

## **Creating an LID Environment in an Ultra Urban Setting – Part 2**

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### **Abstract**

The City of Bremerton, Washington, with its 40,000 residents, is typical of a mature medium-sized Puget Sound city. Its older central business district is served by a stormwater system that is over 60 years old. Stormwater is currently routed, untreated, through a conventional storm drain system directly into Puget Sound. The City is going through significant revitalization efforts and employing Low Impact Development (LID) in an aggressive manner. This paper is a follow-up to one presented at the 2008 LID Conference in Seattle and presents additional examples of the use of LID in addressing the stormwater issues associated with major public infrastructure/transportation projects.

Case studies of implementation of LID into significant transportation projects are presented, including a major 1,600 foot long urban bridge structure, an “economic stimulus” project involving a mile long roadway project in a commercial industrial area, and the introduction of pervious asphalt paving in a combined sewer overflow reduction project. A discussion of how engineering culture barriers were overcome to open the door for the introduction of LID into urban transportation projects is presented.

### **Introduction**

The City of Bremerton, Washington, with its 40,000 residents, is typical of a mature medium-sized Puget Sound city. Its older central business district is served by a stormwater system that is over 60 years old. Stormwater is currently routed, untreated, through a conventional storm drain system directly into Puget Sound.

Bremerton is in the final stages of completion of a multi-year, \$45 million dollar combined sewer overflow (CSO) reduction project. This \$1,000+ per capita investment, mandated by court order, will undoubtedly achieve environmental compliance, but at a cost that challenges the concept of social justice in this community with twenty percent of its population living at the poverty level.

While some much larger communities in this country are forestalling massive CSO reduction efforts, and taking the time to study the potential of LID to help reduce CSO reduction costs, Bremerton has taken a leadership role in implementing LID.

Bremerton's efforts can serve as an example to demonstrate the potential to other communities of the multi faceted benefits of LID.

Through the creative application of LID in ultra urban environments Bremerton believes that dollars invested in improving the function of the stormwater environment will reap additional benefits in the form of a transformed street infrastructure. This paper presents the potential this community has realized, and how it is extending LID's deployment from the conventional land development project to major urban public works infrastructure projects.

### Policy/Planning/Administration Considerations

Bremerton adopted its first Stormwater Mangement Plan in 1996 with the conventional suite of stormwater projects and solutions. As part of the Plan's first update in 2009, in response to the City's NPDES permit and the Puget Sound Partnership's Action Agenda, major emphasis on LID was included in the Plan, including a capital improvement plan line item for implementing LID opportunities.

The Stormwater Management Plan, with thorough consideration given to LID, was integrated into Bremerton's Comprehensive Plan and adopted by the city council, creating strong policy support for LID.

In a related action, the city council adopted its multi-year transportation improvement program with a budget item included for the creation of "green streets". With the City's primary infrastructure policy documents recognizing the potential for LID in both stormwater management and its street system, Bremerton has certainly taken a leadership position in implementing LID.

### Change in Engineering Culture

The culture of the engineering community, just like any other community whether it be societal, institutional, or professional, is shaped by the teachings and examples of its predecessors and leadership. And while policy sets the direction of a community endeavor, those doing the day to day work in carrying out the mission hold the keys to its success.

In the case of the municipal or county level public works community, acceptance by the engineers doing the day to day delivery of public and private capital improvements is critical to LID's successful deployment. Countless decisions are made on a daily basis in the course of planning, designing and constructing public infrastructure projects. Opportunities for LID are created, capitalized upon or lost by the engineers associated with a project.

Recognizing the influence and power of the engineering community is of paramount importance in developing a successful LID implementation strategy. The past teachings and trainings of this group of professionals has created inertia to be

reckoned with. Given that LID is a relatively new concept in the civil engineering profession there exists a vast majority of civil engineers in influential positions that have never been exposed to the science behind the concept. While the newly trained engineer has a greater likelihood of training and acceptance of LID, they are most often of significantly less influence than their “old school” supervisors.

While laws and policies will ultimately change the civil engineering community’s acceptance of LID, a carefully developed plan dealing with education and training will certainly accelerate its acceptance as a main stream practice. Bremerton has recognized this fact and set out upon an aggressive course of action to change its engineering culture from within. It has made significant investments during the past three years in the training of its existing staff in the many facets of civil engineering related to LID.

For example, all employees in its engineering division have been encouraged to attend any and all free or low cost trainings provided by regional, state and federal entities providing LID training. This includes trainings sponsored by the Kitsap Homebuilders Foundation, Washington State University, the University of Washington, the Puget Sound Partnership, the Washington Department of Ecology, and the EPA. The staff time commitment by the City has been significant.

All civil engineers in the City’s public works department have been trained in the use of the Western Washington Hydrology Model, a continuous hydrologic simulation model. Prior to this type of model, all civil engineers had been trained using single event hydrologic models as the standard for stormwater planning and design. The use of simulation modeling represents the new age of civil engineering stormwater science and is integral to LID planning and design.

To this point in time, one half of its professional engineering staff have been sent to an eight day certificate course that teaches the full range of elements included in LID, ranging from rain gardens to pervious pavement to green roofs and water harvesting. Considerations from planning and design to construction and maintenance are all included in this training provided by Washington State University.

While physical limitations to LID, primarily in the form of soil types and slopes, do exist, it has been this author’s experience that resistance to change by the engineering culture remains as a primary impediment to wider acceptance of LID. And while education is probably going to be the most effective tool to greater acceptance of LID, more opportunities for deployment of LID will be realized if one understands the reasons for the current opposition and develops strategies to counteract the opposing forces.

At the government institutional level one most often comes up against a culture adverse to risk, or constrained by standards and operating procedures that were intended to make plan review and development consistent and cost efficient to produce. Often times this standardization of professional practice leads to mediocrity and a product that, in the long run, is not optimally designed.

## Major Transportation Projects

The City of Bremerton is a team member in the design of an \$83million, sixteen hundred foot long bridge replacement project. The agency primarily responsible for designing the bridge has been bound by its own design manuals and procedures, as well as AASHTO requirements. The design agency's project team was faced with schedule and budget constraints and resorted to the standard suite of stormwater treatment methodologies, including proprietary mechanical filtration devices. This was done to reduce uncertainties searching for a creative LID approach.

In this case the problem with the standard design approach was that the life cycle cost for the capital and ongoing maintenance cost for the conventional solution was estimated to be many times greater than utilizing LID, in the form of gravel infiltration beds. When the design team was challenged with implementing LID it balked at seriously considering the LID alternative and promoted the case of design procedures, standards and standard solutions. The City was able to prevail in favor of the LID design by reminding the design agency's project team that they were designing a bridge for the City with City stormwater standards, which allowed for LID.

With this realization the design agency's team consulted with one of their well qualified LID professionals to work with the City in developing an LID approach to dealing with the bridge's stormwater. A gravel infiltration bed LID BMP is in the final stages of design and will treat the runoff from approximately 800 linear feet of elevated bridge deck.

Another example of standard design philosophy driving sub-optimum design is related to a \$3million "economic stimulus" roadway project planned for the City and the Port of Bremerton's Airport Industrial Park. A well respected local consulting firm was engaged by the Port of Bremerton to complete construction documents in an eleventh hour effort to secure American Recovery and Reinvestment Act (ARRA) funding. The Port and their consultant were aware of the City's efforts to aggressively implement LID within its jurisdiction. However, state transportation agency design standards were used for anticipated ease of design review and approval.

The construction plans that were initially submitted for stormwater management included approximately 1,000 feet of ninety-six inch diameter corrugated metal pipe to serve as a detention vault for flow control requirements. Open detention/infiltration basins were not allowed within the airport environs due to Federal Aviation Administration concerns about the open water surfaces attracting birds and associated flight hazards.

The City was not interested in inheriting the long term maintenance and eventual replacement of the detention pipe and requested that the design firm redesign the project with LID provisions. The City also provided cost estimates to the Port illustrating that close to \$1 million dollars in project capital costs could be saved if the project was redesigned using gravel infiltration beds under porous pavement. The

Port, almost immediately, negotiated a contract amendment with the design firm to change the stormwater provisions in the construction documents. The project is under construction with porous pavement as an integral element of roadway and drainage design.

### City Capital Improvement Projects

**Major City Streets.** Bremerton has been awarded a Federal Surface Transportation Program (STP) grant to reconstruct its main downtown commercial and residential street in a multi-modal, greenstreet, concept to serve as a significant element of the City's transportation system. Pacific Avenue connects the Bremerton Transportation Center and Washington State Ferry Terminal with the redeveloping downtown core, the redeveloping near downtown higher density residential neighborhood, and Evergreen Park.

This system reconstruction project is based upon the idea of using multi-modal transportation projects to assist in the transportation efficiency related redevelopment of aged urban infrastructure. The primary intent of the project is to significantly improve bicycle and pedestrian transportation access along its route to a key regional transportation hub.

Incorporated within the design is the concept of enhancing non-motorized transportation through safety improvements such as intersection treatments/curb bulb outs, narrowed street width, bicycle lanes, and improved urban aesthetics.

All these features lend themselves to the integration of LID in the form of increased area and potential for rain gardens, as well as the introduction of pervious pavement into the near downtown street infrastructure. The partially completed nine city block project will be finished in 2011. The six million dollar project is funded through State of Washington, U. S. Department of Transportation and City of Bremerton funding in approximately equal shares.

**CSO Reduction.** During the final stages of the City's final element of its multi-year, \$45 million court ordered sanitary and storm sewer separation-combined sewer overflow (CSO) reduction project, the City had gained enough experience and confidence in LID to exchange a portion of the conventional storm sewer system with a gravel infiltration trench beneath porous pavement in one of the City's downtown streets.

The conventional CSO reduction design called for the extension of a storm drain lateral and catch basins approximately 300 feet to collect parking lot and street gutter flow. Upon closer examination of the street and the objective of the storm drain extension the project engineer agreed that the porous pavement/infiltration trench concept could achieve the same purpose. Since the project was already under contract a change order was negotiated with the contractor and a reasonable price adjustment was agreed upon.

The work was completed and is functioning as anticipated. The lesson learned by the City was that the use of LID, in the form of pervious pavement, for CSO reduction will be price competitive with standard trench, pipe and catch basin storm sewer designs if included in the construction documents at the time of project bidding.

Another significant conclusion the City has come to at the end of their CSO reduction project is that LID would have most assuredly saved the City millions of dollars had the potential for LID's role in solving CSO problems been more widely accepted at the start of this major investment ten years ago. Cities contemplating LID as an approach to solving their CSO problems will hopefully learn from Bremerton's experience in this area.

Urban waterfront park restoration. Bremerton's location is characterized by rolling topography, abundant rainfall, and miles of waterfront on the Puget Sound. Bremerton's forefathers had the wisdom to secure a number of waterfront locations for city parks. Lion's Park, which sits directly adjacent to the Sinclair Inlet of Puget Sound, is planned for a major renovation. The last major renovation to this urban park was nearly four decades ago.

The park as currently developed has baseball/softball fields, children's play areas, a waterfront trail, and paved parking lots situated directly adjacent to marine beach and shellfish beds. Runoff from the parking lots is currently short circuited directly to this resource area.

The City applied for and received from the Washington Department of Ecology a \$1million grant to assist in the renovation of the park in an aggressive LID manner. The design process was well integrated with the community through a number of public meetings. LID received strong support from the citizenry as the right thing to do.

The construction phase of the renovation project is underway and includes the full array of LID features, including green roofs on park shelters, rain gardens, and porous walkways. The parking lot is designed to be relocated well away from the shoreline and constructed using a pervious asphalt pavement structure.

### Watershed Scale Planning and LID

Washington State has growth management legislation that has set the stage for strong comprehensive planning at the local level. Bremerton's Comprehensive Plan, adopted in 2004, initiated the City's venture into LID with a calling for the City to adopt the principals of LID. Increasingly detailed sub area plans completed since then have called for the continuation of LID as a guiding policy with respect to stormwater management in the sub areas of the City. These plans have reinforced the pursuit of LID as a stormwater management tool to be applied as opportunities become available.

The City now desires to take LID planning one step further and integrate it into its land use, transportation and utility planning efforts. The concept of synergy is being pursued in the area of infrastructure planning from a multi-purpose standpoint where utility and transportation planning are coupled with community/urban design.

For example, the City is pursuing resources to fund the land use planning of a 7,000 acre area annexed into the City that heretofore had been partially developed in a haphazard manner. This area, which had been outside of the City's jurisdiction, comprises the major part of a drainage basin that outlets directly into critical estuarine waters.

The planning project seeks to use critical environmental considerations, including stormwater management, to develop a land use plan for the Gorst Creek area recently opened up to development by sanitary sewer service extension. The sanitary sewer service was provided to correct decades long pollution issues due to failing individual sewage treatment systems.

The Environmental Protection Agency's System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) is anticipated to be a key tool in the development of the plan. SUSTAIN is computer based decision support system for selection and placement of LID BMPs at strategic locations in urban watersheds.

Bremerton is also looking at developing a companion planning effort for a basin located within a built up, ultra urban part of the City. This project would prepare a Green Streets Plan that integrates Bremerton's Mon-Motorized Transportation Plan and Bremerton's Stormwater Management Plan with LID.

Concepts anticipated to be employed include such recognized pedestrian/bicycle friendly techniques as traffic calming circles, intersection bulb outs and street neck downs. These transportation system devices can serve the dual role as opportunities for deployment of bioswales, rain gardens, and porous pavement where appropriate.

The placement of the LID stormwater BMPs will be determined through the use of the SUSTAIN model to help determine and optimize the most effective way to address stormwater retrofit in an ultra urban basin.

## Summary and Conclusion

This paper has presented an overview of the LID implementation program of a moderately sized community in western Washington State. It is generally recognized that Bremerton is a leader in Washington State in the adoption and implementation of LID practices to help manage stormwater issues.

Bremerton has implemented a multi-faceted program to employ LID as a mainstream strategy in how it deals with both private and public sector infrastructure projects. The scale of project where LID is being deployed ranges in construction cost from a few tens of thousands of dollars to many millions of dollars. Project funding for these

works include conventional bank financing, municipal budget sources, state budget sources, and federal funding, including recent economic stimulus resources.

The implementation has been deliberate, with the origination coming from policy adopted in the comprehensive planning process and detailed in neighborhood planning efforts, Bremerton's Stormwater Management Plan and annual budget line items.

Bremerton's administrative leadership recognized the role its engineering staff would play in the success of the program and financially supported the training of its engineering staff. This approach has reaped benefits for the City in tangible cost savings to both the private investor and the taxpayers. In addition, the City has been recognized as a leader in the LID realm in Washington State.

Bremerton is increasing its efforts in using LID to continue to shape the future of this community through the desire to strategically incorporate LID in its master planning of recently annexed areas of the City, as well as through Green Street planning for the redevelopment of its existing environs.

In conclusion, this modest city of 40,000 residents is demonstrating that LID is a sound and feasible concept in an ultra urban setting.