Appendix B
of the March 2011
NPDES Annual Report

Low Impact Development (LID) Report
for the
March 31st, 2011 Annual Report
(Pursuant to Section S9.E.4 of NPDES Phase II Permit)

Executive Summary

This report has been created to meet the requirements of S9.E4 of the Western Washington (NPDES) Phase II Municipal Stormwater Permit and represents an opportunity for the City to provide opinion and information of the potential requirement of LID in the NPDES Phase II municipal permit when it is re-issued. The following bullets summarize the key points of this report.

- While LID techniques have significant potential benefits, such as improving water quality and improving flow control through emphasizing infiltration, these techniques are a not the cure all for all stormwater issues and include limitations and potential impacts (e.g. lack of established standards for installation, inspection and maintenance, current hydrologic modeling does not accurately address LID techniques and stormwater credits, and potential impacts to groundwater and soil/slope stability).
- The City recommends against requiring the use of LID where feasible in the next Phase II Permit. We recommend that LID be encouraged and incentivized rather than required.
- If LID is required in the next permit, it will likely have significant financial impacts to both the public and private sectors to meet design, installation, inspection and maintenance requirements.
- While impacts of LID techniques are primarily beneficial in nature, LID impacts may have adverse impacts to groundwater, soil and slope stability and soil health.
- The feasibility and limitations for each of different LID techniques are summarized in Table A – The LID Feasibility Matrix.
- Only one LID technique – narrowing sidewalks - is identified as not feasible in SeaTac due to conflicts with Americans with Disabilities Act (ADA) requirements and the City's pedestrian access needs. Alternatively, the City proposes the use of porous concrete to meet the goal of reducing impervious sidewalk surfaces.
- The report identifies two goals for the promotion and measurement of LID use: 1) To better promote the potential benefits of using both structural and nonstructural LID techniques; and 2) To identify options for providing incentives for the use of LID techniques. The report further identifies that these goals could be measured through an audit of development permits.
- The report describes a five to seven year timeline needed for the adoption and implementation of LID, if the Department of Ecology (DOE) chooses to require it where feasible for all Phase II jurisdictions.

Applicability of Report

This report is intended to meet the requirements of Section S9.E.4. of the Western Washington Phase II Municipal Stormwater Permit as modified on June 17, 2009. The contents of this report have been developed based on the results of the City of SeaTac multi-departmental Low Impact Development (LID) Team and the Permit Stakeholders Committee.

Please note that Phase II permittees are currently not mandated to require implementation of LID techniques where feasible in this permit cycle. Therefore this document should be considered a preliminary planning document intended to meet the reporting requirements of the permit and as such is not a commitment to require implementation of LID techniques.

Overview

For the purposes of this report Low Impact Development (LID) is defined as a stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings. LID techniques include both structural and non-structural (i.e. design) techniques which emphasize the preservation of open space and infiltration of stormwater.

For the sake of brevity, descriptions of the different LID techniques are not included in this report. If needed, descriptions for the different LID techniques can be found in the 2005 Low Impact Development (LID) Technical Guidance Manual for the Puget Sound (http://www.psp.wa.gov/downloads/LID/LID_manual2005.pdf).

The City of SeaTac has created the LID Feasibility Matrix (Table A) to summarize the feasibility of, and barriers and limitations to the use of the different LID techniques currently available based upon the results of the LID Team and the Permit Stakeholders Committee meetings. The table lists the different LID techniques and characterizes their use as Feasible, Not Feasible or Limited. The table also identifies whether the techniques are Structural or Non-Structural and provides a brief description of the barriers/limitations to their use.

Table A

LID Feasibility Matrix			
LID Techniques	**Feasible/ Not Feasible/ Limited**	**Structural/ NonStructural**	**Barriers/Limitations**
Site Analysis	F	NS	No Barriers - recommend modifying application requirements to clarify additional LID application requirements (Soil analysis, infiltration rates)
Conserve Native Vegetation and Open Space	F	NS	No Barriers
Narrow Sidewalks	NF	NS	Conflicts with pedestrian access needs and ADA access requirements
Narrow Road widths	L	NS	Allowed to, but not below, 20' unobstructed travel path needed for fire safety vehicles - limited to residential roads
Reduced Setbacks	L	NS	Allowed within PUD and other planning codes. Must maintain minimum side yard setback separation between structures for fire safety
Cluster Development	F	NS	Allowed within PUD and other planning codes
Street Design			
Curbless Roads to Bio-infiltration	L	S	Sidewalks must be separated from road with bio-infiltration to address safety issue. Must have clearly defined edge.
Curb Inlets to Bio-Infiltration	F	S	Allowed in existing standards. 90° curbs required adjacent to sidewalks to prevent illegal parking
Bio-Retention/Rain Gardens	L	S	Landscaping/screening requirements can conflict with the use of bio-retention system design. Access, inspection and maintenance are also issues.

Table A (Continued)

LID Techniques	Feasible/ Not Feasible/ Limited	Structural/ Non-Structural	Barrier/Limitations
Clearing and Grading	F	NS	No barriers
Phased Clearing and Grading	F	NS	No barriers
Preserve Native Vegetation	F	NS	No barriers
Preserve/Stockpile Organic Soil Layer	F	NS	No barriers
Minimize Compaction of Soils	F	NS	No barriers
Soil Amendments	F	NS	No barriers
Pervious Paving (porous concrete/ pervious asphalt/pavers)	L	S	Required defined edge and sufficient load capacity for Fire safety vehicles. Not allowed within vehicular travel paths on arterials or collectors due to spill containment and durability concerns. Allowed in public right of way in residential areas and on public property on a site by site basis. Feasible for sidewalks except for curb ramps and heavy load/volume driveways
Green Roofs	F	S	Modify building standards to require engineered designs and make manufacturer responsible for certification of membrane. Fire may need to specify venting requirements.
Minimum Excavation Foundations	F	S	Engineered structural designs required
Tree Wells/Boxes	F	S	No barriers

I. Summary of Barriers to the Use of LID (S9.E.4.a.)

Barriers to the individual LID techniques are identified in Table A. The feasibility column denotes LID techniques as Feasible (F), Not Feasible (NF) or Limited (L). A brief summary of

the barriers to the different LID techniques are listed in the Barriers/Limitations column. They are further discussed below:

Site Analysis
The City finds this non-structural LID technique to be feasible. It would however require changes to submittal requirements and the development review process. It is also important to point out the impacts to the development industry. It is the development industry that would bear the costs of the additional site analysis necessary for the different LID techniques. These costs would likely represent an insignificant burden to large developments which already include significant site analysis. However, these costs could represent a significant upfront cost burden to small development projects which may not be accustomed to this level of site analysis.
Measures to Address Barriers – Measures would include distribution of educational materials identifying site analysis requirements and promoting the potential benefits of LID. Further, the City would also evaluate thresholds of when such site analysis would be required. These thresholds would be based on the size and scope of the development project, in an attempt to not overburden small developers.

Conserve Native Vegetation and Open Space
There are no barriers to the use of this LID technique other than site conditions and contractor education.

Narrow Sidewalks
Narrowing sidewalks has both regulatory and community acceptance barriers. The regulatory barriers include the Americans with Disabilities Act and the City's construction standards. Further, the need for expansion of pedestrian access along city roads is an issue commonly raised by residents.
Measures to Address Barriers – The goal of this LID technique is to reduce impervious surfaces. Since both the regulatory and community acceptance barriers make the use of this technique not feasible, the City would address this by allowing pervious sidewalks where feasible.

Narrow Roadway Widths
The City identifies the feasibility of this technique as limited based on one primary barrier – fire/safety equipment access requirements. Fire and safety regulations require a minimum 20 foot unobstructed travel path (outside of parking areas) to allow fire safety to ingress/egress, and provided sufficient area to operate equipment. Therefore roadway narrowing is feasible down to, but not below, the minimum 20 foot unobstructed travel path.

An additional limitation to narrowing road widths is traffic capacity requirement. Travel lanes must be able to meet the demands of both standard and multi-modal traffic. To this end it unlikely that roadway narrow, could occur in high traffic areas like arterials & collector streets, limiting its use to low traffic residential areas.

Community acceptance (both property owners and developers) may be another barrier, but may be overcome with public education.
Measures to Address Barriers – In communications with fire safety staff it has become abundantly clear that the 20 foot minimum road width is an inflexible requirement. Alternatively, pervious paving options can be pursued to attain a net result of reducing the amount of impervious surfaces.

Reduced Setbacks
The City foresees a limited use of this technique due to regulatory constraints with planning and fire safety codes. It is allowed in the City's PUD (clustered development) and other planning codes, but is still subject to minimum side yard separation between structures for fire safety.
Measures to Address Barriers – None needed.

Clustered Development
This LID technique is allowed within the City's PUD regulations and other planning codes.

Street Design
Curbless Roads to Bio-Infiltration – In addition to standard site feasibility issues, curbless roadways with adjacent sidewalks represent a pedestrian safety issue. Also a clearly defined roadway edge is needed to address safety issues in low visibility conditions. Further, additional maintenance staff and training may be needed to address the inspection, maintenance and repair of bio-infiltration areas.
Measures to Address Barriers – The City would need to provide development standards for this LID technique establishing clear design criteria requiring bio-infiltration areas to separate roads and sidewalks and create a clearly defined road edge.

Bio-Infiltration/Rain Gardens (Bio-Retention)
While primarily feasible, this technique is not without its limitations. Existing city landscaping/screening regulations can discourage or conflict with the use/design of bio-retention systems (e.g. vegetation/shrubs in rain gardens are often not counted towards the landscaping requirement). Also as specified above, use of these systems would lead to increases in labor costs needed to inspect and maintain these systems. Training of inspection and maintenance staff may also be significant for this BMP. Maintenance of this BMP includes vegetation assessment, soil assessment and infiltration assessment. Another important consideration is the need to access these facilities for inspection purposes, especially if they are located on private property. For example, it would be next to impossible to access residential backyard rain gardens over the long term, not to mention the task of enforcing maintenance of these facilities on a lot by lot basis.
Measures to Address Barriers – Revise existing landscaping requirements to allow for landscape vegetation within bio-retention areas to count towards the landscape requirements. Establish standards which limit the use of rain gardens in plats and

residential developments to common areas where access easements are established for inspection and maintenance.

Clearing and Grading
There are no barriers to the use of this LID technique other than site conditions and contractor education.

Pervious Paving
This LID technique includes porous concrete, pervious asphalt and pavers. While a popular technique within the environmental community, this LID technique does come with some serious limitations and are as follows:

1. Defined edge safety issues – Pervious paving techniques can be constructed without the need for curb or storm gutters. In this circumstance, a clearly defined roadway edge is needed to address safety issues in low visibility conditions.
2. Spill containment and cleanup issues – In the case of spills, pervious surfaces allow pollutants to infiltrate into soils, subsoils and potentially groundwater. Standard spill cleanup techniques (absorbents) are not effective once the spill is infiltrated into the pavement. Therefore removal of paving surface and below contaminated soils/base materials may be required to adequately clean up a spill. If this is necessary, it will incur significant impacts in terms of material cost, labor and equipment costs, as well as traffic impacts.
3. Durability with heavy vehicles – Industry specialists and the EPA's own online webinars have indicated that there is a durability issue with pervious paving with heavy vehicles, especially in turning areas (i.e. intersections, ROW entrances/approaches). Spalling of pervious asphalt and porous concrete and fracture and/or dislocation of pavers is not an uncommon result of heavy load turning on pervious paving areas. Please note that this limitation applies to the travel path only, parking areas and sidewalks not subject to heavy vehicles do not have the same limitation.
4. Costs – The cost of pervious paving materials and installation is currently higher than the traditional paving materials. However, if the costs of stormwater infrastructure materials, which would not be needed with the use pervious paving, are factored into the equation, it is likely that costs would be equivalent or even favor pervious paving. Implementation of this technique would however incur training costs for staff that would install, inspect or maintain these techniques.
5. Lack of adopted standards – Manufacture and installation of pervious paving is more complex than traditional methods. Industry standards currently exist certifying both manufacturers and installers for some of these techniques, such as porous concrete. To our knowledge state and local transportation agencies have not adopt these standards or certification requirements.
6. Training on Installation, Inspection and Maintenance – Training of city staff on the installation, identification, inspection and maintenance of these techniques would be necessary to ensure their long term function.

Measures to Address Barriers – 1) The City would need to provide development standards for this LID technique establishing a clearly defined road edge when curb and gutters are not used with pervious paving. 2) Since spills most commonly occur at intersections and along arterials and collectors, use of pervious would not be allowed or would be strictly limited in these areas. 3) This limitation would also be used to address the durability issue of heavy vehicles which also most commonly use arterials and connectors in their path of travel. 4) Regional standards for the manufacture, installation and maintenance would have to be adopted for these techniques to ensure their quality, long term functionality and durability.

Green Roofs

While listed as a feasible LID technique, there are some implementation issues that need to be addressed. The International Building Code (IBC) does not currently include standards for green roofs. Correct installation of the waterproof membrane is essential for protection of the building. Also, landscaping and other green roof features may hinder fire safety staff from establishing roof ventilation during fires. Another building consideration is the addition load placed on the roof from the soils and vegetation

Measures to Address Barriers – Until building and fire codes are updated to address green roof issues, modify City standards to: 1) require the installers of roof membrane to certify installation of membrane and; 2) engineered structural designs to accommodate additional loads; and 3) address fire and safety needs for ventilation, etc.

Minimum Excavation Foundations

This LID technique is also listed as feasible within the LID Feasibility Matrix, however there is a minor issue which warrants mentioning. The IBC does not specifically address requirements for minimum excavation foundations. However general requirements within the IBC allude to the need for geotechnical analysis and engineer certification of this type of foundation. Further, given load and strength requirements, this type of foundation would likely be used only in residential single family construction applications.

Tree Wells/Tree Filtration Boxes

While listed as feasible this LID technique does include additional training cost and staff/labor costs for inspection and maintenance of this BMP. Similar to the bio-retention systems, staff will need to be trained on the inspection and maintenance of the vegetation, soil health and infiltration capacity.

Flow Control Modeling for LID Techniques – Existing hydrologic modeling techniques (i.e. King County Run-Time Series or the Western Washington Hydrology Model) do not fully address how infiltration rates should be included in flow control modeling for all low impact development techniques. Especially in the case of the King County Surface Water Design Manual, limited stormwater credits are given for the use of LID techniques. As a result developers are not given sufficient incentives or encouragement to use these techniques.

Measures to Address Barriers – Update existing regional hydrologic modeling methods and stormwater design manuals to adequately model infiltration and the other benefits of LID techniques and provide accurate credits/incentives for their use.

Environmental Constraints

This report does not identify specific environmental constraints which can limit the use of the individual LID techniques. It is assumed that a site assessment of the individual project sites will drive the selection of the different LID techniques. Site conditions which will have the most significant effects on LID use include: soils and subsoils, topography, proximity to sensitive areas, slope gradient, hydrology and groundwater hydrology.

Impacts to Groundwater and Interflow - It should also be noted that there has been insufficient scientific analysis of the potential environmental impacts of the re-introduction of surface waters into the post construction modified groundwater table, specifically the potential increases to interflow and soil saturation, as well as the subsequent impacts to soil and slope stability. It should not be assumed that LID infiltration techniques will result in deep groundwater infiltration. Further post construction modified soils do not have the same capacity as preconstruction soils to hold and transport shallow subsurface flows such as interflow.

Source Control vs. Treatment – LID techniques commonly focuses on onsite infiltration of stormwater, in an attempt to mimic preconstruction hydrologic conditions. This on-site infiltration also provides water quality treatment – as the contaminated stormwater is filtered by soils as it infiltrates. LID does not eliminate the source of the stormwater pollutants, it merely redirects pollutant carried by stormwater into soils rather than down the storm system and into our waterways. While some pollutants carried by stormwater will break down in the soils, metals other pollutants will not. As pollutants build up in the soils, it can have a detrimental effect on soil health and vegetation.

Measures to Address Barriers – Regional standards should be established requiring site analysis/feasibility assessment requirements for LID use that include identification and analysis of potential off-site impacts from increases to ground water and interflow in terms of impacts to: structures, seasonal groundwater tables, and soil and slope stability.

Financial Costs of LID Techniques

The financial impacts have been mentioned in this section for several of the different LID techniques. They include increases to construction costs, training costs and labor costs. There are too many unknowns involved in the implementation of the different LID techniques to attempt to quantify the financial impacts of requiring these techniques. However, it is clear that the potential increased demand on staff time alone resulting from the required inspection of both private and public stormwater systems and the maintenance of public stormwater systems (pursuant to NPDES permit) would likely require increased staffing levels.

Community Acceptance and Understanding

While not discussed in detail, community acceptance is a significant factor in the use of LID techniques. If the potential benefits of LID techniques are promoted through education and pilot projects, as well as encouraged through equitable stormwater credits and other incentives, public acceptance and demand for LID techniques should increase. Contrarily, if LID techniques are mandated where feasible, it would likely result in resistance from the development community, primarily due to the increased upfront costs to development projects.

II. LID Practices Available and Reasonably Implemented (S9.E.4.b.1.i.)

In 2009 the City of SeaTac's LID Team conducted a review of its codes and standards to determine: 1) which LID techniques were allowed within the City and; 2) what, if any limitations are attached to the individual LID techniques. Techniques listed as Feasible (F) or Limited (L) within Table A are currently available and can reasonably be implemented within the City of SeaTac. Details on these limitations are discussed in the above section. Only one LID technique, narrow sidewalks, is listed as Not Feasible (NF) within SeaTac. As discussed in the above section, this technique conflicts with both pedestrian access needs and ADA requirements. Further, alternative LID techniques, such as porous concrete, are available to meet infiltration needs.

[Note: SeaTac does not currently require any LID techniques, nor do we plan to do so before 2012. LID techniques are currently encouraged, but not incentivized.]

III. Potential Non-Structural Actions and LID Techniques (S9.E.4.b.ii.)

Table A also identifies which of the LID techniques are considered Structural (S) and Non-Structural (NS) in the third column of the table. Nonstructural LID techniques allowed within SeaTac include:

1. Site Analysis
2. Conserve Native Vegetation and Open Space
3. Narrow Road Widths
4. Reduced Setbacks
5. Clustered Development
6. Clearing and Grading Techniques

The only nonstructural technique not currently allowed in SeaTac is narrow sidewalks due to conflicts with pedestrian access needs and ADA requirements. SeaTac has no plans to change that in the future.

IV. Goals and Metrics to Identify, Promote, and Measure LID Use (S9.E.4.b.iii.)

Goals and Promotion

1. To better promote the potential benefits of using both structural and nonstructural LID techniques.
2. To identify options for providing incentives for the use of LID techniques.

Indicators and Measurement

The clear indicator for the success of the promotion of benefits of the use of LID, as well as any incentives the City may decide to offer, is the actual utilization of these LID techniques and incentives. Measurement of the utilization of these techniques and incentives can be accomplished through an audit of development permits that have been approved by the City.

V. Potential Schedule to Require and Implement the Non-Structural and LID Techniques on a Broader Scale in the Future (S9.E.4.b.iv.)

The City of SeaTac has no plans to require the implementation of LID techniques on a broader scale in the future. It is the opinion of the City that LID techniques should be encouraged rather than required. Public education and incentives should be used to raise public acceptance of these techniques rather than mandating their use where feasible. Once the public accepts the use and potential benefits of LID, demand for and use of these techniques will increase without the need of a mandate.

For example the City of SeaTac has used LID techniques in two of its recent public constructions projects: porous concrete on a sidewalk installation and porous concrete and pervious asphalt in the parking area and sidewalks of a new fire station. These projects can be used as examples to raise public awareness and acceptance of the use and potential benefits of LID.

However, if the Phase II jurisdictions were mandated to require the use of LID techniques where feasible in a future NPDES permit, there are several tasks which must be considered in a potential schedule for implementing these techniques. These tasks include, but are not limited to:

1. Creation/adoption of regional standards for use of the different LID techniques, including standards for :
    a. manufacture of LID materials (i.e. porous concrete and pervious pavement)
    b. criteria for use of LID techniques (i.e. what are the specific environmental conditions which restrict the use of certain LID techniques – slope, soils, infiltration rates, or what level of site analysis is required to determine optional off-site impacts)
    c. design of structural LID techniques
    d. installation of LID techniques
    e. inspection and maintenance of LID techniques
2. Modification and adoption of regional stormwater modeling methods to accurately credit LID techniques based on infiltration rates.
3. Draft, adopt and implement changes to local regulations including:

a. Environmental review under the State Environmental Policy Act
b. Establishing criteria for:
    i. what is LID
    ii. what is feasible (e.g. what factors are considered in determining feasibility)
    iii. what extent LID must be implemented on a project by project basis to meet this mandate
c. Public review and comment
d. City Council approval

4. Training of City staff on the review, inspection and maintenance of these techniques.
5. Evaluation of cost impacts of these new requirements and securing funding to cover additional costs.

Potential Timeline for Implementation of Tasks

Task 1 - Creation/Adoption of Regional Standards	2 years
Task 2 – Modification and Adoption of Stormwater Modeling	2-3 years
Task 3 – Draft, Adopt and Implement Regulations	1-2 years
Task 4 – Training of Staff	(Concurrent with Task 3)
Task 5 – Evaluation of Cost and Securing Funding	Ongoing

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Public Comments

Received at 2/22/11 Transportation and Public Works Council Sub-Committee Meeting

Comment

If LID is required where feasible by Ecology in next permit issuance, could the City conduct city-wide analysis to determine LID feasibility, rather than the developer having to do it on each site.

Staff Response (3/3/11)

Potential LID requirements are speculative at this point, so it is too early fully respond to this question. However, the following issues make this proposal problematic.

Given the following:

1. *Soils are not homogenous across properties or jurisdictions.*
2. *Existing Soil Survey information identifies general regional soil patterns and are not site specific.*
3. *Drainage patterns and hydrology can change with time.*

Any feasibility analysis would likely have to be done on a site by site basis, at the time development is proposed to get an accurate picture of feasibility. Further, any such proposal would require significant resources (staff time and money) to pursue.