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# Impervious Surfaces in the New York City Watershed

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# ARTICLE

# IMPERVIOUS SURFACES IN THE NEW YORK CITY WATERSHED

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## INTRODUCTION

Sprawl is "low-density, land consumptive, centerless, auto-oriented development, typically located on the outer suburban fringes."[1] Sprawl increases traffic, air pollution, noise pollution, and infrastructure costs.[2] At the same time, sprawl degrades water quality, reduces biodiversity, reduces open space, and deteriorates

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1. NAT'L TRUST FOR HISTORIC PRES., CHALLENGING SPRAWL: ORGANIZATIONAL RESPONSES TO A NATIONAL PROBLEM 7 (1999).

2. *See generally* CLARION ASSOCS., THE COSTS OF SPRAWL IN PENNSYLVANIA: FINAL REPORT (2000).

existing hamlets and village centers.[3] Sprawl also raises taxes by increasing the costs of roads, housing, schools, utilities, and transportation.[4] Sprawl lowers the quality of life by decimating agricultural lands, natural areas and open spaces; concentrating poverty and accelerating socio-economic decline in cities, towns, and older suburbs; and increasing pollution and stress.[5] Furthermore, sprawl deteriorates civic life and the social fabric in the United States.[6] Sprawl's greatest threat to water quality is the resulting increase in impervious surfaces.

This article focuses on sprawl's threat to water quality, particularly in the New York City drinking water supply watersheds. Part I of this article discusses the New York City drinking water supply watersheds and the 1997 New York City Watershed Memorandum of Agreement, which was designed to protect the City's drinking water source. Part II examines the impacts of impervious surfaces on water quality. Part III of this article reviews alternatives to impervious surfaces. Parts IV reviews and discusses mechanisms for reducing impervious surfaces in the New York City watersheds.

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3. *See id.*

4. *Id.* at 6; e-mail from Karen Argenti, The Gaia Institute, to Marc Yaggi, Riverkeeper, Inc. (Feb. 14, 2001, 12:21 AM) (on file with the *Fordham Environmental Law Journal*). An analysis of a recent New Jersey study revealed that roads built to serve sprawling new development in the pattern of Montgomery Township or Raritan Township (500 people per square mile) cost local taxpayers on average $10,000 per person. Taxpayer costs drop all the way to $3,000 per person when new roads are built in the denser communities of Princeton, Red Bank, Montclair or Collingswood (5,000 to 7,500 people per square mile). Even better, residents of new urban-style development in the pattern of Hoboken or Jersey City pay less than $2,000 per person—the smallest costs for new roads. *Id.*

5. *See* CLARION ASSOCS., *supra* note 2, at 10, 11; *see generally* CTR. FOR URB. POL'Y RESEARCH, RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY, THE COST AND BENEFITS OF ALTERNATIVE GROWTH PATTERNS: THE IMPACT ASSESSMENT OF THE NEW JERSEY STATE PLAN (Sept. 2000), *available at* http://www.state.nj.us/osp/planz.ias.ia2000co.htm (last visited Nov. 25, 2001).

6. *See* ROBERT D. PUTNAM, BOWLING ALONE 187, 208, 407 (2000).

Finally, Part V discusses extralegal mechanisms for promoting pervious surfaces and better site design in the New York City Watershed.

## I. THE NEW YORK CITY WATERSHED

### A. *Background*

The New York City Drinking Water Supply Watershed is a collection of reservoirs and controlled lakes in upstate New York that provide over nine million New Yorkers with up to 1.5 billion gallons of clean, unfiltered drinking water every day.[7] The reservoirs and lakes are located in three watersheds—the Croton, the Catskill, and Delaware.[8] The Croton Watershed, located entirely east of the Hudson River in parts of Westchester, Putnam, and Dutchess Counties, is approximately 375 square miles in size and provides up to 10% of the City's water supply.[9] The Catskill and

7. HELEN BUDROCK, THE CATSKILL CTR. FOR CONSERVATION & DEV. INC., SUMMARY GUIDE TO THE TERMS OF THE WATERSHED AGREEMENT: A GUIDE BOOK FOR GOVERNMENT OFFICIALS, PLANNING AND ZONING BOARD MEMBERS 1 (1997) [hereinafter SUMMARY GUIDE].

8. NEW YORK CITY WATERSHED MEMORANDUM OF AGREEMENT (1997), art. I, para. 14 [hereinafter MOA], *available at* http://www.nysefc.org/tas/MOA/ MOAPg1.htm (last visited Dec. 27, 2001). "In January 1997, Governor Pataki, New York City Mayor Giuliani, the EPA Regional Administrator and dozens of officials from state agencies, and county, town and village governments, as well as representatives from environmental organizations, signed the historic NYC Watershed Memorandum of Agreement (MOA)." *Id.* In addition to New York City residents, certain populations of Westchester, Putnam, Orange, and Ulster Counties tap into the New York City system. SUMMARY GUIDE, *supra* note 7, at 1.

9. Press Release, Dep't of Justice, New York City Agrees to Filter Croton Drinking Water System (May 20, 1998) (on file with the *Fordham Environmental Law Journal*). In times of drought, the Croton can provide up to 30% of the water supply by using the Croton Falls Reservoir Pump Station, and the Cross River Pump Station to pump Croton water into the Delaware Aqueduct. *Id.*

Delaware Watersheds, located west of the Hudson River, with additional reservoirs east of the Hudson,[10] are approximately 1,600 square miles in size, and provide up to 90% of the City's water supply.[11]

Currently, developers and a burgeoning population threaten the East-of-Hudson Watershed.[12] Putnam County is the fastest growing suburban county in New York State.[13] Developers are pushing into every unoccupied corner of the Croton Watershed, building roads, strip malls, office complexes, apartment buildings and residential subdivisions.

### B. *The Watershed Agreement*

#### 1. Events Leading to the Agreement

In accordance with the Safe Drinking Water Act Amendments of 1986, the U.S. Environmental Protection Agency ("EPA") promulgated the 1989 Surface Water Treatment Rule, which required surface water suppliers to filter their water unless the supplier could ensure the integrity of its water supply through a comprehensive watershed protection scheme.[14] In 1990, the New York City Department of Environmental Protection ("DEP") released a draft Watershed Protection Plan, which revised watershed rules and regulations for the first time since 1953, along with a proposed land acquisition program.[15]

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10. SUMMARY GUIDE, *supra* note 7, at 1. Water from the Delware Watershed travels via the Delaware Aqueduct to the West Branch Reservoir in Putnam County and then to the Kensico Reservoir in Westchester County. Water from the Catskill Watershed travels via the Catskill Aqueduct to the Kensico Reservoir in Westchester County. *Id.*

11. *Id.*

12. ROBERT F. KENNEDY, JR. ET AL., WATERSHED FOR SALE: EXPLOSIVE DEVELOPMENT THREATENS NEW YORK CITY'S DRINKING WATER SUPPLY (Nov. 1999), *available at* http://www.pace.edu/lawschool/envclinic/report.htm (last visited Dec. 26, 2001).

13. *Id.*

14. 40 C.F.R. § 141.71 (2001).

15. SUMMARY GUIDE, *supra* note 7, at 3.

In 1993, "the EPA issued NYC a one-year Filtration Avoidance Determination" ("FAD").[16] As a condition of FAD, NYC was required to issue final Watershed Regulations, which involved restrictions within the watershed that would reduce contaminants and prevent the degradation of the water supply.[17] However, there were exemptions for certain activities that were designed to promote responsible growth in certain areas, while protecting water quality through increased regulation of activities within those areas.[18] The FAD further required NYC to begin acquiring land and conservation easements within the Watershed.[19] Permanently securing buffer zones around water supply areas was a prudent way to prevent the water quality degradation that threatened NYC's water supply.

At the end of 1993, EPA granted NYC a second FAD until December 15, 1996.[20] As part of the FAD's conditions, NYC was required to have watershed protection programs in place and acquire 80,000 acres of watershed land by December 31, 1999.[21] This condition was ultimately dropped in the final agreement because NYC was not able to achieve this goal.[22]

When it became clear that the Watershed Protection Plan was creating incredible controversy and spurring lawsuits from upstate communities, Governor Pataki decided to bring federal, state, and local officials together with key environmental groups to negotiate an agreement that would end the litigation.[23] The purpose of the agreement was to consider the property rights and economic vitality of the communities in the watershed, and to provide a framework for protecting drinking water.[24] As a comprehensive protection scheme, the 1997 New York City Watershed Memorandum of Agreement—signed by more than 60 watershed towns—New York City, New York State, the federal government, and five environmental groups—currently regulates land uses and various pollutants in

16. *Id.*
17. *Id.*
18. *Id.*
19. *Id.* at 3.
20. *Id.* at 4.
21. *See* SUMMARY GUIDE, *supra* note 7, at 4.
22. *Id.* at 1.
23. *Id.*
24. *Id.*

NYC's 2,000 square mile watershed.[25] The Watershed Agreement is designed to protect the three watersheds through three main programs: land acquisition, partnership programs, and rules and regulations.[26]

2. Land Acquisition

The Watershed Agreement recognizes the correlation between open space and water quality. As a result, the Agreement commits New York City to spending $250 million dollars to purchase and protect in perpetuity land in the Catskill and Delaware Watersheds.[27] The City also committed to spending $10 million on land acquisition in the Croton Watershed.[28] To preserve upstate/downstate relationships, the City is permitted to buy property only on a willing buyer, willing seller basis, even though the City possesses eminent domain power.[29] New York City's Land Acquisition program prioritizes property in the watershed by its importance to water quality.[30]

3. Partnership Programs

The Agreement's partnership programs are designed to maintain and enhance water quality, while also to boost environmentally sensitive economic development in the Catskill region through various programs and grants and low interest loans to businesses.[31] For example, the City is currently spending $13.6 million to pump out and inspect individual residential septic systems and to repair, replace and upgrade failing systems.[32] The Watershed Agreement also created the Catskill Fund for the Future, which provides approximately $59.7 million "to establish a program supporting

25. *See* MOA, *supra* note 8, at art. I.
26. SUMMARY GUIDE, *supra* note 7, at 2.
27. MOA, *supra* note 8, at art. II, para. 74(a).
28. *Id* at art. II, para. 74(b).
29. SUMMARY GUIDE, *supra* note 7, at 5.
30. *Id.* at 6.
31. *See generally* MOA, *supra* note 8, at art. V.
32. MOA, *supra* note 8, at art. V, para. 124.

responsible, environmentally sensitive economic development projects in the West of Hudson Communities."[33]

Another Partnership Program is the Wastewater Treatment Plant Upgrade Program. This program obligates New York City to upgrade to microfiltration or an equivalent technology over 100 wastewater treatment plants in the watershed.[34] Other programs include New Sewage Treatment Infrastructure Facilities, Sand and Salt Storage Facilities, Stormwater Retrofits, Stream Corridor Protection, Public Education, and Forestry Management.[35] Most of the Partnership Programs are facilitated through the Agreement-created Catskill Watershed Corporation.[36]

### 4. Rules and Regulations

The watershed rules and regulations set out controls on various land uses in the watershed.[37] For example, the regulations prohibit any part of an absorption field for a new conventional individual subsurface sewage treatment system within the limiting distance of 100 feet of a watercourse or wetland, or 300 feet of a reservoir, reservoir stem or controlled lake.[38]

More pertinent to the subject matter of this article, the watershed regulations prohibit the construction of an impervious surface within 100 feet of a watercourse or wetland, and 300 feet of a reservoir, reservoir stem, or controlled lake.[39] These regulations, however, are riddled with exceptions. In fact, the impervious surface regulations contain at least 10 exceptions.[40]

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33. *Id.* at art. V, para. 135.

34. MOA, *supra* note 8, at art. V, para. 141; *see also* CATSKILL WATERSHED CORP., OTHER PROGRAMS, COMMS. & ADVISORY GROUPS, *available at* http://www.cwconline.org/programs/othpro.htm (last visited Oct. 26, 2001).

35. *See* MOA, *supra* note 8, at art. V.

36. *Id.* at art. V, para. 120.

37. *See generally* N.Y. CITY R. & REGS. tit. 15, §§ 18-38, 18-39 *available at* http://www.ci.nyc.ny.us/html/dep/html/ruleregs/finalrandr.html (last visited Dec. 27, 2001).

38. *Id.* at § 18-38(a)(5).

39. *Id.* at § 18-39(a)(1).

40. *Id.* at §§ 18-39(a)(2)(i)-(vi), (3), (4), (5), (6).

An emphasis on impervious surfaces is important because recent studies confirm that the greatest threat to source water and the most common source of dangerous microbes in drinking water is the expansion of impervious surfaces in the watershed.[41] Because the well-established connection between pavement and pollution was not widely understood or accepted by government officials during the watershed negotiations, there is very little in the Watershed Agreement that gives the City direct authority to curtail construction of impervious surfaces that are farther than 300 feet from the reservoirs or 100 feet from watercourses.[42]

## II. IMPERVIOUS SURFACE IMPACTS

### A. *Generally*

Impervious surfaces are surfaces that prevent infiltration of water into soil, thus posing a threat to water quality.[43] Examples of impervious surfaces are roads, driveways, parking lots, sidewalks, and rooftops. Impervious surfaces impact water quality by increasing the volume and magnitude of stormwater and facilitating the delivery of pollutants into receiving waters.[44] Stormwater scours the pavement, transporting a multitude of pollutants including motor oil, engine coolant, brake linings, rust, nutrients, litter, animal waste, sand, salt, and other materials found on roads, parking lots, and

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41. *See generally* Tom R. Schueler, *The Importance of Imperviousness,* 1 WATERSHED PROT. TECHS., 100 (1994); Jayne E. Daly, *The Protection of New York City's Drinking Water,* 1995 PACE L. REV. 63, 69 (an article published in the 1995 *Pace Law Review* commemorative edition, and on file with Pace Law School and the *Fordham Environmental Law Journal*).

42. *See* SUMMARY GUIDE, *supra* note 7, at 15.

43. Daly, *supra* note 41, at 69; CHESAPEAKE BAY FROM SPACE, IMPERVIOUS SURFACES: WHAT IS AN IMPERVIOUS SURFACE?, *at* http://chesapeake.towson.edu/impervious/what_imp.htm (last visited Oct. 26, 2001); *see* Chester L. Arnold, Jr. & C. James Gibbons, *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator,* 62 J. AM. PLANNING ASS'N 243, 245 (1996).

44. Daly, *supra* note 41, at 69.

sidewalks.[45] Moreover, impervious surfaces generate pollutants by attracting traffic, pesticides, fertilizers, and other land uses.[46] "Parking lots, shopping areas, business and industrial areas often produce hydrocarbon and metal concentrations that are twice those found in the average urban area."[47]

A significant public health issue associated with runoff is the addition of pathogens and toxic contaminants to receiving waters.[48] When stormwater scours pollutants off of pavement into surface waters, it can contribute *Cryptosporidium* and *Giardia* cysts, which lead to gastrointestinal illnesses and other health problems, from human and animal fecal waste.[49] Alachlor, which can lead to eye, kidney, brain, spleen, heart, prostate and ovary problems, is found in runoff from herbicides.[50] Herbicides also can contribute endothall, which is linked to stomach problems, brain and skeletal malformations, weight loss, and kidney and adrenal discoloration.[51] Runoff from paint and batteries sends cadmium, which is linked to

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45. *See id.* at 69-75.

46. Arnold & Gibbons, *supra* note 43, at 245.

47. GEODIGITAL MAPPING, INC., SIGNIFICANT SOURCES OF URBAN STORM WATER RUNOFF IN UNINCORPORATED AREAS OF THE SOUTH COAST OF SANTA BARBARA COUNTY IDENTIFIED FROM LANDSAT IMAGERY: REPORT TO THE SANTA BARBARA COUNTY WATER AGENCY 2 (2000).

48. Daly, *supra* note 41, at 69.

49. COMM. TO REVIEW THE NY CITY WATERSHED MGMT. STRATEGY, NAT'L RESEARCH COUNCIL, WATERSHED MANAGEMENT FOR A POTABLE WATER SUPPLY: ASSESSING THE NEW YORK CITY STRATEGY 97 (2000) [hereinafter NRC REPORT]; U.S. Envtl. Prot. Agency, *National Primary Drinking Water Standards* (2001) [hereinafer WATER STANDARDS REPORT], *at* http://www.epa.gov/safewater/mcl.html (last visited Nov. 2, 2001).

50. *See* U.S. Envtl. Prot. Agency, *IRIS: Integrated Risk Information System for Alachlor, at* http://www.epa.gov/iriswebp/iris/subst/0129.htm (last visited Sept. 19, 2001); WATER STANDARDS REPORT, *supra* note 49.

51. *See* U.S. Envtl. Prot. Agency, *IRIS: Integrated Risk Information System for Endothall,* http://www.epa.gov/iriswebp/iris/subst/0155.htm (last visited Sept. 19, 2001); WATER STANDARDS REPORT, *supra* note 49.

kidney damage and cancer, into surface waters.[52] Further, the increased levels of disinfection required to combat the increased levels of pollutants magnify the risk of haloacetic acids, which are linked to an increased risk of bladder, colon, and rectal cancer.[53]

Impervious surfaces have several negative impacts on ecosystems. In addition to the impacts of increased levels of pollutants on water quality, runoff increases stream erosion, widens stream channels, induces eutrophication, reduces groundwater recharge, reduces tree cover and magnifies water temperature fluctuations, and degrades riparian and in-stream habitat.[54]

### B. *Water Quality Degradation*

When dealing with stormwater, the primary design consideration for civil engineers is to direct the runoff from paved surfaces as quickly as possible.[55] Traditional civil engineering gave little consideration to the downstream effects. However, pavement and stormwater can have irreversible impacts on water quality.[56] Impervious cover has been linked to stream conditions showing that

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52. *See* 29 C.F.R. § 1910.127 (2000); WATER STANDARDS REPORT, *supra* note 49.

53. NRC REPORT, *supra* note 50, at 104; *see also* S.F. Pub. Util. Comm'n Water Quality Bureau, *Haloacetic Acids Fact Sheet*, *at* http://www.cisf.ca.us/puc/wqfs/haloacet.htm (last visted Nov. 2, 2001).

54. Arnold & Gibbons, *supra* note 43, at 245.

55. *See* Ed Hunt, *Time to Try Zero Impact Development?*, Tide Pool, *available at* http://65.165.109.4/holz.html (last visited Jan. 2, 2002).

56. Schueler, *supra* note 41, at 101 (1994).

> Transport-related imperviousness often exerts a greater hydrological impact than the rooftop-related imperviousness. In residential areas, runoff from rooftops can be spread out over pervious areas, such as backyards, and rooftops are not always directly connected to the storm drain system. This may allow for additional infiltration of runoff. Roads and parking lots, on the other hand, are usually directly connected to the storm drain system.

*Id.*

impacts to a stream fall into four general categories: hydrologic impacts, geomorphic impacts, water quality impacts, and biological impacts.[57]

Although best management practices can reduce pollutant loadings to streams, eventually a threshold is crossed at which it is impossible to maintain predevelopment water quality.[58] Tom Schueler of The Center for Watershed Protection, classifies stream quality levels by percent imperviousness.[59] For example, streams in an area of 1 to 10% impervious cover are classified as "stressed streams."[60] In 11 to 25% impervious cover areas, streams are impacted.[61] And in areas of 26 to 100% impervious cover, streams are degraded.[62] Most notable is that stream degradation occurs at levels of impervious cover as low as 10%.[63] In fact, recent research indicates that watersheds are demonstrably and irreversibly degraded when as little as 10% of their surface area is covered by impervious surfaces.[64]

The post-construction runoff from suburban residential development can be up to 10 times that of pre-development conditions and runoff from new commercial development can be as much as 18 times higher.[65] A recent California study found that imperviousness in single-family residential areas ranges from 25% to nearly 60%; imperviousness in industrial areas is typically 60% to

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57. CTR. FOR WATERSHED PROT., IMPERVIOUS COVER AND LAND USE IN THE CHESAPEAKE BAY WATERSHED 1 (Jan. 2001).

58. Schueler, *supra* note 41, at 102.

59. *Id.* at 107.

60. *Id.*

61. *Id.*

62. *Id.*

63. *Id.*

64. Derek Booth & C. Rhett Jackson, *Urbanization of Aquatic Systems: Degredation Thresholds, Stormwater Detection, and the Limits of Mitigation*, 33 J. AM. WATER RESOURCES ASS'N 1077, 1084 (1997); GEODIGITAL MAPPING, INC., *supra* note 47, at 2.

65. F. KAID BENFIELD ET AL., NAT'L RES. DEF. COUNCIL, ONCE THERE WERE GREENFIELDS: HOW URBAN SPRAWL IS UNDERMINING AMERICA'S ENVIRONMENTAL ECONOMY AND SOCIAL FABRIC, (1999), *cited in* Chad Nelsen, *Sprawl: Polluting A Wave Near You*, *at* http://www.surfrider.org/makingwaves10/sprawl1.htm (last visited Oct. 26, 2001).

70%; and in commercial areas it is 80% to 90%.[66] Impervious surface impacts on runoff volume can be quite dramatic. "For example, a 1-inch rainstorm over 1 acre of open space will typically generate 218 cubic feet of runoff. The same storm over a 1-acre paved parking lot will produce 3,450 cubic feet of runoff, nearly 16 times more than the natural setting."[67] Other studies report that the yearly volume of runoff can increase by 2 to 16 times the pre-development rate, with proportional reductions in groundwater recharge.[68]

Research indicates that the first flush pollutant loading in urbanized areas is more harmful to water quality than raw sewage.[69] A 1991 study in the Greater Vancouver Regional District estimated that first flush loadings exceeded the combined contaminant loadings from the region's three wastewater treatment plants over the same period of time.[70] In the New York City watersheds, there are 102 sewage treatment plants.[71] The approximately 3,863 miles of roads and thousands of driveways and parking lots likely exceed the adverse impacts of these 102 treatment plants.[72]

Impervious surfaces also cause an increase in sedimentation levels in watercourses. For example, a typical sprawling development can contribute 5.7 million tons of sediment, while a concentrated development brings 3.4 million tons.[73] A sprawling development

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66. *See* GEODIGITAL MAPPING, INC., *supra* note 47, at 2.

67. *Id.*

68. Schueler, *supra* note 41, at 100.

69. GUTTERIDGE ET AL., DEP'T OF NAT'L DEV. & ENERGY AUSTL. WATER RES. COUNCIL, CHARACTERIZATION OF POLLUTION IN URBAN STORMWATER RUNOFF (1981), *cited in Importance of Being Pervious, at* http://www.alternatives.com/aqualibrium/ pervious.htm (last visited Nov. 16, 2001).

70. *Id.*

71. JAMES M. TIERNEY, FALLING FAR BEHIND: REPORT ON THE N.Y. CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION'S PROGRAM TO UPGRADE WASTE WATER TREATMENT PLANTS WITHIN THE N.Y. CITY WATERSHED (2000).

72. Telephone Interview with Mike Johnston, N.Y. State Dep't of Trans. (Sept. 17, 2001).

73. SAFETY, AGRIC., VILL.'S, & ENV'T, PA ROUTE 41: TWO LANES OR FOUR? HOW A CREATIVE APPROACH TO HIGHWAY IMPROVEMENT CAN TAME THE THREAT OF SPRAWL, (2001), *at*

can add 1.6 million pounds of nitrous oxide, while concentrated development adds closer to .08 million pounds.[74]

Moreover, road salt applications associated with impervious surfaces impact water quality. In the Croton Watershed, road salt applications range from 37 to 298 tons per lane per mile per year.[75] A scientific assessment by Environment Canada[76] concluded that the heavy use of road salt is toxic to streams, small lake ecosystems, and groundwater.[77] "High chloride concentrations in groundwater are a concern as the groundwater eventually surfaces at springs and contributes further to surface water contamination."[78] Road salt infiltration is toxic to the environment in groundwater-based supplies.[79] In New York City watersheds, groundwater "is a major contributor to streams."[80] A United States Geological Survey ("USGS") study reports that groundwater discharge "accounts for at least 60% of total annual streamflow" in the Croton Watershed.[81] The study also noted that "deicing salts applied to roads during the winter are a primary source of solutes to groundwater" in the Croton

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http://www.save41.org/white%20paper.htm (last visited Jan. 2, 2002).

74. *Id.*

75. U.S. GEOLOGICAL SURVEY, N.Y. CITY DEP'T. OF ENVTL. PROT., EFFECTS OF RESIDENTIAL AND AGRICULTURAL LAND USES ON THE CHEMICAL QUALITY OF BASEFLOW OF SMALL STREAMS IN THE CROTON WATERSHED, N.Y. 8 (2000).

76. "Environment Canada's mission is to preserve and enhance the quality of the natural environment . . . conserve Canada's renewable resources . . . ; conserve and protect Canada's water resources . . . ; enforce the rules made by the Canada—United States International Joint Commission relating to boundary waters; and coordinate environmental policies and programs for the federal government." Environment Canada, The Green Lane™-About Us: Mandate, Vission and Mission, *at* www.ec.gc.ca/introecmandate.htm.

77. Environment Canada, *Science Assessment Finds Road Salts Toxic to the Environment*, *available at* http://www.ec.gc.ca/press/000811_b_e.htm (visited Sept. 25, 2000).

78. *Id.*

79. *Id.*

80. U.S. GEOLOGICAL SURVEY, *supra* note 75, at 2.

81. *Id.* at 3.

Watershed.[82] The chloride concentration in a drinking water supply depends on salting intensity, soil type, climate, topography, and water volume and dilution.[83] New York has one of the highest road salt application rates among the states.[84] The USGS study found concentrations in the Croton Watershed ranging from 1.8 to 280 milligrams per liter.[85]

Roadside vegetation is adversely impacted by road salt application. A scientific assessment found damage to vegetation approximately 50 meters from roadways that were treated with road salts.[86] It further discovered that salt-sensitive plant species "were disappearing along roadways."[87] The damaged vegetation exhibited "inhibited growth, browning and falling leaves and needles, and sometimes dying limbs and premature plant death."[88] Vegetated buffers provide the greatest protection for water quality. If the vegetation between a road and a watercourse is destroyed, nature's ability to purify stormwater will be diminished.

Similarly, road salt negatively impacts soils. The sodium accumulation may increase soil density and reduce permeability, moisture retention, and fertility, affecting plant growth and erosion control.[89] Again, this can adversely impact water quality by diminishing nature's ability to purify stormwater and by increasing suspended solid deposits. Faulty erosion control contributes to turbidity and pollutants that bind to suspended solids. Federal standards require that a water supply not exceed five turbidity units; faulty erosion control is a major contributor of turbidity and a source of pollutants, as pollutants bind to suspended solids.[90]

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82. *Id.* at 8.

83. COMM. ON THE COMPARATIVE COSTS OF ROCK SALT AND CALCIUM MAGNESIUM ACETATE FOR HIGWAY DEICING , NAT'L RES. COUNCIL, HIGHWAY DEICING: COMPARING SALT & CALCIUM MAGNESIUM ACETATE 8 (1991) [hereinafter HIGHWAY DEICING].

84. *Id.* at 20.

85. U.S. GEOLOGICAL SURVEY, *supra* note 75, at 9.

86. Environment Canada, *supra* note 77.

86. *Id.* at 7.

87. *Id.*

88. HIGHWAY DEICING, *supra* note 83, at 6.

89. *Id.* at 7.

90. 40 C.F.R. § 141.13 (1999).

### C. *Temperature*

Increased levels of impervious surfaces and lack of tree coverage also impact the temperature of watercourses. As a result, stream temperatures are warmer in the summer and colder in the winter.[91] These temperature changes impact aquatic habitat and ultimately water quality.

### D. *Biodiversity*

Stream biodiversity is an important indicator of water quality. Abundant biodiversity indicates a strong ecosystem and a lack of pollutants.[92] A 1992 study of the Anacostia watershed in Maryland found good to fair diversity in headwater streams with less than 10% imperviousness, but poor diversity in areas with 12% or more imperviousness.[93] "Many of the pollutants associated with stormwater runoff can be directly toxic to organisms (e.g., pesticides, metals, hydrocarbons) or can cause conditions in the receiving waters that are detrimental to aquatic organisms and even humans (e.g., eutrophication, pathogens)."[94]

### E. *Volume*

Studies show that runoff volume for a one-acre parking lot is approximately 16 times the amount of volume produced by a one-acre undeveloped meadow.[95] A 1994 study revealed that average stormwater runoff volumes were 26,000 gallons per square mile ($GPM^2$) per day for woodlands; 83,000 $GPM^2$ per day for agriculture and low-density residential; 284,000 $GPM^2$ per day for high-density residential; and 494,000 $GPM^2$ per day for commercial land uses.[96]

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91. Schueler, *supra* note 41, at 102.

92. *Id.*

93. *Id.* at 104.

94. KAREN CAPPIELLA & KENNETH BROWN, CTR. FOR WATERSHED PROT., IMPERVIOUS COVER AND LAND USE IN THE CHESAPEAKE BAY WATERSHED 33 (2001).

95. Schueler, *supra* note 41, at 100.

96. Jonathan M. Harbor, *A Practical Method for Estimating the Impact of Land Use Change on Surface Runoff, Groundwater*

These increases in volume by land use reflect the increasing levels of impervious cover.

### F. *Wetlands Impacts*

Erosion associated with impervious surfaces carries sediment into wetlands, stressing small plants and burying seeds deeper than would naturally occur.[97] "Sediment [also] may carry petroleum products and toxic compounds that stress plants, [resulting in the raised bottom of the wetland and] alters the hydrologic regime."[98] Total suspended solid concentrations increase greatly during construction of impervious surfaces, carrying with them other pollutants, such as phosphorous and nitrogen, which are contained in soils.[99] This overload reduces the effectiveness of wetlands at attenuating pollutants.[100]

When surfacing upslope areas, the "increased runoff will accelerate water flow into wetlands during storms and reduce subsurface flow from uplands after storms."[101] As a result, water inputs into wetlands are high volume and of shorter duration with shorter residence times.[102] The runoff may carry petroleum products and other pollutants into the wetland.[103]

Increased stormwater runoff from new impervious surfaces can cause higher wetland water levels on a more frequent basis and for longer periods of time. "These changes in wetland hydroperiod then result in impacts to plant and animal communities that were adapted

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*Recharge and Wetland Hydrology*, 60 J. AM. PLAN. ASS'N 95, 105 (Winter 1994).

97. CAROLYN B. SNEIDER & STEVEN W. SPRECHER, U.S. ARMY CORPS OF ENG'RS, WETLANDS MANAGEMENT HANDBOOK 3 (2000).

98. *Id.*

99. *See* Richard R. Horner et al., *Effects of Watershed Development on Water Quality Soils, in* WETLANDS AND URBANIZATION: IMPLICATIONS FOR THE FUTURE 237, 243 (2001) (Amanda L. Azous & Richard R. Horner eds., 2001).

100. *See id.* at 242-43.

101. SNEIDER & SPRECHER, *supra* note 97, at 3.

102. *Id.*

103. *Id.*

to the preexisting hydrologic conditions."[104] These higher wetland water levels also diminish the richness of wetland vegetation.[105] This finding is significant because wetland plants play a vital role in pollutant uptake.[106]

An example of impervious surface impacts on wetlands is a two-acre filling project, which directly causes, among other things, the loss of two acres of habitat, two acres of flood storage potential, and two acres of nutrient transformation potential.[107] Indirect impacts from a two-acre fill include;

> alteration of water flow patterns within the wetland; due to reduced circulation, waters may stagnate adjacent to the project; the stagnant portion of the wetland may suffer loss of oxygen; loss of oxygen may alter aquatic community composition; altered habitat may reduce the wetland's ability to export productivity downstream; the stagnant area may also reduce aesthetic benefit . . . .[108]

Additionally, the sum of direct and indirect impacts cumulatively affects wetlands. While a single project may have relatively little effect on the drainage basin's natural resource base, many small projects may cumulatively have an enormous impact.[109] Planners and agencies in the New York City Watershed must begin to realize that the multiple projects proposed and often easily approved can cumulatively have significant impacts on water quality.

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104. Lorin E. Reinelt & Brian L. Taylor, *Effects of Watershed Development on Hydrology, in* WETLANDS AND URBANIZATION: IMPLICATIONS FOR THE FUTURE 221, 222 (Amanda L. Azous & Richard R. Horner eds., 2001).

105. Amanda L Azous & Sarah S. Cooke, *Wetland Plant Communities in Relation to Watershed Development, in* WETLANDS AND URBANIZATION: IMPLICATIONS FOR THE FUTURE 255 (Amanda L. Azous & Richard R. Horner eds., 2001).

106. *See* SNEIDER & SPRECHER, *supra* note 97.

107. *See id.* at 3.

108. *Id.*

109. *Id.*

### G. *Groundwater Impacts*

Watershed development impacts groundwater recharge, which compromises stream baseflow and reduces evapotranspiration.[110] Moreover, wetlands perform the critical function of purifying water before it flows underground and is used as a drinking water source.[111] Groundwater is a source of drinking water for thousands of watershed residents.[112] In addition, groundwater discharge accounts for at least 60% of total annual streamflow in the Croton Watershed of the New York City water supply.[113] When wetland functions are impaired, the wetland's ability to purify water is diminished.

## III. FINDING SOLUTIONS

### A. *Pervious Alternatives*

Impervious surfaces pose numerous threats to water quality and it is critical for watershed advocates and local, state, and federal agencies to consider alternatives. A growing number of pervious surface alternatives are readily available.[114] These products range from porous pavement to gravel pavement and several manufacturers, such as Invisible Structures, Inc., Tarmac America,

110. *See* Reinelt & Taylor, *supra* note 104, at 221. Evapotranspiration is the combination of water that is evaporated and transpired by plants as a part of their metabolic processes. *See* G. A. Clark et al., *Atmospheric Parameters which Affect Envirotranspiration*, 822 Fl. Coop. Extension Serv. 1 (Mar. 1989); Marin Municipal Water District, *Evapotranspiration: What is it and Why is it Important*, *at* http://www.marinwater.org/evapotranspiration.html.

111. *See* SNEIDER & SPRECHER, *supra* note 97, at 72.

112. A large portion of the approximately 15% of Westchester residents and 85% of Putnam residents that are not connected to the New York City water supply system rely on groundwater. *See generally*, U.S. GEOLOGICAL SURVEY, *supra* note 75.

113. *See id.* at 3.

114. *See, e.g.*, Arnold & Gibbons, *supra* note 43, at 253.

Kara Construction, Inc., and UNI-Group USA are touting their products as practical alternatives to impervious surfaces.[115]

Unlike conventional pavement, pervious pavement allows water to pass through and be treated by the underlying soil.[116] Further, pervious surfaces contribute recharge to groundwater and reduce runoff to nearby surface waters.[117] Although the cost of pervious surfaces is typically higher than traditional pavement, this cost may be offset by certain factors,[118] including reducing or even negating the need for stormwater mitigation measures.[119] Moreover, curbs are not necessary for roads and driveways using pervious surfaces.[120]

Many of the pervious surfaces presently on the market are better suited for parking lots and driveways, rather than roads. This is due, in part, to weight and speed limitations.[121] Walden State Pond Reservation in Concord, Massachusetts has been using a pervious parking lot since 1977,[122] and the Grand Canyon Trust building in Flagstaff, Arizona has a pervious parking lot.[123] Both report few problems and little maintenance with their parking lots.[124] Significantly, Walden State Pond Reservation is situated in a climate similar to the New York City Watershed. Further, Flagstaff, Arizona receives approximately 100 inches of snow per year.[125]

When designing and implementing pervious surfaces, the hydrologic cycle must be allowed to continue equal to the pre-development state, so that aquifers are recharged and runoff

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115. *See, e.g.,* Invisible Structure, Inc., *at* http://www.invisiblestructures.com/companypro/companypro.html; Tarmac, *at* http://www.tarmacamerica.com/tarmac/index.html; Kara Construction, Inc., *at* http://www.perviospavement.com/home.htm; Uni-Group U.S.A., *at* http://www.uni_group.org/products.htm.

116. Janis Keating, *Porous Pavement*, STORMWATER, Mar./Apr. 2001, at 30, 30.

117. *Id.* at 31.

118. *Id.* at 30.

119. *See id.*

120. *Id.*

121. *See id.* at 31.

122. Keating, *supra* note 116, at 31.

123. *Id.* at 32.

124. *Id.* at 31-32.

125. *Id.* at 32.

pollutant loadings are prevented.[126] Porous concrete appears to provide the most versatile application, however, the literature indicates that manufacturers are in conflict over its efficacy and durability.[127] It seems logical that a hard freeze in northern regions would result in ice formation within the porous concrete air cells, thereby impeding flow of water through the medium. Other impediments may include maintenance issues and weight limitations.

At least three manufacturers—Petrus UTR Pervious Paving, of Savannah, Georgia, Invisible Structures, of Aurora, Colorado, and Fred Adams Paving, of Morrisville, North Carolina—offer Gravelpave2, a geotextile filter fabric consisting of high impact flexible rings on a flexible grid, that is laid over a six to eight inch sand and stone base and filled with stone.[128] Gravelpave2's application is generally limited to areas of low speed traffic, such as driveways and parking lots.[129] Invisible Structures, Inc. notes that Gravelpave2 has been used for high traffic porous parking areas since 1993, in banks, fast food restaurants, colleges, and residential driveways.[130]

For example, Gravelpave2 is being used at the Navy Pier in Chicago, Illinois[131] and for a parking lot at the Dominican University

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126. THOMAS CAHILL, *A Second Look at Porous Pavement/Underground Recharge*, *in* 1 WATERSHED PROTECTION TECHNIQUES 76, 76 (1994).

127. *Id.*

128. *See* Invisible Structures, Inc., *at* http://www.invisiblestructures.com/GV2/gravelpave.htm (last visited Apr. 13, 2001).

129. *See id.*

130. *See id.*

131. *See* Invisible Structures, Inc., *at* http://www.invisiblestructures.com/Project%20Profiles/Gravelpave/Navy%20Pier/Navypier.html (last visited Apr. 13, 2001).

> This installation is a roof-top garden area for relaxing, picnicking, waiting for a performance, and enjoying the seagulls. Grey Gravelpave2 was filled with small grey gravel and overfilled to give an impression of an English Garden surface. The rectangular perimeter is filled with many colorful flowers in raised planters. Even the smoking urns are grey to match the gravel.

*Id.*

in River Forest, Illinois.[132] According to manufacturers, Gravelpave2's cost is generally between 10 and 15% higher than traditional pavement, but it can eliminate the need for stormwater drainage and collection systems.[133] Moreover, the maintenance of Gravelpave2 over a 15 to 20 year span is so minimal that it can produce an additional savings of 40% over traditional pavement, which requires constant resurfacing.[134]

Petrus UTR Pervious Paving also distributes pervious concrete, a blend of Portland cement, coarse aggregate rock, and water.[135] The manufacturer recommends a 6 to 10 inch road base of a specific

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132. *See* Invisible Structures, Inc., *at* http://www.invisiblestructures.com/Project%20Profiles/Gravelpave/Dominican/dominican.html (last visited Apr. 13, 2001).

> Tree preservation, keeping runoff out of Des Plains River, and low maintenance were the three most important reasons for using Gravelpave2. Amy McCormack, Vice President for Business Affairs, spearheaded the decision, and claims that this parking lot 'is ten times more beautiful than any kind of parking surface I've seen.' Dominican University earned 'Environmental For Excellence' from Invisible Structures, Inc. No drainage system was required which lightened the stormwater load on the local storm sewers and nearby Des Plaines River. 'We were able to increase the amount of parking while decreasing the amount of runoff,' McCormack said. Eliminating a drainage system accounts for considerable savings when comparing parking surface treatments. Major existing trees that were preserved, utilize the stormwater.

*Id.*

133. Invisible Structures, Inc., *at* http://www.invisiblestructures.com/FAQs/FAQs.html#Anchor-available-3800 (last visited Apr. 13, 2001).

134. *See id.* Maintenance should only involve brooming the gravel back into place or adding a small amount of stone once or twice a year.

135. *See* Petrus UTR Pervious Paving, *Tree-friendly Drainage Solutions Make Developers, Owners & ADA Happy*, *at* http://www.petrusutr.com/paving_paper.htm (last visited June 28, 2001).

stone and 6 inches of pervious concrete in the wearing layer.[136] The cost of this product is between $4.50 and $5.50 per square foot and the acceptable load range falls between 1,400 and 2,400 pounds per square inch.[137] The manufacturer advises, however, that porous concrete may lose its efficacy and durability in areas above the frost line.[138]

Kara Construction, Inc., of Treasure Coast, Florida, also distributes porous concrete, which the company describes as "the pavement that actually drinks water."[139] The manufacturer claims that its "concrete pavement . . . allows pure rainwater to seep through the paved surface and into the soil as nature intended. This process greatly reduces or eliminates the need and the cost of expensive stormwater drainage systems and retention areas."[140] The pavement is comprised of a special blend of Portland Cement, coarse aggregate rock, and water.[141] When properly installed, the manufacturer claims a water drainage rate of between 8 and 12 gallons per minute per square foot.[142] According to the manufacturer, a similar product has been used successfully in Europe for the last 50 years.[143]

Tarmac America, with manufacturing plants in Florida and Virginia, produces EnviroConcrete, a pervious concrete of coarse aggregate, Portland Cement, and water.[144] Impervious sub-bases, such as clay, require a permeable layer at least six inches thick installed between the subbase and the pavement.[145] Contrary to Petrus UTR's warning that pervious concrete may lose its efficacy and durability above the frost line, Tarmac America asserts that freeze/thaw studies have demonstrated the viability of pervious

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136. *See id.*

137. *See id.*

138. *See id.*

139. *See* Kara Construction, Inc., *at* http://www.perviouspavement.com/what.htm (last visited Sept. 15, 2001).

140. *See* Kara Construction, Inc., *at* http://www.perviouspavement.com/ home.htm (last visited Apr. 13, 2001).

141. *See id.*

142. *See id.*

143. *See id.*

144. *See* Tarmac America, *Ready Mix Concrete, at* http://www.tarmacamerica.com/products/readymix/pervious.html (last visited June 28, 2000).

145. *See id.*

concrete in colder climates.[146] Tarmac America's claim is based on an in-house study of 100 cycles of freeze/thaw, which recorded a sample loss of 0%.[147] In fact, Tarmac America indicates that among its successes are its performance on parking lots, roadways, sidewalks, and residential subdivision streets.[148]

UNI-Group U.S.A., of Palm Beach Gardens, Florida, manufactures UNI® Eco-Stone, "a flexible pavement system with pavers as the wearing course, a bedding layer, a base, a subbase, and subgrade with design consideration for water in-flow."[149] Furthermore, "[t]he bedding layer is often the same aggregate material that is used to fill the drainage voids and joints of the paver."[150] The use of filter layers or geotextiles may be required to prevent migration of particles between layers.[151] In areas where frost action may be a factor, accurate specifications for the filter criteria must be incorporated into the design of the drainage system.[152] A reduction in perviousness of the Eco-Stone paving system may occur due to organic growth over a three to five year period.[153] Commercial street sweeping/vacuuming of the paving system is recommended on an approximate four-year cycle.[154] UNI-Group paving systems have been used successfully in states above the frost line such as Oregon and Kansas.[155] In particular, the product is being used in a subdivision in Bend, Oregon, which endures over 350 freeze/thaw cycles each year.[156]

Presto Products, of Appleton, Wisconsin, offers the Geoblock® Porous Pavement System, "a series of interlocking geotextile blocks

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146. *See* e-mail from Jim Holland, Tarmac America, to William Wegner, Riverkeeper, Inc. (Oct. 31, 2000).

147. *See id.*

148. *See* Tarmac America, *supra* note 144.

149. UNI-Group USA: Manufacturers of UNI® Paving Stone, *at* http://www.uni-groupusa.org/informat.htm (last visited Nov. 16, 2001).

150. *Id.*

151. *Id.*

152. *Id.*

153. *Id.*

154. UNI-Group USA-Pavement, *at* http://www.uni-groupusa.org/case.htm (last visited Dec. 14, 2000).

155. *Id.*

156. *Id.*

designed to offer turf protection and load support in areas used by heavy vehicles."[157] The blocks create a flexible structural bridge system within the topsoil layer to support and distribute concentrated loads.[158] The Geoblock® Porous Pavement System is ideal for use in areas of low speed traffic.[159]

Some manufacturers recommend that completed porous pavement be vacuum-cleaned twice per year.[160] Most problems with porous pavement are related to clogging caused by improper or inadequate erosion/sediment control.[161] Once the spaces in porous pavement become clogged, stormwater cannot recharge groundwater.[162] According to Thomas Cahill of Cahill Associates in Pennsylvania, several important guidelines must be followed for porous pavement to work properly.[163] There must be field verification of the project soils to assure adequate thickness with acceptable drainage qualities and construction related sedimentation must be directed away from the porous pavement.[164] Cahill also suggests that special safeguards be included in the porous pavement bed design and that the installation be supervised and spot-checked.[165]

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157. *See* Presto Geoblock Porous Pavement System, *at* http://www.prestogeo.com/solutions/Geoblock/porous_pavement.html(last visited Sept. 15, 2001).

158. *See id.*

159. *See* Presto Case Studies, *at* http://www.prestogeo.com/files/pdfs/porous_pavement_technology.pdf (last visited Sept. 15, 2001).

160. *See* CAHILL, *supra* note 126.

161. *Id.*

162. *Id.* at 76.

163. *Id.*

164. *Id.* 77.

165. *Id.*

> Project success in part has resulted because of certain engineering features in porous surface/recharge bed design. (1) Selected filter fabric is placed generously on the floor and sides of the recharge bed after excavation/bed preparation, providing an inexpensive barrier between the stone-filled recharge bed and the soil mantle interface. This filter fabric allows water to pass readily, but prevents soil fines from migrating up into the rock basin, reducing the effective storage volume of the recharge bed. (2) In the event that the porous pavement

### B. *Innovative Site Design*

In addition to using pervious alternatives, developed sites can be designed to reduce impervious coverage and increase water quality benefits. A study of impervious surface coverage in the Chesapeake Bay watershed found that "car habitat [i.e. streets, driveways, and parking lots] exceeded the building footprint in every urban land use category, ranging from 55 to 75% of the total impervious surface area for a site. This finding suggests that better site design techniques that reduce the amount of car habitat have the most potential to reduce the mean impervious cover associated with that land use category."[166]

Clustering is the most commonly used conservation zoning measure. Several communities in the New York City Watershed have zoning regulations that allow clustering.[167] Generally,

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> were to become clogged, the edge of the porous paved area is designed to function as a linear overflow inlet around the perimeter of the parking bay. The inlet is accomplished quite simply by allowing a width of the bed around the perimeter to go unpaved, later to be topped off with a decorative river stone of some sort. Wheel stops are placed at the edge of the pavement, preventing vehicles from disturbing this emergency overflow. (3) Most intense traffic is directed away from porous surfaces. Porous surfaces are limited to parking areas receiving [sic.] least wear and tear. Roadways ringing the parking areas receive conventional pavement, but drain into the recharge beds.

*Id.* at 77.

166. CAPPIELLA & BROWN, *supra* note 94, at iii (2001).

167. N.Y. TOWN LAW § 278(1)(a) (McKinney 2001). Cluster development is defined as:

> a subdivision plat or plats, approved pursuant to this article, in which the applicable zoning ordinance or local law is modified to provide an alternative permitted method for the layout, configuration and design of lots, buildings and structures, roads, utility lines and other infrastructure, parks, and landscaping in order to preserve the natural and scenic qualities of open lands.

*Id.*

clustering allows a developer to avoid lot size requirements and build homes closer together, thereby preserving more open space.[168] The purpose of the law is to "enable and encourage flexibility of design and development of land in such a manner as to preserve the natural and scenic qualities of open lands."[169]

Towns should take pro-active design measures to reduce imperviousness because it makes sense both environmentally and fiscally.[170] Innovative site design can prevent waterbodies from excessive degradation related to impervious surfaces and it may save developers the expense of treating more stormwater runoff.[171]

## IV. LEGAL MECHANISMS REGULATING IMPERVIOUS SURFACES

In a September 2000 poll conducted nationwide, 76% of those polled indicated that their state needed to do more to manage and plan for new growth and development.[172] Forty-seven percent strongly agreed that government should give funding priority to maintain services in existing communities rather than encouraging new development in the countryside.[173] And 56% strongly agreed that communities should establish zones for green space, farming, and forests outside of existing cities and suburbs that would be off-

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168. 2 PATRICK J. ROHAN, ZONING AND LAND USE CONTROLS § 12.01[3] (Eric D. Kelly ed., rev. vol. 1996).

169. N.Y. TOWN LAW § 278(2)(b) (McKinney 2001).

170. 1 CENTER FOR WATERSHED PROTECTION, APPROACHES TO BETTER SITE DESIGN: WATERSHED LEADERSHIP KIT (CD-ROM, 1999). According to the Center for Watershed Protection, the annual maintenance costs for natural open space are only $75/acre; while annual maintenance costs for lawns and passive recreation (trails, bike paths) are $240-270/acre and $200/acre respectively. *Id.*

171. *Id.*

172. BELDEN RUSSONELLO & STEWART RESEARCH & COMMUNICATIONS, NATIONAL SURVEY ON GROWTH AND LAND DEVELOPMENT SEPTEMBER 2000 FOR SMART GROWTH AMERICA (Sept. 2000) (a national survey conducted September 7-10, 2000), *available at* http://www.smartgrowthamerica.com (last visited Apr. 16, 2001). The survey polled 1,007 adults. *Id.*

173. *Id.* at 2.

limits to developers.[174] Only 6% of those polled had a great deal of confidence in having private developers make land use decisions.[175] In the New York City Watershed, 63% of 400 registered voters in Westchester County indicated that suburban sprawl is a serious problem in their communities.[176]

### A. *Ordinances*

Impervious surface limiting ordinances promote open space preservation.[177] These ordinances involve cluster development, which can reduce impervious cover by 10% to 50% and reduce the need to clear 35% to 60% of the site.[178] An example includes the Land Preservation District Ordinance of Montgomery County, Pennsylvania, whose purpose is to preserve open land, sensitive natural areas, and rural community character that would be lost

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174. *Id.*

175. *Id.* at 3.

176. Press Release, The Trust for Public Land, Poll Finds Westchester Voters Concerned About Sprawl, Support Land Conservation (Aug. 7, 2000) (on file with the *Fordham Environmental Law Journal*).

177. Ctr. for Watershed Protection, Open Space, *at* http://www.wp.org/Model%Ordinances/Open%20Space.htm (last visited Jan. 2, 2002).

178. *Id.* The Center for Watershed Protection notes that open space development advantages include: reduced impervious cover in a development; reduced pollutant loads to streams and other water courses; reduced potential pressure to encroach on resource buffer areas; reduced soil erosion potential by reducing the amount of clearing and grading on the site; preservation of green space; preservation open space for recreation; lower capital cost of development; lower stormwater management costs by concentration of runoff in one area and reducing runoff volumes; a wider range of feasible sites to locate stormwater BMPs; lower costs of future public services needed by the development; possible increase in property values; creation of urban wildlife habitat islands; and support other community planning goals, such as pedestrian movement, neighborhood enhancement, farmland preservation, affordable housing, and architectural diversity. *Id.*

under conventional development.[179] This Ordinance contains neighborhood open space standards that require 75% of each tract to be set aside as open space.[180] The Center for Watershed Protection also has an Open Space Model Ordinance on its website.[181]

### B. *Offsets*

One potential solution for limiting impervious surface growth in the watershed is to establish an offset scheme.[182] For example, any development proposing to use impervious surfaces in a watershed basin at or exceeding the critical 10% threshold would need to remove a corresponding amount of impervious surface in the same basin.[183] Or, the developer may be required to replace a corresponding amount of impervious surface with pervious surface in the same basin.[184] This proposed offset scheme appears to be a lawful exercise of a regulatory body's power to protect the public health, safety, and welfare.[185] Moreover, the current watershed regulations, which regulate new impervious surfaces, are constitutional.[186] It is also unlikely that a Fifth Amendment takings problem would arise because project applicants are not being denied all economically viable use of their property.[187] Thus, an offset scheme should help maintain or even reduce a basin's impervious surface coverage.

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179. Montgomery County, P.A., *Open Space Model Ordinance, at* http://www.stormwater.net/Model%20Ordinances/open_space_land_preservation_ord.htm (last visited Dec. 27, 2001).

180. *Id.*

181. Ctr. for Watershed Prot., *Open Space Model Ordinance, at* http://www.cwp.org/Model%20Ordinances/open_space_model_ordinance.htm (last visited Dec. 27, 2001).

182. *See generally* Kittay v. Giuliani, 112 F. Supp.2d 342 (S.D.N.Y. 2000).

183. Schueler, *supra* note 41, at 104.

184. *See, e.g.*, NRC REPORT, *supra* note 49, at 13-14.

185. *Id.*

186. *See generally Kittay*, 112 F. Supp.2d 342.

187. *See generally* Lucas v. S. C. Coastal Council, 505 U.S. 1003 (1992) (suggesting that applicants would merely be required to adjust a project to protect public health and welfare).

### C. *State Environmental Quality Review Act*

Another process for curbing impervious surfaces in the watershed is through the State Environmental Quality Review Act ("SEQRA") process.[188] SEQRA "requires the consideration of environmental impacts along with social and economic factors in all agency decisionmaking."[189] Agencies must strictly adhere to SEQRA's procedures for reviewing environmental impacts.[190] These impacts, along with mitigation measures and alternatives, are considered through the environmental impact statement (EIS) process. If an EIS is required for a project, it must include an evaluation of the proposed project's potential significant adverse environmental impacts.[191]

The EIS also must include a mitigation section. Agencies must take measures to mitigate impacts and must make a finding that adverse environmental impacts have been mitigated to the maximum extent practicable.[192] Further, an EIS must consider a range of reasonable alternatives, including a "no action" alternative.[193] "The range of alternatives may also include: sites, technology, scale or magnitude, design, timing, use, [and] type of action."[194]

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188. State Environmental Quality Review Act (SEQRA), N.Y. ENVTL. CONSERV. LAW §§ 8-0101–8-0117 (McKinney 2001).

189. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, WHAT IS SEQR? (rev. Nov. 1997) (a pamphlet produced by the N.Y. State Department of Environmental Conservation discussing the State Environmental Quality Review Act).

190. *See generally* Jackson v. N.Y. State Urban Dev. Corp., 67 N.Y.S.2d 400 (1986).

191. *See* N.Y. COMP. CODES R. & REGS. tit. 6, § 617.9(b)(5)(iii) (2000). These impacts include, where applicable, reasonably related short-term, long-term, and cumulative impacts; unavoidable adverse impacts; irreversible and irretrievable commitments of resources; growth-inducing impacts; effect on energy use and conservation; effect on generation of solid waste. *Id.*

192. *See id.* §§ 617.9(b)(5)(iv), 617.11(d)(5).

193. *Id.* § 617.9(b)(5)(v).

194. MARK A. CHERTOK, OVERVIEW OF THE STATE ENVIRONMENTAL QUALITY REVIEW ACT 23 (Jan. 2001) (a memorandum written by an attorney of Sive Paget & Riesel and on file with the author and the *Fordham Environmental Law Journal*);

Agency and public comments should require applicants to include innovative site designs in their alternatives analysis. Moreover, pervious surfaces should be included as mitigation measures. When used properly, SEQRA can be a valuable tool for reducing impervious surfaces.

### D. *Total Maximum Daily Loads*

A Clean Water Act ("CWA") program that has great potential for reducing impervious surfaces in the watershed is the Total Maximum Daily Load ("TMDL") program.[195] Under CWA § 303(d), states are required to develop a list of impaired waters for those waterbodies that do not meet water quality standards. Once a waterbody is placed on the impaired waters list, the state must develop a TMDL that will allow the waterbody to meet the water quality standard for a specific pollutant.[196]

A TMDL is the amount of pollutant loading that a waterbody can assimilate and still meet water quality standards.[197] Once the state determines the TMDL figure for a pollutant, the amount of pollutant allowed into the water is split up between point sources (a wasteload allocation) and non-point sources (load allocation).[198] Then, the state must develop an implementation plan that sets forth mechanisms for reducing permitted discharges and controlling non-point sources of pollution.[199]

Many experts favor the TMDL program because it is one of the only avenues for addressing non-point source pollution. TMDLs first became visible around 1999, after environmental groups brought a few successful lawsuits.[200] TMDLs, however, have been a

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*see also* N.Y. COMP. CODES R. & REGS. tit. 6, §§ 617.9 (b)(5)(v)(a)–(g)(2000).

195. Federal Water Pollution Control Act, § 303(d); 33 U.S.C. § 1313(d) (2001).

196. *Id.*

197. *Id.*

198. *Id.*

199. *Id.*

200. *See, e.g.*, Raymond Proffitt Found. v. U.S. Envtl. Prot. Agency, 930 F. Supp. 1088 (E.D. Pa. 1996). EPA disapproved Pennsylvania's revised water quality standard. *Id.* at 1090-95. When Pennsylvania failed to make another submission within 90

part of the CWA since its inception in 1972. In fact, states urged that the TMDL program be left on the books.[201]

Several reservoirs in the New York City watershed are phosphorous impaired.[202] Phosphorous is a water quality problem for several reasons, including impacts on aquatic life, and color and taste.[203] More importantly where a drinking water supply is concerned, phosphorous increases algal growth.[204] When algae die there is an increase in organic carbon, which can react with chlorine and create a disinfection byproducts called trihalomethanes, which are linked to increased risks of cancer and miscarriage.[205]

In the Summer of 2000, New York State Department of Environmental Conservation (DEC) submitted to EPA its Phase II Phosphorous TMDLs.[206] In October, the EPA approved the TMDLs,

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days, the court held that such action triggered EPA's mandatory duty to "promptly prepare and publish" proposed regulations setting forth a new or revised water quality standard. *Id.* at 1090. EPA's 19-month delay was a breach of that duty and not in accordance with law. *Id* at 1101-02. The court ordered EPA to immediately prepare and publish water quality standards. *Id* at 1101; *see also* Sierra Club v. Clifford, No. CIV.A.96-0527, 1998 WL 1032129 (E.D. La. Sept. 22, 1998); *but see* Natural Res. Def. Council v. Fox, 93 F. Supp.2d 531 (S.D.N.Y. 2000) (holding that EPA's failure to declare the New York State's slow progress in promulgating TMDLs a "constructive submission" was not arbitrary, capricious, or not in accordance with the law).

201. OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY AND IMPLEMENTATION 14 (1999). New York State Governor Nelson Rockefeller was the principal witness for state interests, preferring the system of water quality standards, rather than "arbitrary emission standards." *Id.*

202. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, BUREAU OF WATERSHED MGMT., PHASE II PHOSPHOROUS TOTAL MAXIMUM DAILY LOADS FOR RESERVOIRS IN THE NEW YORK CITY WATER SUPPLY WATERSHED (DELAWARE, DUTCHESS, GREENE, PUTNAM, SCHOHARIE, SULLIVAN, ULSTER AND WESTCHESTER COUNTIES) 5 (June 2000) [hereinafter PHOSPHOROUS TMDL REPORT].

203. *Id.* at 7.

204. *Id.*

205. NRC REPORT, *supra* note 49, at 5-6, 104.

206. *See generally* PHOSPHOROUS TMDL REPORT, *supra* note 202.

which set forth a limit of 15 mcg/l in the source water reservoirs and kept an earlier 20 mcg/l limit for the rest of the reservoirs.[207] Currently, the state is meant to be formulating an implementation plan.

With a meaningful implementation plan, the new TMDL levels should require a more thorough review of phosphorous export in the SEQRA process. One practical consequence is that project applicants would need to reduce impervious surfaces in order to reduce phosphorous export.

## V. EXTRALEGAL MECHANISMS FOR PROMOTING PERVIOUS SURFACES AND BETTER SITE DESIGN IN THE NYC WATERSHED

### A. *Incentives*

Incentives are often used as a tool for promoting environmentally sensitive actions and preventing pollution at the source. Examples of incentive programs include the Clean Bay Business program in Palo Alto, California.[208] The Clean Bay Business program grants "Clean Bay Business" status for a year to businesses that use all recommended BMPs and do not violate water pollution laws.[209] "The program increased compliance from 4% in 1992 to 94% in 1998, and violations dropped by 90% from 1992 to 1995."[210]

Although this incentive program does not directly address impervious surfaces, regulators should seek similar innovative programs to reduce impervious surfaces. For example, agencies could give developers tax credits if pervious alternatives are used on a development site. Municipalities also may consider disincentives to keep developers from sprawling throughout their community.

207. Press Release, EPA Approves More Stringent Phosphorous Caps for New York City Drinking Water Reservoirs (Oct. 19, 2000), *available at* http://www.epa.gov/region02/news/2000/00194.htm (on file with the *Fordham Environmental Law Journal*).

208. LEHNER ET AL., NATURAL RES. DEF. COUNCIL, STORMWATER STRATEGIES: COMMUNITY RESPONSES TO RUNOFF POLLUTION (May 1999), *available at* http://www.nrdc.org/water/pollution/storm/stoinx.asp (last visited Oct. 25, 2001).

209. *Id.*

210. *Id.*

Such disincentives include refusing to pay for sewers, roads, and other infrastructure to service the proposed development, and upzoning.

### B. *Training Workshops*

Another extralegal mechanism for reducing impervious surfaces in the watershed includes establishing training workshops for regional and local planning agencies and project applicants.[211] Carefully planned workshops can teach planners and developers about the dangers of impervious surfaces, and pervious surface alternatives and innovative site design solutions.[212] As a result, planners are better informed when reviewing project applications and applicants will have a greater understanding of development alternatives.

## CONCLUSION

Impervious surfaces are one of the greatest threats to water quality. It is time for New York City drinking water supply regulators and advocates to discuss mechanisms for reducing such surfaces. Reducing stormwater runoff by reducing impervious surfaces contributes to local economies by "avoiding costly treatment of contaminated waters, minimizing property damage from erosion and flooding, preventing human illness, and protecting recreational waters. . . . [Moreover] [p]reserved areas offer parks, ponds offer beauty and wildlife habitat, clean streets are more attractive, sediment control improves fisheries, and flow control prevents flooding."[213] Several alternatives, including pervious surfaces and better site design exist to achieve this goal. The next step is to determine which alternatives can be used in the watershed and what legal and extralegal mechanisms can be used to encourage or require them. The barriers to implementation are insignificant in light of the

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211. *See generally id.*

212. *Id.*

213. George Aponte Clarke & Nancy Stoner, *Stormwater Strategies: The Economic Advantage, in* 2 STORMWATER 16 (Jan./Feb. 2001), *available at* http://www.forester.net/sw_0101_stormwater.html (last visited Jan. 2, 2002).

threat to unfiltered drinking water for over half of New York State's population.