Barriers to Low Impact Development

Prepared by the Local Government Commission for the
Southern California Stormwater Monitoring Coalition

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About the Southern California Stormwater Monitoring Coalition
The Southern California Stormwater Monitoring Coalition (SMC) was formed in 2001 by cooperative agreement of the Phase I municipal stormwater National Pollutant Discharge Elimination System (NPDES) lead permittees, the NPDES regulatory agencies in Southern California and the Southern California Coastal Water Research Project. The goal of the SMC is to develop the technical information necessary to better understand stormwater mechanisms and impacts, and then develop the tools that will effectively and efficiently improve stormwater decision-making.

www.socalsmc.org

About the Local Government Commission
The Local Government Commission is a nonprofit, nonpartisan, membership organization that provides inspiration, technical assistance, and networking to local elected officials and other dedicated community leaders who are working to create healthy, walkable and resource-efficient communities.

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Executive Summary

While many communities understand the benefits of Low Impact Development (LID), getting LID projects built has been difficult. In an effort to address this issue, the Southern California Stormwater Monitoring Coalition (SMC) commissioned the Local Government Commission (LGC) in partnership with the Center for Water and Land Use at University of California, Davis Extension (UCDE) to assist with identifying barriers SMC members and other practitioners have faced and in prioritizing strategies to remove those barriers.

Broad categories of barriers to LID have been largely identified. Therefore, the purpose of this project is to dig deeper into these barriers by investigating the more complex web of codes, processes and perceptions surrounding LID implementation. LGC performed an extensive literature review and engaged SMC members as well as representatives from local and regional public agencies, environmental organizations, and the private development community to gain further clarity on key barriers facing LID implementation. Top barriers identified as part of this process are as follows:

- Technical Infeasibility
- Lack of Acceptable Performance Data for Manufactured LID Products
- Lack of Municipal Design Guidelines and Plans
- Conflicts with LID in the Public Right-of-Way
- Conflicts with Broader Sustainable Planning Goals
- Lack of Interdepartmental Coordination and Leadership at Top Levels of Local Government
- Challenges with Operations and Maintenance
- Inconsistent Interpretation of Permit Requirements
- Lack of a Definition, Guidance, and Examples of Off-site and Regional LID Solutions
- Specific Permit Requirements but Vague Guidance

As next steps for addressing these barriers, the Local Government Commission recommends the following actions be taken by the SMC:

1. **Support the development of municipal LID design guidelines and plans recognized by the State and Regional Water Boards.** Specifically, discuss and reach consensus among SMC municipal members regarding the need and importance for a standard LID definition and technical guidance manual that is recognized by the State and Regional Water Boards. Once the priority is established, explore opportunity to work with a third-party organization with a statewide presence and authority on LID to explore to develop the manual.

2. **Support the development of a clear definition and guidance of off-site and regional LID solutions.** SMC members should discuss and clarify the need and importance for flexibility within stormwater permits to allow priority water quality issues in the watershed to be addressed at the appropriate scale without giving permit priority to on-site options alone. Local and regional public agency members of SMC can draft recommendations for how this can be accomplished within the current framework of stormwater permits and submit to the State and Regional Water Boards for consideration. There are a handful of municipalities throughout California that are attempting to or have developed stormwater management solutions at a neighborhood or community-wide scale. The SMC can highlight these efforts and help create opportunity for peer-to-peer learning by organizing trainings, workshops, and/or webinars.

3. **Support interdepartmental coordination and leadership at top levels of local government.** Local elected officials have the final say when it comes to land use. Therefore, mayors, city council members and county supervisors have a leadership role to play in advancing solutions to LID implementation. The SMC could sponsor educational dinner forums for elected officials and top administrative staff that feature experts in the field and promising LID implementation case studies from other

communities. Also, much of the research and educational materials demonstrating the benefits of LID and green infrastructure techniques are not suitable for the elected official audience. Therefore, the SMC could draft a one-page factsheet suitable for a busy local elected official that provides a high-level overview of LID; key data points demonstrating economic, social, and environmental benefits of LID; links to additional information; and key questions elected officials can ask of their staff to learn more about their city's LID program and how they can help in overcoming challenges.

Project Background and Process

While many communities understand the benefits of Low Impact Development (LID), getting LID projects built has been difficult. In an effort to address this issue, the Southern California Stormwater Monitoring Coalition (SMC) commissioned the Local Government Commission (LGC) to assist with identifying barriers SMC members and other practitioners have faced and in prioritizing strategies to remove those barriers. The Center for Water and Land Use at University of California, Davis Extension (UCDE) also provided support to this effort.

Broad categories of barriers to LID have been largely identified. Therefore, the purpose of this project is to dig deeper into these barriers by investigating the more complex web of codes, processes and perceptions surrounding LID implementation. LGC conducted a literature review of existing studies and reports on barriers to LID. From this review, a comprehensive list of barriers to LID was compiled and organized into three tiers based on scale - site/project scale, municipal/regional scale, and state/national scale. Some barriers fall across all three tiers, such as educational training for those in the public and private sector.

The comprehensive list of barriers was then further refined, developed, and prioritized using input received from public agency staff and the broader development community. The first round of input was received via two online surveys developed and distributed by LGC. One survey was developed specifically for staff representing local and regional public agencies and the other targeted representatives from the development community. Respondents were asked to rank a list of barriers based on level of relevance in obstructing LID implementation in their work, jurisdiction and/or region. The survey also provided an opportunity for respondents to share additional barriers to LID not captured in the survey. Further, they were also asked to share their experiences as a local jurisdiction, agency or organization in overcoming the barriers and implementing a successful LID project.

LGC distributed the surveys through the following networks: Southern California Stormwater Monitoring Coalition, California Stormwater Quality Association (CASQA), the Nonpoint

Education for Municipal Officials (NEMO) list serve, the Southern California Chapter of the Building Industry Association (BIA), Southern California Chapter of American Society of Landscape Architects, Orange County/Inland Empire Chapter of the Urban Land Institute (ULI), and the Southern California Chapter of the American Society of Civil Engineers. A list of literature reviewed is included in Appendix A.

The LGC received 115 responses to the survey from local and state public agency staff with 67 of these representing cities, counties, and regional agencies (e.g., Caltrans) from the Southern California area. The titles and positions of those that responded from public agencies include stormwater manager/NPDES coordinator, community development director, public works director, sustainability coordinator, planner, engineer, environmental inspector, parks department, and hydrologist. Almost half of these respondents reported having 0 – 4 years of experience working with LID. The LGC received twenty-six responses from the development community. All respondents were from the Southern California region and represented private land developers and private design and engineering consultants. Over 60% of respondents to the survey reported having 0 – 9 years of experience working with LID. Copies of both surveys are included in Appendix B.

As a follow up to the online survey, two focus groups were organized in Southern California in November 2011. A public agency focus group was held in Riverside, California, with participants representing nine different local public agencies. The other focus group brought together those representing the private sector development community and included six participants representing land developers and private sector engineers. A list of those who participated in the two focus groups and the agendas for both focus groups are included in Appendix C. Phone interviews were also conducted and a list of those who participated in these interviews is included in Appendix D.

Key Barriers to LID Implementation

Based on feedback received through the process described above, LGC was able to identify key barriers facing LID implementation. These key barriers are further described below and are listed starting with site/project scale barriers and moving to regional barriers. These key barriers do not capture all the input received; therefore, a short list is provided at the end of this section to capture additional barriers worth reporting.

Technical Infeasibility

Respondents from the development community and local public agencies both ranked technical infeasibility as one of the top barriers to LID implementation. Most commonly mentioned were challenges with water infiltration on hillsides, poorly draining soils, high groundwater tables, arid climates, and space constraints – especially in urbanized areas of a community. Additionally, public agency staff shared that they struggle with adequately addressing the multitude of challenging conditions and sites within their municipality. Both the public and private sectors agree that when soils are well draining, accommodating LID is relatively straightforward. However, in the case of soils with poor infiltration, the cost and complexity of solutions increases.

Many respondents provided feedback on what they felt were promising and not-so-promising LID treatment solutions. For example, infiltration is by far the preferred LID treatment but it only works on sites with well draining soils. Given the variance of soil types, the development community expressed interest in guidelines or alternatives when dealing with poorly draining soils so as to avoid more expensive LID treatments.

Flow-through planters are viewed as the next best solution when infiltration does not work, however there are drawbacks to the use of this approach. Respondents reported that flow-through planters are often not well maintained, thus leading to inundation and the resulting loss of vegetation, which compromises performance. There was also concern about water

quality benefits given these LID treatments are located on private property and usually only treat stormwater collected from a development's roof. It should be noted, that the performance of flow-through planters to meet hydromodification requirements was not explicitly mentioned by respondents given the focus of this study is on barriers to Low Impact Development implementation.

Other LID treatments that received support as promising solutions were reuse, retention, and drywells. Respondents pointed out that there are limited uses for the reuse of runoff water. Reuse could be more economically feasible if collected water could be used for building functions (e.g. toilet flushing or industrial cooling.)

There was a concern about the long–term maintenance of drywells located on private property. Drywells can be designed in various way but are commonly trenches, basins, or manholes that collect runoff and allow it to slowly infiltrate into the ground. Particular concern was expressed for drywells located in retention basins. Drywells in this condition can become clogged, leaving the drywell submerged under stagnant water and unable to be cleaned out. One local jurisdiction shared that they address this challenge by attempting to keep all drywells outside of retention basins so they are accessible by vacuum trucks.

LID treatments the respondents did not favor included permeable asphalt and concrete; stormwater planters integrated with the structure; cisterns; and green roofs. In the case of permeable asphalt and concrete, there were many concerns expressed, including the inability of contractors to install them correctly, and installation costs – which respondents reported as double that of conventional paving materials. Additionally, there were concerns about the durability of the materials over time; ability of maintenance crews to correctly maintain permeable pavement correctly; and that permeable asphalt would clog over time and might need to be completely repaved rather than resurfaced. Finally, concerns were shared about fire departments pushing back on permeable asphalt and concrete fearing that these materials will not hold up under the weight of fire trucks.

As for stormwater planters integrated with the structure, respondents pointed out there is very limited experience with this technology. They noted that water entering the planters from downspouts is at high velocity and needs special design considerations.

In general, green roofs are viewed as not economically feasible. Respondents noted that public agencies might pursue green roofs as part of a public demonstration project but green roofs do not make sense for the private sector due to higher construction and maintenance costs. In addition, local fire departments have shared concerns that green roofs may violate fire brush requirements.

There were several concerns about the use of cisterns. Respondents pointed out that cisterns can require a large amount of space, thus making it both expensive and challenging to accommodate, particularly on a small site. They also pointed out there is little data available about the size of reoccurring storms at a sub-region scale, making it difficult to appropriately size a cistern. Further, there are not many options for the reuse of collected water and even if there were, then there would need to be a better understanding of the nexus between indoor water demands and volume of runoff that could be collected by the cistern. In addition, stored water used for landscaping must comply with vector control issues thus requiring additional treatment. There was a perception that the additional treatment increases the cost of the water thus making it uneconomical for the owner to reuse for irrigation or other purposes.

Lack of Acceptable Performance Data for Manufactured LID Products

When soils do not drain well, bio-filtration becomes one of the next best LID treatment options. Respondents representing the development community expressed strong support for using manufactured bio-filtration systems. Companies creating these systems are perceived by the development community as leading the charge in developing the engineering and design solutions to overcome many of the technical barriers. The development consultants expressed they often look to manufacturers as resources for learning about effective LID products.

Local jurisdictions push back on manufactured systems, stating that these systems do not adequately manage volume on site. Other jurisdictions do not accept manufactured solutions based on lack of acceptable data proving these solutions work. Local jurisdictions further expressed concern that manufacturers are advertising their products as LID compliant, which can be very misleading to the development community. As a counter, the development community expressed the need for local agencies to increase their knowledge of available tools and products on the market before passing judgment on all manufactured solutions.

In summary, using manufactured bio-filtration systems will continue to be a challenge until there is agreement by key stakeholders (i.e., local agencies, regional water boards, and the private development community) that these systems satisfy the goals and definition of LID. Concern has been raised that there is not a generally accepted definition of LID, thus defining an appropriate LID solution, such as bio-filtration, may be futile until this larger issue is addressed.

Lack of Municipal Design Guidelines and Plans

A public agency staff person recognized that "cities have to make it easy for those designing projects to do the right thing", but most cities do not have design guidelines or standard construction plans for LID treatments nor do they have any funding to create them. Municipalities are creating LID standards slowly, one-by-one or using guidelines and plans from other cities that have already developed them. With no design guidelines and plans in place, costs are increased on the design side of a project and the city has less control over the integrity and aesthetic quality of the final LID design. Support was expressed for a standard design template that is recognized by regional water boards so that cities could provide predictable guidance to developers for designing and constructing quality LID features.

Conflicts with LID in the Public Right-of-Way

Locating LID in the public right-of-way (ROW) has the potential to be a win-win solution for both the private and public sectors, however challenges remain. The development community supports locating LID features in the public ROW because they can maximize the build out of the site, which is increasingly important for infill and redevelopment sites where land is limited and profit margins thin. The public sector and the watershed are positioned to benefit because LID in the public ROW can be designed to capture and treat the runoff generated by streets, which carry some of the pollutants that pose the greatest threat to water quality.

Questions regarding ongoing maintenance of LID located in the public ROW will need further exploration. Among the solutions suggested were maintenance agreements between the local public agency and developer where the developer assumes the responsibility. As a new approach, the City of Los Angeles will allow developers to locate LID in the public ROW as long as developers prove they have exhausted all other opportunities. One other condition of this agreement is that the developer must design the LID treatment to also accept water from the street. Another idea presented was to include maintenance of LID in the Declaration of Covenants, Conditions, and Restrictions (CC&Rs), which outlines the rules and regulations residents must abide by in Home Owners Association (HOA) communities.

Questions also remained regarding the compatibility of infiltrating water with other “dry” and “wet” utilities already located in the public ROW. Some emphasized an attitude shift will need to occur on the part of local public agencies to consider LID as yet another utility to be included among the many other utilities located in the public ROW. It was noted more research would have to be conducted to better understand how LID (and infiltrating water) can co-exist with other uses in the public ROW.

Another argument made for including LID in the public ROW was to allow development to be more compact. As one respondent put it, “every other sustainability factor - energy, transportation, air quality, etc. - calls for more dense development except for storm water management, which tends to limit density.” The issue of LID discouraging compact

development and Smart Growth Principles came up multiple times, therefore, this issue is discussed in detail as a separate key barrier to LID implementation below.

Local agency staff did not demonstrate strong support for the use of permeable concrete or asphalt in public streets for several reasons. Streets are constantly taken apart and put back together. Pervious asphalt and concrete must be poured thicker than conventional asphalt and concrete. This means an increased amount of asphalt or concrete to cut through and repair when accessing utilities in the street. Another concern of pervious asphalt used on public streets was the ability of maintenance crews to recognize it and understand how to maintain it. Local public agency staff felt parking lots are better suited for pervious pavement rather than the public ROW. Local agency staff were also supportive of LID located in alley ways as opposed to streets given alley ways have less constraints. Several cities in Southern California are already pursuing "green alleys", such as Los Angeles and Anaheim.

Conflicts with Broader Sustainable Planning Goals

Many respondents shared the view that the current approach to stormwater management is working against many of the other sustainable planning principles communities are trying to implement including building more compactly and promoting infill development. One respondent expressed that "LID should be used to help create better design but it should also be recognized that there are other larger planning concepts that will actually reduce the need for LID (i.e., Smart Growth principles and/or infill developments eliminates the creation of additional pavement and thus runoff)." Concern was also expressed that LID is "simply unhelpful" in the face of climate change where infill will be one of the key solutions to reducing greenhouse gas emissions. There is a general perception that the current approach to LID encourages suburban style development by forcing building separation and lower density development.

Respondents argued that permit requirements should not be applied equally, but that leniency be allowed in addressing challenging sites (such as infill sites) that are consistent with broader

goals to grow and develop more sustainably. It was noted, “more LID opportunities exist with greenfield projects but greenfield projects come with new roads that increase impervious area.” Another respondent shared, “In this economy, development and especially infill project profit margins are very small. It may be technically feasible to implement LID (green roofs, etc.) but the increased costs may wipe out any profit and therefore the project may not be viable.” Some cities expressed that infill development is one of the only options in their community, thus the costs associated with implementing LID could have a devastating impact on the local economy.

Lack of Interdepartmental Coordination and Leadership at Top Levels of Local Government

Stormwater management is no longer under the sole discretion of public works and is forcing cross-departmental conversations and coordination. Given that stormwater management is bleeding into other departments, there is confusion over how LID complies with each department’s codes and ordinances. Some public agency engineers express frustration of bearing the burden of pushing LID from the bottom up without the support of higher-level administrators. The success of a municipality in implementing LID can often be traced back to the person responsible for implementation and their capacity and authority to take on this task. As expressed by one respondent, “Find out who is in charge of the NPDES program and evaluate what authority they have to effect change. Some staff attempt to direct other departments with limited success.” To facilitate cross-departmental coordination and collaboration will require those at the high organizational level (e.g., city managers, county administrative officers, elected officials) to understand LID and each department’s role in a successful LID program.

There are many benefits and desirable outcomes of LID that go beyond stormwater management. Communicating these benefits to local elected officials (i.e., mayor, city council member, county supervisor) and having these benefits be a part of public discourse will help garner more support for LID. It was also pointed out that management priorities change; and with the downturn in the economy, local government management is more concerned about

developer support rather than introducing new development requirements, such as LID. Having elected official support is also key to ensure policies in support of LID are advanced, especially developed and adopted at the General Plan level.

Challenges with Operations and Maintenance

Respondents expressed many issues with operations and maintenance. Three main themes were: 1) difficulties with managing a highly dispersed LID system that is mostly located on private property; 2) capacity of operations and maintenance crews recognizing, understanding, and knowing how to maintain LID features; and 3) private sector versus public sector responsibility for long term maintenance of LID features. Local public agencies also expressed concern over the cost of new technologies that may be needed for maintenance, something many local governments cannot afford.

Local jurisdictions have limited staff and resources to take on additional operations and maintenance, which is exacerbated by having highly dispersed LID features each with a unique maintenance regime. Because of staff and resource constraints, local jurisdictions have explored maintenance agreements with the developer but have concerns that private property owners may not be properly maintaining LID features. Local government agencies also expressed concern over the operation and maintenance of “hidden” LID features (e.g., cisterns, perforated pipes, etc.) located underground.

The Riverside County Flood Control District offers one example of a local jurisdiction addressing the challenge of operations and maintenance. The District provides developers the option of being included in a maintenance district if the developer follows the concepts in the District’s LID manual. In other municipalities, there has been discussion about using Community Development Block Grant funding to assist property owners to install and maintain their own rain gardens. With this approach, each property owner would be able to receive funding for long term maintenance based on performance of the rain garden.

Another issue brought up by respondents is that many LID features have not been maintained long enough to gain an understanding of what works and what does not. For example, the build up of metals over time stemming from deferred maintenance is a concern. Many expressed need for post-construction monitoring of LID features so as to gain a better understanding of their effectiveness and maintenance needs.

Inconsistent Interpretation of Permit Requirements

There is recognition that regional water board standards and county stormwater permits are becoming increasingly similar, but each permittee interprets these requirements very differently. Consistency also came up as an issue in regards to the variations between technical reports and methodologies for calculating runoff in different counties and sub-regions in Southern California. One respondent pointed to the variation between local jurisdictions based on "diversity in risk management strategies at the top level of local government." One county shared that it strives for consistency with all city partners but are subject to two separate NPDES Permits. This creates a lot of conflict within the county because the requirements with respect to LID and hydro-modification are different depending on where a project may be located.

There is also disparity between regions and permittees regarding the resources available for implementing LID. Uniformity is needed between regions and cities to provide consistency and predictability for developers. Regional Caltrans offices also have different standards and approaches to LID and coordination is needed here as well.

Lack of a Definition, Guidance, and Examples of Off-site and Regional LID Solutions

Both the development community and local government staff seem to agree that regional solutions can help with the looming question of how LID is maintained over the long term. The implementation of LID on a site-by-site basis has resulted in a dispersed LID system with most treatments located on private property. There are inherent difficulties in providing ongoing

maintenance, monitoring, and ensuring effective operation with this type of dispersed system. Many believe obtaining water quality benefits through LID is more feasible and cost effective if there is a designated organization or agency responsible for maintaining LID.

It is perceived by local municipalities that regional water boards are generally supportive of regional solutions but pressure from environmental groups inhibits regional water boards from pursuing this approach. There is a perception that environmental groups feel source control is better than treatment and feel regional approaches allow projects to escape water quality requirements. From the viewpoint of regional water boards, little progress has been made on regional or sub-regional solutions due to lack of input received from local municipalities on this issue. Regional water board staff also pointed to difficulties (in general) for local jurisdictions to demonstrate that regional solutions provide water quality benefits (e.g., flow reduction and pollutant removal) that equal or exceed on-site LID solutions. In addition, it is argued that to make regional solutions work, there must be plans developed identifying projects and sites that can be used to substitute for on-site control. Many cities have not yet taken this step.

Another hurdle in pursuing regional solutions is the term itself. Currently, the term "regional" does not have a set definition that is recognized by key stakeholders (i.e., regional water boards, local public agencies, environmental groups, development community, etc.). Because of this, a regional solution can mean anything from collecting and treating stormwater from multiple-sites, a single neighborhood, multiple cities, to an entire watershed. It is argued there cannot be a valuable conversation on pursuing regional solutions if there is not a common definition used by all stakeholders.

Specific Permit Requirements but Vague Guidance

Water quality standards are pollutant specific but guidance on how to reach standards is vague. Engineers expressed appreciation for codes becoming more scientific and measurable but also advocated for flexibility and the allowance for creative solutions, which is often required with LID projects. In addition, coming up with "creative solutions" is often outside the comfort zone

of the engineering culture. The use of Maximum Extent Practical standard was also mentioned as being extremely vague and not sufficient for establishing predictable project requirements at the initial planning stage. Public agencies felt more detailed technical guidance within each region would be incredibly beneficial for designing and implementing LID.

Further, regional water boards have the power to fine, which leads to local governments being overly cautious in trying new and/or different LID treatments. Respondents felt that if regional water boards provided an opinion or approval of LID treatments before construction, it would help boost the confidence of local governments in trying new things. Since regional water boards cannot promote a certain technology, there would need to be a third party (such as the California Stormwater Quality Association (CASQA)) that could provide LID guidelines, which would then be recognized or endorsed by the regional water boards. This type of approach could be modeled after the Leadership in Energy and Environmental Design (LEED) system, where the U.S. Green Building Council has developed standards for green building that are now being recognized and endorsed by local governments.

Additional Barriers

The barriers listed above rose to the top as key concerns from both the private and public sectors though there are additional barriers worth mentioning. For example, many respondents stressed the importance of educating all levels and departments within local government as well as the development community, regional water boards, and private property owners. Implementation within local government often falls to engineers who (as one respondent expressed it) “are not adequately trained to understand the complexities associated with geomorphology, meteorological science as it relates to infiltration and runoff response, geotechnical engineering, subsurface hydrology, etc.” Providing trainings is not a solution unto itself since many local governments are under-staffed and do not have time to attend educational sessions.

More subtle barriers are the conflicting codes and attitudes towards LID. Private and public sector respondents expressed it is perceived that regulatory agencies view water quality standards as primary, no matter what the associated cost and/or consequence. For example, it was shared that for road construction projects safety should be a priority above all else including water quality. A common code conflict noted was building regulations move water away from buildings but at the same time water quality regulations want water to be infiltrated on site and often near buildings. Many developers back away from infiltration near buildings for fear of structural damage.

Lack of life-cycle cost-benefit data was also an expressed concern of respondents. It was expressed that municipalities are generally very risk-adverse and are unwilling to try new concepts (such as innovate LID solutions) if there is an opportunity for failure. Some respondents pointed to the opportunity of testing out innovative LID projects by incorporating them into Capital Improvement Projects (CIP).

Recommended Actions for Removing Barriers to LID

As for next steps, the Local Government Commission recommends the SMC consider advancing the following solutions:

Support the Development of Municipal LID Design Guidelines and Plans Recognized by the State and Regional Water Boards

There is a pressing need for an improved definition of LID as well as municipal design guidelines and plans that are endorsed by the state and regional water boards. Having this guidance in place will provide clarity to both the public and private sectors regarding appropriate LID techniques and technologies that can be used to satisfy permit requirements. As an underlying assumption, statewide LID guidance material must be drafted in such a way as to address the variability in climate, geography, development context, and other conditions from region to region throughout the State.

One of the most promising strategies for moving forward would be a third party organization, such as the SMC, CASQA, or university partner, to lead a work group in developing a statewide LID technical guidance manual to include template design guidelines and plans (including construction specifications and details) that a municipality can easily adopt and provide to developers. Preparing the statewide manual would provide an opportunity to draft a more detailed definition of what constitutes LID as well as identify and pull together the best design approaches to various LID measures. A third-party approach to developing a State-endorsed guidance manual could be modeled after recent legislation on water-efficient landscaping (i.e., AB 1881 and AB 2717) requesting the California Department of Water Resources to update the local water efficient landscape model ordinance based on recommendations from the stakeholder workgroup led by the California Urban Water Conservation Council (CUWCC). As a part of this legislation, the State's local water efficient landscape model ordinance became the default ordinance of local municipalities unless the local municipality adopted their own ordinance of greater or equal effectiveness. This last stipulation (if applied to a state-wide LID

manual) would allow early adopter communities, regions, or agencies that have already invested in manuals to continue using their own ordinances and policies.

Many other states have already produced guidance materials to assist local public agencies and the private sector in implementing LID and meeting stormwater permit requirements. In 2005, the State of Washington produced the *Stormwater Management Manual for Western Washington: Volume I -- Minimum Technical Requirements and Site Planning* that provides technical guidance on stormwater control measures that comply with water quality standards for new development and redevelopment. Similarly, the Massachusetts Department of Environmental Protection revised their *Stormwater Handbook* in 2008, which provides a robust chapter (over 133 pages) on structural BMP specifications and plans covering everything from rain gardens, to tree box filters, to dry wells, and more. There are also many examples of guidance materials produced at the regional or local level in California, such as the *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies* prepared for SMC by the Low Impact Development Center and the *Riverside County Design Handbook for Low Impact Development Best Management Practices.*

Massachusetts has also established the Massachusetts Stormwater Technology Evaluation Project (MASTEP) administered by UMass Amherst to address the challenge of verifying the performance and effectiveness of new, innovative stormwater treatment technologies being introduced into the marketplace. The goal of MASTEP is to provide clarity to communities about whether or not new technologies comply with permit requirements and to help users make informed decisions when approving or using proprietary stormwater technologies. The Project gives manufacturers of stormwater technologies the opportunity to upload detailed product information (including performance testing) that is then carefully analyzed and screened by MASTEP staff. Reviews of the technologies are posted on a publicly accessible and searchable database.

Fortunately, a statewide effort in California to develop a LID technical guidance manual would not have to start from scratch. Local municipalities, flood control districts, regions, and even state agencies such as Caltrans have already made considerable investments in drafting LID guidance materials. CASQA alone has produced four handbooks to address the various life cycles and contexts of stormwater BMPs – Construction, Industrial, Municipal, and New Development and Redevelopment. CASQA recently updated the Construction Handbook and is planning to update the New Development and Redevelopment BMP Handbook.

While the abundance of information and guidance materials on LID is a blessing, it can also be a curse. Multiple (and sometimes conflicting) standards, construction plans, details, and specifications are in circulation on a wide variety of LID features, all of varying quality. These resources and information are also highly dispersed, leaving public agencies and the private sector with the task of patching together solutions appropriate to their own circumstances or project. This situation has created a confusing environment for public and private sector stakeholders in seeking assistance in implementing LID. Therefore, the State and Regional Water Boards have a key role to play in helping to establish consistency for LID implementation by facilitating a process of gathering and evaluating existing technical guidance, standards, and specifications for LID; and then creating one comprehensive document that all California communities and regions can use. As stated above, it is recommended that a third party organization help lead this process, such as CASQA, the SMC, or university partner.

Based on the above assertions, LGC recommends the following actions to be taken by the SMC to help advance solutions that address the need for a standard LID definition and technical guidance manual endorsed by the State and Regional Water Boards.

1. Discuss and reach consensus among the SMC municipal members regarding the need and importance for a standard LID definition and technical guidance manual that is endorsed by the State Water Board and Regional Water Boards. Advocate for this to be a priority issue addressed by the State Water Board.

The SMC should begin by facilitating a conversation with its members on how current definitions for LID can be improved. Next, the SMC should identify the specific technical needs of various municipalities. For example, while there is an abundance of guidance materials on how to select, size, design, construct, and maintain LID BMPs, municipalities struggle with finding the time and resources to draft construction plans, details, and specifications for various LID features for inclusion in their library of construction documents. Municipalities in this position express a need for a set of "live" Auto CADD files of construction plans, details, and specifications for various LID features they could use and adapt to their own communities.

The next step will be for non-State SMC members to communicate to the State Water Board, CASQA, and the State Legislature, the pressing need for a standard LID definition and technical guidance manual (along with specific recommendations for what should be included in the manual.) The SMC should draft and submit letters to Board Members of the State Water Board and their representatives in the State Legislature. Further, SMC municipal members should testify at a State Water Board meeting, and/or work with CASQA to engage other regions of the state to develop a more influential, state-wide educational and advocacy effort.

2. Work with a third-party organization with a statewide presence and authority on LID to explore opportunities for developing a statewide LID technical guidance manual.

It is understood there is limited capacity at the State Water Board to lead the development of a statewide LID technical guidance manual. Fortunately, there are highly competent third-party organizations in California that have the knowledge and capacity to lead this effort. We suggest the SMC take the lead or propose CASQA or a university partner, such as UC Davis. The SMC should also commit to actively participate in, contribute to, and/or provide financial support to CASQA's efforts to update the *New Development and*

Redevelopment BMP Handbook and assist with other related activities including converting CASQA's *Municipal Handbook* to a stormwater program manager's webportal.

Support the Development of a Clear Definition and Guidance of Off-site and Regional LID Solutions

Stormwater permits in California clearly prioritize managing stormwater at the site level, which has proven to be a hurdle when trying to solve issues at a neighborhood, community, or regional scale. Off-site and regional LID projects are discussed primarily as a means of alternative compliance that may be pursued once on-site LID solutions are demonstrated to be technically infeasible. Because they are perceived as second tier options, off-site and regional LID projects fail to receive equal attention or guidance in stormwater permits. There is no clear definition for off-site mitigation and regional projects, no straightforward guidance, and generally no approval process. In some cases where there is an approval process, it is usually the Executive Officer of the regional board who must sign-off on the proposed project.

By prioritizing site level stormwater management and making it difficult to gain approval for other solutions, developers and local governments are discouraged from planning and developing off-site projects that are capable of addressing multiple community goals. Larger scale projects could also enjoy the economic savings associated with more efficient operations, maintenance, and monitoring costs. These projects could also address broader water quality issues such as pollution, flooding, and groundwater recharge and sustainable development and growth goals (i.e., building complete, walkable, compact communities that reduce auto dependency). Further, public and private sector stakeholders involved in LID implementation have pointed out that current stormwater permits funnel private development dollars to on-site LID projects, which do not always treat the pollutants that pose the greatest threat to water quality and watershed health.

Communities are facing severe budget and staffing constraints. The ability to address multiple objectives at once, including water quality goals, housing a growing population, urban revitalization, and more has become increasingly crucial. It is more important than ever that scarce private and public dollars be spent wisely so as to achieve the greatest economic, environmental and social return on investment. The pressure for multi-objective projects funded by multiple sources will only intensify as competition for diminishing financial resources increases.

Many regional water boards have tried to address the issue of how to resolve larger watershed issues through the NPDES permit. Most have developed some variation of a watershed planning requirement where permittees are asked to map out water management activities and water quality processes in the watershed alongside plans for future urban growth and development.

As a part of these planning efforts, permittees are required to identify the highest water quality priorities in the watershed and then develop strategies to address these priorities through control measures and BMPs, including the use of regional or sub-regional projects and retrofit projects (i.e., converting existing streets to green streets, etc.). In most cases, the off-site or regional projects can only be pursued as a means of alternative compliance, which means that each individual proposed development project has to demonstrate the infeasibility of on-site urban runoff control measures before regional or district-wide solutions can be pursued. This means every new development or redevelopment project must go through an additional, time-consuming procedural layer. This process also interferes with the ability of a city or county to efficiently plan a district or regional solution for stormwater control and collect an in-lieu fee to finance implementation of the plan.

Some NPDES permits have tried different approaches to removing the additional procedural layer for communities interested in pursuing neighborhood, district or regional LID solutions. Ventura County's permit (adopted in 2009) allows permittees to develop a Redevelopment Project Area Master Plan (RPAMP) for urbanized areas that demonstrate exceptional

constraints. As of 2012, not a single RPAMP has been submitted to the Los Angeles Regional Water Board for review. Projects included within the RPAMP are required to go through a detailed review process by the Regional Water Board Executive Officer, which is not required for other on-site LID projects. The Plan must also be constructed within the time frame of the 5-year NPDES permit. The economic downturn and decline in development put construction projects on hold and unable to be completed within the required time frame. The City of Ventura did explore developing a RPAMP as part of the City's redevelopment plans for the Westside District but instead decided to develop a green streets retrofit master plan that will serve as off-site mitigation for future development projects.

The Santa Ana Regional Water Board also tried to address the need for streamlined approaches for communities pursuing off-site or regional solutions in Orange County's Model Water Quality Management Plan (WQMP) released May 2011. Permittees can develop WQMPs at various scales (i.e., site, sub-regional, or regional) for the purpose of minimizing pollutant loads from new or redevelopment projects.

While language in the Model WQMP states that implementing LID at the project level is the preferred approach, it recognizes that it may be more appropriate to implement LID at a broader scale in order to achieve multiple community benefits (i.e., groundwater recharge, implement smart growth, etc.) and/or avoid significant constraining factors. In these situations, the WQMP allows permittees to pursue regional or sub-regional LID projects outright without requiring development projects to first maximize the use of LID on-site. The WQMP notes that a watershed-wide feasibility analysis must be completed that demonstrates that a regional or sub-regional LID project is preferred and is consistent with other permit requirements.

As demonstrated, the regional water boards are addressing off-site and regional LID solutions, but there is a lot of catching up to do to make it just as easy to pursue larger scale projects as it is to implement LID on-site.

As noted earlier, there is no clear definition of what is considered a "regional" solution and there are very few examples to point to. Many regional water boards do include reference to off-site, sub-regional, or regional solutions in the permits but do not provide sufficient detail regarding what types of projects would be acceptable, at what scale these projects should be planned (i.e., watershed, city-wide, neighborhood, street, multiple sites, etc.), and how the projects should relate to new development or redevelopment (e.g., can regional projects be located in the same watershed as new development or do regional projects need to serve the stormwater needs of the new development?).

The current stormwater permits developed by the Santa Ana Regional Water Board for Riverside, Orange, and San Bernardino Counties do provide one example of an approval of a sub-regional LID project, which is "a 100 unit high density housing unit with a small strip mall and a school." The Board would require that the project, "connect all roof drains to vegetated areas (if there are any vegetated areas, otherwise storm water storage and use may be considered or else divert to the local storm water conveyance system, to be conveyed to the local treatment system), construct a storm water infiltration gallery below the school playground to infiltrate and/or harvest and re-use the design capture volume." This example for a regional project has less detail and is defined as "projects that address storm water from multiple developments."

Permittees in Orange County developed language defining regional projects to be included in the Model WQMP and submitted the language to the Santa Ana Regional Water Board for approval. As a result, the Orange County's Model WQMP defines regional as "several developments within the same watershed" with examples of permitted projects being a "regional infiltration basin, regional wetland, or groundwater injection and/or recharge facility." The definition provided for a sub-regional project is "multiple adjacent developments within the same watershed" with examples of a permitted project being "a neighborhood wet pond BMP for harvest and use" or as another example "a high density housing unit

development with a small strip mall and a school could connect all roof drains to vegetated areas, and construct a stormwater infiltration gallery below the school playground".

As demonstrated by the examples above, local governments cannot confidently develop and implement LID solutions beyond the site-level without additional information on the types of projects that would be acceptable, at what scale these should be planned, and how the projects relate to future new development and redevelopment projects. There is also a need to streamline the process for communities interested in pursuing off-site and/or regional solutions so they can pursue these solutions outright without additional procedural hoops to jump through, particularly in the instance where solutions were identified through a watershed analysis approved by a Regional Water Board.

LGC recommends the following actions be taken by the SMC to help advance solutions that address the need for additional clarity and guidance for implementing LID solutions beyond the site level.

1. Discuss and reach consensus among SMC members regarding the need and importance for flexibility within stormwater permits to allow priority water quality issues in the watershed to be addressed at the appropriate scale without giving permit priority to on-site options alone. Municipal members of SMC can work together to draft recommendations for how this can be accomplished within the current framework of stormwater permits and submit to the State and Regional Water Boards for consideration.

   The NPDES permits SMC municipal members to operate under all refer to off-site and regional solutions but there are glaring inconsistencies in how each stormwater permit addresses these solutions as well as the information provided in each of the permits. Addressing these inconsistencies and informational gaps is a first step toward gaining a better understanding of how off-site, regional and sub-regional solutions can be pursued.

SMC municipal members should request that off-site and regional LID solutions given equal status to on-site solutions, especially where the solutions are identified as a part of a watershed-based planning effort required by the State and/or Regional Boards.

SMC members should prioritize the support and resources needed to confidently pursue off-site and regional solutions. For example, one of the underlying difficulties in setting up an off-site mitigation program or pursuing regional solutions is establishing a reasonable in-lieu fee program. The SMC could seek funding to develop a model in lieu fee ordinance template based on a hypothetical watershed and water quality plan.

2. Create opportunity for peer-to-peer learning on developing LID solutions at various scales within a community and/or watershed.

There are a handful of municipalities throughout California that are attempting to develop more holistic approaches to stormwater management that integrate multiple community priorities and are, at the same time, in compliance with current stormwater regulations. However, these exploratory efforts are not well known by the greater stormwater community. The SMC could play a role in convening peer-to-peer learning sessions (i.e., conferences, workshops, webinars) that will help build collective knowledge on how to develop off-site mitigation strategies and/or sub-regional or regional solutions.

For example, the City of Ventura has developed the Westside District Green Streets Retrofit Plan and would be able to share the process they went through to prepare this plan as well as the challenges, successes, and lessons learned. It would also be useful to learn about the experiences of the cities of Ontario and Chino as they move forward with a regional wetland that will serve as alternative compliance for a new development project in their region.

Another learning session might highlight how municipalities can and have successfully integrated LID considerations into future growth plans, such as General Plans and Specific Plans. These long-range planning efforts provide the best opportunity for aligning land use

and broader stormwater management goals, but success requires intentional conversations between the planning and public works departments. The learning sessions would bring planning and public works staff together to explore how to best integrate land use planning with stormwater management so as to comply with new permit requirements while creating resource efficient, walkable communities.

These learning sessions could be provided at the annual CASQA Conference or organized separately to specifically serve SMC members. The events could also be organized in coordination with the State and Regional Water Boards as a co-training for local government and regional water board staff.

Funding for training is available at the State Water Board and could be pursued by the SMC. The Local Government Commission and UC Extension are willing to organize and facilitate these sessions, upon request.

Support Interdepartmental Coordination and Leadership at Top Levels of Local Government

Local elected officials have the final say when it comes to land use. Therefore, mayors, city council members and county supervisors have a leadership role to play in advancing solutions to LID implementation. As a membership organization of local elected officials, the Local Government Commission has over 30 years of experience in reaching out to this group of leaders and has a proud record of success in setting the table for new local government policy initiatives. Building from our experience, LGC recommends the following actions be taken by the SMC in an effort to build capacity at the top levels of government to advance LID implementation:

1. ### Sponsor Educational Dinner Forums for Elected Officials and Top Administrative Staff.

   For over a decade, the LGC has organized regional dinner forums for local elected officials and top administrative staff throughout the State to highlight innovative ideas and solutions

on a range of sustainable growth and development issues. LGC has found these forums to be an effective model for building leadership at the local level by providing a casual setting for elected officials to learn about cutting-edge strategies, ask questions, find support from their peers, and feel a part of a larger movement.

The regional dinner forum model can be utilized by the SMC to introduce, educate, and inspire local elected officials and top administrative staff to take action on implementing LID in their own community. Typically, LGC dinner forums serve 25 – 35 elected officials with the average base cost being $4,000 - $5,000 per forum. The cost per forum can increase if additional value-added tasks are included as a part of the scope, such as additional time spent on providing follow up assistance to forum participants

As a general rule of thumb, the forum should balance informative and inspiring presentations with time for facilitated group discussion. LGC recommends identifying a knowledgeable and inspiring speaker to kick-off the forum with a high level introduction to what it takes to create and build resilient, livable communities with an emphasis on the role of green infrastructure and LID principles. The broad introduction should be followed by one or two speakers (preferably local elected officials) that could share an example of implementing an LID-related project, policy, or program in their own community. The following are potential examples of projects, policies, and programs local governments have used to advance LID that could be highlighted at a forum on LID implementation:

City of Ventura - In 2008, City of Ventura City Council directed staff to dedicate up to 20% of the Pavement Maintenance Plan (PMP) construction budget to incorporate green street elements into street paving projects with the goal of improving stormwater quality; creating safe, attractive, and pedestrian-friendly streets; reducing flooding; and reducing greenhouse gas impacts. The current funding for the 5-year PMP is $16 million, with up to $3.2 million of these funds to be spent on green street improvements. As a part of the Council's directive, a multidisciplinary and interdepartmental Green Streets Committee was

formed to develop a Green Street Improvement Plan for existing streets. It includes: 1) a matrix of various green street design interventions including information on cost, benefits, and complexity; 2) a comparison of green design interventions relative to cost and effectiveness, and 3) cost estimates for various green street elements that could be incorporated in typical street resurfacing projects.

The City Council also earmarked $500,000 for a green street demonstration project. Katherine and Hartman Streets in Ventura's mid-town area have been selected for this pilot project. The retrofit project will also provide opportunity for off-site stormwater mitigation for future development that cannot include LID on-site. This approach will allow the initial investment of $500,000 by the Council to be paid back by future development projects, with those funds dedicated to a revolving fund for future green street projects.

City of Los Angeles – In November 2004, Los Angeles voters passed Proposition O, which provides a much-needed funding mechanism to tackle an array of water-related issues in the City, including stormwater management. The City is able to issue general obligation bonds for up to $500 million to support projects that will clean local waterways; protect drinking water; stop polluted runoff; clean and reuse stormwater; and conserve water. The driving force behind Proposition O was Los Angeles Councilmember Jan Perry who helped draft the language for the initiative. Overarching goals of the initiative are to support compliance with the Federal Clean Water Act, stormwater permit requirements and total maximum daily loads as well as address public health and environmental impacts. An interdepartmental team including the City's Departments of Public Works, Engineering, and Sanitation was formed to lead the development of multi-benefit and multi-objective projects that respond to the goals set forth in Proposition O. To date, over half of the projects installed with Proposition O funding are types of infiltration planters, including a bio-swale at the Westminister dog Park in Venice and tree wells on Grant Boulevard, also in Venice. The City's first green street project on Oros Street was also funded through Proposition O funding.

County of Sacramento – Staff in Sacramento County's Stormwater Quality Program knew designing, constructing, and maintaining green streets in their jurisdiction would require unprecedented collaboration of multiple County departments. They also knew that green streets and LID were relatively new concepts to other departments that are unfamiliar with stormwater management trends and permit requirements. To overcome these challenges, the Stormwater Quality Program hosted and organized a half-day design charrette for County staff that brought together representatives from the Departments of Transportation, Water Resources, and Community Development. The event featured educational presentations from LID and green street experts and hands-on experience working together on a conceptual design for a green street in the County. The charrette helped set the foundation for a multi-department collaboration on designing and constructing the County of Sacramento's first green street project.

2. Draft Educational Materials Suitable for an Elected Official Audience.

While there is a plethora of available research and educational materials demonstrating the benefits of LID and green infrastructure techniques, most are not suitable for the elected official audience. Busy, time-constrained elected officials need information that is concise and to the point. Therefore, to fill this gap, the SMC could sponsor the creation of a one-page summary document that provides a high-level overview of LID; key data points demonstrating economic, social, and environmental benefits of LID; links to additional information; and key questions elected officials can ask of their staff to learn more about their city's LID program and how they can help in overcoming challenges. As an added bonus, the SMC could have this one-page document produced in coordination with the regional dinner forums, therefore, providing elected officials take home material to pass along to staff and/or to use in taking action themselves.

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Appendix A.

Literature Review

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Appendix B.

Online Surveys

Barriers to LID Implementation - Development Community Survey

1. Introduction

Thank you for participating in this online survey. We appreciate your assistance in better understanding the barriers to Low Impact Development (LID) from the private sector (specifically those involved with the design, development, and construction of projects). A similar survey was sent to local, regional, and state government agencies.

LID is a stormwater management approach that mimics natural hydrology through the use of decentralized landscape and engineering features that detain and treat runoff as close to the source as possible. Broader definitions of LID can include infill and redevelopment as well as narrow streets since this reduces the increase of impervious pavement from new development and thus runoff.

There are a variety of barriers that prevent optimal LID implementation. Some are easier to spot than others. For example, building codes that do not allow curb cuts is an obvious barrier to LID implementation while vague regulatory language can cause confusion and add time to permit approval which in the end impedes LID implementation.

We have organized the potential barriers to LID implementation into three "tiers" representing different levels of influence - site scale, city/regional scale, and state/national scale. As you will see, some barriers fall across all three tiers.

The survey should take you 10 - 15 minutes to complete.

Responses from this survey as well as follow up phone calls and focus groups will be used to inform the Stormwater Monitoring Coalition on the main impediments to LID implementation. Recommendations for overcoming main impediments will be prepared by LGC and the Center for Water and Land Use at UC Davis Extension.

Thank you again!

Laura Podolsky, LGC
Jeff Loux, UC Davis Extension
Darla Inglis, UC Davis Extension

2. General Information

1. Please let us know who you are.

Name:
Employer:
Address:
Address 2:
City/Town:
State:
ZIP:
Email Address:
Phone Number:

2. What is your title/position?

Barriers to LID Implementation - Development Community Survey

3. Do the municipalities you work with typically require or encourage LID?

- Yes
- No

4. Are you based in California?

- Yes
- No

5. Do you and/or your company/firm have experience with integrating LID in development projects?

- Yes
- No

6. How many years of experience do you have working with LID?

- No Experience
- 0 - 4 years
- 5 - 9 years
- 10 - 14 years
- 15 - 19 years
- 20 - 24 years
- 24+ years

7. What types of development projects have you been involved with that include LID design and what LID technologies did you use?

We are trying to determine if LID is been achieved in some development types but not others. For example, using LID techniques such as rain gardens in a low density housing project might be easier to achieve than accommodating bioswales in a high density downtown infill project.

3. Tier I - Site Scale Barriers to LID Implementation

Barriers to LID Implementation - Development Community Survey

1. The following barriers to LID were identified at the site or project scale. We understand many MS4 permits are now requiring LID, though barriers still remain during this transition between conventional stormwater management methods and LID. Therefore, please rank the following barriers based on level of relevance they have in implementing LID based on your experience.

	not relevant	relevant	very relevant	N/A
Lack of technical specifications (e.g. plant selection, soil type, etc.)	○	○	○	○
Lack of technical feasibility (e.g. sizing requirements, poorly draining soils, etc.)	○	○	○	○
Lack of performance criteria for LID structural BMPs	○	○	○	○
Operations and maintenance (e.g., lack of protocols, proper equipment and/or budget)	○	○	○	○
Lack of life cycle cost-benefit analysis for design, construction, and/or maintenance	○	○	○	○
No clear economic incentive to use LID	○	○	○	○
City/County staff knowledge/capacity to assist with implementation	○	○	○	○
Developer or developer design team's knowledge/capacity to implement	○	○	○	○
Compatibility with existing or adjacent development that does not use LID	○	○	○	○
Liability concerns	○	○	○	○
Vector concerns (i.e. ponding, draw-down time, mosquito, etc.)	○	○	○	○

Other (please specify)

Barriers to LID Implementation - Development Community Survey

2. Please use this space to elaborate on any of the constraints above. For example, if technical feasibility is an issue then list the exact constraint (e.g. poorly drained soils, high groundwater, potential to mobilize pollutants in soil, slope stability, etc.) below. Also, please share any ways in which you and/or your company/firm has encountered and successfully overcome any of the above mentioned barriers.

4. Tier II - City and regional scale barriers to LID implementation

Barriers to LID Implementation - Development Community Survey

1. The following barriers to LID were identified at the city/county-wide scale or regional scale. Please rate the following barriers based on level of relevance they have in obstructing LID implementation based on your experience.

	not relevant	relevant	very relevant	N/A
Conflicts with city or county codes (e.g. set-backs, water conservation directives, curb and gutter, county health, etc.)	○	○	○	○
Conflicts with city or county road or sidewalk standards	○	○	○	○
Unclear or vague regulatory language	○	○	○	○
Unclear "crediting" of LID design for stormwater compliance (e.g. conventional storm water management may still be required even with LID)	○	○	○	○
Increased operation and maintenance costs	○	○	○	○
Lack of early integration of LID in project development process	○	○	○	○
Challenges with city/county inter-departmental coordination	○	○	○	○
Regional transportation planning requirements or funding	○	○	○	○
Public acceptance (a.k.a., public pushback)	○	○	○	○
Liability concerns	○	○	○	○
LID is "recommended" rather than "required"	○	○	○	○
Long-term ownership of LID (i.e. public vs. privately maintained)	○	○	○	○

Other (please specify)

Barriers to LID Implementation - Development Community Survey

2. Please use this space to elaborate on any of the constraints above that you have direct experience with and/or insight to share. For example, please share any ways in which you and/or your company/firm has encountered and successfully overcome any of the above mentioned barriers.

5. Tier III - State and national scale barriers to LID Implementation

1. State and national regulations, plans or other directives may create barriers to optimal LID implementation at the site level. Please rank the following barriers based on level of relevance they have in obstructing LID implementation based on your experience. Please note that we recognize that some of the programs we listed below may pose a host of obstacles such as lengthy review/approval timelines, policies that conflict with LID goals, and/or legal constraints. Feel free to elaborate on specific obstacles within these programs in the space provided at the end of the list.

	not relevant	relevant	very relevant	N/A
Set-backs or restrictions on sensitive ecological areas, special status species habitat, etc.	○	○	○	○
Special permit requirements (e.g. Army Corps 404 discharge permits, CA Fish and Game 1600 permits, U.S. Fish and Wildlife permitsetc.	○	○	○	○
CEQA/NEPA review	○	○	○	○
National Pollutant Discharge Elimination System (NPDES)	○	○	○	○
Total Maximum Daily Loads (TMDL) requirements	○	○	○	○
Public Health considerations	○	○	○	○
American Disabilities Act considerations	○	○	○	○
LEED/LEED ND does not credit LID	○	○	○	○
Standards that treat all sites equally (e.g. infill vs. greenfield)	○	○	○	○

Other (please specify)

Barriers to LID Implementation - Development Community Survey

2. Please use this space to elaborate on any of the constraints above that you have direct experience with and/or insight to share. For example, please share any ways in which you and/or your company/firm has encountered and successfully overcome any of the above mentioned barriers.

6. General Barriers

1. Some barriers span all three tiers. These barriers are listed below. Please rate the following barriers based on level of relevance they have in obstructing LID implementation based on your experience.

	not relevant	relevant	very relevant	N/A
Different or conflicting LID guidance or criteria from different agencies and groups	○	○	○	○
Lack of successful demonstration projects	○	○	○	○
Alternatives to LID are "easier" to design, construct, and maintain	○	○	○	○
Conflicting or confusing definitions of LID (e.g. source control BMPs, treatment control BMPs, LID, and hydromodification BMPs)	○	○	○	○

Other (please specify)

2. Please use this space to elaborate on any of the constraints above that you have direct experience with and/or insight to share. For example, please share any ways in which you and/or your company/firm has encountered and successfully overcome any of the above mentioned barriers.

7. Additional Barriers

Barriers to LID Implementation - Development Community Survey

1. Please share any additional information relevant to your work and implementing LID.

8. Follow up

1. Would you be willing to participate in a phone call conversation or focus group that will allow us to better understand barriers to LID implementation? If so, please check which activity or activities below. Volunteers are greatly appreciated!

- ☐ Phone Call
- ☐ Focus Group

9. Thank You!

Congratulations! You are finished.

We appreciate your help with this effort. For more information regarding this effort, please contact:

Laura Podolsky
Local Government Commission
lpodolsky@lgc.org
(916) 448-1198 x311
www.lgc.org

Barriers to LID Implementation - Public Agency Survey

1. Introduction

Thank you for participating in this online survey. We appreciate your assistance in better understanding the barriers to Low Impact Development (LID) implementation most relevant to your jurisdiction and region.

LID is a stormwater management approach that mimics natural hydrology through the use of decentralized landscape and engineering features that detain and treat runoff as close to the source as possible. Broader definitions of LID can include infill and redevelopment as well as narrow streets since this reduces the increase of impervious pavement from new development and thus runoff.

There are a variety of barriers that prevent optimal LID implementation. Some are easier to spot that others. For example, building codes that do not allow curb cuts is an obvious barrier to LID implementation while vague regulatory language can cause confusion and add time to permit approval which in the end impedes LID implementation.

We have organized the potential barriers to LID implementation into three "tiers" representing different levels of influence - site scale, city/regional scale, and state/national scale. As you will see, some barriers fall across all three tiers.

The survey should take you 10 - 15 minutes to complete.

Thank you again!

Laura Podolsky, LGC
Jeff Loux, UC Davis Extension
Darla Inglis, UC Davis Extension

2. General Information

1. Please let us know who you are.

Name:
Employer:
Address:
Address 2:
City/Town:
State:
ZIP:
Email Address:
Phone Number:

2. Please check what sector you represent from the choices below:

- Public sector
- private sector

3. What is your title?

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4. How many years have you been with your current employer/municipality?

- 0 - 4 years
- 5 - 9 years
- 10 - 14 years
- 15 - 19 years
- 20 - 24 years
- 24+ years

5. Does your municipality typically require or encourage LID?

- Yes
- No

6. Does your municipality have any direct experience with requiring or implementing LID for development projects?

- Yes
- No

7. How many years of experience do you have working with LID-related projects?

- No Experience
- 0 - 4 years
- 5 - 9 years
- 10 - 14 years
- 15 - 19 years
- 20 - 24 years
- 24+ years

8. What types of development projects have you been involved with that include or could include LID design? What LID technologies or approaches have been required or implemented?

We are trying to determine if LID is been achieved in some development types but not others. For example, using LID techniques such as rain gardens in a low density housing project might be easier to achieve in your municipality than accommodating bioswales in a high density downtown infill project.

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3. Tier I - Site Scale Barriers to LID Implementation

1. The following barriers to LID were identified in the literature at the site or project scale. Please rank the following barriers based on level of relevance they have in obstructing LID implementation in your jurisdiction.

	Not relevant	relevant	very relevant	N/A
Lack of technical specifications (e.g. plant selection, soil type, etc.)	○	○	○	○
Lack of technical feasibility (sizing requirements, poorly draining soils, etc.)	○	○	○	○
Lack of data on how pollutants affects groundwater quality	○	○	○	○
Lack of performance criteria for LID structural BMPs	○	○	○	○
Operations and maintenance (e.g., lack of protocols, proper equipment and/or budget)	○	○	○	○
Lack of life cycle cost-benefit analysis for design, construction, and/or maintenance	○	○	○	○
No clear economic incentive for applicant to use LID	○	○	○	○
Staff knowledge/capacity to assist with implementation	○	○	○	○
Developer or developer design team's knowledge/capacity to implement	○	○	○	○
Poorly drained soils/low infiltration capacity	○	○	○	○
Compatibility with existing or adjacent development that does not use LID	○	○	○	○
Liability concerns	○	○	○	○
Vector concerns (i.e. ponding, draw-down time, mosquito, etc.)	○	○	○	○

Other (please specify)

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2. Please use this space to elaborate on any of the constraints above. For example, if technical feasibility is an issue then list the exact constraint (e.g. poorly drained soils, high groundwater, potential to mobilize pollutants in soil, slope stability, etc.) below.

3. Could you identify any ways in which your jurisdiction has encountered and successfully overcome any of the above mentioned barriers? Have you heard of creative solutions adopted by other municipalities for addressing these barriers?

4. Tier II - City and regional scale barriers to LID implementation

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1. The following barriers to LID were identified in the literature at the municipal or regional scale. Please rate the following city and regional level barriers based on level of relevance they have in obstructing LID implementation in your jurisdiction and/or region.

	Not relevant	relevant	very relevant	N/A
Conflicts with municipal or county codes (e.g. set-backs, water conservation directives, curb and gutter, county health, etc.)	○	○	○	○
Conflicts with city or county road or sidewalk standards	○	○	○	○
General plan or specific plan compliance and consistency	○	○	○	○
Inconsistency with smart growth principles	○	○	○	○
Unclear or vague regulatory language	○	○	○	○
Unclear "crediting" of LID design for stormwater compliance (e.g. conventional storm water management may still be required even with LID)	○	○	○	○
Lack of street standards that integrate LID	○	○	○	○
Increased operation and maintenance costs	○	○	○	○
Lack of early integration of LID in project development process	○	○	○	○
Challenges with inter-departmental coordination	○	○	○	○
Regional transportation planning requirements or funding	○	○	○	○
Public acceptance	○	○	○	○
Staff knowledge/capacity to assist with implementation	○	○	○	○
Developer or design team knowledge/capacity to implement	○	○	○	○
LID is not included in watershed management or comprehensive drainage master plans	○	○	○	○
Liability concerns	○	○	○	○
Fragmented watershed and	○	○	○	○

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water quality planning				
Poor monitoring and oversight of regulatory compliance	○	○	○	○
Homeowner Association restrictions	○	○	○	○
LID is "recommended" rather than "required"	○	○	○	○
Long-term ownership of LID (i.e. public vs. privately maintained)	○	○	○	○
Insufficient evidence of program effectiveness	○	○	○	○

Other (please specify)

2. Could you identify any ways in which your jurisdiction has encountered and successfully overcome any of the above mentioned barriers? Have you heard of creative solutions adopted by other municipalities for addressing these barriers?

5. Tier III - State and national scale barriers to LID Implementation

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1. State and national regulations, plans or other directives may create barriers to optimal LID implementation. Please rank the following barriers based on level of relevance they have in obstructing LID implementation in your jurisdiction and/or region. Note specific programs are listed below and we recognize each program may pose a host of obstacles such as lengthy review/approval timelines, policies that conflict with LID goals, and/or legal constraints. Feel free to elaborate on specific obstacles within these programs in the space provided at the end of the list.

	Not relevant	relevant	very relevant	N/A
Set-backs or restrictions on sensitive ecological areas, special status species habitat, etc.	○	○	○	○
Special permit requirements (e.g. Army Corps 404 discharge permits, CA Fish and Game 1600 permits, U.S. Fish and Wildlife permitsetc.	○	○	○	○
AB 32 objectives (e.g. reducing climate change or greenhouse gas (GHG) emissions)	○	○	○	○
State or federal funding constraints or limitations	○	○	○	○
CEQA/NEPA review	○	○	○	○
National Pollutant Discharge Elimination System (NPDES)	○	○	○	○
Total Maximum Daily Loads (TMDL) requirements	○	○	○	○
Public Health considerations	○	○	○	○
American Disabilities Act considerations	○	○	○	○
Water right considerations	○	○	○	○
LEED/LEED ND does not credit LID	○	○	○	○
Standards that treat all sites equally (e.g. infill vs. greenfield)	○	○	○	○

Other (please specify)

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2. Could you identify any ways in which your jurisdiction has encountered and successfully overcome any of the above mentioned barriers? Have you heard of creative solutions adopted by other municipalities for addressing these barriers?

6. General Barriers

1. Some barriers span all three tiers. These barriers are listed below. Please rate the following barriers based on level of relevance to your jurisdiction.

	Not relevant	relevant	very relevant	N/A
Different or conflicting LID guidance or criteria from different agencies and groups	○	○	○	○
Lack of successful demonstration projects	○	○	○	○
Alternatives to LID are "easier" to design, construct, and maintain	○	○	○	○
Education and training for developers and their design teams	○	○	○	○
Education and training for public agencies and staff	○	○	○	○
Conflicting or confusing definitions (e.g. source control BMPs, treatment control BMPs, LID, and hydromodification BMPs)	○	○	○	○

Other (please specify)

2. Could you identify any ways in which your jurisdiction has encountered and successfully overcome any of the above mentioned barriers? Have you heard of creative solutions adopted by other municipalities for addressing these barriers?

7. Additional Barriers

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1. Please share any additional information relevant to your jurisdiction that was not mentioned in this survey.

8. Follow up

1. Would you be willing to participate in a phone call conversation or focus group that will allow us to better understand barriers to LID implementation? If so, please check which activity or activities below. Volunteers are greatly appreciated!

- ☐ Phone Call
- ☐ Focus Group

2. Do you know of key stakeholder(s) (i.e. developer, stormwater engineer, planner, watershed conservation group, regulating agency, etc.) for us to follow up with to better understand barriers to LID implementation? If so, please provide their information below.

9. Thank You!

Congratulations! You are finished.

We appreciate your help with this effort. For more information regarding this effort, please contact:

Laura Podolsky
Local Government Commission
lpodolsky@lgc.org
(916) 448-1198 x311
www.lgc.org

Appendix C.

Focus Group Agendas and Participant List

Public Agency Focus Group Participants
November 3, 2011
Location: Riverside County Flood Control and Water Conservation District Office

Name	Title	Affiliation
Trung Chanh Phan	Stormwater/Wastewater Compliance Specialist	City of Fullerton
Matt Bennett	Senior Civil Engineer/ NPDES Coordinator	City of Yorba Linda
Richard Boon	Chief	Orange County Stormwater Program
Terry Fritz	NPDES Coordinator	City of Redlands
Ammar Eltawil	Civil Engineering Associate IV	City of Los Angeles, Public Works
Keith Linker	Principal Civil Engineer	City of Anaheim
Michael Shetler	Stormwater Program Administrator	County of Riverside
Mindy Davis	Planner	County of San Bernardino, Public Works

Community Development Focus Group
November 2, 2011
Location: Los Angeles County Department of Public Works Headquarters

Name	Title	Affiliation
Ian Adam	Principal / Stormwater Manager	Fusco Engineering, Inc.
Omar Dandashi	VP Engineering	Lewis Operating Corp.
Vik Bapna	Principal	California Watershed Engineering
Tricia Johns	Principal	KPFF Consulting Engineers
Andrew Nickerson	Associate / Senior Project Manager	PSOMAS
Jason Marechal	Practice Builder	Kimley-Horn and Associates, Inc.

Barriers to Low Impact Development

Community Development Focus Group

November 2, 2011 ■ 1:00 – 3:30 pm
Los Angeles County Department of Public Works Headquarters
900 S. Fremont Ave., Alhambra, CA 91803

Meeting Purpose: To gain a better understanding of barriers to LID implementation from the perspective of the development community.

Meeting Agenda

1:00 **Welcome and Introductions**
Meeting Facilitators:
Laura Podolsky – Project Manager, Local Government Commission
Jeff Loux - Director, Land Use and Natural Resource Program, UC Davis Extension

1:15 **Group Discussion**

Overview Question: Please share an experience with a LID project that was successfully implemented and what made it successful. Also share when processes have been challenging and why.

Municipal Policies and Standards

- What are specific policy and/or design standard barriers you have experienced with LID projects?
- Do you find there are times in which competing needs for space (i.e., not related to stormwater) can make an LID technique not feasible?
- Do municipal policies and standards adequately address LID in more challenging development contexts, such as infill, redevelopment, and higher density projects?

Regional, State, and Federal Policies and Procedures

- Which environmental permits and/or agencies are the most challenging to work with on projects that include LID and why?
- Do you run into challenges working in a region transected by multiple regional water boards and/or local jurisdictions each with different permits and processes?

Site Level Challenges

- What is the number one site-level constraint to LID (e.g., space, soil, slope, high groundwater, etc.)? Can this constraint be addressed through new technologies; additional education on the part of staff or consultant design team; more detailed design standards, or other? Are certain projects (e.g., infill, greenfield development, roadways, etc.) more affected by this constraint than others?
- Are there a handful of LID techniques you tend to use and why?
- Are there LID treatments being promoted/encouraged that do not make sense (i.e., expensive to build, hard to maintain, technically not feasible, etc.) on the ground?
- Which LID treatments show promise and could use additional support (i.e. additional research, pilot projects, etc.) to advance their use?

Costs Associated with Designing, Building, and Maintaining LID

- Are there specific LID techniques that are especially cost prohibitive?
- Are there extra costs associated with LID versus conventional stormwater management? If so, are the extra costs mostly from the design/planning stage, cost to build (including labor and/or materials), cost to maintain or other?
- What incentives would help promote the use of LID? Do different development types (i.e., infill, redevelopment, higher density projects, etc) need additional support and/or incentives to make project feasible?

Capacity to Implement

- Who do you consult with on projects that include LID?
- Have you included new types of expertise on consultant teams for projects that include LID?
- What has your experience been like working with city/county staff and/or other regional, state, or federal agency staff?
- Are there stakeholders that could greatly influence or advance LID adoption with additional education, such as local policy makers, public health officials, city managers, etc.?

Perception of LID

- What is the perception of LID by the general public? Are there LID techniques that are more favorable to the public than others?

3:15 **Summary and Next Steps**
Laura Podolsky – Project Manager, Local Government Commission

3:30 **Adjourn**

Barriers to Low Impact Development

City and County Agency Focus Group

November 3, 2011 ■ 8:30 – 10:45 am

Finance Conference Room
Riverside County Flood Control and Water Conservation District
1995 Market Street, Riverside, CA 92501

Meeting Purpose: To gain a better understanding of barriers to LID implementation from the perspective of city and county staff.

Meeting Agenda

8:30 **Welcome and Introductions**
Meeting Facilitators:
Laura Podolsky – Project Manager, Local Government Commission
Jeff Loux - Director, Land Use and Natural Resource Program, UC Davis Extension

8:45 **Group Discussion**

Overview Question: Please share an experience with a LID project that was successfully implemented and what made it successful. Please share an experience when processes have been challenging and why.

Municipal Policies and Standards

- What are policy and/or design standard barriers you have experienced with LID projects? How has your city/county addressed these barriers?
- Do you find there are times in which competing needs for space (i.e., not related to stormwater) can make an LID technique not feasible?
- Does your city's/county's policies and standards address LID in more challenging development contexts, such as infill, redevelopment, and higher density projects?

Regional, State, and Federal Policies and Procedures

- Which environmental permits and/or agencies are the most challenging to work with on projects that include LID and why?

Site Level Challenges

- What is the number one site-level constraint to LID (e.g., space, soil, slope, high groundwater, etc.)? Can this constraint be addressed through new technologies; additional education on the part of local government staff or consultant design team; more detailed design standards, or other? Are certain projects (e.g., infill, greenfield development, roadways, etc.) more affected by this constraint than others?
- Are there a handful of LID techniques used more often than others?
- Are there LID techniques being promoted/encouraged that do not make sense (i.e., expensive to build, hard to maintain, technically not feasible, etc.) on the ground?
- Which LID treatments show promise and could use additional support (i.e. additional research, pilot projects, etc) to advance their use?

Costs Associated with Designing, Building, and Maintaining LID

- Are there specific LID techniques that are especially cost prohibitive?
- Are there extra costs associated with LID versus conventional stormwater management? If so, are the extra costs mostly associated with the design/planning stage, cost to build (including labor and/or materials), cost to maintain and operate or other?
- What incentives would help promote the use of LID among the development community? Do different development types (i.e., infill, redevelopment, etc) need additional support and/or incentives to make project feasible?

Capacity to Implement

- Have you consulted with other city/county departments on projects that include LID? Does your city/county have the expertise in-house to implement LID?
- What has your experience been like working with private sector consultants and/or other representatives from the development community?
- Are there stakeholders that have the potential to greatly influence or advance LID implementation if they received additional education or exposure, such as local policy makers, public health officials, city managers, etc.?

Perception of LID

- What is the perception of LID by the general public? Are there LID techniques more favorable to the public than others?

10:30 **Summary and Next Steps**
Laura Podolsky – Project Manager, Local Government Commission

10:45 **Adjourn**

Appendix D.

Phone Interview Participants

Name	Title	Affiliation
John Kemmerer	Associate Director, Water Division	U.S. EPA Region 9
Eric Becker	Water Resource Control Engineer	San Diego Regional Water Quality Control Board
Wayne Chiu	Water Resource Control Engineer	San Diego Regional Water Quality Control Board
Christina Arias	Water Resource Control Engineer	San Diego Regional Water Quality Control Board
Ejigu Solomon	Unit Chief, Storm *Water* Compliance & Enforcement Unit	Los Angeles Regional Water Quality Control Board
Ivar Ridgeway	Environmental Scientist	Los Angeles Regional Water Quality Control Board
Michael Roth	Water Resources Control Engineer	Santa Ana Regional Water Quality Control Board
Adam Fischer	Orange County NPDES Permit Liaison	Santa Ana Regional Water Quality Control Board
Kathleen Fong	Water Resources Control Engineer	Santa Ana Regional Water Quality Control Board
Mark Grey	Director of Environmental Affairs	Building Industry Association of Southern California
Carmel Brown	Founder	CKB Environmental Consulting, Inc.
Mike Borst	Chemical Engineer	U.S. EPA, Green Infrastructure Performance
Xavier Swamikannu	Consultant	
Paul Crabtree	Founder	Crabtree Group Inc.
Jennifer Krebs	Principal Environmental Planner	San Francisco Estuary Partnership
Greg Gearheart	Stormwater Section Supervisor	California State Water Resources Control Board
Eric Bernsten	Stormwater Section	California State Water Resources Control Board
Anna Lantin	Vice President	RBF Consulting
Scott Taylor	Senior Vice President	RBF Consulting
Dalia Fadl	Assistant Engineer	Dpt. of Water Resources, Sacramento County
Ray Olson	Director	City of Ventura Environmental Services Office
Arne Aslem	Water Quality Manager	Ventura County Watershed Protection District
Chris Crompton	Manager, Environmental Resources	OC Watershed, Orange County Public Works
Jonathan Bishop	Chief Deputy Director	CA State Water Resources Control Board
Mike Antos	Research Manager	Council for Watershed Health
Eric Stein	Principal Scientist	Southern CA Coastal Water Research Project
Bob Collacot	Consultant	Riverside County Flood Control District
Daniel Apt	Senior Associate	RBF Consulting