Civil & Environmental Consultants, Inc.

TN Stream Quantification Tool & Stream Design Approach

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Introduction

- Clark Chewning – Project Manager, CEC
  - P.E., 11+ years, stream restoration design focus
- Caleb Duke – Project Manager, CEC
  - PWS, TN-QHP., 8+ years stream and wetland mitigation focus

History of the SQT

- The Tennessee Stream Quantification Tool (TN SQT) is a modification of the North Carolina Stream Quantification Tool (Harman and Jones, 2017)

- The Tennessee regionalized version of this tool was funded by USEPA Region 4 through a Wetland Program Development Grant facilitated by Diana Woods of USEPA

History of the SQT

- The TNSQT was formed collectively by USACE and TDEC

- The Tennessee Stream Quantification Tool (TN SQT) and Tennessee Debit Tool is the current methodology to evaluate stream impacts and stream compensatory mitigation associated with permit authorizations under Sections 404/401 of Clean Water Act and/or Sections 9 or 10 of Rivers and Harbors Act of 1899

Tennessee Stream Quantification Tool (SQT)

- Determine functional difference between existing condition score (ECS) and proposed condition score (PCS)

- SQT promotes high-quality stream restoration by matching restoration goals with site's restoration potential
  - Based on TN Reference Reach data and analysis performed by Jennings Environmental, LLC

Tennessee Debit Tool

- Debit Tool is an Excel-based tool that applicants must complete to determine debits (functional loss) for proposed impact activities

- Debits determine number of mitigation credits needed to offset proposed impacts

Reach Information and Reference Standard Stratification

Reach ID:		Drainage Area (sqmi):		ETW/ONRW:		Upstream Latitude:	
Existing Stream Type:	G	Existing Bed Material:		Data Collection Season:		Upstream Longitude:	
Reference Stream Type:	B	Existing Stream Slope (%):		Macro Collection Method:		Downstream Latitude:	
Ecoregion:	67fhi	Flow Type:		Valley Type:		Downstream Longitude:	

EXISTING CONDITION ASSESSMENT					Roll Up Scoring			
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	ECS
Hydrology	Catchment Hydrology	Watershed Land Use Runoff Score		0.80	0.80	0.80	Functioning	
	Reach Runoff	Stormwater Infiltration		0.80	0.80			
Hydraulics	Floodplain Connectivity	Bank Height Ratio		0.80	0.80	0.80	Functioning	
		Entrenchment Ratio		0.80				
Geomorphology	Large Woody Debris	Large Woody Debris Index			0.80	0.80	Functioning	
		# Pieces		0.80				
	Lateral Migration	Erosion Rate (ft/yr)			0.80			
		Dominant BEHI/NBS		0.80				
		Percent Streambank Erosion (%)		0.80				
		Percent Armoring (%)		0.80				
	Riparian Vegetation	Left - Average Diameter at Breast Height (DBH; in)		0.80	0.80			
		Right - Average DBH (in)		0.80				
		Left - Buffer Width (feet)		0.80				
		Right - Buffer Width (feet)		0.80				
		Left - Tree Density (#/acre)		0.80				
		Right - Tree Density (#/acre)		0.80				
		Left - Native Herbaceous Cover (%)		0.80				
		Right - Native Herbaceous Cover (%)		0.80				0.80
		Left - Native Shrub Cover (%)		0.80				
		Right - Native Shrub Cover (%)		0.80				
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value)						
	Bed Form Diversity	Pool Spacing Ratio		0.80	0.80			
		Pool Depth Ratio		0.80				
		Percent Riffle (%)		0.80				
		Aggradation Ratio						
	Plan Form	Sinuosity		0.80	0.80			
Physicochemical	Bacteria	E. Coli (Cfu/100 mL)		0.80	0.80	0.80	Functioning	
	Organic Enrichment	Percent Nutrient Tolerant Macroinvertebrates (%)						
	Nitrogen	Nitrate-Nitrite (mg/L)		0.80	0.80			
	Phosphorus	Total Phosphorus (mg/L)		0.80	0.80			
Biology	Macroinvertebrates	Tennessee Macroinvertebrate Index		0.80	0.80	0.80	Functioning	
		Percent Clingers (%)						
		Percent EPT - Cheumatopsyche (%)						
		Percent Oligochaeta and Chironomidae (%)						
	Fish	Native Fish Score Index						
		Catch per Unit Effort Score						

Tennessee Stream Quantification Tool (SQT)

- Design Tool OR NOT? SQT must be utilized in conjunction with design for success of restoration projects
- Aids with site selection standards-Reference Stream analysis
- Function based assessment based on 3-main categories
  - Physical
  - Chemical
  - Biological

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SQT Workbook (Credit Tool)

- Used to analysis restoration potential of a mitigation site
- Functional feet assessment of streams on a site
- Aid in design parameter and selection

SQT Workbook (Credit Tool)

- Compares ECS to PCS to determine functional lift (Credits) to be generated restoration efforts
- SQT plays a major role in a successful restoration project by implementing Reference Stream data

PROPOSED CONDITION ASSESSMENT				
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value
Hydrology	Catchment Hydrology	Watershed Land Use Runoff Score		
	Reach Runoff	Stormwater Infiltration		
Hydraulics	Floodplain Connectivity	Bank Height Ratio Entrenchment Ratio		
Geomorphology	Large Woody Debris	Large Woody Debris Index # Pieces		
	Lateral Migration	Erosion Rate (ft/yr) Dominant BEHI/NBS Percent Streambank Erosion (%) Percent Armoring (%)		
	Riparian Vegetation	Left - Average Diameter at Breast Height (DBH; in) Right - Average DBH (in) Left - Buffer Width (feet) Right - Buffer Width (feet) Left - Tree Density (#/acre) Right - Tree Density (#/acre) Left - Native Herbaceous Cover (%) Right - Native Herbaceous Cover (%) Left - Native Shrub Cover (%) Right - Native Shrub Cover (%)		
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value)		
	Bed Form Diversity	Pool Spacing Ratio Pool Depth Ratio Percent Riffle (%) Aggradation Ratio		
	Plan Form	Sinuosity		
Physicochemical	Bacteria	E. Coli (cfu/100 mL)		
	Organic Enrichment	Percent Nutrient Tolerant Macroinvertebrates (%)		
	Nitrogen	Nitrate-Nitrite (mg/L)		
	Phosphorus	Total Phosphorus (mg/L)		
Biology	Macroinvertebrates	Tennessee Macroinvertebrate Index Percent Clingers (%) Percent EPT - Cheumatopsyche (%) Percent Oligochaeta and Chironomidae (%)		
	Fish	Native Fish Score Index Catch per Unit Effort Score		

Hydraulics	Floodplain Connectivity	Bank Height Ratio Entrenchment Ratio
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	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value)
	Bed Form Diversity	Pool Spacing Ratio Pool Depth Ratio Percent Riffle (%)
		Aggradation Ratio
	Plan Form	Sinuosity

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SQT in Design

- P-P spacing
- Sinuosity
- Large woody debris

SQT in Design

P-P spacing

- Ratio of 3-5 is typical design range; based on reference reach data
- Outside of that = credit reduction
- Due to very low-gradient system, larger p-p spacing was used
  - Bankfull slope varied from 0.06% to 0.25% across site
- Stable design was chosen over max. credit production to promote long-term stability and functionality of stream system

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SQT in Design

Sinuosity

- 1.2 minimum for C channels
- > 1.4 = credit reduction (for C channels)
- Site promoted opportunity to increase stream length further
- Final design included sinuosity within range of SQT to avoid credit reduction

SQT in Design

“**Large woody debris** is described as the organic matter over 1 m in length and at least 10 cm in diameter at one end (sticks to logs). When multiple pieces of debris accumulate in the stream channel and retard water flow, a debris dam is formed” (Davis et al., 2001)

SQT in Design

- **Count:** Count LWD Within BKF for 100 m
- **Index:** Calculation of LWD from below water surface to floodplain (Zone 1-4) & ability to influence morphology

SQT in Design

Incorporating LWD into design

- Can be in form of in-stream structures

- Can be in other forms
  - Root wads
  - Log vanes
  - Bridges or ramps, as long as w/in BKF channel

Perspectives/Experiences/Recommendations

- Designing with SQT
  - Difficult with certain parameters
  - Design to standards vs. losing credits
- SQT in various types of mitigation (Banking, PRM)
  - Debit tool & SQT Workbook (PRM)
  - SQT workbook (Mitigation Banking)
- Focus on developing appropriate design instead of simply maximizing credits (p-p spacing ratio as an example)

Summary

- SQT is useful tool for determining restoration potential. SQT collectively gives Regulatory Agencies, Bankers, and Public some common ground.
- Design – some SQT geomorphic parameters are easier to design for than others
  - BHR, ER, max pool depth are more attainable, esp. on mitigation banks
  - P-p spacing, sinuosity, LWD can prove difficult to balance btw. SQT & appropriate design

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Questions?

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