SMC California LID Evaluation & Analysis Network (SMC CLEAN)

Targeted Research Questions

August 8, 2017

SMC CLEAN Goals, and Objectives – From SMC CLEAN Work Plan

The following are the goals and objectives identified in the SMC CLEAN Work Plan, which are provided for reference. The focus of this document is Goal 3 and focus on Objectives 3C & 3D. Objective 1A is included for context.

Goal #1: Development and Ongoing Facilitation of a Technical Advisory Committee to assist in accomplishing the SMC CLEAN Mission & Goals.

- Objective #1A: Identify Potential Research Questions
- Objective #1B: Develop Work Plan
- Objective #1C: Develop branding for the project.
- Objective #1D: Ongoing coordination with consulting team and review comment of project products
- Objective #1E: Ongoing identification of project partners

Goal #2: Provide Ongoing Collaboration with Project Partners and Others Performing LID Monitoring and Serving as a Clearing House for LID Monitoring Information.

- Objective #2A: Ongoing collaboration with Project Partners to understand LID monitoring efforts, lessons learned.
- Objective #2B: Ongoing collaboration with Project Partners on potential future funding (i.e. grants) to make the SMC CLEAN project more robust and maximize the current funds allocated to the project.
- Objective #2C: Development of an SMC CLEAN Website for Collaboration of Project Partners and a platform for the development of an LID Monitoring Clearing House
- Objective #2D: Evaluate development of an SMC CLEAN Online LID Data Submittal Tool/Clearing House
- Objective #2E: Ongoing collaboration with the SWRCB and the GI/Data Standards Initiative

Goal #3: Development of Targeted LID Research Questions

- Objective #3A: Evaluate Current LID Monitoring Data & LID Research
- Objective #3B: Identify Gaps in LID Monitoring Data
- **Objective #3C: Identify Target LID Research Questions to answer short term need for use in calibration of watershed programs**
  - **Calibration of watershed models**
  - **Potential modification of watershed management programs**
- **Objective #3D: Identify Target LID Research Questions to answer long term for modification of LID design, construction, maintenance, and monitoring**

Goal #4: Development of LID Monitoring Plan Elements

- Objective #4A: Development of Standard LID Project Data-Information List
- Objective #4B: Development of Standard LID/GI Monitoring Protocol
- Objective #4C: Development of Data Sharing Protocol
- Objective #4D: Development of SMC CLEAN Database
- Objective #4E: Develop LID Operations Conceptual Model
- Objective #4F: Develop SMC CLEAN Monitoring Plan based on targeted LID research questions for short term and long term needs.

Goal #5: Perform Targeted LID Monitoring

- Objective #5A: Implement targeted LID monitoring to answer short term needs
- Objective #5B: Implement targeted LID monitoring to answer long term needs

Goal #6: Analyze LID Monitoring Data Collected

- Objective #6A: Analyze monitoring data to answer short term needs
- Objective #6B: Analyze monitoring data to answer long term needs

Goal #7: Make Recommendations & Update the Southern California LID Manual

- Objective #7A: Develop technical memorandum on bioretention/biofiltration performance for short term needs, for use in calibration of watershed programs and any associated recommendations for bioretention/biofiltration design, construction, maintenance, and monitoring.
- Objective #7B: Develop technical memorandum on bioretention/biofiltration performance and associated recommendations for long term needs for modification of bioretention/biofiltration design, construction, maintenance, and monitoring.
- Objective #7C: Develop Standard Bioretention/Biofiltration Monitoring Design Plans and Specifications.
- Objective #7D: Update the Southern California LID Manual to incorporate recommendations for bioretention/biofiltration design, construction, maintenance, and monitoring.
- Objective #7E: Development SMC CLEAN Phase 1 Project Report

Objective 1A: Definition of Potential Research Questions

The first Objective #1A identified in collaboration with the TAC potential research questions to help further define and articulate the details within the scope of work and work plan for the SMC CLEAN project. The specific research questions identified by the TAC for potential exploration are as follows:

- Understanding the range of performances under varying conditions and how ambient conditions affect performance
    - What is the mechanism by which the greatest benefit is achieved i.e. reduction in concentration or reduction in volume of stormwater?
    - What is the expected range of performance for different pollutant / chemical / biological categories experienced by LID treatment

    - What are the benefits to different physical fractions during treatment? Is all benefit in the particulate form?
    - How do the different climate zones in California affect LID performance?

- Understanding factors that influence performance (e.g. plants, soils, etc)
    - What is the magnitude of pollution removal benefits of different forms of LID infrastructure?
    - How do different LID designs affect LID performance?
    - How does the bioretention soil matrix affect bioretention performance?
    - How does the plant pallet affect LID performance?

- Understanding how implementation and management affects performance (installation, maintenance, real world)
    - How does construction and construction sequencing affect LID performance?
    - What are the effects of maintenance on LID performance?
    - Do proprietary BMPs perform in the real world setting compared to manufacturer specifications?

Identification of Targeted SMC CLEAN Research Questions

Discussions with the SMC CLEAN Technical Advisory Committee identified two primary needs associated with the project. The first is a short term need for a quantification of LID performance in Southern California, needed for use in providing empirical data to calibrate estimates for compliance measures such as the recently developed watershed programs (i.e. EWMPs, WQIPs, etc.) and their associated watershed/water quality models (i.e. RAA, RAS), and TMDLs. The second is more of a long term need to serve as collaboration entity and clearing house of LID monitoring data in order to understand the effectiveness of various LID BMPs overtime and understand how the differences in design, construction, and maintenance affect their performance. Objectives 3C & 3D below address these two needs respectively.

Objective 3C: Identify Target LID Research Questions to answer short term need for use in calibration of watershed programs

To answer the short-term need for use in calibration of watershed programs the focus is two-fold, 1) verification and understanding the pollutant removal of LID systems and 2) understanding the hydrologic benefits of LID systems. Since bioretention systems (with and w/o underdrains) are the most commonly implemented LID BMPs in Southern California and with a need for a targeted focus of the initial phase of the SMC CLEAN it is proposed to focus on bioretention/biofiltration systems to answer this 2-part focus. Data availability is the primary criteria for the selection of BMPs to evaluate. Other LID data will be collected and evaluated to the extent feasible, however the focus of the initial phase of the SMC CLEAN project will be on bioretention systems. The watershed calibration will use information regarding bioretention systems to understand if 1) the assumed pollutant removal effectiveness associated with bioretention systems which is used to support water quality outcomes that are

integrated into watershed plans is accurate and 2) are bioretention systems achieving one of the primary purposes of LID of mimicking pre-development (naturally occurring) hydrology for the drainage areas in which they are implemented. Watershed plans can then be modified to optimize bioretention size based on understanding of pollutant removal and hydrologic benefit. The questions below will be answered using data obtained from the SMC CLEAN project partners and with the data resulting from the monitoring to be performed as part of the project. With the 2-part focus of understanding the pollutant removal and hydrologic benefits of bioretention systems the following specific research questions have been identified to accomplish Objective 3C:

- What are the pollution removal benefits of bioretention systems in Southern California?
    - Calculate/characterize the pollutant removal benefits of bioretention systems with underdrains
    - Calculate/characterize the pollutant removal benefits of bioretention systems without underdrains.
    - If possible, discern whether changes in the bioretention soil matrix (BSM) being implemented in Southern California affects performance across pollutants.
- What are the hydrologic benefits of bioretention systems in Southern California?
    - Calculate/characterize the volume reduction of bioretention systems with underdrains.
    - Calculate/characterize the flow duration effects of bioretention systems.
    - Compare/evaluate the measured hydrologic benefits (volume and flow attenuation) with bioretention system design parameters.

The answers to the questions above should be completed by June of 2018 (2 wet seasons).

Objective 3D: Identify Target LID Research Questions to answer long term for modification of LID design, construction, and maintenance

To answer the long-term need to understand how the differences in design, construction, and maintenance affect LID performance the focus will be on gathering existing data not currently accessible (i.e. Prop 84 data) including the meta data (design, construction, and maintenance information) and evaluate how these elements effect pollutant removal and hydrologic performance. The focus of the long-term effort will be bioretention systems and will incorporate to the extent feasible research and monitoring being performed by project partners and evaluation of the meta data to understand what elements are affect performance. Data collected and evaluated to date suggest that it is possible and perhaps likely that even with access to data sets not currently available the data and information may not yet exist to adequately answer the questions identified below. If the data and information to answer these questions cannot be obtained within the constraints of this project, then the priority focus of Objective 3D will be to identify critical data needs and to provide clear guidelines for LID data collection so that more robust data are generated from projects in the future. With better datasets these questions can be more and more effectively addressed going forward. ensure that the standard LID data/information is generated for future LID projects so that the questions below can be answered in the long-term. The following specific research questions have been identified to accomplish Objective 3D, however these questions will take a longer time frame to answer and the SMC CLEAN project will establish a standard LID monitoring protocol and identify the process studies that would need to be

performed and identify those that have been performed and are being performed to quantify the kinetics of removal processes in bioretention systems, both helping to answer the following long-term questions:

- How do specific bioretention designs/configurations affect pollutant removal and hydrologic performance?
    - What are the most common bioretention designs/configurations (isolate soil depth, aggregate depth, and underdrain configuration as the differentiating factors) being implemented in Southern California (identify maximum 3 configurations)?
- How do different bioretention plants affect pollutant removal and hydrologic performance?
    - How do systems with and without plants affect pollutant removal and hydrologic performance?
    - What are the effects of different plants as identified in studies by others?
- How does maintenance for bioretention systems affect pollutant removal and hydrologic performance?
    - What is the frequency of monitoring for an individual LID BMP that would need to be performed to identify the pollutant removal and hydrologic performance effects of maintenance of an individual LID BMP?
    - What type of maintenance records are needed to identify the pollutant removal and hydrologic performance effects of maintenance of an individual LID BMP?
    - Can preliminary conclusions be drawn regarding pollutant removal and hydrologic performance effects of maintenance with information currently being collected and if so what are they?
- What kind of impacts are evident from improper construction of bioretention systems and how are these impacts affecting pollutant removal and hydrologic performance?
    - What are the typical construction errors that are seen with bioretention systems?
    - What are the qualitative impacts affecting pollutant removal and hydrologic performance of the typical construction errors that are seen with bioretention systems?
- What Southern California specific factors (i.e. climate) effect affect pollutant removal and hydrologic performance in comparison to bioretention data from project partners outside of Southern California?
    - What are the translators for Southern California of performance from bioretention studies performed elsewhere?
    - How do bioretention design parameters (soil depth, aggregate depth, and underdrain configuration) affect the translators?