

References (alphabetical)

Advantages of Conservation Subdivisions for Developers, Arendt, Randall, at http://www.landchoices.org/conservationsubs/advnt_consubs_devel.htm

A Landscape Analysis of New York City's Water Supply, Mehaffey et al., US Environmental Protection Agency, at <http://www.epa.gov/esd/land-sci/ny.htm>

"Building in the NYC Watershed," Greene County Soil & Water Conservation District, at <http://www.gcswcd.com/swp/wap/building-nyc-watershed.html>

Burnsville Rainwater Gardens, at <http://www.burnsville.org/DocumentCenter/Home/View/450>

Chapter 5 – Low Impact Development, University of Louisville Center for Land Use and Environmental Responsibility, at http://louisville.edu/landuse/Chapter_5_Low_Impact_Development.pdf

Construction Stormwater Inspection Manual, NYSDEC, Version 1.05, 2007, at http://www.dec.ny.gov/docs/water_pdf/inspectman.pdf

Economic and Adaptation Benefits of Low Impact Development, Roseen et al., at http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/JEE%20FTL%203-30-12.b.pdf

Green and Gray Infrastructure, US Environmental Protection Agency, at <http://www.epa.gov/nrmrl/wswrd/wq/stormwater/green.html>

Green Infrastructure, US Environmental Protection Agency, at <http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm>

Green Parking, US Environmental Protection Agency, at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=89

Insights from the Field: Forests for Water, Talberth et al., World Resources Institute, February 2012, at http://pdf.wri.org/insights_from_the_field_forests_for_water.pdf

Low Impact Development, US Environmental Protection Agency, at <http://water.epa.gov/polwaste/green/index.cfm>

Low Impact Development Hydrologic Analysis, Prince George's County, Maryland Department of Environmental Sciences, Programs and Planning Division, at <http://www.riverfriends.org/Portals/0/LID%20Hydrologic%20Analysis%20Manual.PDF>

Low Impact Development Manual for Mountaintop Communities, Kendall and Axelson, at http://www.gcswwd.com/images/stories/pdf/wap/mbsdw/lid_guide_final_9_28_11.pdf

Low Impact Development Technologies, Whole Building Design Guide, a program of the National Institute of Building Sciences, 2010, at <http://www.wbdg.org/resources/lidtech.php>

Model Development Principles for the Central Rappahannock, at http://www.riverfriends.org/Portals/0/LID_principles.pdf

New York Standards and Specifications for Erosion and Sediment Control, New York State Department of Environmental Conservation Division of Water, August 2005, at <http://www.dec.ny.gov/chemical/29066.html>

New York State Stormwater Management Design Manual, New York State Department of Environmental Conservation, August 2010, at <http://www.dec.ny.gov/chemical/29072.html>
Playbook for Green Buildings + Neighborhoods, at <http://www.greenplaybook.org/infrastructure/act/policy/regulatory.htm>

Predicting Future Water Quality from Land Use Change Projections in the Catskill-Delaware Watersheds, Hall et al., SUNY ESF and Yale University School of Forestry and Environmental Studies, 2008/2011, at http://environment.yale.edu/gisf/files/Chapt_1_4.pdf

Protecting Water Resources with Higher Density Development, US Environmental Protection Agency, January 2006, at http://www.epa.gov/smartgrowth/pdf/protect_water_higher_density.pdf

Protecting Water Resources with Smart Growth, US Environmental Protection Agency, May 2004, at http://www.epa.gov/dced/pdf/waterresources_with_sg.pdf

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, US Environmental Protection Agency, December 2007, EPA 841-F-07-006

Rules and Regulations for Protection from Contamination, Degradation and Pollution of the New York City Water Supply and its Sources, Final Regulations – Effective May 1, 1997, as Amended April 4, 2010

Stormwater Management Best Practices, US Environmental Protection Agency, at http://www.epa.gov/oaintmnt/stormwater/best_practices.htm#permeablepavers

The Economics of Low Impact Development: A Literature Review, MacMullan and Reich, ECONorthwest, November 2007, at http://www.econw.com/media/ap_files/ECONorthwest-Economics-of-LID-Literature-Review_2007.pdf

The New York City Watershed Protection Program: A Case Study in PES, Schwartz, John, NYCDEP, at http://www.nycwatershed.org/watershed-tours/DEP-PES_World_Bank_LAC_20110512.pdf

Three Keys to BMP Performance – Concentration, Volume, and Total Load, US Environmental Protection Agency, at <http://cfpub.epa.gov/npdes/stormwater/urbanbmp/bmptopic.cfm>

Vermont Low Impact Development Guide for Residential and Small Sites, Vermont Environmental Conservation, 2010, at http://www.vtwaterquality.org/planning/docs/pl_LID%20Guide.pdf

Water Quality Scorecard, US Environmental Protection Agency, October 2009, at http://www.epa.gov/smartgrowth/pdf/2009_1208_wq_scorecard.pdf

Why Green Infrastructure?, US Environmental Protection Agency, at http://water.epa.gov/infrastructure/greeninfrastructure/gi_why.cfm#WaterQuality

Appendix A

Item 1

Full Survey

Low Impact Development Strategies for the West-of-Hudson

[Exit this survey](#)

1.

1. In what capacity do you work with land use and development (i.e. Town, Planning or Zoning Board member; planner; engineer; developer, etc.)?

2. Which of the following best describes your level of experience with Low Impact Development projects or strategies?

3. What types of BMPs are used most often in your designs (select all that apply)?

Permeous pavement

Bioretention basins

Engineered wetlands

Open space/buffers

Inlet/filter systems

Extended detention basins (dry or wet)

Below-ground detention/infiltration

Other (please specify)

4. What are the biggest determining factors in choice of BMP (select all that apply)?

Cost

Removal efficiency

Size

Installation/maintenance

Other (please specify)

	33%
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2.

5. What do you see as impediments to the approval of projects utilizing LID strategies (specific to the NYC watershed or in general)?

6. Have your local codes and ordinances been reviewed or compared to model development principles (i.e. Better Site Design Handbook)? Do they allow for or encourage better site design?

7. Do local codes allow for or encourage cluster, open space, or conservation development?

Yes

No

8. What problems have you encountered during design/construction of BMPs or LID projects (select all that apply)?

Cost

Timing/phasing of installation

Buffer/wetlands preservation

Construction/installation issues

Lack of acceptance by owners

Outlet channel/level spreader construction

Coordination between developer, builder, and contractor

Other (please specify)

3.

9. What problems, if any, have you encountered with maintenance of BMPs or LID projects (select all that apply)?

Replacement of proprietary filters or soil media

Education of maintenance staff

Monitoring/maintenance requirements

Documentation

N/A

Other (please specify)

10. Where should education efforts be focused (i.e. local government, homeowners, developers, etc.) to most effectively increase awareness and use of LID strategies? Please include any successful educational opportunities you have offered or attended in your answer.

100%

[Prev](#)

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Appendix A

Item 2

LID Survey Results¹

1. In what capacity do you work with land use and development? (23 responses)

1. Planning
2. Planner
3. Town planning board
4. Watershed assistance coordinator
5. SWCD (minor advisory/design capacity)
6. Engineering tech for watershed ag. program
7. Planner
8. County dept. head
9. Promote water quality on logging sites
10. Regulatory agency
11. Environmental. Engineer
12. Planner
13. Regional regulatory
14. NYCDEP SW group
15. Engineering - land surveying
16. Planning board
17. Engineer/zba
18. T/V planning board
19. Planning
20. Communications director
21. Watershed management
22. Engineer GCSWCD
23. Planning board

2. Level of experience with LID projects/strategies? (25 responses)

1. None (4) – 16%
2. Minimal (8) - 32%
3. **Moderate (12) - 48%**
4. Extensive (1) – 4%

3. What types of BMPs are used most often in your designs? (22 responses – “select all”)

1. Pervious pavement (11) – 50%
2. **Bioretention basins (15) – 68.2%**
3. Engineered wetlands (11) - 50%
4. **Open space/buffers (15) – 68.2%**
5. Inlet/filter systems (10) – 45.5%
6. Ext. detention (9) – 40%
7. Below-ground det./inf. (5) – 22.7%
8. Other (5) – 22.7% [used these on demo projects; BMPs on skidtrails; stormwater management – erosion/sediment control; on-farm BMPs to reduce nonpoint source pollution. Logger forestry practices; non-structural operation/maintenance]

4. What are the biggest determining factors in choice of BMP? (23 responses – “select all”)

1. **Cost (19) – 82.6%**
2. Removal efficiency (6) – 26.1%
3. Size (11) – 47.7%

¹ 26 responses from 59 sent for a rate of 44%

4. Installation/maintenance (14) – 60.9%
5. Other (9) – 39.1% [ability to reduce localized flooding/promotion of good environmental practices; answered based on things heard; site conditions; communities requesting/promoting best practices; landscaping appeal; series of wetlands/stilling ponds – BMPs determined by best fit and space available; efficiency; water quality; demonstration]

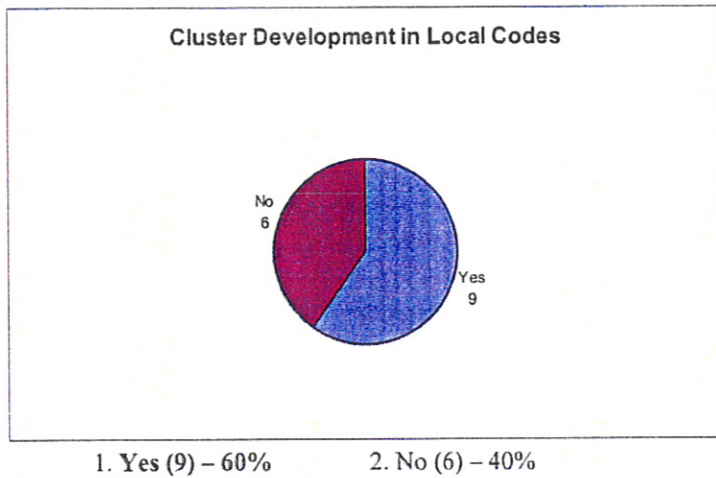
5. Impediments to the approval of projects utilizing LID? (15 responses)

1. Permits
2. **Cost**; space
3. **Cost**
4. People are used to traditional practices, are unaware of LID, and **cost**
5. **Initial cost/long-term maintenance**
6. Awareness and willingness to pay up front
7. NYC watershed regulations not impediment
8. Engineers lack of understanding LID
9. **Impact on economic growth**
10. **Cost** to implement DEP-desired BMPs; project area unavailable to implement desired BMPs; limited types of systems acceptable to DEP (requirements for quality and quantity)
11. Lack of knowledge at engineering firms; **lack of enabling language in local land use laws**
12. NRCS standards, funding, landowner buy-in
13. Landowners who want to develop as they see fit with no gov't interference
14. **Cost**
15. **Lack of support from local leaders**

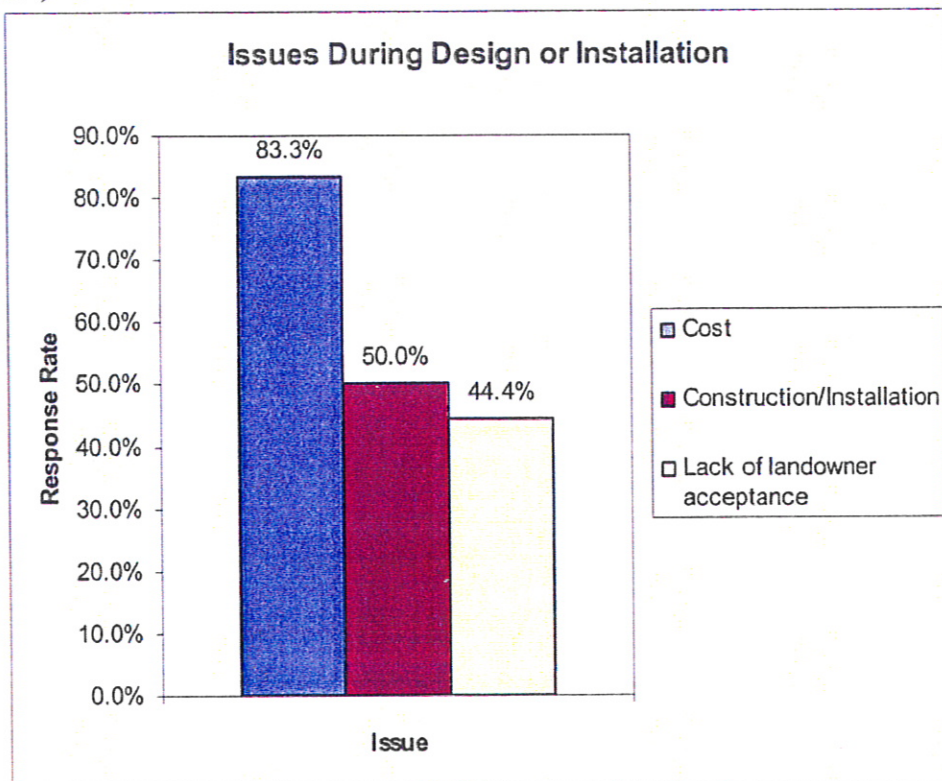
6. Have local codes been reviewed or compared to model development principles? (13 responses)

1. Some – the more recently overhauled zoning codes address BMPs
2. Six communities in Greene county going through Mountaintop Better Site Design workshop with hopeful outcome of adopt or allow these practices
3. NA
4. Some
5. Some munis have, but not all
6. Unknown
7. No
8. Not sure if they've been reviewed or compared; local PB tries to encourage better site designs where practical
9. Do not specifically address model development principles, don't believe use precluded
10. Unknown
11. I think they are trying
12. Not sure
13. No and no

7. Do local codes allow for or encourage cluster development? (15 responses)



8. Problems encountered during design/construction of LID projects? (18 responses – “select all”)



1. Cost (15) – 83.3%
2. Timing/phasing of installation (5) – 27.8%
3. Buffer/wetlands preservation (5) – 27.8%
4. Construction/installation issues (9) – 50%
5. Lack of acceptance by owners (8) – 44.4%
6. Outlet channel/level spreader construction (1) – 5.6%
7. Coordination between developer, builder and contractor (5) – 27.8%
8. Other

9. Problems during maintenance? (13 responses – “select all”)

1. Replacement of proprietary filters or soil media (3) – 23.1%
2. Education of maintenance staff (8) – 61.5%
3. **Monitoring/maintenance requirements (10) – 76.9%**
4. Documentation (4) – 30.8%
5. N/A (3) 23.1%
6. Other (4) – 30.8% [LID parking lot is a challenge in the winter, but with the plow raised less gravel is kicked up; non-LID practices are rarely if ever maintained – LID requires less maintenance than traditional; landowner buy-in, funding for operations/maintenance or repair/replacement; cost]

10. Focus of education efforts? (19 responses)

1. Homeowners and **gov't** agencies
2. Engineers, contractors, CEOs, planning boards
3. Developers and landowners need to understand why it's in their best interest to use BMPs and LID for their projects without getting into too much detail, many developers in the jurisdiction I work for do everything legally possible to avoid constructing conservation subdivisions. More conventional ways of doing things are still seen as better for the bottom line, and may very well be. Educational efforts need to first determine how BMPs and LID are better for the bottom line, and then promote such facts
4. The watershed summit in 2009 and Scott Horsley got rave reviews because he presented the material in an easy to understand fashion with lots of pictures. All targeted audiences listed are important, not sure with working with one over the other will make a difference.
5. **Local gov't** and developers
6. **Local gov't** to assure the practices are permitted, encouraged during review process and maintenance is handled in long-term through maintenance district or an escrow. Developers to ensure proper installation and maintenance
7. **Local gov't** and developers. Once they understand these concepts, it is easier for them to express themselves to potential customers and residents. The most successful educational opportunity I have was one where we tried to apply the practices in a real-life setting. We were given a plan for an existing subdivision, some highlighters and told to implement LID practices that were realistic
8. **Local gov't**, CEOs, developers, engineers, planners. Schoharie Watershed Water Quality Summit
9. Planning boards and developers
10. **Local gov't** and engineers should be targeted. Successful training sessions include: GC watershed summit; CWC (Fleishmanns) training
11. **Local gov'ts** – on several occasions local building inspectors/CEOs and planning boards have deliberately directed property owners to ignore DEP stormwater regulations. Other instances in the towns simply do not know the DEP or NYSDEC regulations in regard to site development. Engineers – too many engineers are still stuck in the “end of pipe” treatment approach where the end result is an ugly grass hole with a concrete box outlet structure. The combination of hideous designs couple with inexplicably high invoices to the land owner have resulted in an aversion to properly handling stormwater runoff. I have been involved in several residential subdivisions where both traditional and LID concepts have been employed. In each instance, the folks who installed rain gardens throughout the site were very receptive to the design and installation as their property value was not decreased by building a large open water sump. Who doesn't like flower beds?
12. **Gov't**, developers
13. Generally the development sites don't lend well to most applications of LID. Where practical and where they can be implemented there's resistance by the owners and developers in establishing a good and practical maintenance program. Most LID strategies are too complex and therefore not implemented or properly maintained. Keeping it simple and practical will be more effective and thence better accepted
14. **Local gov't** first and foremost; then developers, engineers, survey firms, homeowners, etc.
15. Landowners
16. Town boards (to pressure planning boards to adhere to LID), town planning boards (huge learning curve for new members), county planning boards (Del Cnty very favorable to development), landowner education (subdivision/development is not the answer), civic groups (rotary, senior's club - get the word out and let them share the message)

17. Must push the envelope on water quality issues. Continue to hammer home the importance of clean water, and draw parallels between poor land use and degradation of water quality. Not just to city resource users, but locally!!

18. **Local gov't** planning board

19. **Local gov't** officials