GREENING RUNOFF: THE UNSOLVED NONPOINT SOURCE POLLUTION PROBLEM, AND GREEN BUILDINGS AS A SOLUTION

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I. INTRODUCTION

Water quality in America has improved dramatically since the adoption of the Clean Water Act in 1972.[1] The goal of clean water, however, remains a long way off. Although the nation has taken great strides in reducing pollution from point sources[2] such as industrial facilities, much of the remaining water pollution is caused by nonpoint source[3] pollution such as runoff from agriculture, mining, logging, and urbanized areas. Federal regulation, unfortunately, has largely failed to control the nonpoint source pollution problem.[4]

In this Note, I explore the evolution of nonpoint source pollution regulation and how green buildings can be part of the solution. Part II examines how the Clean Water Act attempts to regulate nonpoint source pollution. It summarizes recent developments applying the CWA's total maximum daily load provisions to nonpoint source pollution and the problems that remain. Part III focuses on how green buildings can be used in urban areas to help reduce the nonpoint source pollution problem. After examining how Leadership in Energy and Environmental Design (LEED), the dominant green building stan-

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1. *See* Drew Caputo, *A Job Half Finished: The Clean Water Act After 25 Years*, 27 ENVTL. L. REP. 10,574, 10,576 (1997).

2. A point source is "any discernible, confined and discrete conveyance . . . from which pollutants are or may be discharged." Clean Water Act (CWA) § 502(14), 33 U.S.C. § 1362(14) (2000 & Supp. V 2005).

3. Nonpoint sources are land uses such as timber harvesting, agriculture, and urban development that result in water pollution. U.S. GEN. ACCOUNTING OFFICE, GAO RCED-99-45, WATER QUALITY: FEDERAL ROLE IN ADDRESSING—AND CONTRIBUTING TO—NONPOINT SOURCE POLLUTION 18 (1999) [hereinafter GAO, WATER QUALITY].

4. *See* Caputo, *supra* note 1, at 10,575.

dard, can help reduce urban runoff, I discuss how specific low-impact development techniques such as permeable pavement and green roofs can control nonpoint source pollution. Finally, Part IV analyzes how development patterns as a whole contribute to the nonpoint source pollution problem. After summarizing how urban sprawl leads to water pollution, this Note concludes by examining LEED for Neighborhood Developments (LEED-ND) and how it can reduce the impacts of sprawl on our nation's water.

II.
THE CLEAN WATER ACT

The Clean Water Act[5] (CWA) was adopted in 1972 with the objective to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[6] The Act aimed to achieve a "goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water,"[7] also known as the goal for fishable/swimmable waters.[8]

In order to achieve this goal, the CWA has focused on the control of effluent discharged by point sources.[9] A point source is "any discernible, confined and discrete conveyance . . . from which pollutants are or may be discharged."[10] It is illegal for a point source to discharge any pollutant unless the source has obtained a National Pollutant Discharge Elimination System (NPDES) permit.[11]

As a backstop to the NPDES system, states are required to establish water quality standards for the bodies of water within their borders.[12] States must specify a use for the body of water such as fishing

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5. 33 U.S.C. §§ 1251–1387 (2000 & Supp. V 2005).

6. CWA § 101(a), 33 U.S.C. § 1251(a).

7. CWA § 101(a)(2). Drinking water is regulated by the Safe Drinking Water Act, 42 U.S.C. §§ 300f–300j-26 (2000 & Supp. IV 2004).

8. *See* Jeffrey M. Gaba, *New Sources, New Growth and the Clean Water Act*, 55 ALA. L. REV. 651, 651 (2004).

9. *Id.* at 654. Effluent is any liquid waste discharged into a river, lake, or other body of water. *See id.* at 655.

10. CWA § 502(14), 33 U.S.C. § 1362(14). Examples of point sources include "any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged." *Id.*

11. CWA § 301(a), 33 U.S.C. § 1311(a); Gaba, *supra* note 8, at 654. *See also* CWA § 402 (establishing the National Pollutant Discharge Eliminations System permits). Point sources are required to use the Best Available Technology (BAT) to control the discharge of pollutants, which is determined by the Environmental Protection Agency (EPA). CWA §§ 301(b), 306, 33 U.S.C. §§ 1311(b), 1316.

12. CWA § 303, 33 U.S.C. § 1313.

and swimming,[13] and then establish criteria and an antidegradation policy to protect that use.[14]

The CWA, and the NPDES system in particular, have been very successful in reducing point-source pollution.[15] From the time the CWA was passed in 1972 through the late 1980s, industrial water pollution controls reduced pollution by more than one billion pounds each year.[16] For all the CWA's success, however, many of the nation's waters are still impaired, which means they do not meet water quality standards.[17] About 40% of the water bodies that have been assessed by the states do not meet the standard for fishable/swimmable waters.[18] The primary reason for this continued pollution problem is pollution caused by nonpoint sources.[19]

A. Nonpoint Sources

Nonpoint sources are land uses such as timber harvesting, agriculture, and urban development that result in water pollution.[20] The pollution results from rainwater, snowmelt, or irrigation water that moves over or through the land, picking up pollutants and transferring them into streams, lakes, rivers, and coastal water.[21] Different land uses produce different pollutants, such as sediment, nutrients, pesticides, bacteria and viruses, salts, oil and grease, toxic chemicals, and heavy metals.[22] There has been very little progress in addressing polluted runoff since the enactment of the CWA, and it is quite possible that the problem has gotten worse.[23]

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13. 40 C.F.R. § 131.10 (2006).
14. 40 C.F.R. §§ 131.11–131.12 (2006).
15. Caputo, *supra* note 1, at 10,575.
16. *Id.* at 10,576 n.32.
17. GAO, WATER QUALITY, *supra* note 3, at 18. Impaired waters are waters that are not meeting water quality standards, regardless of the source of the pollution. *Id.* at 18 n.1.
18. Caputo, *supra* note 1, at 10,577–78. The standard for fishable/swimmable waters is that they be able "to fully support a healthy aquatic community and/or human activities all year round." *Id.* at n.45.
19. GAO, WATER QUALITY, *supra* note 3, at 18.
20. *Id.*
21. *Id.* For example, agriculture produces nonpoint source pollution through soil erosion, pesticides, and fertilizers that wash off the land and into bodies of water. *See id.* at 44.
22. *Id.* at 18.
23. Caputo, *supra* note 1, at 10,577.

B. Congress's Response to Nonpoint Source Pollution

Cognizant of the problems presented by nonpoint source pollution, Congress amended the Clean Water Act in 1987.[24] The amendments required that "programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this chapter to be met through the control of both point and nonpoint sources of pollution."[25] Unfortunately, the substantive section of the amendment, Section 319, has not effectuated this goal.

Section 319 requires the governor of each state to submit to the EPA an assessment report identifying waters that cannot achieve water quality standards due to nonpoint source pollution, identifying categories and subcategories of nonpoint sources that pollute those waters, and describing the process for identifying best management practices (BMPs) to "reduce, to the maximum extent practicable, the level of pollution resulting from such category, subcategory, or source."[26] The governor of each state must also submit a state management program, which must identify the best management practices and programs to achieve implementation of those practices, and set forth a schedule for that implementation.[27] Section 319 also includes grants for implementing management programs and protecting groundwater quality.[28]

Unfortunately, Section 319 has largely failed to clean up nonpoint source pollution.[29] Slow and inadequate funding is one of several issues that have crippled state Section 319 programs.[30] Although nonpoint sources were recognized years ago as the leading cause of water pollution, the EPA continued to spend the vast majority of its control funds on point source pollution.[31] In fiscal year 1990, the EPA spent less than 6% of funds available for point and nonpoint

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24. David Zaring, Note, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515, 525 (1996). *See also* Water Quality Act of 1987, Pub. L. No. 100-4, § 316, 101 Stat. 7, 52 (codified as amended at 33 U.S.C. § 1329 (2000 & Supp. V 2005)).

25. CWA § 101(a)(7), 33 U.S.C. § 1251(a)(7) (2000 & Supp. V 2005).

26. CWA § 319(a)(1)(C), 33 U.S.C. § 1329(a)(1)(C) (2000 & Supp. V 2005).

27. CWA § 319(b).

28. CWA §§ 319(h)–(i).

29. *See generally* ROBERT W. ADLER ET AL., THE CLEAN WATER ACT 20 YEARS LATER 171–91 (1993) (evaluating § 319's lack of success at controlling nonpoint source pollution).

30. *Id.* at 171, 190–91 (finding funding among at least eight major problems with water runoff management under § 319).

31. U.S. GEN. ACCOUNTING OFFICE, GAO RCED-91-10, WATER POLLUTION: GREATER EPA LEADERSHIP NEEDED TO REDUCE NONPOINT SOURCE POLLUTION 51 (1990) (drawing evidence from estimates of EPA officials).

source-related water pollution control activities on activities related to nonpoint source pollution.[32] As a result, states could only allocate millions of dollars for a problem they claim will take billions to correct.[33] In addition, there has been inadequate oversight from the EPA, and as a result, Section 319 policies can vary widely by state.[34] Many states relied on voluntary compliance by landowners, which proved to be ineffective.[35] These problems were described by one commentator as "not enough carrot, not enough stick," and without adequate incentives or penalties, Section 319 failed to solve the nonpoint source pollution problem.[36]

C. The TMDL Provisions of Section 303(d)

Although Section 319 has proved to be ineffective in battling nonpoint source pollution, the total maximum daily load (TMDL) provisions of Section 303(d) show more promise. Section 303 of the CWA requires each state to adopt a water quality standard for each of its waters within 180 days of the adoption of the CWA.[37] Any state that does not comply with this deadline will have its standards set for it by the EPA administrator.[38]

Section 303(d) requires each state to identify the waters within its boundaries for which best available technology (BAT) point source controls are not stringent enough to implement the applicable water quality standard.[39] The state is then required to establish the TMDL for pollutants identified by the EPA.[40] The TMDL must be "established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."[41]

The state is then required to submit the list of impaired waters (the 303(d) list) and the TMDLs to the EPA.[42] The CWA requires the states to submit the 303(d) list and TMDLs within 120 days of passage

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32. *Id.*
33. *Id.* at 29.
34. ADLER ET AL., *supra* note 29, at 171, 188.
35. *Id.* at 191.
36. Zaring, *supra* note 24, at 526–27.
37. CWA § 303(a)(3)(A), 33 U.S.C. § 1313(a)(3)(A) (2000 & Supp. V 2005).
38. CWA § 303(b)(1)(A).
39. CWA § 303(d)(1)(A). A common example is a body of water that is free of point source pollution, but does not meet the applicable water quality standard due to nonpoint source pollution. *See infra* Part II.D.
40. CWA § 303(d)(1)(C).
41. *Id.*
42. CWA § 303(e).

of the Act.[43] If the EPA disapproves of either the 303(d) list or the TMDLs, the Administrator is required to promulgate them himself.[44]

D. Pronsolino v. Nastri*: Applying TMDLs to Nonpoint Source Pollution*

The current TMDL regulations define the total maximum daily load as the sum of the individual loads from point sources, the loads from nonpoint sources, and the loads from natural background pollution.[45] The EPA's inclusion of nonpoint source pollution in the calculation of TMDLs was challenged in *Pronsolino v. Nastri*.[46]

The appellants in the case, the Pronsolinos, purchased 800 acres of timberland in the Garcia River watershed in California in 1960.[47] The Garcia River, subject to a TMDL for sediment imposed by the EPA pursuant to Section 303(d)(2), is impaired only by nonpoint source pollution.[48] The appellants applied for a permit in 1998 to harvest timber from their land.[49] In order to comply with the Garcia River TMDL, they were required to mitigate "90% of controllable road-related sediment run-off" and prohibited from removing certain large trees and from harvesting between mid-October and May 1.[50]

The appellants then filed suit against the EPA, challenging the EPA's authority to establish TMDLs for rivers that are only impaired by nonpoint source pollution and seeking a determination of whether the Garcia River TMDL was authorized by the CWA.[51] The Ninth Circuit upheld the regulations, deferring to the EPA's interpretation of Section 303(d) under the *Chevron* doctrine[52] and holding that Section 303(d) can include waters impaired only by nonpoint source pollution.[53] To date, no other circuit has considered this question, so there

43. CWA § 303(e)(2).

44. CWA § 303(a)(3)(C).

45. 40 C.F.R. 130.2(i) (2005). Natural background pollution is the background concentration from non-manmade sources. Memorandum from Tudor T. Davies, Director, Office of Sci. & Tech., U.S. EPA to Water Mgmt. Div. Dirs. (Nov. 5, 1997), *available at* http://www.epa.gov/waterscience/library/wqcriteria/naturalback.pdf.

46. 291 F.3d 1123 (9th Cir. 2002).

47. *Id.* at 1129.

48. *Id.*

49. *Id.*

50. *Id.* at 1129–30.

51. *Id.* at 1130.

52. *See* Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc., 467 U.S. 837, 844 (1984) (holding that "considerable weight should be accorded to an executive department's construction of a statutory scheme it is entrusted to administer").

53. *Pronsolino*, 291 F.3d at 1141.

appears to be little question that TMDLs can be used to regulate nonpoint source pollution nationwide.

E. Problems with Applying the TMDL Provisions to Nonpoint Source Pollution

Although *Pronsolino* was a step forward in regulating nonpoint source pollution under the TMDL provisions of Section 303(d), there is still no guarantee that TMDL plans, once established, will actually be implemented. Even though a TMDL identifies the maximum load of pollutants that can enter a body of water from categories of nonpoint sources, it need not specify how large of a load a particular parcel of land may contribute nor how the state should implement the TMDL.[54] The EPA is not required to include implementation or monitoring plans within the TMDL, as implementation and monitoring are state responsibilities.[55] States can choose not only how they will implement a TMDL, but also if they will implement it at all.[56] States that do not implement TMDLs are only penalized by a loss of federal grant money[57] since there is no statutory provision requiring implementation of TMDLs or establishing any enforcement mechanism.[58] In *Sierra Club v. Meiburg*,[59] the Eleventh Circuit rejected an attempt to force the EPA to implement established TMDLs.[60] According to the court, the CWA gives the responsibility of implementing TMDLs to the state.[61]

In 2000, the EPA promulgated rules requiring states to include an implementation plan when they submit a TMDL (the 2000 Rules).[62] Congress, however, immediately moved to block these rules by adding a rider to an appropriations bill prohibiting the EPA from using any funds to implement the new rules in 2000 or 2001, delaying them until

54. *See id.* at 1140.

55. *See id.*

56. *See id.*

57. *See id.*

58. *See id. See also* CWA § 309, 33 U.S.C. § 1319 (2000 & Supp. V 2005) (establishing the enforcement mechanisms of the CWA); CWA § 505, 33 U.S.C. § 1365 (establishing citizen suits).

59. 296 F.3d 1021 (11th Cir. 2002).

60. *Id.* at 1024.

61. *Id.* at 1031.

62. Revisions to the Water Quality Planning and Management Regulation, 65 Fed. Reg. 43,586, 43,662, 43,668 (July 13, 2000) [hereinafter 2000 Rules]. These regulations are also notable for their unique question-and-answer approach to rulemaking. *See id.* at 43,664–70.

the Bush administration took power.[63] The Bush administration first pushed back the effective date of the 2000 Rules to April 30, 2003,[64] which gave the EPA time to withdraw them before they could take effect. On March 19, 2003, the 2000 Rules were withdrawn.[65] Once more, states were required to establish TMDLs but had no obligation to implement them.

A second problem with the TMDL process is that states can avoid any responsibility under Section 303(d) simply by failing to submit anything to the EPA Administrator. The CWA gives the EPA authority to issue TMDLs for a state only after the state has submitted a TMDL and the Administrator has disapproved it.[66] Thus, when the EPA first began implementing Section 303(d), most states did nothing.[67] The EPA, therefore, was powerless to take action.[68] The constructive submission doctrine, established in *Scott v. City of Hammond*,[69] tightened this loophole. Under this doctrine, a state's failure to submit a proposed TMDL to the EPA is deemed to be the constructive submission of an inadequate TMDL, which then gives the EPA authority to promulgate a TMDL itself.[70]

The constructive submission doctrine, however, is not a perfect solution to the problem of states avoiding their responsibility to establish TMDLs. In *San Francisco Baykeeper v. Whitman*,[71] an environmental group sued to force the EPA to establish TMDLs for California, because the state was years behind the statutory deadline for establishing them itself.[72] The state did not submit any TMDLs until more than fifteen years after the statutory deadline, and as of

63. *See* ROBERT W. ADLER, CTR. FOR PROGRESSIVE REFORM, CPR PERSPECTIVES SERIES, TMDLS, NONPOINT SOURCE POLLUTION, AND THE GOALS OF THE CLEAN WATER ACT, http://www.progressiveregulation.org/perspectives/TMDLs.cfm (last visited Jan. 16, 2008).

64. Effective Date of Revisions to the Water Quality Planning and Management Regulation, 66 Fed. Reg. 53,044 (Oct. 18, 2001).

65. Withdrawal of Revisions to the Water Quality Planning and Management Regulation, 68 Fed. Reg. 13,608 (Mar. 19, 2003).

66. CWA § 303(d)(1)(D)(2), 33 U.S.C. § 1313(d)(1)(D)(2) (2000 & Supp. V 2005).

67. *See* OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY, AND IMPLEMENTATION 51 (2d ed. 2002).

68. *See id.*

69. 741 F.2d 992, 996 (7th Cir. 1984) ("We believe that, if a state fails over a long period of time to submit proposed TMDL's, this prolonged failure may amount to the 'constructive submission' by that state of no TMDL's."). *See also* HOUCK, *supra* note 67, at 51–53.

70. HOUCK, *supra* note 67, at 51–52; *Scott*, 741 F.2d at 996; CWA § 303(d)(1)(D)(2).

71. 297 F.3d 877 (9th Cir. 2002).

72. *Id.* at 879. *See also* CWA § 303(e) (setting deadline for submission of state plan that includes TMDLs).

May 2000, had only completed a small number.[73] The Ninth Circuit refused to apply the constructive submission doctrine, reasoning that because California had submitted at least some TMDLs and established a schedule for completing the rest, the state had not clearly and unambiguously decided not to submit any TMDLs.[74] If other circuits follow the Ninth Circuit's lead, states could avoid taking any real action under Section 303(d) by submitting a token number of TMDLs to the EPA and claiming that the rest will be forthcoming sometime in the future.[75]

TMDLs remain an imperfect, though important, step towards regulating and controlling nonpoint source pollution. There are, however, a number of reasons why states and municipalities may wish to start focusing on their nonpoint source pollution problems. The 2008 presidential election will most likely bring a new EPA Administrator and possibly rules similar to the 2000 Rules that would resurrect the requirement that states submit implementation plans along with TMDLs. States may anticipate future nonpoint source regulation and wish to start working on the problem now.[76] States may also wish to push the envelope regardless of national regulations, as California does with auto emissions,[77] and choose to impose more stringent environmental regulations than required by the CWA. In the next section, I examine how states and municipalities that choose to regulate

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73. *Baykeeper*, 297 F.3d at 880. There are 685 bodies of water listed on California's 2002 Section 303(d) List of Water Quality Limited Segments, of which twenty-three have completed TMDLs. California Environmental Protection Agency State Water Resources Control Board, 2002 Clean Water Act Section 303(d) List Summary Tables, http://www.waterboards.ca.gov/tmdl/303d_sumtables.html (click on "Total Water Bodies Listed") (last visited Jan. 16, 2008) (listing 685 bodies of water); California Environmental Protection Agency State Water Resources Control Board, TMDL Completed List 2002 (July 2003), http://www.swrcb.ca.gov/tmdl/docs/2002_tmdl_comp_list_020403.pdf (listing twenty-three bodies of water with completed TMDLs).

74. *Baykeeper*, 297 F.3d at 883.

75. *See* Houck, *supra* note 67, at 53. Like the Ninth Circuit, the Tenth Circuit has also interpreted the constructive submission theory as applying "only when the state's actions clearly and unambiguously express a decision to submit no TMDL for a particular impaired waterbody." Hayes v. Whitman, 264 F.3d 1017, 1024 (10th Cir. 2001). In that case, the Tenth Circuit refused to apply the constructive submission doctrine to Oklahoma where the state submitted "somewhere between three and twenty-nine" TMDLs. *Id.* at 1022.

76. *Cf.* Felicity Barringer & Andrew Ross Sorkin, *Utility to Limit New Coal Plants in Big Buyout*, N.Y. Times, Feb. 25, 2007, at A1 (a high profile example of the power industry anticipating future carbon dioxide regulation).

77. California has long been at the forefront of emissions regulations and has proposed legislation to require automakers to produce more efficient vehicles to meet these standards, which affect 30% of the vehicles on the road. *See* John M. Broder, *California Wants Strict Auto Emission Rules*, N.Y. Times, May 23, 2007, at A19.

nonpoint source pollution can use green buildings and green building techniques to reduce nonpoint source pollution in urban areas.

III.
Urban Nonpoint Source Pollution and Green Building Solutions

The built environment has more "direct, complex, and long-lasting impacts" on the ecosystem than any other human activity.[78] Green buildings are designed to lessen this impact by "increasing the efficiency with which buildings . . . use energy, water, and materials" and improving "siting, design, construction, operation, maintenance, and removal."[79]

One of the ways that buildings impact the ecosystem is through their effect on stormwater runoff.[80] When buildings and infrastructure are constructed on greenfields (or previously undeveloped lands), largely pervious surfaces are replaced with impervious ones.[81] Impervious surfaces are "any material that prevents the infiltration of water into the soil."[82] This decrease in pervious surface area can increase both the volume and velocity of runoff.[83] In addition, development can adversely affect wetlands and other ecosystems that can absorb and control stormwater,[84] thus exacerbating the effects of stormwater runoff. Green buildings can help address stormwater runoff problems by reducing stormwater's effects and protecting the ecosystems that absorb and control stormwater.[85]

In the United States, the predominant definition of a green building is that of the U.S. Green Building Council (USGBC).[86] Founded

78. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery 55 (2005). These impacts result from both the production and manufacture of building components, as well as the construction process itself. *Id.* Estimates suggest that 90% of all materials ever extracted from the earth currently reside in today's buildings and associated infrastructure. *Id.*

79. Building Design & Construction, White Paper on Sustainability: A Report on the Green Building Movement 4 (2003).

80. Kibert, *supra* note 78, at 160. Runoff is water that falls as rain, is not absorbed into the soil, and runs off the land as surface water. The American Heritage Dictionary of the English Language (4th ed. 2004), http://dictionary.reference.com/browse/runoff (last visited Dec. 20, 2007).

81. Kibert, *supra* note 78, at 160.

82. Chester L. Arnold, Jr. & C. James Gibbons, *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator*, 62 J. Am. Plan. Ass'n 243, 244 (1996).

83. *Id.* at 244–45.

84. *See id.*, at 245.

85. *See, e.g., id.* at 251–55.

86. *See* Kibert, *supra* note 78, at xii.

in 1993, the USGBC spent its first five years developing a standard to measure a building's resource efficiency and environmental impacts.[87] This standard, known as Leadership in Energy and Environmental Design (LEED), quickly gained wide acceptance in both the public and private sectors.[88]

LEED encompasses a number of discrete programs.[89] There are standards for new construction (LEED-NC), existing buildings (LEED-EB), commercial interiors (LEED-CI), core and shell projects (LEED-CS), homes (LEED-H), and neighborhood developments (LEED-ND).[90]

A. LEED for New Construction

The most common LEED standard is LEED for New Construction.[91] This program was originally designed to guide high-performance commercial and institutional projects, with a focus on office buildings.[92] LEED-NC, however, has also been applied to schools, residential buildings, manufacturing buildings, laboratories, and many other types of buildings;[93] over time, it has become a widely accepted measure of green buildings.[94]

LEED-NC evaluates how green a building is by using a point system.[95] After meeting certain prerequisites, a building can earn a total of sixty-nine possible points in six different categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design Process.[96] The USGBC assigns different ratings for different numbers of points: 26–32 points for LEED Certified, 33–38 points for LEED Silver, 39–51 points for LEED Gold, and 52–69 points for LEED Platinum.[97]

87. *Id.* at 3.
88. *Id.*
89. *See* USGBC: Leadership in Energy and Environmental Design, http://www.usgbc.org/DisplayPage.aspx?CategoryID=19 (last visited Aug. 26, 2007).
90. *Id.*
91. KIBERT, *supra* note 78, at 72.
92. USGBC: LEED for New Construction, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220 (last visited Aug. 26, 2007).
93. *Id.*
94. KIBERT, *supra* note 78, at 72.
95. U.S. GREEN BLDG. COUNCIL, GREEN BUILDING RATING SYSTEM FOR NEW CONSTRUCTION & MAJOR RENOVATIONS, VERSION 2.2 5, 9–10 (2005), *available at* https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1095 [hereinafter LEED-NC].
96. *Id*. at 6–7.
97. *Id.* In many cities and states there are financial benefits for achieving a certain LEED level, such as tax benefits and zoning allowances. USGBC: Project Certifica-

B. How LEED-NC Can Reduce Nonpoint Source Pollution

There are a number of points in the LEED-NC program that, if earned, can help reduce nonpoint source pollution. The majority of these points are in the Sustainable Sites category, in which the prerequisite and six of the points deal with nonpoint source pollution.[98]

The prerequisite for receiving any of the points in the Sustainable Sites category is SS Prerequisite 1: Construction Activity Pollution Prevention Required.[99] The intent of the prerequisite is to "[r]educe pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation."[100] Pollution from construction sites is a major source of pollution, responsible for 6% of the country's impaired rivers, 11% of impaired lakes, ponds, and reservoirs, and 11% of impaired estuaries.[101]

Construction can affect water quality in multiple ways. First, construction in greenfield areas can involve site grading and removal of topsoil.[102] Both of these practices can lead to severe erosion during the construction process.[103] The effect on water quality can be severe, primarily because of the sediment that washes into the water.[104] This form of pollution, known as siltation, is the largest cause of impaired water in rivers and the third largest in lakes.[105] In addition, a number of pollutants are absorbed by minerals and organic particles in the sediment, which are then washed into the water.[106] This process is the main way that many pollutants, including nutrients, metals, and organic compounds, end up in the nation's waters.[107] It is estimated that over 600 million tons are eroded from construction sites annually,

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tion, http://www.usgbc.org/DisplayPage.aspx?CMSPageID=64 (last visited Nov. 27, 2007).

98. LEED-NC, *supra* note 95, at 11–26.

99. *Id.* at 11.

100. *Id.*

101. National Pollution Discharge Elimination System—Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges, 64 Fed. Reg. 68,722, 68,728 (Dec. 8, 1999).

102. U.S. EPA, PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT 6 (2006) [hereinafter PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT]. Site grading is the process of changing the elevation (or grade) of a site. *See, e.g.*, *id.* (describing complete leveling of development in a picture).

103. *Id.*

104. National Pollution Discharge Elimination System—Regulations for the Revision of the Water Pollution Control Program Addressing Storm Water Discharges, 64 Fed. Reg. at 68,728.

105. *Id.*

106. *Id.*

107. *Id.*

which makes soil and erosion control critical environmental measures.[108]

In addition to erosion, construction activities can contribute to nonpoint source pollution in other ways. Construction can result in soil compaction by heavy equipment, which can then lead to increased amounts of runoff.[109] Even when the land remains unpaved, "the volume of runoff from highly compacted lawns is almost as high as from paved surfaces."[110] Finally, construction sites can produce other pollutants, such as sanitary waste or concrete truck washouts, which can then be carried off-site by runoff.[111]

In order to meet the LEED-NC Construction Activity Pollution Prevention Requirement prerequisite, a project must "[c]reate and implement an Erosion and Sedimentation Control (ESC) Plan for all construction activities associated with the project."[112] The plan must conform to the more stringent of either the erosion and sedimentation standards of the EPA Construction General Permit (which normally applies only to construction sites larger than one acre) or any local standards, and must prevent both loss of soil during construction and sedimentation of storm sewers or receiving streams.[113]

The first point in the Sustainable Sites category that deals with water quality is SS Credit 1: Site Selection. It requires that the building not be built within 100 feet of any wetlands.[114] This distance requirement helps ensure that the wetlands remain undisturbed and able to help control stormwater.[115] Additionally, the building may not be constructed on previously undeveloped land that lies fifty feet or less from any water body, which helps ensure that the water bodies remain free from impact.[116]

The second point that deals with water quality is SS Credit 2: Development Density & Community Connectivity. This point is intended to "channel development to urban areas with existing infrastructure," thereby protecting greenfields.[117] In order to obtain this

108. Kibert, *supra* note 78, at 149.
109. Protecting Water Resources with Higher-Density Development, *supra* note 102, at 6.
110. *Id.*
111. National Pollution Discharge Elimination System—Regulations for the Revision of the Water Pollution Control Program Addressing Storm Water Discharges, 64 Fed. Reg. at 68,729.
112. LEED-NC, *supra* note 95, at 11.
113. *Id.*
114. *Id.* at 12.
115. Kibert, *supra* note 78, at 160.
116. LEED-NC, *supra* note 95, at 12.
117. *Id.* at 13.

point, the building may not be constructed on a previously undeveloped site that is in a floodplain or within fifty feet of a body of water.[118] Building in already developed areas, known as infill, can help reduce runoff by replacing development that would have occurred on greenfields and thus would have created additional impervious surfaces.[119] The amount of runoff reduction achieved can be considerable. It has been estimated that a typical greenfield development at the Chicago fringe would cause ten times more runoff than an infill development in the urban core.[120] SS Credit 3: Brownfield Redevelopment can help reduce runoff in the same way, by using previously developed land rather than paving over greenfields.[121] One study has found that "every brownfield acre redeveloped would have required a minimum of 4.5 acres had the same project been located in a greenfield area."[122]

The two Site Development Credits, 5.1: Protect or Restore Habitat and 5.2: Maximize Open Space, also help deal with water quality. These credits require the developer to either "conserve existing natural areas"[123] or "provide a high ratio of open space to development footprint."[124] Preserving large, continuous areas of absorbent open space helps to ensure water resource protection.[125] These areas of open space "reduce and slow runoff, absorb sediments, [and] serve as flood control."[126] In order to maintain water quality, sufficient amounts of open space should be set aside to absorb, filter, and store stormwater.[127]

The most important LEED points in the Sustainable Sites category that deal with water quality are SS Credits 6.1 and 6.2. SS Credit 6.1: Stormwater Design: Quantity Control is intended to "[l]imit disruption of natural water hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from

118. *Id.* at 12.
119. U.S. EPA, USING SMART GROWTH TECHNIQUES AS STORMWATER BEST MANAGEMENT PRACTICES 39 (2005).
120. *Id.*
121. LEED-NC, *supra* note 95, at 14.
122. JONATHAN P. DEASON ET AL., PUBLIC POLICIES AND PRIVATE DECISIONS AFFECTING THE REDEVELOPMENT OF BROWNFIELDS: AN ANALYSIS OF CRITICAL FACTORS, RELATIVE WEIGHTS AND AREAL DIFFERENTIALS 5.3 (2001), http://www.gwu.edu/~eem/Brownfields/project_report/chapters-html.htm#chapter5.
123. LEED-NC, *supra* note 95, at 19.
124. *Id.* at 20.
125. PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT, *supra* note 102, at 4.
126. *Id.*
127. *Id.*

stormwater runoff, and eliminating contaminants."[128] In order to obtain this point, a project must implement a stormwater management plan that controls the quantity of stormwater runoff.[129]

SS Credit 6.2: Stormwater Design: Quality Control is intended to "[l]imit disruption and pollution of natural flows by managing stormwater runoff."[130] This credit requires a stormwater management plan that "reduces impervious cover, promotes infiltration, and captures and treats the stormwater runoff from 90% of the average rainfall using acceptable best management practices (BMPs)."[131] The BMPs used must be able to remove 80% of the average annual post development total suspended solids load.[132]

C. Low Impact Development Techniques that Can Help Control Runoff

Even though the LEED program has proved to be very popular, it still has its share of critics.[133] The most common complaint is that LEED certification is too costly and bureaucratic.[134] Full LEED certification is not necessary, however, to use green building techniques to control the quantity and quality of stormwater runoff. Several of these techniques are collectively known as Low Impact Development (LID) techniques.[135] As described by the EPA, LID techniques are designed to maintain or replicate "the predevelopment hydrologic regime" by creating "a functionally equivalent hydrologic landscape."[136] These techniques are aimed to control stormwater at the source by using smaller controls distributed throughout the site.[137]

Using LID techniques can reduce or eliminate the need for traditional stormwater control measures.[138] In addition, LID offers both

128. LEED-NC, *supra* note 95, at 21.

129. *Id.* Stormwater management plans can incorporate many of the Low Impact Development techniques as well as other best management practices. *See infra* Section III.C.

130. LEED-NC, *supra* note 95, at 22.

131. *Id.*

132. *Id.*

133. *See, e.g.,* Auden Schendler & Randy Udall, *LEED is Broken; Let's Fix It*, GRIST, Oct. 26, 2005, http://www.grist.org/comments/soapbox/2005/10/26/leed/index1.html.

134. *Id.* (describing numerous problems with LEED, including "its cost, focus on points instead of green design, the complexity of energy modeling, the crippling bureaucracy, [and] the misleading hype about the benefits of green building").

135. *See* U.S. EPA, LOW IMPACT DEVELOPMENT 1 (2000) [hereinafter LOW IMPACT DEVELOPMENT].

136. *Id.*

137. *Id.*

138. *Id.*

economic and environmental benefits.[139] According to the EPA, "LID measures result in less disturbance of the development area, conservation of natural features and can be less cost intensive than traditional stormwater control mechanisms."[140] Finally, LID techniques can be used in retrofitting existing urban areas with pollution controls, as well as in new development.[141]

One common LID technique is the use of bioretention and biofiltration practices. Bioretention and biofiltration involve multiple components with each performing a separate function in the removal of pollutants and the reduction of stormwater runoff.[142] Bioretention and biofiltration typically include the traditional stormwater techniques of detention and infiltration.[143]

Detention is a practice that temporarily stores runoff and then discharges it into streams or other water bodies.[144] The most common forms of detention are wet or dry detention ponds.[145] The main purpose of these ponds is to reduce peak runoff flow.[146] In addition, they can also improve water quality by holding water long enough that some of the sediment and other contaminants have an opportunity to settle out before the water drains.[147]

Infiltration is a practice that temporarily stores runoff in basins from which the water slowly absorbs into the ground below.[148] Infiltration, like detention, can help reduce peak runoff flow.[149] In addition to reducing peak flow, infiltration can remove pollutants from the runoff. Infiltration can remove up to 83% of nitrogen and 98% of copper from runoff water.[150]

Bioretention and biofiltration improve on these traditional techniques through the use of plants as an additional filter medium.[151] Plants can absorb nutrients and metals and facilitate the microbial breakdown of pollutants.[152] Plants also "physically block[ ] the

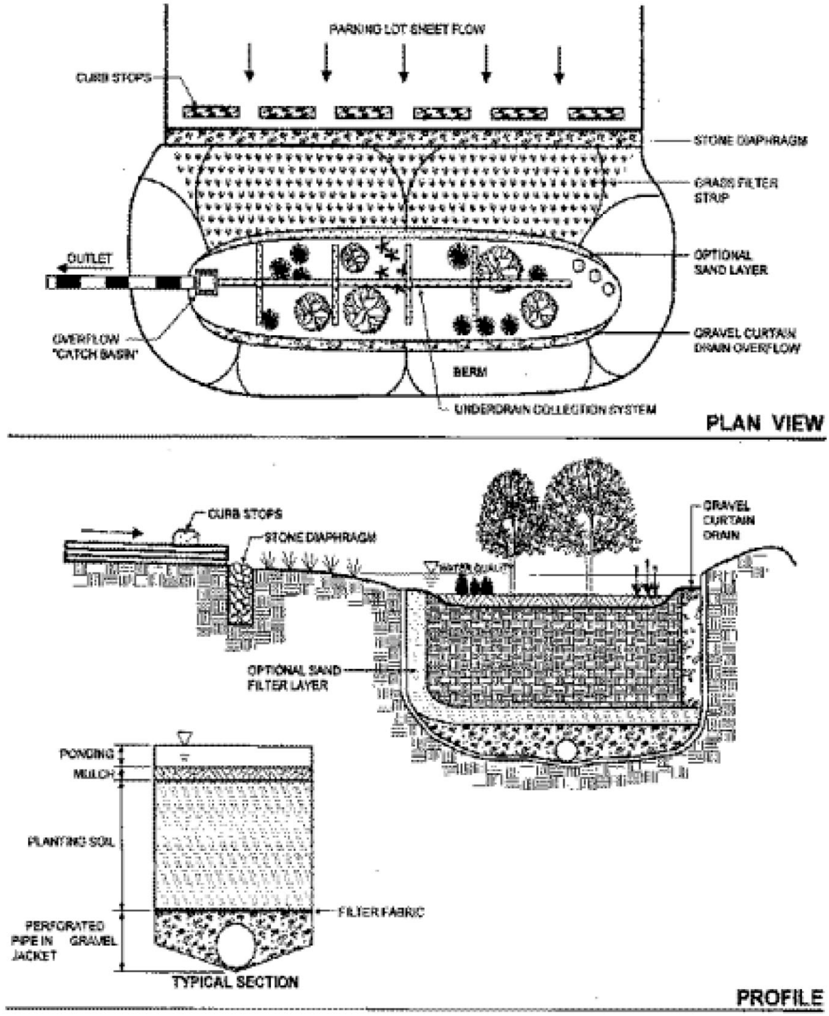
139. *Id.* at 2.
140. *Id.*
141. *Id.* at 3.
142. *Id.* at 4.
143. *See* PETER H. LEHNER ET AL., NAT'L RES. DEF. COUNCIL, STORMWATER STRATEGIES: COMMUNITY RESPONSES TO RUNOFF POLLUTION 72–74 (1999).
144. *Id.* at 72.
145. *Id.*
146. *Id.*
147. *Id.*
148. *Id.* at 74.
149. *Id.*
150. *Id.*
151. *Id.* at 73.
152. *Id.*

stormwater flow, slowing the flow and allowing contaminants to settle out."[153] A final advantage of bioretention systems is that they usually require less space, are cheaper to build, require less maintenance, and are more aesthetically pleasing than detention ponds.[154]

According to the EPA, bioretention cells typically consist of six components. First, "grass buffer strips reduce runoff velocity and filter particulate matter."[155] Second, a sand bed assists with both the aeration and draining of the planting soil and in the flushing of pollutants from soil materials.[156] A ponding area can provide storage of excess runoff, facilitates the settling of particulates, and allows for the evaporation of excess water.[157] An organic layer provides a medium for microorganisms to break down petroleum-based and other organic pollutants, filters pollutants, and prevents soil erosion.[158] Planting soil can store stormwater, allowing plants to absorb nutrients from the water, and can also absorb hydrocarbons, heavy metals, and nutrients through clays in the soil.[159] Finally, the plants remove water through evapotranspiration and pollutants through nutrient cycling.[160] See Figure 1.

153. *Id.*
154. LOW IMPACT DEVELOPMENT, *supra* note 135, at 12.
155. *Id.* at 5.
156. *Id.*
157. *Id.*
158. *Id.*
159. *Id.*
160. *Id.* Evapotranspiration is the process of transferring moisture from the earth to the atmosphere by evaporation of water and transpiration from plants. Nutrient cycling is the process in which plants remove nutrients from the soil while growing and return them to the soil as they decompose. THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE (4th Ed. 2004), http://dictionary.reference.com/browse/Evapotranspiration (last visited Dec. 20, 2007).

FIGURE 1: BIORETENTION CELL[161]



A study done by the Environmental Engineering Laboratory at the University of Maryland confirms the effectiveness of bioretention systems at removing heavy metals from runoff.[162] This study used synthetic runoff to test the effectiveness of bioretention systems in the lab and existing bioretention facilities in the field.[163] The lab results

161. Stormwater Manager's Resource Center, Stormwater Management Fact Sheet: Bioretention, http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Filtering%20Practice/Bioretention.htm (last visited Dec. 7, 2007).

162. Allen P. Davis et al., *Water Quality Improvement Through Bioretention*, 75 WATER ENV'T RES. 73, 81 (2003).

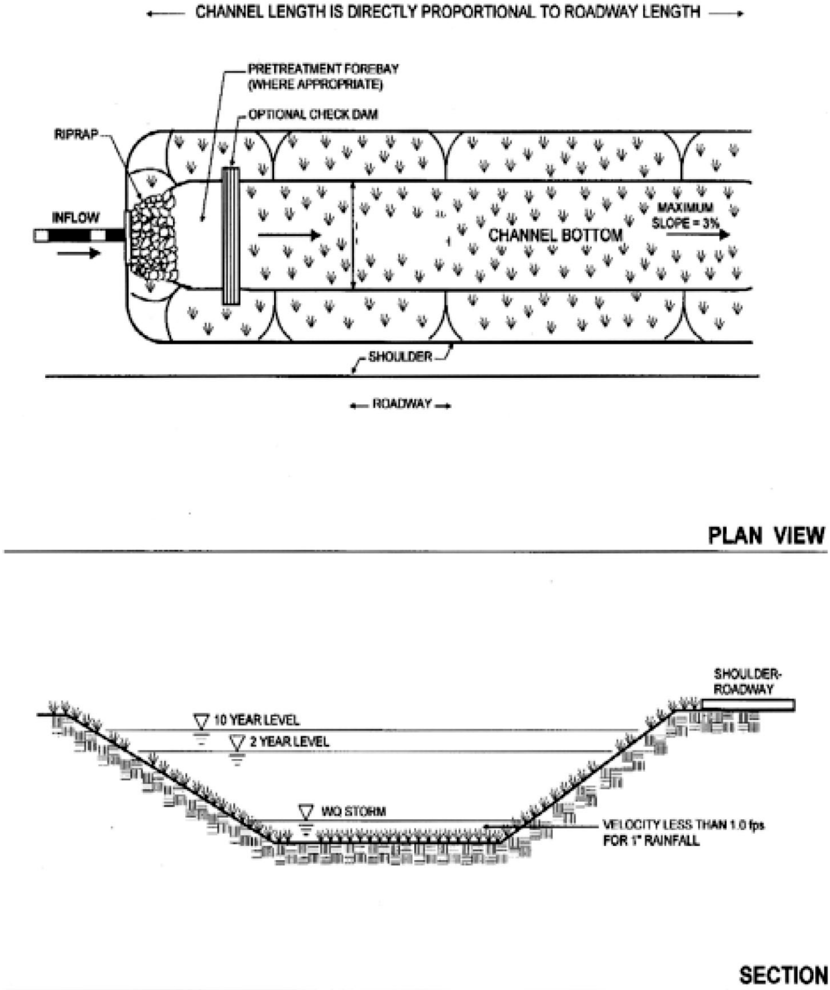
163. *Id.* at 74.

indicate that bioretention systems can remove over 99% of copper, lead, and zinc mass from runoff.[164] Results from the field were mixed, as one system removed up to 70% of these heavy metals while the other removed over 95%, a disparity possibly attributed to differences in plant density and age between the two facilities.[165] Properly maintained bioretention systems should be able to remove close to 100% of these heavy metals from runoff.[166]

Another common LID technique is the use of grass swales. Swales are "wide ditches with moderately sloped banks and bottoms covered with filtering turf."[167] Swales can reduce stormwater runoff velocity as well as filter the runoff.[168] Swales primarily remove sedimentation, but they also allow water to infiltrate and be adsorbed.[169] See Figure 2.

164. *Id.* at 76–78.
165. *Id.* at 81.
166. *Id.*
167. LEHNER ET AL., *supra* note 143, at 74.
168. LOW IMPACT DEVELOPMENT, *supra* note 135, at 7.
169. *Id.*

FIGURE 2: GRASS SWALE[170]



In 1999, a water quality consulting firm performed a study comparing two grass swale systems and a conventional curb-and-gutter system.[171] Total runoff volume from the swale systems was 70 to 94% less than that from the conventional system.[172] In addition, a pollution loading analysis showed that significantly fewer pollutants

170. Stormwater Manager's Resource Center, Stormwater Management Fact Sheet: Grass Channel, http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Open%20Channel%20Practice/Grassed%20Channel.htm (last visited Aug. 29, 2007).

171. U.S. EPA, NATIONAL MANAGEMENT MEASURES TO CONTROL NONPOINT SOURCE POLLUTION FROM URBAN AREAS 5-21 (2005) [hereinafter NATIONAL MANAGEMENT MEASURES].

172. *Id.*

were released from a swale system as compared to the conventional system.[173]

A third LID technique is the use of permeable pavements instead of standard asphalt or concrete. Permeable pavements decreases the impervious surface area, thereby reducing the volume of runoff and "allow[ing] stormwater to infiltrate into underlying soils," which can remove pollutants from the water.[174] There are two types of permeable pavement—porous asphalt and pervious concrete.[175] Instead of using fine aggregate, as conventional asphalt and concrete do, permeable pavements employ coarse aggregate, which allows for the passage of air and water.[176] This technique is best suited for parking lots, sidewalks, and other low-traffic areas because permeable pavements are not yet as durable as regular asphalt or concrete.[177]

Modular pavement can also be used to control stormwater runoff. Modular pavement consists of a sand or gravel base supporting alternating blocks of permeable material and a "strong structural material such as concrete."[178] This pavement is "usually . . . used in low-volume traffic areas such as overflow parking lots" and is designed to be able to support cars "while allowing infiltration . . . into the underlying soils."[179]

Studies have shown permeable pavements to be very effective in reducing runoff and water-borne pollutants.[180] One of these studies tested permeable pavements used on an employee parking lot at the King County Public Works facility south of Seattle, in one of the wettest areas of the country.[181] This study found that the permeable pavements tested infiltrated nearly all the rainwater and generated only insignificant amounts of surface runoff.[182] In addition, infiltration was very effective at removing copper and zinc as compared to conventional asphalt.[183] Finally, although motor oil was detected in 89%

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173. *Id.*

174. LOW IMPACT DEVELOPMENT, *supra* note 135, at 8.

175. NATIONAL MANAGEMENT MEASURES, *supra* note 171, at 5-15.

176. *Id.*

177. LOW IMPACT DEVELOPMENT, *supra* note 135, at 8.

178. NATIONAL MANAGEMENT MEASURES, *supra* note 171, at 5-17.

179. *Id.*

180. *See id.* at 5-17–5-19.

181. Benjamin O. Brattebo & Derek B. Booth, *Long-term Stormwater Quantity and Quality Performance of Permeable Pavement Systems*, 37 WATER RES. 4369, 4370 (2003).

182. *Id.* at 4371.

183. *Id.* at 4373.

of surface runoff from asphalt, none was detected in the water that infiltrated through the permeable pavements systems.[184]

Green roofs are another LID technique that can help control stormwater runoff. A green roof incorporates living vegetation into its structure.[185] Green roofs "are typically multilayered and include [plant] . . . mats, a mineral-based substrate, and a synthetic matrix."[186] Mat systems can be used on roofs with slopes of up to thirty degrees.[187]

Green roofs can effectively reduce urban stormwater runoff by decreasing the amount of impervious surfaces in urban areas.[188] In addition, green roofs intercept and retain rainfall that would otherwise drain off the building and promote evaporation instead of runoff.[189] Storm runoff can be reduced by 90%, and the flow of stormwater can be delayed for several hours, reducing the probability of combined sewer overflows.[190] A study done at Michigan State University showed that green roofs can retain over 96% of stormwater during light rain, almost 83% during medium rainfall, and on average retain over twice as much water as a conventional gravel roof.[191] Furthermore, the vegetation on a green roof can filter pollution and heavy metals from rainwater,[192] in a similar way that bioretention and biofiltration systems do. Green roofs have been shown to remove over 95% of cadmium, copper, and lead from runoff.[193] However, in order to reduce pollution it is important that green roofs be properly designed. Poorly designed roofs can actually increase the level of phosphorus in runoff, due to nutrients leaching from the soil.[194] Finally, green roofs allow for stormwater runoff control while conserving the land that

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184. *Id.* at 4369.

185. NATIONAL MANAGEMENT MEASURES, *supra* note 171, at 4-18.

186. *Id*. *See also* EARTH PLEDGE, GREEN ROOFS: ECOLOGICAL DESIGN AND CONSTRUCTION 134–36 (2005).

187. NATIONAL MANAGEMENT MEASURES, *supra* note 171, at 4-18.

188. LOW IMPACT DEVELOPMENT, *supra* note 135, at 7.

189. NATIONAL MANAGEMENT MEASURES, *supra* note 171, at 4-18.

190. KIBERT, *supra* note 78, at 154.

191. Nicholaus D. VanWoert et al., *Green Roof Stormwater Retention: Effects of Roof Surface, Slope, and Media Depth*, 34 J. ENVTL. QUALITY 1036, 1040 (2005).

192. KIBERT, *supra* note 78, at 155.

193. M. A. Monterusso et al., *Runoff Water Quantity and Quality from Green Roof Systems*, 639 ACTA HORTICULTURAE 369, 370 (2004).

194. AMY MORAN, BILL HUNT & JONATHAN SMITH, HYDROLOGIC AND WATER QUALITY PERFORMANCE FROM GREENROOFS IN GOLDSBORO AND RALEIGH, NORTH CAROLINA, http://www.bae.ncsu.edu/greenroofs/GRHC2005paper.pdf (last visited Jan. 16, 2008).

would otherwise be needed to construct runoff controls in urban areas.[195]

But even if every building in the country used these green techniques to control nonpoint source pollution, we would still have to deal with the adverse consequences of our land use patterns. In the next section of this Note, I discuss how urban sprawl negatively impacts water quality and examine LEED for Neighborhood Developments as a possible solution to this problem.

IV.
URBAN SPRAWL, ITS IMPACT ON WATER QUALITY, AND GREEN BUILDING SOLUTIONS

According to General Lucius Clay, the chairman of President Eisenhower's Advisory Committee on a National Highway Program, our highway system has enabled us to "disperse our factories, our stores, our people; in short, to create a revolution in living habits. Our cities have spread into suburbs, dependent on the automobile for their existence."[196] Today this growth pattern is known as urban sprawl.[197]

There are a number of characteristics that typically define sprawl, as laid out by Howard Frumkin, Lawrence Frank, and Richard Jackson in *Urban Sprawl and Public Health*. First, "different land uses—residential, commercial, office, recreational, and so on—tend to be separated from each other."[198] Residential streets and cul-de-sacs empty into busy arterial strips, lined with strip malls accessible only by cars and surrounded by a sea of parking.[199] Walkable "town center" neighborhoods are few and far between, and public open space is lacking.[200] The distance from houses to work places or shopping centers tends to make walking and biking impractical for most trips.[201] Mass transit is also impractical, due to the low density of development.[202] This combination of factors produces "a heavy reliance on the automobile."[203]

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195. LOW IMPACT DEVELOPMENT, *supra* note 135, at 7.

196. Richard F. Weingroff, General Lucius D. Clay: The President's Man, http://www.fhwa.dot.gov/infrastructure/clay.htm (last visited Nov. 27, 2007).

197. HOWARD FRUMKIN ET AL., URBAN SPRAWL AND PUBLIC HEALTH: DESIGNING, PLANNING, AND BUILDING FOR HEALTHY COMMUNITIES 1 (2004).

198. *Id.* at 2.

199. *Id.*

200. *Id.*

201. *Id.*

202. *Id.*

203. *Id.*

A large body of work has been written about the negative impact of urban sprawl. Although social impacts of sprawl are a frequent target of attack,[204] environmental impacts are increasingly seen as a problem.[205] Sprawl is detrimental to water quality because the quantity and toxicity of stormwater runoff is increased for two main reasons: the low-density character of sprawl and the increased reliance on the automobile caused by sprawl.

A. Water-Quality Impacts of Low-Density Development

Low-density development impairs water quality by increasing the amount of impervious surfaces, which increases the amount of stormwater runoff.[206] The most common types of impervious surfaces are roads and roofs, but also include sidewalks, patios, and compacted soil.[207] Although low-density development may seem at first glance to have more pervious surfaces than higher-density development, the reality is quite different, due to a number of key factors identified by the EPA.[208]

First, the pervious surface in typical sprawl development is more impervious than people assume. Most lawns, although nominally pervious, are a contributor to runoff because of their compacted nature.[209] This compaction, caused by construction practices, is exacerbated on suburban lawns "due to mowing and the presence of a dense mat of roots."[210] This can cause lawns in suburban areas to generate up to 90% as much runoff as pavement.[211] Therefore, typical suburban zon-

204. *See, e.g.*, KENNETH T. JACKSON, CRABGRASS FRONTIER: THE SUBURBANIZATION OF THE UNITED STATES 116–18 (1985) (criticizing the decreased mobility of the inner-city poor); Paul A. Jargowsky, *Sprawl, Concentration of Poverty, and Urban Inequality*, *in* URBAN SPRAWL: CAUSES, CONSEQUENCES & POLICY RESPONSES 39–71 (Gregory D. Squires ed., 2002) (criticizing the exacerbation of class inequality caused by sprawl); John Powell, *Sprawl, Fragmentation, and the Persistence of Racial Inequality*, *in* URBAN SPRAWL: CAUSES, CONSEQUENCES & POLICY RESPONSES 73–117 (Gregory D. Squires ed., 2002) (also criticizing the exacerbation of racial inequality caused by sprawl).

205. *See, e.g.*, David J. Cieslewicz, *The Environmental Impacts of Sprawl*, *in* URBAN SPRAWL: CAUSES, CONSEQUENCES & POLICY RESPONSES 23–38 (Gregory D. Squires ed., 2002).

206. *See* PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT, *supra* note 102, at 1.

207. Washington State Department of Transportation, Highway Runoff Manual G-22 (2006), http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-16/HighwayRunoff.pdf.

208. *See* PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT, *supra* note 102, at 7–9.

209. *Id.* at 7.

210. *Id.*

211. FRUMKIN ET AL., *supra* note 197, at 128.

ing measures that limit the number of houses by requiring larger lawns result in a net loss of infiltration and other water quality functions as compared to the land predevelopment.[212]

Another factor that affects the water quality in urban sprawl areas is the fact that density and imperviousness are not equivalent.[213] There can be a wide variation in the impervious area per home, depending on housing design and infrastructure.[214] For example, thirty single-family houses will produce much more impervious cover than a single apartment building with thirty units.[215] Therefore, low density does not necessarily mean less impervious surface area.

In addition, lower density development often requires more off-site impervious infrastructure such as roads and parking lots.[216] Total impervious area in a watershed does not depend solely on the amount of impervious surfaces on each lot.[217] The off-site infrastructure necessary for sprawling development also creates impervious surfaces, and "lower-density development can require substantially higher amounts of this infrastructure per house and per acre than denser developments."[218] Studies show that streets, driveways, and parking lots make up 75% of the total amount of impervious surfaces in a development with a density of two homes per acre, while only making up 56% of the impervious surfaces at a density of eight homes per acre.[219]

Finally, low-density development does not limit total growth in a region, merely that on a site.[220] The same amount of growth still occurs in a region regardless of a particular municipality's low-density zoning, as jobs, climate, and culture account for most of a region's population gain or loss, rather than density limits.[221] The rest of the growth must go somewhere, and absent urban infill and regional planning, it will lead to more sprawl and more impervious surfaces.[222] Therefore, water quality can end up being significantly worse "than if growth had been accommodated at higher densities on fewer sites."[223]

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212. PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT, *supra* note 102, at 7.
213. *Id.*
214. *Id.*
215. *See id.* ("[A] three-story condominium building of 10 units on one acre can have less impervious surface than four single-family homes on the same acre.").
216. *Id.* at 8.
217. *Id.*
218. *Id.*
219. *Id.*
220. *Id.*
221. *Id.*
222. *See id.* at 9.
223. *Id.*

To examine the effects of density levels on water quality, the EPA used a computer model to test the stormwater impacts from different development densities.[224] This model, which is a "peer-reviewed sketch model developed specifically to compare the water quantity and quality differences among different development patterns," measured the amount of runoff produced at each density.[225] The amount of runoff produced, in general, is proportional to the amount of associated pollutants such as nitrogen, phosphorus, and sediment that enter the water.[226] The impervious surface area for each development pattern was estimated by assuming each house has a footprint of 2265 square feet, the average size of new homes, and estimating the amount of impervious infrastructure necessary for each development pattern using data from the U.S. Natural Resources Conservation Service.[227]

For a high-density development pattern of eight houses per acre, each house was estimated to produce 4950 cubic feet of runoff per year.[228] If 10,000 houses were built at this density in a 10,000 acre watershed, 8.1% of the watershed would be covered by impervious surfaces, and 49.5 million cubic feet per year of runoff would be produced.[229] A sprawling development pattern produces much more impervious cover and runoff. A density of one house per acre would produce 18,700 cubic feet per year of runoff per unit.[230] One hundred eighty-seven million cubic feet per year of stormwater runoff would be produced at the watershed level, 20% of which would be covered by impervious surfaces.[231] Lower density therefore produces a much larger amount of runoff, and has a much higher impact on water quality.

B. *Automobile-Related Impact of Sprawl on Water Quality*

One key feature of sprawl is that it produces a very high reliance on automobiles.[232] The resulting increase in car use also greatly impacts water quality, as driving contributes many pollutants to urban runoff.[233] These pollutants come from automotive fluids, part deterio-

224. *Id.* at 9–27.
225. *Id.* at 9.
226. *Id.*
227. *Id.* at 9–11.
228. *Id.* at 13.
229. *Id.* at 17.
230. *Id.* at 13.
231. *Id.* at 17.
232. *See* Cieslewicz, *supra* note 205, at 26.
233. *See* LEHNER ET AL., *supra* note 143, at 32.

ration, and exhaust fumes that are deposited onto roads and parking lots and then picked up by runoff.[234] Engine coolants and antifreeze leakage results in ethylene glycol and propylene glycol washing into the water.[235] Oil, grease, and other hydrocarbons also can leak from vehicles and end up in the water.[236] Heavy metals such as cadmium, copper, and zinc are deposited onto the road by brake pad and tire wear and are then washed into the water.[237] Finally, vehicle exhaust contains large amounts of nitrogen, which is deposited onto roads and picked up by stormwater runoff.[238]

The amount of pollutants deposited and picked up by runoff in this fashion is significant. The EPA has estimated that 35% of nitrogen that enters the Chesapeake Bay comes from mobile sources such as cars and trucks.[239] Seventy-five percent of the total copper load in the lower San Francisco Bay can be attributed to vehicles—50% from brake pad wear and 25% from exhaust emissions that were deposited on the ground.[240]

Cars can also indirectly contribute to runoff and pollution problems. Urban sprawl requires a large amount of automobile-related infrastructure to handle the automobile trips generated. Roads and parking lots can account for more than 60% of the impervious surfaces in sprawling areas.[241] They are also a very dirty form of impervious surface. Streets have the highest pollutant loads in most land use categories.[242] Nationally, transportation land uses have the second highest level of pollutant concentrations, behind only piped industrial sources.[243]

C. LEED-ND: The USBGC's Answer to Sprawl

The U.S. Green Building Council has recently turned their attention to the problems caused by urban sprawl. Along with the Congress for the New Urbanism and the National Resources Defense Council (NRDC), the USGBC has developed LEED for Neighborhood

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234. *Id.* at 32–33.

235. *Id.* at 33.

236. *Id.* at 34.

237. *Id.* at 33.

238. *Id.*

239. U.S. EPA, PROTECTING WATER RESOURCES WITH SMART GROWTH 30 (2004), *available at* http://www.epa.gov/dced/pdf/waterresources_with_sg.pdf.

240. LEHNER ET AL., *supra* note 143, at 33.

241. FRUMKIN ET AL., *supra* note 197, at 128.

242. LEHNER ET AL., *supra* note 143, at 34.

243. *Id.*

Development (LEED-ND).[244] LEED-ND combines green building principles with the principles of new urbanism and smart growth.[245] The hope of the USGBC is that LEED-ND will "encourage developers and community leaders to revitalize existing urban areas, reduce land consumption, reduce automobile dependence, promote pedestrian activity, improve air quality, decrease polluted stormwater runoff, and build more livable, sustainable, enduring communities for people of all income levels."[246]

LEED-ND is intended to be used to certify projects that "constitute whole neighborhoods, fractions of neighborhoods, or multiple neighborhoods," as opposed to the typical LEED certification of a single building.[247] According to the LEED-ND Core Committee, an ideal neighborhood

> has a legible center and edge; is limited in size, typically five minutes average walk from center to edge; has a mix of land uses, to allow for some basic daily needs to be satisfied within the neighborhood; accommodates a diversity of household types; has an integrated network of walkable streets; and has special sites reserved for public spaces and civic buildings.[248]

Like LEED-NC, LEED-ND uses a point system to evaluate a neighborhood development. A possible total of 114 points can be earned in five categories: Location Efficiency, with two prerequisites and twenty-eight points; Environmental Preservation, with five prerequisites and thirteen points; Compact, Complete, & Connected Neighborhoods, with three prerequisites and forty-two points; Resource Efficiency, with twenty-five points; and Other, with six points.[249] A project with 46–56 points earns a rating of LEED Certi-

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244. U.S. Green Bldg. Council, LEED-ND: LEED for Neighborhood Developments Rating System—Preliminary Draft 3 (2005), *available at* https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=959 [hereinafter LEED-ND]. LEED-ND's pilot program was initiated in early 2007, and the post-pilot program should launch in early 2009, after a public comment period and final approvals and balloting. U.S. Green Bldg. Council, Frequently Asked Questions: About LEED for Neighborhood Development 1, *available at* http://www.usgbc.org/ShowFile.aspx?DocumentID=3357 (last visited Jan. 17, 2008).

245. LEED-ND, *supra* note 244, at 3. New urbanism and smart growth both focus on compact, human-scaled neighborhoods as an antidote to urban sprawl. *See* Congress for the New Urbanism, Charter for the New Urbanism, http://cnu.org/sites/files/charter_english.pdf (last visited Nov. 29, 2007); Smart Growth Online, About Smart Growth, http://www.smartgrowth.org/about/default.asp (last visited Nov. 29, 2007).

246. LEED-ND, *supra* note 244, at 3.

247. *Id.* at 4.

248. *Id.*

249. *Id.* at 9–10.

fied, 57–67 points earns a rating of Silver, 68–91 earns a rating of Gold, and 91 or more points earns a LEED Platinum rating.[250]

D. How LEED-ND Can Reduce Nonpoint Source Pollution

LEED-ND, like LEED-NC, has a number of prerequisites and points that deal directly with nonpoint source pollution. In the Environmental Preservation category, one of the prerequisites is Erosion and Sedimentation Control.[251] This prerequisite, intended to reduce water pollution from erosion during construction, requires a sediment and erosion control plan for the entire project.[252] The plan must prevent loss of soil during construction and prevent sedimentation of storm sewers and receiving streams.[253]

There are also five points in the Environmental Preservation category that directly deal with runoff. To earn the Maintain Stormwater Runoff Rates point, the amount of runoff produced during the wettest twenty-four hours of a two-year period, known as the post-project two-year twenty-four-hour peak discharge volume, must not exceed the pre-project volume.[254] Two points may be earned for the Reduce Stormwater Runoff Rates credit.[255] In order to earn these points, a developer must implement a stormwater management plan that results in a 25% decrease in the rate and quantity of post-project stormwater runoff.[256] Finally, two points may be earned for the Stormwater Treatment credit.[257] This credit requires the implementation of a stormwater management plan that captures and treats the runoff from 90% of the average annual rainfall and uses best management practices that are capable of removing 80% of the average annual post-development total suspended solids.[258]

There are a number of other points that deal with runoff and nonpoint source pollution.[259] However, the greatest reduction in nonpoint source pollution is from channeling the pattern of develop-

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250. *Id.* at 10. Once LEED-ND is finalized, it is likely that cities and states will provide incentives for developers to meet the LEED-ND standard.

251. *Id.* at 29.

252. *Id.*

253. *Id.*

254. *Id.* at 43.

255. *Id.* at 44.

256. *Id.*

257. *Id.* at 45.

258. *Id.*

259. *See, e.g.*, *id.* at 27 (Prerequisite: Wetland & Water Body Protection), 91 (Credit: Greywater & Stormwater Reuse).

ment away from urban sprawl toward a new urbanist manner, with higher density, mixed uses, and alternatives to automobiles.

E. How New Urbanist Developments Can Reduce Nonpoint Source Pollution

A study of water pollution patterns on the South Carolina coast has shown that a new urbanist style development would significantly cut stormwater runoff pollution.[260] The "Belle Hall" study examined the theoretical development of a 583-acre site in Mt. Pleasant, South Carolina, comparing the effects of a typical sprawl development and a new urbanist development with the same amounts of residential, commercial, and industrial space.[261] The runoff produced by each of these development options was analyzed using computer models.[262] The research team concluded that sprawl development would generate 43% more runoff, three times as much sediment loading, and higher nitrogen and phosphorus levels than traditional town development.[263] New urbanist developments help reduce nonpoint source pollution by their higher density, which reduces the need for cars, their mixed use nature, and the resulting increase in transit use.

The higher density of new urbanist developments lessens the impact of nonpoint source pollution as compared to typical sprawl development.[264] For a given number of houses, denser developments consume less land than lower density developments.[265] Consuming less land creates less impervious cover in a watershed and thus less runoff.[266] Finally, by reducing the amount of impervious cover, higher density development makes it "technically easier and more cost-effective to implement structural runoff controls,"[267] such as holding ponds and infiltration systems.

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260. NEW URBANISM: COMPREHENSIVE REPORT & BEST PRACTICES GUIDE 20-10 (Robert Steuteville et al. eds., 2d ed. 2001) (referring to new urbanist development as "traditional town development" as opposed to suburban sprawl).

261. *See id. See also* U.S. EPA, *Urban Runoff Notes*, NONPOINT SOURCE NEWS-NOTES, Jan.–Feb. 1996, *available at* http://www.epa.gov/OWOW/info/NewsNotes/issue44/urban2.html [hereinafter *Urban Runoff Notes*].

262. *Urban Runoff Notes*, *supra* note 261. Unfortunately there are no physical studies currently available, presumably due to the difficulties involved in collecting stormwater runoff over a multi-acre site.

263. *Id.*

264. *See generally* PROTECTING WATER RESOURCES WITH HIGHER-DENSITY DEVELOPMENT, *supra* note 102.

265. *Id.* at 1.

266. *Id.*

267. LEHNER ET AL., *supra* note 143, at 59.

New urbanist developments also lessen the impact of nonpoint source pollution by reducing the impact of automobiles. The higher density of new urbanist developments can reduce the amount of infrastructure needed for cars, such as roads and parking spaces, and therefore reduce the amount of runoff generated.[268] Streets built for cars have multiple, wide lanes and require lots of pavement.[269] New urbanist developments typically have narrow streets, which slow traffic by requiring the driver to be cautious.[270] These narrow streets also require less impervious surface area than conventional designs.[271] In addition, new urbanist developments typically feature on-street parking, which not only slows the flow of traffic and creates a buffer between moving cars and pedestrians, but also reduces the amount of impervious surfaces by replacing off-street parking structures and private driveways.[272]

The mixed-use nature of new urbanist developments also lessens the impact of automobiles. For example, parking demand for various land uses is generated at different times of the day or week.[273] Varied parking demand in mixed-use developments allows the joint use of the same parking spaces, reducing the number of parking spaces needed to accommodate all uses, and therefore reducing impervious cover.[274] Mixing complementary uses also allows drivers to accomplish multiple errands in one trip instead of separate journeys. The reduced vehicle miles traveled minimizes pollutant discharge,[275] and the decreased demand for parking spaces reduces impervious cover and creates room for more open spaces.[276]

Finally, the higher density and mixed-use nature of new urbanist developments make the use of mass transit more practical. Concentration of development near transportation can reduce vehicle miles traveled and automobile-related infrastructure, reducing impervious cover and pollutant discharge.[277]

A recent study of land use and transportation in the metropolitan Atlanta region confirms that people living in dense, mixed-use areas—

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268. *See* Philip R. Berke et al., *Greening Developments to Protect Watersheds*, 69 J. AM. PLANNING ASS'N 397, 398 (2003).

269. PETER CALTHORPE, THE NEXT AMERICAN METROPOLIS 27 (1993).

270. *See* Berke et al., *supra* note 268, at 400.

271. *Id.*

272. *Id.*

273. *Id.* at 401.

274. *Id.*

275. LEHNER ET AL., *supra* note 143, at 61.

276. Berke et al., *supra* note 268, at 402.

277. LEHNER ET AL., *supra* note 143, at 61.

the hallmarks of new urbanism—drive less, take more trips by transit, and walk more than other residents of the region.[278] The SMARTRAQ study isolated three land use factors for study—neighborhood density, street connectivity, and mix of nearby land uses—to determine the walkability of each neighborhood studied.[279] The researchers then compared neighborhoods of similar demographic characteristics across the region to see how these land use characteristics influenced travel patterns.[280] Residents living in neighborhoods with low walkability drive 30% more each weekday and 40% more on the weekend than do comparable residents of highly walkable neighborhoods.[281]

V. CONCLUSION

If we as a nation wish to return all of our waters to a condition that is safe for fishing and swimming, we will have to tackle the remaining nonpoint source pollution problem. Green buildings and green building techniques show promise as solutions to nonpoint source pollution in developed areas. These techniques can be used not only at the level of an individual building, but also as solutions to our current inefficient and destructive land use patterns. States and municipalities that wish to begin tackling the nonpoint source pollution problem should consider green buildings and green building techniques as part of the solution.

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278. DAVID GOLDBERG ET AL., NEW DATA FOR A NEW ERA: A SUMMARY OF THE SMARTRAQ FINDINGS 15–20 (2007), *available at* http://www.act-trans.ubc.ca/smartraq/files/smartraq_summary.pdf.

279. *Id.* at 18.

280. *Id.* The research team also gathered information about which type of neighborhood the participants would prefer to live in to control for self-selection. A forthcoming article promises to prove that even after controlling for self-selection, residents of more walkable neighborhoods drive less and walk more than residents of less walkable neighborhoods. SMARTRAQ – Upcoming Journal Articles, http://www.act-trans.ubc.ca/smartraq/pages/reports_upcoming.htm#SelfSelection (last visited Nov. 25, 2007).

281. GOLDBERG ET AL., *supra* note 278, at 19–20.