



# Ecological Health Assessments: Application to Ecologically- Engineered Stormwater Systems

Trisha Culbertson  
Kansas State University Biological and  
Agricultural Engineering

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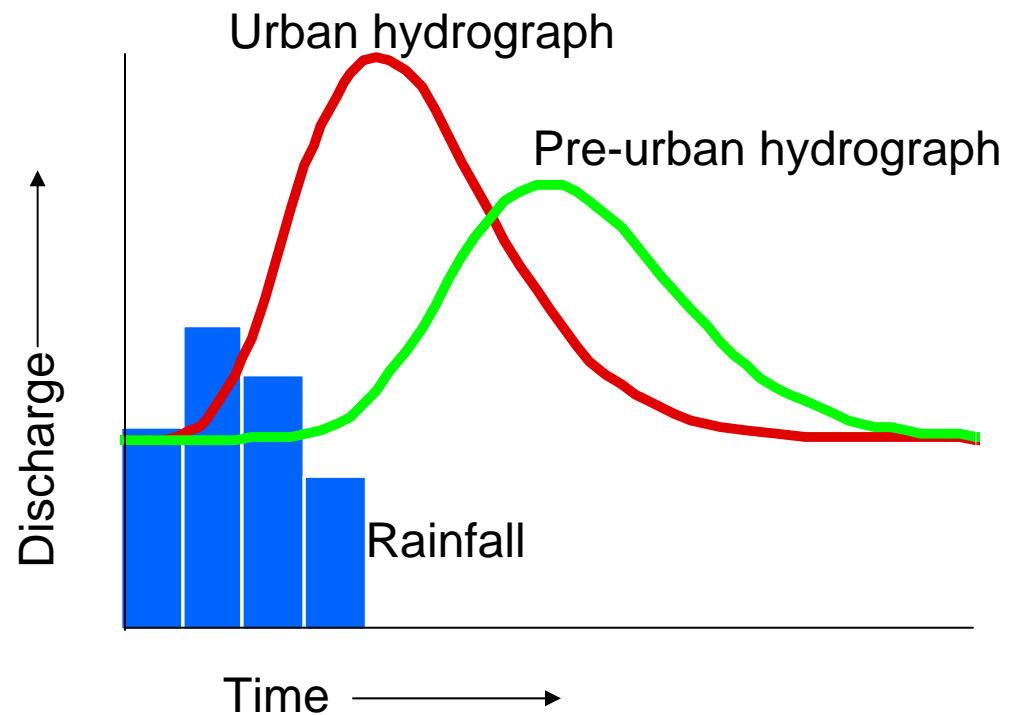
# Outline

- Introduction
  - What is an ecologically-designed stormwater system?
  - What is an ecological health assessment?
- Objective
  - Explain how an ecological health assessment can be applied to enhance the long-term monitoring of ecologically-designed stormwater systems.
- Case Study
  - Discuss development and application of an ecological health assessment for two stormwater study sites in northeastern Kansas

Introduction:

# Ecologically-Engineered Stormwater Systems

- Goal: maintain post-development hydrology and water quality as closely as possible to pre-development conditions through natural ecosystem processes, including:
  - Infiltration
  - Evapotranspiration
  - Pollutant sorption
  - Nutrient cycling
- Ecoregion guides system design
  - Kansas: tallgrass prairie ecosystem



Introduction:

# Ecological Stormwater Systems

- A few challenges to successful implementation of ecologically-designed stormwater systems:
  - Maintenance
    - Unlike more traditional stormwater systems, the performance of ecologically-designed systems relies upon ecosystem processes; therefore, these systems require different maintenance regimes to insure sustainability of these functions
  - Long-term monitoring
    - Typical monitoring (if any) primarily considers hydrologic and chemical aspects of system performance
    - Can be time and cost-prohibitive
    - Does not usually consider ecosystem health—which is critical to maintenance of ecosystem processes

Introduction:

# Ecological Health Assessments

- A healthy ecosystem is one that maintains its organization and autonomy over time and is resilient to stress
  - attributes of ecosystem health, such as the integrity of nutrient cycles, are difficult to directly measure
- Ecological and biological indicators are used as surrogates for assessing ecosystem health
  - Concept formalized in the 1980s and has since been applied to wide variety of ecosystems

Objective:

## Ecological Health Assessments: Application to Ecologically-Engineered Stormwater Systems

- Goal: develop an ecological health assessment tool that is...
  - Easy to use
    - Target users are municipal stormwater managers
  - Relevant to ecological stormwater system design and intended performance
    - Selected indicators should provide insight to the ability of the system to maintain desired ecosystem processes (i.e. infiltration)

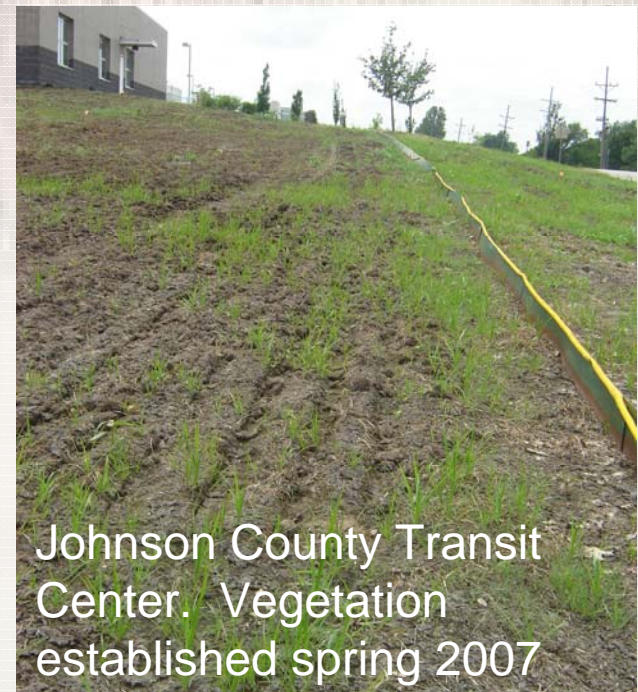
Methods:

## Ecological Health Assessments: Application to Ecological Stormwater Management

- Based on health assessments developed for grasslands, a set of indicators was developed and applied to two ecologically-designed stormwater sites



Quinton Heights, Topeka Kan.  
Vegetation established spring 2004



Johnson County Transit  
Center. Vegetation  
established spring 2007

Methods:

## Ecological Health Assessments: Application to Ecological Stormwater Management

- Health assessment consisted of four main categories:
  - Vegetation Health
  - Soil Health and Structure
  - Erosion Indicators
  - Biotic Health
- Indicators chosen to provide insight to ability of system to maintain desired ecological functions, namely infiltration (to reduce runoff volume) and sedimentation (to improve runoff quality)



Methods:

## Ecological Health Assessments: Application to Ecological Stormwater Management

- Site given score of 1 (Poor) through 4 (Excellent) in each category based on...
- Vegetation Health
  - Density, diversity, appearance
- Soil Health and Structure
  - Organic matter layer color/thickness, tilth, compaction, rooting depth and density
- Soil Erosion
  - Evidence of soil erosion, recolonization of deposits by vegetation
- Fauna Health
  - Based on presence or absence of desirable (worms, beetle larvae, other soil arthropods) and undesirable species (mosquitoes)

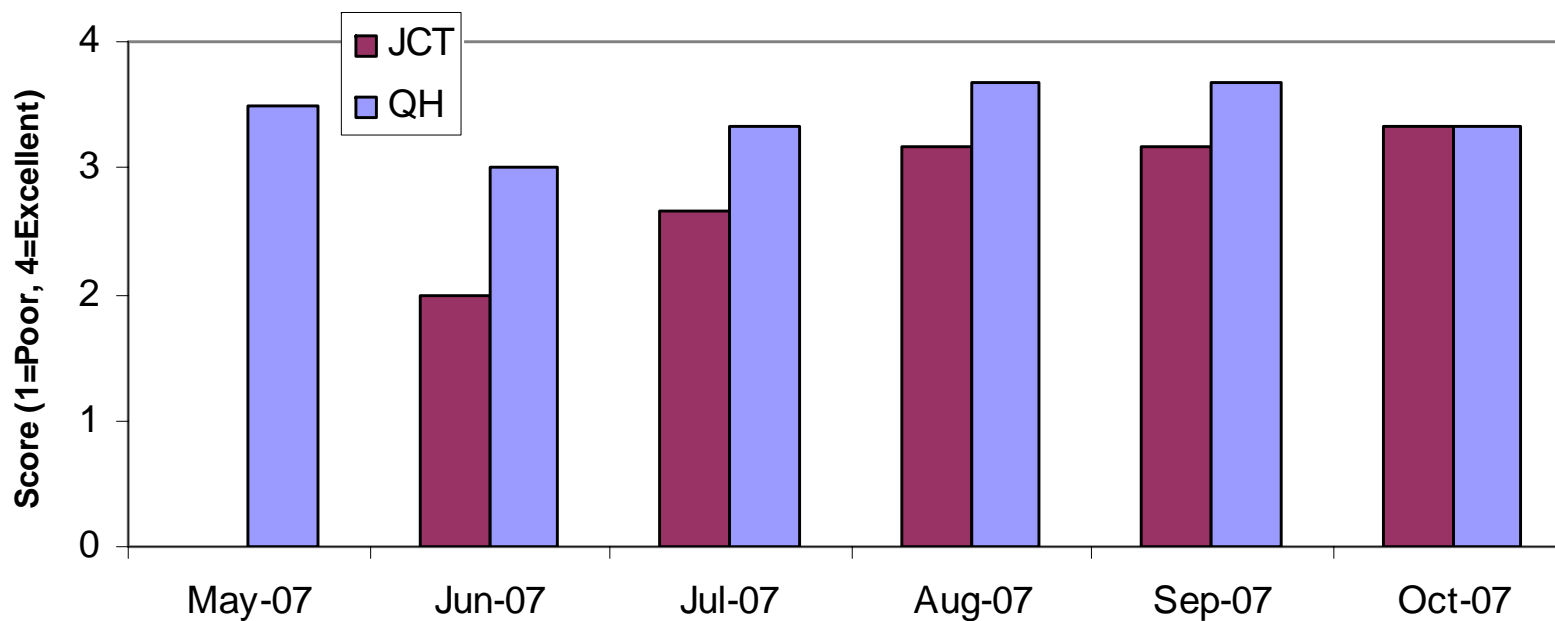
Results:

# Ecological Assessment: Vegetation Health

Plant appearance, density, diversity



### Vegetative Health Scores



grasses and forbs dominate  
Quinton Heights basin

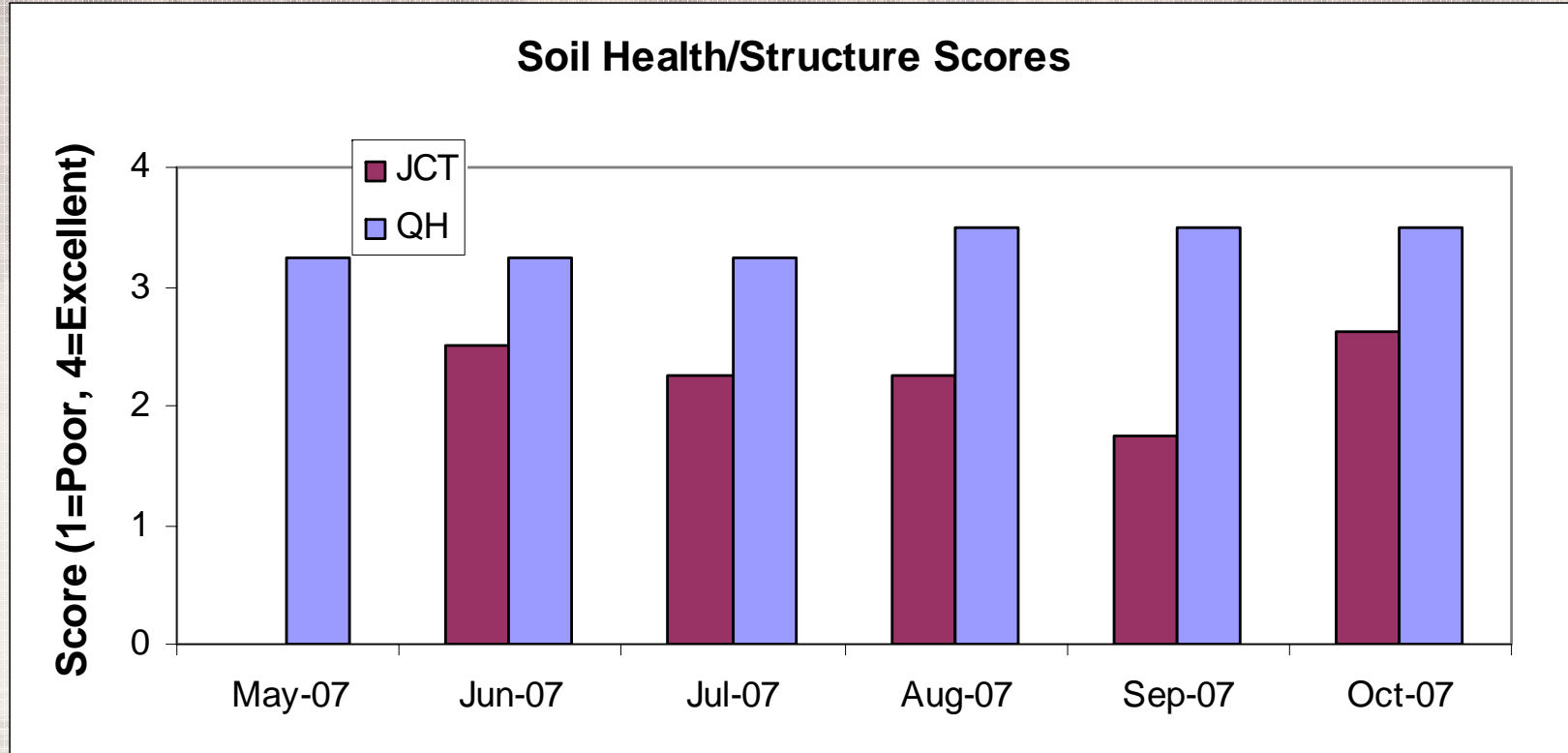
Quinton Heights

Johnson County

Results:

# Ecological Assessment: Soil Health and Structure

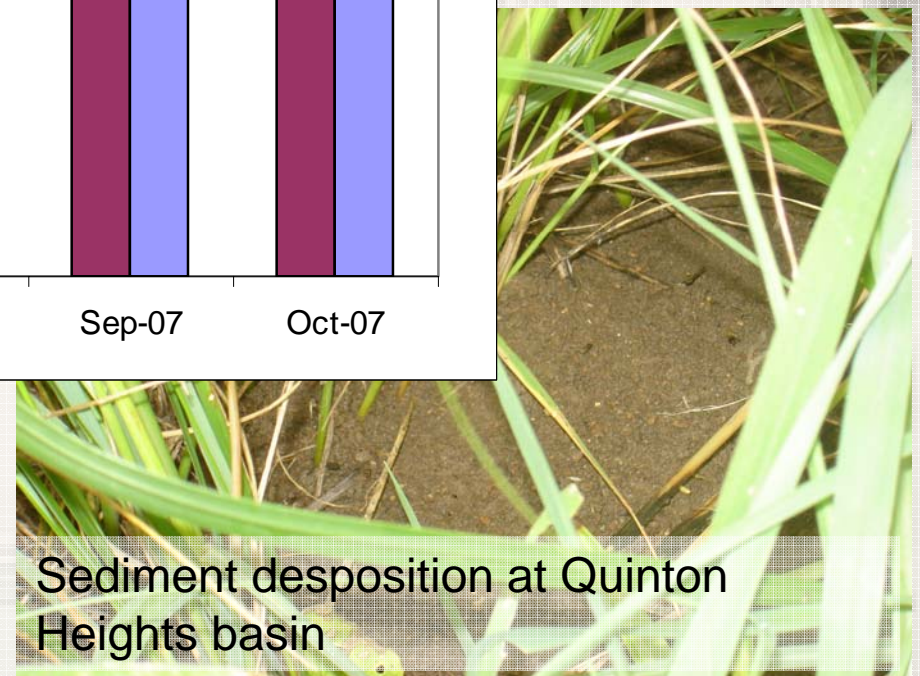
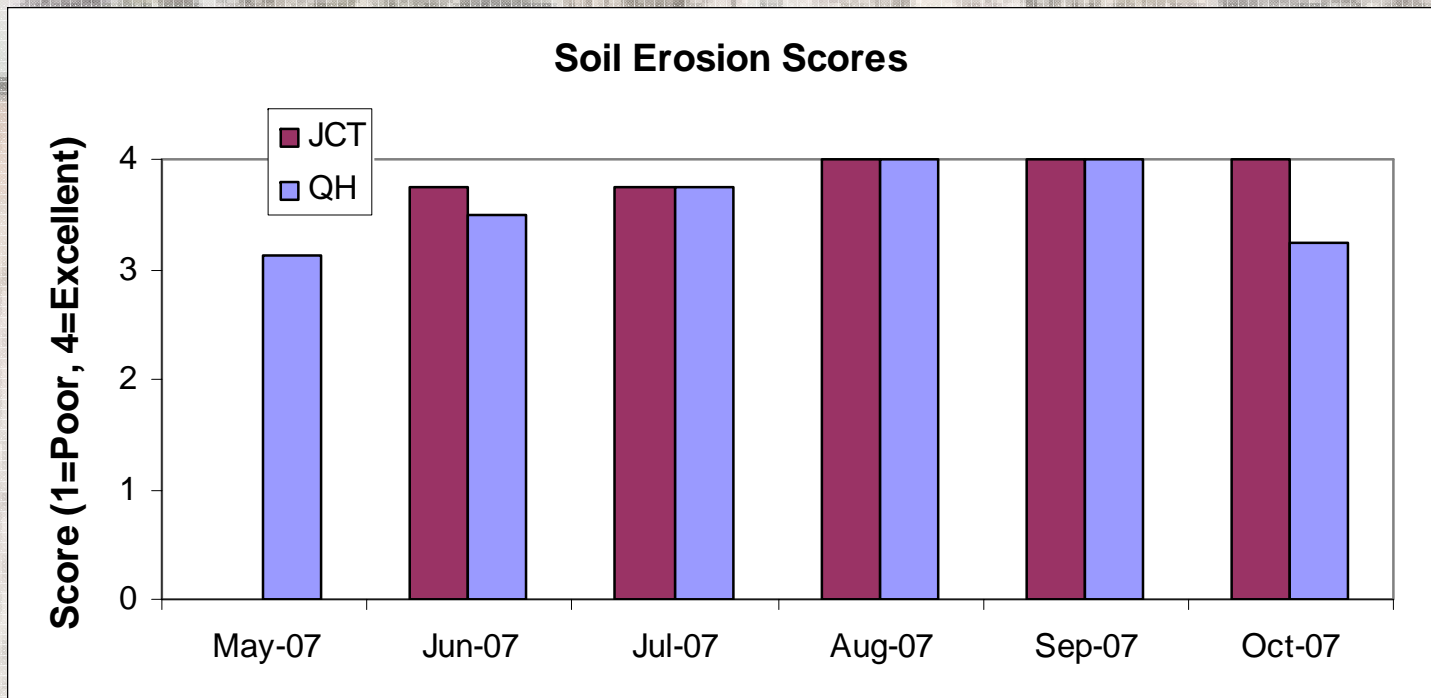
Organic matter layer color/thickness, tilth, compaction, rooting depth and density



Results:

# Ecological Assessment: Soil Erosion Indicators

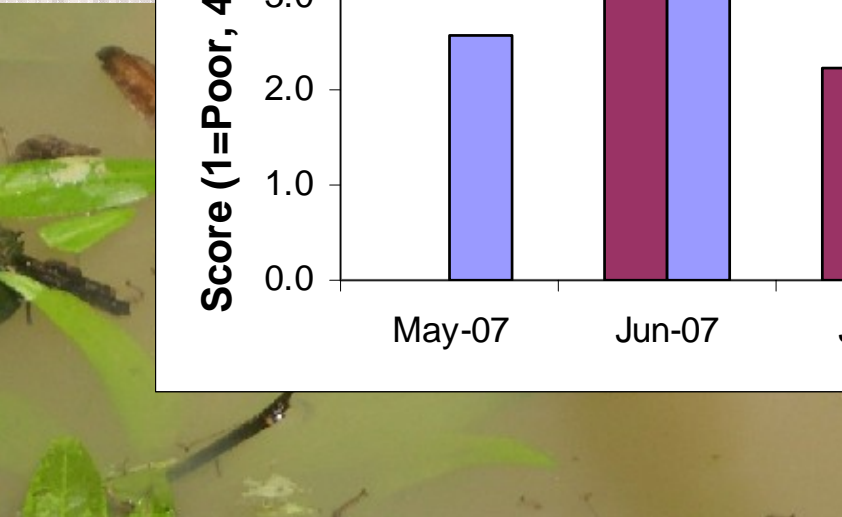
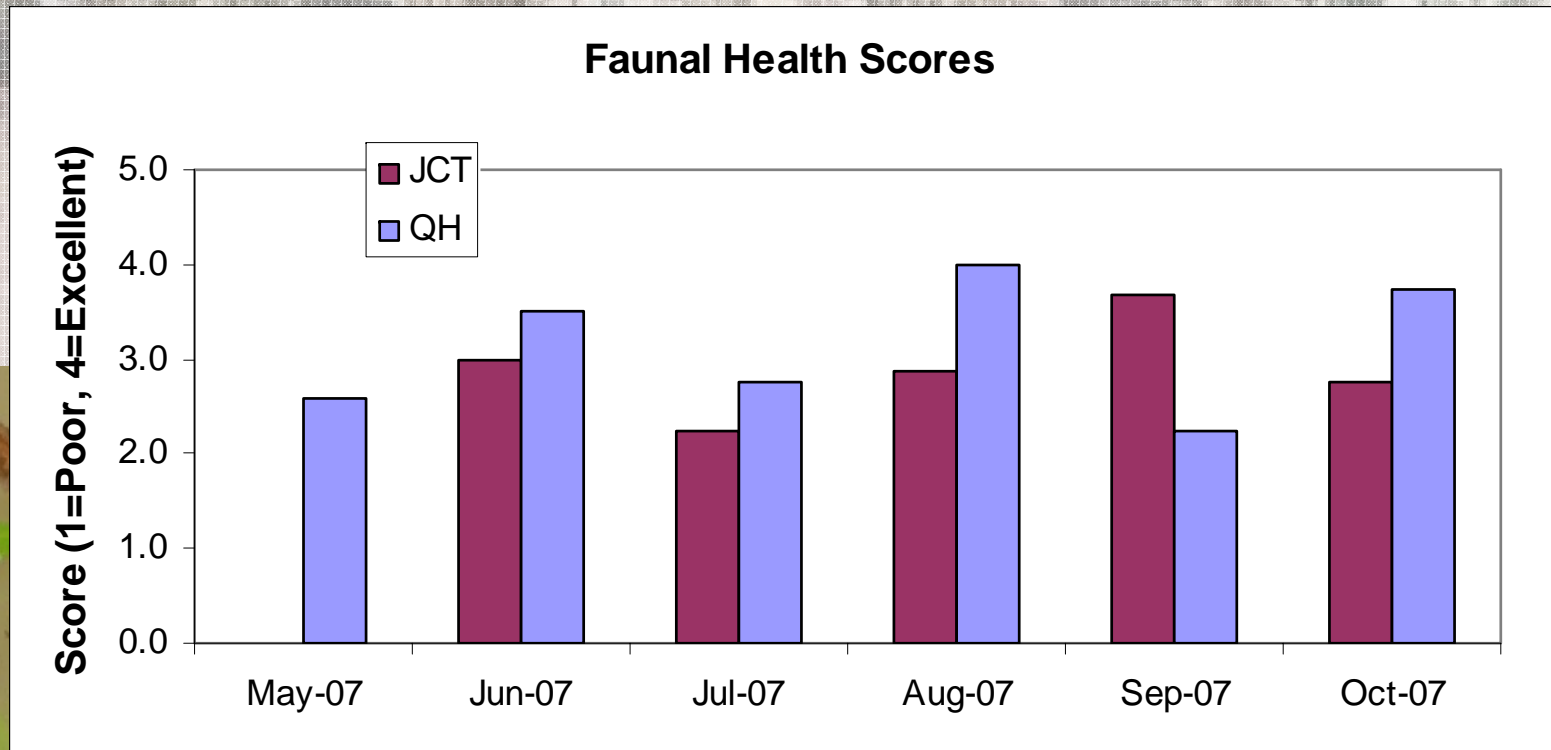
Evidence of erosion, recolonization of deposits by vegetation



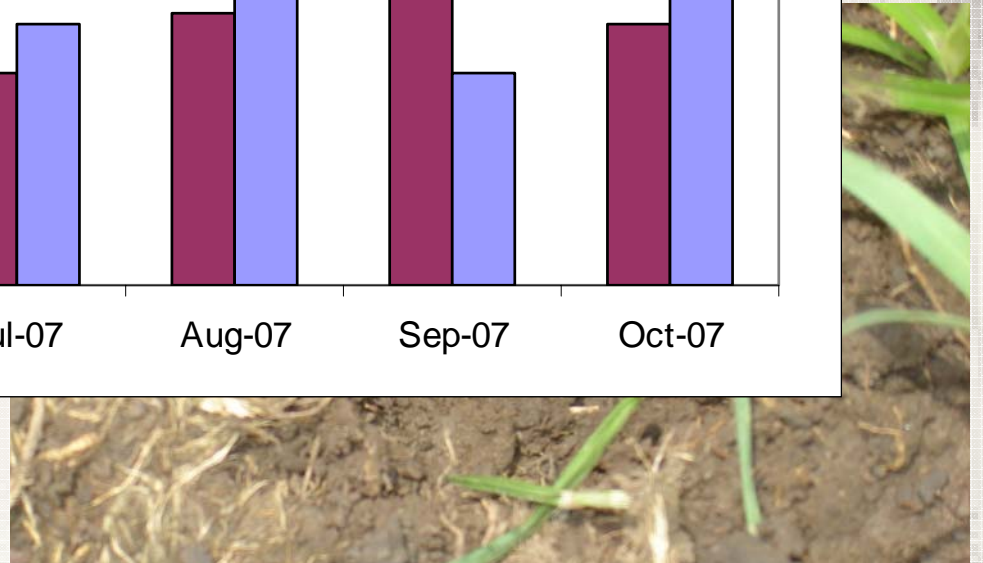
Results:

# Ecological Assessment: Fauna Health

presence or absence of desirable or undesirable species



Example of mosquito larvae found at Quinton Heights (source: [www.co.monroe.in.us](http://www.co.monroe.in.us))

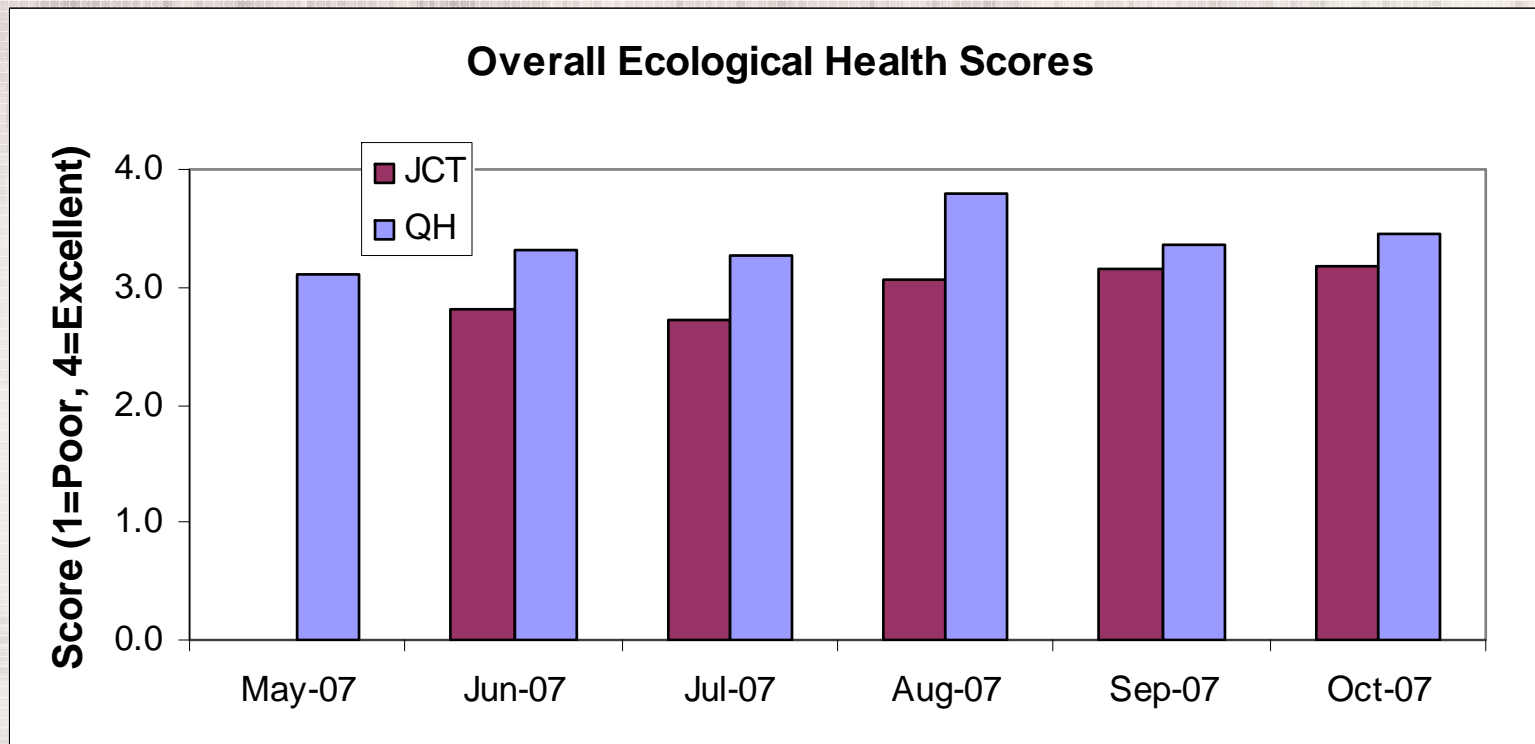


Earthworm found at Johnson County site

Results:

# Ecological Assessment: Overall Health Score

- Overall health score calculated by averaging scores from each category
  - Expected overall ecological health of Quinton Heights to be higher than Johnson County



Conclusions:

## Ecological Health Assessments: Application to Ecological Stormwater Management

- Health assessment developed for this study could easily be incorporated into long-term monitoring program
  - Apply annually at same time of year (ideally in early fall) to provide rapid assessment of system development and potential performance
  - Help guide management decisions to maintain desired ecosystem functions

# Acknowledgements

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  - Dr. Stacy Hutchinson
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