (RB) 10	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody TC-Trib
 Station Number _____

Investigators T. O'Neal Date: 4/24/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score <u>6</u>	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score <u>9</u>	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score <u>10</u>	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.
4 Channel Alteration Score <u>10</u>	No channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score <u>6</u>	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score <u>8</u>	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score <u>8</u>	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score <u>6</u>	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) <u>3</u> Score (RB) <u>3</u>	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) <u>5</u> Score (RB) <u>5</u>	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) <u>6</u> Score (RB) <u>2</u>	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody TC-UP
 Station Number _____

Investigators J. O'Neil

Date: 4/24/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover > 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present. Score <u>11</u>	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.	
2 Pool Substrate Characterization Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common. Score <u>10</u>	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.	
3 Pool Variability Even mix of large-shallow, large-deep, small-shallow, small-deep pools present. Score <u>13</u>	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.	
4 Channel Alteration No Channelization or dredging present. Score <u>18</u>	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.	
5 Sediment Deposition <20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars. Score <u>11</u>	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.	
6 Channel Sinuosity Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line. Score <u>14</u>	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.	
7 Channel flow Status Water reaches base of both lower banks and minimal amount of channel substrate is exposed. Score <u>↑</u>	Water fills >75% of the available channel.	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.	
8 Condition of Banks Banks stable; no evidence of erosion or bank failure; <5% affected. Score <u>11</u>	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.	
9 Bank Vegetative Protection (each bank) > 90% of the stream bank surfaces covered by vegetation. Score (LB) <u>6</u> Score (RB) <u>6</u>	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.	
10 Grazing or other disruptive pressure (each bank) Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally. Score (LB) <u>8</u> Score (RB) <u>8</u>	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.	
11 Riparian vegetative zone Width (each bank) Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone. Score (LB) <u>8</u> Score (RB) <u>8</u>	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.	

APPENDIX H-1

ADEM-FIELD OPERATIONS-ENVIRONMENTAL INDICATORS SECTION
 GLIDE/POOL HABITAT ASSESSMENT FIELD DATA SHEET

Name of Waterbody
 Station Number

TC - Restoration

Investigators

J. D. [Signature]

Date: 4/24/19

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 Instream Cover Score 13	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
2 Pool Substrate Characterization Score 16	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
3 Pool Variability Score 12	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.
4 Channel Alteration Score 9	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
5 Sediment Deposition Score 13	<20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
6 Channel Sinuosity Score 10	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
7 Channel flow Status Score 10	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel.	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.
8 Condition of Banks Score 11	Banks stable; no evidence of erosion or bank failure; <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% affected.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
9 Bank Vegetative Protection (each bank) Score (LB) 7 Score (RB) 7	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
10 Grazing or other disruptive pressure (each bank) Score (LB) 5 Score (RB) 5	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
11 Riparian vegetative zone Width (each bank) Score (LB) 2 Score (RB) 2	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.

APPENDIX C - Photographs of Rapid Stream Assessment Stations

DA3-Upstream Sampling Site



DA3-Restoration Sampling Site



DA3-Downstream Sampling Site



DAE-Restoration Site (not sampled)



DAE-Downstream Sampling Site



D4-D6-Downstream Sampling Site



D4-D6-Restoration Sampling Site



JB1-Upstream Sampling Site



JB1-Restoration Sampling Site



JB2-Downstream Sampling Site



JA-Downstream Sampling Site



J4-2-Upstream Sampling Site



J4-2-Restoration Sampling Site



J4(1-2)-Downstream Sampling Site



TC2-Tributary Sampling Site



TC(1-2)-Upstream Sampling Site



TC(1-2)-Restoration Sampling Site



JB (Bass Pro Shop) Sampling Site

