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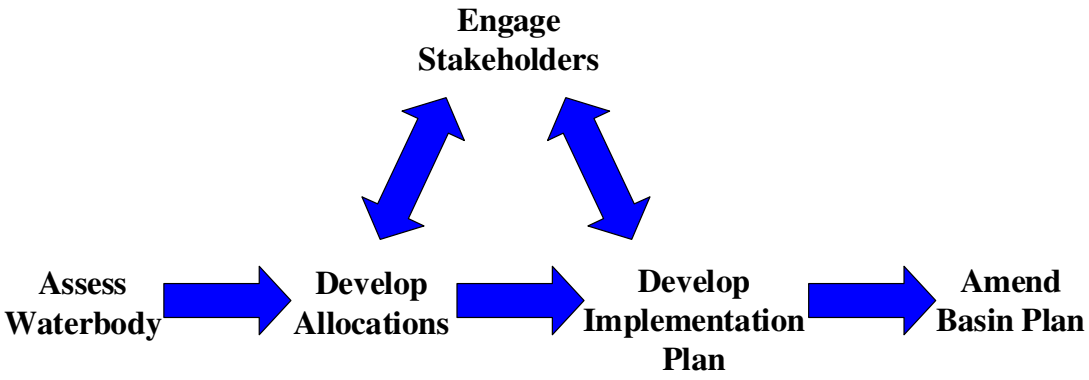
Development of Stakeholder and Allocation Models For TMDL Assessments

National Energy Technology Laboratory and Lawrence Livermore National Laboratory

Background

The federal Clean Water Act (CWA) Section 303(d) requires each state to conduct a biennial assessment of its waters, and identify those waters that are not achieving water quality standards. The result of this assessment is called the 303(d) list. Over 30,000 segments of waterways have been listed as impaired by the Environmental Protection Agency (EPA). The CWA also requires states to establish a priority ranking for waters on the list of impaired water and to develop and implement Total Maximum Daily Loads (TMDLs) for these waters. The process steps to be followed in developing a TMDL are:



While a great deal of effort has gone into developing methods to assess waterbodies, very few tools exist to assist TMDL developers with engaging stakeholders, developing fair and equitable allocations, and developing transparent and effective implementation strategies. With this aim in mind, Lawrence Livermore National Laboratory (LLNL) and the National Energy Technology Laboratory (NETL) are collaborating on tools to "close the loop" between stakeholders and regulators in the TMDL process.

Primary Project Goal

The purpose of this project is to improve the processes used by regulators and decision makers to engage stakeholders, enabling the development of more cost effective, transparent and accepted TMDLs.

Objectives

The major objectives of this effort are to develop modeling tools for effectively engaging stakeholders and formulating allocation and implementation plans that can be used

nationwide and that are accepted by regulators and stakeholders. Once completed, these tools will be made available to interested stakeholders and the EPA.

Accomplishments

The initial focus the NETL/LLNL effort is on the Dominguez Channel located in the Los Angeles Basin. Efforts are currently underway to develop TMDLs for a variety of heavy metal pollutants impairing this water body. Stakeholder Preference and Allocation models (versions 1.0) have been developed and will be refined this year. The stakeholder model includes the major stakeholder groups include nongovernmental organizations, oil refineries, the Port of Los Angeles, and the Los Angeles Department of Public Works. However, the tools being developed for the Dominguez Channel TMDL are general and will be applicable to other watersheds and pollutants.

A prototype ***stakeholder preference model*** has been developed that uses multi-attribute utility (MAU) theory to quantitatively structure and assess the preferences of major stakeholder groups for proposed implementation plans. The model uses information and data collected from the various stakeholders to quantitatively structure their preferences into meaningful and well defined attributes. These attributes can be expressed mathematically in common units for structured tradeoffs that produce utility values or metrics of how well an implementation plan would be received by the stakeholders. The stakeholder preference model has shown the potential to achieve TMDLs that are more widely accepted by all interested and responsible parties and could facilitate other steps in the TMDL process. Preliminary results from the Dominguez Channel have shown some different values among stakeholders, especially in the areas of scheduling and cost of the implementation plan. The stakeholder attribute list has also established the importance of each attribute to the various stakeholder groups, giving regulators the ability to make tradeoffs to maximize the interests of all parties.

The Figure below is a “Stacked bar ranking” of sample results generated by the stakeholder preference stakeholder preference model. The color-coded bars represent the individual level of preference for each stakeholder group in the model and the overall stakeholder groups utility values (preferences) from an illustrative TMDL plan tested with the model. As shown, the “non-profit,” “city government,” and “government agencies” stakeholders prefer Plan 2, which has a higher overall utility value. However, the industrial stakeholders preferred Plan 1, which has an overall lower utility but a higher one for that particular stakeholder. The MAU stakeholder preference model can be used to balance the overall watersheds utility (preference) with that of each individual stakeholder.

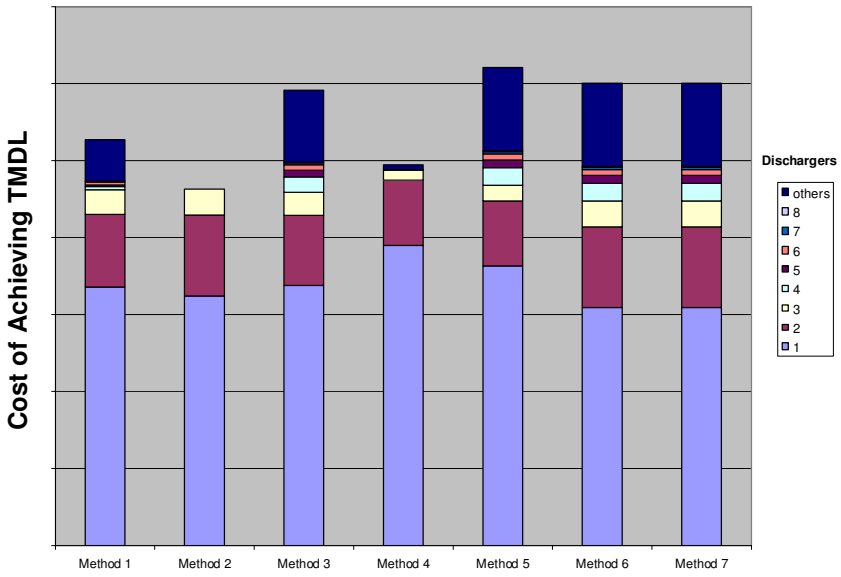
Ranking for Best TMDL Plan Goal

Alternative	Utility
Plan 2	0.676
Plan 1	0.512

Best for Non-Profit Organizations
Best for Government Agencies
Best for City Government
Best For Industry

Preference Set = GG Preference Set

An ***allocation model*** has also been developed to assess the outcomes of allocation and implementation strategies. How TMDL allocations are structured can have a large impact on the total cost for water pollution control, on who pays what share of this cost, and on the acceptance of the allocation and implementation plan by stakeholders. The allocation model currently only addresses cost, but will be extended to consider schedule and effectiveness of options for achieving the TMDL established by the waterbody assessment. The model is based on a material balance around the entire watershed, with spatial effects handled using a tanks-in-series mixing model of the interconnected sub-watersheds. Individual sources and sinks are considered within each sub-watershed. Temporal effects are handled by considering various time-average pollutant concentrations and loadings, such as annual, seasonal, and rain event specific. The model can be used to examine a range of approaches for allocation, from the equalization of all effluent concentrations (Method 1 below) to the minimization of the total treatment cost for all dischargers (Method 2). As an example, a comparison of the cost distributions for a variety of allocation strategies is given below:



In this example, the cheapest option is to have the three largest dischargers do all additional treatment necessary to meet the TMDL requirement (Method 2). This result might be implemented in a fair and equitable way by means of a watershed-wide effluent trading program.

The stakeholder and allocation models are being designed as complimentary tools to be used interactively throughout the TMDL development process. For example, the Allocation Model can be used by the TMDL developer to estimate the cost, effectiveness and schedule of any allocation and implementation plan. This information along with stakeholder attributes and preference data is input to the Stakeholder Preference Model. The output from the Stakeholder Preference Model allows the TMDL developer to measure the individual and overall acceptance of the plan by stakeholders. If acceptance is low, the developer may want to modify the plan or propose a new plan, which can be re-analyzed with the models.

Benefits

The development of tools to engage stakeholders in the TMDL process has the potential to reduce the cost of and shorten the schedule for implementing the TMDL, and to improve the acceptance of the TMDL by all interested and responsible parties.

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