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ARTICLES

THE PATHOLOGY OF PROPERTY NORMS: LIVING WITHIN NATURE'S BOUNDARIES

LYNDA L. BUTLER*

INTRODUCTION

For centuries property rights have played a critical role in defining a society's fundamental relationship with its foundation ecosystem.¹ In colonial America, for example, the expectation of property rights in land contributed to the development of America's capitalist economy, private property system, republican political structure, and exploitative attitude

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1. See generally *BEDER INTERNATIONAL INSTITUTE OF ECOLOGICAL ECONOMICS, THE ROYAL SWEDISH ACADEMY OF SCIENCES, RIGHTS TO NATURE* (Susan S. Hanna et al. eds., 1996) (discussing the relationship between property rights regimes and the natural environment). For a discussion of the importance of private property to ancient and modern civilizations, see RICHARD SCHLATTER, *PRIVATE PROPERTY* (1951).

toward natural resources.² On a more global scale, the quest for water resources and rights has had similarly profound effects.³ Scholars have explained how mathematics and engineering were developed in part to design irrigation systems,⁴ astronomy was used to predict seasonal and climatic changes affecting the availability of water,⁵ civil engineering was developed to deal with flooding and water supply projects,⁶ and legal and political systems were needed to impose water allocation rules.⁷ What these linkages often ignore is the importance of water and soil to ecological systems, and the impact of urbanization and land development on watersheds and ecosystems.

This failure to give serious consideration to the connections between land development, water use, and ecosystem health reflects a fundamental problem within American property law and current ecosystem and resource management practices. The problem is adherence to a value system that poses serious obstacles to effective management of ecosystems and natural resources. The obstacles raised by property norms are especially evident in the core justifications, fundamental principles, and key policies of American property law, and in the legal principles governing allocation and management of natural resources. For the most part, disputes over natural resources are resolved by determining who has the right to conduct a

2. The abundance of land in colonial America apparently created expectations in immigrants of becoming private landowners. Almost from the beginning, colonists settling in Virginia expected to be able to acquire land from the colony's seemingly inexhaustible supply. Efforts by the Crown and royal governors to assert royal prerogatives over colonial lands "never were successful in convincing the Virginia colonists that land grants were a matter of royal grace and generosity." LYNDIA LEE BUTLER & MARGIT LIVINGSTON, *VIRGINIA TIDAL AND COASTAL LAW* § 8.1, at 266 (1988). See also FREDERICK JACKSON TURNER, *THE FRONTIER IN AMERICAN HISTORY* 168-69 (1920) (maintaining that frontier conditions, and not the character of the earlier settlers, primarily influenced the development of American democracy). See generally JAMES W. ELY, JR., *THE GUARDIAN OF EVERY OTHER RIGHT* (1992) (discussing the role of property in shaping the American constitutional order).

3. See generally LUDWIK A. TECLAFF, *WATER LAW IN HISTORICAL PERSPECTIVE* 1-4 (1985) (discussing the impact of water on the past development of civilization).

4. See ROBERT BRITAIN, *RIVERS, MAN AND MYTHS: FROM FISH SPEARS TO WATER MILLS* 83-84, 92-96, 108-10, 183-84 (1967). See also *After the Warming: Episode One* (PBS Television Broadcast, Nov. 21, 1990) (discussing the ecological evolution of the world and its effect on the development of civilization).

5. See BRITAIN, *supra* note 4, at 77-79. See also *After the Warming*, *supra* note 4 (discussing the importance of water to ancient cultures and the development of mathematical systems to predict weather changes).

6. See LUDWIK A. TECLAFF, *THE RIVER BASIN IN HISTORY AND LAW* 16-17 (1967).

7. See *id.* at 24. See generally MORTON J. HORWITZ, *THE TRANSFORMATION OF AMERICAN LAW, 1780-1860*, at 31-62 (1977) (discussing the great impact of water law on the transformation of property law into a pro-development body of law).

use—that is, by engaging in “rights talk.”⁸ Although issues relating to ecosystem health and resource conservation also may arise in disputes, these issues generally do not control resolution of the disputes.⁹ Rather private property norms tend to drive allocation of interests in natural resources, particularly water resources, and management of natural systems.¹⁰

Although the precise meanings and expectations attributed to private property norms may vary from group to group or person to person, the norms generally involve a belief in the existence or necessity of certain key attributes of property, particularly land ownership. Basic characteristics of property include:¹¹ a preference for private ownership;¹² exclusivity, or the power and right to exclude others;¹³ free transferability, or the right to

8. See MARY ANN GLENDON, *RIGHTS TALK: THE IMPOVERISHMENT OF POLITICAL DISCOURSE* 3–4 (1991); Eric T. Freyfogle, *Ownership and Ecology*, 43 CASE W. RES. L. REV. 1269, 1286–87 (1993).

9. The obstacles raised by property norms are especially evident in the legal principles governing water resources. For a discussion of the evolution of watershed protection laws and programs, see BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS (Lance H. Gunderson et al. eds., 1995) [hereinafter BARRIERS AND BRIDGES]. See also Robert W. Adler, *Addressing Barriers to Watershed Protection*, 25 ENVTL. L. 973 (1995).

10. See *infra* Part I.

11. For hundreds of years scholars have debated and discussed the key characteristics of property. According to Honoré, for example, property has eleven key characteristics: the right to possess, the right to use, the right to manage, the right to the derivative income, the right to the capital, the right to security, the power of transmissibility, the absence of term, the prohibition of harmful use, liability to execution, and residuary character. See LAWRENCE C. BECKER, *PROPERTY RIGHTS: PHILOSOPHIC FOUNDATIONS* 18–20 (1977) (discussing Honoré’s concept of ownership). Richard Posner, on the other hand, identifies four characteristics that are, in his view, necessary for the efficient use of resources and therefore are critical traits of property. According to Posner, property must be: 1) valuable (“scarce as well as desired”); 2) owned by someone (or as Posner states, subject to “the criterion of universality”); 3) exclusive (giving the owner the power to exclude others from using a resource); and 4) freely alienable or transferable. RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* § 3.1, at 36–38 (5th ed. 1998).

12. See 2 SIR WILLIAM BLACKSTONE, *COMMENTARIES ON THE LAWS OF ENGLAND* 3–5 (Dawsons of Pall Mall ed. 1966) (1766); POSNER, *supra* note 11, § 3.2. See also Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972) (developing a legal framework, based on the concept of entitlement, for analyzing various aspects of the pollution problem).

13. See POSNER, *supra* note 11, § 3.1. The Supreme Court has, in various cases, recognized the importance of exclusivity. See *Nollan v. California Coastal Comm’n*, 483 U.S. 825 (1987) (deciding that government could not, without payment of just compensation, condition the approval of a rebuilding permit on the landowners’ transfer to the public of lateral access across their beachfront property); *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419 (1982) (deciding that a law requiring landlords to permit cable companies to install cable facilities on rental property was an unlawful taking); *Kaiser Aetna v. United States*, 444 U.S. 164 (1979) (holding that government could not, without payment of just compensation, require owners of a marina to open the marina to the public). Cf. JAMES M. ACHESON, *THE LOBSTER GANGS OF MAINE* 48–49, 73–77, 142–44 (1988) (discussing different kinds of property falling along a spectrum of exclusivity).

alienate property;¹⁴ and a reasonable expectation of gain, including the right to conduct an economically viable use free from unfair government or private interference.¹⁵ The phrase "unfair government or private interference" is intended to capture a variety of legal standards defining when government or private interference with property rights is unlawful. The phrase, for example, would include government interference that denies a landowner a reasonable return,¹⁶ or singles out a landowner "to bear public burdens which, in all fairness and justice, should be borne by the public as a whole."¹⁷ It also would include private action that directly interferes with a property owner's lawful attempt to make a gain from her own property¹⁸ or engages in unfair competition or unfair trade practices to reap the benefits of another property owner's investment and labor.¹⁹ The key attributes of property reflect an image of private ownership that separates the owner from the owned resource and that gives the owner general control over the property as against all others.²⁰ Though some legal restrictions on land use exist, stringent restrictions are the exception rather than the rule. That is, a property owner "can, for the most part, do as she likes."²¹

14. See POSNER, *supra* note 11, § 3.1. Restraints on alienation have been disfavored for hundreds of years. See generally 6 AMERICAN LAW OF PROPERTY §§ 26.1-4 (1952) (discussing the long-standing policy favoring freedom of alienation).

15. See *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003 (1992) (recognizing a property owner's right to be free from government action that denies all economically beneficial or productive use of land); *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 130-31, 136 (1978) (focusing on permitted uses to determine whether the challenged government law allowed the landowner to receive a reasonable return); *International News Serv. v. Associated Press*, 248 U.S. 215, 236 (1918) (recognizing the right to acquire property by honest labor and the right to a reasonable opportunity to reap the benefits of one's skill, labor, or stock in trade free from unfair competition); *Keeble v. Hickeringill*, 103 Eng. Rep. 1127 (Q.B. 1707) (recognizing the right to make a livelihood from one's property free from unlawful interference). During certain periods in the development of American legal thought, the expectation of freedom from government interference with property rights has been expressed in absolutist terms even by jurists. See G. EDWARD WHITE, *From Sociological Jurisprudence to Realism: Jurisprudence and Social Change in Early Twentieth-Century America*, in *PATTERNS OF AMERICAN LEGAL THOUGHT* 99, 102 (1978).

16. See *Penn Cent.*, 438 U.S. at 130-31, 136.

17. *Armstrong v. United States*, 364 U.S. 40, 49 (1960).

18. See *Keeble*, 103 Eng. Rep. at 1128.

19. See *International News Serv.*, 248 U.S. at 236.

20. See Freyfogle, *supra* note 8, at 1274-75.

21. *Id.* at 1275. See also Stewart E. Sterk, *Neighbors in American Land Law*, 87 COLUM. L. REV. 55, 55 (1987) ("Whoever is allocated an ownership right . . . is largely free to do with it as he sees fit . . ."); WHITE, *supra* note 15, at 100-02 (discussing the late nineteenth century notion of absolute property rights). Statements that property rights are absolute can have different meanings. See JOHN CHRISTMAN, *THE MYTH OF PROPERTY* 29-31 (1994).

This article will demonstrate the pervasive and pathological effects of property norms on land and water use, natural resource allocation, and ecosystem management. Those norms have played a significant role in the development of water and other resource allocation systems, affecting the rules, standards, and criteria guiding allocation of rights and resolution of use conflicts.²² The norms also have significantly affected the focus, scope, and stringency of watershed and land use management programs in ways that detrimentally impact the effectiveness of the programs and the health of ecosystems.²³ Land ownership norms, in particular, have contributed to the development of a pathology of escalating land and water use, and of ineffective watershed or ecosystem management over the long term. Land norms have controlled the development of principles governing water allocation and use, producing water allocation systems that generally ignore ecological values, cumulative and ecosystem-wide impacts of water use, and mounting evidence of the need for stronger water conservation and growth control measures.²⁴ In addition, while some ecosystem or watershed management programs have achieved success over the short term,²⁵ land norms have had pathological effects on management programs over the long term. These effects have contributed to the development of less resilient ecosystems that are more prone to becoming persistently degraded by disturbances once absorbed by the ecosystem.²⁶

To demonstrate the pervasive and pathological influence of property norms on ecosystem health, the article first discusses the inherent conflict between traditional private property norms and effective ecosystem management, and then explores the pathological effects of property norms on resource allocation systems and ecosystem management programs. Part I examines the rights-based nature of resource allocation and management systems. The discussion will demonstrate that even when allocation and management decisions are based on scientific evidence and

22. See *infra* Part I.A.

23. See *infra* Part I.B.

24. See *infra* Part II.A.

25. For example, Virginia's ban on phosphate detergents produced surprisingly quick results. Effective January 1, 1988, the ban reduced the concentration of phosphorus discharged from secondary treatment plants by about 50% in only one year. See CHESAPEAKE EXECUTIVE COUNCIL, THE FIRST PROGRESS REPORT UNDER THE 1987 CHESAPEAKE BAY AGREEMENT 21 (Jan. 1989) [hereinafter 1989 CHESAPEAKE EXECUTIVE COUNCIL PROGRESS REPORT].

26. See *infra* Part II.B. Traditional forest management policies, for example, have placed a high priority on preventing forest fires and minimizing the occurrence of insect infestation. This priority has led to greater contiguity of forest areas and therefore to greater devastation once fires or defoliating insects disturb an area. Disturbances of forests having more contiguous area tend to result in more extensive damage. See generally Gordon L. Baskerville, *The Forestry Problem: Adaptive Lurches of Renewal*, in BARRIERS AND BRIDGES, *supra* note 9, at 37-102.

principles, the decisions reflect the influence of land ownership norms. Part II then explores the pathological effects of property norms on land and water use choices and on watershed and ecosystem management programs. These pathological effects will be studied in the use context through a narrative of conflict over water, and in the management context through an examination of studied managed ecosystems. Particular emphasis in the watershed management context will be placed on the Chesapeake Bay management program, one of the world's most watched programs.

Finally, in Part III, the article offers some thoughts on how to stop the pathologies of escalating land and water use and of ineffective ecosystem management over the long term. Three principal solutions will be proposed: first, an internal solution that calls for the reexamination of property norms shaping the behavioral incentives of land use decisionmakers;²⁷ second, an external solution that advocates the adoption of an adaptive approach to watershed and ecosystem management to guide the reexamination of property norms and, when necessary, apply pressure on the private property system to account for the ecological costs of land use;²⁸ and third, a bridge-building and fairness-enhancing solution that recommends more effective monitoring of ecosystems for surprise in order to gauge ecological integrity and ensure rough proportionality between redefined property rights and the scales of private use.²⁹ All of the proposed solutions recognize that humans must continually reassess their impact on the foundation ecosystem in defining their norms, rules, and standards.

I. THE INHERENT CONFLICT BETWEEN TRADITIONAL PROPERTY NORMS AND ECOSYSTEM MANAGEMENT

Many of the norms, principles, and policies of traditional American property law inherently conflict with the goal of effective ecosystem management over the long term.³⁰ These key norms, principles, and

27. See *infra* Part III.A.

28. See *infra* Part III.B.

29. See *infra* Part III.C.

30. The term "ecosystem" has been defined in a variety of ways to include different levels of complexity and scale. See Anthony W. King, *Considerations of Scale and Hierarchy*, in *ECOLOGICAL INTEGRITY AND THE MANAGEMENT OF ECOSYSTEMS* 19, 20 (Stephen Woodley et al. eds., 1993) [hereinafter *ECOLOGICAL INTEGRITY*]. One widely used definition describes an ecosystem as "[t]he organisms living in a particular environment . . . and the physical part of the environment that impinges on them. The organisms alone are called the community." EDWARD O. WILSON, *THE DIVERSITY OF LIFE* 396 (1992) (glossary). As Oliver Houck has noted, the United States Fish and Wildlife Service has used this definition to conclude that "an ecosystem can be anything from 'a drop of water' to 'the

policies reflect a strong "societal preference for individualism and autonomy"³¹ that has thwarted efforts to develop effective ecosystem-based management. Captured in some of the basic attributes of private property, this social preference has shaped the development of resource allocation systems and management programs. Standards and rules governing resource allocation, management, and use all have been affected by the private-rights-based thinking of traditional property law.³²

The strong ties between private property norms and resource allocation and management systems necessarily limit the systems' ability to recognize and account for ecological interests. As numerous scholars have explained, the private property system does not effectively account for ecological values that are not easily measured, particularly values that reflect intangible interests or have long-term implications.³³ The private property system also does not effectively include environmental resources that are too plentiful to make creation of a private property system worthwhile,³⁴ or that are public goods involving either economies of scale

entire biosphere." Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 874 n.13 (1997) (quoting U.S. FISH & WILDLIFE SERVICE, AN ECOSYSTEM APPROACH TO FISH AND WILDLIFE CONSERVATION 6 (1994)). The ecosystem concept implicitly includes the concepts of ecosystem function and ecosystem structure. Ecosystem function refers to the "functioning or operation of the ecosystem, its integrated holistic dynamics, and not the role or job of the ecosystem." King, *supra*, at 20. Ecosystem structure generally means the "distribution of matter and energy among system components." *Id.* The term "watershed" traditionally has been defined from a hydrological perspective to mean "a unit of natural or disturbed land on which all the water that falls (or emanates from springs) collects by gravity and fails to evaporate and runs off via a common outlet." PETER E. BLACK, *WATERSHED HYDROLOGY* 278 (2d ed. 1996).

31. Sterk, *supra* note 21, at 90. For a discussion of colonial laws governing land distribution and use, see BUTLER & LIVINGSTON, *supra* note 2, §§ 8.1–5, at 245–303; ELY, *supra* note 2, at 10–25; John F. Hart, *Colonial Land Use Law and Its Significance for Modern Takings Doctrine*, 109 HARV. L. REV. 1252, 1259–81 (1996).

32. For examples, see *infra* Parts I.A & I.B.

33. See, e.g., STEVEN C. HACKETT, *ENVIRONMENTAL AND NATURAL RESOURCES ECONOMICS* 42–59 (1998) (explaining why markets fail to protect environmental quality); MARK SAGOFF, *THE ECONOMY OF THE EARTH* 24–49, 74–98 (1988) (discussing issues relating to valuation of environmental interests). For a discussion of some of the issues raised by economic perspectives to environmental values, see Lynda L. Butler, *Private Land Use, Changing Public Values, and Notions of Relativity*, 1992 BYU L. REV. 629, 641–44, 648–51. For provocative discussions of the services provided by ecosystems and of the value of those services to society, see *NATURE'S SERVICES* (Gretchen C. Daily ed., 1997) and Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton & Marjan van den Belt, *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE 253 (1997).

34. Two resources typically given as examples of plentiful resources are the oceans and air. See Lynda L. Butler, *Environmental Water Rights: An Evolving Concept of Public Property*, 9 VA. ENVTL. L.J. 323, 358 (1990). The costs of implementing a private allocation system for such resources would

or high but diffused public demand.³⁵ Resource allocation and management systems accordingly favor consumptive uses and private interests over ecological uses and public interests.³⁶ While current thinking on water allocation and watershed management recognizes and attempts to correct the limitations of traditional approaches, current systems still are limited in many ways by the norms underlying property rights, particularly land ownership. Parts I.A and I.B examine the rights-based nature of resource allocation systems and ecosystem management programs.

A. THE RIGHTS-BASED NATURE OF RESOURCE ALLOCATION SYSTEMS

In the United States, traditional resource allocation systems are largely based on private property principles and policies that define and allocate private rights of use, control, exchange, and expectation of gain.³⁷ This focus on private rights exists not only in fundamental principles defining original acquisition of property rights and key theories, policies, and instrumental ends of property law, but also in the basic principles governing allocation of specific natural resources. A comparison of some of the principles, policies, and allocation rules governing private property generally and natural resources specifically will demonstrate the rights-based nature of resource allocation systems. Because of their rights-based focus, resource allocation systems inherently conflict with effective ecosystem management over the long term.

1. *Key Principles, Policies, and Rules Defining the Private Property Concept*

The fundamental principles governing original acquisition of property rights reward the first laborer, first discoverer, and first captor. Preference basically is given to those who have controlled, cultivated, developed, or otherwise conquered nature.³⁸ The common law doctrines used to promote this preference "presuppose[] . . . an agrarian or a commercial people" who

outweigh the benefits, and the resources thus are generally treated as exceptions to the private property approach. *See id.* at 358–59.

35. The "public goods exception" typically occurs when the private market system "predictably fails to produce socially optimal uses." *Id.* at 358. Government control arguably is needed in the public goods situation to correct the market's failure and achieve proper allocation of resources. *See id.*

36. *See* Eric T. Freyfogle, *Water Rights and the Common Wealth*, 26 ENVTL. L. 27, 28–30 (1996).

37. For a discussion of whether property norms include the profit motive, see *infra* notes 241–243 and accompanying text.

38. *See* Carol M. Rose, *Possession as the Origin of Property*, 52 U. CHI. L. REV. 73, 87–88 (1985).

value “lasting control” of resources for purposes of promoting commerce and trade.³⁹ By awarding property rights to the first possessor, the common law of property is giving “significance and form to what might seem the quintessentially individualistic act: the claim that one has, by ‘possession,’ separated for oneself property from the great commons of unowned things.”⁴⁰ People who want to live in harmony with the land, without controlling and developing it, generally are not protected by the principles governing original acquisition of property.⁴¹

Consider also the fundamental legal conception of property as a preference-satisfying device—a commodity that allows individuals to satisfy their preferences through market exchanges.⁴² As Gregory Alexander explains in his thoughtful work *Commodity & Propriety*: “Legal writing, especially scholarly writing and judicial opinions, has increasingly come to reflect the idea that the basic, if not the sole, purpose of property is the satisfaction of individual preferences through market transactions.”⁴³ Although the commodity view of property has influenced America since its colonization, this view has gained strength in the last twenty-five years as the law and economics movement has grown.⁴⁴ Adherence to the market view of property has meant the development of market-oriented policies of property law. Those policies have affected natural resource allocation and management systems in ways that undermine ecological integrity.

One key policy is the promotion of present use and development, particularly short-term productive use. The central importance of this policy to property law can be seen in its incorporation into a wide variety of property law doctrines. The present use and development policy, for example, is reflected in the theory of economic takings developed by the Supreme Court to protect economically beneficial use of land,⁴⁵ the present

39. *Id.* at 87.

40. *Id.* at 88.

41. *See id.* at 87. This point is implicitly reflected in Justice Marshall’s opinion in *Johnson v. M’Intosh*, 21 U.S. (8 Wheat.) 543, 590 (1823). *See generally* HORWITZ, *supra* note 7, at 32–34 (discussing the evolution of the first-in-time priority rule from an agrarian, natural use doctrine to “an offensive doctrine justified by its power to promote economic development”); Christopher Vecsey, *American Indian Environmental Religions*, in *AMERICAN INDIAN ENVIRONMENTS* 1, 1–37 (Christopher Vecsey & Robert W. Venables eds., 1980) (discussing the relationship between American Indians and nature).

42. *See* GREGORY S. ALEXANDER, *COMMODITY & PROPRIETY* 1–17 (1997) (introducing the commodity, or market, and the propriety, or public good, conceptions of property).

43. *Id.* at 379.

44. *See id.* at 8–9, 379–84. *See generally* HORWITZ, *supra* note 7, at 31–62 (discussing the transformation of property law from a system based on an agrarian vision of absolute dominion and use to a utilitarian vision of productive development and use).

45. *See, e.g.,* *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003 (1992).

use orientation of water allocation laws,⁴⁶ and the mechanical settlement and use requirements of colonial and early statehood land distribution laws.⁴⁷ In other words, from its fundamental constitutional context to its mechanical allocation rules, the traditional property system has been designed to promote short-term productive use—"to ensure prompt and tangible financial returns."⁴⁸ This goal generally conflicts with the "lengthy observation periods and managerial forbearance" required for effective ecological management.⁴⁹

Another key policy of property law, the promotion of certainty and stability, also conflicts with some basic components of effective ecosystem management. As many have already explained, property law needs to promote certainty and stability in order to encourage investment and use, reduce transaction costs, facilitate the administration of property regimes and the resolution of property conflicts, and clarify the deterrents and incentives faced by property owners.⁵⁰ The importance to property law of promoting certainty is evidenced by its impact on a wide range of laws affecting natural resources, including wild animals,⁵¹ oil and gas,⁵² water,⁵³ and land.⁵⁴ Because ecosystems are ever changing and unpredictable, protection of ecosystems will require policies that conflict with the certainty goal underlying many property law principles.⁵⁵

2. *Private Property's Domination of Resource Allocation Systems*

The fundamental principles, values, and policies defining the private property concept have controlled the development of America's natural resource allocation systems. Two of those systems—land distribution laws

46. See *infra* notes 67–69, 75–88, 91–95 and accompanying text.

47. Throughout Virginia's colonial and early statehood periods, for example, its land distribution system was used to promote various economic, political, and social goals. See generally BUTLER & LIVINGSTON, *supra* note 2, §§ 8.1–.5, at 245–303 (discussing Virginia's colonial and early statehood land laws).

48. Robert B. Keiter, *Ecosystems and the Law: Toward an Integrated Approach*, 8 ECOLOGICAL APPLICATIONS 332, 332 (May 1998).

49. *Id.*

50. See, e.g., *Pierson v. Post*, 3 Cai. R. 175 (N.Y. 1805) (discussing the importance of certainty and stability to wild animal law).

51. See, e.g., *id.*

52. See, e.g., *Hammonds v. Central Ky. Nat. Gas Co.*, 75 S.W.2d 204 (Ky. 1934) (applying the wild animal escape rule to terminate ownership rights over gas when the gas escapes), *overruled by Texas Amer. Energy Corp. v. Citizens Fidelity Bank & Trust Co.*, 736 S.W.2d 25 (Ky. 1987).

53. See *infra* notes 81, 90 and accompanying text (discussing the first-in-time rule governing use of surface waters in western states).

54. See, e.g., *Tapscott v. Cobbs*, 52 Va. (11 Gratt.) 172 (1854) (protecting the first possessor).

55. See Keiter, *supra* note 48, at 332.

and water allocation systems—are discussed briefly to highlight the pervasive influence of the private property concept.

The land laws used to distribute interests in real property in the colonial and early statehood periods demonstrate the influence of core values underlying property law: individualism, self-autonomy, and certainty. Although a communal system of landholding initially was tried in Jamestown, the first permanent settlement in America, it was abandoned seven years after its adoption. In granting power to a group of investors to establish the Virginia colony, King James I authorized the distribution of land to private parties upon nomination and approval by the King.⁵⁶ Eventually known as the London Company, the group of investors decided initially to hold land in the colony for the common use and benefit of the settlers.⁵⁷ The investors apparently feared that immediate distribution of private land rights would leave them with insufficient funds to cover the costs of colonization. One of the London Company's pamphlets explained that a party interested in purchasing land in the Virginia colony would need to buy stock in the Company and hold it for a seven-year period. At the end of the period, the purchaser would receive land from the Company.⁵⁸ When the first seven-year period ended in 1616, the Company carried out its promised land distribution, abandoning its communal (or plantation) system.⁵⁹ The Company apparently realized that the communal system was thwarting development⁶⁰ and replaced it with a land distribution system that favored greater distribution to private parties.⁶¹

American land laws generally distributed geometrically distinct tracts of land to individuals who met land settlement requirements designed to promote land use and development for various social, political, and

56. See Letters Patent to Sir Thomas Gate, Sir George Somers, and others, for two several Colonies and Plantations, to be made in Virginia, and other parts and Territories of America, 4 Jam.—Stith's App. No. 1, pa. 1 (Apr. 10, 1606), reprinted in 1 WILLIAM WALLER HENING, *THE STATUTES AT LARGE* 57–66 (1823); The Second Charter to the Treasurer and Company, for Virginia, erecting them into a Corporation and Body Politic, and for the further enlargement and explanation of the privileges of the said Company and First Colony of Virginia, 7 Jam.—Stith's App. No. 2 (May 23, 1609), reprinted in HENING, *supra*, at 80–98.

57. See NOVA BRITANNIA: OFFERING MOST EXCELLENT FRUITES BY PLANTING IN VIRGINIA 23–24 (1609), reprinted in 1 TRACTS AND OTHER PAPERS VI (Peter Smith ed. 1947) (Peter Force coll. 1835) (advertisement pamphlet to entice settlers to Virginia colony).

58. See *id.* The pamphlet indicated that shareholders would receive land dividends at a rate of at least 500 acres per share. See *id.* at 24.

59. See BUTLER & LIVINGSTON, *supra* note 2, § 8.1, at 245.

60. See *id.* at 245.

61. See *Instructions to Governor Yeardley, 1618*, reprinted in 2 VA. MAG. HIST. & BIOGRAPHY 154 (1894).

economic purposes.⁶² Some sort of use—for example, pasturing and clearing—typically was required to acquire title.⁶³ Other requirements might include payment of consideration, surveying and locating the specified amount of land, returning a completed plat, and defeating objections to the issuance of a grant.⁶⁴ All of the requirements were part of a lengthy process of separating not only the purchased land from the waste and unappropriated lands still available for entry and grant, but also the purchaser from his neighbors.⁶⁵ Property rights in land, in other words, reflected notions of separateness and boundedness that are at odds with the principles of connectedness and fluidity at the core of ecosystem science.

The traditional American systems of law governing water use in both the water-rich East and the water-poor West also have reflected the preferences for individualism, autonomy, separateness, and economic development promoted by American land laws and underlying the private property concept.⁶⁶ Water allocation and management systems are especially important to effective ecosystem management goals because of the importance of water to ecosystems and land use. From a physical perspective, water both constrains and enables land development. Despite the two-sidedness of this link between water resources and land use, American water allocation systems generally only focus on the enabling role of water. That is, the traditional water allocation systems generally encourage out-of-stream, consumptive uses of water designed to enable land development and do not allow ecosystem characteristics and needs to dominate water use decisions.⁶⁷ This clear preference for consumptive use

62. See BUTLER & LIVINGSTON, *supra* note 2, § 8.1, at 262–68; Sterk, *supra* note 21, at 55. For a discussion of the land settlement and land grant process in Virginia, see BUTLER & LIVINGSTON, *supra* note 2, §§ 8.1–.5, at 245–303. See generally PAUL W. GATES, HISTORY OF PUBLIC LAND LAW DEVELOPMENT 33–74 (1968) (discussing colonial land systems, state cessions of western land claims, and the development of public land laws and policies); HORWITZ, *supra* note 7, at 101–08 (discussing the relationship between property rights and individualism); PATRICIA NELSON LIMERICK, THE LEGACY OF CONQUEST: THE UNBROKEN PAST OF THE AMERICAN WEST (1987) (discussing the role of the federal government in promoting and regulating land development in the American West).

63. See BUTLER & LIVINGSTON, *supra* note 2, § 8.1, at 262–63.

64. See *id.* § 8.3, at 279–81.

65. See Sterk, *supra* note 21, at 90 (“The geometric-box allocation generally permits landowners to avoid interaction with others, including neighbors, unless both the landowner and the other provide for interaction by explicit agreement.”). See generally ALEXANDER, *supra* note 42, at 97–126 (discussing the revision of land law during the Jacksonian era to promote the economic conception of property); BUTLER & LIVINGSTON, *supra* note 2 (discussing the colonial and early statehood land distribution laws in Virginia).

66. See HORWITZ, *supra* note 7, at 34.

67. See Butler, *supra* note 34, at 326–30; Freyfogle, *supra* note 36, at 27–30.

is reflected in the alienability of traditional water rights⁶⁸ and in the traditional systems' treatment of water as a commodity to be used and transported to meet human ends.⁶⁹ A brief discussion of the traditional systems will demonstrate their enabling effect on land development and use, as well as their unsuccessful constraining effect.

Under the system traditionally governing the water-rich East, rights in a watercourse arise as an incidence of owning land adjoining the watercourse.⁷⁰ Owners of such riparian land generally have the right to make reasonable use of the water in the watercourse for the benefit of their riparian land.⁷¹ Because other riparians along the watercourse have a similar right, each riparian's right to reasonable use is subject to the correlative rights of other riparians.⁷²

Two key aspects of the riparian doctrine define the scope of water use rights. First, the water use must be tied to riparian land; a riparian proprietor can only exercise her rights for the benefit of riparian land.⁷³ Second, the riparian use must, in most traditional riparian jurisdictions, be reasonable.⁷⁴ Both requirements incorporate land ownership norms. The riparian land requirement restricts the land that can benefit from the use of a watercourse by recognizing that riparian rights inhere in the ownership rights of riparian landowners. The reasonable use requirement defines the quantitative use rights of riparian owners.⁷⁵ In developing this standard, the courts traditionally have assumed that the riparian user is a private agrarian who supplies all his or her consumptive water needs.⁷⁶

68. See A. DAN TARLOCK, *LAW OF WATER RIGHTS AND RESOURCES* § 5.17 (11th ed. 1999). See also Lynda L. Butler, *Allocating Consumptive Water Rights in a Riparian Jurisdiction: Defining the Relationship Between Public and Private Interests*, 47 U. PITT. L. REV. 95, 137-56 (1985) (discussing the transferability of consumptive and nonconsumptive water rights in a riparian jurisdiction); *infra* note 80 and accompanying text (discussing the transferability of riparian rights).

69. See Freyfogle, *supra* note 36, at 35.

70. See Butler, *supra* note 34, at 327.

71. See Butler, *supra* note 68, at 105. In the nineteenth century most courts followed the natural flow theory, which generally gave each riparian the right to receive the natural flow of the watercourse. Under this approach a downstream riparian could enjoin a use by an upstream riparian if the use diminished the quality or quantity of water, regardless of whether the downstream riparian was injured. See TARLOCK, *supra* note 68, § 3.12[1].

72. See Butler, *supra* note 68, at 106-07. A riparian is entitled to the use of the flow of a watercourse after reasonable use by upstream riparians but may not unduly interfere with the correlative rights of downstream riparians. See *id.*

73. See *id.* at 107-25.

74. See *id.* at 125-30.

75. See *id.* at 125-26.

76. See *id.* at 125.

The riparian doctrine incorporates private property norms in a number of ways. Besides reflecting a preference for private ownership of water rights, the doctrine treats riparian rights as vested property rights whose allocation is tied to the ownership of riparian land—not to the jurisdiction, the needs of political units, or the interests of the public. Additionally, the traditional riparian system prefers consumptive riparian uses through the reasonable use requirement and through the principles and rules governing resolution of water use conflicts. Riparians along a watercourse know that upstream riparians have the right, and therefore the opportunity, to conduct their reasonable uses before the water reaches the downstream users.⁷⁷ Under certain circumstances this right entitles “an upstream riparian to exhaust the water in the watercourse.”⁷⁸ Further, when an unlawful riparian use has been conducted, typically only riparian landowners who can establish injury are entitled to relief from the courts.⁷⁹ Finally, like other property interests associated with ownership, riparian rights are transferable and sometimes even severable.⁸⁰

Under the system traditionally governing the water-poor West, allocation of water rights is based upon priority in time: a water user who diverts water from a watercourse and uses it for a beneficial purpose acquires rights superior to subsequent users.⁸¹ Although the prior appropriation doctrine does not require holders of water rights to own riparian land,⁸² the doctrine clearly encourages the actual, present, and consumptive use of water. To perfect their right, appropriators must physically divert water from the watercourse.⁸³ Through this requirement the courts have ensured that a party must have physical control of the claimed water before the party may successfully assert an appropriative

77. See *supra* notes 71–72 and accompanying text.

78. Butler, *supra* note 68, at 126–27.

79. See *id.* at 136–37. In a riparian jurisdiction, the injury requirement means that the complaining riparian must own riparian land that is downstream from the point of diversion. See *id.* at 136 n.112.

80. Courts have allowed riparian rights to be transferred in one of two ways. A riparian landowner generally has the right to transfer his or her water rights along with the riparian land, much as easements transfer as incidents to the benefited land when the land is conveyed. See TARLOCK, *supra* note 68, § 3.18. See generally *id.* § 3.04 (discussing the nature of riparian rights, which resemble a number of different property interests). Alternatively, a riparian can, in some riparian jurisdictions, sever the riparian rights from the land to which they are appurtenant and separately transfer the rights. See Butler, *supra* note 68, at 139–42. Though the extent of this severability rule is not clear, the rule does implicitly recognize the importance of redistribution and reallocation of water rights. See Butler, *supra* note 68, at 138–39.

81. See TARLOCK, *supra* note 68, §§ 5.05[2], 5.10; Butler, *supra* note 34, at 329.

82. See TARLOCK, *supra* note 68, § 5.07[1].

83. See *id.* § 5.15.

right.⁸⁴ Further, courts traditionally have interpreted the beneficial use requirement of the prior appropriation doctrine to include uses that provide economic or commercial benefits regardless of the environmental consequences or the foreseeability of a water shortage.⁸⁵ Courts following this interpretation view instream uses as inherently wasteful because they leave water in place in the stream and thus reduce the water available for consumptive use.⁸⁶ Actual, present use is also encouraged by the prior appropriation rule that nonuse can result in loss of appropriative rights; appropriators should regularly use a definite quantity of water to avoid this possibility.⁸⁷ Finally, once an appropriative right is perfected, it generally is transferable.⁸⁸

Like the riparian doctrine, traditional prior appropriation law incorporates private property perspectives into its requirements. In addition to treating appropriative rights as a form of property,⁸⁹ prior appropriation law is based on a basic principle of property law: priority in time, priority in right.⁹⁰ Furthermore, the prior appropriation doctrine encourages private parties to divert water from a watercourse and use it for beneficial purposes.⁹¹ Traditional definitions of beneficial use include almost any type of consumptive use of water “without regard for environmental consequences or foreseeable shortages”;⁹² as “long as a single drop remained in the stream or aquifer,” users could continue to appropriate the water.⁹³ The “dominant message” of the traditional prior appropriation doctrine is that “water is a commodity, an object that exists for humans to move and manipulate, a thing that exists primarily to serve human needs.”⁹⁴ Like other objects of property rights, water is treated as a “tool for one person—the owner—to use to gain economic advantage over other persons.”⁹⁵

84. See Butler, *supra* note 34, at 330.

85. See Freyfogle, *supra* note 36, at 42.

86. See Butler, *supra* note 34, at 329.

87. See TARLOCK, *supra* note 68, § 5.18[1].

88. See *id.* § 5.17[1].

89. See Freyfogle, *supra* note 36, at 28.

90. See TARLOCK, *supra* note 68, § 5.08[1]. See generally Richard A. Epstein, *Possession as the Root of Title*, 13 GA. L. REV. 1221 (1979) (discussing the justifications for first possession systems); Rose, *supra* note 38 (discussing the meaning of the first possession rule).

91. See TARLOCK, *supra* note 68, § 5.08[1].

92. Freyfogle, *supra* note 36, at 42.

93. *Id.* at 28.

94. *Id.* at 35.

95. *Id.*

Although the courts and legislatures of many states have modified their traditional system to provide for protection of ecological and other instream uses, the reforms generally suffer from numerous problems and limitations.⁹⁶ Like the traditional common law systems, the reforms tend to treat instream water use as another category of water use rather than as a responsibility of the holders of traditionally recognized water rights. Thus, consumptive water users generally are not held accountable for some of their significant external use costs.⁹⁷

Resource allocation systems developed for land and water resources traditionally have relied on private property norms to define the scope and nature of interests allocated under the systems. Because those norms include preferences for consumptive use, separate and discrete privately held interests, transferability of interests, private control, and freedom to seek economic advantage from the interests, resource allocation systems conflict in a number of ways with ecosystem management goals. Property norms have had a similar, but less direct, impact on natural resource and ecosystem management programs.

B. THE RIGHTS-SENSITIVE NATURE OF RESOURCE AND ECOSYSTEM MANAGEMENT PROGRAMS

Resource and ecosystem management efforts also reflect the influence of property rights and land ownership norms.⁹⁸ A brief discussion of the nature and scope of property's influence will reveal how responsive natural resource and ecosystem management programs are to property norms. That influence then will be contrasted with an approach recommended by experts—an ecosystem-based approach to management. The contrast will highlight even more the rights-sensitive nature of current management programs.

96. See Butler, *supra* note 34, at 330–56 (discussing these modifications and their resultant problems and limitations).

97. See Freyfogle, *supra* note 36, at 30–31, 50.

98. Resource management programs developed separately from environmental management programs. Years before concerns about air and water quality led to the development of environmental programs, resource management programs had been formulated and implemented to manage renewable natural resources (like forests, water, and wildlife) and nonrenewable resources (like soil and minerals). See generally WILLIAM R. MANGUN & DANIEL H. HENNING, *MANAGING THE ENVIRONMENTAL CRISIS* 1–19, 111–82 (2d ed. 1999) (discussing environmental and natural resource administration, and renewable and nonrenewable resource management). Environmental programs, in comparison, developed much later in response to widespread concern for environmental degradation. Because of their focus on specific pollution or degradation problems, environmental laws generally do not provide comprehensive management and use systems for natural resources. See *id.* at 111.

1. *Property's Influence on Resource and Ecosystem Management Programs*

Several key aspects of the property system have influenced natural resource and ecosystem management programs. These characteristics include the property system's preference for private ownership,⁹⁹ the system's tendency to allow severability or divisibility of interests in resources,¹⁰⁰ its rights basis,¹⁰¹ its focus on present use,¹⁰² its protection of reasonable expectations of gain,¹⁰³ and its presumption of transferability.¹⁰⁴ Consistent with these traits, tangible natural resources generally are divided into separate, discrete categories for purposes of ownership, management, and use. The underlying assumption appears to be that natural resources are materials to be exploited by humans.¹⁰⁵

Consider the basic approaches to management and use of land and water resources. For centuries the primary focus of land programs has been the allocation of ownership rights in surface land. That allocation has involved the "division of surface area into discrete parcels separated by rigid boundary lines."¹⁰⁶ Often the boundaries used to define those categories reflect human values rather than ecological concerns or scientific

99. See *supra* note 12 and accompanying text.

100. See Freyfogle, *supra* note 8, at 1274–75. For an example of this tendency, see ROGER A. CUNNINGHAM, WILLIAM B. STOEBOCK, DALE A. WHITMAN, *THE LAW OF PROPERTY* §§ 8.9, 8.11 (2d ed. 1993) (discussing the scope, divisibility, and apportionability of easements and profits).

101. See Freyfogle, *supra* note 8, at 1275–76, 1286–88.

102. See Butler, *supra* note 33, at 632–40 (discussing private land use expectations); Lynton Keith Caldwell, *Land and the Law: Problems in Legal Philosophy*, 1986 U. ILL. L. REV. 319, 323–25 (discussing the extent to which land use systems based on individual rights and social rights consider present and future consequences of use decisions).

103. See *supra* note 15 and accompanying text.

104. See *supra* note 14 and accompanying text. See also ALEXANDER, *supra* note 42, at 127–33, 138–49 (discussing the commodification and marketability of property).

105. See Vecsey, *supra* note 41, at 33. Sometimes this assumption has resulted in the transfer of ownership of natural resources to private parties; other times it has led to the creation or protection of private interests in resource use. See, e.g., MANGUN & HENNING, *supra* note 98, at 114 (discussing the transfer of forests to private ownership); *id.* at 126–31 (discussing private grazing interests). It has also led to the creation of public resource management programs that stress human use over environmental quality and ecosystem health. Public land management, for example, has stressed timber production, grazing, and oil and mineral extraction over environmental quality. "Beaver populations are controlled to maximize timber revenue, while net wetlands loss continues; riparian habitat is stripped by livestock, lowering water tables and degrading water quality; careless lumbering clogs the streams with silt." ALICE OUTWATER, *WATER* 183 (1996). Although many resource managers now claim to "use ecological approaches in management activities[,]" in reality, this orientation may be confined to superficial treatment and short-range planning." MANGUN & HENNING, *supra* note 98, at 3.

106. Sterk, *supra* note 21, at 55.

understandings.¹⁰⁷ This "geometric-box allocation is generally well adapted to a society whose members highly value individualism and autonomy."¹⁰⁸ Water management programs similarly have drawn boxes around different types of waters, separating surface water from groundwater despite principles of hydrology.¹⁰⁹

The approaches of land and water programs reflect the rights basis and present use orientation of the American property system, which have encouraged the development of a homocentric approach to resource and ecosystem management. The rights basis and present use orientation have caused the focus of management efforts to shift from the managed system or resource to "the relative interests of humans."¹¹⁰ As a result, traditional management programs sometimes have serious gaps in coverage, focusing primarily on those ecological resources widely valued or recognized as needing immediate action, and often exempting or even ignoring other resources that are either not as degraded or valued, or that are privately owned.¹¹¹ Additionally, the property rights of transferability and reasonable expectation of gain have infused management programs with an economic perspective that affects the scope and implementation of the programs.

The influence of the economic perspective can be seen in the atomistic approach of traditional watershed management programs, which tend to ignore the system as a whole and focus instead on individual elements or resources within the system in ways that are consistent with property law

107. See, e.g., Adler, *supra* note 9, at 991-93 (discussing the political fragmentation of water programs); Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 CHI.-KENT L. REV. 893, 905-06 (1994) (discussing the need to determine ecosystem boundaries by ecological principles, not politics).

108. Sterk, *supra* note 21, at 90.

109. See TARLOCK, *supra* note 68, §§ 4.03, 6.06. This approach still is well embedded in the law. In a 1997 decision, a federal district court held that discharges to groundwater from an unlined pond did not qualify as a point source discharge subject to the Clean Water Act despite a hydrological link to the surface water. The court explained that, according to legislative history, Congress did not intend to regulate even hydrologically connected groundwater. See *Umatilla Waterquality Protective Ass'n v. Smith Frozen Foods, Inc.*, 962 F. Supp. 1312, 1318-19 (D. Or. 1997).

110. Freyfogle, *supra* note 8, at 1276. See also Noss, *supra* note 107, at 894 (noting the utilitarian approach of traditional natural resource management policies). For examples of the private rights/human use approach, see MANGUN & HENNING, *supra* note 98, at 114-26 (discussing the use orientation of forest policy); *id.* at 126-31 (describing the overuse of rangeland and the ineffectiveness of range policy in protecting rangeland); *id.* at 131-45 (discussing the use orientation of water policy).

111. See Lynda L. Butler, *State Environmental Programs: A Study in Political Influence and Regulatory Failure*, 31 WM. & MARY L. REV. 823, 881-92 (1990) (discussing the scope of state environmental legislation).

policies and land ownership norms.¹¹² The influence of the economic perspective also can be seen in the targeting of specific ecological resources for regulatory action designed to promote economic interests.¹¹³ Other examples of the atomistic and targeting perspectives include: wetlands regulations that focus on selected land use changes and ignore other activities in wetlands (like soil removal, drainage, and destruction of plant life) that affect their health;¹¹⁴ fishery management plans that focus on the adequacy of fish populations for economic purposes, and ignore factors affecting the health of the population;¹¹⁵ water flow protection plans that maintain flow because of its value for consumptive or out-of-stream uses, not because of its instream value;¹¹⁶ and forest ecosystem programs that stress the continuous production of goods and services from the forest over other policy goals.¹¹⁷

112. For examples of this approach, see *supra* note 109 and accompanying text (discussing water management programs that separate surface waters from groundwater); *infra* note 113 and accompanying text (discussing estuarine watershed programs). See generally Robert B. Keiter, *Conservation Biology and the Law: Assessing the Challenges Ahead*, 69 CHI.-KENT L. REV. 911, 913–20 (1994) (discussing the domination of the consumptive use ethic and utilitarian considerations over biological concerns). Some scholars attribute the development of an atomistic approach to the neoclassical economic view of ecology. See Ernest Partridge, *Holes in the Cornucopia*, in *THE BUSINESS OF CONSUMPTION* 247, 263–64 (Laura Westra & Patricia H. Werhane eds., 1998). This economic view is replicated in the libertarian concept of property. See *id.* at 264.

113. Fishery management programs often reflect this economic perspective. See, e.g., Geraldine McCormick-Ray, *A Watershed Perspective for Chesapeake Bay Management*, in *TOWARD A SUSTAINABLE COASTAL WATERSHED: THE CHESAPEAKE EXPERIMENT*, PROCEEDINGS OF A CONFERENCE 235, 240–41 (Paula Hill & Steve Nelson eds., 1994) [hereinafter *SUSTAINABLE COASTAL WATERSHED*] (discussing the effects of targeting oyster production in the Chesapeake Bay). Cf. Noss, *supra* note 107, at 894–97 (discussing the emergence of conservation biology in reaction to the utilitarian focus of management programs). See generally ALEXANDER, *supra* note 42 (discussing the economic, or commodity, and the public good, or propriety, conceptions of property).

Protection of estuarine watersheds traditionally has included both the atomistic and targeting perspectives. In the Chesapeake Bay, for example, management efforts have focused on oyster production and have ignored the ecological functions of oyster reefs and the processes that sustain oysters. See McCormick-Ray, *supra*, at 241. Management efforts also have stressed the productivity of Bay species over the role of freshwater in maintaining the habitats on which those species depend. See *id.* at 236–40.

114. See THE CONSERVATION FOUNDATION, *THE FINAL REPORT OF THE NATIONAL WETLANDS POLICY FORUM, PROTECTING AMERICA'S WETLANDS: AN ACTION AGENDA* 44–47 (1988) (discussing regulatory gaps in wetlands programs); WILLIAM L. WANT, *LAW OF WETLANDS REGULATION* §§ 4.06[3]–[6] (May 1999) (discussing activities that may not be regulated by federal wetlands laws even though they destroy wetlands).

115. See, e.g., McCormick-Ray, *supra* note 113, at 236–40.

116. See Freyfogle, *supra* note 36, at 41–42.

117. See MANGUN & HENNING, *supra* note 98, at 114–23. See also Keiter, *supra* note 112, at 913 (noting that “Congress historically has subsidized commodity production activities . . . at such disproportionately high levels that biological considerations have all but been forgotten” in the management of public lands).

Further, even when watershed management efforts rely on scientific principles, they often do so with a twist—a property or land ownership norm twist. For example, riverine watershed management programs traditionally have focused on the hydrologic functions of watersheds to ensure the return of water to the waterway for future use by riparian owners.¹¹⁸ From a hydrologic perspective, a watershed serves the functions of water collection, storage, and discharge.¹¹⁹ An ecological perspective, in comparison, recognizes that a watershed also provides a habitat for flora and fauna, and serves as a pathway for the processing of environmental chemicals.¹²⁰ Consistent with the hydrologic perspective, traditional riverine management programs have promoted the rehabilitation of abused or naturally altered lands for the purpose of controlling runoff and enhancing water flow,¹²¹ the protection of sensitive areas to minimize the need for rehabilitative measures,¹²² and the enhancement or manipulation of the water resource characteristics that influence hydrologic functions.¹²³ These traditional programs tend to ignore the ecological functions of watersheds, and concentrate instead on improving or maintaining water flow through the control of runoff, erosion, and other disturbances to water flow.¹²⁴

A good example of the traditional perspective is the federal government's channelization policy, which promotes the straightening of rivers or streams to produce a swifter and more efficient water flow. Although the policy enhances water flow for consumptive use and prevents some natural flooding of adjoining private lands, its ecological costs are significant. Besides increasing runoff and erosion, the policy results in the removal of vegetative land cover and in increased flooding of downstream

118. Courts use the same reasoning to explain why they restrict riparian land to land within the watershed. *See, e.g.,* Anaheim Union Water Co. v. Fuller, 88 P. 978, 980 (Cal. 1907); Town of Gordonsville v. Zinn, 106 S.E. 508, 511 (Va. 1921). For a discussion of the watershed restriction, see Butler, *supra* note 68, at 111–17. For a discussion of the physical processes and characteristics of rivers, see LUNA B. LEOPOLD, A VIEW OF THE RIVER (1994). *See generally* JEFFREY F. MOUNT, CALIFORNIA RIVERS AND STREAMS (1995) (providing an overview of the physical and biological processes shaping California's rivers and discussing the interaction of land use practices with those processes).

119. *See* BLACK, *supra* note 30, at 300.

120. *See id.* at 301.

121. *See id.* at 322–23. Examples include removal or restriction of the cause of disturbances to water flow and manipulation of vegetative cover to minimize runoff and augment flow. *See id.* at 323. For a discussion of methods for rehabilitation, *see id.* at 323–28.

122. *See id.* at 322. For a discussion of protection techniques, *see id.* at 329–34.

123. *See id.* at 312–13, 322. For a discussion of enhancement techniques, *see id.* at 334–38.

124. *See* MOUNT, *supra* note 118, at xiii (describing the different perspectives to riverine watersheds taken by geologists, biologists, hydrologists, and engineers).

areas.¹²⁵ Government agencies implementing the channelization policy ignore these ecological costs and focus instead on maximization of hydrologic functions.

2. *Ecosystem-Based Approaches to Management*

For years experts have called for the development of ecosystem-based approaches to watershed management that would differ markedly from traditional programs influenced by property norms.¹²⁶ According to current thinking, an ecosystem-based approach to watershed management recognizes the importance of the natural processes affecting the watershed's health, the spatial and temporal dimensions of the ecosystem, the system's inputs, the need for a top-down ecological approach to management, the dynamic nature of the watershed, and the interdependencies and interactions within the watershed.¹²⁷ The ecological characteristics of coastal ecosystems, for instance, suggest the need for a holistic, ecosystem-based approach to watershed management. Coastal ecosystems are characterized by complex interactions occurring between the land and water resources of the watershed over time.¹²⁸ Because of the complex interactions, management efforts that focus solely or primarily on localized areas, individual resources, or particular sources of pollution generally fail to halt, much less reverse, ecosystem degradation. Indeed, despite years of point source regulation, the health of species in many

125. See MANGUN & HENNING, *supra* note 98, at 140.

126. See Adler, *supra* note 9, at 974-78.

127. See McCormick-Ray, *supra* note 113, at 235-40, 242-44. See also COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY: THE TWENTY-FOURTH ANNUAL REPORT 206-10 (1993) (federal agency report discussing principles and guidelines for ecosystem management); Keiter, *supra* note 112, at 927-33 (discussing the ecosystem management concept). For further discussion of the need for an integrated and dynamic or adaptive approach to ecosystem management, see BARRIERS AND BRIDGES, *supra* note 9; ECOLOGICAL INTEGRITY, *supra* note 30; Carl J. Walters & Ray Hilborn, *Ecological Optimization and Adaptive Management*, 9 ANN. REV. ECOLOGY & SYSTEMATICS 157 (1978). For a discussion of changes in thinking on ecosystem functioning, see BARRIERS AND BRIDGES, *supra* note 9, at 20-23; C.S. Holling, *The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change*, in SUSTAINABLE DEVELOPMENT OF THE BIOSPHERE 292, 298-300, 306-08 (W.C. Clark & R.E. Munn eds., 1986).

128. See Adler, *supra* note 9, at 981-86. See also David L. Correll, Thomas E. Jordan, & Donald E. Weller, *The Chesapeake Bay Watershed: Effects of Land Use and Geology on Dissolved Nitrogen Concentrations*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 639 (discussing the effects of land use and geology on nutrient dynamics); S. Diane Eckles, *Toward a Sustainable Watershed: The Wetlands Landscape Analysis Project*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 259 (discussing a project to assess the impact of changes in landscape structure on ecosystem functioning); Leonard Shabman, *Sustainable Development for the Chesapeake: Land Settlement Connection*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 3 (discussing the impact of land settlement policy on the Chesapeake Bay).

watersheds has continued to decline.¹²⁹ Many experts now attribute this continued decline, at least in part, to nonpoint sources of pollution.¹³⁰ Controlling those sources of pollution requires a broader approach.

One key element of an ecosystem-based approach to watershed and ecosystem management is recognizing the importance of natural processes—in particular, interactions between the biological, physical, and chemical processes affecting the health of watersheds.¹³¹ Although a single product or resource within a watershed still may be important to a management plan, and especially to efforts to gain public support, key structuring processes must be the primary focus of watershed management efforts.¹³² According to experts, such a focus results in more effective protection of ecosystems.¹³³

For example, management efforts that understand the essential role of freshwater flow in the Chesapeake Bay watershed system will, in the long run, provide more effective protection of target species and their habitats than product-oriented efforts.¹³⁴ Freshwater flow serves as an “environmental connector”¹³⁵ in the Chesapeake Bay system, connecting “the habitats and species to the dynamics of the watershed system[,] . . . deliver[ing] energy, particles, and chemicals that mix with saline water” to affect the topography, shoreline, species distribution, chemical composition, and habitats of the system.¹³⁶ Without an appreciation of the impact of freshwater flow on the quality and quantity of suitable habitats for target species, watershed management efforts would not adequately protect the habitats; such management efforts would ignore the paramount

129. See Adler, *supra* note 9, at 987–88.

130. See *id.* at 989–91.

131. See Alan Brandt, *Physical Processes in the Chesapeake Bay and Their Bio-Chemical Effects*, in *SUSTAINABLE COASTAL WATERSHED*, *supra* note 113, at 99; Eckles, *supra* note 128, at 261; McCormick-Ray, *supra* note 113, at 235, 240.

132. See McCormick-Ray, *supra* note 113, at 235, 240. See also C.S. Holling, *What Barriers? What Bridges?*, in *BARRIERS AND BRIDGES*, *supra* note 9, at 3, 26–28 [hereinafter Holling, *What Barriers? What Bridges?*] (discussing the key structuring variables and processes that affect ecological organization); C.S. Holling, *Cross-Scale Morphology, Geometry, and Dynamics of Ecosystems*, 62 *ECOLOGICAL MONOGRAPHS* 447, 451–52 (Dec. 1992) [hereinafter Holling, *Cross-Scale Morphology*] (discussing the extended keystone and entrainment hypotheses).

133. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 28–34. See generally Lance H. Gunderson, C.S. Holling, & Stephen S. Light, *Barriers Broken and Bridges Built: A Synthesis*, in *BARRIERS AND BRIDGES*, *supra* note 9, at 489, 489–532; McCormick-Ray, *supra* note 113, at 235, 240.

134. See McCormick-Ray, *supra* note 113, at 235, 236–40.

135. *Id.* at 239.

136. *Id.* at 239–40.

importance of “[e]stuarine connectivity” to “maintenance and restoration of ecosystem function.”¹³⁷

A second key element of an ecosystem-based approach recognizes the importance of considering ecologically appropriate spatial and temporal scales in making management decisions.¹³⁸ In a riverine watershed, for instance, spatial and temporal dimensions include not only the longitudinal or upstream/downstream dimension of the river, but also the lateral or upland/floodplain dimension, the vertical or groundwater/surface water dimension, and the temporal dimension.¹³⁹ The longitudinal dimension recognizes that the activities and conditions existing in upstream areas cannot be isolated from downstream conditions and uses.¹⁴⁰ The lateral dimension reflects the notion that watershed management cannot focus solely on the water body, but rather must also include connections between the water body and the surrounding land and ecosystems.¹⁴¹ The vertical dimension reinforces the hydrologic principle of interconnectedness between surface water and groundwater.¹⁴² The temporal dimension suggests that management take into account changes in the other dimensions over time.¹⁴³

Another key element of an ecosystem-based approach recognizes the importance of focusing on system inputs that sustain productivity, rather than on system outputs.¹⁴⁴ A management approach that focuses primarily or solely on the products of an ecosystem ultimately isolates the managed products and the decisionmaking process from the ecosystem, creating a more vulnerable ecosystem.¹⁴⁵ Consideration of system inputs at the

137. *Id.* at 240.

138. See Adler, *supra* note 9, at 982; Keiter, *supra* note 112, at 929; King, *supra* note 30, at 22–24, 28–30, 35–39; Robert V. Thomann, *The Significance of Resource Scale in Water Quality and Ecosystem Modeling and Decision Making*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 20.

139. See Adler, *supra* note 9, at 982. See generally MOUNT, *supra* note 118, at 12–15 (discussing a model river system and the dependent and independent variables affecting it).

140. See Adler, *supra* note 9, at 982. See also MOUNT, *supra* note 118, at 134–42 (discussing the longitudinal profile of a river).

141. See Adler, *supra* note 9, at 982. See also Correll et al., *supra* note 128 (discussing the effects of land use and geology on the nutrient dynamics of the Bay watershed); James A. Lynch & Edward S. Corbett, *Nitrate Export from Managed and Unmanaged Forested Watersheds in the Chesapeake Bay Watershed*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 656 (discussing changes in stream chemistry due to timber harvesting).

142. See Adler, *supra* note 9, at 982. See also MOUNT, *supra* note 118, at 83–99 (discussing the relationship between river flow and groundwater).

143. See Adler, *supra* note 9, at 982.

144. See McCormick-Ray, *supra* note 113, at 244.

145. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 25, 28–34; McCormick-Ray, *supra* note 113, at 240.

watershed scale provides a more complete view of ecosystem structures and functions, which can lead to more effective management decisions.¹⁴⁶ For instance, consideration of nutrient-loading activities—instead of just particular products or resources—can result in more effective protection of the Chesapeake Bay system and its species.¹⁴⁷ Restricting nutrients (nitrogen and phosphorous) that enter the Bay improves water quality and protects submerged aquatic vegetation beds that provide nursery grounds for juvenile species.¹⁴⁸

The remaining elements of an ecosystem-based approach to management recognize the need for a top-down, biocentric approach that reflects the dynamic nature of ecosystems and the interconnectedness of their components. Such an approach requires monitoring and managing species and other variables that play a central role in the health of the ecosystem, regardless of their economic importance; it also requires maintenance of system integrity to ensure habitat continuity, including protection of the ecosystem's ability to rebuild habitats in response to change.¹⁴⁹ To be scientifically sound, a management program must respond to the dynamic nature of ecosystems and their hierarchies.¹⁵⁰ In addition, it must recognize the principle of vertical and horizontal interconnectedness. Under this principle an ecosystem or watershed is greater than the sum of its parts because of the interactions, interdependencies, and feedbacks that relate the parts horizontally and vertically.¹⁵¹ Due to these complex connections, a disturbance in one small part of an ecosystem or watershed can affect the whole system.¹⁵²

146. See McCormick-Ray, *supra* note 113, at 244–45.

147. See *id.*

148. See McCormick-Ray, *supra* note 113, at 236, 244; James T.B. Tripp & Michael Oppenheimer, *Restoration of the Chesapeake Bay: A Multi-State Institutional Challenge*, 47 MD. L. REV. 425, 428–38 (1988). See generally SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 397–504 (discussing long-term trends in the Bay's water quality and living resources).

149. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 32–33; McCormick-Ray, *supra* note 113, at 235–36, 240. System integrity "implies the integrity of both system structure and function, a maintenance of system components, interactions among them, and the resultant behaviour or dynamic of the system." King, *supra* note 30, at 25. "Assessment of ecosystem integrity is strongly dependent upon the perspective from which observations are organized." *Id.* at 27. One way to counteract this problem of perspective is to include indicators of integrity from as many different perspectives as practical. See *id.*

150. See Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 CHH.-KENT L. REV. 875, 875–83 (1994). Estuarine ecosystems, for example, are constantly changing in reaction to coastal erosion and accretion, climate, and salinity flux. See McCormick-Ray, *supra* note 113, at 242–44.

151. See Freyfogle, *supra* note 36, at 35–38; Holling, *What Barriers? What Bridges?*, *supra* note 132, at 24–25; King, *supra* note 30, at 30–39; McCormick-Ray, *supra* note 113, at 235.

152. See Robert Costanza & Jack Greer, *The Chesapeake Bay and Its Watershed: A Model for Sustainable Ecosystem Management?*, in BARRIERS AND BRIDGES, *supra* note 9, at 169, 178–80. For

Modern mapping techniques have provided compelling evidence of the need for a holistic approach to watershed and ecosystem management that considers time and space scales as well as human and ecological systems. Until space satellites allowed us to see the entire Chesapeake Bay system all at once, maps of the Bay system typically just portrayed the Chesapeake Bay as a great body of water with numerous coastal communities located on outlying areas.¹⁵³ Mapping by satellite imagery, however, has given us the ability to see the Bay system as one tremendous drainage basin with the Bay proper at the receiving end of the land use activities of almost fifteen million people.¹⁵⁴ That drainage basin includes more than forty significant rivers and one thousand streams, and stretches from Vermont, west into West Virginia, and south almost to North Carolina.¹⁵⁵

Until landowners become responsible in a cumulative, temporal, and spatial sense for the impact of their land uses on the health of a watershed, land development and water use will continue to increase virtually without restraint. Lawmakers and landowners alike must realize that the impact of a land use occurring early in the development of an ecosystem probably will not be the same as the impact of a similar land use occurring later. They must realize that the impact of a residential development project occurring at the same time as two other residential projects is probably not as detrimental as the impact of a similar residential development project occurring simultaneously with fifty other such projects. The ability of an ecosystem to absorb adverse ecological impacts often decreases as the ecosystem becomes increasingly stressed and tightly connected.¹⁵⁶ Equally as important to ecosystem integrity, the ability of human systems to respond to adverse ecological change tends to decrease as the management

example, the cumulative effect of land use activities in the Chesapeake Bay watershed, which have increased runoff, and overfishing of the oyster population, which had filtered the water during feeding, led to greater sedimentation in Bay waters. Because of the resulting cloudier waters, the amount of algae and phytoplankton has increased. This increase has reduced the available light in the waters. As the available light decreases, the quantity of aquatic grasses decreases. The decline in aquatic grasses, in turn, means less food or shelter for ducks, crabs, and other wildlife. *See id.* at 179–80.

153. *See* VIRGINIA MARINE RESOURCES COMM'N, *TIDEWATER VIRGINIA ATLAS 1* (1st ed. 1977).

154. The most famous map using modern technology is probably the 1987 map that the Chesapeake Bay Foundation distributed in poster form. The map is based on landsat data gathered and distributed by the Earth Observation Satellite Company located in Lanham, Maryland.

155. *See* Tom Horton, *Chesapeake Bay—Hanging in the Balance*, 183 NAT'L GEOGRAPHIC, June 1993, at 16.

156. As an ecosystem stores nutrients and accumulates biomass, it becomes more connected in its organizational structure and competitive interactions. Eventually competitors are prevented from using accumulated energy and materials, and some organisms are destroyed. *See* Holling, *supra* note 127, at 299–300, 306–09.

unit becomes more localized and product-oriented.¹⁵⁷ The right to use and develop land, in other words, cannot be frozen in time; it cannot have the same meaning for all landowners over time and space. Effective watershed and ecosystem management requires the consideration of temporal and spatial scales as well as ecological hierarchies in defining land rights, especially the right to use and develop land.

Recent thinking on ecological systems views those systems as complex, nonlinear systems that normally involve discontinuous behavior and structural change. Traditional thinking viewed ecosystems as highly ordered systems evolving along a linear path leading toward a sustained equilibrium point.¹⁵⁸ Today experts recognize that ecological succession is much more chaotic and subject to chance, with unpredicted events (for example, a new business innovation or new institution) causing moves to unexpectedly different systems.¹⁵⁹ Even with their more random, chaotic nature, ecological systems still can have their evolutionary paths readjusted and new opportunities for renewal created.¹⁶⁰ That is, ecosystems still can be positively affected by management if the pathological effects of property norms on management efforts are recognized and addressed.

II. THE PATHOLOGY OF PROPERTY NORMS

Property norms have contributed to the development of a pathology of escalating land and water use, and of ineffective watershed and ecosystem management over the long term. These pathologies result, in part, from the influence of property norms on the allocation and use of land and water resources, and on the rights-based focus of watershed and ecosystem management programs—even initially successful programs. Property norms have contributed to the legal system's treatment of water as a discrete resource to be exploited and allocated to individual private users. Property norms also have encouraged landowners to develop linearly along waterfronts, despite the ecological significance of undisturbed riparian habitats and the adverse effects of sprawling, linear development. Further, even when a holistic approach to watershed or ecosystem management is

157. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 28–34.

158. See *id.* at 19–20; Holling, *Cross-Scale Morphology*, *supra* note 132, at 466.

159. See DANIEL B. BOTKIN, *DISCORDANT HARMONIES: A NEW ECOLOGY FOR THE TWENTY-FIRST CENTURY* 6–13 (1990); Gunderson et al., *supra* note 133, at 511; Holling, *What Barriers? What Bridges?*, *supra* note 132, at 21; Holling, *Cross-Scale Morphology*, *supra* note 132, at 466–67. For a discussion of the development of the science of ecology, see Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI.-KENT L. REV. 847 (1994).

160. See Gunderson et al., *supra* note 133, at 509–11.

adopted, property norms tend to affect the focus, scope, and stringency of the program, as well as its future direction, in ways that detrimentally impact the effectiveness of the program and the health of ecosystems. The pathologies of escalating land and water use and of ineffective watershed management are discussed in Parts II.A and II.B.

A. THE PATHOLOGY OF ESCALATING LAND AND WATER USE

The pathological effects of land ownership norms on allocation and use of land and water resources are pervasive and profound. In addition to failing to consider the cumulative impact of private use in defining the scope and nature of individual rights, property owners and decisionmakers generally have preferred consumptive uses over the preservation, conservation, or maintenance of natural resources. Decisionmakers also have been unwilling to ban or even seriously restrict land use to protect the ecological health of a watershed, and have tended to find no significant environmental impact even when projects involve diversions and transfers of significant amounts of water from a watercourse.¹⁶¹ Many land use planners and policymakers are reluctant to adopt growth controls that reflect sound science and ecosystem management principles or that recognize moral or ethical bases for imposing some responsibility for ecosystem integrity on property owners. The land ownership norms producing these pathological effects may have been appropriate when natural resources were more plentiful, ecological degradation was minimal, land ownership was the main source of wealth, and land development generally occurred in compact urban areas. The norms, however, do not reflect the current ecological conditions found in stressed ecosystems, the sprawling land settlement patterns of modern, developed societies, or the powerful economic incentives now captured in a landowner's power to subdivide, transfer, and profit from land development.

Land development and use continue to escalate in America's coastal areas. Although the size of America's heartland is significantly larger than the size of its coastal areas, the population of the coastal areas outnumbers the population of the vast heartland by more than 16 million.¹⁶² America's coastal areas now are home to about one-half of the nation's population, but account for only 20% of the total land area of the United States if

161. See, e.g., *North Carolina v. Hudson*, 665 F. Supp. 428, 432 (E.D.N.C. 1987) (discussing the Army Corps of Engineers' finding of no significant impact in a water supply project involving the City of Virginia Beach, Virginia).

162. See Thomas J. Culliton, *Population: Distribution, Density and Growth—National Picture* (visited May 25, 1999) <http://state_of_coast.noaa.gov/bulletins/html/pop_01/national.html>.

Alaska is included and only 11% if Alaska is excluded.¹⁶³ Experts predict that the population of America's coastal areas will increase by an average of 3,600 people per day, a rate of growth that exceeds the national rate.¹⁶⁴ By 2015 the coastal population is expected to reach 165 million,¹⁶⁵ an increase of over 100% since 1960.¹⁶⁶ Not surprisingly, the population density of America's coastal areas (excluding Alaska) has "increased dramatically since 1960,"¹⁶⁷ rising from an average of 275 to nearly 400 people per square kilometer by 1990.¹⁶⁸ The significant increase in coastal population and development is now imposing serious pressure on coastal ecosystems.¹⁶⁹

Although a desire to live in coastal areas may be the primary cause of the population increase in those areas, property norms have had a significant impact on the land settlement patterns of the population. Until the middle of the nineteenth century, settlement and growth occurred primarily in urban areas. Beginning in the 1950s, Americans began spreading out into rural areas, including less protected, more open coastal areas.¹⁷⁰ By the 1960 census, the population of suburban areas exceeded the population of central cities for the first time.¹⁷¹ In coastal areas development related to population growth has been particularly intense. Though comprising only 11% of the nation's land area (excluding Alaska), coastal areas accounted for about one-half of all residential and

163. See THOMAS J. CULLITON, MAUREEN A. WARREN, TIMOTHY R. GOODSPEED, DAVIDA G. REMER, CAROL M. BLACKWELL, & JOHN J. McDONOUGH, III, U.S. DEP'T OF COMMERCE, FIFTY YEARS OF POPULATION CHANGE ALONG THE NATION'S COASTS: 1960-2010, at 3 (1990) [hereinafter CULLITON, FIFTY YEARS]; Thomas J. Culliton, *Population: Distribution, Density and Growth—Introduction* (visited May 25, 1999) <http://state_of_coast.noaa.gov/bulletins/html/pop_01/intro.html> [hereinafter Culliton, *Coastal Population*]. Although Virginia's coastal areas have only 22% of the state's land area, they are predicted to have 63% of its population by 2000. See CULLITON, FIFTY YEARS, *supra*, at 8. The same imbalance in population distribution exists worldwide. Over 50% of the world's population lives within 200 kilometers of the coast on only about 10% of the earth's nonpolar land space. See DON HINRICHSSEN, COASTAL WATERS OF THE WORLD 1 (1998).

164. See Culliton, *Coastal Population*, *supra* note 163.

165. See *id.*

166. See CULLITON, FIFTY YEARS, *supra* note 163, at 3. By 2025 almost 75% of Americans are expected to live in America's coastal areas. See HINRICHSSEN, *supra* note 163, at 14.

167. CULLITON, FIFTY YEARS, *supra* note 163, at 6.

168. See HINRICHSSEN, *supra* note 163, at 14.

169. See CULLITON, FIFTY YEARS, *supra* note 163, at 1. Globally, "[m]ore than half of the world's coastlines suffer from severe development pressures." HINRICHSSEN, *supra* note 163, at 7.

170. See Jeffrey A. Zinn, *Coastal Demographics and Development Patterns* (visited Mar. 10, 1999) <<http://www.cnre.org/nle/mar-20/j.html>>.

171. See RUTHERFORD H. PLATT, LAND USE AND SOCIETY 393 (1996). In 1980 an estimated 68 million people lived in central cities compared to 101 million in suburbs. See *id.* at 22 fig.I-5.

nonresidential construction between 1970 and 1989.¹⁷² During that period an average of 384,000 new single-family homes were authorized for construction in coastal areas each year, while the early 1970s saw almost 700,000 new multi-family homes authorized for construction in coastal areas each year.¹⁷³ The demographic shift away from urban areas thus has led to more sprawling, linear development of land and greater fragmentation of local government power as new local governments have been formed.¹⁷⁴ At the core of the problem of sprawling development is America's preference for low-density, single-family residential development—detached homes separated from neighbors' homes by adequately sized lots and situated in a rural setting.¹⁷⁵

These land settlement patterns are due in part to the incentives that private property norms and changing economic conditions have created. The private property attributes of transferability, severability, divisibility, and a reasonable expectation of gain have combined with the diminishing supply of undeveloped land and the changing role of land as a source of wealth to create powerful economic incentives to subdivide tracts of land and develop linearly. For centuries land was not only the main source of wealth and power, but also the main basis for survival. Alexis de Tocqueville once observed that although the "laws of the United States are extremely favorable to the division of property . . . [,] a cause more powerful than the laws prevents property from being divided to excess."¹⁷⁶ He explained how estates in land were rarely divided, because the eldest son usually took the estate intact to provide a parcel sufficiently large to support his family.¹⁷⁷ Today survivorship and support of families no longer depend on owning land, and wealth no longer is derived primarily from landholdings; property rights now involve far more than property in land.¹⁷⁸ The constraints on the division of land that Alexis de Tocqueville

172. See THOMAS J. CULLITON, JOHN J. McDONOUGH, III, DAVIDA G. REMER, & DAVID M. LOTT, U.S. DEP'T OF COMMERCE, *BUILDING ALONG AMERICA'S COASTS* 5, 8 (1992) [hereinafter CULLITON, *COASTAL BUILDING*].

173. See *id.* at 8–9.

174. See PLATT, *supra* note 171, at 393.

175. Coastal areas have experienced an increase in both lot and house size since 1970. See CULLITON, *COASTAL BUILDING*, *supra* note 172, at 8. See also Doug Porter, *Reinventing Growth Management for the Twenty-First Century*, 23 WM. & MARY ENVTL. L. & POL'Y REV. 705 (1999) (discussing Americans' fixation with single-family homes in the suburbs).

176. 1 ALEXIS DE TOCQUEVILLE, *DEMOCRACY IN AMERICA* 293 (Phillips Bradley ed., Vintage Classics 1990) (1835).

177. See *id.* at 293–94. Siblings of the eldest son usually went out into the wilderness "to seek their fortune." *Id.* at 293.

178. See ALEXANDER, *supra* note 42, at 259–61 (discussing the decreasing economic importance of land and the emergence of the property-as-value concept).

once recognized are gone. When this change is combined with a decreasing supply of undeveloped land, an increasing population, and a landowner's power to transfer, subdivide, and profit from land use, a recipe for sprawling development and environmental degradation is created. Though private property norms may not be the sole cause of the sprawling development or ecological degradation, the norms nevertheless are an important part of the problem.

Another equally dramatic story of escalating land use concerns America's loss of wetlands. Since the late 1700s, over half of the approximately 220 million acres of wetlands in the continental United States have been drained and converted to various uses.¹⁷⁹ Twenty-two states have lost at least 50% of their original wetlands, while seven have lost over 80%.¹⁸⁰ Although the rate of loss has decreased since the 1970s due to government regulation, acquisition of environmentally sensitive lands, and other factors, estimates of losses on nonfederal lands indicate that between 70,000 and 90,000 acres of wetlands still are lost annually.¹⁸¹

Escalating land use has also taken a significant toll on America's forests. A recent study of 11.4 million acres within the Chesapeake Bay watershed—roughly one quarter of the watershed—revealed that average tree cover declined from 51% in 1973 to 39% in 1997.¹⁸² Once covering 95% of the watershed, Chesapeake Bay forests are becoming increasingly fragmented even in unanticipated places. In the study region, rapid tree loss occurred not only in expected locations around urban areas but also in unanticipated areas throughout the region.¹⁸³ The widespread tree loss indicates that forests are being cut down not only in urban areas but also in agricultural areas.¹⁸⁴ One expert disheartened by the results noted that the rapid and extensive tree loss “nearly forecloses any hope of preserving large, unfragmented forest tracts” in the region.¹⁸⁵ Explaining the magnitude of the tree loss in more concrete terms, the expert noted that the flood control benefits that would have been provided by the lost tree cover in just the Baltimore-Washington corridor of the study region were

179. See WILLIAM J. MITSCH & JAMES G. GOSSELINK, *WETLANDS* 45–47 (2d ed. 1993).

180. See *id.* at 46–47 fig.3-4.

181. See U.S. ENVTL. PROTECTION AGENCY, EPA843-K-95-001, *AMERICA'S WETLANDS* (Dec. 1995). See generally MITSCH & GOSSELINK, *supra* note 179, at 565–75 (discussing legal protection of wetlands in the United States).

182. See Karl Blankenship, *Forests closest to Bay losing ground to development*, *BAY J.*, May 1999, at 1.

183. See *id.* at 6.

184. See *id.*

185. *Id.*

estimated to be about \$1.08 billion, while the benefits in annual air pollution control for the same corridor would have totaled about \$88 million.¹⁸⁶ Other benefits that could no longer be provided by the lost tree cover include water pollution control, wildlife habitat, and energy savings.¹⁸⁷

Virginia Beach, a coastal city in Virginia, demonstrates well the pathological effects of property norms on land and water use. For years the city has been attempting to secure a permanent water supply that would meet its present and future needs. The saga of Virginia Beach's unwavering quest for water reveals that land ownership norms, economic development goals, and individual rights-based thinking all have contributed to escalating land and water use.

Located on the Atlantic Ocean in the lower Chesapeake Bay watershed, Virginia Beach is a resort city of approximately 430,000 inhabitants¹⁸⁸ that has been without an adequate water supply since the 1970s.¹⁸⁹ Tired of being dependent on other localities for water,¹⁹⁰ the city began searching for an alternative water supply to protect it even in times of drought.¹⁹¹ To alleviate some of its immediate water needs, the city

186. See *id.* at 6-7.

187. See *id.* at 7. See generally *Forests Offer Tree-mendous Benefits*, BAY J., May 1999, at 7 (describing the many quantifiable benefits provided by trees).

188. See BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES 1997, at 47 (117th ed. 1997) [hereinafter 1997 STATISTICAL ABSTRACT].

189. See FEDERAL ENERGY REGULATORY COMM'N, FINAL ENVIRONMENTAL IMPACT STATEMENT: NONPROJECT USE OF PROJECT LANDS AND WATER FOR THE CITY OF VIRGINIA BEACH WATER SUPPLY PROJECT, BRUNSWICK COUNTY, VIRGINIA, FERC No. 2009-003, at xvii (1995) [hereinafter FERC FEIS ON GASTON].

190. See U.S. ARMY CORPS OF ENGINEERS, WATER SUPPLY STUDY HAMPTON ROADS, VIRGINIA 1-8 (1984) [hereinafter ACE WATER SUPPLY STUDY]. Two other localities, Norfolk and Portsmouth, own the major water storage reservoirs and treatment facilities in southeastern Virginia. See Jan Harris, *Build It and the Water Might Come*, PROGRESSIVE ENGINEER, Nov.-Dec. 1997, at 11.

191. Virginia Beach had relied on Norfolk to meet its non-emergency water needs. When drought conditions existed, Virginia Beach also received some water from wells owned by Isle of Wight County, Suffolk, and Southhampton. See ACE WATER SUPPLY STUDY, *supra* note 190, at 1-8, 1-9; VIRGINIA DEP'T OF ENVIRONMENTAL QUALITY, HAMPTON ROADS WATER SUPPLY UPDATE, at II-5 (1993) [hereinafter DEQ WATER SUPPLY UPDATE]. Drought conditions, for example, existed in 1977, 1980, 1981, 1986, and 1991. See *id.* at II-8, II-9. In 1992 the City of Norfolk limited Virginia Beach's supply of water to 30 million gallons of water per day during wet weather and 15 million gallons per day during droughts. See *id.* at II-9; Harris, *supra* note 190. Estimates by the Federal Energy Regulatory Commission, however, indicate that Virginia Beach's demand for water will reach 54 million gallons per day by the year 2030. See *North Carolina v. Federal Energy Regulatory Comm'n*, 112 F.3d 1175, 1182 (D.C. Cir. 1997), *cert. denied*, 118 S. Ct. 1036 (1998). The Army Corps of Engineers concluded that the Virginia Beach area would need 60 million gallons per day by 2030. See *id.* at 1181.

adopted water conservation measures.¹⁹² The conservation measures included requiring the installation of low-use plumbing fixtures in new construction, offering incentives for retrofitting existing plumbing with low-use fixtures, holding public education programs, promoting water recycling programs, and maintaining low water line pressure.¹⁹³ Although the conservation measures produced a low per capita water demand (about 82 gallons per day per person), they did not solve the city's long-term water supply problems.¹⁹⁴ Further, according to the city, the adverse economic impact of the water restrictions was significant, costing between eight and ten thousand jobs and about \$2 billion in capital improvements.¹⁹⁵ The city considered a number of other alternatives, including waste water reuse, desalinization, groundwater use, and withdrawal from lakes and rivers, before deciding on a plan to divert and pipe water from Lake Gaston in the Roanoke River Basin.¹⁹⁶

The Roanoke River flows from the mountains of Virginia, near the City of Roanoke, southeasterly to the coast of North Carolina.¹⁹⁷ Dams have been constructed on the River in several places to control flooding and facilitate power production.¹⁹⁸ Many lakes have been created by the dams, including Gaston, Kerr (mostly in Virginia), and Roanoke Rapids (in North Carolina).¹⁹⁹ The Virginia Power Company²⁰⁰ has a license from the Federal Energy Regulatory Commission ("FERC") to operate one of the dams on the Roanoke River.²⁰¹ The reservoir formed by this dam, Lake Gaston, is located partly in Virginia but primarily in North Carolina.

Under Virginia Beach's plan, the city proposed to construct a 60-inch pipeline to carry 60 million gallons of water per day from Lake Gaston some 84.5 miles across southern Virginia to the city.²⁰² Virginia Beach

192. See DEQ WATER SUPPLY UPDATE, *supra* note 191 at II-17.

193. See *id.*

194. See *id.* at II-18.

195. See Katrice Franklin, *Plug Pulled on Last Water Limit, Beach Hopes Move Will Bring a Steady Flow of Economic Opportunity*, VIRGINIAN PILOT & LEDGER STAR (Norfolk, Va.), Sept. 2, 1998, at B1, available in 1998 WL 15062283. The city lifted the last of the conservation measures in September 1998 after its alternative water supply project finally was completed. The City Council ultimately reserved 38% of the new water supply provided by the project for economic development initiatives. About forty thousand new homes could be served by the additional water. *Id.*

196. See *North Carolina v. Hudson*, 665 F. Supp. 428, 432 (E.D.N.C. 1987).

197. See *id.* at 432; FERC FEIS ON GASTON, *supra* note 189, at 3-3.

198. See FERC FEIS ON GASTON, *supra* note 189, at 3-4.

199. See *id.* at 3-17, 3-18.

200. Virginia Power was formerly known as the Virginia Electric & Power Company (VEPCO). See *North Carolina v. City of Virginia Beach*, 951 F.2d 596, 599 (4th Cir. 1991).

201. See *id.*

202. See *North Carolina v. Hudson*, 665 F. Supp. 428, 432 (E.D.N.C. 1987).

would receive 80% of the water, while nearby Virginia localities would get the remaining portion.²⁰³ The pipeline project required the permission of the Army Corps of Engineers ("Corps") because the project affected navigable waters of the United States.²⁰⁴ The pipeline project also required the permission of FERC because certain hydropower lands and waters would be involved.²⁰⁵ Both EPA and FERC ultimately decided that a full

203. The pipeline project included plans to allocate 48 of the 60 million gallons per day (mgd) to Virginia Beach, 10 mgd to Chesapeake, and 1 mgd each to Franklin and Isle of Wight County. *See id.*

204. On July 15, 1983, Virginia Beach applied to the Corps for two permits needed to begin the project. One permit would allow construction of the pipeline itself, as well as a water intake system at Lake Gaston. The second permit would allow execution of a water storage reallocation contract for Kerr Reservoir pursuant to the Water Supply Act of 1958, 43 U.S.C. § 390b (1994). *See North Carolina v. Hudson*, 665 F. Supp. 428, 432-33 (E.D.N.C. 1987). In January 1984, after holding public hearings on the environmental assessment, the Corps issued a final environmental assessment and granted Virginia Beach a construction permit. *See id.* at 432. After the Corps' permit decision was made, several lawsuits were filed. One suit involved the state of North Carolina, which sued to prevent construction of the pipeline. *See id.* at 433. The Roanoke River Basin Association subsequently intervened as plaintiffs. *See id.* The challenge to the permit was based primarily on the project's detrimental environmental impact on the basin, on the need for a full environmental impact statement, and on the water needs of Virginia Beach as compared to localities actually situated in the basin. *See id.* at 436. In another case, Virginia Beach sued to obtain a declaratory judgment that the permit was valid. *See City of Virginia Beach v. Roanoke River Basin Ass'n*, 776 F.2d 484, 486 (4th Cir. 1985). The court refused to grant the city relief, holding that the original court had no jurisdiction over the North Carolina defendant. *See id.* at 488. The court, however, allowed the city to join the case filed in the Eastern District of North Carolina, which involved the same issues. *See id.* The city accordingly transferred its action to the federal district court in North Carolina. *See Hudson*, 665 F. Supp. at 433. Ultimately, after years of litigation, the issuance of the permit was upheld. *See Roanoke River Basin Ass'n v. Hudson*, 940 F.2d 58, 66 (4th Cir. 1991), *cert. denied*, 502 U.S. 1092 (1992).

205. Virginia Power filed an application with FERC, asking it to approve the withdrawal of water from Lake Gaston, the construction and operation of a water intake facility, and the transfer of necessary easements. This application was made in February 1991—some seven years after Virginia Beach obtained its construction permit from the Corps. *See In re City of Virginia Beach*, 42 F.3d 881, 883 (4th Cir. 1994). FERC is the licensor of the hydropower facility at Lake Gaston and the immediately surrounding land that is included in the project. *See North Carolina v. City of Virginia Beach*, 951 F.2d 596, 598 (4th Cir. 1991). Virginia Power sought permission from FERC to grant the necessary easements to Virginia Beach and to amend its license from FERC to allow the withdrawals. *See id.* at 599; *North Carolina v. Federal Energy Regulatory Comm'n*, 112 F.3d 1175, 1181-82 (D.C. Cir. 1997); *Federal Energy Regulatory Comm'n*, Order Approving Non-Project Use of Lands and Waters and Amending License, Project No. 2009-003, 72 Fed. Energy Reg. Comm'n Rep. (CCH) ¶ 61,075 (July 26, 1995) [hereinafter *FERC Gaston Order*]. For 22 miles, the pipeline follows a utility easement held by Virginia Power. *See Harris, supra* note 190, at 13.

For almost two years, FERC waited while the Department of Commerce considered North Carolina's argument that the project was inconsistent with the North Carolina Coastal Zone Management ("CZM") plan. *See City of Virginia Beach v. Brown*, 858 F. Supp. 585, 587 (E.D. Va. 1994). Under the Coastal Zone Management Act ("CZMA"), no federal agency can issue or alter a permit for a project that a state has determined will interfere with its CZM plan unless the project is approved by the Secretary of Commerce. *See Coastal Zone Management Act of 1972*, 16 U.S.C. § 1456(c)(3)(A) (1994). The Department of Commerce and the Justice Department (which was called in for legal advice) considered and changed their positions on the question of whether the CZMA allowed North Carolina to object to the pipeline project even though the project would be located

environmental impact statement ("EIS") was needed, despite earlier findings to the contrary. Becoming impatient with the bureaucratic delays, Virginia Beach brought suit against FERC to compel it to enter a final decision on the application for approval of the pipeline. Although the court denied the petition because of the extraordinary remedy it would have required, the court expressed concern about the administrative burdens imposed on Virginia Beach: "[W]hile we cannot be happy about the overall time elapsed, we confirm that there are rational explanations for the length of each time segment."²⁰⁶ Finally, in July 1995, some four and one-half years after FERC received Virginia Power's application, FERC issued a final EIS,²⁰⁷ and approved the application.²⁰⁸

The long and highly contested regulatory review process ultimately produced a number of findings and conclusions in Virginia Beach's favor. For example, in issuing a final environmental assessment and granting Virginia Beach a construction permit, the Corps found that the proposed withdrawal would have no significant environmental impact on Lake Gaston itself or on downstream areas.²⁰⁹ More specifically, the Corps relied heavily on Virginia Beach studies to conclude that, even in a worst-case scenario, downstream wildlife populations would not be affected by the proposed pipeline project.²¹⁰ Proponents of the pipeline maintained that the water withdrawals would have minimal effect. Minimum downstream flows apparently could be maintained even in times of drought by withdrawing water from the Kerr Reservoir. Furthermore, proponents stressed that the water level in Lake Gaston would not decrease because of the pipeline withdrawals, though the level in Kerr could fall about three inches during a serious drought.²¹¹ FERC reached similar conclusions in issuing a final environmental impact statement and approving the use of

entirely in Virginia. *See Brown*, 858 F. Supp. at 587. Eventually, this legal question became moot in May 1994, when the Department of Commerce overruled North Carolina's objection to the project. *See id.* at 590.

206. *In re City of Virginia Beach*, 42 F.3d 881, 886 (4th Cir. 1994).

207. *See FERC FEIS ON GASTON*, *supra* note 189, at 6-11.

208. *See FERC Gaston Order*, *supra* note 205, at 61,389 & 61,400-01.

209. *See North Carolina v. Hudson*, 665 F. Supp. 428, 437-38 (E.D.N.C. 1987).

210. *See id.* at 442. The federal district court found the Corps' worst-case scenario analysis to be unreliable and directed the Corps to conduct analysis that was independent of the Virginia Beach studies. The court concluded that, without this independent analysis, the Corps' decision was arbitrary and capricious. *See id.* at 443. After conducting its independent analysis, the Corps issued a second environmental assessment, which came to the same conclusions as the first. The court subsequently upheld the conclusions of the second assessment. *See North Carolina v. Hudson*, 731 F. Supp. 1261, 1273 (E.D.N.C. 1990), *aff'd sub nom. Roanoke River Basin Ass'n v. Hudson*, 940 F.2d 58 (4th Cir. 1991).

211. *See Harris*, *supra* note 190, at 13.

hydropower lands and waters. It concluded that the pipeline project would relieve Virginia Beach of "serious water supply problems that have severely constrained the life style of its citizens and clouded its economic future."²¹² The Commission also noted that the downstream effects of the withdrawals could be sufficiently mitigated by upstream water release measures.²¹³

Despite all of Virginia Beach's regulatory and judicial victories, North Carolina has not yet given up its fight to stop the project²¹⁴ and appears to

212. FERC Gaston Order, *supra* note 205, at 61,399.

213. See FERC FEIS ON GASTON, *supra* note 189, at 6-11, 6-12.

214. Despite receiving FERC approval, Virginia Beach has experienced a number of setbacks. In April 1995, Virginia Beach and North Carolina agreed to a mediated settlement that provided a way to end their eleven-year dispute. See *Agreement on the Gaston Pipeline: Go with the Flow*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), Apr. 29, 1995, at A8. Among other provisions, the negotiated settlement proposed to limit the City of Norfolk's ability to sell water outside southeastern Virginia. See Karen Weintraub & Alex Marshall, *Lake Gaston Deal Irks Norfolk*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), May 11, 1995, at A1. It also proposed to give certain North Carolina cities the right to drain up to 20 million gallons of water per day without Virginia localities being able to object. See W.W. "Ted" Bennett Jr., *The Lake Gaston Pipeline: Let's Have Fair Play for all Virginians*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), June 8, 1995, at A10. Due to partisan posturing, and to the objections of Norfolk delegates, the Virginia General Assembly failed to approve the settlement. See Ken Stolle, *Democrats Blocked Special Session*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), July 1, 1995, at A12.

Other setbacks include difficulties between Virginia Beach and several Virginia localities, as well as new challenges raised by North Carolina. See, e.g., Toni Guagenti, *Pipeline Fight's Not over Til It's Over In Victory's Wake, Beach Awaits N.C.'s Next Shot*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), May 11, 1997, at A1 (discussing the costly legal battles waged in Virginia and North Carolina over the pipeline). One Virginia locality, Isle of Wight, had refused to approve Virginia Beach's request to lay pipe through the county. See JoAnn Frohman, *IW Jilts Beach on Water Proposal: City Says '87 Deal with County Moot*, DAILY PRESS (Newport News, Va.), Dec. 13, 1995, at B1. After over a year of arguing and threats, the dispute was resolved in May 1996, when Virginia Beach agreed to pay Isle of Wight \$3 million for permission to have the pipeline discharge water into Ennis Mill Channel in the county. See JoAnn Frohman, *IW Board Approves Lake Gaston Pipeline: County to Receive \$3 Million Payment*, DAILY PRESS (Newport News, Va.), May 17, 1996, at C1. A similar dispute occurred in 1989 when Brunswick County threatened to deny Virginia Beach permission to construct the intake portion of the pipeline in the county. See *Gaston Pipeline Warning Issued*, DAILY PRESS (Newport News, Va.), Feb. 23, 1989, at B3. After another \$3 million payment, the city received the necessary permission. See *Water Project Pact Reached*, DAILY PRESS (Newport News, Va.), Aug. 18, 1989, at B7. In addition, a dispute recently arose between Virginia Beach and the City of Suffolk over the expansion of a pumping station needed to treat Lake Gaston water being piped to Virginia Beach. The City of Suffolk had placed strict limitations on the expansion of the Norfolk water treatment plant, which will treat the Gaston water. Norfolk, Virginia Beach, and the City of Chesapeake jointly brought suit against Suffolk to challenge the limitations. In addition, Virginia Beach sought damages for the expense of delaying completion of the project. See *City of Suffolk v. City of Norfolk*, No. 97-85 (Va. 5th Cir. 1998) (order granting joint motion for dismissal); John Murphy, *Cities Hope to Settle Local Gaston Lawsuit*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), July 10, 1997, at A1. In October 1997, the cities settled the dispute; Suffolk agreed to allow the expansion in exchange for more than \$4 million. See *City of Suffolk v. City of Norfolk*, No. 97-85 (Va. 5th Cir. 1998); Katrice Franklin & Karen Weintraub, *Suffolk Makes Regional Peace in Long Water War*, VIRGINIAN-PILOT & LEDGER

be willing to play what it regards as its "trump card"—a challenge to the renewal of Virginia Power's fifty-year license to operate the hydroelectric dam which created Lake Gaston.²¹⁵ That license expires in 2001.²¹⁶ In a January 1997 press release, James Gilmore, the Virginia Attorney General at the time and currently the Governor of Virginia, described North Carolina's battle against Virginia as an attack on Virginia's "sovereign rights."²¹⁷

To date, what has Virginia Beach's Lake Gaston project produced? In addition to actual construction of the pipeline,²¹⁸ the project has involved a tremendous amount of judicial and legal resources, producing at least 13 published court opinions through May 1997.²¹⁹ The record for one 1990

STAR (Norfolk, Va.), Oct. 16, 1997, at B13. Finally, in July 1995, North Carolina challenged FERC's issuance of licenses allowing Virginia Beach to complete the pipeline. *See* North Carolina v. Federal Energy Regulatory Comm'n, 112 F.3d 1175, 1182 (D.C. Cir. 1997). On May 9, 1997, a three-judge panel of the D.C. Circuit denied North Carolina's petition for review, concluding that the FERC order was not arbitrary or capricious. *See id.* at 1194. In November 1997, North Carolina appealed the decision to the Supreme Court, which allowed the prior rulings to stand without comment. *See id.*, cert. denied, 522 U.S. 1108 (1998).

215. *See* Guagenti, *supra* note 214, at A1. On January 28, 1999, Virginia Power filed a license application for the Gaston hydropower project. *See* Virginia Power & Electric Co., *Notice of Application Tendered for Filing With the Commission and Soliciting Additional Study Requests*, Project No. 2009-018 (Feb. 22, 1999) <<http://cips.ferc.fed.us/hydro/p/p-2009.00n.txt>>.

216. *See* Guagenti, *supra* note 214, at A1.

217. VA Attorney General News Release, *Attorney General Gilmore Files Brief In Support Of Lake Gaston Pipeline; Vows to Continue Fight* (Jan. 10, 1997) (on file with author).

218. Despite ongoing legal challenges, the Lake Gaston pipeline began pumping water on August 5, 1997. *See Lake Gaston Pipeline is Running Despite Ongoing Fight in the Courts*, WINSTON-SALEM JOURNAL, Aug. 8, 1997, at B7. The first water pumped from Lake Gaston took 15 days to reach the Hampton Roads region. *See Lake Gaston Water Finally Reaches Hampton Roads*, DAILY PRESS (Newport News, Va.), Aug. 22, 1997, at C5. Construction was completed in November 1997, and the pipeline became operational in January 1998. *See* Interview with Tom Leahy, Water Resources Division Manager, Dep't of Public Utilities, City of Virginia Beach, Virginia (July 17, 1998); *Local Update*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), Jan. 7, 1998, at B3.

219. The legal issues raised by those lawsuits have covered a wide range of topics. *See generally* North Carolina v. Federal Energy Regulatory Comm'n, 112 F.3d 1175 (D.C. Cir. 1997) (challenging FERC approval of the pipeline project as arbitrary and capricious); *In re* City of Virginia Beach, 42 F.3d 881 (4th Cir. 1994) (seeking a writ of mandamus to compel FERC to render a decision on the city's pipeline application); Roanoke River Basin Ass'n v. Hudson, 991 F.2d 132 (4th Cir. 1993) (challenging the disposition of lawyer's fees); North Carolina v. City of Virginia Beach, 951 F.2d 596 (4th Cir. 1991) (considering whether Virginia Beach could continue construction of portions of the pipeline that were outside FERC's jurisdiction prior to completion of FERC's review); City of Virginia Beach v. Roanoke River Basin Ass'n, 776 F.2d 484 (4th Cir. 1985) (seeking a declaratory judgment that the Corps' permits were properly issued and raising a personal jurisdiction issue); City of Virginia Beach v. Brown, 858 F. Supp. 585 (E.D. Va. 1994) (questioning North Carolina's authority to review the water withdrawal project under its Coastal Management Plan); City of Virginia Beach v. United States Dep't of Commerce, 805 F. Supp. 1323 (E.D. Va. 1992) (challenging the refusal to release information requested under the Freedom of Information Act), *aff'd in part & rev'd in part*, 995 F.2d 1247 (4th Cir. 1993); North Carolina v. Hudson, 731 F. Supp. 1261 (E.D.N.C. 1990) (upholding

decision alone consists of 23 volumes of material.²²⁰ In addition, as of May 1997, the City of Virginia Beach had paid \$8.6 million in legal fees.²²¹ Countless federal, state, and local governmental units have been involved in the dispute, and some have even changed their position more than once on the project's desirability.²²²

Will the legal system ultimately allow the most populated city in Virginia and geographically one of the largest cities in the United States²²³ to obtain an adequate water supply? Certainly. Like many states in the water-rich East, Virginia's water allocation laws link water use to ownership of riparian land, but seem to allow creation of public water supplies as long as the necessary property rights, defined according to traditional norms, and the consent of affected local jurisdictions are obtained.²²⁴ Furthermore, American property law historically has recognized a landowner's right to use his land.²²⁵ One of the most important ways to exercise that right is to develop the land; development requires water. When the property right of use and enjoyment is coupled

issuance of the permits despite the alleged significant impact of the project on the striped bass population), *aff'd sub nom.* Roanoke River Basin Ass'n v. Hudson, 940 F.2d 58 (4th Cir. 1991) (upholding issuance of the permits despite concerns about the striped bass population, water quality, and the future water needs of North Carolina); North Carolina v. Hudson, 665 F. Supp. 428 (E.D.N.C. 1987) (challenging the Corps' issuance of permits under NEPA, the Water Supply Act, and the Clean Water Act); City of Virginia Beach v. Board of Supervisors of Mecklenburg County, 246 Va. 233 (1993) (challenging Virginia Beach's ability to use water stored in a reservoir located in two counties without the consent of those counties); Tidewater Ass'n of Homebuilders, Inc. v. City of Virginia Beach, 241 Va. 114 (1991) (challenging the constitutionality of a fee imposed by Virginia Beach on new and expanding water users to fund the pipeline project).

220. See North Carolina v. Hudson, 731 F. Supp. 1261, 1263 n.2 (E.D.N.C. 1990), *aff'd sub nom.* Roanoke River Basin Ass'n v. Hudson, 940 F.2d 58 (4th Cir. 1991).

221. See Guagenti, *supra* note 214, at A1.

222. See City of Virginia Beach v. United States Dep't of Commerce, 805 F. Supp. 1323 (E.D. Va. 1992), *aff'd in part & rev'd in part*, 995 F.2d 1247 (4th Cir. 1993).

223. Virginia Beach ranked 17th in land area out of 77 United States cities having a 1992 population of 200,000 or more. See BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, COUNTY AND CITY DATA BOOK 1994, at xxvii (12th ed. 1994) [hereinafter 1994 COUNTY AND CITY DATA BOOK].

224. See Butler, *supra* note 68, at 156-79 (discussing public consumptive water rights under the riparian doctrine). See generally Tarlock, *supra* note 68, §§ 3.12, 3.20 (discussing the allocation of riparian rights under the common law and under statutory modifications of the common law).

225. See, e.g., Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1015-16 (1992) (declaring that a regulation denying a landowner all economically viable or productive use of his land is a compensable taking); Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 414-16 (1922) (recognizing that government action can go too far under the Constitution in restricting private land use); 1 GEORGE W. THOMPSON, COMMENTARIES ON THE MODERN LAW OF REAL PROPERTY § 1, at 3-5, § 5, at 25-31 (1980 repl.) (discussing the meaning of ownership and property). See generally 6A AMERICAN LAW OF PROPERTY § 28.1 (1954) (discussing a possessor's right to "exclusive use and enjoyment of his estate").

with recent takings caselaw,²²⁶ it is difficult to envision a locality or state prohibiting or significantly restricting private land development to control water use and protect a watershed.²²⁷ Yet without such a prohibition or restriction, private property owners will continue to develop their land, and water use will continue to rise.

From an ecological perspective, it is difficult to understand how the social and legal systems could allow a city without an adequate freshwater supply to continue to grow and develop its land virtually without restraint. During the period from 1980 to 1990, Virginia Beach experienced almost a 60% increase in households²²⁸ and saw its population grow almost 131,000 (from 262,199 to 393,089).²²⁹ By the year 2010, Virginia Beach's population is expected to reach approximately 580,000, an increase of over 185,000 persons from the 1990 population.²³⁰ From 1980 to 1986, Virginia Beach authorized 45,195 building permits for new private housing units.²³¹ These permits represented 49.1% of the 1980 housing stock of Virginia Beach.²³² In comparison, during the same time period, the entire state of Virginia approved building permits for new private housing units that represented only 17.2% of its 1980 housing stock.²³³ Statistics for the United States reveal that building permits issued during the 1980–1986 period represented 11.3% of the 1980 housing stock.²³⁴

226. See, e.g., *Dolan v. City of Tigard*, 512 U.S. 374 (1994) (invalidating, under the Takings Clause, a city's decision to condition the issuance of a building permit on the dedication of a portion of the applicant's private property for a public greenway and for a bicycle/pedestrian pathway); *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003 (1992) (invalidating, under the Takings Clause, a state law that prevented construction of a permanent habitable structure on private beachfront property and that deprived the landowner of all economically viable use); *Nollan v. California Coastal Comm'n*, 483 U.S. 825 (1987) (deciding that a state could not, without payment of just compensation, condition issuance of a permit to rebuild a house located on privately owned beachfront property on the transfer of an easement allowing public access through the property).

227. For an analysis of recent Supreme Court takings cases, see *TAKINGS* (David L. Callies ed., 1996).

228. See 1994 COUNTY AND CITY DATA BOOK, *supra* note 223, at 608.

229. See *id.* at 606.

230. See *id.*; CENTER FOR PUBLIC SERVICE, UNIV. OF VA., VIRGINIA STATISTICAL ABSTRACT 598 (1994–1995).

231. See BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, COUNTY AND CITY DATA BOOK 1988, at 566 (1988). This figure excludes mobile homes, motels, hotels, group residential structures (e.g., college dormitories and nursing homes), and conversions of or alterations to existing buildings. See *id.* app.G, at G-8. A housing unit is defined as "a house, apartment, mobile home or trailer, group of rooms, or single room occupied or, if vacant, intended for occupancy as separate living quarters." *Id.*

232. See *id.* at 566.

233. See *id.* at 540.

234. See *id.* at 6.

Although property norms may not be the primary or even key reason for Virginia Beach's significant increase in population, property norms have had a significant impact on how Virginia Beach is handling its growth. Efforts by Virginia Beach to control development have produced mixed results. In 1986 Virginia Beach attempted to control its "leapfrogging" development by downzoning 3,500 acres of land from unit development to agricultural use.²³⁵ The Virginia Supreme Court invalidated the city's attempt as "piecemeal" (as opposed to comprehensive) downzoning that was not justified by a change in circumstances or prior mistake affecting the public health, welfare, or safety.²³⁶ Because other neighboring properties were not similarly downzoned, the city's action did not appear to promote its goal of promoting orderly growth and discouraging leapfrog development.²³⁷ Since that decision, the commitment of Virginia Beach to controlling growth and development has been questionable and unpredictable. One of the city's main tools for controlling growth, the Green Line created in the city's 1979 Comprehensive Plan, has been violated by developers and city officials alike. The Green Line establishes a boundary beyond which no city services are to be offered.²³⁸ As recently as 1997, the Virginia Beach Planning Commission approved housing projects that were located beyond the Green Line and included services provided by the city.²³⁹ In an effort to attract tourism, the city also approved a golf course to be located in an area beyond the Green Line.²⁴⁰

Some might question whether the private property concept is actually responsible for the escalating development and environmental degradation, or whether the real culprit is the profit motive. This line of inquiry would distinguish the private property concept from the profit motive, and ask whether environmental degradation would exist even in the absence of a private property rights regime. Because private property rights help to internalize externalities, it is tempting to respond that degradation probably would occur more rapidly when private property rights did not exist and

235. See *City of Virginia Beach v. Virginia Land Investment Ass'n No. 1*, 239 Va. 412, 415-16 (1990).

236. See *id.* at 416.

237. See *id.* at 414-16.

238. See CITY OF VIRGINIA BEACH, VA., COMPREHENSIVE PLAN 26 (Nov. 4, 1997) (retaining and claiming rigid adherence to the Green Line as a "defense against sprawl") (on file with author); Tom Holden, *Beach Commission Approves Rezoning for Houses Below Green Line*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), May 15, 1997, at A1.

239. See Holden, *supra* note 238; Toni Guagenti, *Beach Planners Approve Golf Course, 108 Homes*, VIRGINIAN-PILOT & LEDGER STAR (Norfolk, Va.), June 12, 1997, at B11.

240. See Guagenti, *supra* note 239.

that therefore property rights do not necessarily cause escalating development and environmental degradation.

The strength of this view depends in part on whether the distinction between private property norms and the profit motive is real. The profit motive has been defined by some as the desire to increase individual wealth and by others as the seemingly insatiable desire for more.²⁴¹ Because private property rights include the power to take economic gambles through the exercise of the rights of use, transferability, reasonable expectation of gain, and exclusive control, it is difficult to separate the desire to maximize individual wealth from private property norms. The rights of use, transferability, and reasonable expectation of gain all revolve around the desire to promote wealth maximization for the individual property owner. Under current economic thinking, property rights are recognized when it is efficient to do so.²⁴² Property norms thus incorporate and promote the profit motive, however it is defined.²⁴³

Further, to the extent that a distinction between property norms and the profit motive exists, it does not negate all of the harms that private property owners have caused to the environment. Even if a private property regime is less likely to cause environmental ruin than other regimes, that fact does not address the environmental harms that private property owners have caused. The point is not that private property norms are the sole or primary cause of environmental degradation, but rather that traditional private property norms are biased against environmental quality and ecological integrity, and therefore are part of the problem. Solving the problem of environmental degradation thus will require some reexamination of private property norms.

Accepting that private property norms are part of the problem of escalating land and water use does not mean the abandonment of the private property regime. To the contrary, less drastic solutions, like the redefinition of private property norms, should be tried first. What the Virginia Beach situation makes clear is that water rightholders and their consumers—here collectively an entire city—have relied on property

241. See Mark Sagoff, *Do We Consume Too Much?*, in *THE BUSINESS OF CONSUMPTION*, *supra* note 112, at 271, 285.

242. See Harold Demsetz, *Toward a Theory of Property Rights*, 57 *AM. ECON. REV. PAPERS & PROC.* 347 (1967).

243. Evidence of this incorporation can even be found in the Supreme Court's gradual shift away from viewing property as a physical thing having only use value to recognizing property as including "the exchange value of anything." JOHN R. COMMONS, *LEGAL FOUNDATIONS OF CAPITALISM* 14 (1924). See also ALEXANDER, *supra* note 42, at 259–61 (discussing property as exchange value in the Supreme Court).

norms to escape responsibility for escalating growth and water use even when the growth and use exceed the capabilities of the rightholders' water resources. Cumulative impacts of private land use on the ecosystem are basically ignored. Private land development is allowed even in times of mandated water restrictions. Economic development is used as the justification for spending over \$250 million on a water supply project that will allow more growth and water use to occur.²⁴⁴ Little, if any, relationship exists between water supply and water demand.²⁴⁵ Some sense of accountability—even a vague sense of responsibility for ecosystem integrity—is noticeably absent from the discussions of many developers, property owners, and city officials, who instead promote land development and economic growth. Property norms, in other words, have had pathological effects on the land use preferences and decisions of many private landowners and public officials.

These effects could be minimized or reversed if actual ecological conditions and costs were considered in defining property rights. Instead of raising the property rights banner to demand more water to enable greater land use, decisionmakers could be using water supply as a "crucial control factor" in distributing population and growth and avoiding overuse and excessive concentration.²⁴⁶ Instead of correlating water needs to population, industrial, and urban projections, decisionmakers could be breaking the "self-fulfilling prophecy" of water allocation decisions²⁴⁷ by using water supply as an ecological constraint on development and use. Decisionmakers could prefer uses that return water or at least minimize its use over uses that consume large quantities of water.

Importing water is not like importing food, drugs, and other goods. Indeed, the need to import water reveals much about the ecological conditions of the receiving area. Although water is a renewable resource, it is not a fungible good that can be mass produced. At some point in time, its removal will drastically alter ecological conditions in the exporting and importing systems. The effectiveness of management programs in taking such an ecologically conscious approach is considered next.

244. Some of the estimated costs of the project include \$150 million for construction of the pipeline, \$100 million to upgrade water treatment processes, and \$10 million in legal and regulatory expenses. See Harris, *supra* note 190, at 11, 13.

245. See MANGUN & HENNING, *supra* note 98, at 133.

246. See *id.* at 133–34.

247. *Id.* at 133.

B. THE PATHOLOGY OF INEFFECTIVE
ECOSYSTEM MANAGEMENT OVER THE LONG TERM

While some management programs have achieved success in managing ecosystems or watersheds over the short term, property norms have pathologically affected management programs over the long term. These effects have contributed to the development of less resilient ecosystems that are more likely to become persistently degraded by disturbances once absorbed by the ecosystem.²⁴⁸ Even when the management program is comprehensive in scope, program administrators and policymakers have tended to integrate property norms into the management program. This integration has affected not only the setting of goals and standards, but also the focus of management efforts, the implementation of goals, the enforcement of standards, the subsequent monitoring of ecological indicators, and the internal operations of the management institutions.²⁴⁹ The integration of property norms into management programs is evidenced by the widespread adoption of the atomistic and product-oriented perspectives underlying the private property system.²⁵⁰ Such perspectives typically result in the targeting of specific ecological indicators (e.g., water, trees, or fish) to promote social objectives (e.g., maintaining employment, promoting economic activities, or protecting livelihoods)—all under the guise of environmental protection.²⁵¹

Studies of managed ecosystems indicate that targeting an ecological variable to minimize problems caused by fluctuation in that variable ultimately results in lower resilience in the managed ecosystem, greater rigidity in management institutions, and greater societal dependence on the controlled variable.²⁵² Management strategies that target ecological variables admittedly have been successful in reducing the variability of the ecological target, and even in reversing or slowing environmental degradation over the short term.²⁵³ Those strategies, however, have adversely affected ecosystems over the long term, causing a reduction in spatial heterogeneity that makes a system more vulnerable to large-scale

248. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 6–8.

249. See *id.* at 7–9.

250. A wide variety of ecosystem management programs have incorporated the atomistic and product-oriented perspectives into their management programs. Those systems include eastern North America forests, the forests of the Sierra Nevada, the savannas of South Africa, the Everglades, the Chesapeake Bay system, the Columbia River basin, the Great Lakes, and the Baltic Sea. See *id.* at 7, 10–11.

251. See *id.* at 6–7.

252. See *id.* at 6, 8.

253. See *id.* at 7–8.

disturbances.²⁵⁴ Further, the initial successes of the targeting strategies have led to changes in the management institutions and in the incentives of people benefited or burdened by the management program; these changes have decreased their ability or desire to respond to future ecological crises.²⁵⁵ Once initial successes were achieved, the management institutions tended to shift their focus to the efficiency of their internal operations. Ecological monitoring programs received less financial support, became less concerned about detecting unexpected ecological changes in the ecosystem, and focused more on local needs.²⁵⁶ Success in controlling the variability of the ecological target led to the development of dependent industries which pressed for the continued targeting of the ecological variable.²⁵⁷ The initial success also led to changes in society; those citizens who were not directly benefited tended to become more passive over time, relying on the management institutions which had achieved the initial success and which were slowly becoming more rigid.²⁵⁸

These pathological effects can be countered by decisionmaking processes and management approaches that are more flexible²⁵⁹ and that recognize the need to reevaluate and, if necessary, redefine underlying norms. Greater flexibility is needed to enable managers to identify changes in the health of ecosystems and to ensure adaptation of the ecological and human systems to the changes.²⁶⁰ Greater flexibility can be achieved, in part, by recognizing that controlled monitoring programs produce more rigid management institutions incapable of adapting to unexpected change. Rather than being tied to past successes or to economically significant ecological variables, monitoring must be experimental, looking for unexpected ecological crises, and must allow for active intervention and corrective responses.²⁶¹ The pathological effects of rights-based ecosystem management can be broken by an approach that looks beyond policies and research goals designed to control targeted ecological variables valued by social and economic systems. Traditional property norms should not control the setting or definition of ecosystem management goals, especially not when the norms are defined or applied in a static way. Policymakers and managers must recognize the need for—and the legitimacy

254. *See id.* at 7–8.

255. *See id.* at 8.

256. *See id.* at 8–9.

257. *See id.* at 8.

258. *See id.*

259. *See id.* at 9.

260. *See id.*

261. *See id.* at 9, 30.

of—redefining underlying property norms, as well as the accompanying rights and obligations, in light of new or evolving information and conditions. Although property norms may capture traditional political or cultural beliefs,²⁶² property norms do not reflect principles of ecology, especially those principles relating to ecosystem integrity and to the spatial, temporal, and hierarchical scales of landscape ecology.²⁶³

An examination of the Chesapeake Bay management program will provide some insights into the pathological effects of property norms on watershed and ecosystem management. Those insights will suggest potential ways for breaking the pathology of rights-based ecosystem management through more flexible, adaptive management and through considerations of scale and integrity in decisionmaking processes.

1. *The Chesapeake Bay Management Program*

The Chesapeake Bay Management Program “has become a model” of effective ecosystem management.²⁶⁴ A voluntary effort involving Maryland, Pennsylvania, Virginia, the District of Columbia, and the federal government,²⁶⁵ the Bay program has, over time, evolved from a water quality program aimed at the decline in living resources to “the integrated ecosystem management of land, air, water, and living resources.”²⁶⁶ The Bay program involves what some experts have characterized as a “best-case scenario.”²⁶⁷ Development of the program occurred after there was widespread recognition of the ecological problems in the Bay system, significant scientific study and analysis of the problems, extensive community support for protecting the Bay ecosystem, and well-coordinated

262. Scholars disagree about the degree to which property norms reflect traditional political beliefs or constitutional values. Compare, e.g., ELY, *supra* note 2 (assessing the role of property and economic rights in constitutional history), and RICHARD A. EPSTEIN, TAKINGS 3–18 (1985) (discussing the political tradition reflected in the Takings Clause of the U.S. Constitution), with William Michael Treanor, *The Original Understanding of the Takings Clause and the Political Process*, 95 COLUM. L. REV. 782 (1995) (discussing the original understanding and subsequent misunderstandings of the Takings Clause).

263. For a discussion of scale considerations, see *infra* Part II.B.2.

264. Ann Pesiri Swanson, *Governing the Chesapeake Bay—an Evolution of Ecosystem Management*, in SUSTAINABLE COASTAL WATERSHED, *supra* note 113, at 14, 14.

265. See CHESAPEAKE BAY COMM’N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF VIRGINIA, MARYLAND AND PENNSYLVANIA 1993, at 1 [hereinafter 1993 CHESAPEAKE BAY COMM’N REPORT]. The Chesapeake Bay Commission is a tri-state legislative commission which guides Maryland, Pennsylvania, and Virginia “in cooperatively managing the Chesapeake Bay.” *Id.* The Commission acts as “the legislative arm of the Chesapeake Bay Program,” implementing program decisions and helping to develop policy. *Id.*

266. Swanson, *supra* note 264, at 14.

267. Costanza & Greer, *supra* note 152, at 170, 196.

efforts by scientists, government leaders, private environmental groups, and members of the media to highlight and deal with the Bay's problems.²⁶⁸

Since early European settlers arrived in Jamestown in 1607, the Chesapeake Bay has undergone significant ecological change. The largest single estuary in the United States, the Chesapeake Bay covers an area of 4,400 square miles and has 8,100 miles of shoreline.²⁶⁹ Its drainage basin extends some 6,400 square miles into six states and the District of Columbia.²⁷⁰ Once providing, acre for acre, the most productive fishing grounds in the world,²⁷¹ the Chesapeake Bay supported bountiful populations of oysters, crab, and finfish harvest and extensive beds of submerged aquatic vegetation—all existing in water so clear that one could often see to the bottom.²⁷² Oysters used to be so numerous that some experts estimate they were capable of filtering and cleaning the equivalent of the entire volume of water in the Bay in less than a week.²⁷³ Today this self-cleaning function is no longer effective because of the drastic decline in the oyster population. Increased nutrient and sediment inputs into Bay waters have altered the chemical, physical, and ecological balance of the waters, adversely affecting water quality and causing catastrophic declines in the abundance of submerged aquatic vegetation. Overfishing and disease have decimated major fisheries and, in turn, caused further changes. Turbidity, primary production, and the oxygen content of the Bay waters all have been affected.²⁷⁴

With a population currently totaling about 14 million and projected to exceed 17 million by 2020,²⁷⁵ the Chesapeake Bay watershed is facing even greater ecological deterioration unless its management program can overcome some serious obstacles to effective management. The same characteristics that make the Bay especially sensitive to stress also indicate that the Bay's ecological problems will be difficult to address as long as traditional property norms and rights-based thinking control.²⁷⁶ Because the Bay is a broad, shallow estuary, it experiences constant mixing of freshwater, seawater, and nutrients in unpredictable patterns. These

268. *See id.* at 170, 195–98.

269. *See id.* at 173.

270. *See id.*

271. *See id.* at 177.

272. *See id.* at 179; STEVEN G. DAVISON, JAY G. MERWIN, JR., JOHN CAPPER, GARRETT POWER & FRANK R. SHIVERS, JR., *CHESAPEAKE WATERS* 18–19, 50–54, 76–82 (2d ed. 1997).

273. *See Costanza & Greer, supra* note 152, at 180.

274. *See id.* at 177–81.

275. *See id.* at 182.

276. *See id.* at 170.

interactions cause nutrients to be recycled easily, contributing both to the Bay's productivity and sensitivity.²⁷⁷ When combined with the Bay's openness and vast, habitable coastline, this productivity makes the Bay watershed an especially attractive area for settlement and use.²⁷⁸ Its complexity, productivity, and unpredictability mean not only that the Bay system is relatively resilient,²⁷⁹ but also that the limits of the Bay's resilience are hard to detect.

The management program for the Bay system evolved slowly over several decades. In the mid-1960s to mid-1970s, government leaders, environmentalists, and citizens became increasingly concerned about deteriorating conditions in the Bay.²⁸⁰ In the late 1970s, a period of intense scientific study began with the support of political leaders.²⁸¹ Then, in 1983, Maryland, Pennsylvania, Virginia, the District of Columbia, and the EPA initiated the period of formal ecosystem management by executing the first Chesapeake Bay Agreement.²⁸² At the beginning of this formal period, the environmental agenda of the Bay program consisted primarily of "a very loose commitment to cooperate in efforts to protect the Bay."²⁸³ For the most part, joint ventures and meetings among the participating jurisdictions were "relatively rare;"²⁸⁴ voluntary programs adopted by individual participants made up most of the early Bay program.²⁸⁵ The one key exception to this "loose commitment" was reflected in the efforts of the Chesapeake Bay Commission, which worked to protect the Bay through cooperative efforts.²⁸⁶

It was not until the execution of the Chesapeake Bay Agreement of 1987 that the participating jurisdictions agreed to work together to develop and implement programs that produced a healthier Bay.²⁸⁷ The agreement established specific goals, objectives, and commitments for living

277. *See id.* at 170-71.

278. *See id.* at 171.

279. *See id.* at 170-71.

280. *See id.* at 197-98.

281. *See id.* at 198-99.

282. *See id.* at 199-201.

283. CHESAPEAKE BAY COMM'N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF PENNSYLVANIA, MARYLAND & VIRGINIA: 1988 AND 1989, at 1 [hereinafter 1988-1989 CHESAPEAKE BAY COMM'N REPORT].

284. *Id.*

285. *See* CHESAPEAKE BAY COMM'N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF PENNSYLVANIA, MARYLAND AND VIRGINIA: 1986, at 7 [hereinafter 1986 CHESAPEAKE BAY COMM'N REPORT]. For a discussion of those individual programs, see *id.* at 7-12.

286. *Id.* at 13.

287. *See* 1988-1989 CHESAPEAKE BAY COMM'N REPORT, *supra* note 283, at 1, app. B.

resources, water quality, and population growth and development, among other topics.²⁸⁸ Some of the more ambitious commitments in the 1987 agreement included commitments to achieve 40% reductions in the Bay's nitrogen and phosphorus levels by 2000,²⁸⁹ develop a Bay-wide wetlands protection policy,²⁹⁰ develop and adopt basin-wide strategies for reducing toxins and conventional pollutants,²⁹¹ and adopt resource management strategies for important species.²⁹² In a relatively short period of time, the 1987 agreement resulted in the implementation of special restoration programs for certain commercially valuable and stressed fisheries, programs to reestablish and protect submerged aquatic vegetation, regulation of point source discharges by wastewater treatment facilities, enforcement of sediment controls, and development of regulatory programs for critical coastal areas.²⁹³

Although the famed "toes" or "sneaker" test still cannot be met, the Chesapeake Bay program has made some progress. Under the "toes" test, the Bay will be far along the road to recovery when the waters of Maryland's Patuxent River are so clear that people can wade in the River up to their chest and see their toes.²⁹⁴ Scientists cannot yet see their toes, but have observed reductions in the Bay's phosphorous levels, as well as a gradual recovery of submerged aquatic vegetation.²⁹⁵ The restoration program for striped bass also has produced positive results.²⁹⁶ Despite these successes, much work remains to be done. Development and implementation of a formal management program has revealed the "full

288. See *id.* app. B at B-1.

289. See *id.* at 21, app. B at B-3.

290. See *id.* at 20-21, app. B at B-2.

291. See *id.* at 21-22, app. B at B-3.

292. See *id.* at 20, app. B at B-2.

293. See 1989 CHESAPEAKE EXECUTIVE COUNCIL PROGRESS REPORT, *supra* note 25, at 18-25.

294. See DAVISON ET AL., *supra* note 272, at 195-96; Horton, *supra* note 155, at 23, 26. This lay person's test for water quality originated with Bernie Fowler, a former Maryland politician and waterman who remembers once being able to wade into water and see his sneakers no matter how deep he waded. By 1988, Fowler could not see his feet after wading into water just eight inches deep. By June 1995, that distance had improved to 40 inches. See DAVISON ET AL., *supra* note 272, at 195. See generally *Tributary teams plan June wade-ins to promote water quality awareness*, BAY J., June 1999, at 6. The wade-ins have expanded beyond the Patuxent River to include other Bay tributaries. See *id.*

295. See 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 1. But see DAVISON ET AL., *supra* note 272, at 186 (suggesting that phosphorus concentrations appear to be rising). The Bay watershed once had over 600,000 acres of submerged grass. By 1984 that figure had shrunk to 38,000 acres. Since then, acreage has improved to 64,000 in 1994. See *id.* at 190.

296. See 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 1, 42; Costanza & Greer, *supra* note 152, at 178.

extent of the bay's problems"²⁹⁷ and has highlighted the need for a holistic, ecosystem-based approach.²⁹⁸

One of the Bay's most serious and complex problems involves nonpoint source pollution. Although the Bay program has reduced some nutrient levels through regulation of industries, sewage treatment plants, and other point sources discharging directly into waterways, the program has experienced greater difficulty in restricting nonpoint sources that indirectly contribute nutrients and sediment to waterways through runoff.²⁹⁹ Controlling nonpoint sources requires moving beyond the immediate coastal area to land "far from the water's edge."³⁰⁰ Effective control of nonpoint source pollution also requires an understanding and recognition of the scales of individual land use—of the connection between an individual user and the Bay ecosystem.

Consider the impact of farmers on the Chesapeake Bay system. Although no one farmer is causing serious harm to the Bay, the cumulative impact of agricultural use is both significant and serious. Farmers represent less than 3% of the Bay's population yet use approximately 25% of the 41 million acres in the Bay's watershed and apply almost 700 million pounds of fertilizer annually.³⁰¹ One estimate places 90% of the 8 million acres of fertilized cropland in the Chesapeake Bay watershed beyond the control of comprehensive management plans to restrict nitrogen and

297. Costanza & Greer, *supra* note 152, at 200.

298. *See id.*

299. *See* CHESAPEAKE BAY COMM'N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF MARYLAND, PENNSYLVANIA & VIRGINIA: 1992, at 17–19, 25 [hereinafter 1992 CHESAPEAKE BAY COMM'N REPORT]; Costanza & Greer, *supra* note 152, at 200. *See also* CHESAPEAKE BAY COMM'N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF MARYLAND, VIRGINIA & PENNSYLVANIA: 1996, at 49–55 [hereinafter 1996 CHESAPEAKE BAY COMM'N REPORT] (discussing the status of nutrient levels and management efforts). The Bay Program recently completed a review of its decade-old goal of reducing nutrients 40% by the year 2000. A report of that review concluded that the 40% goal would not be met unless efforts to reduce nutrients were accelerated and that the 40% goal, in any event, would not be enough to restore the Bay. *See* Karl Blankenship, *Review warns 40% goal will not be enough*, BAY J., Dec. 1997, at 1. *See also* DAVISON ET AL., *supra* note 272, at 215–16 (discussing the difficulties in meeting the Bay program's nitrogen goals). *See generally* *Special Report: Chesapeake Bay Nutrient Report Card*, BAY J., Apr. 1998 (providing a report on the nutrient loads of individual river basins).

300. Shabman, *supra* note 128, at 3. *See generally* 1992 CHESAPEAKE BAY COMM'N REPORT, *supra* note 299, at 25–33 (discussing nutrient management in the Bay region).

301. *See* Horton, *supra* note 155, at 2, 21. *See also* EPA: *Farms Are Worst Polluters*, DAILY PRESS (Newport News, Va.), May 14, 1998, at C8 (noting that farming is "responsible for 70 percent of waterway pollution"). *See generally* *Activities of the Environmental Protection Agency Related to Livestock Feeding Operations: Hearing Before the Subcomm. on Forestry, Resource Conservation, and Research, and the Subcomm. on Livestock, Dairy, and Poultry of the House Comm. on Agriculture*, 105th Cong. 105-50 (1998) (discussing EPA's Draft Strategy on Animal Feeding Operations).

phosphorous runoff into Bay waters.³⁰² Livestock farms compound the problem by producing large amounts of waste—on average about five tons for each person in the United States.³⁰³ Not surprisingly, instead of seeing a reduction in nitrogen ten years after the first Bay agreement was signed, experts noticed about a 2% increase in nitrogen from all sources.³⁰⁴

Another serious problem involves the continuing decline in living resources. Though management of striped bass probably has “averted an irreversible decline of that species,”³⁰⁵ jurisdictions involved in the Bay program generally are “well behind promised deadlines to carry out management plans”³⁰⁶ for other fisheries. After decades of disease, overfishing, and pollution, the Bay’s oyster population is “in serious decline.”³⁰⁷ In 1993 the Chesapeake Bay Commission estimated oyster stocks “to be one percent of their historic levels.”³⁰⁸ This decline has had serious ecological and economic impacts. Scientists now understand the valuable function that oysters play in filtering water; they can remove silt, algae, and pollutants from up to fifty gallons of water per day.³⁰⁹ Today the Bay’s oyster population needs about a year to filter the same volume of water that oysters used to be able to clean in just a few days.³¹⁰ In addition, scientists now understand the value of the habitats provided by the reefs that oysters naturally grow; dredging and oyster harvesting have seriously depleted those reefs.³¹¹ Once reaching from the Bay’s bottom to its water surface, oyster reefs now only “lie low and scattered across the bottom of the bay.”³¹² In economic terms, the drastic decline in the oyster population has meant a significant loss of revenue. For decades, Virginia was a leading producer of American oysters, with oyster harvests totaling eleven

302. See Horton, *supra* note 155, at 31.

303. See *National standards sought for manure management*, BAY J., Mar. 1998, at 4. The waste from the 600 million chickens produced each year on the Delmarva Peninsula exceeds 3.2 billion pounds per year and contains “as much nitrogen as a city of almost 500,000 people.” *Id.* The EPA recently blamed 70% of waterway pollution on agricultural uses, which contributed more pollution to American waterways than sewage waste treatment plants, urban storm sewers, and pollutants deposited from the air. See EPA: *Farms Are Worst Polluters*, *supra* note 301.

304. See Horton, *supra* note 155, at 31.

305. Costanza & Greer, *supra* note 152, at 178. See also CHESAPEAKE BAY PROGRAM, U.S. ENVTL. PROTECTION AGENCY, THE STATE OF THE CHESAPEAKE BAY: 1995, at 31–32 [hereinafter STATE OF THE CHESAPEAKE] (discussing successes of the striped bass program); *Striped Bass: A Chesapeake Treasure*, BAY J., Sept. 1991, at 7 (discussing management of striped bass).

306. Costanza & Greer, *supra* note 152, at 178.

307. 1993 CHESAPEAKE BAY COMM’N REPORT, *supra* note 265, at 39.

308. *Id.*

309. See *id.*; Horton, *supra* note 155, at 31.

310. See 1993 CHESAPEAKE BAY COMM’N REPORT, *supra* note 265, at 39.

311. See *id.*; Costanza & Greer, *supra* note 152, at 179.

312. Costanza & Greer, *supra* note 152, at 179.

million pounds as recently as 1981; today Virginia does not even have a sufficient oyster population to support an oyster industry.³¹³ Other fisheries have experienced less devastating declines.³¹⁴ Despite these declines, fisheries management has tended to favor preservation of the watermen's livelihood over preservation of the species supporting their livelihood.³¹⁵

Loss of habitat and ecologically significant land cover also remains a serious problem within the Bay system.³¹⁶ Forests and wetlands are critical to maintaining the resilience of the Bay ecosystem. Both types of land cover trap pollutants, preventing them from reaching more sensitive parts of the Bay system.³¹⁷ Yet both now "cover only about half as much of the watershed as they once did,"³¹⁸ and they continue to decline in acreage. Indeed, despite the no net loss policy in place since 1989, wetlands still are being lost in the Bay watershed, though at a slower rate. One study indicates that during the 1980s alone the Bay lost 3,000 acres of wetlands

313. See CHESAPEAKE BAY COMM'N, ANNUAL REPORT TO THE GENERAL ASSEMBLIES OF VIRGINIA, MARYLAND & PENNSYLVANIA: 1994, at 43 [hereinafter 1994 CHESAPEAKE BAY COMM'N REPORT]; 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 39; BUTLER & LIVINGSTON, *supra* note 2, § 4.2, at 76. Maryland has experienced similar losses in its oyster industry. See Costanza & Greer, *supra* note 152, at 177.

314. See 1996 CHESAPEAKE BAY COMM'N REPORT, *supra* note 299, at 27-34; 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 41.

315. See DAVISON ET AL., *supra* note 272, at 190-94; Horton, *supra* note 155, at 31. For examples of the pressures that regulators face, see Mark Di Vincenzo, *Watermen Battling New River Lease Law*, DAILY PRESS (Newport News, Va.), Apr. 1, 1993, at C1; Tina McCloud, *Mathews Waterman vs. New Bay Rules*, DAILY PRESS (Newport News, Va.), Oct. 27, 1992, at B1; Stephanie Sharpe, *Waterman Lobbies to Be Sure He'll Have a Tomorrow*, DAILY PRESS (Newport News, Va.), Aug. 27, 1990, at B1. See generally Kim A. McDonald, *As Catch Goes Down, Arguments Well Up*, 42 CHRON. OF HIGHER EDUC., Nov. 24, 1995, at A8 (discussing the debate over management of declining fisheries nationwide).

316. A 1995 report stated that the Bay watershed was losing eight acres per day of wetlands and had lost 300 acres per day of forest land from 1980 to 1990. See STATE OF THE CHESAPEAKE, *supra* note 305, at 3, 6. The report projected the amount of urban and suburban land to increase 35% over 1985 acreage by the year 2000. See *id.* at 5.

317. See Horton, *supra* note 155, at 31-32. See also COMMITTEE ON CHARACTERIZATION OF WETLANDS, NATIONAL RESEARCH COUNCIL, WETLANDS: CHARACTERISTICS AND BOUNDARIES 34-41 (1995) (discussing wetlands' functions); 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 33-35 (describing the environmental benefits of riparian forests); *Forests Offer Tree-mendous Benefits*, *supra* note 187 (describing the many benefits provided by trees). Although forests still cover almost 60% of the lands in the Bay's watershed, the forests are only responsible for 14% of the nitrogen and 3% of the phosphorus runoff. See Bill Matuszeski, *Commentary, Readiness to sacrifice forests for sprawl is almost stumping*, BAY J., Mar. 1998, at 20. Like wetlands, then, "forests represent a huge natural pollution treatment system." *Id.*

318. Horton, *supra* note 155, at 31. See also *supra* notes 182-187 and accompanying text (discussing the decline of tree cover in the Bay watershed).

annually.³¹⁹ Among other factors, the continuing loss has been attributed to unregulated land uses, sprawling development, and regulations that allow destruction of small wetland tracts.³²⁰ Despite the laws protecting wetlands, the overwhelming majority of wetlands permit applications are approved.³²¹ In addition, suburban sprawl is now consuming almost “four times as much open space for every new resident” as the “more compact housing patterns” prevalent through the 1950s.³²²

Nontraditional management approaches and decisionmaking processes are needed to deal with the environmental problems caused by sprawling development, escalating land and water use, and nonpoint source pollution. Those problems require solutions that consider the interactions between a user and the environment, and that impose restraints on land and water use to reflect those interactions. Because of the pathological effects of property norms, traditional management approaches and decisionmaking processes have not dealt effectively with these types of environmental problems—problems that involve components interacting across a range of scales and hierarchical levels. Property norms influence the decisions of lawmakers, regulators, managers, and planners by funneling their decisions towards rights-based choices and ignoring considerations of scale relating to individual land and water use. Although these choices may make some sense from traditional property law and political theory perspectives, they ignore the scale-dependency of ecosystems and ecological integrity.³²³

The Bay program demonstrates the influence of property norms in a number of ways. Participating jurisdictions have taken atomistic and product-oriented approaches in setting and implementing goals. Both Maryland and Virginia, for example, have gone to great lengths to protect the economic interests of existing users of valuable ecological “products.” Delaying implementation of fishing limits, avoiding fishing bans, and limiting the territorial or seasonal scope of fishing restrictions are common

319. See *Directive goes beyond ‘no net loss,’ requires gain in Bay states’ wetlands*, BAY J., Dec. 1997, at 12.

320. See *id.*; Horton, *supra* note 155, at 31–34.

321. See CHESAPEAKE BAY FOUNDATION, WETLANDS PERMITTING PROGRAMS IN THE CHESAPEAKE BAY AREA 4 (Oct. 1994) (noting that 7% or less of individual permit applications for Bay area projects are denied).

322. Horton, *supra* note 155, at 31, 34. See generally Lee R. Epstein, *Where Yards Are Wide: Have Land Use Planning and Law Gone Astray?*, 21 WM. & MARY ENVTL. L. & POL’Y REV. 345 (1997) (discussing the problem and causes of sprawl, and proposing a new American dream). For a discussion of the impact of land use on watersheds and estuaries, see Charles S. Hopkinson, Jr., & Joseph J. Vallino, *The Relationships Among Man’s Activities in Watersheds and Estuaries: A Model of Runoff Effects on Patterns of Estuarine Community Metabolism*, 18 ESTUARIES 598 (Dec. 1995).

323. For further discussion of the concepts of scale and integrity, see *infra* Part II.B.2.

tactics of management plans for Bay fisheries, even when population declines are serious.³²⁴ In addition, despite the now well-documented link between land use and the environment,³²⁵ the Bay program's land use management efforts have been rather limited in scope, focusing primarily on land use within the immediate coastal area and often providing exemptions, variances, or generous grandfather provisions to property owners within regulated areas.³²⁶ Virginia laws governing land use within the Bay watershed, for instance, have tended to include generous grandfather provisions for regulated property owners.³²⁷ Further, government regulators at all levels remain reluctant to adopt comprehensive and aggressive land use management programs that would apply throughout a watershed and control growth for environmental purposes.³²⁸

The effect of property norms on the Chesapeake Bay management program is most evident at the local government level where critical decisions are made about water and sewer service and about permissible

324. For some examples of these approaches to fisheries management, see DAVISON ET AL., *supra* note 272, at 190-94. See also Houck, *supra* note 30, at 946-53 (discussing the problematic approaches to fisheries management taken by the United States). A comparison of two annual reports of the Chesapeake Bay Commission reveals how little progress has been made in the fisheries management area. Compare 1993 CHESAPEAKE BAY COMM'N REPORT, *supra* note 265, at 39-43 (describing the serious decline in the oyster population, the troubling decline in the crab fishery, the encouraging increase in juvenile striped bass, the problem of exotic species, and the need for more effective management) with 1986 CHESAPEAKE BAY COMM'N REPORT, *supra* note 285, at 15-22 (discussing the low stock levels of oysters, striped bass, herring, and perch, as well as the need for improved management efforts). Even though the oyster population has experienced devastating reductions, heated debate arose when the Chesapeake Bay Foundation called for a three-year moratorium on oystering. See DAVISON ET AL., *supra* note 272, at 191-92; Tom Horton, *To Restore & Protect Chesapeake Bay*, in CHESAPEAKE BAY FOUNDATION, SAVE THE BAY: 25TH ANNIVERSARY 3, 16 (1992) [hereinafter CBF 25TH ANNIVERSARY].

325. See STATE OF THE CHESAPEAKE, *supra* note 305, at 5-9; Butler, *supra* note 111, at 883 & n.226.

326. Virginia's Chesapeake Bay laws generally protect 100 feet landward of tidal waters and wetlands from development and use, though exemptions and reductions in the protected buffer may be granted. See Chesapeake Bay Local Assistance Bd., Revised Final Regulation VR 173-02-01, Chesapeake Bay Preservation Area Designation and Management Regulations, 7 Va. Regs. Reg. 3778 §§ 3.2(B)(5), 4.1(B), 4.3(B), 4.5, 4.6 (Aug. 26, 1991). Other Virginia laws protecting coastal resources also contain exemptions enacted for the benefit of private property owners. See, e.g., 1988 Va. Acts. ch. 740, amended by 1991 Va. Acts. ch. 114 (to expire July 1, 1993) (exempting landowners in the Sandbridge Beach area from the state's Coastal Primary Sand Dune Protection Act to allow them to construct bulkheads or other protective structures). Maryland generally uses a 1,000 foot buffer zone. See MD. CODE ANN., NAT. RES. II § 8-1807 (Supp. 1999). See generally DAVISON ET AL., *supra* note 272, at 201-10 (discussing the Maryland and Virginia Chesapeake Bay acts).

327. See, e.g., Butler, *supra* note 111, at 910 & n.331.

328. For a discussion of failed efforts to adopt stringent land use controls within the Bay watershed, see *infra* notes 334-343 and accompanying text.

land uses. Once the decision to provide water and sewer service is made, the battle over preservation or conservation of undeveloped land is usually lost. Local officials rarely take action to prevent sprawling land development, not even when they could legitimately do so by refusing to extend public water and sewer service.³²⁹ Although this failure is undoubtedly due to a variety of political pressures exerted on government decisionmakers,³³⁰ property owners nevertheless play a significant role in local, state, and federal political processes.³³¹ Further, though localities have promoted lower density uses through their zoning laws and comprehensive plans, those uses still result in loss of ground cover and contribute to the problem of sprawling development.³³²

Overcoming the pathological effects of property norms requires a recognition of the importance of considerations of scale and integrity to land use decisionmaking. Private landowners, governmental units, courts, and other parties making land use choices need to recognize that different types of integrity are at issue. In addition to the personal integrity involved in the concept of constitutionally protected property rights,³³³ land use choices involve the integrity of the property system and the integrity of ecosystems. Parties making land use choices need to recognize the importance of scale to system integrity. Until land use choices reflect the true scales of private land use, the long-term integrity of ecosystems, and perhaps even the property system, will continue to be threatened.

329. See, e.g., *supra* notes 223–240 and accompanying text. Current legal and economic pressures pose serious obstacles to government action that would prevent development of a tract of land. Recent Supreme Court decisions provide greater protection for the development and use of private property. In a 1992 decision, for example, the Court concluded that government action that resulted in a total deprivation of value was a taking. See *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003, 1019, 1030 (1992). Although a government decision to deny the extension of water and sewer service to a particular tract of land arguably does not diminish the value of land that already lacks such service, the economic pressures on local officials to approve development projects are substantial.

330. A number of land use experts have commented on the messy politics of local zoning decisions. See, e.g., RICHARD F. BABCOCK, *THE ZONING GAME* 104–11 (1966) (discussing the judiciary's lack of confidence in local land use decisionmaking); Daniel R. Mandelker & A. Dan Tarlock, *Shifting the Presumption of Constitutionality in Land-Use Law*, 24 *URB. LAW.* 1, 30–32, 36–39 (1992) (discussing the territorial nature and capture theory of local government politics).

331. See Lynda L. Butler, *The Politics of Takings: Choosing the Appropriate Decisionmaker*, 38 *WM. & MARY L. REV.* 749, 756–58 (1997). For a discussion of the influence of property norms on state environmental programs, see Butler, *supra* note 111, at 838–44.

332. The environmental impacts of low-density sprawling development are substantial. See Epstein, *supra* note 322, at 349 & n.15.

333. For a discussion of the importance of property to individual freedom and to the integrity of the person, see FRIEDRICH A. HAYEK, *THE CONSTITUTION OF LIBERTY* 124–27, 140–42 (1960). See generally MARGARET J. RADIN, *REINTERPRETING PROPERTY* (1993) (discussing various theories of property rights).

Although some policymakers in the Chesapeake Bay program have taken the first step in overcoming the pathological effects of property norms by recognizing the importance of considerations of scale in land use management, much work remains to be done. A panel of experts, appointed by the Chesapeake Executive Council to study the impacts of growth and development on the watershed and called the Year 2020 Panel, found low-density sprawl to be the most destructive pattern of development to the Bay.³³⁴ The panel noted that undeveloped land in the Bay watershed had been developed at a rate exceeding the rate of population growth. Between 1950 and 1980 the population for the Chesapeake basin increased almost 50%, while the amount of land developed for residential and commercial purposes increased 180%.³³⁵ The panel estimated that between 1980 and 2020, 59% more land in the Bay's watershed would be developed if land consumption continued at the same rate, and between 1990 and 2020, 2.6 million more residents would populate the watershed.³³⁶ The report called for stringent measures to avoid the serious harm that unchecked growth would otherwise cause.³³⁷ The measures included concentrating development in suitable areas and directing growth in rural areas to existing settlements.³³⁸ The report's most controversial recommendation was the "usurpation of local prerogatives by a statewide land use management scheme" that included all state lands in the watershed.³³⁹

To date, none of the jurisdictions participating in the Chesapeake Bay program have wholeheartedly adopted the report's recommendations. In Maryland a coalition of farmers, developers, and property rights advocates defeated legislative proposals that would have adopted the Year 2020 Panel's measures, including statewide land use management.³⁴⁰ Eventually the Maryland legislature passed a weaker act requiring localities to add the panel's key policies to their comprehensive plans and to implement the

334. See YEAR 2020 PANEL TO THE CHESAPEAKE EXECUTIVE COUNCIL, POPULATION GROWTH AND DEVELOPMENT IN THE CHESAPEAKE BAY WATERSHED TO THE YEAR 2020, at 1-2, 28-29, 36 (Dec. 1988) (on file with the author) [hereinafter 2020 PANEL REPORT]; CBF 25TH ANNIVERSARY, *supra* note 324, at 12.

335. See 2020 PANEL REPORT, *supra* note 334, at 28-29.

336. See *id.* at 1, 27, 29; DAVISON ET AL., *supra* note 272, at 216.

337. See 2020 PANEL REPORT, *supra* note 334, at 4-8; DAVISON ET AL., *supra* note 272, at 218.

338. See 2020 PANEL REPORT, *supra* note 334, at 5-6; DAVISON ET AL., *supra* note 272, at 218.

339. DAVISON ET AL., *supra* note 272, at 218. See also 2020 PANEL REPORT, *supra* note 334, at 4-5.

340. See DAVISON ET AL., *supra* note 272, at 218.

policies through zoning and other ordinances.³⁴¹ In Virginia, a commission appointed to consider the 2020 report proposed legislation that was defeated.³⁴² The Pennsylvania governor did not even appoint a panel to consider the 2020 proposals, calling the proposals “draconian.”³⁴³ These experiences suggest that property owners and policymakers still have not recognized the true scales of private land use or the importance of scale to ecosystem integrity. The importance of considering scale and integrity in land use decisionmaking is discussed next.

2. *Considerations of Scale and Questions of Integrity*

Property norms have influenced the landscape scales and the types of integrity considered in land use decisionmaking. The legal system has narrowly defined the scales of land use to exclude significant externalities and has restricted the types of integrity considered in defining property rights, obligations, and liabilities. The narrow definitions of scale include ecologically irrelevant temporal and spatial scales, as well as ecologically inconsistent scales of observation, particularly management units controlling land use decisionmaking. For most land use choices, the principal management unit is the individual landowner, who, as a general matter, need only consider the spatial limits of his or her tract of land and the temporal scales most likely to maximize net profit. In other words, the scales of the key land use decisionmaker—the private landowner—are generally much smaller than the actual scales of the owner’s land use and, therefore, are much smaller than the scales needed to maintain the integrity of the ecosystem.³⁴⁴ Further, the types of integrity that are important to the individual user—economic and personal integrity—tend to undermine the integrity of ecosystems. Land use decisionmakers who need focus only on their own economic well-being and personal freedom have little, if any, incentive to consider the integrity of the whole ecosystem.³⁴⁵ A discussion of the concepts of ecosystem, ecosystem integrity, and landscape scales

341. See MD. CODE ANN., NAT. RES. II § 8-1808 (Supp. 1999); DAVISON ET AL., *supra* note 272, at 218.

342. See DAVISON ET AL., *supra* note 272, at 218.

343. SUSAN Q. STRANAHAN, *SUSQUEHANNA, RIVER OF DREAMS* 300 (1993). A state legislative committee, however, considered the Year 2020 Panel’s proposals and made some recommendations. As of 1996, the recommendations had not been adopted. See DAVISON ET AL., *supra* note 272, at 218. For an update on a 1999 bill proposed to revise land use practices in Pennsylvania, see *Bills would revise land practices in PA, fund open space purchases*, BAY J., June 1999, at 17.

344. For further explanation of the relationship between scale of use and ecological integrity, see *infra* notes 351–355 and accompanying text.

345. For further explanation, see Garrett Hardin, *The Tragedy of the Commons*, 162 *SCIENCE* 1243 (1968).

will demonstrate how detrimental the narrow conceptions of scale and integrity are to environmental quality.

The concept of an ecosystem includes not only its constituent components, but also the interactions among the components and their structure and functioning.³⁴⁶ In other words, an ecosystem is greater than the sum of its parts because of the dynamic interactions occurring among those parts and because of the structure and function of the ecosystem.³⁴⁷ Under this conceptual definition, an ecosystem is not limited to a particular level of organization or hierarchy, or to particular temporal or spatial scales; rather, it may involve a range of scales and hierarchical levels.³⁴⁸

The concept of ecosystem integrity involves the functions and structure of a system, as well as maintenance of its components and the interactions among them.³⁴⁹ No single component should be treated in isolation from the system's functions, structure, and other components. Ecosystem integrity, however, does not necessarily require preservation of all components. Some changes in structure have little, if any, impact on the functioning of an ecosystem. An ecosystem may be resilient to the loss of even common components because of functional redundancy or equivalence; system components may perform equivalent functions that compensate for a change in structure. When redundancy or equivalence does not exist, however, changes can result in significant alterations in ecosystem function.³⁵⁰

Because the concept of ecosystem integrity "implies maintenance of some normal state" of operation, function, or structure measured over sufficient time and space, ecosystem integrity is "scale-dependent."³⁵¹ The scale of an ecosystem may refer to its spatial and temporal dimensions, as well as to "the observation set used to define . . . [the] system and measure ecosystem integrity."³⁵² The spatial dimension involves the area occupied by the ecosystem, while the temporal dimension refers to the time period

346. See King, *supra* note 30, at 25.

347. Ecosystem function "generally refers to the functioning or operation of the ecosystem, . . . and not the role or job of the ecosystem." *Id.* at 20. Ecosystem structure "commonly refers to the distribution of matter and energy among system components." *Id.*

348. See *id.* at 23.

349. See *id.* at 25.

350. See *id.* at 25-27. Perspective does, of course, affect whether a change is viewed as a loss in ecosystem integrity. The loss of a rare species may be considered a loss of ecosystem integrity when viewed from a community, ethical, or aesthetic perspective, but not when viewed from an ecosystem function perspective. See *id.* at 27. For further discussion of the importance of perspective, see *id.* at 26-27.

351. *Id.* at 29.

352. *Id.* at 28.

used to describe the system.³⁵³ The scale of the observation set may be determined by the scale of the management unit monitoring or measuring integrity.³⁵⁴ If the extent (areal expanse or length of time) of the management unit does not match the attributes of the monitored ecosystem, invalid measurements of ecosystem integrity loss may result. Ecosystems require minimum spatial and temporal extents for system functions to occur and system structure to be maintained. A loss in ecosystem integrity may result when a management unit has a smaller spatial and temporal reach than that of the ecosystem it is managing, or when a management unit develops management practices for scales less than the minimum amount required for ecosystem interactions to occur.³⁵⁵

Property rights in land have not traditionally been defined in light of the spatial and temporal dimensions of land use. For years traditional property norms have reflected a "liberal conception of ownership"³⁵⁶ that includes an individualistic view of scale based on personal economic and political freedom.³⁵⁷ Proponents of this concept of ownership generally adhere to a theory of limited government. Under this theory the primary purpose of government is to protect individuals from violence, including violence against an individual's property rights. Supporters of this theory generally believe that "the only legitimate functions of government are the protection of life, liberty, and property from external threats (the military), internal threat (the police), and civil disputes (the courts)."³⁵⁸ To a libertarian, society consists of "an aggregate of discrete, autonomous individuals, each owning items and parcels of property, totally encapsulated by title and well-defined boundary lines."³⁵⁹

Although the liberal conception of property has played a critical role in the development of the American political structure and legal system,³⁶⁰

353. *See id.*

354. *See id.*

355. *See id.* at 28–29.

356. CHRISTMAN, *supra* note 21, at 3.

357. *See id.* at 29–31; ALEXANDER, *supra* note 42, at 1, 3–7; ELY, *supra* note 2, at 153. For further discussion of the relationship between liberty and liberal ownership, see CHRISTMAN, *supra* note 21, at 67–83.

358. Partridge, *supra* note 112, at 264. For a discussion of a more modern, libertarian view of property, see Eric T. Freyfogle, *Owning the Land: Four Contemporary Narratives*, 13 J. LAND USE & ENVT'L. L. 279, 286–92 (1998) (discussing Richard Epstein's revised version of the libertarian concept of property).

359. Partridge, *supra* note 112, at 264.

360. *See* ELY, *supra* note 2, at 26–58 (discussing the role of private property rights in establishing the new constitutional order in America). *But see* CHRISTMAN, *supra* note 21, at 67–83 (critiquing defenses of liberal ownership based on considerations of liberty); William J. Novak, *Common Regulation: Legal Origins of State Power in America*, 45 HASTINGS L.J. 1061 (1994) (arguing that the

the liberal view is not the only conception of property that has been important to American legal thought. The conception of property as “the private basis for the public good” also has had a long tradition.³⁶¹ In *Commodity and Propriety*, Professor Gregory Alexander explains that this alternate vision of property reflects the notion that the individual human is an “inherently social being, inevitably dependent on others not only to thrive but even just to survive. This irreducible interdependency means that individuals owe one another obligations, not by virtue of consent alone but as an inherent incident of the human condition.”³⁶² The public good view of property recognizes that property is central to social stability, “anchor[ing] the citizen to his . . . rightful place” and providing a basis for imposing social obligations for the good of the community.³⁶³ This vision thus prefers to view property as providing a basis for social stability and participation rather than a basis for personal gain, commodification, and speculation.³⁶⁴

Further, even if the liberal conception of property controlled the development of American political and legal thought, that conception still needs to be reexamined in light of modern ecological problems and conditions. Such an evaluation would reveal that the liberal conception of property fails to consider concepts and principles that are critical to ecological integrity. Omitted from the liberal conception of property is a sense of responsibility for externalities imposed by property owners on important common resources and on the components, structure, and functioning of ecosystems. Under traditional property law, a landowner “has no direct incentive (in the absence of negotiations)” to consider costs that he imposes on other resources, whether privately or publicly owned.³⁶⁵ He only has the incentive to consider costs and “economize on the use of those resources from which he has the right to exclude others.”³⁶⁶ Also

liberal theory of ownership and government was not the single or even dominant theory in the early republic).

361. ALEXANDER, *supra* note 42, at 1. See also David Schultz, *Political Theory and Legal History: Conflicting Depictions of Property in the American Political Founding*, 37 AM. J. LEGAL HIST. 464 (1993) (discussing two sometimes contradictory approaches to analyzing American political theory and their impact on depictions of property: a rhetorical approach focusing on the expressed views of the founders and an institutional approach looking at how the law treated property).

362. ALEXANDER, *supra* note 42, at 1–2.

363. *Id.* at 2, 4. For a discussion of four views of property now affecting legal discourse, see Freyfogle, *supra* note 358, at 286–303 (discussing the libertarian ideal of individual autonomy, the more traditional narrative of property that focused on economic opportunity, a community-centered narrative of property, and a bio-centric narrative of property).

364. See ALEXANDER, *supra* note 42, at 40.

365. Demsetz, *supra* note 242, at 356.

366. *Id.*

omitted from the liberal conception of property is any recognition of the carrying capacity of land or the finiteness of natural resources. One of the implicit assumptions of liberalism is the "infinite availability of the natural resources necessary" for the "pursuit of material comforts."³⁶⁷ The traditional, geometric-based approach to allocating land rights has, for the most part, reinforced the limited externality perspective and the assumption of infinite availability underlying the liberal conception of property. This reinforcement has occurred through the traditional approach's focus on discrete, unitary tracts of land and its failure to consider the interactions and interdependencies existing between landowners and the foundation ecosystem.³⁶⁸ Traditional property law thus fails to include the principles of ecological connectedness and carrying capacity in the definition of property norms, rights, and obligations.

Because land is a critical part of the ecosystem, property rights in land should, as a matter of ethics and ecology, reflect the ecological and landscape dimensions of land use, not just the individual user's economic considerations. A property system that defines land rights primarily in the context of a society's individual rights-based approach to political or economic systems is ignoring the physical, chemical, and biological processes linking individual tracts of land to the ecosystem. In addition to being viewed as the subject of individual ownership, appropriation, and commodification, rights in land must be defined in light of land's role as "one of the key constituents of life on earth."³⁶⁹ Scale should become a "fundamental determinant" in defining the moral and legal obligation of landowners when the consequences of failing to consider appropriate scales could result in serious damage or avoidable, catastrophic losses.³⁷⁰

367. Susan M. Leeson, *Philosophic Implications of the Ecological Crisis: The Authoritarian Challenge to Liberalism*, 11 *POLITY* 304, 305 (1979). For arguments that resources remain abundant, see Sagoff, *supra* note 241; Julian L. Simon, *Scarcity or Abundance?*, in *THE BUSINESS OF CONSUMPTION*, *supra* note 112, at 237-45.

368. See Sterk, *supra* note 21, at 90, 93-95.

369. PLATT, *supra* note 171, at 4. Platt maintains that land also needs to be defined in light of cultural and other noneconomic values that people attach to land as a sense of place. See *id.* at 5-6. For a general discussion of land's critical importance to humans and of the need for improved management of land's resources, see ANTHONY YOUNG, *LAND RESOURCES* (1998).

370. K.S. Shrader-Frechette & E.D. McCoy, *Statistics, Costs and Rationality in Ecological Inference*, 7 *TRENDS IN ECOLOGY & EVOLUTION* 96, 98 (1992). The inherent complexity of natural systems means that many different models or characterizations of the systems are possible. See Bryan G. Norton, *Improving Ecological Communication: The Role of Ecologists in Environmental Policy Formation*, 8 *ECOLOGICAL APPLICATIONS* 350, 358 (1998). Because of the numerous models available, the choice of scale often reflects a choice of values; the modeler chooses to model a subset of the system's "actual dynamics.... Those choices express evaluations of ecological and social significance." *Id.* at 359. While scientists often prefer scales with ecological significance, lawmakers

Indicators of system integrity are necessarily greater than social parameters when the system involves natural resources that are critical to ecological as well as social systems. Maintaining the integrity of ecological systems requires consideration of scales that are greater than individual landowners or individual tracts of land. The scales of space, time, and observation help to capture the interactions among the system components, as well as the structure and functions of the system. Incorporating considerations of scale into the definition of property rights, powers, and obligations, in other words, would capture the connections between individual rights, property system integrity, and ecosystem integrity. Such incorporation would help to ensure the inclusion of important ecological interests in the concept of landed property in ways that are tailored to individual users.

The massive Chapman's Landing development project proposed for southern Maryland demonstrates the importance of considering ecologically relevant scales of private land use. The project proposed the residential and commercial development of approximately 2,250 acres covering about 2.25 miles of the Potomac River shoreline in Maryland.³⁷¹ The master plan for Chapman's Landing called for the creation of a city comparable in size to Annapolis. The development would have included 4,600 dwelling units, 2.26 million square feet of commercial space, a marina, and a 200-acre golf course—all on a tract of land that is about 90% forested, much of it old growth.³⁷²

The development plan called for the destruction of significant historical and ecological resources. The site contains historical resources from the colonial and early statehood periods, as well as important archaeological resources dating back to prehistoric times.³⁷³ Chapman's Landing has an unusually broad range of habitats that support a unique assemblage of flora and fauna, including many rare, threatened, and endangered species.³⁷⁴ The site is rich in amphibians, reptiles, birds,

defining property rights have, in the past, chosen scales with social—that is, political—significance. Effective ecosystem management requires greater sensitivity to the value choices underlying the definition of scale. This sensitivity is especially needed when serious but avoidable losses are possible.

371. See Friends of Mount Aventine, *Help Protect Chapman Forest on the Potomac River South of Washington, D.C.* (visited Jan. 1998) <<http://www.radix.net/~foma/fomahpfacts.html> [hereinafter FOMA, *Facts*]; Friends of Mount Aventine, *Main Issues* (visited Feb. 4, 1998) <<http://www.radix.net/~foma/topics.html#TOP>> [hereinafter FOMA, *Main Issues*]; Friends of Mount Aventine, *The Keystone Report: Establish the Potomac River Heritage Reserve* (visited July 6, 1998) <<http://www.radix.net/~foma/keystone.htm>> [hereinafter *The Keystone Report*].

372. See FOMA, *Facts*, *supra* note 371; FOMA, *Main Issues*, *supra* note 371; *The Keystone Report*, *supra* note 371.

373. See *The Keystone Report*, *supra* note 371.

374. See *id.*

mammals, fish, rare butterflies, and plants,³⁷⁵ and includes a tributary of the Potomac River having exceptional water quality and fish habitats.³⁷⁶

In assessing the environmental effects of the project, the Army Corps of Engineers and the Maryland state and local governments generally examined direct impacts only, ignoring important considerations of scale involving indirect and cumulative impacts of the project on the surrounding environment.³⁷⁷ According to one scientist, instead of trying to provide meaningful protection to wildlife, the developer proposed to protect a "quarter-mile no-build zone around a bald eagle nest and a ravine wetland filled with very rare ferns."³⁷⁸ Instead of trying to protect an exceptional, continuous habitat of old growth and mature forest, the developer proposed the largest single loss of forest habitat since the passage of the Chesapeake Bay legislation.³⁷⁹ The geographical context of the tract suggests the magnitude of this loss. Located on important waterways and surrounded by other undeveloped lands, Chapman's Landing forms an intricate part of a relatively large area of continuous forest habitat. Due to its steep ravines, the tract has remained "essentially intact."³⁸⁰ Development of the tract would seriously fragment the forest habitat and decimate critical interior forests.³⁸¹ Rather than examining the impact of the development on transportation, schools, and other infrastructure needs, or on the species dependent on the continuous habitat, the local government made some changes in its land use laws to allow increases in the development's

375. See *id.*

376. See Andrew H. Macdonald, *Good Engineering Will Not Protect the Bay from Chapman's Landing*, BALTIMORE SUN, Aug. 1, 1997, at 15A; FOMA, *Facts*, *supra* note 371; *The Keystone Report*, *supra* note 371. For a discussion of the serious threat to fisheries that development of Chapman's Landing poses, see James P. Long, *Threat to Anadromous and Semi-Anadromous Fish by Development Plans for the Chapman Forest* (visited July 6, 1998) <<http://www.radix.net/~foma/LongAnad.htm>>.

377. See Macdonald, *supra* note 376; Letter from W. Michael McCabe, Regional Administrator, U.S. Envtl. Protection Agency, to Colonel Bruce Berwick, Cominader, U.S. Army Corps of Engineers, Baltimore Dist. (Oct. 10, 1997) (visited Apr. 20, 2000) <<http://www.radix.net/~foma/epa2corps1097WEB.html>>. The Chapman's Landing developer met with the Army Corps of Engineers to discuss preparation of a wetlands permit application under a joint state/federal permitting process. The public was not invited to any of these meetings. See Friends of Mount Aventure, *Maryland Regulatory Process on Chapman's Landing* (visited July 6, 1998) <<http://www.radix.net/~foma/MarylandRegulatoryStatus.htm>>.

378. Macdonald, *supra* note 376, at 15A.

379. See *Charles County Weighs Development Many Fear the Impact of 12,000-Resident Housing Project*, DAILY RECORD (Baltimore, Md.), July 21, 1995, at 5; FOMA, *Facts*, *supra* note 371; *The Keystone Report*, *supra* note 371.

380. See *The Keystone Report*, *supra* note 371.

381. See generally *id.* (discussing the serious effects of fragmentation on ecological resources in the Chapman's Landing tract).

density.³⁸² Instead of examining the water supply needs of the entire proposed development or the impact of increased water use on other areas, Maryland issued a water appropriation permit for up to 390,000 gallons per day, only enough for the first 600 homes.³⁸³

Eventually the Governor of Maryland and environmentally active groups worked together to preserve Chapman's Landing. Early on, those efforts had no impact. By mid-March 1998, the developer had begun to clear the land despite ongoing negotiations with the state and a private conservation group interested in buying the property.³⁸⁴ This action caused the Governor of Maryland to announce that the state would use its power of eminent domain to protect at least part of the site.³⁸⁵ The announcement failed to halt the clearing operations; by the end of June 25, 1998, the developer had cleared approximately 80 acres.³⁸⁶ Finally, on October 28, 1998, the Governor of Maryland announced that the Mellon Foundation purchased the remaining portion of Chapman's Landing to spare it from development.³⁸⁷

Although some may question whether the Chapman's Landing dispute demonstrates the pathology of property norms, given the ultimate resolution of the dispute, it is not the final result that is critical to evaluating the pathology of property norms, but rather the rights, obligations, and norms affecting the private landowner. The developer in Chapman's Landing had the right to develop the tract, assuming compliance with traditional permit and zoning requirements, and owed no obligation to account for ecological costs not reflected in those requirements. Indeed, the developer did not even have to account fully for increased demands on infrastructure or water resources.³⁸⁸ Had it not been for the activities of concerned citizens and the persistence of the Maryland Governor and a private foundation, the development would have proceeded. Further, for every land development dispute like Chapman's Landing, many more are not resolved in such an environmentally friendly manner. The Chapman's

382. See FOMA, *Main Issues*, *supra* note 371.

383. See Macdonald, *supra* note 376.

384. See Heather Dewar, *Chapman's Landing Work Begins Despite State Talks; Developer Says He's 'Open to Proposals' for Land*, BALTIMORE SUN, Mar. 27, 1998, at 2B.

385. See Michael Dresser, *State to Acquire Frostburg Depot for \$600,000; Board Also Gives OK to Seek Condemnation of Chapman's Landing*, BALTIMORE SUN, Apr. 16, 1998, at 1B; Friends of Mount Aventine, *Dramatic Events in Campaign to Preserve Chapman Forest* (visited July 6, 1998) <<http://www.radix.net/~foma/fomanews0498.htm>> [hereinafter FOMA, *News*].

386. See FOMA, *News*, *supra* note 385.

387. See Md. Governor's Press Office, *Chapman's Landing Preserved in Entirety* (visited June 17, 1999) <<http://www.gov.state.md.us/gov/press/1998/oct/html/chaplast.htm>>.

388. See *supra* notes 382-383 and accompanying text.

Landing tract happened to get everyone's attention; it had the right combination of ecological, historical, and social conditions working in its favor. Most other tracts of undeveloped land are not as appealing targets for government or private foundation acquisition, though the costs of land development may be just as significant.

Incorporating considerations of scale into definitions of property rights and obligations would not mean the end of private property rights in land. What would change is that the scale of individual land use would be reflected in the evaluation of the rights, obligations, and the expectations of property owners, as well as the importance of the government interest. Instead of using traditionally limiting property norms and rules to determine the benefits and burdens of government action and the reasonableness of private owners' expectations, lawmakers and policymakers would use a more integrated concept of property that included the ecological costs of land use. Individual landowners would continue to have the power to make use decisions, take economic gambles, and exclude others, but would bear responsibility for the scales of those decisions. The integrity of the person still would be protected through the concept of property. This protective function, however, would not be performed in a void, without consideration of the impact of property rights on the integrity of the ecosystem. Rather ecological concepts of scale and integrity would be used to evaluate whether a private land use is adversely affecting common environmental resources that are part of the public stock and upon which we all depend. Private property rights would be defined in light of the impact of private use on resources that perform important ecological services critical to system integrity. After all, the nature and desirability of a free society would change considerably if the exercise of private rights so depleted natural resources and degraded the environment that the health or survival of humans was seriously threatened.

Accounting for the true scales of land use will require a systemic approach that reflects an integrated or holistic concept of integrity. Although traditional property norms protect the personal integrity of an individual owner in both an economic and political sense, they fail to consider ecological or system integrity. Because of its focus on personal integrity, the liberal conception of property discounts the importance of system connectedness and integrity and of sustaining the resource base of the foundation ecosystem. In determining the benefits and burdens of government action affecting land use and the legitimacy of private expectations, lawmakers need to consider the true costs of private land use—not only to other rightholders but also to the ecosystem. Concepts of

scale and ecological integrity would help to determine those costs. Government action that forces internalization of private land use costs by restricting land use or imposing some sort of stewardship obligation on property owners would represent an important step toward a more holistic concept of integrity.

The concept of integrity used to define property rights thus must itself become integrated. It must involve not only personal integrity, but also system integrity. Although an exploration of the meaning of system integrity is beyond the scope of this work, several scholars have begun the task of defining a principle of integrity which can produce a much needed "changed consciousness" in western societies.³⁸⁹ Necessitated by the magnitude of environmental problems, this changed consciousness would require an "understanding of the self not as primarily individualistic, but as relational in line with the primacy of ecosystemic wholes."³⁹⁰ Such an understanding would provide a better basis for justifying the imposition of an environmental obligation on landowners³⁹¹—that is, for developing the concept of a "citizen landowner." Ultimately adherence to the holistic or integrated principle of integrity would help to restore harmony to ecological systems.³⁹²

An important cause of the individualistic perspectives now controlling American legal and economic systems is the pathology of property norms. To alter the present pattern of escalating land and water use, and of ineffective ecosystem management over the long term, the legal system must wholeheartedly embrace the concept of ecological integrity. That embrace must include the limits that ecological integrity places on individual action; those limits are "the limits of humankind as a species."³⁹³ Considerations of scale would help to recognize these limits.

One example of how a systemic approach to scale would shift property norms from a personal to an integrated concept of integrity involves the debate over the appropriate property benchmark to be used in defining constitutionally protected property and measuring the economic impact of government action on property rights. A majority of the

389. See LAURA WESTRA, AN ENVIRONMENTAL PROPOSAL FOR ETHICS: THE PRINCIPLE OF INTEGRITY 8 (1994). See also Christopher B. Barrett & Raymond E. Grizzle, *A Holistic Approach to Sustainability Based on Pluralism Stewardship*, 21 ENVTL. ETHICS 23 (1999) (advancing a holistic approach to environmental policymaking based upon the principle of pluralistic stewardship).

390. WESTRA, *supra* note 389, at 9.

391. See *id.* at 17.

392. See *id.* at 14–15.

393. *Id.* at 12.

Supreme Court has clarified that government action that deprives a property owner of all economically beneficial use is a per se taking.³⁹⁴ Supreme Court justices, however, have disagreed about the appropriate property benchmark. Some justices have focused on the regulated portion—the property directly affected—in measuring the economic impact.³⁹⁵ Others have examined the property as a whole in deciding whether the government action constitutes a taking, and refuse to divide the property into discrete segments.³⁹⁶ An approach that isolates the discrete, regulated portion ignores the scales of private land use choices and recognizes only the economic incentives of the modern real estate market. Today the market provides significant monetary rewards for the subdivision of land. A landowner's power to subdivide has become a highly refined tool for maximizing profit, and will only increase in value and importance as the quantity of undeveloped land declines. This valuable power and right to subdivide has contributed to the shift from more compact urban settlement patterns to sprawling development. Use of the discrete, regulated portion benchmark would allow the property owner to manipulate the dimensions of the protected property to maximize the amount of economic loss. As Justice Stevens noted in a dissenting opinion, the "smaller the estate, the more likely that a regulatory change will effect a total taking."³⁹⁷ Under a systemic approach to scale, the discrete, regulated portion would not be isolated from the whole in evaluating rights, obligations, and expectations of the property owner.

Another example of how systemic consideration of scale would alter property norms concerns the validity of time-specific moratoria on development. Because government action that prohibits the development of undeveloped land for a set period of time prevents the landowner from making an economically viable use during that period, some have argued that such action constitutes a taking.³⁹⁸ Others have disagreed, reasoning

394. See *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003 (1992).

395. See, e.g., *id.* at 1016 n.7 (suggesting that a court examine the degree to which state law has "accorded legal recognition and protection to the particular interest in land with respect to which the takings claimant alleges a diminution in (or elimination of) value"); *Pennsylvania Coal v. Mahon*, 260 U.S. 393 (1922) (focusing on the regulated portion).

396. See, e.g., *Keystone Bituminous Coal Ass'n v. DeBenedictis*, 480 U.S. 470, 497–502 (1987) (looking at the property as a whole); *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 130–31 (1978) (focusing on "rights in the parcel as a whole").

397. *Lucas*, 505 U.S. at 1065 (Stevens, J., dissenting).

398. See JULIAN C. JUERGENSMEYER & THOMAS E. ROBERTS, *LAND USE PLANNING AND CONTROL LAW* §§ 9.5, 10.8.B., 10.9.C (1998) (explaining and criticizing this temporal segmentation approach to takings).

that moratoria are temporary and only prevent immediate development.³⁹⁹ Under a systemic approach to scale, economically viable use would be defined in light of long-range, as well as immediate, time scales. Future development opportunities would be considered in deciding whether an economically viable use remained.

A final example of how systemic consideration of scale would alter property norms concerns the question of how the calculus of takings would be affected by the existence of a power to transfer development rights to another tract of land located in an ecologically less sensitive or critical area. Some have maintained that giving transfer development rights to regulated landowners does not negate the existence of a taking, and may not even reflect the amount of just compensation due.⁴⁰⁰ Others argue that transfer development rights speak to the economic impact of the government action on the property owner and therefore should be considered in deciding whether a taking exists.⁴⁰¹ Under a systemic approach, the scope and nature of property rights would be defined in light of ecological concepts like connectivity, continuity, and scale of habitat. Because transfer development rights provide a way to exercise property rights in land located in ecologically fragile areas without seriously damaging the areas, a systemic approach would favor the inclusion of such rights in the landowner's bundle of rights in evaluating the existence of a taking. The transfer development rights concept allows property rights in land to be exercised in ways that reflect ecological scales of use, minimizing habitat fragmentation and destruction in ecologically sensitive areas.

Fulfilling the obligation to consider the scales of land use often will involve relatively minor changes in the way land uses are conducted. In a voluntary program in Pennsylvania, for example, farmers are considering the scales of their land use by achieving "nutrient balance," limiting the amount of nutrients that are released to the amount that the farmer uses.⁴⁰² One farmer has worked with an agronomy professor from Pennsylvania State to limit excessive use of nutrients. In addition to weighing "every pig, every bag of feed and fertilizer, every truckload of hay, livestock bedding, and manure leaving and entering his operation,"⁴⁰³ the farmer used government funds to build storage pits to hold manure until it could be

399. See *id.* § 10.9.C (concluding that moratoria are not per se takings).

400. See *Suitum v. Tahoe Reg'l Planning Agency*, 520 U.S. 725, 745, 746-48 (1997) (Scalia, J., concurring); *Penn Cent.*, 438 U.S. at 138, 150-52 (Rehnquist, J., dissenting). See also JUERGENSMEYER & ROBERTS, *supra* note 398, § 9.9.

401. See *Penn Cent.*, 438 U.S. at 137-38; JUERGENSMEYER & ROBERTS, *supra* note 398, § 9.9.

402. See Horton, *supra* note 155, at 21-22.

403. *Id.* at 21.

removed by a neighbor who needed fertilizer. The use of the storage pits reduced runoff from the farm and decreased the neighbor's use of commercial fertilizer by 30%.⁴⁰⁴

The complexities of the temporal and spatial scales of private land use admittedly obfuscate the connections between individual land use and ecosystem integrity. Incorporation of temporal scales is difficult to achieve when the impacts of uses and the solutions for minimizing those impacts take longer than the lives of those who remember pristine conditions. The passion for cleaning up the Chesapeake Bay may ebb with the death of the generation who can remember clear waters, abundant oyster reefs, fourteen foot sturgeon, and submerged aquatic grasses so extensive and rich with life that forest ecosystems paled in comparison.⁴⁰⁵ Incorporation of spatial scales also is difficult to achieve when the affected area is as expansive as the Chesapeake Bay watershed. Questions of jurisdiction and complex biological, chemical, and physical interactions all add uncertainty to the task. Even if all of the interactions are not understood, though, land use decisions that reflect some of the scales of land use are more likely to produce a resilient ecosystem than management efforts based on the individual focus of traditional norms.⁴⁰⁶ Unless the individual manager—the property owner—begins to consider the temporal and spatial scales of private land use, the threat to ecosystem integrity and ultimately to property system integrity will grow.

III. BREAKING THE PATHOLOGICAL EFFECTS OF PROPERTY NORMS

Innovative solutions are needed to break the pathological effects of property norms on ecosystem integrity. First and foremost, lawmakers and policymakers must confront and reexamine the property norms driving resource use and affecting management decisions. Until the impact of these norms on ecosystem integrity is better understood, future management efforts are, at best, likely to produce the same short-term success and long-term dangers that already have been observed in managed ecosystems. To the extent possible, management goals must be translated

404. *See id.* at 22.

405. *See id.* at 22–23, 26.

406. One argument sometimes made in response to proposals to promote ecological integrity relies on the scientific uncertainty of the ecological integrity concept. Understanding all of the intricacies of the concept, however, is not a necessary condition to achieving more resilient ecosystems. After all, “scientific uncertainty accompanies all human intervention . . .” WESTRA, *supra* note 389, at 50.

into behavioral incentives that encourage policymakers and landowners to avoid the property norms "trap"⁴⁰⁷—the individual-rights-based thinking that diverts attention from the scales of private land use and decouples human and ecological systems. Some fundamental changes in property norms—or at least the interpretation or application of those norms—must occur if environmental quality is to be achieved within the current political framework.⁴⁰⁸

The sources, bases, and assumptions of those norms need to be reevaluated in light of the historical development of the property concept and in light of the economic, political, and ecological conditions of modern life.⁴⁰⁹ Such a reevaluation must keep in mind the inherent adaptability of the property concept,⁴¹⁰ distinguishing between the core essence of property that should remain unchanged and the remaining portion that is free to adapt to change.⁴¹¹ Such a reevaluation also must keep in mind the civic nature of property ownership—that is, the notion that property ownership is intimately connected to civic virtue, providing a basis for leaders to become sufficiently independent from self-interest and therefore capable of acting in the interest of the greater public good.⁴¹² The

407. See Costanza & Greer, *supra* note 152, at 203–06 (discussing the "social traps" that lead to mismanagement of ecosystems). As these scholars explain, human institutions provide "incentive structures [that] often lead to behavior that is directly counter to the long-term health of the whole system." *Id.* at 203. Decisionmakers become trapped by local conditions and cultural values. See *id.*

408. For further discussion of the relationship between property rights and political values, see *infra* notes 421–429 and accompanying text. For a pessimistic view of the relationship between environmental quality and democratic values, see generally WILLIAM OPHULS, *ECOLOGY AND THE POLITICS OF SCARCITY* (1977) (discussing how American political values are unsuitable for dealing with growing ecological problems); WILLIAM OPHULS, *ECOLOGY AND THE POLITICS OF SCARCITY REVISITED* (1992) (continuing his discussion of how American political processes are ill-equipped to deal with the worsening environmental situation).

409. Some scholars have already begun this reevaluation process. Commentators, for example, have reexamined the role of property in American legal thought and the relationship between property and fundamental political values. See, e.g., ALEXANDER, *supra* note 42 (discussing different conceptions of property). See also John D. Echeverria, *The Politics of Property Rights*, 50 OKLA. L. REV. 351, 374 (1997) (arguing that the role of property in promoting liberty is less important now); CHRISTMAN, *supra* note 21, at 3 (arguing that the traditional liberal conception of property is "truly a myth that ought to be exposed and abandoned"). Commentators also have begun to define a green theory of property. See, e.g., J. Peter Byrne, *Green Property*, 7 CONST. COMMENTARY 239 (1990).

410. For a discussion of the adaptive nature of American property law, see Butler, *supra* note 33. For a similar discussion of the flexibility of German property law, see RUDOLF DOLZER, *PROPERTY AND ENVIRONMENT: THE SOCIAL OBLIGATION INHERENT IN OWNERSHIP* (International Union for Conservation of Nature and Natural Resources Environmental Policy and Law Paper No. 12, 1976).

411. For an example of the results of a similar reevaluation under German law, see DOLZER, *supra* note 410, at 57 (identifying the power of disposition and the power to exclude as part of the unchangeable portion of property under German law).

412. See ALEXANDER, *supra* note 42, at 1–2, 12–13, 22–23, 40–41. For discussions of the social or civic view of property, see *id.* at 26–42; Jerry L. Anderson, *Takings and Expectations: Toward a*

libertarian view of property defines "in material terms the legal and political sphere within which individuals are free to pursue their own private agendas and satisfy their own preferences, free from governmental coercion or other forms of external interference";⁴¹³ this individual-rights-based view generally ignores the tradition of the civic conception of property present in American legal thought.⁴¹⁴ Over the years property rights advocates have tended to focus on the unchangeable portion of the property concept, allowing that portion to control the entire property concept. Lost in that focus have been the inherent adaptability and the civic nature of property. Finally, a reevaluation of property norms must consider the limiting effect of property-rights-based thinking on the development of market models and economic concepts, especially economic thinking about externalities and obligations to ecosystems.⁴¹⁵ Traditional property-rights-based thinking has produced a market model that reflects social preferences for individualism and autonomy; discrete packages of rights and narrow definitions of externalities focusing on relations between insular individuals are natural consequences of traditional thinking. Educational, legal, and political efforts are needed to overcome traditional thinking and help instill a sense of civic and ecological responsibility in the property concept.⁴¹⁶

Second, in addition to the internal reevaluation of property norms, lawmakers and policymakers should adopt an external solution that will maintain pressure on the property system to account for ecological costs. Lawmakers and policymakers could accomplish this goal by adopting an adaptive, ecologically based approach to ecosystem management that consistently ties management efforts to ecological integrity and forces resource users to consider and respond to ecological conditions in making use decisions. An adaptive approach recognizes the spatial and temporal scales of human uses, and varies its response according to differences in the scales of land uses and to successional changes in ecosystems. Such an approach also understands the need to separate the ecosystem management unit from the individual user.⁴¹⁷

"Broader Vision" of Property Rights, 37 U. KAN. L. REV. 529 (1989); Stanley N. Katz, *Thomas Jefferson and the Right to Property in Revolutionary America*, 19 J. L. & ECON. 467 (1976); Schultz, *supra* note 361.

413. ALEXANDER, *supra* note 42, at 1.

414. *See id.* at 1-2.

415. For a discussion of traditional economic models and theory in the environmental context, see HACKETT, *supra* note 33, at 17-59.

416. For further discussion, see *infra* Part III.A.

417. For further discussion, see *infra* Part III.B.

Finally, lawmakers and policymakers need to adopt an information-gathering solution to ensure that fair and effective changes are made in property norms and ecosystem management practices. Lawmakers and policymakers could accomplish this goal by recognizing the importance of comprehensive monitoring not only to ecological integrity but also to distributive justice and individual fairness. An effective monitoring program allows scientists to gauge the health of ecosystems and identify causes of continuing pollution. Equally as important, it allows scientists to measure the scales of private land use and therefore helps to ensure the proportionality of use restrictions to the scales of a particular land use.⁴¹⁸ Through comprehensive and experimental monitoring, policymakers can learn about the spatial and temporal extent of land uses, the impact of different land uses on ecosystem integrity, and the effectiveness of current solutions.⁴¹⁹ Each of these types of solutions will now be introduced.

A. AVOIDING THE PROPERTY NORMS TRAP:
REDEFINING PROPERTY RIGHTS AND OBLIGATIONS

Breaking the pathological effects of property norms on ecosystem integrity will require a reexamination of the norms shaping the behavioral incentives of land use decisionmakers. The norms need to be redefined in light of the spatial and temporal dimensions of land use. A resource allocation system that allows users to ignore significant scales of use eventually will self-destruct. As a general matter, the common law system of property only requires property rightholders to account for costs imposed on the interests of other rightholders and virtually ignores the costs imposed on ecological resources and non-rightholders. At the very least, property owners should bear an obligation to consider fully the costs of their land use choices over time and to account for those costs in an appropriate manner. The power to make use decisions should not be divorced from the obligation to consider and account for the costs of land use decisions on human and ecological systems.⁴²⁰

418. Hopefully such proportionality will help the government to defend land use regulations against takings challenges. In *Dolan v. City of Tigard*, the Supreme Court required the government to show rough proportionality between a land use exaction and the projected impact of the proposed use. 512 U.S. 374, 391 (1994). The exaction conditioned approval of development on the dedication of property to public use. *See id.* In *City of Monterey v. Del Monte Dunes at Monterey, Ltd.*, a unanimous Supreme Court clarified that the rough proportionality test of *Dolan* had not been extended "beyond the special context of exactions." 526 U.S. 687, 702 (1999).

419. For further discussion, see *infra* Part III.C.

420. Urban economists have stressed the importance of forcing users to take into account the marginal costs of their uses—that is, the costs attributed to the last unit of production, as opposed to the costs that have been averaged out across all users in the defined set. *See* Robert C. Ellickson, *Suburban*

1. *Reexamining the Bases for Property Norms*

The sources or bases for traditional property norms first need to be examined in light of the historical development of the property concept and in light of current political, economic, and ecological conditions. Modern interpretations of property norms primarily focus on the relationship between property and political and economic freedom, justifying property rights because of their importance to individual liberty. Some scholars have questioned whether this singular focus makes sense now given the development of American law and society in ways the framers did not anticipate.⁴²¹ Such developments include changes in the role that land plays in our political and economic systems. Because land is no longer the primary source of wealth, land rights are not as critical as they once were to promoting economic freedom. Further, the political functions served by land ownership have changed as other protections for individual freedoms have developed. Although land ownership still is important in providing individuals with a zone of privacy insulated from most government control, land ownership no longer is critical to the existence of an individual's political and economic freedom. Land's role in maintaining ecological integrity, in contrast, remains essential, and indeed is probably becoming more critical as supplies of undisturbed and undeveloped land dwindle. Property norms should respond to these key changes in the role of land in our political, economic, and ecological systems.

For example, traditional property norms reflect an economic view of the role of government that tends to ignore externalities extending beyond the interests of individual rightholders. Under that view the purpose of government is primarily to define the sphere of property: to define the legal and political realm within which individuals are free to satisfy their own preferences and pursue their own vision of what is good.⁴²² Proponents of

Growth Controls: An Economic and Legal Analysis, 86 YALE L.J. 385, 441–43 (1977) (discussing and critiquing this position).

421. See, e.g., CHRISTMAN, *supra* note 21, at 125–39, 161–84 (arguing for the abandonment of the traditional, liberal conception of property in favor of a model that is distribution-sensitive); JENNIFER NEDELSKY, *PRIVATE PROPERTY AND THE LIMITS OF AMERICAN CONSTITUTIONALISM* (1990) (arguing that private property is inappropriately insulated from democratic debate and has distorted American constitutionalism away from egalitarian principles). See also William H. Simon, *Social-Republican Property*, 38 UCLA L. REV. 1335 (1991) (offering social-republican property as an alternative to classical liberal property and classical socialism).

422. See ALEXANDER, *supra* note 42, at 1–2, 379, 382–83. Under Richard Epstein's interpretation of Locke's theory of civil government, individuals surrender their right to use force to the sovereign in exchange for "a superior form of public protection." EPSTEIN, *supra* note 262, at 15. "The private rights of individual relationships are . . . preserved as much as possible even after the formation of civil society." *Id.* at 12–13. The task of government thus is "to ensure that all of the surplus [created by the

this view recognize the social good in protecting individual rightholders from externalities but ignore or reject the social good in protecting common environmental resources from externalities.⁴²³ The focus on externalities imposed on insular individuals has proven insufficient to restrain rights-based thinking in ways that adequately promote ecosystem integrity.⁴²⁴ By focusing almost exclusively on externalities imposed on insular individuals, particularly rightholders, proponents have ignored the broader scales of private land use.

The preference-satisfying, economic view of property that currently controls the interpretation of property norms also ignores the public or civic dimension of property that has long been part of American legal thought. Under the civic conception of property, "the core purpose of property is not to satisfy individual preferences or to increase wealth but to fulfill some prior normative vision of how society and the polity that governs it should be structured."⁴²⁵ This conception has a much broader focus than exchange value or individual marketplace preferences, intentionally including noneconomic interests and values not reflected in marketplace transactions.⁴²⁶ Until the law and economics movement succeeded in changing the rhetoric of property to an instrumental, market-oriented rhetoric, noneconomic values like the right to life, liberty, and personal security were regularly part of the property dialogue.⁴²⁷ Property norms, in other words, did not focus primarily on exchange value and satisfaction of personal preferences through marketplace transactions. Noneconomic values were very much a part of the property dialogue. Returning to some version of this tradition of civic property would allow ecological interests to be reflected in property norms.

formation of a civil society], save that necessary to govern the state, is retained by the individual members of the union." *Id.* at 10. Private property plays a critical role in this overall scheme of government, representing the "sum of the goods that the individual gets to keep outside of the control of the state." *Id.* at 13.

423. This view of government is frequently reflected in statements attacking various environmental laws as unfairly singling out private property owners to bear the public costs of environmental protection. No mention is made of the costs imposed by private land use on ecosystems. A private landowner's degradation of natural resources or ecological systems apparently is not considered a cost of conducting the land use. *See, e.g., Private Property Rights and Environmental Laws: Hearings Before the Senate Comm. on Env't and Pub. Works*, 104th Cong. 181 (1995) (statement of Jonathan H. Adler, Director of Environmental Studies for the Competitive Enterprise Institute).

424. *See* HACKETT, *supra* note 33. *See also* Kenneth J. Arrow, *Foreward to RIGHTS TO NATURE*, *supra* note 1, at xiv (noting that "traditional economic analysis of production . . . fails to be rich enough to encompass the actual links observed in the use of natural living systems as resources").

425. ALEXANDER, *supra* note 42, at 2.

426. *See id.* at 379-81.

427. *See id.* at 380.

The reevaluation of property norms thus need not result in the abandonment of the private property system and the development of an alternative, environmentally friendly approach to defining relationships among individuals, government, the public, and natural resources. Although such an alternative approach might be especially appropriate for certain types of common pool resources,⁴²⁸ it could, if taken too far, ignore the fundamental building block role that private property has played in American economic and political systems. Though private property now may have certain functional equivalents that are performing some of property's political functions, private property still remains an important part of American political and economic systems.⁴²⁹ Any effort to break the pathological effects of property norms on ecological integrity therefore should recognize that the core essence of the private property concept must remain. If a redefinition of traditional property norms can correct the environmentally destructive path now taken by property norms, it is imperative that such a reexamination be conducted before more drastic alternatives are taken.

2. General Redefinition of Property Norms

Although specific recommendations about the redefinition of property norms must await a careful reevaluation of those norms, some general observations can be made at this time. First, it is clear that property norms must impose a greater degree of responsibility for the environment on property owners. Ecological integrity must be promoted at the individual as well as the societal level. Lawmakers must recognize the dual nature of property ownership: In addition to giving the holder rights and powers, private property obligates the holder to act as a responsible member of social and ecological systems. The political and legal systems that define the relationship of individual citizens and government to resources now must formally recognize the ecological connectedness of all natural resources, whether owned privately or held in common. Property rights must be interpreted in light of the need to maintain ecological processes and sustain species and ecosystems.

This directive admittedly does not answer some of the "big picture" questions raised by the call for a reevaluation of property norms. It does not, for example, tell us how much ecological integrity is necessary. Nor does it tell us what morals should be used to develop a stewardship

428. For a discussion of some alternative approaches, see RIGHTS TO NATURE, *supra* note 1.

429. See ELY, *supra* note 2, at 153–56 (discussing the continued importance of property).

obligation or an adaptive or sustainable property concept.⁴³⁰ It does, however, lay down an important principle: that the private property concept must move towards sustainability and a process of adaptive definition. Possible ways to achieve this principle now being explored by scholars include developing new priority principles that do not prefer human interests;⁴³¹ calculating the economic value of ecological services;⁴³² modifying economic systems to reflect various sustainability concepts;⁴³³ and considering greater use of a variety of property and social control arrangements.⁴³⁴

Moving land ownership norms toward a sustainable and adaptive property concept will require basing those norms not only on the economic and political functions of property but also on the ecological services provided by land. The individualistic, "island view" of property that developed under traditional American law reveals much about us as citizens and people. In addition to showing the importance that we attach to individualism, it reveals that we do not believe landowners owe a legal obligation to social and ecological systems. This belief is hostile, in some fundamental ways, to modern notions of responsible citizenship. Though landed property traditionally was tied to good citizenship, this relationship was individually based; wealthy landowners tended to participate more in government. As social and ecological conditions change, the concept of the citizen owner also must change. It is no longer enough for citizen landowners to participate actively in government; citizen landowners also must think ecologically beyond their property boundaries.

3. *Judicial Redefinition of Property Norms*

One key step in moving toward sustainable and adaptive property is judicial recognition of the spatial and temporal dimensions of private land use in resolving property conflicts and defining property rights. Because of the external and cumulative effects of individual land use and because of

430. For a thoughtful critique of the concept of ecological integrity as the basis of a set of morals that would collectively form an environmental ethic, see WESTRA, *supra* note 389. For an argument that a holistic approach based on pluralistic stewardship is needed, see Barrett & Grizzle, *supra* note 389.

431. See, e.g., PAUL W. TAYLOR, *RESPECT FOR NATURE: A THEORY OF ENVIRONMENTAL ETHICS* (1986).

432. See, e.g., Costanza et al., *supra* note 33.

433. See, e.g., HACKETT, *supra* note 33, at 249-305 (discussing sustainable development, production, and consumption); James Salzman, *Sustainable Consumption and the Law*, 27 ENVTL. L. 1243 (1997) (discussing sustainable consumption from a legal perspective).

434. See RIGHTS TO NATURE, *supra* note 1; Sterk, *supra* note 21.

the relationship between scale and integrity,⁴³⁵ courts need to capture scale dimensions in defining the rights, powers, obligations, and liabilities of property owners. It is time for courts to recognize the legitimacy of imposing an obligation on property owners to account for the ecological costs of land use choices determined in light of appropriate considerations of scale. It is also time for courts to recognize that the liberal, economic view of property has skewed the definition and evolution of property rights. For the most part, changes in the common law of property do not occur under the economic view unless the desires of interacting persons to adjust to changes in costs and benefits have produced some corresponding new private property right in someone.⁴³⁶ Court decisions involving property rights generally do not recognize the scale of land use. When a property conflict involves two private property owners, the dispute tends to be framed in the context of the conflicting private interests. When the property conflict involves a private landowner and a governmental unit, the broader public interest admittedly may help to establish the basic constitutional legitimacy of the government's exercise of power or explain why the private use is harmful or illegal. In evaluating the constitutionality of the economic impact of the government action on the property owner, however, the public interest apparently is not even to be considered.⁴³⁷ This refusal to consider the public interest in determining the legitimacy of the economic impact on the property owner reflects a failure to recognize the temporal and spatial scales of private land use.

Recognition of the temporal and spatial scales of land use is especially important to a determination of the fairness of the government restriction to the individual. Before a court can determine whether government action unfairly singles out a private landowner, the court needs to have an accurate understanding of the scales of the regulated conduct. Considering the consequences of land use over spatially and temporally relevant scales will help to ensure that fairness is defined in light of the individual landowner's impact on future generations, the public interest, and ecological integrity over the short and long term. Current landowners

435. See *supra* notes 351–355 and accompanying text.

436. See ALEXANDER, *supra* note 42, at 379–82; Demsetz, *supra* note 242, at 348–53.

437. See, e.g., *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003, 1015–16 (1992) (adopting a per se taking rule for total deprivations of value that does not normally allow for “case-specific inquiry into the public interest advanced in support of the restraint”); *Pennsylvania Coal v. Mahon*, 260 U.S. 393, 413 (1922) (noting that “usually in ordinary private affairs the public interest does not warrant much” government interference with property rights). The phrase “public interest” is being used broadly here to include the interests of non-rightholders and the promotion of ecological integrity.

should not have monopoly power over the use of a scarce or irreplaceable resource like land when that resource is vital to everyone's survival.⁴³⁸

The common law of property provides sufficient basis for reinterpreting or redefining property norms to reflect considerations of scale and impose an ecological obligation on property owners. Under the common law, property rights change over time as circumstances and conditions change.⁴³⁹ In the nineteenth century, courts began to recognize the dynamic, evolving nature of common law property and moved away from a static approach.⁴⁴⁰ Under the dynamic view, common law property rights are relative, varying in meaning and strength even at the same point in time according to the nature of the conflicting interests.⁴⁴¹ The inherent flexibility of property, long recognized by the common law, provides the means for developing an adaptive property concept that is sufficiently experimental to allow the concept to react to new scientific data about the scales and impacts of land use. The challenge for modern courts formulating the adaptive property concept is to identify its core essence which should remain unchanged. Recognizing the existence of an unchangeable core is not, however, tantamount to denying the adaptability of property. Nor is it tantamount to concluding that private property rights are absolute and generally free from government restraint.⁴⁴²

The common law of property is inherently adaptable and evolving in large part because it is not controlled by a single theory or conception of property. Rather property law has been defined through a dialectic involving conflicting conceptions of the dominant role and purpose of

438. In the nineteenth century, courts began to recognize that an absolutist conception of property stressing dominion, priority in time, and a broad power to exclude created monopoly power in protected property rights. To encourage competitive economic development, the courts gradually freed property from these absolutist, exclusionary biases "by enlarging the range of noncompensable injuries." HORWITZ, *supra* note 7, at 40. See generally *id.* at 31-62 (discussing the transformation of the conception of property from the eighteenth to the nineteenth centuries).

439. See Butler, *supra* note 33, at 660-61; Carol M. Rose, *Property Rights and Responsibilities*, in THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY 49, 50 (1997). See also Demsetz, *supra* note 242, at 350 (recognizing that adjustments in property rights occur in response to gradual changes in social mores, technology, and people's desires to respond to new cost-benefit possibilities).

440. See HORWITZ, *supra* note 7, at 1-4, 31-34.

441. See ALEXANDER, *supra* note 42, at 319-23, 325-29, 381 (recognizing contributions of legal realists such as Hohfeld and Ely in defining social and relational aspects of property ownership); Butler, *supra* note 33, at 658-59.

442. Indeed, there is ample historical evidence that private property was not meant to be absolute, but rather subject to the public good. See ALEXANDER, *supra* note 42; Anderson, *supra* note 412; Echeverria, *supra* note 409.

property.⁴⁴³ One conception, the vision of civic property, affected the early formation of property theory, while a second, the commodification or economic view, has controlled property law more recently.⁴⁴⁴ That one conception now dominates the legal and scholarly discourse does not signify the end of the dialectic. It simply means that negative reaction to a now subordinate conception led to the dominance of another vision. Nothing in the ongoing dialogue about property suggests that future shifts in property theory will not occur.⁴⁴⁵ To the contrary, the history of the common law of property suggests that it has used the dialectic "to correct itself in ways that improve American society."⁴⁴⁶ This corrective function has, for hundreds of years, served an invaluable role in making property a stable American institution and should be allowed to continue. Now the dialectic needs to be allowed to readjust the relationship between property norms and ecology, and resolve the problems of scale and integrity caused by current property norms.

The common law of property also has recognized the legitimacy of restricting private land uses in light of their cumulative effects on natural systems.⁴⁴⁷ Although this recognition has occurred primarily in situations involving traditionally recognized public rights or nuisances, it nonetheless provides reluctant courts with a basis for expanding consideration of cumulative effects to include private property's "piggyback" use of common environmental resources.⁴⁴⁸ Further, through its efficiency norm, the common law of property provides a basis for imposing an obligation to internalize the ecological costs of land use. While such internalization may not have been necessary when natural resources were more abundant and ecological systems were better able to absorb the adverse effects of land use, the decline in the quantity and health of ecological resources is now well documented.⁴⁴⁹

To counter arguments for greater accountability and restriction of landowners, proponents of a liberal conception of property sometimes

443. See ALEXANDER, *supra* note 42, at 384–85.

444. See generally ALEXANDER, *supra* note 42 (discussing the conflicting conceptions).

445. See *id.* at 384.

446. *Id.* at 386.

447. See Rose, *supra* note 439, at 52.

448. See *id.* at 51. As support, Professor Rose points to traditionally recognized public rights like fishing and traditionally accepted nuisances like noise, smoke, and odors that involve tangible physical invasions. See *id.* at 52 & n.7.

449. See, e.g., COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 127; U.S. ENVTL. PROTECTION AGENCY, CHESAPEAKE BAY: A FRAMEWORK FOR ACTION (1983).

argue that property owners traditionally have practiced stewardship.⁴⁵⁰ As evidence, they point to private landowners like the Nature Conservancy that have protected hundreds of acres of environmentally sensitive lands. Advocates of this position stress that private property laws are neutral and that what matters most is who owns the land. While one landowner might be motivated by profit, another could be influenced by conservation. Private property laws allow both motives to impact land use.

That some property owners are guided by the conservation motive does not mean that property norms do not have pathological effects on ecological systems. Not all property ownership must lead to environmental degradation for a problem to exist. Landowners like the Nature Conservancy are the exception rather than the rule. The bias of the property system towards economically valuable use and consumption means that most ordinary landowners cannot afford to conserve their land in a natural state. The ordinary landowner, even an environmentally friendly one, cannot afford to choose stewardship over profit; his resources simply are too limited for him to have the ability to ignore the normal market incentives promoted by property norms.

Further, even assuming that the stewardship ethic was once the norm, it clearly is not the norm today. Not enough private landowners are voluntarily preserving enough acres of land to make voluntary stewardship the key to protecting ecological integrity. Land settlement patterns have changed significantly since the colonial and early statehood periods when land was the main source of wealth and more compact urban settlements and large landholdings were commonplace.⁴⁵¹ More importantly, the economic value of a landowner's power to subdivide has become too significant for landowners to ignore. Just as the nature of the landowner's power to subdivide has changed in response to market conditions, so must the judiciary's definition of property rights and obligations change in response to ecological conditions.

450. See 10 RICHARD R. POWELL, *POWELL ON REAL PROPERTY* § 69.02, at 69-4 (Patrick J. Rohan ed., 1998) (the "law of land in England and in America . . . [reflects] a change from the viewpoint that he who owns may do as he pleases with what he owns, to a position which hesitatingly embodies an ingredient of stewardship"). This view has, at times, controlled resource management decisions. For example, the ideal that farmers had a "'love of land [that] bonded . . . [them] to the rigorous observance of rules'" designed to protect the earth was once a key premise of the management program for the Florida Everglades. Stephen S. Light, Lance H. Gunderson, & C.S. Holling, *The Everglades: Evolution of Management in a Turbulent Ecosystem*, in *BARRIERS AND BRIDGES*, *supra* note 9, at 103, 124-25 (quoting J.E. Dovell, *A History of the Everglades in Florida* (1947) (unpublished Ph.D. thesis, University of North Carolina, Chapel Hill)).

451. See Butler, *supra* note 33, at 637; Shabman, *supra* note 128, at 3-4; *supra* notes 176-178 and accompanying text.

4. *Legislative and Administrative Redefinition of Property Norms*

In addition to judicial consideration of scale in defining property rights, legislative and administrative branches must incorporate the temporal and spatial dimensions of land use into laws governing development and growth. Innovative and bold approaches to land use management are becoming increasingly necessary. While it is important that the courts redefine property norms to reflect the scales of land use, this process of change will necessarily be gradual and ad hoc. Legislatures, on the other hand, can address issues of scale comprehensively and systematically through a number of devices designed to alter the behavioral incentives of land users.⁴⁵² These devices will not be effective, however, unless they are followed by timely implementation and persistent enforcement. Only through the combined efforts of all branches of government can a redefinition of property norms occur.

One way to incorporate ecologically relevant considerations of scale into land use choices is to mandate that local governments consider off-site, as well as on-site, impacts of proposed projects. Unless statutes authorize such consideration, many courts tend to define strictly the scope of a locality's power to review land development projects.⁴⁵³ Statutory authorization and direction to consider off-site impacts would recognize the need to incorporate the scales of private land use into land use decisionmaking.

In addition to mandating consideration of scale by land use decisionmakers, legislatures could impose an affirmative obligation on property owners to consider scale by requiring property owners who are proposing development projects of a certain size or density to conduct more effective impact analysis for manmade and natural infrastructures and systems.⁴⁵⁴ This analysis would include an evaluation of the impact of the proposed development on the transportation infrastructure, the ground and surface water supply, drainage and sewerage systems, schools, ecological systems, and other shared resources. If the proposed development would impose new demands on the water supply, for example, the landowner would be required to demonstrate how those demands could be met using available resources. If the proposed development would eliminate

452. In dealing with the problem of nutrient runoff, for example, a legislature can, with the passage of a single act, impose fines on farmers to force them to reduce nutrient runoff. *See, e.g., Maryland Senate OKs Farm Runoff Fines*, DAILY PRESS (Newport News, Va.), Feb. 25, 1998, at C5.

453. *See* DANIEL R. MANDELKER, LAND USE LAW § 9.09 (4th ed. 1997).

454. Some states have already adopted statewide land use planning programs that incorporate growth controls. *See generally id.* at 421–35 (discussing growth control programs).

wetlands or other critical environmental resources, the landowner would have to explain the impact of the loss on the watershed from the perspectives of ecosystem functions and integrity, focusing not only on the loss to the developed tract but also on the cumulative impact of the loss to the watershed as a whole. If the development would result in a loss of land cover or cause erosion and runoff, the landowner would have to document the amount and type of land cover lost⁴⁵⁵ or ground eroded, assess the ecological and physical effects of the lost land cover or increased erosion and runoff on the watershed, and explain how those effects could be minimized, mitigated, or reversed. Such explanations should consider the spatial and temporal dimensions of the impacts given conditions within the watershed.

Although these infrastructure impact studies admittedly would increase the costs of development, internalization of the costs of private land use is needed to control growth and effectively protect ecosystems. All too often, developers either are not required to conduct ecosystem or watershed based infrastructure studies, or are able to avoid them through private agreements or court challenges.⁴⁵⁶ When the demands of development on natural and manmade infrastructures are not adequately addressed, the results can be serious. Just consider the plight of New Zealand's largest city, which experienced a blackout blamed on rapid growth. The last of four aging power cables failed on February 20, 1998, sending the city of one million into darkness for weeks. In addition to economic losses resulting from closed shops and businesses, the city experienced fires, spoiled food, and other health and safety problems.⁴⁵⁷

455. The Board of Supervisors of Fairfax County, Virginia, voted in March 1999 to require developers to document the location, type, and condition of all trees, shrubs, and other plants before developers cut them down. Although the County cannot require developers to save trees, it hopes that the documentation requirement will encourage voluntary efforts to minimize the loss of vegetation. *See VA to require developers to document vegetation*, BAY J. (May 1999), at 16. A legislatively imposed obligation to minimize loss of ground cover is needed to deal with the growing problem of lost vegetative land cover.

456. In the Chapman's Landing project discussed earlier, the developer apparently tried to divide the project into smaller parts, possibly to avoid comprehensive review. The developer also met in private with the Army Corps of Engineers, Maryland's Department of Natural Resources, and other federal and state agencies to discuss the application that the developer eventually would file. *See supra* notes 371-388 and accompanying text.

457. *See New Zealand Blackout Blamed on Rapid Growth*, DAILY PRESS (Newport News, Va.), Feb. 26, 1998, at A11. Another power failure also occurred in May 1998. *See Power Outage Again Hits New Zealand*, DAILY PRESS (Newport News, Va.), May 11, 1998, at A12. Although a subsequent study faulted the utility, *see Utility Faulted for Five-week Blackout in New Zealand*, DAILY PRESS (Newport News, Va.), July 22, 1998, at A8, earlier news accounts suggest that rapid growth played a major role. *See New Zealand Blackout Blamed on Rapid Growth, supra*.

Land development is not simply a matter of whether a structure can be built on a particular site; it also raises important questions about the ability of manmade and natural infrastructures to absorb the impacts of development and sustain ecosystems.

Furthermore, the infrastructure and system impact studies must become the responsibility of all landowners proposing a development or use of an ecologically significant size, density, or scale of use. The studies should not be imposed only on owners of land in critical or buffer areas; uses in the interior portions of a watershed also can seriously degrade the ecosystem. Ecological problems are caused by land uses occurring throughout a watershed, not just those in the coastal area. The scales of land use extend well beyond the temporal and physical constraints of the individual user. Land uses not only affect ecological resources located miles away; they also interact and combine with other uses, causing more serious consequences. It is time for landowners to recognize and account for their interference with the "life-support services" provided by ecological systems.⁴⁵⁸

The infrastructure impact studies must also be required early enough in the decisionmaking process to make a difference. Preliminary government decisions that make development possible must be recognized as critical decisions. Once a local governmental unit decides to allow the extension of water and sewer service to a particular area, development eventually will follow unless preexisting rights or interests prevent development.⁴⁵⁹ Those types of decisions must be made only after meaningful consideration of the impact on available natural resources and ecological systems. At present, the key to growth control is effective management of water and sewerage services. The importance of such services would change, of course, if technologically advanced septic systems gain widespread acceptance. Those systems use technology that allows land not previously suitable for development to be developed.⁴⁶⁰

458. See Jane Lubchenco, *Entering the Century of the Environment: A New Social Contract for Science*, 279 *SCIENCE* 491, 492 (1998).

459. A local government, for example, may seek to acquire conservation easements restricting development on agricultural land. See Stephen C. Fehr, *Montgomery's Line of Defense Against the Suburban Invasion, County Preserves Open Space, Allows Dense Development Elsewhere*, WASH. POST, Mar. 25, 1997, at A1.

460. See Judith Haynes, *New Septic Systems Could Open Land for Development*, DAILY PRESS (Newport News, Va.), Mar. 9, 1998, at B2 [hereinafter *New Septic Systems*]. See also Judith Haynes, *Va. Tests Septic Options*, DAILY PRESS (Newport News, Va.), Mar. 9, 1998, at B1 (discussing use of new septic system technology in Virginia). See generally *SITE CHARACTERIZATION AND DESIGN OF ON-SITE SEPTIC SYSTEMS* (M.S. Bedinger et al. eds., 1997) (discussing dramatic changes in on-site septic system technology).

Poor percolation of land traditionally has been an important constraint on development. A locality which adopts the new technology no longer will be able to control growth simply by relying on the fact that the soil will not percolate sufficiently to support a conventional septic system.⁴⁶¹

Although some jurisdictions have adopted innovative growth management programs that consider scale through infrastructure impact reviews,⁴⁶² significant differences exist between these programs and the suggested approach. First, the programs do not redefine the norms underlying property rights to impose an ecological obligation on property owners, recognize sustainable or adaptive property concepts, or capture ecologically relevant spatial and temporal scales. Under an ecologically based approach to land use management, a decisionmaker evaluating a proposed or current land use or defining authorized land uses would consider, among other factors, whether individual tracts of land performed critical ecological functions, played an important role in sustaining ecosystem structure, or promoted ecosystem resilience.⁴⁶³ If so, the land use decisionmaker then would consider the type of obligation that should be imposed on the landowner to protect ecosystem functions, structure, and integrity.⁴⁶⁴ Such an ecologically based view of land is not generally reflected in the innovative land management programs in effect today;⁴⁶⁵ ecological concepts are not typically used as guiding principles in land use decisionmaking. Nor do current growth management programs necessarily force landowners to bear the marginal costs of their land use.⁴⁶⁶ Rather the programs tend to assume the continuing existence of traditional property rights and norms, and view growth management primarily as the control of

461. See *New Septic Systems*, *supra* note 460, at B2.

462. See, e.g., FLA. STAT. ANN. § 380.06 (West Supp. 1999) (regulating developments with regional impacts); MD. CODE ANN., ENVIR. § 9-512(b)(1) (1996) (linking building permits to adequate water and sewerage systems); OR. REV. STAT. §§ 195.020(3)–(4), 195.060, 195.065, 195.070, 195.075, 195.145, 197.295, 197.296, 197.298, 197.303, 197.307 (1991 & Supp. pt. 3 1998) & 268.390 (Supp. pt. 4, 1998) (providing for the creation of urban growth boundaries, urban service agreements, and urban reserve areas to control growth); VT. STAT. ANN. tit. 10, §§ 6086(a)(9)(A), (G), (H), (J), (L) (1997) (requiring state officials reviewing development permit applications to consider the impact of growth, utility services, the costs of scattered development, and rural growth areas, among other factors).

463. See Keiter, *supra* note 48, at 336; Joseph L. Sax, *Property Rights and the Economy of Nature: Understanding Lucas v. South Carolina Coastal Council*, 45 STAN. L. REV. 1433, 1442–46 (1993).

464. See Keiter, *supra* note 48, at 336.

465. Nor is this view widely shared by state legislatures or courts. See *id.*

466. See, e.g., FLA. STAT. ANN. § 163.3180(7) (West Supp. 1999) (allowing averaging in calculating the level of transportation service in compact geographic areas). For a discussion of the impact of considering average costs instead of marginal costs in making use decisions, see Ellickson, *supra* note 420, at 441–43.

the characteristics of growth (e.g., rate, type, amount, location, and quality). While the negative impact of growth on manmade and natural infrastructures is a concern of the programs, this concern is reflected in strategies to control input features of growth, not in a redefinition of property rights and obligations.⁴⁶⁷

Further, even when land use programs require consideration of the impact of proposed development on the infrastructure, they tend to discount the importance of the ecological infrastructure. In Maryland, for example, state and local governments must, before issuing a building permit, consider existing and approved developments in the relevant service area to determine if the water supply, sewerage, or solid waste systems would adequately serve the proposed development.⁴⁶⁸ Florida goes a step further, requiring certain necessary public facilities and services to be available when development is approved.⁴⁶⁹ Those necessary facilities include roads, potable water, sanitary sewer, solid waste, drainage facilities, parks and recreation, and mass transit.⁴⁷⁰ Noticeably absent from the lists of infrastructure services are ecological services. Although ecological considerations admittedly appear in other parts of the states' environmental or land use laws,⁴⁷¹ their absence from the provisions governing the regional impact of development on infrastructure suggests that the life-support services provided by the ecological infrastructure are taken for granted.

Protecting the important ecological services provided by land and other natural resources will require changes in private property norms to incorporate principles of ecology. It also will require changes in ecosystem management approaches to reflect the latest ecological concepts and information. Through the adoption of an adaptive approach to ecosystem management, external pressure can be imposed on the property system to take into account ecological principles and data.

467. See DANIEL R. MANDELKER, ROGER A. CUNNINGHAM, & JOHN M. PAYNE, *PLANNING AND CONTROL OF LAND DEVELOPMENT* 653-59 (4th ed. 1995) (comparing growth management programs to traditional zoning). See also MANDELKER, *supra* note 453, §§ 10.01-10.12 (discussing legal issues raised by growth management programs).

468. See MD. CODE ANN., ENVIR. § 9-512(b)(1) (1996).

469. See FLA. STAT. ANN. § 163.3180(1) (West Supp. 1999).

470. See *id.* § 163.3180(1). Florida requires the public facilities and services "needed to support development" to be available "concurrent with the impacts of such development." *Id.* § 163.3177(10)(h).

471. See, e.g., 1 FLORIDA BAR, FLA. ENVTL. AND LAND USE LAW, (1986, 1988, 1991 & 1993) (discussing environmental provisions in the Florida Code); 2 FLORIDA BAR, *supra*, (2d ed. 1994 & 1996) (again discussing environmental provisions in the Florida Code).

B. ADAPTIVE ECOSYSTEM MANAGEMENT

Effective ecosystem management requires a flexible, adaptive, and ecologically based approach to management. Instead of striving to tame the environment in order to promote social objectives, adaptive management tries to manage the environment in a way that responds to the variations, rhythms, and cycles of nature.⁴⁷² Rooted in ecology, adaptive management links management policies to biological time scales and to ecosystem integrity. Concepts like resilience, cycles of ecosystem succession, functional equivalence, and population fluctuation play an important role in adaptive management policies.⁴⁷³ Under the adaptive management concept, human interactions with nature are viewed as experiments that provide opportunities for learning. Eventually, once the lessons are learned, adaptive management policies are changed to reflect the new understandings and knowledge.⁴⁷⁴ Surprise and uncertainty, in other words, are "integral" parts of adaptive management.⁴⁷⁵ Crises and unpredictable interactions are viewed as inevitabilities requiring adaptation of appropriate policies.⁴⁷⁶

For years humans have responded to the dynamic nature of the environment by attempting to control—or as some would say manipulate—the variability of different components of natural systems. Fish populations have been controlled through fishing restrictions and manmade fish ladders, pests in forest ecosystems through spraying, and grass on public rangelands through the selection of drought-resistant species. Although these strategies may work in the short term, they also have contributed to a loss of resilience in the foundation ecosystem.⁴⁷⁷ Because of this and other long-term, adverse consequences, some scientists have begun urging management institutions to recognize the need for adaptive management. Instead of using technology and engineering to control the variability of change in the environment, these scientists stress the need to adapt to change. Instead of managing the environment primarily or solely for social

472. See Frances Westley, *Governing Design: The Management of Social Systems and Ecosystems Management*, in *BARRIERS AND BRIDGES*, *supra* note 9, at 391, 394.

473. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 20–23; Kai N. Lee, *Deliberately Seeking Sustainability in the Columbia River Basin*, in *BARRIERS AND BRIDGES*, *supra* note 9, at 214, 229; R.E. Munn, *Monitoring for Ecosystem Integrity*, in *ECOLOGICAL INTEGRITY*, *supra* note 30, at 105, 105–06.

474. See Lee, *supra* note 473, at 227, 229.

475. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 12–13.

476. See Gunderson et al., *supra* note 133, at 490–92.

477. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 6–9.

objectives, the scientists identify sustainability as their goal.⁴⁷⁸ Instead of allowing private property rights to control ecosystem management, proponents of adaptive management treat “economic uses of nature as experiments” that might require new management policies and rules to deal with adverse impacts.⁴⁷⁹

An adaptive ecosystem management approach will help to ensure that the ecological dimensions of property use are considered—that is, that ecologically sustainable scales are defined and incorporated into property rights. Under mainstream economic thinking, economic growth provides a solution to, or at least a justification for ignoring, the problems of inequitable income distribution and maintenance of economic scale within sustainable limits.⁴⁸⁰ Increases in productivity theoretically mean more wealth is available for everyone.⁴⁸¹ Further, because a growth-oriented policy provides real benefits, making many better off without directly making anyone worse off, “bigger” is presumed to be the optimal scale. One key problem with this reasoning is that it only addresses *economic* scales at a microeconomic level. Adaptive ecosystem management would serve as a check on microeconomic analysis, ensuring that *ecological* scales are considered at the management level in solving ecological problems.⁴⁸²

An adaptive management approach to ecosystem management may require greater caution in making land use decisions. Because of the unpredictable and ever-changing nature of ecosystems, many land use decisions are made under uncertainty. Some scientists have urged the adoption of a policy of prudence or caution to minimize the possible adverse ecological consequences of decisions made under uncertainty.⁴⁸³ Under a policy of prudence, decisionmakers facing uncertainty would “have an ethical obligation to risk erring on the side of preservation” of the natural environment.⁴⁸⁴ To justify this approach, scholars explain that ethics require decisionmakers to minimize avoidable catastrophic

478. See Lee, *supra* note 473, at 234.

479. *Id.* at 227.

480. See HERMAN E. DALY, BEYOND GROWTH: THE ECONOMICS OF SUSTAINABLE DEVELOPMENT 48–52 (1996) (discussing allocation, income distribution, and scale under economic thinking).

481. See *id.* at 51.

482. In recent years a group of scholars has begun to use principles of biology, ecology, and environmental science to reform assumptions of macroeconomics. For an introduction to some of the thinking of these ecological economists, see ECOLOGICAL ECONOMICS: THE SCIENCE AND MANAGEMENT OF SUSTAINABILITY (Robert Costanza ed., 1991).

483. See, e.g., Noss, *supra* note 107, at 896–97.

484. *Id.* at 897.

consequences.⁴⁸⁵ Many ecosystem management decisions would fall into this situation.⁴⁸⁶

Altering decisionmaking preferences will, in turn, require a rethinking of property norms. The rights-based focus of traditional property norms can lead to the view that economic expectations and uses generally deserve constitutional protection from government interference. Under this view government should compensate property owners adversely affected by regulation benefiting the public regardless of its negative externalities to ecological systems or common environmental resources. The more absolute this view becomes, the more it limits the effectiveness of the adaptive management concept. Incorporating an expectation of the unexpected into property rights will require a change in thinking about the nature of constitutionally protected property. Although constitutional protection of property would remain a fundamental part of our political values and structure, such protection could not entail the same sense of constancy that now prevails among many courts, legislators, academics, and property owners. The scope of constitutionally protected property rights should no longer be determined at the time of the initial investment or purchase of the property. The nature of a landowner's power and right to control use of her land should no longer ignore the negative externalities to ecosystems. Property rights should not be defined without sufficient regard for the foundation ecosystem. Ecological integrity will require a more informed view of the relationship between property rights and ecological resources—one that recognizes the importance and necessity of an adaptive property concept that complements the adaptive management approach.

Once more flexible approaches to defining property rights and managing ecosystems are taken, a system for ensuring fair, accurate changes in property rights and management techniques will be needed. A comprehensive monitoring system can help to meet this need.

C. THE IMPORTANCE OF MONITORING FOR SURPRISE

Comprehensive monitoring of ecosystems is important not only to the health of the systems but also to the landowners who use the resources within the ecosystem. Studies of managed ecosystems indicate that management institutions have tended to ease up on monitoring over time as initial management goals are reached and short-term successes are

485. See *id.* at 896–97; Shrader-Frechette & McCoy, *supra* note 370.

486. See Noss, *supra* note 107, at 896–97; Shrader-Frechette & McCoy, *supra* note 370.

achieved. Instead of continuing to monitor the ecosystem for “surprises,” the management institutions typically have shifted resources to operational objectives.⁴⁸⁷ Funds once used for experimental monitoring are instead used for improving operational efficiency. What monitoring efforts that remain tend to focus on the targeted ecological product. The managed ecosystem’s gradual loss of resilience and gradual increase in vulnerability often goes unnoticed.⁴⁸⁸

These studies provide compelling evidence of the importance of a comprehensive and experimental monitoring program to ecological integrity. A management program that monitors for surprise ensures that the indicators of ecological integrity are constantly and objectively measured, and that the measurements are reproducible.⁴⁸⁹ Because of the complexity of monitoring for ecological integrity, however, management institutions need to set monitoring priorities. Factors and questions developed by researchers can be used to set those priorities.⁴⁹⁰

Comprehensive and experimental monitoring recognizes that ecosystems do not follow predictable linear paths of succession. Change in ecosystems can be unpredictable and chaotic; insignificant or noncritical attributes are not necessarily the first to be affected. By monitoring for surprise, a management program ensures that changes in critical attributes are identified relatively quickly. An adaptive ecosystem management program cannot succeed without an effective monitoring plan for identifying changes in conditions on a continuous basis. Although some changes may be irreversible, many others will occur at the margin or will be symptomatic, providing evidence of ecosystem health. Identifying those more marginal or symptomatic changes through monitoring will allow the management program to respond before the changes affect the ecosystem in its entirety.

487. See Holling, *What Barriers? What Bridges?*, *supra* note 132, at 8.

488. See *id.*

489. See Munn, *supra* note 473, at 105, 108.

490. One scientist suggested consideration of the following factors in setting monitoring priorities: critical limiting factors for sustainability; current threats to ecosystem integrity; the existence of irreversible trends; interactions between various societal interests; surprises or discontinuities that might occur within the next thirty to fifty years; and the types of questions that the monitoring system would be expected to answer. See *id.* at 110. The abundant literature on ecological integrity provides a strong foundation for developing more specific monitoring programs. See *id.* at 112. See generally Andrew Robertson, Paul Orlando, & Donna Turgeon, *Monitoring the Coastal Environment* (visited May 25, 1999) <http://state_of_coast.noaa.gov/bulletins/html/mcwq_12/mcwq.html> (discussing the importance of monitoring coastal areas and the need for new approaches to environmental monitoring).

Comprehensive and experimental monitoring of ecosystems also can help to produce data needed to measure and understand the scales of land use. Besides providing property owners with scientific evidence of the temporal and spatial scales of their land use, the monitoring data can provide a rational basis for defining criteria and standards to govern land use and development. This function is especially important given the general "concerns for proportionality [that] animate the Takings Clause."⁴⁹¹ Further, although the Supreme Court has not extended the more specific "rough proportionality" test developed in *Dolan v. City of Tigard* beyond the exactions context, the *Dolan* decision clearly establishes a more demanding standard of judicial review for some land use restrictions.⁴⁹²

Some scholars have argued that fairness and equity require treating the first land user in an area the same as the last similar user. The apparent thinking is that the behavior of the users is equivalent and that the first contributes as much to the congestion as the last.⁴⁹³ This position seems persuasive when fairness is defined in the present and focuses only on the status of being a land user; hindsight tells us that all users are part of the problem. The argument loses persuasiveness, however, when other temporal and spatial dimensions are considered. The timing of a use, for example, can affect the ecological impact of the use. Uses conducted at a time when ecosystems are resilient will have a different impact than similar uses conducted at a time when ecosystems are stressed and more vulnerable. The cumulative effects of piggybacking onto common resources also are likely to differ for earlier and later uses. Temporal and spatial scales, in other words, do matter in measuring the ecological consequences of development and use. Comprehensive monitoring can help to ensure that land use restrictions roughly reflect the scales of particular uses.

CONCLUSION

Modern society faces increasingly serious problems of escalating land and water use and of ineffective watershed and ecosystem management over the long term. Although some progress has been made in recognizing and correcting the ineffectiveness of traditional management systems in dealing with those problems, the steps taken generally do not recognize the role of traditional property norms in contributing to those problems. The

491. *City of Monterey v. Del Monte Dunes at Monterey, Ltd.*, 526 U.S. 687, 702 (1999). See *supra* note 418 and accompanying text.

492. See *supra* note 418 and accompanying text.

493. See Ellickson, *supra* note 420, at 447-48.

traditional norms' focus on the relationship between property and individual freedom leads to land use and ecosystem management practices that ignore the pathological effects of property use on environmental and other common resources. Although the fundamental building block role played by private property in the American economic and political systems suggests that the core essence of private property must remain intact, the increasingly stressed conditions of modern ecosystems require private property law to move toward a more adaptive conception of property. Such an adaptive approach would take into account the impact of property use on ecological and other common systems. Such an approach also would recognize the legitimacy of imposing a greater degree of responsibility for the environment on property owners through judicial, legislative, and administrative action. One key way private property law could not only become more adaptive but also impose greater responsibility is to incorporate the scales of land use into the definition of property rights, powers, duties, and liabilities.

In addition to solutions that work within the private property system, external solutions also are needed to impose pressure on the property system to respond to modern ecological conditions. One external solution that would parallel the adaptive conception of property is the adoption of an adaptive approach to ecosystem management. Under such an approach, interactions between property owners and nature would provide opportunities for assessing impacts and fine-tuning or changing management policies. Although constitutionally protected property rights would remain a fundamental part of our legal and political structure, the scope of those rights would no longer be defined solely or primarily from the economic view of property.

Finally, a comprehensive monitoring system is needed to ensure that fair, accurate changes in management policies and property rights are made. A monitoring program that monitors an ecosystem for surprise provides valuable information about the health of the ecosystem. Equally as important, such a monitoring program produces data needed to measure the scales of private land use, and thus helps to ensure that land use restrictions are generally proportional to the scales of particular land uses.