Ecological Modeling for Utoy Creek Watershed Restoration

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Table of Contents

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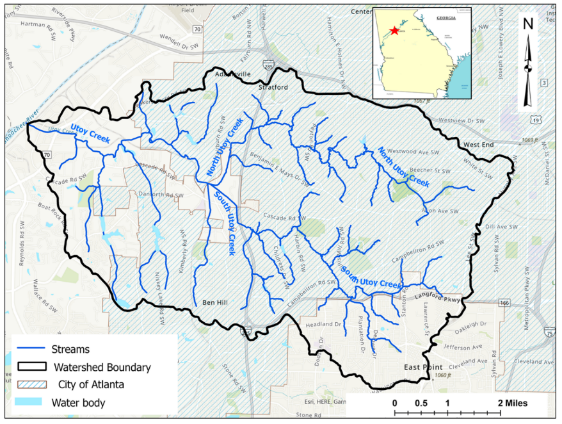
**Model Accessibility**: An interactive version of this report may be accessed [here](https://usace-wrises.github.io/UtoyEcoMod/). The underlying numerical code as well as an MS Word version of this analysis may be downloaded from [this github repository](https://github.com/USACE-WRISES/UtoyEcoMod.git).

**DISCLOSURE**: This website represents a preliminary and working version of decision models for a stream restoration study in Utoy Creek, Atlanta, Georgia. The project is led by the Mobile District of the U.S. Army Corps of Engineers (USACE) in partnership with the City of Atlanta. This site **DOES NOT** reflect agency findings or outcomes, and this is merely intended as documentation of methods and working notes for internal use. Please refer to the project manager for the Utoy Creek study, Alex Smith ([alexandria.n.smith@usace.army.mil](mailto:alexandria.n.smith@usace.army.mil)), for up-to-date information about the project. A final version of this report will ultimately be included as an appendix to the more detailed feasibility study report.

**MISSING DATA AND METHODS**: This analysis is missing a variety of information prior to sharing, specifically:  
- Check that the objectives presented in Section 2.1 align with project objectives.  
- Ecological data are being quality controlled and have known erros at this point (i.e., equal riparian areas for left and right bank). Additionally, we need to revisit whether year-0 should be equal to the FWOP for all alternatives.  
- The Utoy Instream Model is also under development and subject to change. For instance, the current version removes hydrologic metrics as well as a few geomorphic metrics (BEHI).

# **1. Introduction**

The Utoy Creek watershed drains the southwest portion of the City of Atlanta into the Chattahoochee River (Figure 1). This small-to-middle order stream is within the Piedmont region of the southeastern United States, and Utoy Creek exhibits many common characteristics of regional streams such as historical channel degradation due to poor sediment management as well modern challenges like flashy runoff from urban development. The majority of Utoy Creek’s watershed is situated within City of Atlanta boundaries; however, downstream portions of the watershed are within Fulton County. Two main tributaries, North and South Utoy Creeks, unite to form the main stem approximately five miles upstream the Chattahoochee River (EPA, 2016). The total combined length of the main stem and primary tributaries is approximately 22 miles (Walker, 2016). Including sub-tributaries, the total length of stream is over 50 miles in the Utoy Creek watershed. The total drainage basin is approximately 33.7 square miles with 64% developed and 18% impervious.



*Figure 1. Overview of the Utoy Creek watershed.*

In partnership with the City of Atlanta, the USACE’s Mobile District is leading a feasibility study of potential stream restoration actions in the Utoy Creek watershed. The study is authorized through the USACE’s continuing authorities program for aquatic ecosystem restoration (Section 206, WRDA 1996). In summer 2023, the project development team conducted preliminary project planning activities such as identification of problems and opportunities, setting ecosystem restoration objectives, and screening potential restoration sites. From fall 2023 to summer 2024, the project development team advanced restoration planning through actions such as field data collection, design of alternatives, ecological modeling, cost estimation, analysis of socio-economic benefits, and public and interagency meetings. This report summarizes…Specifically, this document…

This report does the following…Our objectives are…

# **2. Project Planning Framework**

Decision support modeling builds from the planning framework established for a restoration study as a whole. As such, this chapter briefly reviews major components of restoration planning in Utoy Creek.

## *Plan Formulation Strategy*

Restoration project planning sets the stage for all other design, analysis, or decision tasks. A sound plan formulation strategy clearly articulates a problem statement and objectives from which all choices about design or analysis flow (McKay et al. 2012). The USACE project development team identified objectives for the Utoy Creek restoration project through three primary means. First, USACE policies and budget criteria were used as a template for local objectives. Second, existing local plans and studies in the Utoy Creek watershed were examined. Third, project objectives were compiled from prior studies in the region (e.g., Proctor Creek and Butler Creek). Fourth, preliminary objectives were presented to technical and non-technical stakeholders at a charrette in May 2023. Based on these approaches, the following objectives were identified.

*Overarching objective: Improve instream conditions suitable for a diversity of aquatic organisms (e.g., fish, crayfish, salamanders, benthic macroinvertebrates, turtles)*.  
- Restore channel geomorphic conditions to less disturbed conditions.  
- Reduce sediment loading from the stream bed and banks.  
- Increase instream habitat for a diverse assemblage of local fauna.  
- Increase connectivity of movement corridors for aquatic species

*Overarching objective: Improve riparian conditions supportive of a diverse aquatic and riparian community*. - Restore natural sources of organic carbon (i.e., energy) within the system.  
- Increase floodplain connectivity to support biogeochemical cycling.  
- Improve temperature and light regimes.  
- Increase riparian habitat to support native biodiversity.  
- Increase connectivity of movement corridors for riparian species

*Overarching Objective: Restore flow regimes to a best attainable condition*. - Decrease peak flows.  
- Decrease hydrologic flashiness.  
- Improve watershed capacity to attenuate high flows.

*Secondary Objectives: Pursue socio-economic outcomes while restoring instream and riparian systems*.  
- Increase resiliency to disturbances (e.g., watershed development, climate change, large floods).  
- Promote social benefits and equity.  
- Promote aesthetics and recreation.  
- Improve water quality (e.g., TSS, zinc, nutrients).

In pursuit of these objectives, different information was required as planning proceeded from early watershed problem screening to feasibility-level design. The USACE project development team developed a three-phase approach to analysis of the Utoy Creek watershed restoration (Table 1). In phase 1, activities focused on screening sites to a focal set of locations aligned with USACE objectives. This phase used a suite of high-level assumptions and preliminary data on ecological benefits and costs to reduce 60+ potential restoration locations to a more workable 20 sites for more detailed analysis. Phase 2 focused on feasibility-scale analysis of these 20 sites including collection of additional field and analytical data, development of conceptual designs, execution of ecological models, and estimation of cost. This phase ultimately focused on producing site-scale recommendations of restoration actions. Phase 3 examined the portfolio of recommended actions at the watershed-scale, which analysis of ecological outcomes as well as other project effects (i.e., development of a narrative about the “comprehensive” socio-economic benefits of an investment). These phases required a series of assumptions regarding each analytical step, which are briefly presented in Table 1. Additional information on discipline-specific assumptions can be found elsewhere in feasibility documents.

Table 1. Overview of the three-phase approach to Utoy Creek analyses.

| Scoping Issue | Site Screening (Aug 2023) | Site-Scale Analysis (Chapter 2) | Watershed-Scale Analysis (Chapter 3 and 4) |
| --- | --- | --- | --- |
| Primary purpose of analysis | Screen out sites to a smaller set for more detailed data collection and analysis | Identify cost-effective restoration actions at each site. | Develop an effective portfolio of sites for the watershed. |
| Formulation of alternatives | ERDC identification of a conceptual action based largely on channel evolution | Field-based identification of needs followed by multi-disciplinary discussion of actions into a conceptual plan, which was then formalized into a suite of actions and quantities | All combinations of sites with recommended actions |
| Number of alternatives | Two: future without project and maximum build out | Four: future without project, maximum build-out, two intermediate solutions with varying levels of cost and benefit | One per site |
| Ecological Benefits | Simple habitat unit based solely on scoring sites relative to project objectives. | Separate instream (UIM) and riparian (REFI) models parameterized by a combination of field measurements, analyses, and judgement. See Figure 1. | Sum of site-scale habitat units for the recommended action. |
| Cost | Rapid, qualitative cost estimates based on prior unit cost | Site-specific, rough order of magnitude (ROM) cost engineering analyses | Sum of site-scale costs for the recommended action |
| Treatment of Time | Snapshot with and without project (i.e., no temporal forecast) | Temporal trajectories over 50-year horizon based on years 0, 2, 10, and 50 and annualized over the life of the project | Use of annualized benefits and costs from site-scale recommendations |
| Other Social Effects | Preliminary, qualitative field assessment for relative comparison among divergent sites | None | Combined metric based on field assessment, census data, and public input, which is aggregated for groups of nearby sites |
| Regional Economic Development | None | None | None |
| National Economic Development | None | None | None |

Blah, blah, blah.

## *Site Screening*

Insert brief description of site screening?

# **2. Ecological Model Development**

Insert introduction.

## *Utoy Instream Model (UIM)*

Insert description of UIM.

## *Riparian Ecosystem Function Index (REFI)*

Insert description of REFI. This can be shorter since it is documented elsewhere.

## *Model Testing and Evaluation*

Insert brief description of model testing. Compare REFI with spreadsheet. Compare UIM with spreadsheet.

# **3. Model Application**

Describe model application in Utoy Creek to obtain ecological benefits.

# **4. Summary of Ecological Outputs for Utoy Creek**

In this section, yada yada yada. Blah, blah, blah.

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# *Appendix A: Acronyms*

* CEICA: Cost-effectiveness and incremental cost analysis.
* CoA: City of Atlanta.
* PED: Pre-construction Engineering and Design.
* ROM: Rough Order of Magnitude.
* TSP: Tentatively Selected Plan.
* USACE: U.S. Army Corps of Engineers.

# *Appendix B: Site-scale Alternatives*

Do we want to dump all of the ecological model inputs or outputs here? It makes for a huge set of tables, but it is a good practice for transparency and reproducibility.