Subject:
Application for the 2011 J. Robert Havlick and Thomas H. Muehlenbeck Awards

To:
Brandi Allen
ballen@transformgov.org

From:
Youn Sim, Civil Engineer, Ph.D, P.E.
Los Angeles County Department of Public Works
Los Angeles County Flood Control District
Watershed Management Division
900 S. Fremont Avenue
Alhambra, CA 91803-1331
626-458-4314
626-458-3534 (fax)
ysim@dpw.lacounty.gov

Summary
Improving the water quality of the region's coastal watersheds is a significant undertaking. To help public and private entities address the challenge of managing urban runoff and stormwater, the Los Angeles County Flood Control District (LACFCD) has developed the Watershed Management Modeling System (WMMS). The WMMS identifies cost-effective projects through an integrated, watershed-based approach.

Background
The LACFCD was established in 1915 under the Los Angeles County Flood Control Act. Its boundaries encompass approximately 2,752 square miles. The LACFCD's mission is to construct, operate, and maintain an advanced system for flood protection and water conservation, while improving water quality and maximizing habitat, open space and recreational opportunities.

The LACFCD operates and maintains 15 major flood control dams and reservoirs, 487 miles of open channels, 79,957 catch basins, 2,919 miles of underground storm drain conduits, 62 pump plants, 155 sediment entrapment basins, 234 crib dams, 27 sediment placement sites, 27 spreading grounds, 24 low-flow diversion structures, and 3 seawater intrusion barriers. The LACFCD's major programs are categorized as flood control, water conservation, and urban runoff and stormwater quality.

Urban stormwater runoff has been identified as a major cause of degradation of rivers and streams with metals, organic chemicals, and pathogens. The LACFCD is dedicated to improving the surface water quality by identifying and characterizing pollutant sources via effective stormwater monitoring and management. Efforts have been expanded to active public education about stormwater pollution sources, impacts, and methods of prevention. In addition, through cooperation with stakeholders, the LACFCD has developed projects for storm and urban runoff water quality enhancement. These projects often include flood control, water conservation, recreation, habitat protection, and open space benefits.

How is it a quantum leap of creativity?
Although similar attempts have been made in other parts of the country, the scale and level of detail of the WMMS is unprecedented. It is the first decision support system of its kind to account for parcel-scale details of hydrologic, pollutant transport and best management practices (BMP) processes while encompassing 3,000 sq miles of coastal watersheds.

Many creative "leaps" were made in order to make the WMMS the first of its kind. The extensive amount of data was used from 148 rainfall gages spanning 20 years, water elevation readings behind 20 dams, 5 sanitary sewage treatment plant discharge records, evaporation readings from 20 gages, water conservation records from 27 spreading grounds, 79 stream gage records, the ASCE BMP database, and 12 years of water quality monitoring records. A system of this resolution and magnitude has never been created before and all this data has never been viewed in a holistic manner until the development of this innovative system. The Los Angeles County parcel data and its associated tax code values were used to create a land use layer. A land use layer of this resolution has never been created in Los Angeles County before.

Built on an extensive body of relevant studies in the Los Angeles region and a state-of-the-art optimization technique, the WMMS provides a unique framework in which managers can evaluate alternative stormwater BMPs and low-impact development (LID) methods. An optimized solution to a specific management objective can be identified based on benefits and costs.

Who has benefited from the innovation?

More than 80 municipalities and numerous agencies in Los Angeles County will benefit from the innovative decision support system. The system will greatly help them make their management decisions by effectively considering cost and benefits of various options to meet management objectives such as water quality improvement and other public works priorities. Further it will help them efficiently use limited public funds by maximizing the benefits of their management decisions. Specific benefits are described in the answers to the next question.

How was the innovation initiated and implemented?

Development of Innovative Decision Support System

As a regional agency that serves most county areas that include more than 80 municipalities and numerous other agencies, the LACFCD has developed the WMMS as a decision support system for effective stormwater management and planning for all of its coastal watersheds. The WMMS simulates hydrologic and pollutant transport processes and subsequently identifies cost-effective combinations of local-scale and watershed-scale BMPs. Local-scale BMPs, often referred to as LID-type BMPs, present a viable option for individual cities to control pollution at the source. Watershed-scale BMPs treat residual runoff from the entire watershed.

Using the integrated, watershed-based approach, the WMMS will help decision makers develop projects that achieve overall watershed goals while recognizing needs of individual municipality and other public and private entities within the watershed. The system provides project recommendations in terms of type and quantity of BMPs allocated to specific parcel land uses. This allows decision makers to conveniently select locally available parcels/areas and implement them.

The WMMS and its results will be made available to the public. Using the WMMS, different entities within the watershed can cooperatively develop cost-effective and mutually beneficial solutions that address multiple issues, including water quality, water conservation, flood protection and open-space development. This eventually will lead to effective watershed-based stormwater management.

Specific project goals

- Simulates hydrologic and pollutant generation and transport processes all major watersheds within the county boundary;
- Provide a comprehensive list of cost-effective local- and watershed-scale BMP solutions that can be used to develop multipollutant TMDL implementation plans for all county watersheds;
- Provide technical guidance for LID implementation at new and redevelopment projects by quantifying water conservation and pollution reduction benefits; and

- Develop a watershed management tool for future planning of multibenefit projects involving water quality, flood control, water conservation and open-space development components.

Project Components

The WMMS system development was conducted through two phases. In the first phase, USEPA's existing watershed models were adopted and further improved by refining the watershed details such as parcel-scale land uses along with physiographical characteristics of the watershed. The second phase developed a state-of-the-art BMP selection system based on optimization algorithm. Finally the two components are integrated into each other to form the WMMS. The system will be continuously updated in the future to reflect the latest watershed condition changes such as on-going urbanization and consequent land use changes.

The WMMS Advantage

The WMMS provides four main benefits:

- Providing a mechanism for phased BMP implementation, with quantified pollutant load reduction to be achieved;
- Integrating additional watershed management benefits in addition to those of water quality;
- Allowing for an iterative, adaptive approach to water quality improvement goals through continuous refinement and improvement of selected BMP solutions; and
- Making information available to cities for their water quality planning needs.

What risks were associated with planning and developing the innovation?

No major risk was anticipated in developing the innovative system. Caution was paid to ensure all watershed characteristics such as actual land use and parcel data are accurately incorporated. Incorrect or insufficient data could seriously affect the system results which would ultimately misrepresent watershed conditions.

What was the environment in which the innovation was created and sustained?

Stormwater Quality in Southern California: TMDLs

Coastal watersheds in Los Angeles County span about 3,000 sq miles. Major surface waters originate from pristine mountains in the north and flow to the Pacific Ocean through urbanized foothill and valley areas and high-density residential and industrial coastal areas, terminating at highly utilized recreational beaches and harbors. To date, water bodies within the county have been prescribed more than 23 total maximum daily loads (TMDLs), including trash, metals, toxic pollutants, bacteria, nutrients and chlorides. Within the next few years, approximately 30 additional TMDLs are expected to be established. TMDLs of many pollutants are allocated to publicly owned treatment works, municipal separate storm sewer systems (MS4s), freeways and highways, and industrial and construction sites.

Challenges & Approach

TMDLs for Los Angeles County's water bodies are allocated mostly to storm drain outlets. Because there are thousands of drain outlets, TMDL compliance often is based on water quality measured at receiving waters instead of quantifying total loads at all storm drain outlets. It should be noted that in addition to the discharges permitted by the MS4 permits, a variety of

discharges occur every day under 5,600 active National Pollutant Discharge Elimination System permits issued by state regulatory agencies. Consequently, it is nearly impossible to demonstrate the water quality improvement effect as a result of individual management actions toward TMDL compliance at the receiving waters.

In order to overcome such challenges, a watershed-based approach is needed to address the water quality of entire watersheds. In the watershed-based approach, collective impact of a variety of pollutant sources—from point to nonpoint—is evaluated; thereby comprehensive, long-term strategies for overall water quality improvement of the entire watershed can be planned.

What were execution costs and savings?

The total costs for the system development include a consultant contract (approximately $2 million) plus additional costs for in-house staff labor. Several existing economic impact studies have estimated the costs to meet regulatory standards by building necessary projects. With the conventional infrastructure planning strategies, the cost was estimated to range from $54 billion to $102 billion. However, with the use of innovative decision support system for cost-effective project development, significant savings of public funds are expected. Further, the WMMS enable agencies and managers to evaluate possible proposals, strategies, and alternatives relatively easily with minimal costs.

What lessons were learned that could be shared with other local governments?

An important lesson learned during the development of the WMMS was stakeholder involvement. The successful development of the innovative system would not have been possible without active cooperation of a variety of stakeholders of Los Angeles County areas. An extensive effort was made to involve stakeholders. This allowed stakeholders to have a sense of ownership of the project which leads to acceptance of the project and results. In particular, since the system will be used to help meet regulatory requirements, the involvement of regulatory agencies such as USEPA and state regulatory agencies was critical.

Which department and/or individual championed the innovation?

The Los Angeles County Public Works (Watershed Management Division) on behalf of the LACFCD championed the development of the innovative system. In addition, it has been a true stakeholder-driven effort. For example, the USEPA has provided technical as well as financial support. Their technical expertise gained from numerous TMDL developments and implementation nationwide was invaluable. A Technical Advisory Committee, consisting of watershed committee representatives, State and Federal regulators, researchers, and nongovernmental organization representatives, provided critical input in the system development.

To date, the innovative system has been highlighted in many national events including:

- Invited by National Association of Counties (NACO) for nationwide webcast presentation
- Invited by USEPA to Water Environmental Federation Conference
- Invited to present an article at *Stormwater Magazine*
- Invited to present an article at *Urban Coast Journal*
- Presented at numerous national conferences (i.e., ASCE and APWA conferences)