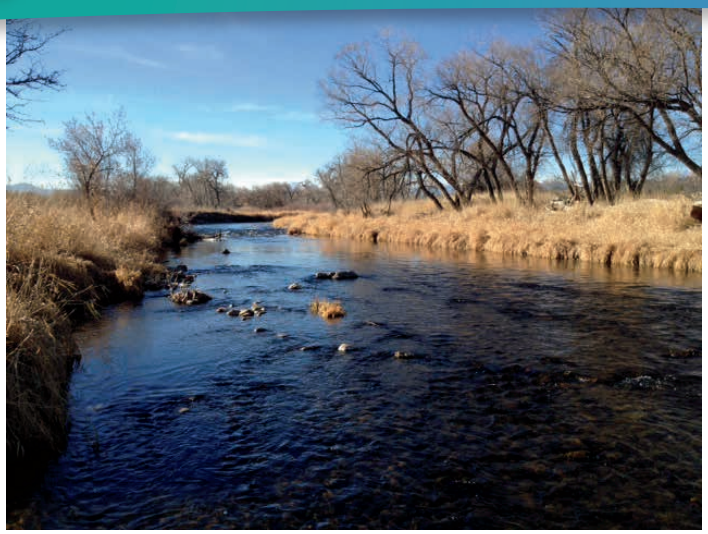
Executive Summary

WERF

Applying a predictive modeling framework to develop management strategies for site-specific numeric nutrient water quality criteria



Boulder Creek, City of Boulder, Colorado.

Modeling Guidance for Developing Site-Specific Nutrient Goals – Demonstration: Boulder Creek, CO (LINK2T14)

The Central Issue

States typically develop numeric nutrient criteria with guidance from the U.S. Environmental Protection Agency (EPA) using one or more of three categories of approaches:

- Reference condition approach.
- Stressor response analysis.
- Process-based (mechanistic) modeling.

EPA guidance has mainly focused on using reference condition and stressor-response approaches. Previously, WERF completed research on the use of models to set waterbody-specific nutrient goals, including numeric nutrient criteria and allowable nutrient loadings.

Context and Background

In 2013 WERF developed a Nutrient Modeling Toolbox (NMT) containing factsheets on 30 models capable of quantifying the relationship between nutrient loads and their impacts in terms of water quality or ecological response indicators. Seven case studies are included in the NMT to demonstrate the application. The case studies focus on the determinations needed to select a model.

NMT
Nutrient Modeling Toolbox
Your Connection to Developing Site-Specific Nutrient Criteria

For this research, WERF and the Colorado Monitoring Framework conducted a demonstration of the NMT. The project team applied the LINK1T11, *Modeling Guidance for Developing Site-Specific Nutrient Goals*, process to select and calibrate a nutrient response model. Ultimately, the researchers' goal was to create a starting point for specific guidance for process-based modeling. The technical findings were used to craft a staged, adaptive nutrient management strategy for Boulder Creek.

Findings and Conclusions

Overall, the LINK1T11 process is highly beneficial for understanding receiving waters and improving management strategies. The chosen demonstration site was Boulder Creek, a wadeable stream that drains the Rocky Mountains and flows through the City of Boulder, CO. The project team applied the LINK1T11 process to select and calibrate a nutrient response model of the creek. Ecological response variables of interest were dissolved oxygen, pH, bottom algae chlorophyll-a, and benthic macroinvertebrates. After model calibration, the project team applied the model to various scenarios of nutrient reduction in the Boulder Creek watershed. Maximum feasible nutrient reductions were not predicted to attain the default chlorophyll-a goals or pH criteria at all locations. However, results did indicate that it would be practical to reduce bottom algae and pH in specific stream segments. The model indicates that environmental benefits could be maximized by more phosphorus control and less nitrogen control than would be pursued under default regulations.

Management and Policy Implications

The application of the LINK1T11 process to Boulder demonstrates that the technical insights gained would improve default management strategies in very practical ways. The predictive framework was shown to help set realistic expectations for environmental responses to nutrient controls. It was also found to aid the adjustment of management strategies to maximize environmental benefits and/or reduce costs.

Executive Summary

Modeling Guidance for Developing Site-Specific Nutrient Goals – Demonstration: Boulder Creek, CO

This project demonstrates that screening-level models can be used effectively to support adaptive management. They allow stakeholders to take advantage of information gleaned from early implementation steps to refine the modeling framework and adjust subsequent steps. The research also demonstrated that conceptual models should be developed with the assistance of local experts and those most familiar with local or regional conditions. The model-based approach can be used alone or in combination with other methods and may be beneficial when permit writers and permittees are faced with understanding the relative contributions from multiple sources.

Related WERF Research

Project Title	Research Focus
Modeling Guidance for Developing Site-Specific Nutrient Goals (LINK1T11)	Presents guidance and tools for the use of models to set waterbody-specific nutrient goals, including numeric nutrient criteria and allowable nutrient loadings. The NMT contains factsheets on 30 models capable of quantifying the relationship between nutrient loads and their impacts in terms of water quality or ecological response indicators. Seven case studies in the NMT demonstrate the application and focus on the decision/judgements that need to be made regarding the use of the model.
Linking Receiving Water Impacts to Sources and to Water Quality Management Decisions: Using Nutrients as an Initial Case Study (WERF3C10)	Captures the state of the knowledge on nutrients and lays out a framework for addressing nitrogen control. The framework includes establishing water quality impacts, linking these impacts to nutrients, quantifying major nitrogen sources, evaluating the costs and benefits of available nitrogen controls, estimating receiving water responses to controls, and assessing water quality for potential improvements.
Technical Approaches for Setting Site-Specific Nutrient Criteria (99WSM3)	Provides methods to derive nutrient criteria for surface waters based on local factors such as water quality requirements or designated uses.

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