Maximizing BMP Performance in Urban Areas: A Modeling Approach to More Accurately Estimate Performance to Minimize BMP Footprint

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Highlights

- Limited space in urban environments required BMPs to maximize treatment in the smallest possible space.
- Modeling BMPs simultaneously allows for a more accurate estimate of performance leading to smaller BMPs providing the same or better treatment.

Introduction

Finding suitable locations for stormwater retrofits in highly urban areas can be a dauting task. Add in stringent water quality regulations that require significant treatment and volume reductions to meet and the task becomes even more daunting. A robust modeling-based approach that optimizes treatment to maximize volume and pollutant reduction in such settings is critical. To accomplish this task, Tetra Tech has developed and applied a modeling-based approach that simultaneously evaluates the function and performance of multiple BMPs implemented in series in multiple watersheds to evaluate the overall combined impact at different compliance locations. This method has been applied for multiple permittees and stake holders in Southern California including the Los Angeles Department of Water and Power, the Los Angeles Department of Public Works Bureau of Engineering, and the Gateway Management Authority to alleviate local flooding, increase water supplies through stormwater capture, improve water quality, and provide recreational, social, and economic benefits.

Methodology

To evaluate the wholistic impact of the combined BMPs in the watershed, elements of Los Angeles County's Watershed Management Modeling System (WMMS), EPA System for Urban Stormwater Treatment and Analysis IntegratioN (SUSTAIN) and EPA Stormwater Management Model (SWMM) were used to apply a "state of the science" modeling-based approach to simultaneously evaluate potential diversion rates and BMP footprints for multiple regional BMPs (an example of 6 potential sites is shown in Figure 1) to determine the combined impacts to water quantity and quality of the overall watershed. Several thousand simulations consisting of different combinations of diversion rates and BMP sizes were applied to develop a cost-effectiveness curve based on annual stormwater capture to recommend the optimal configuration(s). The cost functions for the various elements of the BMPs for each site were specified in the SUSTAIN model based on estimates of probable construction costs for various elements associated with each BMP.

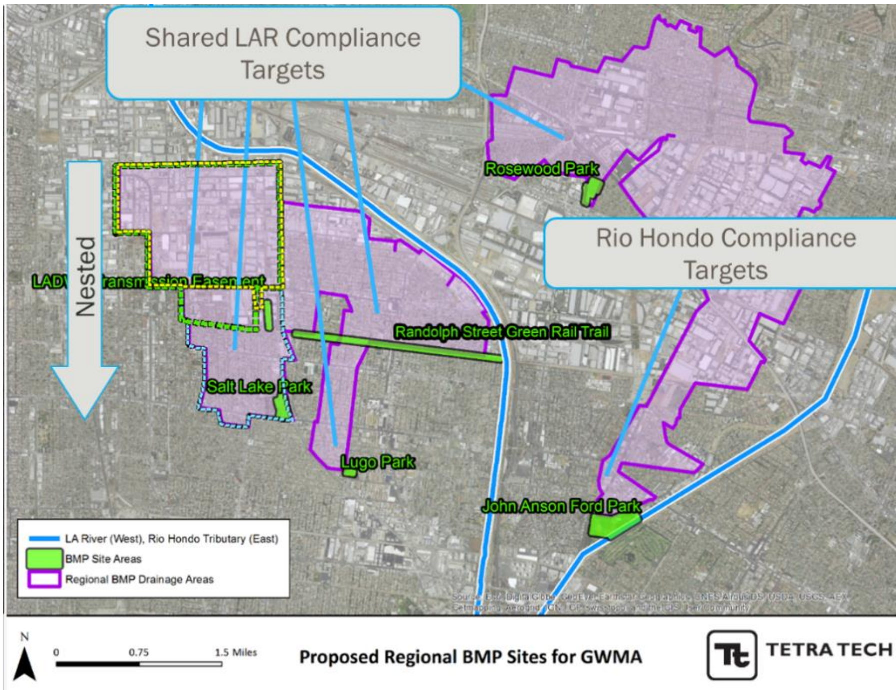

Figure 1. Location of 6 Potential BMP Locations in the LA River and Rio Hondo Watersheds.

This "nested" analysis approach, illustrated in Figure 2, was applied for three separate feasibility studies that included 22 BMPs in three watersheds, Rio Hondo, Upper LA River, and the Upper San Gabriel River, in the Los Angeles area.

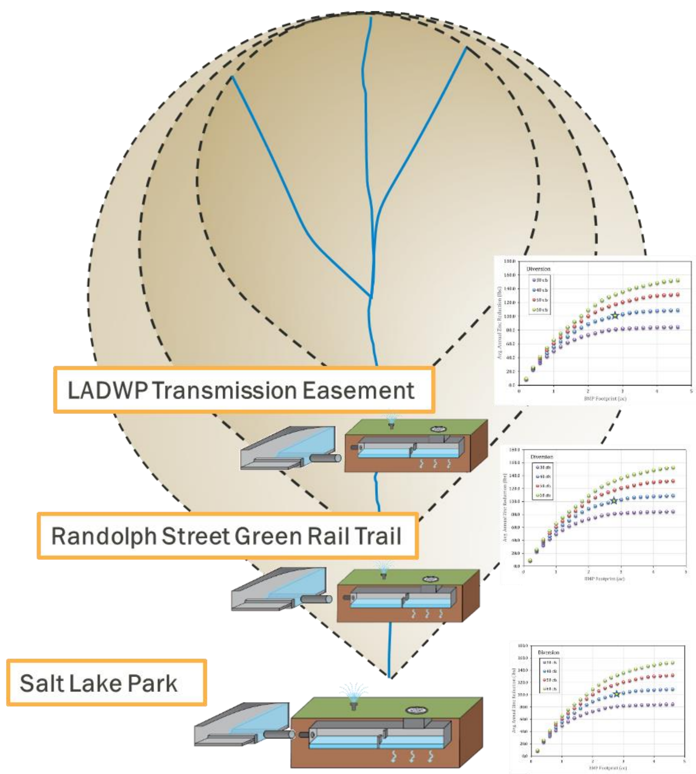

Figure 2. Illustration of the "nested" approach for 3 potential project locations.

Results and discussion

The analysis showed that the same pollutant reduction and treatment could be provided with smaller BMPs, when compared to the typical approach of capturing the runoff produced by the 85th percentile storm at each potential location. For the feasibility study for the LA Parks Stormwater Program, the results showed that the same pollutant load reductions could be achieved with 31 acre-feet less storage when comparing the approach applied in the Enhanced Watershed Management Program (Figure 3). The most cost-effective alternative is expected to capture approximately 3,000 ac-ft/year of stormwater runoff over a 10-year period.

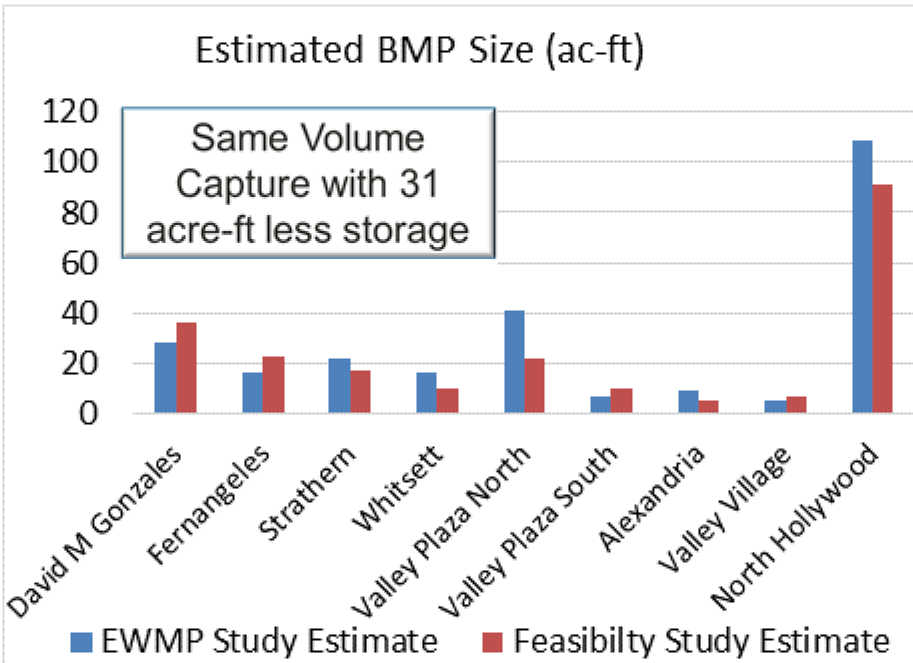

Figure 3. BMP size estimated in the EWMP compared to the nested analysis applied in the feasibility study.

Conclusions and future work

The nested analysis approach provides the most accurate representation of several interdependent drainage networks within the watershed drainage area and optimizes the cumulative volume capture and pollutant load reduction for the overall watershed by considering the impacts of the performance of BMPs located upstream and downstream of the BMP. This approach more accurately predicts the performance for the overall watershed allowing permittees to strategically invest where impact is highest. This approach is currently being applied to feasibility studies in Southern California to optimize performance in the smallest BMP footprints possible to meet the compliance targets for the lowest possible cost.