OWNING THE LAND: FOUR CONTEMPORARY NARRATIVES

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I. INTRODUCTION&EMDASH< /SFONT>;TALES OF EDEN, OLD AND NEW

The craft of history has a lot to do with the telling of stories. Cast by an able historian, a narrative can perform weighty work interpreting the past and enlightening the present. A single story can illustrate a line of reasoning at the same time that it presents it. An apt incident can stand for and help explain a larger, messier course of conduct. Ordinary people use narratives in much the same way, to exemplify a bit of wisdom or probe the meaning behind an event.

During the colonial period of American history, storytelling remained a cherished art. It was also a time when people sought meaning in the world around them and in the grand sweep of history that carried them onward. Given the religious temper of the day, many colonists instinctively looked to the Bible to help make sense of their lives and work. For some of them, the New World represented a promised land, not unlike the land that Moses sought on the Exodus. For John Winthrop and his band of Puritans, New England was the place God chose for them to erect their city on a hill, that their light might shine forth to all the lands in accordance with the Sermon on the Mount in Matthew. Over and over, however, the Book of Genesis gave the colonists a sense of what they were about, and within Genesis the story of Adam and Eve in the Garden of Eden.[1]

The Eden narrative fascinated the colonists, just as it had caught the interest of generations before them. That fascination arose, paradoxically, as much from the story's ambiguity and malleability as it did from its importance.[2] The garden story was not so much a single tale as it was a collection of raw materials out of which several tales might arise. One narrative that took root likened the New World to the Garden of Eden itself.[3] Just as Adam and Eve were placed in the Garden, so too the colonists were led to America. The colonists found this America to be a lush, fertile land, wonderfully designed and so abundant in its yield that the colonists' needs would all be met for generations without end. In this narrative, America was a friendly, productive place. The unbroken forest represented wealth, and so did the river teeming with fish. To enjoy this garden the colonists needed merely to live in it, in as godly a way as they knew how.

Alongside this America-as-Eden narrative grew a second, much different narrative. In this alternative story, America was not Eden; it was the wilderness where Adam and Eve were banished when they misbehaved.[4] This wilderness had much potential to it, but the colonists needed to transform it with their labors, taming and controlling it, before the land would be habitable.[5] In this story, the ideal garden was not the unaltered land that greeted the colonists when they first arrived.[6] It was the well-tended, pastoral countryside around a New England village or a Virginia plantation. Trees needed to be cut, the land plowed, fences erected, and wild beasts driven off before Eden would rise again.[7]

This second narrative diminished the luster that attached to the raw New World, but it comported much better with the harsh realities of hard-working frontier life. It also fit together well with the institution of private land ownership, so important in the colonists' minds and lives. Adam and Eve might frolic and gambol, feeding upon grapes at their leisure, but colonists worked hard for their bread. Before working, however, they needed to gain access to a piece of land. They wanted secure access, enabling them to plant in the spring knowing they could reliably harvest in the fall. They wanted, in short, their own private property.

By the time of the Revolution, colonial culture had changed markedly from the early days, and the economy had changed along with it. The science and politics of the Enlightenment had given a boost to modes of thought that valued the individual human as a distinct moral entity, apart from the surrounding social order.[8] Increasingly, nature was viewed, not as an organic whole filled with mystery, but as a collection of parts that fit together in complex yet ultimately knowable ways.[9] In the economic realm, farming increased not to yield food for home consumption, but to produce surplus crops or livestock to sell in the market.[10] A full market economy was still a long way off, but it was plainly coming, and bringing with it a heightened emphasis on individualism and individual rights.[11]

To Americans wrapped up in this change, the writings of John Locke made a good deal of sense.[12] Locke celebrated the common individual, arguing he possessed natural rights that arose in advance of any social order and trumped even the powers of the King.[13] Preeminent among these individual rights was the right to property, which Locke justified by way of his well-known labor theory. As Locke interpreted the Bible, God originally gave the Earth to humankind collectively, as property in common, yet any individual who wanted could seize a thing from the common stock, including land, and make it his own simply by mixing his labor with it.[14] Before the labor was added, the thing had no value.[15] Once the labor was mixed in, value arose and the thing became private property.[16]

Locke's labor theory of property made particularly good sense in North America, more so than it did in England. Frontier colonists could easily see how labor was the key ingredient in the creation of value. Moreover, because land was plentiful, one person's occupation of land did not deny his neighbor the chance to gain land too. Back in England, a person had to buy property or inherit it, and one person's occupation of land did deny another the chance to use it.

Americans instinctively linked Locke's theory of property to their dominant narrative about the Garden of Eden, the narrative in which labor transformed the dangerous wilderness into a peaceful, pastoral garden.[17] North America was the raw land described by Locke, waiting to be

seized. By mixing labor with it the colonists gained property rights at the same time they transformed the land into the new Eden.[18] Private property proved to be a highly effective engine of progress. It provided just the incentive needed to induce the rebuilding of paradise in accordance with divine instructions.

Bolstered by Locke's theory, this progressive Eden narrative overshadowed the alternative narrative that valued more highly the untouched land. Jefferson kept alive this alternative narrative when he defended the beauty and perfection of North America to his doubtful European correspondents.[19] By the time Jefferson died in 1826, the alternative tradition enjoyed renewed favor among romantic writers who looked to nature for meaning and inspiration.[20] Writers, however, were an elite few, and this interpretation gained little support until the end of the nineteenth century. By then, the frontier had ended and people began to realize that something had disappeared along with it.[21] Outdoor hiking and camping gained in popularity, as people sought to regain contact with the dwindling wilds. For example, citizens founded the Boy Scouts and Campfire Girls.[22] John Muir regaled readers with his adventures in the Sierras and Alaska and gained an audience when he spoke of the inherent value of wild lands. In *The Call of the Wild*,[23] Jack London captured the public imagination with his tale of a domestic dog that joined the wolves. *Tarzan of the Apes*,[24] a true blockbuster of the day, told the captivating tale of an English infant reared in the jungle.[25]

By the late nineteenth century the American landscape itself became a more ambiguous source of narrative material, just like the Eden material in the Book of Genesis. The landscape too became the stuff from which conflicting stories might arise. Labor could indeed add value to the American land and make it more productive, just as John Locke said it did, but the land also had value without labor and too much labor could be as bad as too little of it. When misapplied or over applied, labor could bring ruin to the land by scraping away the trees, eroding the soil, and polluting the waters. Altering the wilderness sometimes did not bring progress, but decline.

As the countryside showed more and more scars of misuse, this declensionist interpretation made greater sense for people. It prompted calls for conservation, pollution control, and the preservation of wildlife refuges and wilderness areas.[26] Conservation measures became more numerous, placing limits on the expanding market economy that Locke's reasoning had helped fuel.[27] Just as important as the real limits that the conservation movement imposed were the symbolic and psychological challenges it presented. To see inherent value in the land, as John Muir and others did, implied that humans alone had not created all value. If the land was a fruitful garden before humans entered it, then humans became merely tenders of that garden subject to divinely set instructions, and the private property rights they held were limited accordingly. For humans, this interpretation represented a demotion in status, from conqueror and value-creator to something much less, a steward of preexisting value and a shepherd of animals and plants lent in trust.

Over the centuries, Americans have rarely thought about giving up private property or reducing its importance in the national fabric, but they have eagerly debated what ownership ought to entail.[28] A concern about the role of government in the lives of people, especially the role of the federal government, fueled the debate over the past decade.[29] The particular concern has been the expansion of regulations aimed at stemming the degradation of lands and waters.

As a cultural institution, private property has long reflected a good deal of inner tension over how the individual fits together with the community.[30] It reflects the values associated with individualism, such as privacy, autonomy, and opportunity, as well as the values associated with community well being, mutual-aid, and neighborly solidarity. Currently, the individual side of things has become resurgent, or at least has gained conspicuous defenders out to chip away at the community's power. Today's champions of the individual have not drawn openly upon the Bible. Nevertheless, their rhetoric is recognizable as the Lockean version of paradise regained, with private property as the source of traction.

Drawing upon John Locke, critics of land-use regulations piece together an updated narrative of land ownership, informed and given shape by libertarian political theory and market economics. This powerful rhetoric builds upon the tradition of liberal individualism that has so dominated American culture.[31] The centerpiece of this narrative, the star character, is the autonomous individual human, possessor of essential rights and vigorous participant in the market economy.[32]

Despite its prominence, the narrative of autonomy is not the only story about property rights being told today. Vying for public support are three other narratives which also explain where private property came from, why it exists, and what ownership ought to entail. For intensive land users, a good deal of short-term profits are at stake in this story-trading enterprise. Behind the money, though, are fundamental questions about how people and land fit together, as well as how the individual human fits into the larger social whole. First, where does value come from? Does value come from the individual landowner or from the communities of which the owner is necessarily a part, both the community of nature and the surrounding social community? The second question regards the essential nature of the human animal; are we inherently good or bad, and do we act altruistically? A related question is whether we act best when making decisions alone or together. Are we basically self-directed loners, distinct from one another and our natural surroundings, or are we better understood as socially constructed and intimately connected to each other and the land? To own land is necessarily to possess power, which leads inevitably to questions about that power. How should power be divided between the individual and the community? Who can be trusted with power, and where lies the greatest danger of its misuse?

Ultimately, there are the questions about the nature of the good and how it is best pursued. Is there such a thing as the common good, something that one can talk about distinct from the aggregate preferences of individuals? Furthermore, in the pursuit of that good, are people better off relying on one another, on their more-or-less democratic institutions of governance, or should they instead choose the automatic pilot option, giving into the market and letting the invisible hand lead where it will?

Widely varied answers to these questions are embedded in today's four narratives of land ownership. This Article discusses in turn the libertarian

narrative of individual autonomy, the more traditional narrative of property focused on economic opportunity, a community-centered narrative that understands property as an evolving tool to meet community needs, and a biocentric narrative that looks to the land itself to prescribe the rules on how it can be used. This discussion begins reviewing these tales with the one that has stirred up the most controversy lately, the narrative of autonomy. It is in this narrative that one finds John Locke talked about most openly, along with his optimistic story of endless progress.

II. THE LIBERTARIAN IDEAL OF AUTONOMY

The libertarian perspective on private property gained considerable ground in the late 1980s. It was spurred on, not just by unpopular environmental constraints, but by the publication of a book that presented the view coherently and passionately—*Takings*, by Professor Richard A. Epstein of the University of Chicago Law School.[33] Epstein's book leveled a broad attack on all forms of government regulation, particularly land-use rules.[34] It struck a responsive chord, and quickly became a leading text, not just among libertarian scholars, but among wise-use groups, ardent free-market advocates, and all manner of opponents of environmental rules.

Epstein argued that the private property rights of an owner were so fixed and secure that governments could do little to diminish them without paying compensation for any drop in value.[35] The only exception was a law that banned an owner from engaging in land uses that were so obviously harmful to neighbors as to amount to what the old common law deemed a nuisance.[36] As Epstein saw things, a landowner could use his land as he pleased so long as he did not spew pollution onto neighboring lands or otherwise physically disturb what a neighbor was doing.[37] Laws that went beyond nuisances and restricted other, noninvasive activities interfered with a landowner's vested private rights.[38] They were unconstitutional, and landowners deserved compensation for their losses.[39] Laws that restrained the alteration of wildlife habitat, for instance, were plainly unconstitutional unless compensation was paid.[40] So were laws restricting the draining and filling of wetlands and laws banning construction on ecologically sensitive lands.[41]

Epstein began his book with a story similar to John Locke's.[42] In the early days of pre-history, Epstein related, humans lived without governments or other communal structures. Land then was unowned, and any person could gain ownership of a vacant parcel simply by occupying it first.[43] But tensions arose because some people failed to respect the property rights of others, selfishly seizing the fruits of their neighbor's work.[44] Tensions also arose as resources became scarce and people had trouble finding vacant land to grab.[45] In response, people created governments to protect their private rights, vesting them with just enough power to maintain peace.[46] In short, private property came first, and governments were formed to keep it secure.

In his argument, Epstein made extensive use of Locke's writings, particularly Locke's fundamental claim that individual rights existed independently of government and hence trumped the wishes of lawmaking majorities.[47] When Epstein got to the details of Locke's labor theory, however, he found that it really did not fit his purposes, and he ended up revising the theory significantly to meet his needs. The beginning chapter of Locke's story, God's gift of the Earth to humans in common, was the first to go.[48] Writing for a secular audience, Epstein had no use for God in his narrative, nor did he like the notion of land being owned initially in a collective way. If land was owned by everyone, it was hard to explain how a single individual could seize a parcel and make it his own without getting group consent.[49] To seize a piece of the common fund was a type of theft, and it was not clear why others would put up with it.

The very centerpiece of Locke's theory, the idea that property rights arose through labor, also troubled Epstein.[50] If working the land translated into ownership, then awkward questions quickly arose: How much labor did a person need to expend, and for how long? Could one merely scratch the soil and plant a few seeds, or was major construction required? And what about vacant, undeveloped land? Could a person ever claim ownership of such land, or must it remain unowned until someone finally put it to use? For Locke, the quantity-of-labor issue was a minor detail in his world of presumed abundance, and as for vacant lands, they became government property as soon as governments were created. All of this disturbed Epstein. In a world of scarcity, the quantity-of-labor question was simply too important to ignore. If the government took over vacant land, it would presumably possess broad discretion to dictate the terms on which people might use the land.

To avoid these troubles, Epstein revised Locke's story materially. Epstein's story began with land unowned and an individual did not need to labor on the land to gain it.[51] He merely needed to be the first to occupy it.[52] By eliminating the requirement of labor and allowing a person to gain title to vacant land, Epstein avoided Locke's problems and denied governments excessive power over unaltered land. Yet, as Epstein made these changes to Locke's story, he wiped out all sense that private ownership rewarded a person for labor expended and, thus, stimulated that labor. Without a requirement for labor, individual ownership no longer rested on a theory of desserts, and it was no longer true, as Locke presumed, that a parcel's value derived entirely from the labor expended on it.

Lacking any theory of desserts to justify private property, or for that matter any formal theory of natural rights, Epstein found himself turning to utilitarian arguments to bolster his case.[53] First occupancy, he admitted, was not the only possible way of allocating unowned property—it was not in some way a natural law of the universe. Nonetheless, Epstein claimed, first occupancy enjoyed "very attractive utilitarian features."[54] First occupancy, he also admitted, faced objections based on fairness, particularly by those who arrived too late to get in on the original division of land and other things. Epstein turned again to considerations of utility. Late arrivals were better off anyway, for a world with private property was better than a world in which nothing was owned privately. Far from complaining about their comparative disadvantage&EMDASH;far from complaining that nothing was left for them to seize for free&EMDASH;people should be grateful just to live in a world in which private property was possible.[55]

In the end, Epstein's debt to Locke's specific theory was modest indeed. So extensively did Epstein revise Locke that his citation reflected merely

the lawyer's love of precedent. Rather than relying on Locke's property theories, Epstein's true debt ran far more to Locke's general ideas, as one of the creators of the dominant culture of liberal individualism.[56] Locke created and wrote about a fictional world populated by individuals, both individual landowners and individual parcels of land. An individual in this world could seize land, mix labor with it, and thereby create value, all without adversely affecting neighbors or seeking their permission.[57] Locke's hero was the isolated individual, disconnected from any community, human or otherwise. Locke described a fictional countryside composed of individual land parcels, as isolated and discrete as their respective human owners. When Locke's hero labored on his personal piece of the Earth, his actions stayed within his boundaries, without positive or negative externalities. Because a land parcel's value came entirely from human labor, raw land was worth nothing and its destruction entailed no loss of wealth. The narrative of autonomy accepts these individualistic premises and builds upon them, creating a tale in which the collective whole no longer counts for much at all. This near-total denial of community is reflected in several features of the autonomy narrative.

The meaning of land ownership—that is, the bundle of rights that accompany ownership status—is largely static in this narrative.[58] Epstein created his ideal bundle of landowner rights by looking to Blackstone and an idealized version of English common law.[59] To this base he mixed in one part nineteenth-century American jurisprudence and one part twentieth-century macroeconomics. He could have used another formulation of landowner rights, given that various combinations of rights are consistent with the narrative of auton omy. What was important for Epstein, and for the narrative of autonomy, was that these rights remain stable once in place so that the market economy could work best.

The static nature of property rights in the narrative of autonomy has two related implications. First, the lawmaking community has little if any power to redefine property rights over time or otherwise regulate land uses, except to deal with aggression and physical invasions. The power to make land-use decisions rests at the level of the individual landowner, not at any higher level of organization. The corollary implication is that property is no longer an organic institution; instead, it is a formal institution based on first principles and deductive reasoning. Property rights no longer shift over time in response to changes in public values and knowledge, nor do they respond to population increases, changes in technology, and other material factors.[60]

By vesting power in the individual owner, the narrative of autonomy carries with it a particular narrative of power and how it is misused.[61] Power in the hands of individual owners, according to this story, is relatively benign. Individual owners might act up and need occasional containment, but real danger arises only when power shifts to the community. A community with power will inevitably abuse it, seeking wealth for itself and trampling on individual rights. The narrative of autonomy responds to this danger by minimizing the public's power to act collectively, displaying in the process a deep distrust of democracy.

Finally, in its depiction of the moral landscape, the narrative of autonomy denies a community has legitimate substance to it apart from the members that compose it.[62] Individuals acting in concert become merely a special interest group, nothing more. Because a community lacks cohesion and identity, one cannot talk sensibly of the well being of the community or of community health. By easy extension, one also cannot talk sensibly of such a thing as a land community that includes non-human forms of life, or of the ecological health of such a community, or of duties that a landowner might owe in recognition of his membership in such a community.

III. THE TRADITIONAL UNDERSTANDING

The second and more truly conservative perspective on private property sinks its roots into traditional understandings of what private property has meant to generations of Americans. It too contains an implicit tale of individualism, but its emphasis lies less on autonomy than on self-reliance, mutual respect and, above all, opportunity. On the contemporary scene, this perspective enjoys support among various members of the United States Supreme Court, most notably Justice Antonin Scalia.[63]

The traditional understanding of property places great weight on property's place in American history, particularly in the late nineteenth century when the frontier conquest was complete and a market economy dominated.[64] For generations, landless poor from around the world came to America, gained land, and produced wealth. Although private property was always an important engine of growth in this land of opportunity, its full value was not recognized until the late nineteenth century. Before then, communities exercised substantial control over property, sometimes even taking land from people without paying for it.[65] By the late nineteenth century, when the post-Civil War amendments to the Constitution were comfortably on the books, private property as an institution had come into its maturity.[66] Fully developed, the norms of private ownership protected the individual land parcel as a discrete market commodity and as the indispensable site of domestic life and economic enterprise.[67] In that mature form, soon encrusted by tradition, private ownership gained protection in the Constitution, particularly in the due process clause of the Fourteenth Amendment.[68]

Like the libertarian narrative of autonomy, the traditional understanding of property sees human labor as a mechanism that brings value to land. Even vacant land, however, can have value by operation of market forces, and land speculation in this narrative is as honored and protected as physical toil.[69] Humans act most industriously when they stand to gain as individuals, and private ownership serves its function only so long as it provides adequate opportunities for people to labor and earn wealth.[70] To serve this function, land development must remain possible and economic expectations need protection.

Unlike the libertarian view, however, the traditional interpretation recognizes the reality and utility of human communities.[71] Because land-uses are not as autonomous as John Locke supposed and their effects spill over property boundaries, the community has the right to regulate an owner's rights and to change them over time, a function largely denied by the libertarian scheme. But such changes can only occur if property's traditional core functions are adequately preserved.[72]

The traditional understanding of private property&EMDASH;the "historical compact" as Justice Scalia would call it&EMDASH;protects particular core rights, including the right to build a home and otherwise labor on the land in time-honored ways.[73] Landowners have the right to exclude anyone from their property, as well as rights to reap the land's income and to transfer the land at will. The community has no legitimate interest in what the landowner does within the bounds of his own land. If he wants to ruin the soil, strip the trees, or destroy wildlife habitat, he is free to do so, as long as the harmful effects of his conduct do not traverse the all-important boundary.[74] What the community can rightly worry about are the impacts a landowner has on neighboring land and on the community as a whole, not just physical invasions of neighbors as in the libertarian vision of ownership,[75] but other land uses that clearly disrupt the public's health, safety, or welfare.[76]

This traditional interpretation appeared in several prominent Supreme Court decisions in the late 1980s and early 1990s, mostly written by Justice Scalia. The first prominent case arose out of California and involved a landowning couple, the Nollans, who sought a permit to rebuild their beachfront vacation cottage into a much larger, year-round home.[77] The California Coastal Commission, charged with protecting and enhancing the coastal zone for the common good, was willing to allow the construction, but only if the Nollans in return granted the public permission to walk along their beach, up to the high-tide line.[78] As the Supreme Court viewed it, however, this regulatory requirement cut too deeply into private property's core values, both the right to exclude and the right to build a structure as ordinary as a home.[79] Public access to the beach, the Court agreed, had become difficult. But the Nollans alone had not caused the problem, and the state could not insist that they and landowners like them solve it. If the public wanted better access, the public should pay for it.[80]

A second Supreme Court decision, also warmly received by conservative audiences, involved a land developer, David Lucas, who owned two vacant lots on a barrier island off the coast of South Carolina.[81] Other landowners on the island had built homes, and Lucas merely wanted to do the same.[82] But before he broke ground, the South Carolina legislature realized that construction on fragile barrier islands caused many problems and it imposed a ban on construction close to the water&EMDASH;a ban that covered David Lucas's lots.[83] As in the Nollans' case, the Supreme Court viewed the state law as the equivalent of a physical taking of Lucas's land.[84] The law, Justice Scalia announced, undercut Lucas's legitimate expectations.[85] As a landowner, he was entitled to make economic use of his land so long as he avoided doing anything traditionally considered harmful, and building a home was almost by definition not harmful. If the state wanted Lucas's land set aside as a nature preserve, it should buy the land from him.[86] As it went about resolving these cases, the Supreme Court was troubled by the prospect that a group of lawmakers could simply awaken one day and change all the rules of land ownership, with no compensation to those most affected.[87] That power, the Court seemed to say, posed too much of a threat to property's core entitlements.

The *Lucas* decision drew strong dissents from other members of the Supreme Court who were willing to give South Carolina's legislature greater leeway in balancing environmental goals against the benefits of secure development rights.[88] Over time, the dissenters pointed out, circumstances and values change.[89] Conduct once con sidered innocuous can be viewed as harmful, even building a house. Ecological effects once ignored or tolerated can become more worrisome. A legislature that allowed unwise development in the past, before ill effects became known, should not be hampered from changing its mind.

Given the limited room for changes in property law, this narrative of tradition reflects in weakened form the same distrust of democracy that characterizes the narrative of autonomy.[90] Humans are basically self-interested creatures, out to get what they want, and they will take advantage of other people unless barred from doing so. Aggression and deception are ways of taking advantage that need control. But government regulation is also a way for some people to take advantage of others, and it too needs control.[91] Regulations that do more than ban overt harm, that seek to promote some particular vision of the common good, are especially suspect. Lurk ing behind them is the prospect, if indeed not the certain reality, that some elite group is unfairly extracting wealth from some other group. The Constitution protects against this kind of theft, and it does so by enshrining a traditional image of ownership.

The particular virtue of this narrative of tradition is that it senses and respects the need for ordinary people to think that property has a settled, core content to it. Property would not likely serve its various functions—economic, civic, and personal—unless owners could rest easy in their thoughts that they possessed something the state could not simply seize, destroy, or redefine out of existence.[92] Of the various functions that property serves, economic development is perhaps the most important in this story. The tradition to which this narrative turns derives from an historical period, the late nineteenth century, when economic development was the prime national goal. Had this narrative instead looked to a different period in American history&EMDASH;to the first years of the nineteenth century, for instance&EMDASH;it would have uncovered a different property tradition; one more agrarian in its outlook, one that was more prepared to protect sensitive land uses when they were disrupted by the newer, intensive land uses of commerce and industry.[93]

In its embrace of a backward-looking vision, the narrative of tradition has a solid measure of conflict if not inconsistency within it. Private property here is a civil rather than a natural right, subject to the lawmaking powers, and its justification arises from the good consequences that it helps bring about in terms of economic growth. Yet to keep property stable and secure enough to give full confidence to investors, freeing them from their worst regulatory fears, is to sap some of the life out of the institution of private ownership. It is to withhold from the processes of government the power that government has long had to keep the institution in line with shifting social norms and values. Over time, one might guess, this tension would likely grow greater and greater, as the dominant culture continued to evolve and found itself bound to an increasingly dated and wooden ownership scheme.[94]

IV. PROPERTY AND THE EVOLVING COMMUNITY

The third narrative of property ownership, the narrative of social evolution, lacks any single author as conspicuous as Professor Epstein or Justice

Scalia. The elements of this narrative have come to characterize the work of many scholars in various academic disciplines. The narrative is also supported by community advocates and cultural critics from outside the academy, some concerned with environmental degradation, others with pervasive urban and social ills. Two legal scholars who belong comfortably with this group are Professors Joseph Sax of the University of California at Berkeley and Joseph Singer of Harvard University. Sax's concern lies with the land community, about which he has written with passion.[95] Singer's concern is with the human social community, particularly in its urban forms.[96] Despite their different emphases, they share a view of where private property comes from, why it exists, and how it changes over time.[97] One might also attach to this narrative, from outside the legal field, the pioneering wildlife manager and ethicist, Aldo Leopold, with the qualification that his important comments on private property covered only parts of this narrative. Leopold did not speak of the origins of property, but he did perceive it as a cultural creation, arising from people and subject to change by them as their ecological knowledge rose and their moral visions widened.[98]

The narrative of social evolution goes something like this: In the beginning was the social community, a collection of people living as a tribe or small settlement, linked by ties of blood and group identity. Over time, this community found it helpful to allocate property rights to individual community members, both for the good of the individuals involved and the good of the community as a whole. Sometimes property rights were limited to specific, temporary use interests—the right to farm in one place, or to hunt or fish in a given spot, or to use an area to collect firewood or forage for berries.[99] Other times the rights were more inclusive, lasting longer and including powers to transfer the thing owned. Sometimes property was made available as a reward or incentive for labor; other times it was allocated for unrelated reasons&EMDASH;to help people who were sick, to recognize differences in social status, and to promote group identity and survival. However private rights were defined and allocated, they were created by the community and lasted only so long as the community recognized their validity. In the case of land, private rights arose by transfer from the community, not by first occupancy or other private action.[100]

Private property in this narrative of social evolution is very much an organic institution, created by a people and subject to change by them over time.[101] Community interests are paramount, and the community alone decides what ownership entails. Proponents of this narrative embrace the study of history warmly, often noting how property norms have differed widely in time and space. What they derive from history is not a specific bundle of substantive property rights, as in the case of the narrative of tradition, but the overriding lessons of continuous normative change and community control.

Strong individual property rights are not inconsistent with this narrative of social evolution. A community might decide, for instance, that extensive individual rights promote economic activity and indirectly benefit the community at large. Yet the narrative recognizes also that property owners can act in ways contrary to the common good, sometimes by generating external harms, sometimes simply by deviating far from what the community needs at a given time. Thus, the benefits that come from secure property rights are subject to conflicting values and tradeoffs, and it is up to the community in the end to make those tradeoffs.[102] The only limit on community power comes from the takings and due process clauses that, in this narrative, protect landowners from being singled out for ill treatment, but do not insulate them from adverse changes in widely applicable laws.

When proponents of this evolutionary narrative look out onto the land, they are impressed more by the interconnection of the pieces than by their discreteness.[103] Land-use externalities are ubiquitous, with ripple effects that spread far and wide. Given these externalities, private land is always impressed with a public trust, a trust that can be demanding and confining in the case of lands that play critical roles in the functioning of surrounding communities.[104] To own land in such a landscape is to be charged with a duty to use it with restraint, tempering individual gain with due regard for the well being of the whole.

Many proponents of this narrative of social evolution embrace particular visions of what community health is all about, and they are passionate about their views. Yet, this narrative is not one in which experts or committed advocates have the power to dictate land-use rules, however lucidly they might perceive the public good. By granting substantial lawmaking power to the assembled commu nity, this evolutionary narrative rests its faith in the processes of democracy, in the prospect and possibility that people over time will elevate their ethical norms as Aldo Leopold predicted they would. Because the people are in charge in the long-term, public education becomes an important task for proponents of this narrative. Education is essential, along with an unending supply of hope.

Proponents of this tradition supply the sharpest critics of the narrative of autonomy and Professor Epstein's work.[105] One comment they make is that Epstein improperly lifts Locke's liberal vision out of its particular social context. Locke lived and worked at a time when a dominant, guiding moral order was presumed, and Locke himself had no thought of challenging it.[106] His focus on individual autonomy was meant as a corrective to the earlier, feudal age when the hierarchical structure held vast power and the individual counted for little. Locke proposed more of a balance, acknowledging the community's moral authority yet setting against it an emphasis on individual integrity. Today, it is the individual who has gained ascendance, particularly in the rhetoric of the day. To regain the kind of balance Locke had in mind, it is the common good that today needs more weight.

Critics complain with particular vehemence about the poor history that characterizes and weakens the narrative of autonomy.[107] Property, they note, is inherently a social institution, so much so that it is nonsense to speak of property in a pre-social era. For A to have rights against B, B must recognize them and respect them. But B is unlikely to do that without similar assurances from other people—without, that is, a collective agreement among people to respect one another's respective entitlements. As far as anthropologists can tell, humans have always lived in social groups; there never was a pre-social time.[108] If there ever were such a time, it surely had no private property in it.

When they turn to Justice Scalia's tradition-guided narrative, adherents of the social-evolution story are disturbed mostly by the seeming

inconsistency within it. Scalia's narrative accepts the historical reality that property is an evolving cultural institution. However, the community that counts in this narrative is not the community of people now living. It is the community of lawmaking people who lived late in the nineteenth century, people now long dead. But why trust those people, critics ask, and not people alive today? If people several generations ago could fairly balance the relative interests of individual and community, why not lawmakers of the present generation?

V. THE NARRATIVE OF NATURAL USE

The final ownership narrative, one based on the land's natural uses, has similarities with both the narrative of autonomy and the narrative of social evolution. Like the autonomy narrative it harbors great suspicion of democracy and seeks to ground ownership norms in durable values, protected against a misguided populace. Yet, like the narrative of social evolution it sees a landscape dominated by interdependent pieces, with property rights existing only to the extent consistent with the continued well being of the communal whole. In this story, the land is more than just a collection of abstract parcels, circumscribed by human-drawn boundaries. Instead, it is an intricately woven community of life, including the plants and animals that live alongside the resident humans. This land has value, apart from anything humans have done to it.

In the legal literature, this natural-use narrative found its classic expression a quarter-century ago in a relatively brief appellate decision by the Supreme Court of Wisconsin. The decision came in the now-celebrated case of *Just v. Marinette County*,[109] involving the validity of a then-novel regulation protecting sensitive wetlands. The legal issue before the court was a constitutional one—did the wetlands regulation affect the landowner's core property rights to such an extent that the community in fairness ought to compensate the landowner for the loss.[110] To get to that constitutional issue, however, the court first had to explain what it meant to own something like a wetland.

Early in its opinion, the Wisconsin court framed the relevant question as plainly as it could: "Is the ownership of a parcel of land so absolute," it queried, "that man can change its nature to suit any of his purposes?"[111] To this court, knowing what it did about the ecological roles of wetlands, the answer seemed clear:

> An owner of land has no absolute and unlimited right to change the essential natural character of his land so as to use it for a purpose for which it was unsuited in its natural state and which injures the rights of others. The exercise of the police power in zoning must be reasonable and we think it is not an unreasonable exercise of that power to prevent harm to public rights by limiting the use of private property to its natural uses.[112]

To own sensitive land like a wetland, the court announced, was to have the right merely to use land in "its natural state" and for its natural uses; it did not include the right to change the character of the land at the expense of harm to public rights.[113] Nature had its own norms of health, and set its own rules for how land might be used without disrupting that health.

This narrative of natural use is the simplest of all. Drawn from the declensionist Eden narrative, it goes like this: In the beginning was a healthy land—an Eden, rich and complex. People soon entered the picture, dividing the land into pieces and allocating those pieces to private owners. People did not know it at the time&EMDASH;and would not know it for generations&EMDASH;but the land-use rights they obtained were not as unlimited as they supposed. Nature had its own limits, and human-created property rights were conditioned by these limits. Nature, of course, had no courts of law to enforce these limits and no prosecuting attorneys to file suit. But it had powers, nonetheless, and potent ways to express its disappointment. When wetlands were drained, floods and droughts soon followed. When hillsides were plowed, nature reclaimed some of its topsoil. When bulldozers overturned wildlife habitat, the communal membership declined in number and variety.

In this natural-use narrative, the land itself is the lawgiver, supplier not of the details of individual ownership, but of the broad limits beyond which human owners may not wander. The paramount goal is community health, and the relevant community is the land itself. In its pure form—the form set forth in *Just v. Marinette County*&EMDASH;nature's limits constrain property rights pretty much without regard for whether lawmakers like it or not. Thus, like the narrative of autonomy, the narrative of natural use includes restraints on democratic processes&EMDASH;restraints in this case that arise directly from the land.

Just v. Marinette County remains a well-loved decision among committed environmentalists, but its pure version of natural property rights has not caught on. Even admirers of the decision realize that nature's ways are not so clear and predictable as to always distinguish good land uses from bad. Ecological processes are complex, and it is often hard to know what impacts a land-use change will have on surrounding lands and whether the change will or will not diminish land health. Beyond the nagging difficulties of scientific uncertainty there is discomfort with the idea that humans cannot make their own laws. To embrace nature itself as a source of rules, binding on lawmakers and without human interpretation, tinkers with much more than the law of private property: it alters the entire idea of sovereignty and public power. The natural-use perspective, therefore, needs revision to make it tolerable to the modern democratic mind. Nature's integrity can remain a bedrock value and limit. But humans must control the lawmaking process, interpreting the land scientifically and ethically and translating their conclusions and choices into new ownership norms.

VI. TOWARD A NEW NARRATIVE OF OWNING

The environmental movement has stumbled over the past decade in no small part because of clashes over property rights. As many people see it, laws protecting the environment threaten the core values of private property, and the threat seems to be growing. The story of America has been about economic opportunity, landowner independence, and private property—and environmentalism seems to threaten them all. It threatens, that is, the entire progressive narrative that has been so central to America's self-image. The Eden narrative of decline was acceptable so long as it

remained a minor, dissenting perspective on the American saga. But as a dominant perspective, it is simply too frustrating and misanthropic.

Despite recent Supreme Court decisions like *Nollan* and *Lucas*, the Constitution's protection of private property imposes only minor restraints on the power of governments to reshape property laws. Legally, states have considerable leeway in drafting land-use rules, banning activities deemed harmful and insisting that landowners fulfill newly imposed obligations. In other words, states have the power to adopt any of the four perspectives on private property and shape their property laws accordingly. Over the long run, their choices will be based on public sentiment and political power, which means states and local governments will embrace a more ecologically oriented view of property only when the public asks for it or at least stands willing to support it. Public sentiment, of course, is affected by many factors, including awareness of environmental problems and a willingness to change behaviors to alleviate them. But to many, property by its very nature is linked with freedom, opportunity, and progress, all at the heart of America's self identity; and when the law tinkers with ownership rights, it threatens these core values as well.

A central task in the promotion of land health will be the crafting of a new perspective on land ownership, and, surrounding that, a new perspective on the larger American enterprise. Hardly any conservation task is more important, and work on it has only begun. One environmental narrative of ownership is embedded in the work of the late Edward Abbey, a radical writer whose novels and essays inspired readers to rise up in anger at the land's degradation and to strike back, literally or figuratively, by dumping sugar in the gas-tank of the engine progress.[114] Abbey's narrative has serious flaws and is not likely to play more than a minor role in the promotion of land health. Yet it is instructive, nonetheless, and helps illustrate the task that lies ahead.

Abbey lived most of his adult life in the southwestern American desert. He had no thought that humans could improve his chosen home; people only degraded land, just like the Eden tale of decline described. But if Abbey did not embrace America's vision of endless progress, he latched on as firmly as anyone to its liberal individualism. Like Richard Epstein, Abbey was a libertarian, a firm believer in unyielding individual rights. And like Epstein, he endorsed a view of property in which the landowner's rights were stable and predictable over time. Where he disagreed with Epstein, parting widely from him in fact, was on the core element of individual liberty. For Abbey, liberty meant foremost the right to head to the wilds and become part of an unspoiled world, rather than any right to build skyscrapers or golf courses. A country was not fit to live in, Abbey proclaimed, "when a man must be afraid to drink freely from his country's rivers and streams."[115] For Abbey, clean water was as much a civil right as free speech.

In his peculiar way, Edward Abbey surpassed the zeal of Epstein and other political libertarians. Epstein's fear was the abuse of power by government; private power, he seemed to say, could be trusted, subject only to minimum restraints on aggression. Abbey, however, was skeptical of any form of concentrated power. To his mind, evolution and sabotage were the proper responses to corporate pollution and timber clear-cutting, as well as to political oppression. Abbey's radical vision translated readily into a vision of private land ownership. Landowners had secure private rights, to be sure, but they could not pollute the water or air, introduce exotic plants, or drive away the native wildlife. Nature set the baseline for ownership norms, just as it did in the natural-use view of property. Humans were part of the land, just like other animals, but they did not form harmonious social communities. Attached to the land, humans were largely detached from one another.

Abbey stood on the fringe of environmental thought because of his misanthropic views of society and his emphatic embrace of the Eden tale of decline. He was the frontiersman who set out, not to open up wild places so that waves of settlers could follow, but to find an isolated spot where he could live unmolested. Abbey's loner needed a full square mile to call his own to provide sufficient privacy and to buffer his impacts on the land. In a congested world, Abbey's vision simply was not realistic, and in his pragmatic moments Abbey knew it.

Clearly, constructing a new environmental narrative will not come easily. The task is daunting, for a new narrative needs to promote land health while at the same time respecting the individual, encouraging enterprise, and allowing for private rights in land. For such a story to succeed, it needs above all to be a tale of progress and hope.

Because environmentalists so often oppose development projects, they commonly assume a negative stance; they block progress as their critics see it, inhibiting hopes and dreams. In the new century, environmentalism needs to take on a more positive face, casting itself as a movement for the resettlement of America, this time in a mature, durable way. Environmentalism, that is, needs to embrace a narrative of progress, a tale in which humans mold the land in healthy ways, meeting their needs through means that are ethically and naturally sound. In addition, a new environmental narrative needs to emphasize the community much more than the traditional story does, not to the exclusion of the individual but as a vital entity that also deserves respect. Land-use rules would be viewed as expres sions of community values and expectations, as well as tools that the community uses to promote its goals and defend its well being.

But if a new environmental narrative is going to resonate with modern culture, it also needs to promote private property's privacy and civic aims, which means respecting the dignity and moral integrity of the individual landowner. Land-use laws can evolve, yet they need to change slowly enough so that property owners feel sufficiently secure. Ideally, change should occur so smoothly and continuously that most landowners are not disrupted by it and do not come to fear it.

Edward Abbey's work suggests another way in which an environmental narrative can respect the individual—by pointing out how a healthy land expands options for individuals, protecting them as individuals from unwanted pollution and degradation. Older liberal ideas offer a similar message—individuals gain power when they gather with neighbors in pursuit of collective goals. When a community has power to act, individuals gain new, collective ways to achieve their wants. Land-use rules issued by a community may indeed restrict a landowner's rights, but they also protect landowners, particularly those who depend on clean water, clean air, and abundant wildlife.

If a more environmental view is to prevail, however, certain fears must be addressed. One fear, providing fuel for libertarian ideas, is the fear of being excluded from decision-making processes. Another is the fear that changing laws will disrupt investments, expectations, and opportunities. Laws might become so unsettled and unpredictable that investments are no longer safe. To the excluded outsider, power vested in the community provides a danger, not a new opportunity to achieve collective goals.

The lesson here for environmental policy is plain enough: ordinary landowners and other citizens must be drawn into the processes by which land-use decisions are made. Broad-based participation can diminish fears of exclusion. At the same time, such participation can help landowners become more knowledgeable about environmental problems. And the more knowledgeable people are, the more likely they are to see land-use restrictions as legitimate responses to real problems, rather than as the corruption or dismantling of private rights.

In a more progressive environmental tale along these lines, private property can have an honored role. Property law can serve as an important if not indispensable tool for individuals and communities to use as they promote land health&EMDASH;listening to the land, tailoring their lives to a place, and settling in for the long term.

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[1] The visions and utopian dreams of American colonists provide an organizing focus in DANIEL J. BOORSTIN, THE AMERICANS: THE COLONIAL EXPERIENCE (1958). A classic study of Winthrop's mission is EDMUND S. MORGAN, THE PURITAN DILEMMA: THE STORY OF JOHN WINTHROP (1958). The search for meaning in the New World was part of the larger process of discovering the continent's nature, a process that has continued ever since in the form of an ongoing social conversation. As environmental historian Richard White notes, "Americans have defined themselves and their continent in terms of nature while quarreling over what nature contains and what it means." Richard White, *Discovering Nature in North America*, 79 J. AMER. HISTORY 874, 877 (1992). Return to text.

[2] Several widely differing Christian interpretations of the story are considered in ELAINE PAGELS, ADAM, EVE, AND THE SERPENT (1988). Return to text.

[3] *See* DONALD WORSTER, THE WEALTH OF NATURE 9-15 (1993); Carolyn Merchant, *Reinventing Eden: Western Culture as a Recovery Narrative*, *in* UNCOMMON GROUND: TOWARD REINVENTING NATURE 132, 154-56 (William Cronon ed., 1995) [hereinafter Merchant, *Reinventing Eden*]. My thinking about Eden narratives in the United States borrows heavily from the work of Professors Worster and Merchant; less directly it draws upon the three classic studies of LEO MARX, THE MACHINE IN THE GARDEN: TECHNOLOGY AND THE PASTORAL IDEAL IN AMERICA (1964), R.W.B. LEWIS, THE AMERICAN ADAM: INNOCENCE, TRAGEDY, AND TRADITION IN THE NINETEENTH CENTURY (1955), and HENRY NASH SMITH, VIRGIN LAND: THE AMERICAN WEST AS SYMBOL AND MYTH (1950). Return to text.

[4] *See* Merchant, *Reinventing Eden*, *supra* note 3, at 154; Carolyn Merchant, Paradise and Property: Locke's Narrative and the Transformation of Nature (1997) (unpublished manuscript, on file with author). Return to text.

[5] *See* Merchant, *Reinventing Eden*, *supra* note 3, at 140. Return to text.

[6] *See id.* Return to text.

[7] *See id.* Return to text.

[8] Three important works surveying and criticizing the dominance of Enlightenment thought are JOHN RALSON SAUL, VOLTAIRE'S BASTARDS: THE DICTATORSHIP OF REASON IN THE WEST (1992), DAVID EHRENFELD, THE ARROGANCE OF HUMANISM (1978), and WILLIAM LEISS, THE DOMINATION OF NATURE (1972). The American context is considered in HENRY F. MAY, THE ENLIGHTENMENT IN AMERICA (1976). Return to text.

[9] This trend is assessed in its larger context in CAROLYN MERCHANT, THE DEATH OF NATURE: WOMEN, ECOLOGY, & THE SCIENTIFIC REVOLUTION (1980). Return to text.

[10] *See* ALLAN KULIKOFF, THE AGRARIAN ORIGINS OF AMERICAN CAPITALISM (1992); J.E. CROWLEY, THIS SHEBA, SELF: THE CONCEPTUALIZATION OF ECONOMIC LIFE IN EIGHTEEN- CENTURY AMERICA (1974). Return to text.

[11] The classic study, focusing on Western culture, is KARL POLANYI, THE GREAT TRANSFORMATION: THE POLITICAL AND ECONOMIC ORIGINS OF OUR TIME (1944). The English context is considered in JOYCE APPLEBY, ECONOMIC THOUGHT AND IDEOLOGY IN SEVENTEENTH- CENTURY ENGLAND (1978). Appleby considers the rise of economic thought in the United States, and its growing ascendance over civic republican ideas, in various works including her CAPITALISM AND A NEW SOCIAL ORDER: THE REPUBLICAN VISION OF THE 1790S (1984) and LIBERALISM AND REPUBLICANISM IN THE HISTORICAL IMAGINATION (1992).

Implications for property rights are considered in Elizabeth V. Mensch, *The Colonial Origins of Liberal Property Rights*, 31 BUFF. L. REV. 635 (1982). Return to text.

[12] *See, e.g.*, WILLIAM B. SCOTT, IN PURSUIT OF HAPPINESS: AMERICAN CONCEPTIONS OF PROPERTY FROM THE SEVENTEENTH TO THE TWENTIETH CENTURY 36-70 (1977). Return to text.

[13] Locke's ideas of property are set forth principally in Chapter V of his Second Treatise of Government. *See* JOHN LOCKE, TWO TREATISES OF GOVERNMENT 303-20 (Peter Laslett, ed., Cambridge Univ. Press 1988) [hereinafter TWO TREATISES]. These ideas are assessed critically in LAWRENCE G. BECKER, PROPERTY RIGHTS: PHILOSOPHIC FOUNDATIONS 32-56 (1977); ALAN RYAN, PROPERTY AND POLITICAL THEORY 14-48 (1977); RICHARD SCHLATTER, PRIVATE PROPERTY: THE HISTORY OF AN IDEA 151-61 (Russell & Russell 1973). The omission of the right of property in the Declaration of Independence is considered in MORTON WHITE, THE PHILOSOPHY OF THE AMERICAN REVOLUTION 213-28 (1978).

Daniel Boorstin, in his study of Blackstone's commentaries and mid-eighteenth century English legal thought, notes that Locke's work was popular in England during the century, but only because theorists were able to read into it such conflicting interpretations. *See* DANIEL BOORSTIN, THE MYSTERIOUS SCIENCE OF THE LAW 168 (1941). "In the course of the [eighteenth] century, [Locke's theory] was many things to many men, and 'Locke' became the pseudonym for everyman's theory of property." *Id.* Return to text.

[14] *See* TWO TREATISES, *supra* note 13, at 304-06. Return to text.

[15] *See id.* at 311. Return to text.

[16] *See id.* at 314. Return to text.

[17] *See* Merchant, *Reinventing Eden*, *supra* note 3; Merchant, Paradise and Property: Locke's Narrative and the Transformation of Nature, *supra* note 4. Return to text.

[18] *See* Merchant, *Reinventing Eden*, *supra* note 3, at 142. Return to text.

[19] Principally in his NOTES ON THE STATE OF VIRGINIA (William Peden ed., North Carolina Press 1955). Jefferson's work is often considered from different angles. *See, e.g.*, RODERICK NASH, WILDERNESS AND THE AMERICAN MIND ch. 4 (3d ed. 1982) (as a defense of perfection of American nature); MARX, *supra* note 3, 116-44 (as a pastoral ideal). Return to text.

[20] *See* LAWRENCE BUELL, THE ENVIRONMENTAL IMAGINATION *passim* (1995); NASH, *supra* note 19, at 67-107; MAX OELSCHLAEGER, THE IDEA OF WILDERNESS 133-71 (1991); MARX, *supra* note 3; LEWIS, *supra* note 3; DONALD WORSTER, NATURE'S ECONOMY: A HISTORY OF ECOLOGICAL IDEAS 59-111 (2d ed. 1994); ROBERT KUHN MCGREGOR, A WIDER VIEW OF THE UNIVERSE: HENRY THOREAU'S STUDY OF NATURE (1997). Return to text.

[21] *See* NASH, *supra* note 19, at 147. Return to text.

[22] *See id.* at 147-48. Return to text.

[23] *See* JACK LONDON, THE CALL OF THE WILD (1903). Return to text.

[24] *See* EDGAR RICE BURROUGHS, TARZAN OF THE APES (1914). Return to text.

[25] *See id.* at 122-60; OELSCHLAEGER, *supra* note 20, at 172-204. Return to text.

[26] *See* NASH, *supra* note 19, at 129. Return to text.

[27] The classic study is SAMUEL P. HAYS, CONSERVATION AND THE GOSPEL OF EFFICIENCY: THE PROGRESSIVE CONSERVATION MOVEMENT 1890-1920 (1959). Return to text.

[28] Some of the debates are considered in GREGORY S. ALEXANDER, COMMODITY & PROPRIETY: COMPETING VISIONS OF PROPERTY IN AMERICAN LEGAL THOUGHT 1776-1970 (1997); SCOTT, *supra* note 12; William Weston Fisher III, The Law of the Land: An Intellectual History of American Property Doctrine, 1776-1880 (1991) (unpublished Ph.D. dissertation, Harvard University) (on file with the Harvard University Library).

Useful considerations of the role of narratives in debates over private property include Gregory S. Alexander, *Takings, Narratives, and Power*, 88 COLUM. L. REV. 1752 (1988); Carol M. Rose, *Property as Storytelling: Perspectives from Game Theory, Narrative Theory, Feminist Theory*, 2 YALE J. L. & HUMAN. 37, 48-53 (1990); Myrl Duncan, *Property as a Public Conversation, Not a Lockean Soliloquy: A Role for Intellectual and Legal History in Takings Analysis*, 26 ENVTL. L. 1095 (1996); Marc R. Poirer, *Property, Environment, Community*, 12 J. ENVTL. L. & LITIG. 43 (1997). Return to text.

[29] The "wise use" movement, arising in the mid-1990's, is critically considered in *John Echeverria & Raymond Booth Eby, Let the People Judge: Wise Use and the Private Property Rights Movement* (1995). Return to text.

[30] Now the leading assessment is ALEXANDER, *supra* note 28. Two thoughtful considerations are Duncan, *supra* note 28, and Poirer, *supra* note 28. Return to text.

[31] The classic consideration is LOUIS HARTZ, THE LIBERAL TRADITION IN AMERICA (1955). A summary of liberalism today as a public philosophy is set forth in MICHAEL J. SANDEL, DEMOCRACY'S DISCONTENT: AMERICA IN SEARCH OF A PUBLIC PHILOSOPHY 4-7 (1996). In the context of property rights, a useful consideration is Margaret J. Radin, *The Liberal Conception of Property: Cross Currents in the Jurisprudence of Takings*, 88 COLUM. L. REV. 1667 (1988) (sum marizing liberalism in the context of property rights). Return to text.

[32] I define liberalism as historian Lance Banning did in a useful comparison of liberal and classical republican thought:

> *Liberalism* is a label most would use for a political philosophy that regards man as possessed of inherent individual rights and the state as existing to protect these rights . . . A full-blown, modern liberalism, . . . posits a society of equal individuals who are motivated principally if not exclusively by their passions or self-interest; it identifies a proper government as one existing to protect these individuals' inherent rights and private pursuits. . . . Liberalism, thus defined, is comfortable with economic man, with the individual who is intent on maximizing private satisfactions and who needs to do no more in order to serve the general good.

Lance Banning, *Jefferson Ideology Revisited: Liberal and Classical Ideas in the New American Republic*, XLIII WM. & MARY Q. (3d ser.) 3, 11-12 (1986) (emphasis in original). I do not mean to suggest that this version exhausts the possibilities of liberalism in the promotion of communal goals and values, or that it is true to liberalism's historical roots in an accepted moral order. A thoughtful assessment of liberalism's intellectual past is Thomas A. Spragens, Jr., *Communitarian Liberalism, in* NEW COMMUNITARIAN THINKING: PERSONS, VIRTUES, INSTITUTIONS, AND COMMUNITIES 37 (Amitai Etzioni ed., 1995); a more extended consideration is JOHN P. DIGGINS, THE LOST SOUL OF AMERICAN POLITICS: VIRTUE, SELF- INTEREST AND THE FOUNDATIONS OF LIBERALISM (1984). A defense of liberalism against the charge of excessive individualism is presented in WILL KYMLICKA, LIBERALISM, COMMUNITY AND CULTURE (1989). Civic republicanism's appeal as an alternative to liberalism as thus defined is considered in G. Edward White, *Reflections on the "Republican Revival": Interdisciplinary Scholarship in the Legal Academy*, 6 YALE J.L. & HUMAN. 1 (1994). Return to text.

[33] *See* RICHARD A. EPSTEIN, TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN (1985) [hereinafter EPSTEIN, TAKINGS]. The following discussion of Epstein's thinking draws upon this major work as well as many of his articles, including *A Clear View of The Cathedral: The Dominance of Property Rules*, 106 YALE L. J. 2091 (1997); *Some Doubts on Constitutional Indeterminacy*, 19 HARV. J. L. & PUB. POL'Y 363 (1996); *A Conceptual Approach to Zoning: What's Wrong with* Euclid, 5 N.Y.U. ENVTL. L. J. 277 (1996); *History Lean: The Reconciliation of Private Property and Representative Government*, 95 COLUM. L. REV. 591 (1995); Lucas v. South Carolina Coastal Council: *A Tangled Web of Expectations*, 45 STAN. L. REV. 1369 (1993); *Property as a Fundamental Civil Right*, 29 CAL. WEST. L. REV. 187 (1992); *Regulation-and Contract-in Environmental Law*, 93 W. VA. L. REV. 859 (1991); *Takings: Descent and Resurrection*, 1987 SUP. CT. REV. 1. Return to text.

[34] *See generally* EPSTEIN, TAKINGS, *supra* note 33. Return to text.

[35] *See id.* at 35-36. Return to text.

[36] *See id.* at 112-25. Return to text.

[37] *See id.* at 121. Return to text.

[38] *See id.* at 121-25. Return to text.

[39] *See id.* Return to text.

[40] *See id.* at 123. Return to text.

[41] *See id.* at 121-23. Return to text.

[42] *See id.* at 7-18. Return to text.

[43] *See id.* at 10. Return to text.

[44] *See id.* at 10-15. Return to text.

[45] *See id.* Return to text.

[46] *See id.* at 13. Return to text.

[47] *See id.* at 14-15. Return to text.

[48] *See id.* at 10. In deleting God from Locke's story, Epstein noted only that the divine gift created problems because it resulted in the communal ownership of property. He does not note that God's role in Locke's story brought along with it an entire moral order that undergirded and gave shape to the individual's role in society. As Thomas Spragens notes,

> From its outset, liberalism has embraced individualism, in the sense that it prized autonomy and demanded compelling warrant for any governmental restriction of individual freedom. But the individual in Locke, Mill, Adam Smith, and Condorcet enjoyed his or her freedom only within the context of complementary obligations, deriving from communal attachments and responsibilities, from the restraints of a valid moral order, and from the force of human sympathy. No early liberal would have ever defended the buccaneer individualism of a Herbert Spencer or ever even conceived of an individual like Sartre's Orestes, who finds "nothing left in heaven, no right or wrong, or anyone to give me orders" and concludes that he is to live by "no other law but mine."

Spragens, *supra* note 32, at 43 (citation omitted). The divine role in Locke's world view included the sense that humans belonged to God and, as landowners, were subject to the obligations of responsible stewardship. *See id.* at 40. Return to text.

[49] *See* EPSTEIN, TAKINGS, *supra* note 33, at 10-11. Return to text.

[50] Epstein's objections to the labor theory address this issue only tangentially, but it is, I believe, implicit in his comments. His most extended treatment of the labor theory appears in his defense of first possession. *See generally* Richard A. Epstein, *Possession as the Root of Title*, 13 GA. L. REV. 1221 (1979). In the course of discussing the classic case of *Pierson v. Post*, 3 Cai. R. 175 (N.Y. 1805), dealing with the capture of an unowned fox, Epstein criticizes the dissenting judge's position because (according to Epstein) it sought to protect the original hunter's labor invested in the hunt; the majority opinion, which Epstein favors, gave the fox to the party who actually took possession of it, without regard to labor expended—a clearer, easier rule to apply. *See* Epstein, *Possession as the Root of Title*, at 1224-25. Epstein points to various difficulties that arise in attempting to protect the value of a person's labor in various settings; though the particular hypotheticals he presents do not principally deal with the challenge of calculating the value of that labor.

My guess is that Epstein avoids dealing with the issue more directly because of the difficulty that it poses. In Locke's theory, as he recognizes, labor gave rise to property rights only when a thing was so plentiful that it had essentially no value. When a thing did have value, the labor logically would give rise at most to a lien for the value of the labor itself (although Locke did not deal with this factual possibility). *See id.* at 1226. Had Epstein pursued this point, however, he likely would have recognized that labor that trivially improves an item's value—for instance, picking up a book off the floor that the true owner has dropped—cannot reasonably give rise to any claim of a lien for value added. Particularly in the case of land, a person who merely takes possession typically adds no appreciable value to the land, and would hence acquire no property right in the land under a scheme that ignored *de minimus* additions to value. Epstein might have openly defended a claim that minimal labor was enough to create a property right, but in doing so he would have highlighted how far he had deviated from Locke's natural-rights justification for property, in which the protection of labor was a *sine qua non* element. On the other hand, Epstein does claim at one point, without elaboration and in apparent contradiction to his other statements, that "possession does not come without an expenditure of resources." *See* EPSTEIN, TAKINGS, *supra* note 33, at 61. "Think what would happen," he asks, "if the rule were the first one to look at property could claim to be its owner." *Id.* Yet we are left to wonder what further steps are involved in taking first possession of property (staking boundaries? fencing? excluding others?). Moreover, Epstein seems to agree that government can claim ownership of entire regions of land based on first possession, and to grant valid titles to the land, before anyone has ever even looked at the land. *See* Epstein, *Possession as the Root of Title*, *supra*, at 1242 n.27.

Though Epstein presumably understood full well the importance of labor in Locke's natural-rights reasoning, he does make occasional statements that suggest otherwise. *See, e.g., id.* at 1227 (noting labor theory intended merely "to aid the theory that possession is the root of title"). Return to text.

[51] EPSTEIN, TAKINGS, *supra* note 33, at 11. Return to text.

[52] *See id.* Return to text.

[53] *See id.* at 5. Epstein's initially grounds his argument in natural rights reasoning. "The political tradition in which I operate, and to which the takings clause itself is bound, rests upon a theory of 'natural rights.'" *Id.* "The question of governance is how the natural rights over labor and property can be preserved in form and enhanced in value by the exercise of political power." *Id.* at 3. Return to text.

[54] *See id.* at 217. Epstein's earlier "qualified defense" of first possession, *id.* at 1238-43, is couched in utilitarian terms, and his criticisms of Locke's theory would seem logically to undercut any labor-related theory of natural rights in property. In TAKINGS, however, he expressly notes that "one is loathe to adopt a theory of individual rights that rests solely upon the shifting sands of utilitarian calculation." *Id.* at 335. Return to text.

[55] *See id.* at 11. "What is lost to late-comers from the world of acquisition is provided for in the world of trade and commerce for the betterment of those who did not acquire anything from the original commons." *Id.* Return to text.

[56] *Id.* at 10 ("a Lockean, like myself . . ."). *See also* Duncan, *supra* note 28 (usefully critiquing this larger Lockean tradition). Return to text.

[57] *See* TWO TREATISES, *supra* note 13, at 308-09. Return to text.

[58] *See, e.g.*, Richard A. Epstein, *The Static Conception of the Common Law*, 9 J. LEGAL STUD. 253, 258 (1980); EPSTEIN, TAKINGS, *supra* note 33, at 24-30, 60-61. Return to text.

[59] Epstein pays homage to "the classical common law" throughout his book. EPSTEIN, TAKINGS, *supra* note 33, at vii *passim.* Return to text.

[60] *See* Epstein, *The Static Conception of the Common Law*, *supra* note 58, at 258. Return to text.

[61] Epstein presents his evaluation of competing risks in *supra* note 50, at 1239 (because of dangers of "extensive and continuous state control," it is "[b]etter to begin with a system that places wealth in private hands"). Return to text.

[62] *See, e.g.*, EPSTEIN, TAKINGS, *supra* note 33, at *ix* ("Statements about groups of individuals must be translated into statements about individuals."), 13 ("Every transaction between the state and the individual can thus be understood as a transaction between private individuals, some of whom have the mantle of sovereignty while others do not."). Return to text.

[63] Fred Bosselman usefully considers Justice Scalia's writings on property in FRED BOSSELMAN, *Scalia on Land*, *in* AFTER *LUCAS*: LAND USE REGULATION AND THE TAKING OF PROPERTY WITHOUT COMPENSATION 82 (David Callies ed., 1993) and in *Four Land Ethics: Order*, *Reform*, *Responsibility*, *Opportunity*, 24 ENVTL. L. 1439 (1994) [hereinafter Bosselman, *Four Land Ethics*]. My comments on Justice Scalia borrow extensively from Professor Bosselman's work. Return to text.

[64] *See* Bosselman, *Four Land Ethics*, *supra* note 63, at 1500 n.255. Return to text.

[65] *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1028 n.15 (1992). Return to text.

[66] *See id.* Return to text.

[67] *See id.* at 1019 n.8 ("our prior takings cases evince an abiding concern for the productive use of, and economic investment in, land."). Return to text.

[68] *See* U.S. CONST. amend. XIV, § 1. Return to text.

[69] *See, e.g.*, *Lucas*, 505 U.S. at 1030-32 (protecting expectations of owner of vacant land). Return to text.

[70] *See* Bosselman, *Four Land Ethics*, *supra* note 63, at 1485-1506 (discussing the importance to Scalia of preserving economic opportunities). Return to text.

[71] *See* Bosselman, *Four Land Ethics*, *supra* note 63, at 1501 & n.256 (contrasting Justice Scalia's tradition-focused thought with libertarianism). Return to text.

[72] *See Lucas*, 505 U.S. at 1029 (restricting state power in total-deprivation cases to "background principles" of property law). Return to text.

[73] *See Lucas*, 505 U.S. at 1028; Nollan v. California Coastal Comm'n, 483 U.S. 825, 833 n.2 (1987) ("the right to build on one's own property . . . cannot remotely be described as a 'governmental benefit.'"). Dissenting in *Lucas*, Justice Blackmun took strong issue with Justice Scalia's history. *See Lucas*, 505 U.S. at 1055-56 (Blackmun, J., dissenting) ("It is not clear from the Court's opinion where our 'historical compact' or 'citizen's understanding' comes from, but it does not appear to be history."). Return to text.

[74] *See id.* at 1030-31 (takings inquiry should focus on "the degree of harm to public lands and resources, or adjacent private property posed by the claimant's proposed activities"); Babbitt v. Sweet Home Chapter, 515 U.S. 687, 714 (1995) (Scalia, J., dissenting) (opposing regulatory measures to protect endangered species wildlife habitat on private lands). Return to text.

[75] *See e.g.*, EPSTEIN, TAKINGS, *supra* note 33, at 120. Return to text.

[76] *See* Bosselman, *Four Land Ethics*, *supra* note 63, at 1503-05 & nn.266-68. Return to text.

[77] *See Nollan*, 483 U.S. at 828. Return to text.

[78] *See id.* at 827. Return to text.

[79] *See id.* at 831. Return to text.

[80] *See id.* at 841. Return to text.

[81] *See Lucas*, 505 U.S. at 1006-07. Return to text.

[82] *See id*. at 1007-08. Return to text.

[83] *See id.* Return to text.

[84] *See id.* at 1029-30. Return to text.

[85] *See id.* at 1034. Return to text.

[86] *See id.* at 1030. Return to text.

[87] *See id.* at 1018-19. Return to text.

[88] *See id.* at 1036 (Blackmun, J., dissenting), 1061 (Stevens, J., dissenting). Return to text.

[89] *See id.* at 1070-71 (Stevens, J., dissenting). Return to text.

[90] *See, e.g., id.* at 1018 (fear that legislature would press private property "into some form of public service under the guise of mitigating serious public harm"), 1028 n.14 (possibility of legislation "plundering landowners generally"); Stevens v. City of Cannon Beach, 505 U.S. 1207 (1994) (displaying deep distrust of state common law courts). Return to text.

[91] *See Lucas*, 505 U.S. at 1018. This fear runs throughout Justice Scalia's opinions, particularly in *Babbitt*, *Cannon*, *Lucas*, and *Nollan*. Return to text.

[92] Laura S. Underkuffler-Freund usefully considers this need, in real and symbolic terms, in *Takings and the Nature of Property*, 9 CAND. J. L. & JURIS. 161 (1996). Return to text.

[93] In his *Lucas* dissent, Justice Blackmun draws upon historical sources from earlier periods, including the late eighteenth century. *See Lucas* 505 U.S. at 1055-60. The early nineteenth century experience is considered in WILLIAM J. NOVAK, THE PEOPLE'S WELFARE: LAW & REGULATION IN NINETEENTH CENTURY AMERICA (1996); the early regulatory tradition is surveyed in John F. Hart, *Colonial Land Use Law and Its Significance for Modern Takings Doctrine*, 109 HARV. L. REV. 1252 (1996). Even Justice Scalia's focus on the late nineteenth century is skewed by its underappreciation of the continuing vibrancy of legal doctrines promoting the common good. Those doctrines are considered in Harry N. Scheiber, *Public Rights and the Rule of Law in American Legal History*, 72 CAL. L. REV. 217 (1984). Return to text.

[94] Justice Stevens raised this prospect in his *Lucas* dissent ("The Court's holding today effectively freezes the State's common law, denying the legislature much of its traditional power to revise the law governing the rights and uses of property."). *See Lucas*, 505 U.S. at 1068-69. Return to text.

[95] Recent relevant writings by Professor Sax include *The Ecosystem Approach: New Departures for Land and Water*, 24 ECOLOGY L. Q. 883 (1997); *Using Property Rights to Attack Environmental Protection*, 14 PACE ENVTL. L. REV. 1 (1996); *Takings Legislation: Where It Stands and What is Next*, 23 ECOLOGY L. Q. 509 (1996); *Understanding Transfers: Community Rights and the Privatization of Water*, 1 WEST-N.W. 13 (1994); *Property Rights and the Economy of Nature: Understanding Lucas v. South Carolina Coastal Council*, 45 STAN. L. REV. 1433 (1993). Useful earlier reviews of Richard Epstein's work by Professor Sax include *Takings*, 53 U. CHI. L. REV. 279 (1986) and *Some Thoughts on the Decline of Private Property*, 58 WASH. L. REV. 481 (1983). Return to text.

[96] Joseph Singer's relevant recent works include his PROPERTY LAW: RULES POLICIES, AND PRACTICES (2d ed. 1997); *No Right to Exclude: Public Accommodations and Private Property*, 90 NW. U. L. REV. 1283 (1996); *The Social Origins of Property* (with Jack M. Beerman), 6 CAN. J. L. & JURIS. 217, 228 (1993) [hereinafter Singer, *The Social Origins*]; *Sovereignty and Property*, 86 NW. U. L. REV. 1 (1991); *The Reliance Interest in Property*, 40 STAN. L. REV. 611, 653 (1988). Return to text.

[97] Among the many useful contributions to this perspective are Lynda L. Butler, *Private Land Use, Changing Public Values, and Notions of Relativity*, 1992 BYU L. REV. 629; T. Nicolaus Tideman, *Takings, Moral Evolution, and Justice*, 88 COLUM. L. REV. 1714 (1988); Duncan, *supra* note 28, at 1129; Poirer, *supra* note 28, at 66. Return to text.

[98] Leopold's comments on ownership principally appear in his A SAND COUNTY ALMANAC AND SKETCHES HERE AND THERE (1949) and *Round River, in* THE RIVER OF THE MOTHER GOD AND OTHER ESSAYS (1953); some of his most mature comments, however, appear in inaccessible essays and letters. Although Leopold's ideas are ably surveyed in Curt Meine's biography, ALDO LEOPOLD: HIS LIFE AND WORK (1988), his evolving understandings of private property rights await a more extended and focused treatment. Return to text.

[99] One illustration is presented in WILLIAM CRONON, CHANGES IN THE LAND: INDIANS, COLONISTS, AND THE ECOLOGY OF NEW ENGLAND (1983). Return to text.

[100] *See* Singer, *The Social Origins*, *supra* note 96, at 229. Return to text.

[101] *See id.* at 228 ("Because property is socially and politically constructed, the scope of property rights changes over time as social conditions and relationships change."). Return to text.

[102] *See id.* ("The police power embodies the community's ability to regulate and alter the scope of entitlements over time as their social meaning changes. This power to change the scope of property rights is necessary to *preserve* their social function."). Return to text.

[103] *See, e.g.*, Joseph Sax, *The Ecosystem Approach*, *supra* note 95. The interdependence of land uses has been a particular theme of evolutionary writers focused on ecological issues. A fine introduction to that growing body of scholarship is Terry W. Frazier, *The Green Alternative to Classical Liberal Property Theory*, 20 VT. L. REV. 299 (1995). Return to text.

[104] The public trust idea has been a recurring subject of interest for Professor Sax since his early influential work on the subject. *See, e.g.*, Joseph Sax, *Liberating the Public Trust Doctrine from Its Historical Shackles*, 14 U.C. DAVIS L. REV. 185 (1980); Joseph Sax, *The Public Trust Doctrine in Natural Resources Law: Effective Judicial Intervention*, 68 MICH. L. REV. 471 (1970). Return to text.

[105] *See, e.g.*, Joseph Sax, *Takings Legislation: Where It Stands and What Is Next*, *supra* note 69; Joseph Singer, *The Social Origins*, *supra* note 96. Return to text.

[106] *See* note 13, *supra*; Michael Walzer, *The Communitarian Critique of Liberalism*, *in* NEW COMMUNITARIAN THINKING: PERSONS, VIRTUES, INSTITUTIONS, AND COMMUNITIES 52 (Amitai Etzioni ed., 1995). Return to text.

[107] *See* Duncan, *supra* note 28, at 1137; Hart, *supra* note 93, at 1281; Louise O. Halper, *Why the Nuisance Knot Can't Undo the Takings Muddle*, 28 IND. L. REV. 329 (1995); Martin S. Flaherty, *History "Lite" in Modern American Constitutionalism*, 95 COLUM. L. REV. 523 (1995); James M. McElfish Jr., *Property Rights, Property Roots: Rediscovering the Basis for Legal Protection of the Environment*, 24 E.L.R. (NEWS & ANALYSIS) 10231 (1994); John A Humbach, *Evolving Thresholds of Nuisance and the Takings Clause*, 18 COLUM. J. ENVTL. L. 1 (1993); Harry N. Scheiber, *The Jurisprudence-and Mythology-of Eminent Domain in American Legal History*, *in* LIBERTY, PROPERTY, AND GOVERNMENT (Ellen Frankel Paul & Howard Dickman eds., 1989); Thomas C. Grey, *The Malthusian Constitution*, 41 U. MIAMI L. REV. 21 (1986). Return to text.

[108] *See* Carol M. Rose, *Property as the Keystone Right?*, 71 NOTRE DAME L. REV. 329, 363 (1996) ("Virtually all peoples of whom we have any knowledge have invented property regimes for themselves in order to manage the resources they find important." (citations omitted)); Francis S. Philbrick, *Changing Conceptions of Property in Law*, 86 U. PA. L. REV. 691, 692 (1938) ("Wherever man is found, we find both individual ownership and ownership by family groups, large or small, and other associations; with rarer instances of what appears to be true community ownership of particular things."). Return to text.

[109] *See* Just v. Marinette County, 201 N.W.2d 761 (1972), *cited in* EPSTEIN, TAKINGS, *supra* note 33, at 123; *Lucas*, 505 U.S. at 1059 (Blackmun, J., dissenting). Return to text.

[110] *See Just*, 201 N.W.2d at 767. Return to text.

[111] *See Just*, 201 N.W.2d at 768. Return to text.

[112] *Id.* Return to text.

[113] *Id.* Return to text.

[114] No full study of Abbey's thought yet exists. His life is recounted in JAMES BISHOP, JR., EPITAPH FOR A DESERT ANARCHIST: THE LIFE AND LEGACY OF EDWARD ABBEY (1994). Much of Abbey's work is considered in ANN RONALD, THE NEW WEST OF EDWARD ABBEY (1982). Return to text.

[115] EDWARD ABBEY, DESERT SOLITAIRE: A SEASON IN THE WILDERNESS 185 (Ballantine ed. 1971). Return to text.

EMF AT HOME: THE NATIONAL RESEARCH COUNCIL REPORT ON THE HEALTH EFFECTS OF ELECTRIC AND MAGNETIC FIELDS

PATSY W. THOMLEY[*]

I. INTRODUCTION

The quality of life of a country's citizens is most significantly indicated by the country's energy per capita consumption, which is directly proportional to a country's gross national product.[1] The United States is one of the leading consumers of energy with electrical energy making up thirty-six percent of all energy consump tion.[2] Therefore, electrical energy contributes greatly to the quality of life of the citizens of the United States.

Electrical energy provides benefits and conveniences that society now deems necessities. These benefits and conveniences range from the ability to read a book or newspaper after dark on a sultry summer evening, while being cooled by an electrically powered air conditioner to the ability to have a life-threatening tumor diagnosed by magnetic resonance imaging (MRI). Without question, electrical energy is one of the "good" resources contributing to modern life and one on which society now depends. Certainly from the time Benjamin Franklin discovered electricity, the public has been aware of the danger of death or injury upon contact with electrical power. In the seventies, concern arose about the possible ill effects caused by invisible emanations from electrical wires and appliances, consisting of electric and magnetic fields, generally referred to as "electromagnetic fields" or "EMF."[3]

Electric and magnetic fields exist wherever electricity is present. Some scientists, especially epidemiologists, suggest that electric and magnetic fields may cause adverse health effects such as brain cancer, childhood leukemia, testicular cancer, birth defects, and mis carriages.[4] Other scientists disagree with the conclusion that electric and magnetic fields can cause adverse health effects. [5] The press has emphasized the suggestions of harm to health in recent years, causing a public fear of electromagnetic fields.[6] The perception that EMF can cause cancer or otherwise harm health has in some cases affected property values,[7] influenced some governmental bodies to adopt land use rules and regulations affecting power line siting,[8] caused landowners to protest power line siting,[9] and spawned personal injury tort litigation.[10]

In response to public perception and concern, the United States Congress passed the Energy Policy Act of 1992,[11] which established an electric and magnetic fields research and public information dis semination program. In addition to dissemination of information, this program determines whether the electric and magnetic fields produced by using electrical energy affect human health and conducting research to mitigate any potential adverse health effects.[12] The legislation provided that the United States Department of Energy (DOE) would be the agency responsible for electric and magnetic field research and directed the Secretary of Energy to arrange for the National Research Council of the National Academy of Sciences[13] to review and evaluate the research on possible health effects of electric and magnetic fields.[14] In late 1996,[15] the National Research Council reported the conclusion "that the current body of evidence does not show that exposure to these fields presents a human-health hazard."[16]

Part II of this article presents the effect that the controversy surrounding electric and magnetic fields has had on public perception along with some of the concomitant effects on property evaluation, land use, and tort litigation. Part III explains electric and magnetic fields. Part IV summarizes the National Research Council Committee's report of its conclusions after prolonged study of the available acceptable research[17] and the Conclusion, Part V, speculates on the likely effect of the National Research Council Committee's report on public perception.

II. SOME EFFECTS OF THE PUBLIC PERCEPTION OF HARM

When reports of suspected harmful health effects caused by exposure to electric and magnetic fields began to reach the public, the public's concern and fear impacted at least three areas of law. In the area of land valuations, public concern provided a reason for the devaluation of property located near power lines.[18] In the area of land use, public concern influenced some governmental bodies to adopt land use rules and regulations affecting power line siting and caused

neighboring landowners to protest power line siting.[19] In the area of litigation, concern about the health effect of EMF radiation generated some tort litigation.[20]

A. Land Evaluation

Issues concerning the effect of power lines located on or near an owner's property arise when an electric utility attempts to acquire property rights in the land on which it intends to place a power line.[21] A utility may negotiate with the landowner to purchase the property right, either in fee simple or as an easement.[22] If the landowner refuses to negotiate or a price cannot be agreed upon, the utility can exercise the power of eminent domain in a condemnation action.[23]

The exercise of the right of eminent domain requires that just compensation be given for the property taken.[24] The determination of just compensation for the condemned property usually involves computing damages in the amount of compensation for the land actually taken and severance damages, which are those damages caused by a reduction in the value of the remaining property when the condemned property is severed.[25] The measure of damages for the property actually condemned is the fair market value of that property.[26] Since severance damages are based on the reduction in market value caused by the severance, evidence of factors effecting that reduction is relevant and admissible.[27]

When fear of harm caused by exposure to electric and magnetic fields emanating from power lines became widespread, landowners, in an effort to increase severance damages,[28] began to introduce evidence in condemnation cases relating to EMF and the fear of exposure to EMF.[29] Courts required expert testimony regarding biological effects of electric and magnetic fields,[30] and expert or non-expert evidence of the public fear. Evidence of personal fear was inadmissible.[31] One court excluded evidence of harmful effects of power lines because the landowner's proposed experts "could not testify within the reasonable degree of probability necessary to express an opinion concerning the actual physical effects of electromag netic field exposure on humans."[32] Other courts have excluded expert testimony regarding public fear of power lines because the witness failed to quantify any damage to the fair market value of the remaining property,[33] or to show how to calculate with reasonable certainty the effect of the public fear on the market value of the remaining property.[34] Another court found that issues concerning alleged health hazards created by the construction and operation of electric power transmission lines necessitated an action's dismissal because such issues should have been determined by the regulatory agency.[35]

An important case involving a jury's decision after hearing evidence on the fear of electromagnetic fields and the effect of EMF on property that had been condemned for the construction of high-voltage transmission lines is *Houston Lighting & Power Co. v. Klein Independent School District*.[36] Following the utility's condemnation of a strip of land owned by the school district, the school district was awarded $78,604 by the Public Utilities Commission (PUC).[37] The school district then filed objections with the trial court.[38] The utility deposited $78,604 with the court, took possession of the strip of land, and constructed the transmission lines, which were energized in 1984.[39] The school district's pleadings alleged that the callous deci sion to locate the line on the school property, disregarding the safety and health of the school children, made the condemnation void.[40]

At trial, several experts testified for the school district. An engineering professor testified that the children in the intermediate school located 300 feet from the transmission line were being exposed to magnetic fields between six and ten milligauss.[41] An epidemiologist testified about the studies she and other epidemiologists conducted that showed correlation between cancer and power lines.[42] She concluded that the children in the schools were at increased risk of cancer because of the electromagnetic fields.[43] An oncologist testified similarly.[44] A pharmacology department chairman testified that because the electromagnetic fields were not obstructed by buildings or anything else, the children would be exposed to them daily.[45] Testifying for the utility was an expert who critiqued the school district's expert studies.[46]

The jury awarded the school district $104,275 actual damages and $25 million punitive damages, finding that the utility had abused its discretion in condemning the line and that it erected the line in reckless disregard of the school district's use of its property.[47] The lower court permanently enjoined the utility from using the transmission lines and ordered possession of the property restored to the school district.[48]

The appellate court ultimately modified the trial court judgment, deleting the award of punitive damages, and affirming

the actual damages.[49] At the time of the appellate decision, the utility had already received permission from the PUC to relocate the transmission lines in order to avoid the school district property.[50]

The *Klein Independent School District* case thus demonstrates a jury's response to evidence that electromagnetic fields emitted from power lines may be dangerous to public health and that a utility's condemnation of property for power lines may be overturned. The dangers to public health caused by power lines have also increasing ly become an issue in power line siting litigation.[51]

B. Power Line Siting and Land Use

Perceived health hazards associated with electric and magnetic fields emitted from power lines, and the public fear of power lines caused thereby, have frequently been issues in power line siting and land use cases.[52] The siting of power lines is regulated by state agencies, which may be designated the "Public Service Commission" (PSC), the "Public Utility Commission" (PUC), or some similar designation. These regulatory agencies investigate the need for new power lines and study the effects on the public of locating or siting those lines.[53] Public hearings constitute a part of a regulatory agency's investigation, and at these hearings property owners, muni cipalities, and other entities affected by the siting of proposed lines may raise their concerns.[54]

Among the issues considered by a regulatory agency in an evidentiary hearing are the effects of electromagnetic fields on health and safety.[55] Though science has not confirmed the adverse health effects of electromagnetic fields, in an attempt to control the risks of exposure to electromagnetic fields the regulatory agencies have tried to regulate the level of exposure by adopting simple field strength safety standards.[56] Some state regulatory agencies have adopted a strategy of "prudent avoidance" as a means of risk management.[57] A strategy of prudent avoidance means taking steps that would prevent the public from being exposed to electromagnetic fields, but taking only those steps involving modest costs.[58] Some possibilities for prudent avoidance include attempting to route new transmission lines so that they avoid people; widening transmission line rights-of-way; developing designs for distribution systems, including new grounding procedures, which minimize associated fields; developing new approaches to house wiring that minimize associated fields; and redesigning appliances to minimize or eliminate fields.[59]

In addition to the cases involving regulatory agencies and proposed power line sitings or proposed upgrades of existing lines, at least one case involved a pre-existing line and the public perception of health hazards caused by the line. In *Borenkind v. Consolidated Edison Co.*,[60] plaintiffs, who were vendors of residential property located near the power line, sued the utility seeking consequential damages because of the alleged decrease in value caused by the public's perception of a health risk associated with living near the line.[61] However, the court dismissed the complaint.[62]

Electric and magnetic fields and the fear of health hazards associated with power lines have also been issues in cases involving zoning ordinances, zoning changes, and land use ordinances regulating power lines.[63] The town of East Greenwich, Rhode Island, is a party in two such cases: *East Greenwich v. O'Neill*[64] *and East Greenwich v. Narragansett Electric Co.*[65] Because the citizens of East Greenwich expressed concern about the possible harmful effects of electromagnetic fields emanating from power lines, the town adopted an ordinance creating a three-year moratorium on the construction of transmission lines exceeding sixty kilovolts.[66] The ordinance prevented the utility from constructing its proposed transmission line through the town and the utility appealed to the state Public Utilities Commission (PUC), which scheduled a hearing to follow the determination of the outcome of the town's suit challenging the PUC's jurisdiction in the matter.[67] The appellate court invalidated the ordinance and held that the PUC had jurisdiction of the matter.[68]

The *Narragansett Electric Co.* case resulted from the town's suit to quash a PUC order invalidating amendments to the town's comprehensive plan.[69] Implementing its concern about the possible harmful effects of electromagnetic fields emanating from high-voltage power lines, the town council approved five amendments to its comprehen sive plan.[70] On appeal, the court affirmed the PUC's invalidation of the amendments because they invaded the "field of public utilities regulation, which the General Assembly had expressly preempted from town and city intrusion."[71]

Other land use related cases raising electromagnetic field issues[72] include those where landowners challenged a zoning change that would allow construction of a power substation because of the risk of health hazards[73] and where

a town challenged the regulatory agency's decision to grant a utility an exemption from the town's zoning restriction.[74] Interestingly, in one case, the party petitioning the PUC to invalidate the town's rezoning of its lot from heavy industrial to residential was the utility, the party that usually tries to refute the existence of health hazards associated with electromagnetic fields.[75] At the PUC hearing, the utility argued that the rezoning would adversely affect its utility operations.[76] If the utility were to construct power lines on its re-zoned lot and connect them to a substation on its adjoining property, the utility "could be potentially liable for the putative harmful effects of the electromagnetic fields (EMF) from such lines on residents on those lots."[77]

C. Personal Injury Tort Litigation

Liability for the putative effects of electric and magnetic fields emanating from power lines and facilities has been alleged in tort litigation.[78] However, because of the failure of science to definitively link causation of cancer and other alleged personal injuries to electric and magnetic fields, there has been no recovery based on the allegations and few reported cases.[79] When the reports of an association between cancer and the electric and magnetic fields around power lines and electricity became known to the public, the suggestion was that electromagnetic field litigation would be the next asbestos.[80] One source predicts that litigation over health problems allegedly caused by electromagnetic fields will continue despite the National Research Council Committee's report finding no conclusive evidence linking electric and magnetic field radiation exposure with cancer and other diseases.[81]

Health issues related to electromagnetic field exposure have produced litigation in which liability was claimed against utilities for purportedly causing non-Hodgkin's lymphoma,[82] emotional distress,[83] and chronic myelogenous leukemia.[84] However, no definitive scientific proof exists linking the alleged injuries and electromagnetic fields and in none of these personal injury cases did plaintiffs recover.[85] Since electric and magnetic fields have caused litigation and controversy, a discussion of these fields is helpful.

III. WHAT ARE ELECTRIC AND MAGNETIC FIELDS?[86]

General science courses teach that elementary particles of matter such as electrons and protons carry an electric charge, with protons carrying a positive charge and electrons carrying a negative charge. Like charges repel one another and opposite charges attract one another. When an object has the same number of electrons as it does protons, as usually happens, the effect of the charges cancel out and the object has no overall charge. But when an object acquires an excess of positive or negative charges, the object becomes charged.[87] If a charged object is capable of exerting a force on other charges brought into a region around the charged object, then the force is called the "electric field" of the charged object.[88] A "magnetic field" is a mathematical means of representing the magnetic force that a wire carrying a current of electricity exerts on any charged particle that is nearby.[89] These two types of fields, electric and magnetic, are present wherever electric power is present. These fields result from the electric charges that electric power generating stations pump through power lines and ultimately to the consumer of power. In general terms, the electric field originates from the amount of the electric charge pumped, and the magnetic field originates from the motion of that charge.[90] Electric and magnetic fields are ubiquitous in modern society, being found wherever there are power transmission or distribution lines and wherever there is an electrical appliance.[91] A brief description of a power delivery system follows.

A. Power Delivery Systems

Power delivery systems begin with the generation of power, which is measured by "voltage." Voltage is a measure of electric potential energy that makes electric charges flow through a circuit.[92] The power is generated at about 20,000 volts (twenty kilovolts or twenty kV), but because power is more efficiently transferred over long distances at a higher voltage, large transformers increase or "step-up" this voltage to a level measuring from 65 to 765 kilovolts for transmission over high voltage transmission lines.[93] The high voltage transmission lines deliver the power to substations, where it is transferred through step-down transformers to lower-voltage distribution lines in which the voltage measures from five to twenty-five kilovolts.[94] The power then is transferred through a distribution step-down transformer (the large "cans" hanging on the power poles in neighborhoods and along streets) to the customer.[95] The power in homes is measured at 115/230 volts.[96] Just as electrical potential energy causing electric charges to flow through a circuit is called "voltage" and is measured in units called "volts," this flow of charges is called "current" and is measured in units called "amperes" (amps), describing the rate at which the electrical charges flow in a power line or wire.[97] The 115/230 volt wiring in houses is designed to carry currents of up to thirty amps.[98]

Over 370,000 miles of transmission line and over two million miles of distribution line exist in the United States

today.[99] One would have to look long and hard to find dwellings in the United States that are not wired for electricity. Therefore, because of the universal exposure of people to sources of electric power and electric devices, the primary area of investigation for the National Research Council (NRC) Committee was the low-frequency electric and magnetic fields associated with electric power and electric devices.[100]

B. Frequency and the Electromagnetic Spectrum

Electric power is either alternating current (AC) or direct current (DC).[101] Batteries produce direct current; power used in homes and workplaces is alternating current.[102] Power line fields alternate from positive voltage to negative voltage.[103] The number of times per second that the variation occurs is called the "frequency" of the current.[104] One cycle per second is measured as one Hertz (Hz), an internationally accepted unit of frequency.[105] For example, a power field that alternates sixty times per second is said to have a frequency of sixty Hz.[106] The frequency of electric power produced in the United States is sixty Hz, while countries in Europe and other places generally produce power at a frequency of fifty Hz.[107]

Associated with the characteristic of frequency of electromagnetic energy is the characteristic of "wavelength."[108] The relationship between frequency and wavelength is that higher frequencies have shorter wavelengths.[109] Frequency and wavelength of electromagnetic energy are related to the electromagnetic spectrum because the spectrum is a classification of electromagnetic energy by frequency and wavelength ranging from extremely low frequencies (ELF) with longer wavelengths to very high frequencies with shorter wave lengths.[110] The frequencies are commonly expressed as powers of ten; for example, a frequency of 10[9] is one gigahertz (Ghz) and is 1,000,000,000 Hz.[111] The range of the electromagnetic spectrum[112] frequencies is from zero to 10[22113] The extremely low frequencies or extra-low frequencies (ELF)[114] include the fifty to sixty Hertz power associated with electric current in homes.[115] In increasing frequencies, the spectrum includes radio waves at 10[6] to 10[10] Hz, microwaves at 10[10] to 10[12] Hz, infrared radiation at 10[12] to 10[14] Hz, visible light at 10[14] Hz , ultraviolet radiation at 10[15] Hz , and at greater than 10[17] Hz, X-rays and gamma rays, which have very high frequencies and very short wavelengths.[116]

The electromagnetic spectrum ranges from "non-ionizing" radiation at the low end of the spectrum to "ionizing" radiation at the high end.[117] Energy is ionizing if it is capable of causing an atom or a molecule to gain or lose one or more electrons, thus producing charged particles when it interacts with the atoms or molecules.[118] Gamma rays, X-rays, and some types of ultraviolet lights are ionizing radiation.[119]

Ionizing radiation has been long-studied and known to damage biological systems[120] because it is able to break chemical bonds, thereby adversely affecting health.[121] Lower on the spectrum than the ionizing radiation bands are bands of high frequency non-ionizing radiation that do not break chemical bonds. These include visible light, microwaves, and radio and television waves.[122] Microwaves do have the capacity to cause water molecules to vibrate, which produces heat; therefore, microwaves can also adversely affect human health because of the capacity to heat human tissue.[123]

As the lowest bands on the spectrum, ELF energy is non-ionizing and is not able to break chemical bonds, nor can it vibrate water molecules or heat human tissue.[124] The manner in which ELF energy interacts with biological systems is "speculative;"[125] however, ELF effects have been reported to "include effects on cell metabolism and growth, gene expression, hormones, learning and behavior, and promotion of tumors."[126] Scientists have debated the validity of the above effects, leading to the National Research Council Committee's study and report discussing the possible health effects of exposure to electric and magnetic fields.[127]

C. Exposure to Electric and Magnetic Fields

Humans are affected by electric and magnetic fields, which are generated from both external and internal sources. Until about 125 years ago, external human exposure was limited to those fields emanating naturally from atmospheric electricity and geomagnetism.[128] Since the discovery of electricity and its ever-increasing use to power all the modern conveniences, the electric and magnetic fields to which humans are exposed have greatly multiplied.[129] Internal sources also exist because humans and all other organisms have within them "endogenous electric fields and currents that play a role in the complex mechanisms of physiological control such as neural and neuromuscular activity,

tissue growth and repair, glandular secretion, and cell membrane function."[130] Given the role that electric and magnetic fields play internally in the biology of humans, a natural inquiry concerns the effect that the external electric and magnetic fields have on that biology.

Studies have shown that electric and magnetic fields, by the processes of induction, can affect humans by producing currents in the body[131] as well as charges on the surface of the body.[132] When a person's body is exposed to an electrical field, induced fields within the body are extremely weak because the conductivity of the body tissue weakens the electrical field.[133] However, the same is not true for magnetic fields. The conductivity of the body tissue does not affect the magnetic fields, so magnetic fields pass through the body inducing electric currents within the body.[134] Nor do most common building materials weaken magnetic fields, which can pass through thin sheets of metal; however, iron and other magnetic materials that serve as paths of conduction of magnetic fields can sometimes be used as shields from magnetic fields exposure.[135] Because most materials have enough conductivity to sufficiently weaken electric fields, most materials can easily shield people from exposure to electric fields.[136]

The electric power used in homes and workplaces produces both electric and magnetic fields because when electric charges move to create a current, magnetic fields are created.[137] Even if an electric appliance plugged into an electrical outlet is turned off, it might have an electric field present. If the appliance is turned on and operating, a magnetic field will also be present.[138] When the two fields, which are quite different in character, are "coupled" in this manner, they are referred to in the NRC Report as "electromagnetic fields" (EMF).[139] However, because coupling at the low frequencies of fifty and sixty Hz is extremely weak, considering the electric and magnetic fields as independent and not substantially linked is more appropriate. For this reason the NRC Report reserves the use of the term "electromagnetic field" for high frequency fields where the electric and magnetic fields are substantially linked.[140]

The fields to which people are exposed can be measured. The intensity of an electric field is measured in units of volts per meter (V/m).[141] Since a thousand volts equals a kilovolt, a thousand volts per meter is a kilovolt per meter (kV/m).[142] The intensity of an electric field decreases rapidly as distance from the source increases.[143] Several different units are used to measure strength and intensity of a magnetic field. For instance, the ampere per meter (A/m) properly measures magnetic field intensity and corresponds to the V/m for electric fields.[144]

Magnetic flux density is a related quantity indicating magnetic field strength and comprises the number of field lines (lines representing graphically either an electric or magnetic field) that cross a unit of surface area.[145] The unit measuring magnetic flux density is the gauss (G), with 10,000 gauss making a unit called a "tesla."[146] The magnetic field intensity measured in A/m is eighty times as great as the measurement of the magnetic flux density in gauss, though both the gauss and the tesla are considered large units.[147] When measurements of magnetic fields are reported, they are usually in thousandths of a gauss or milligauss (1mG = 0.001 G). For example, the magnetic fields produced underneath the commonly observed neighborhood distribution power lines generally measure around five mG, though densely populated areas may produce fields measuring as high as fifty mG.[148] The strength of magnetic fields produced by electric appliances varies from very few milligauss to several hundred milligauss.[149] The intensity of the magnetic field decreases rapidly as the distance from the source increases.[150]

Though electric fields and magnetic fields at the power line frequency of sixty Hz can each be measured or calculated in most any environment,[151] the determination of human exposure is more diffi cult.[152] Some of the difficulties include the many varieties of electric and magnetic field environments that the average person encounters in a day, the lack of knowledge of the specific characteristic of electric and magnetic fields that interact with biological systems, and whether a specific characteristic does indeed interact with the biological system.[153]

Other problems of measurement and calculation are caused by the perturbation of electric fields by conducting objects.[154] If people and animals are in a measured field, their presence affects the field. Consequently, a significant difference occurs in the measurement of a field without a person present and the measurement of a field with a person present.[155] The measured field of an ELF magnetic field, being unaffected by the presence of humans and animals, represents the actual exposure field.[156]

Given all the above-mentioned problems, typical exposures to electric and magnetic fields have been investigated.

Devices to measure the electric and magnetic fields have been designed to determine the average root mean square (rms) field strength, which is either magnetic flux density for magnetic fields or electric field strength, for a specific time period.[157] The usual minimum time period that the instruments average is about one second.[158]

The electric equipment used in the workplace and the home is responsible for exposure to electric fields in those environments. However, electric fields have not been satisfactorily categorized because of the ease of shielding sixty Hz electric fields. When attempts to measure personal exposure to electric fields have been made, the measurements have depended greatly on several factors, including where the exposure meter was worn, the orientation of the meter, and the presence of any conductors near the exposure.[159] One study found the range of the mean personal exposure to sixty Hz electric fields in home or office to be from five to ten V/m.[160]

While workplace and home electric fields have not been well characterized, power line electric fields have. Ground-level electric fields under a line depend on the line voltage and may be as high as ten kV/m. A field of ten kV/m is strong enough to shock a person touching a vehicle parked under the high-voltage line and can also cause a fluorescent tube to glow when held under the line. The study mentioned above showed that electrical substation, distribution line, and transmission line workers experience a mean personal exposure ranging from fifty to 5,000 V/m.[161]

Exposure to residential magnetic fields is most commonly caused by electric appliances in the home, the grounding system (usually the water pipes), and nearby low voltage distribution power lines.[162] The internal wiring usually is not a significant source of magnetic field exposure unless a problem with the wiring exists.[163] Nor are high voltage transmission lines at a distance of more than one hundred meters from the residence considered a significant source of exposure.[164] However, transmission lines can be a source of magnetic fields if the home is near the line, especially during the time of peak power usage.[165] In addition, substations, while usually not an important source of magnetic fields, do provide a greater possibility of exposure to residences near those facilities because power lines converge at the substations and may be closer to the ground as they approach the substation.[166]

The neighborhood power lines are usually lower voltage distribution lines, not the transmission lines discussed above. As mentioned earlier, the distribution lines produce magnetic fields that are usually about five mG with densely populated areas sometimes measuring up to fifty mG.[167] Burying distribution lines does not necessarily decrease the magnetic field associated with the lines unless the lines are buried in a single metal pipe.[168] The other method of burying the lines is called direct burial, a method that can produce ground-level magnetic fields equal to overhead lines.[169]

Typical exposures to magnetic fields in the home and in the workplace have been studied.[170] While electric appliances cause the strongest magnetic fields in homes, grounding systems, power lines, or a combination of the two, produce fields referred to as "background magnetic fields" in the center of rooms away from most appliances.[171] One study of 992 homes showed that only five percent of the homes had average background magnetic fields greater than 2.9 mG.[172]

The strong magnetic fields produced in homes by electric appliances usually decrease rapidly with distance from the appliance. For example, one study reporting the range of magnetic field strengths of common household appliances showed that the magnetic fields of microwave ovens range from 100 to 300 mG at a distance of six inches and from one to 200 mG at a distance of one foot.[173] The study used measurements of rms fields that were averaged over one second or more for spot measurements and up to twenty-four hours for long-term and personal exposure measurements.[174] Another study showed that ninety-five percent of all of the 485 microwave ovens measured emitted magnetic fields less than seventeen mG at fifty-six centimeters (twenty-two and one-half inches).[175] Differences in design of appliances of the same type can cause different magnetic fields to be produced. Electric blankets have been a cause for concern about exposure to magnetic fields because when blankets are in use they are very close to internal organs, which lie about five centimeters from the surface of the blanket. When magnetic fields associated with conventional electric blankets are measured at that distance, the field strengths average about twenty-two mG.[176]

When personal exposure is measured, the fact that a person moves around the house or workplace means that the measurement is a combination of exposures to electric appliances, power lines, and grounding systems.[177] The office

environment magnetic field measurements are similar to those for the home, however, personal exposure measurements are somewhat higher. This is probably caused by the more constant use of electric equipment and the proximity to that equipment at the workplace.[178]

The foregoing discussion of measuring exposure has been based on direct measurement by instruments of the electric and magnetic fields. Epidemiological studies use indirect methods of measuring magnetic fields and will be considered in the following section discussing the National Research Council Committee Report.[179]

IV. The National Research Council Committee Report

The National Research Council is an agency of the National Academy of Sciences (NAS), granted a charter by Congress in 1863 with the mandate to advise the federal government on scientific and technical matters.[180] Under the charter of the NAS, the National Academy of Engineering was established in 1964 to share responsibility for advising the federal government.[181] In 1916 the NAS organized the National Research Council (NRC) for the purpose of associating the science and technology community with the Academy's purposes.[182] Since its establishment, the NRC has become the chief operating agency of both the NAS and the National Academy of Engineering. The NRC provides services to the government, the public, and the scientific and engineering communities.[183]

When the United States Department of Energy (DOE) requested that the NAS review the scientific evidence of potential health risk from exposure to the electric and magnetic fields generated by electric devices, the Committee on Possible Effects of Electromagnetic Fields on Biologic Systems (NRC Committee) was convened.[184] The charge to the NRC Committee from the DOE included: reviewing and evaluating the existing scientific information on the potential effects of exposure to electric and magnetic fields on cancer incidence, reproduction and development, and learning and behavior; critically examining epidemiological and laboratory data relating to those topics and assess potential health effects; focusing on electric- and magnetic-field frequencies and exposure modalities found in residential settings; and producing a report that contains a review of pertinent information on the effects of electric and magnetic fields; identification of research areas in which data are needed to better understand any potential health hazard; and recommendations for research in those areas and strategies for implementing research that would enhance understanding.[185] If data of appropriate quality is available, the NRC Committee should include a health risk assessment of power-frequency electric-field and magnetic-field exposures.[186]

As the charge reflects, the NRC Committee was to evaluate three categories of health hazards: carcinogenic effects, neurobehavioral effects, and reproductive effects.[187] After almost three years of study, the NRC Committee released its Report.

The NRC Report consists of an Executive Summary, an Introduction, and chapters on Exposure and Physical Interactions, Cellular and Molecular Effects, Animal and Tissue Effects, Epidemiology, Risk Assessment, and Research Needs and Agenda. Appended to the Report are tables summarizing various studies discussed in the Report and a discussion on "wire codes," or wiring configurations, used in some epidemiological studies instead of direct measurement of exposure.[188] The Executive Summary, Introduction, and the Exposure and Physical Interaction chapter are reflected in the materials above. The other chapters are discussed below.

A. Cellular and Molecular Effects

The NRC Report discussed the published scientific studies of the effects on cells and molecules "in vitro" (in glass) of exposure to power frequency electric and magnetic fields.[189] Concluding that residential strength magnetic field exposures do not produce significant in vitro effects,[190] the NRC Report also specifically discussed effects on genotoxicity, signal-transduction pathways, intracellular calcium concentrations, and general patterns of gene expression.[191]

1. Heritable Changes in Cells Exposed In Vitro

Scientists often study the ill effects that certain environmental agents have on genes, or genotoxicity, by using cultured cells. Genotoxicity can be indicated by direct heritable changes such as mutation or chromosomal aberrations, or indications of heritable changes such as DNA damage or repair.[192] After reviewing twenty-nine published articles

reporting effects of exposure to residential power, twenty-four of which used frequency of sinusoidal form, the NRC Committee concluded that power frequency electric and magnetic fields are not directly a genotoxic agent.[193]

2. Transient Changes to Cells Exposed In Vitro

Whereas the NRC Committee found no direct heritable changes, that is, no genotoxicity, in cells exposed in vitro to electric and magnetic fields, it did discuss the evidence that magnetic fields can induce transient changes in cell expression in three categories: signal transduction pathway changes, gene expression changes, and intracellular calcium level changes.[194]

a. Signal Transduction Changes

Signal transduction processes, in which molecular systems inside the cell and at the cell membrane receive signals from the environment and from other cells, provide a mechanism by which cell functions may be influenced by electric and magnetic fields.[195] Metabolic activities, gene expression, cell proliferation, and other intracellular processes are regulated by the signals received, therefore, if the electric and magnetic fields affect or change the path of the communication of signals (signal transduction changes), the function of the cell might be changed.[196] Signal transduction changes are a common result in experiments and such changes alone do not indicate an adverse effect.[197] Studies indicate that changes in membrane-transduction pathways are caused by low frequency electric and magnetic fields.[198] However, most of the studies have not been independently replicated, a requirement given great weight in reaching conclusions about the result of studies and experiments.[199]

One study that has been independently replicated by at least two laboratories[200] observed that magnetic field exposure produces changes in ornithine decarboxylase (ODC) activity, an enzyme involved as a cell membrane signal transduction pathway.[201] The significance of this observation is that ODC activity is associated with mitogen activity and the various activities of tumor-promoting agents during carcinogenesis. The observation led to the hypothesis that low strength electric fields acting on the cell membrane, while not causing cancer, might be a copromoter and act with another tumor-promoting agent to cause more growth of an existing cancer than the agent acting alone.[202]

Among the unreplicated studies examining the effects of magnetic fields on signal transduction pathways is a study suggesting a possible correlation between magnetic field exposure and the growth of cancer cells.[203] The cancer cells exposed to a twelve mG sinusoidal magnetic field at sixty Hz were human estrogen-responsive breast cancer cells, which grow rapidly in the presence of normal concentrations of estrogen, a female sex hormone.[204] The study confirmed that the growth rate decreases in the presence of normal concentrations of melatonin, a hormone produced by the pineal gland, but that exposure to the sixty Hz magnetic field at twelve mG prevented the melatonin's effect of decreasing the cancer cell growth rate.[205] No significant effect was observed when the strength of the magnetic field was lowered to two mG, leading to the suggestion that a threshold for effect might exist between two and twenty mG.[206]

The NRC Committee noted that if other laboratories replicated the above effects, an exception to the observation that cells in tissue culture are not significantly affected by residential strength magnetic fields would exist.[207] Stressing the need for independent replication of most of the studies in the area of signal transduction, the NRC Committee concluded that while evidence exists that fields of strengths greater than residential strength fields[208] probably do have an effect on signal-transduction-related pathways in cells, essentially no evidence exists for such effects at residential field strengths.[209]

b. Gene Expression Changes

Whether exposure to residential strength electric and magnetic fields might change DNA[210] structure or function has been studied. Most studies show that such a change is unlikely, however, a 1991 study[211] reported results showing an increase in transcription activity after brief exposures to fields at higher than residential strengths.[212] Other studies showing changes in gene expression followed,[213] but like the 1991 study, they were highly criticized because of a lack of method precision and a lack of consistent con trols, both external and internal.[214] The criticisms led two groups to attempt replication studies using improved experimental techniques and elaborate precautions.[215] Despite those efforts, the groups failed to replicate the gene expression effects that had been previously reported.[216] The

NRC Committee concluded, "[e]vidence for electric- and magnetic-field effects on gene expression at residential field strengths is completely lacking."[217]

c. Calcium Changes

Calcium, as an inorganic ion that serves as a biochemical event messenger, is important in biological processes such as bone formation, muscle contraction, and synaptic transmission.[218] The concentration of calcium inside a cell regulates enzyme catalysts, thus serving as a second messenger in neural function.[219] Because calcium is so important in biological processes, any external agent causing calcium ions to flow into or out of the cell could have a significant effect on biological function.[220]

During the past two decades many studies have sought the effect that power frequency electric and magnetic fields have on calcium. The NRC Report summarized only such studies that had appeared in peer-reviewed journals from 1990 to October 15, 1994 in Table A3-2 in Appendix A.[221] The NRC Committee notes that, though most of the studies show some sort of positive association between calcium concentration changes and exposure to electric and magnetic fields, problems exist relating to explaining the results,[222] difficulty in observing the effects,[223] and inadequate replication.[224] Only three of the Table A3-2 studies have been replicated by independent laboratories, published in peer-reviewed journals, and have identified explicitly the exposure strengths used.[225] Having met those exacting requirements, the three studies, involving experiments showing an increase in calcium transport when thymic lymphocytes were exposed to pulsed magnetic fields having flux densities that were about 10,000 times greater than the average environmental flux densities, can be given more weight.[226]

The NRC Committee cautioned that results observed when the field strengths are higher than residential and workplace field strengths cannot be extrapolated to the lower field strengths since it is not known whether the mechanisms inducing the high field strength effects are the same as those at the lower strengths.[227] Therefore, based on its analysis of the in vitro experiments, the NRC Committee concluded that fifty to sixty Hz magnetic field exposures induce changes in cultured cells only when the field strengths are 1000 to 100,000 times that experienced at residential levels.[228]

B. Animal and Tissue Effects

Focusing on three areas of principal interest (carcinogenesis, reproduction and development, and neurobehavioral and neuro endocrine responses), the NRC Committee evaluated the published literature on the exposure of animals and tissues to power frequency electric and magnetic fields.[229] In considering this literature, the NRC Committee's criteria for the reported experiments included the following: the literature must be peer-reviewed; results must be exposure related; and results must be statistically significant; with the greatest weight being given to blinded studies[230] that were confirmed in peer-reviewed literature.[231]

The NRC Committee concluded that no convincing evidence exists that adverse health effects such as cancer, harm to reproduction and development, or behavior distortion are caused by exposure to power frequency electric and magnetic fields.[232] However, the NRC Committee did report evidence of a positive health effect associated with the healing of bones when the broken bones were exposed to higher-than-residential field strengths.[233]

Before summarizing more specifically the NRC Committee's conclusions in the areas mentioned above, a background discussion of the use of animals in studies evaluating risk to humans is appropriate. Animal studies, which are important in evaluating risk to humans from suspected toxic agents, are based on two principles: that the effects produced in the laboratory on animals apply to humans; and that exposing animals to the toxic agent in high doses is a valid method to discover possible hazards to humans.[234]

Other important assumptions in animal studies concern the "dose-response" relationship, a relationship forming the basis for toxicology that allows scientists to predict adverse health effects because of the expected predictable interactions between organisms and the toxic agent.[235] The assumptions regarding dose-response relationships include the following: the agent administered caused the response;[236] a relationship exists between the measurement of the dose and the response;[237] and means are available to measure and express toxicity precisely.[238] The foregoing assumptions are presumed to hold true for ELF fields if they indeed are found to be toxic agents.[239]

1. Carcinogenic and Mutagenic Effects

After presenting its conclusion that no convincing evidence exists that exposure to power frequency electric and magnetic fields causes cancer in animals,[240] the NRC Committee discussed the few peer-reviewed laboratory animal studies examining the issue of magnetic fields and cancer, summarized in the Report at Appendix A, Table A4-1.[241]

The experiments on animals examining the carcinogenic effects of exposure to power frequency electric or magnetic fields are either complete carcinogen studies, tumor-initiation studies, or tumor-promotion studies.[242] If an electric or magnetic field's potential to cause cancer development is being tested, then the field is being tested for its potential to be a complete carcinogen.[243] Such a study would need one and a half to two years of exposure of rats or mice to the field.[244] This would allow the animals to be observed for most of their life-spans, during which time exposure to confounding agents[245] must be minimized, and would require a large number of animals because several dosage groups should be included. The number of animals and the length of time involved cause complete carcinogenicity studies to be expensive; therefore, few such studies have been completed. Of three studies, which were studies of control groups exposed to magnetic fields without being exposed to a chemical initiator, and which were criticized by the NRC Committee for having inadequate group sizes, one found an increase in tumors while two found no increase in tumors.[246]

Along with the complete carcinogen approach to studying carcinogenicity, another approach is to assume that the suspected carcinogenic agent acts as either a cancer initiator or a cancer pro moter. Because carcinogenesis is considered a multi-step process, studies of two phases of the process, initiation and promotion, may be performed.[247] Initiation is a genotoxic event where a carcinogen affects the DNA directly.[248] Promotion is responsible for initiated cells changing to cancerous cells.[249] Initiation and promotion studies use less time, fewer animals, and are less expensive than complete carcinogenesis studies.[250] However, because the energies involved in power frequency electric and magnetic fields are too weak to break chemical bonds, and because the in vitro studies provide no evidence of DNA damage from exposure to residential strength fields, no tumor-initiation studies have been reported and few animal studies of tumor promotion have been completed.[251]

A few recent studies have investigated promotion of mammary tumors by exposure to magnetic fields.[252] In theses studies a chemical initiated the tumors, then the tumors were exposed to the magnetic field.[253] Though the studies have yet to be replicated and their results are inconsistent,[254] they seem to suggest a positive relationship between breast cancer in animals treated with a carcinogen and exposure to magnetic fields of about one Gauss.[255]

2. Reproductive and Developmental Effects

The NRC Committee next discussed the biological effects of residential strength electric and magnetic fields on reproduction and development. The NRC Committee considered the following types of studies: effects of electric fields on non-mammals such as fish[256] and chicken;[257] effects of electric fields on mammals such as mice,[258] rats,25[9] swine,26[0] and cattle;[261] effects of magnetic fields on non-mammals such as chicken;[262] and effects of magnetic fields on mammals such as mice[263] and rats.[264] Based on the studies, which are summarized in Appendix A, Table A4-2, the NRC Committee concluded that ELF electric or magnetic fields have not been shown to affect reproduction and development in animals, especially mammals.[265]

3. Neurobehavioral and Neuroendocrine Effects

The third area of concern to the NRC Committee is whether exposure to ELF electric and magnetic fields cause neurobehavioral effects or neuroendocrine effects. These effects were considered separately in the NRC Report.

a. Neurobehavioral Effects

The studies of neurobehavioral effects caused by exposure of animals to ELF electric and magnetic fields that meet the NRC Committee's requirements of publication in peer-reviewed journals and descriptions of methods adequate for replication are summarized in Appendix A, Tables A4-3 through A4-6.[266] Of those studies, only repeatable and reliable reports were discussed by the NRC Committee.[267] The NRC Committee considered the effect on animal

detection of electric fields[268] and magnetic fields,[269] and whether animals would exhibit aversion to those fields.[270] The review of these studies produced two conclusions: although animals can detect and respond to electric fields, the behavioral response is not one of aversion nor are the effects adverse neurobehavioral ones; and little evidence exists of neurobehavioral response in animals to magnetic fields and neither aversive nor adverse behavioral effects have been shown.[271]

b. Neuroendocrine[272] *Effects*

Neuroendocrines consist of various glands in the body that produce hormones which influence nerve activity.[273] Most of the reported studies of the relationship between exposure to electric and magnetic fields and neuroendocrine effects have concerned pineal melatonin production and are summarized in Appendix A, Table A4-7 through Table A4-11.[274] Melatonin is a hormone in humans, and possibly all animals, produced mainly by the pineal gland.[275] The pineal gland, an end-organ of the visual system, has nerves whose activity is determined by light perception at the retina.[276] More melatonin is present during the night than during the day because more is produced in darkness than in light.[277] Melatonin is associated with circadian or biological rhythms of organisms.[278]

Visible light, as well as some ultraviolet wavelengths and some infrared wavelengths, have been shown to alter pineal melatonin production.[279] Residential strength electric and magnetic fields are of extremely low frequency, have long wavelengths, and are below the visible light range.[280] Studies considering the effects of electric fields on melatonin production in animals report suppression of melatonin concentrations,[281] as do studies considering the effects of magnetic fields[282] and studies considering the effects of combined electric and magnetic fields.[283] Humans have been found to have melatonin rhythms that are similar to those in other mammals.[284] However, two reports showed no significant change in blood mela tonin concentrations when adult males were exposed to the electric and magnetic fields of magnetic resonance imaging (MRI).[285]

Understanding how ELF fields affect melatonin production in humans is important because suppression of melatonin levels may be related to the higher cancer incidence reported by some epidemiological studies. The NRC Committee presents two theories that describe a link between the alleged increase in cancer and ELF field exposure:

> [R]educed melatonin concentrations lead to an increased secretion of prolactin and gonadal steroids. That increase causes prolifera tion of cell division in breast or prostate tissue and stimulates growth of initiated cancer cells . . . . [M]elatonin suppression reduced the total antioxidative potential of the organism, thereby increasing the likelihood of damage by a carcinogen to the DNA of any cell. DNA damage can increase the risk of cancer particularly if electric- and magnetic-field exposure also increases the half-life production of free radicals.[286]

Though epidemiological reports have prompted the above possible explanations, no convincing evidence exists that human melatonin concentrations are affected in the same way animal melatonin concentrations are when exposed to ELF fields.[287]

c. Bone Healing and Stimulated Cell Growth

Experiments considering the effects on bone tissue exposed to electric and magnetic fields have been conducted in vivo on animals[288] and humans.[289] In vitro studies of those effects have also been performed.[290] The studies show that normal functions of the bone and the healing processes in bone are influenced by exposure to electric and magnetic fields. Bone fracture healing in response to this exposure has been well documented,[291] but the mechanism by which this healing occurs is not clearly established.[292]

Bone in living organisms is known to possess an electric component,[293] and several hormones are known to regulate activities of the bone cells that synthesize and calcify bone matrix (osteoblasts) and the cells that reabsorb bone mineral and matrix (osteoclasts).[294] Bone growth has long been hypothesized to be influenced by endogenously generated electric fields; consequently, externally generated electric fields applied to bone fractures or defects have been hypothesized to be therapeutic.[295] Upon a review of the experiments testing the hypotheses, the NRC Committee concluded that convinc ing evidence exists of an association between bone-healing in animals and exposures to pulsed magnetic fields with strengths greater than five Gauss.[296] This field strength is much higher than that ordinarily

encountered in residential environments.[297]

C. Epidemiology

Few of the laboratory experiments considering the effects of electric and magnetic field exposure on animals were studies of humans.[298] Humans, however, are the subjects of all epidemiological studies because epidemiology is "the study of patterns of health and disease in human populations to understand causes and identify methods of prevention."[299] Since 1979 when Nancy Wertheimer and Edward Leeper first reported an association between childhood leukemia and electric power distribution line configurations,[300] the question most frequently asked by the public and one that has caused the greatest concern relative to electric and magnetic fields is: "Do they cause cancer?" DOE's charge to the NRC Committee included the mandate to review and evaluate existing evidence on the effect of exposure to residential ELF on the incidence of cancer.[301] Consequently, the NRC Committee reviewed and evaluated more than fifteen years of epidemiological research providing data on cancer in its Report.[302]

Determining whether exposure to electric and magnetic fields causes cancer based on the results of epidemiological studies is a problem because epidemiological research involves studies of observations to which statistical methods are applied, but which lack the ability to assign exposure in a random manner. As the NRC Committee Report explains:

> Without randomly assigning the potential causes of interest (e.g., magnetic-field exposure) and observing the resulting health event (e.g., a change in cancer incidence), a mistaken inference that a given exposure causes a specific disease can result from a number of potential errors or misinterpretations. Conversely, even when a true causal relationship is present, it will not always be discerned easily. Ultimately, causal inference is enhanced when a number of non-causal explanations have been carefully postulated, tested, and refuted.[303]

In fact, the NRC Committee labels the question of when a causal inference has been established as "unanswerable" and substitutes a more practical inquiry of when does evidence of a causal association exist that is sufficient to take some specific action because it *presumes* a causal relationship.[304] Other factors in the problem of determining causality are the potential sources of error in epidemiological studies, including random error,[305] information bias or misclassification,[306] selection bias,[307] and confounding and effect modification.[308]

When epidemiological studies report an association between exposure and disease, as indicated above, a judgment must be made that sufficient evidence exists to justify the acceptance of a causal association. Several criteria have been suggested that bear on the question of causality and also relate to whether errors described above have affected the study. The criteria are:

> Strength of association: If a given exposure and disease are strongly associated (i.e., a large relative risk), then unrecognized confounders are less likely to be responsible for the association;
>
> Consistency: If the association is observed in different populations under different circumstances, it is more likely to be a causal relationship and not a product of some methodologic artifact in the study;
>
> Specificity: A cause should lead to a single effect rather than multiple effects; if multiple diseases are associated with a suspected agent, the associations are more likely to be spurious;
>
> Temporality: The exposure must logically precede the disease in time if the association is causal;
>
> Biologic gradient: A dose-response gradient, in which risk of disease rises with increasing exposure level, is generally more likely to indicate causality than some other pattern of association between exposure and disease;
>
> Plausibility: Plausibility refers to whether the association is supported by scientific studies or information from disciplines other than epidemiology;
>
> Coherence: A causal interpretation should not be in conflict with current knowledge about the natural

history of the disease. This criterion is virtually the same as plausibility;

Experimental evidence: When possible, experimental evidence in the form of randomized trials with prescribed exposures is highly desirable;

Analogy: If other known and accepted causal agents have been found that are similar to the one under evaluation in their manner of action on the biologic system, then the one under evaluation is more likely to be causal.[309]

Because the relationship between childhood cancer, especially leu kemia, and residential exposure to ELF electric and magnetic fields is the major public concern, the NRC Committee concentrated on those epidemiological studies.[310]

D. Cancer Epidemiology and Residential Exposures

Epidemiological studies have persistently reported an association between the incidence of childhood leukemia and "wire codes," a hypothetical estimate of electric and magnetic field exposure.[311] Wire codes are external wire configurations that are used to classify houses according to the amount of magnetic flux density expected to be inside the house.[312] Wire codes are used as substitutes to estimate the size of the magnetic field rather than actually measuring magnetic flux density inside the house.[313] Because the studies are of homes over a period of years retrospectively, actually measuring the magnetic fields inside the homes is too difficult, too expensive, and too time consuming.[314] Wire codes of various classifications,[315] consisting of outdoor factors such as the distance of the home from the power line and the size of the wire near the home, were first used by Wertheimer and Leeper[316] in their study of childhood cancer occurring in Denver, Colorado between 1950 and 1973. The results of that study, which showed an association between electric power distribution lines and childhood cancers, were published in 1979.[317] The 1979 Wertheimer and Leeper study was of 344 cases (children with a Colorado birth certificate who lived in the area most of their lives and who also died of cancer under the age of nineteen between 1950 and 1973) in 491 homes compared to 344 controls (children whose birth certificate was placed next in the birth certificate files unless the next birth certificate was that of a sibling of a case child) in 472 homes.[318] The homes were classified according to two wire codes, High Current Configuration (HCC) and Low Current Configuration (LCC).[319] The results of the study showed that children in HCC homes had a 1.6 to 2.2 times higher incidence of cancer than did the controls.[320] One study has shown that the expected number of cases of childhood leukemia in children up to the age of fourteen is about ten in 100,000.[321] The results in the 1979 Wertheimer and Leeper study mean that the risk to children exposed to HCC wiring configurations is about doubled, or twenty in 100,000. The study accounted for the possible confounders of socioeconomic class, family pattern, and traffic congestion near the homes, but not other possible confounders or bias-causing factors.[322] Consequently, the study has been widely criticized,[323] among other reasons, for its use of wire codes to measure exposure, for its consideration of cancer deaths only and not all diagnosed cancers, and for failing to conduct the study "blind."[324]

Since the 1979 Wertheimer and Leeper study, other researchers have examined the possible association between residential exposure to electric and magnetic fields and the incidence of cancer.[325] The NRC Report organized the results of these studies into tables in Appendix A thus: Table A5-1 summarizes the structures of the studies; Table A5-2 summarizes the methods of control selection in case-control studies; Table A5-3 summarizes exposure assessment approaches; Table A5-4 focuses on childhood leukemia; Table A5-5 focuses on childhood brain tumors; Table A5-6 focuses on childhood lymphoma; Table A5-7 focuses on other childhood cancers; Table A5-8 focuses on childhood cancers in the aggregate; Table A5-9 focuses on cohort studies of residential exposure and cancer including all ages; Table A5-10 focuses on adult leukemia; and Table A5-11 focuses on adult cancers generally.[326] The NRC Committee noted its recognition that increasingly sophisticated study designs have replicated the association between location near power lines and childhood leukemia and its determination to concentrate on studies concerning exposure to magnetic fields and the occurrence of childhood leukemia.[327]

The NRC Committee reviewed the studies of the association between exposure to magnetic fields and the incidence of childhood leukemia by undertaking a "meta-analysis," which is "a statistical method used to provide a single risk estimate that summarizes the results of a set of similar studies."[328] Of the twelve studies focusing on childhood leukemia, results have been conflicting with some reporting an association between childhood leukemia and residential

exposure and some reporting no association.[329] The reaction of scientists examining the evidence has also been conflicting; the disagreements concerning quality, bias, accuracy, and uncertainties have resulted in varying interpretations. Some find evidence of an overall association;[330] others consider the positive results to be caused by bias, either systematic or random with no proper adjustment made for multiple comparisons, with most concluding that no consistent pattern of association has been shown by the results.[331] The NRC Committee's goal in using the meta-analysis included the following:

> (1) to examine quantitatively the consistency of the existing epidemiologic studies; (2) to analyze the influence of any single study on the combined effect measures; and (3) to estimate the sample size or number of studies needed to balance the combined results of previous studies. In short, the purpose of this meta-analysis is to consider the possible role of bias due to random error as an explanation for the observed results in a set of such studies.[332]

After examining the data in the studies focusing on the relationship between residential exposure to magnetic fields and childhood leukemia using a variety of analyses, the NRC Committee concluded that a statistical explanation based on random fluctuations did not support the positive trend in the risk associations.[333] Nor was it clear whether the associations were really due to the exposure to magnetic fields or some other factor.[334]

The magnitude of the possible risk was also uncertain, however, the overall conclusion was that the studies do show an association of childhood leukemia with wire codes, proximity to source, and magnetic fields calculated from power consumption records.[335] The NRC Committee remained puzzled by the inconsistent results of the various studies and also by the lack of a positive association when the exposure was assessed by spot measurements.[336]

The only exposure assessment strategy of the epidemiological studies analyzed that failed to show an association with childhood leukemia was that of spot measurements of magnetic field strength.[337] Another contradiction was the failure of the data to indicate a consistent dose-response relationship.[338] The NRC Committee noted two possible explanations for the spot measurement contradiction if the associations shown by the other exposure assessment strategies were reliable. One explanation is that the other ways to measure exposure might somehow indicate the true risk factor, which might not be related to magnetic field strength.[339] The other explanation is that measurement methods might better represent some element of magnetic field strength that is related to the cause of leukemia.[340] The inconsistent dose-response relationship pattern might be caused by an imperfect correlation with the true risk factor.[341] The NRC Committee suggested that future studies should try to understand these inconsistencies and stressed that "strong and consistent" data suggests "a relatively weak increased risk of leukemia for children living in close proximity to power lines."[342]

The NRC Committee summarized its analysis of the research linking electrical wires near homes to childhood cancer as falling "short of providing definitive evidence that an association exists, and even if an association were proved, the causal agent has not been identified."[343] They also recognized suggestions of bias caused by control selection or too small a number of subjects in some studies.[344] The NRC Committee based its overall conclusion of no association between exposure to magnetic fields and childhood cancer (which seems to be in conflict with its recognition of a link between wire codes and childhood leukemia), on the fact that those epidemiological studies estimating exposure to magnetic fields by measuring present-day average magnetic fields found no association between exposure and childhood leukemia and on the weak association between measured residential magnetic fields and wire code ratings.[345]

A further conclusion of the NRC Committee was that associations between magnetic fields and adult cancers, pregnancy outcome, and neurobehavioral disorders were not supported by epidemiological studies.[346] After examining the epidemiological studies, the studies of animal and tissue effects, and those of cellular and molecular effects, the NRC Committee assessed the risk to human health from exposure to electric and magnetic fields.

E. Risk Assessment

The NRC Committee used a method called "risk assessment" to evaluate the risk to human health from exposure to residential electric and magnetic fields. When some hazard is thought to exist because of results observed in a study, for example, rats developing more cancerous tumors when fed a large amount of saccharin, the risk assessor attempts to

estimate the risk to human health by extrapolation. Risk assessment is based on the principle that health effect data obtained from studying a small number of subjects that have been exposed to a high concentration of a suspected hazardous agent can by extrapolation predict the health effects in a large number of subjects that have been exposed to a lesser concentration of that agent.[347] In the example above, the estimate might be that some specific number of persons ingesting a specific quantity of saccharin will develop cancer.[348]

The four stages of risk assessment are hazard identification,[349] dose-response assessment,[350] exposure assessment,[351] and risk char acterization.[352] Risk characterization is quantitative in that it results in an estimate of the number or proportion (for example, one in one million) of the population that might be adversely affected.[353] The assessor "weighs" the evidence at each stage of the process, with well-designed studies being given more weight than studies with weaknesses in some areas.[354] At the conclusion of the assessment process, all evidence is weighed together to produce an overall conclusion about risk assessment.[355] If all four stages of a risk assessment are used ending in a quantitative risk estimate, the risk assessment is a complete one.[356] If only some of the stages are used, the assessment is said to be a partial one.[357] Whether the assessment is complete or partial depends upon the available data and the purpose of the risk assessment.[358]

The NRC Committee did not perform a complete assessment of the risks of exposure to residential power frequency electric and magnetic fields because of uncertain data.[359] The NRC Committee did use the framework of risk assessment to perform a limited assessment because it recognized the public concern over the possible risks of exposure to residential electric and magnetic fields.[360]

Within the risk assessment framework and concentrating primarily on the risk of childhood cancer, the NRC Committee reviewed its previous conclusions. Under "Hazard Identification," the conclusions included the following: "no consistent or convincing evidence exists of effects" of typical residential electric- and magnetic-field exposure on cultured cells implying a human health effect at that exposure level;[361] "no consistent or convincing evidence" exists of that typical exposure on whole animals implying a human health effect, though neurobehavioral and neuroendocrine changes not considered evidence of adverse health effects on humans have occurred in response to much higher exposure levels;[362] and "a moderately consistent, statistically significant association between wire codes, . . . and childhood leukemia" exists.[363] Under "Dose-Response Assessment," the NRC Committee concluded that the data did not furnish evidence of a dose-response relationship convincing enough for development of a mathematical model.[364]

Under "Exposure Assessment," the NRC Committee acknowledged the universal and unavoidable daily exposure of the popula tion to electric and magnetic fields.[365] This universal exposure would mandate the consideration of how even a very small proven adverse effect would affect public health.[366] Under "Risk Charac terization," the NRC Committee concluded that "the effects of exposure to electric and magnetic fields on biologic systems are either negative or so uncertain that making such an estimate would be injudicious and misleading."[367] Furthermore, the relationship that is assumed to exist between electric and magnetic field exposure and adverse health effects has not been explained in a biologically plausible manner.[368]

Finally under "Overall Conclusions of Risk Assessment," the NRC Committee concluded that the evidence examined by it did not demonstrate that ELF electric and magnetic field exposure constitutes a human health hazard.[369] Only the epidemiological studies of humans suggest adverse health effects with the results of those studies indicating relatively small risks as compared to other harmful exposures studied by epidemiologists.[370] However, uncertainty about the validity of using wire codes as a surrogate for magnetic ex posure, as well as other unresolved questions about epidemiological and laboratory findings, suggest a need for further research.[371]

F. Research Needs and Research Agenda

The NRC Committee proposed areas of research needed to resolve the remaining uncertainties. The epidemiological studies' findings of an association between exposure to electric and magnetic fields and cancer, especially childhood leukemia, are the primary reason the public became concerned about the possible adverse health effects. Thus, epidemiological studies using wire codes should be conducted in a manner designed to eliminate control-selection bias and imprecision.[372] Possible confounders relating to wire codes and other risk factors for childhood cancer should be

tested. In addition, more knowledge about sources of magnetic fields is needed, especially how outside wires relate to magnetic fields inside the homes and whether wire codes are representing some other source of exposure. The NRC Committee recommended improved studies of measured residential magnetic fields and sources of magnetic fields other than power lines.[373]

In addition to proposing epidemiological research, the NRC Committee recommended additional laboratory research. While recommending improved engineering techniques for measuring exposure, the NRC Committee stressed the need for a plausible biological explanation to account for an association between expo sure to electric and magnetic fields and adverse health effects.[374] Among the possible productive areas of research for laboratories suggested were studies of bone-healing, studies of in vitro dose-response, and studies of the role that magnetic fields play as a promoter of initiated cancers or when combined with chemical carcinogens.[375]

Finally, the NRC Committee recognized that its work and all the other work supported by the Energy Policy Act of 1992 is not expected to answer all questions relating to the possible health effects of ELF electric and magnetic field exposure. The five-year program ended in 1997. Beyond that time, continued research is important.[376]

V. CONCLUSION

The long-awaited National Research Council Report on the possible health effects of exposure to the electric and magnetic fields which people encounter daily in their homes and places of work concludes that the current evidence does not show that such exposure presents a health hazard. The report also stresses the importance of continued research in this area of possible health effects. The law has been affected by public alarm at the possibility of electric and magnetic fields causing dreaded illnesses such as cancer, and in the devaluation of property in condemnation cases; power line siting controversies; and the causation of ill health effects as the basis of tort litigation. The NRC Report cautions that causation of health hazards has not been demonstrated in any study; even epidemiological studies reporting an association are not reporting causation.

The bottom line of the report appears to reflect an evolutionary point of the law in these areas. Rare damage awards in tort litigation reflect the lack of causal proof between EMF and adverse health effects.[377] Since land value is affected by public opinion, and the public perception is that EMF is a risk to health, damages for property devaluation have been awarded in some cases. Power line siting controversies are often driven by public opinion of risk, and the law has sometimes responded to that public opinion. Given this, society must to assess the NRC Report's potential impact on public perception of EMF and its relative health risks.

Although the report reflects a comprehensive study of the issue and is the latest scientific consensus on the issue, the NRC Report is not likely to have a great effect on the public perception that EMF is a health hazard because public perception is driven by emotion and often varies from reality. Even if electric and magnetic fields do not present a substantial risk to public health, land values near power lines will be affected because the public is unlikely to believe the report.

Public perception of risk is influenced by several factors including: voluntariness, control, fairness, process, morality, familiarity, memorability, dread, and diffusion in time and space.[378] If a person acts voluntarily, such as smoking a cigarette or using a cellular telephone, that person is less likely to perceive a risk from those acts. Related to voluntariness is control. A person is less likely to perceive risk from sources of exposure over which that person exercises control.

When a result seems unfair, a person is likely to associate it with risk. For example, having the air that the public breathes polluted by a factory seems unfair, so the air pollution is more likely perceived as a risk. When morality is involved, as in child abuse, the action is more likely perceived as a risk. Familiarity also influences risk per ception. The mysterious and complex nature of electric and magnetic fields make them more likely viewed as a risk because people tend to fear what they do not understand.

The memorability of an event, such as Three Mile Island or Chernobyl, causes a greater perception of risk. These memorable events heightened the public's fear of nuclear fallout. Dread of something also causes an increased perception of risk. The dread of contracting cancer underlies the public perception of the risk EMF cause. Moreover,

electric and magnetic fields are here today. Unlike risks occurring in the past or at a distant place, the exposure to these fields is ongoing, increasing the perception of risk.[379]

Ultimately, as long as the public believes that electric and magnetic fields are a health risk, effects of that perception will remain. The devaluation of land located near electric and magnetic fields will likely continue because the perception makes the land less desirable. Controversies over power line siting will continue because of the public perception of risk associated with the EMF emanating from them. Moreover, the conclusions of the NRC Report tend to make proof of causation even more difficult.[380] This will keep the number of damage awards in EMF-based tort litigation at a minimum.

Public perception about the risk of EMF exposure will change only when the public's underlying beliefs are changed. Power companies, health departments, and other entities with an interest in changing the public perception of risk must undertake information dissemination programs to educate the public about the true risks of electric and magnetic fields. Of course, no meaningful education programs can occur until further research is done to ascertain the true risk of electric and magnetic fields. Until research can prove conclusively that electric and magnetic fields pose no real threat to human health, fear, in all of its manifestations, will remain.

VI. APPENDIX

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[1] *See* Imre Gyuk, Office of Conservation & Renewable Energy, United States Dep't of Energy, An Overview and the Scientific Evidence to Date, Address at the Transmission & Distribution EMF Conference 3 (Mar. 1993) (illustrating the proportionality of energy per capita consumption to gross national product) (transcript on file with author). Return to text.

[2] *See id.* Return to text.

[3] *See* NATIONAL RESEARCH COUNCIL, POSSIBLE HEALTH EFFECTS OF EXPOSURE TO RESIDENTIAL ELECTRIC AND MAGNETIC FIELDS 13, 23 (1997) [hereinafter NRC REPORT]. The acronym, "EMF," has become a household word because of the publicity concerning the speculation that electric power lines and appliances may cause adverse health effects. Electric and magnetic fields are related; however, they are different in character. *See infra* Part III. Because the National Research Council Committee's report uses the term electromagnetic field (EMF) only when the electric and the magnetic fields are coupled (e.g., high-frequency fields), the terms "electromagnetic field" and "EMF" will not be used in a general way in the remainder of this article. Where these terms are used in the article, they will be used in connection with the popular or public perception. Return to text.

[4] *See* NATIONAL RESEARCH COUNCIL, *supra* note 3, at 44-54. Nancy Wertheimer and Edward Leeper are among the epidemiologists reporting an association between electric and magnetic fields and cancer. Return to text.

[5] *See* San Diego Gas & Elec. Co. v. Superior Ct., 920 P.2d 669 (Cal. 1996) (involving an amicus brief filed by fourteen scientists in which they argued that there is no scientific basis that electromagnetic fields harm human health). Return to text.

[6] *See, e.g.*, PAUL BRODEUR, CURRENTS OF DEATH: POWER LINES, COMPUTER TERMINALS, AND THE ATTEMPT TO COVER UP THEIR THREAT TO YOUR HEALTH (1989) (noting that a staff writer at THE NEW YORKER magazine published in book form a three-part series of articles on cancer hazards associated with electric and magnetic fields). Return to text.

[7] *See infra* notes 21-51 and accompanying text. Return to text.

[8] *See infra* notes 52-77 and accompanying text. Return to text.

[9] *See id*. Return to text.

[10] *See infra* notes 78-85 and accompanying text. Return to text.

[11] The Energy Policy Act of 1992, Pub. L. No. 102-486, 102 Stat. 2776 (1992) (codified at 42 U.S.C. §13478 (1994)). Return to text.

[12] *See* 42 U.S.C. §13478(a)(1)-(3) (describing the purpose of the program). Return to text.

[13] *See infra* notes 180-83 and accompanying text. Return to text.

[14] *See* 42 U.S.C. §13478(g)(2) (delegating research duties to the DOE). Return to text.

[15] On October 31, 1996, after almost 3 years of study, the Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems released its report, which was widely reported by the news media. Return to text.

[16] NRC REPORT, *supra* note 3, at 2. Return to text.

[17] *See id.* at 17 (noting how the NRC Committee applied standards of acceptability for the research it would recognize). Return to text.

[18] *See infra* notes 21-51 and accompanying text. Return to text.

[19] *See infra* notes 52-77 and accompanying text. Return to text.

[20] *See infra* notes 78-85 and accompanying text. Return to text.

[21] *See* Sherry Young, *Regulatory and Judicial Responses to the Possibility of Biological Hazards from Electromagnetic Fields Generated by Power Lines*, 36 VILL. L. REV. 129, 153 (1991). Young's article provides a good discussion of utilities, their relationship to regulatory bodies, and their right to condemn property. Return to text.

[22] *See id.* Return to text.

[23] *See id.* at 153 (citing Johnson v. Consolidated Gas, Elec. Light & Power Co., 50 A.2d 918 Md. (1947) and Montana Power Co. v. Bokma, 457 P.2d 769, 772 Mont. (1969) as examples of cases holding that a utility has the right of eminent domain). Return to text.

[24] *See* U.S. CONST. amend. V. The Fifth Amendment of the United States Constitution provides "nor shall private property be taken for public use without just compensation." States have similar just compensation provisions. *See* ALA. CONST. art. I, §23. Return to text.

[25] *See* Young, *supra* note 21, at 158. Return to text.

[26] *See id.* (noting the lack of flexibility in estimates of fair market value of the condemned property). Return to text.

[27] *See* Selective Resources v. Superior Ct., 700 P.2d 849, 850, 852 (Ariz. Ct. App. 1984) (ruling in a condemnation action that testimony of expert witnesses concerning the biological effects of exposure to electromagnetic fields was highly relevant to the issue of severance damages). Return to text.

[28] *See* Young, *supra* note 21, at 158-59. Return to text.

[29] *See* Goadby v. Philadelphia Elec. Co., 639 F.2d 117, 122 (3d Cir. 1981) (complaining landowner claimed that

electromagnetic field encroached on his land in an area wider than the right of way); San Diego Gas & Elec. Co. v. Daley, 253 Cal Rptr. 144, 150, 152-53 (1988) (admitting evidence of fear of danger from electromagnetic projections; not admitting evidence that no health hazard exists because fear was affecting the value of the retained land); San Diego Gas & Elec. Co. v. 3250 Corp., 252 Cal. Rptr. 853, 859 (1988) (complaining landowner offered evidence at trial of public fear of electromagnetic fields, no error for court to refuse instruction that harmful effects of fields were a hidden defect); Linnebur v. Public Svc. Co., 716 P.2d 1120, 1121-22 (Colo. 1986) (holding that condemnation action for transmission line easement where landowner appealed exclusion of two expert witnesses' testimony that line created a health hazard was not ripe for appeal); Florida Power & Light Co. v. Jennings, 518 So. 2d 895, 896, 898 (Fla. 1987) (holding that landowner's evidence of the effect of public fear of electromagnetic fields was admissible even though no proof fear was reasonable); Florida Power & Light Co. v. Roberts, 490 So. 2d 969, 971 (Fla. 5th DCA 1986) (allowing severance damages based on testimony about electromagnetic fields since research has shown a link between transmission lines and cancer in people living near the lines); Dixie Textile Waste Co. v. Oglethorpe Power Corp., 447 S.E.2d 328, 330 (Ga. Ct. App. 1994) (excluding landowner's expert testimony regarding public fear of electromagnetic fields as hearsay); Iowa Power & Light Co. v. Stortenbecker, 334 N.W.2d 326, 331 (Iowa Ct. App. 1983) (ruling that expert testimony using words "leukemia" and "multiple sclerosis" to illustrate effects of electromagnetic fields from proposed transmission lines more prejudicial than probative as evidence for jury's determination of effect of public fear on market value of remaining land); Ryan v. Kansas Power & Light Co., 815 P.2d 528, 534-35 (Kan. 1991) (holding evidence of public fear, but not personal fear, of health effects of power lines admissible because purpose of evidence is to show factors affecting property value and damages); Meinhardt v. Kansas Power & Light Co., 661 P.2d 820, 822 (Kan. Ct. App. 1983) (excluding testimony of expert appraisers concerning the basis of public fear, court did not abuse its discretion in excluding biomedical engineer's testimony on the hazardous biological effects of power line, nor in concluding his evidence was not germane to market value issue); Duerson v. Kentucky Power Coop., 843 S.W.2d 340, 343 (Ky. Ct. App. 1992) (holding that EMF emissions from transmission lines were not included in the statutory list of contaminants); Zappavigna v. State, 588 N.Y.S.2d 585, 586, (N.Y. App. Div. 1992); Criscuola v. Power Auth., 592 N.Y.S.2d 79, 81 (N.Y. App. Div. 1992) (claiming severance damages award as a result of "cancerphobia," or a public perception that exposure to EMF poses a health risk). Return to text.

[30] *See, e.g,* Banks v. Georgia Power Co., 469 S.E.2d 218, 222 (Ga. Ct. App. 1996) (excluding testimony regarding EMF because not expert). Return to text.

[31] *See, e.g.,* Ryan v. Kansas Power & Light Co., 815 P.2d 528, 535 (Kan. 1991) (admitting non-expert testimony about fear of lines as not prejudicial nor an abuse of discretion). Return to text.

[32] *Linnebur*, 716 P.2d at 1121-22. Return to text.

[33] *See* Chappell v. Virginia Elec. & Power Co., 458 S.E.2d 282, 284 (Va. 1995). Return to text.

[34] *See* Dixie Textile Waste Co. v. Oglethorpe Power Co., 447 S.E.2d 328, 330 (Ga. Ct. App. 1994). Return to text.

[35] *See* Stannard v. Axelrod, 419 N.Y.S.2d 1012, 1016 (N.Y. Sup. Ct. 1979) (dismissing action seeking to compel Department of Health and Environmental Conservation to abate nuisance caused by creation of health hazards by installation of transmission line because PSC had jurisdiction). Return to text.

[36] 739 S.W.2d 508 (Tex. Ct. App. 1987). Return to text.

[37] *See id.* at 511. Return to text.

[38] *See id.* Return to text.

[39] *See id.* Return to text.

[40] *See id.* Return to text.

[41] *See id.* at 516. For a discussion of gauss unit of measuring magnetic field intensity, see *infra* notes 145-50 and accompanying text. Return to text.

[42] For a discussion of the studies, see *infra* notes 300-45 and accompanying text. Return to text.

[43] *See Klein*, 739 S.W.2d at 516. Return to text.

[44] *See id.* Return to text.

[45] *See id.* at 517 Return to text.

[46] *See id.* Return to text.

[47] *See id.* at 511. Return to text.

[48] *See id.* Return to text.

[49] *See id.* at 521. The appellate court did not explain the basis for an award of actual damages. Return to text.

[50] *See id.* Return to text.

[51] *See* Pam Black, *Rising Tension over High-Tension Lines*, BUS. WK., Oct. 30, 1989, at 158 (estimating that power companies have been parties to more than 100 suits where potential health hazards from power lines were an issue). Return to text.

[52] *See* Woida v. United States, 446 F. Supp. 1377, 1387 (D. Minn. 1987) (declining to require utility to analyze health and safety effects of EMF in its environmental impact statement); Douglas County Bd. Comm'rs v. Public Util. Comm'n, 866 P.2d 919, 922 (Colo. 1994) (challenging PUC conclusion that line upgrade did not cause potential adverse health effects mandating denial of application); Couch v. Delmarva Power & Light Co., 593 A.2d 554, 555-56 (Del. Ch. 1991) (denying injunction against utility where owners of farm land claimed proposed lines would create electromagnetic fields that might be linked to cancer and birth defects); Florida Power Corp. v. State Siting Bd., 513 So. 2d 1341, 1343 (Fla. 1st DCA 1987) (holding that Board erred because it denied certification of proposed transmission line corridor until it could determine whether utility had complied by yet-to-be-adopted rules specifying proposed line width necessary to protect against electric and magnetic fields); Stannard v. Axelrod, 419 N.Y.S.2d 1013, 1016 (N.Y. Sup. Ct. 1979) (holding that issues regarding public health aspects of non-ionizing electromagnetic radiation from proposed high voltage transmission line should have been determined in PSC proceeding); Chester Township v. Power Siting Comm'n, 361 N.E.2d 436, 440-41 (Ohio 1977) (upholding commission's decision to base ruling on engineers' testimony that electromagnetic fields surrounding proposed lines would not be detrimental to public); Fretz v. Pennsylvania Pub. Util. Comm'n, 666 A.2d 372, 375-76 (Pa. Commw. Ct. 1995) (finding that utility's proposed upgrade of line using taller structures and reversed phasing would reduce electromagnetic fields at edge of right of way by more than seventy percent); Barensfeld v. Pennsylvania Pub. Util. Comm'n, 624 A.2d 809, 811 (Pa. Commw. Ct. 1993) (denying Citizens Opposed to Unsafe Power the right to intervene in PUC siting and transaction proceedings or to have proceedings consolidated for several reasons, including the effect of EMF on the public). *See also* State of Wisconsin v. Weinberger, 745 F.2d 412, 420 (7th Cir. 1984) (seeking injunction of extremely low frequency (ELF) submarine communications project where court held that post-1977 evidence of effects of ELF on health was not required to be included in EIS because it did not present a different picture from the one in 1977). Return to text.

[53] *See* Young, *supra* note 21, at 169-78. A PUC balances the public's interest in being able to access a reliable source of electric power against the harm the facilities required to provide that source may cause to the public. *See id.* Return to text.

[54] *See id.* Return to text.

[55] *See* Goadby v. Philadelphia Elec. Co., 639 F.2d at 119 (finding "[b]oth the ground level electric field and the magnetic flux density of the line, using the most extreme theoretical conditions, are well below the danger levels . . . . [T]he proposed line . . . will present no danger to the public's health or safety."). Return to text.

[56] *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, OTA-BP-E-53, BIOLOGICAL EFFECTS OF POWER FREQUENCY ELECTRIC AND MAGNETIC FIELDS&EMDASH;BACKGROUND PAPER 76 (May 1989) [hereinafter OTA BACKGROUND PAPER]. THE OTA BACKGROUND PAPER is an earlier report on the possible health effects of electric and magnetic fields by the Congress of the United States Office of Technology Assessment (OTA), an office whose function is to help Congress keep abreast of technological changes. Return to text.

[57] *See* Douglas County Bd. of Comm'r v. Public Util. Comm'n, 829 P.2d 1303, 1306 (Colo. 1992) (challenging PUC conclusion that cost of burial of proposed lines as a means of prudent avoidance outweighed the benefits of burial). Return to text.

[58] *See* OTA BACKGROUND PAPER, *supra* note 56, at 78-79 (citing M.G. Morgan et al., *Controlling Exposure to Transmission Line Electromagnetic Fields: A Regulatory Approach that is Compatible with the Available Science*, PUBLIC UTILITIES FORTNIGHTLY (Mar. 17, 1988)). Return to text.

[59] *See id.* at 79. Return to text.

[60] 626 N.Y.S.2d 414 (N.Y. Sup. Ct. 1995). Return to text.

[61] *See id*. Return to text.

[62] *See id.* at 415-16. Return to text.

[63] *See generally* Sager A. Williams, Jr., Comment, *Limiting Local Zoning Regulation of Electric Utilities: A Balanced Approach in the Public Interest*, 23 U. BALT. L. REV. 565 (1994) (discussing zoning laws applied to the electric power industry because of EMF). Return to text.

[64] 617 A.2d 104 (R.I. 1992). Return to text.

[65] 651 A.2d 725 (R.I. 1994). Return to text.

[66] *See O'Neill*, 617 A.2d at 106. The ordinance was known as the "High Voltage Line Moratorium Act" and stated that the purpose of the Act was to allow time for those entities studying the effects of exposure to electromagnetic fields to determine whether they present a health risk. *See id.* at n.1. Return to text.

[67] *See id.* at 107. Return to text.

[68] *See id.* at 114. Return to text.

[69] *See* 651 A.2d at 725. Return to text.

[70] *See id.* at 727-30. The amendments provided that the siting and construction of power lines and power generating facilities be done in an effort to reduce EMF exposure, that future substations be designed with the same objective, and that the town adopt a policy to regulate siting of lines to reduce EMF exposure to the lowest possible level. Return to text.

[71] *Id.* at 729. Return to text.

[72] *See, e.g.*, Nynex Mobile Communications Co. v. Hazlet Township Zoning Bd. Of Adjustment, 648 A.2d 724 (N.J. Super. Ct. App. Div. 1994). In this case, the town had denied a zoning variance to permit a cellular telephone facility on top of a nonconforming-use water tower. *See id.* The town's experts said that EMF was "definitely detrimental," though the level of cause and effect was *unknown. See id.* at 728. The court, in reversing the denial of the variance, said that "the so-called health and safety issues are nothing but rank speculation" and "unsubstantiated fears which cannot form the basis for a denial of an otherwise viable application." *Id.* at 732. For a discussion of EMF with respect to cellular telephone facilities, *see* Dean J. Donatelli, Note, *Locating Cellular Telephone Facilities: How Should Communities Answer When Cellular Telephone Companies Call?*, 27 RUTGERS L.J. 447 (1996). Return to text.

[73] *See* MacNamara v. County Council of Sussex County, 738 F. Supp. 134, 137-38, 141-42 (D. Del. 1990) (dismissing claim because property owners concerned about EMF had no property interest with respect to the rezoning that was protected by due process). Return to text.

[74] *See* Town of Framingham v. Department of Public Util., 244 N.E.2d 281 (Mass. 1968). Return to text.

[75] *See* Newport Elec. Corp. v. Town of Portsmouth, 650 A.2d 489, 493 (R.I. 1994) (complaining utility company supported its objection to the re-zoning to residential of its lots located next to its property zoned industrial and on which it may construct a future power line by testimony that it had "concerns and objections relative to EMF and these overhead power lines."). Return to text.

[76] *See id.* Return to text.

[77] *Id.* at 493. Return to text.

[78] *See* John Weiss, *The Power Line Controversy: Legal Responses to Potential Electromagnetic Field Health Hazards*, 15 COLUM. J. ENVTL L. 359, 363 (1990). Return to text.

[79] *See id.* Return to text.

[80] *See* Andrews Continuing Education Institute, Electromagnetic Field Litigation: The Next Asbestos? (1993) (transcript on file with author). This seminar was presented "for attorneys, insurers and other professionals interested in the latest legal strategies, and state-of-the-art scientific data concerning magnetic fields" and "[f]eatur[ed] cellular telephone, power line and radar gun litigation discussions, a mock EMF trial and much more!" *Id.* at 1. In May 1993 Andrews Publications began publishing the ELECTROMAGNETIC FIELD LITIG. REP., a monthly journal reporting on cases involving personal injury, property devaluation, fear of cancer, admissible science and other issues in the electromagnetic field litigation area of law. Return to text.

[81] *See* Mark A. Hoffman, *Study Debunks EMF Risks: Report Sees No Link to Illness*, BUSINESS INSURANCE (Nov. 4, 1994), 1996 WL 12786305. For a survey of health and other claims related to EMF, *see generally* ELECTROMAGNETIC FIELD LITIG. REP. (reporting cases involving electromagnetic litigation). Return to text.

[82] *See* Jordan v. Georgia Power Co., 466 S.E.2d 601, 603 (Ga. App. 1995) (claiming that as a result of EMF property was unsafe and Nancy Jordan developed non-Hodgkin's lymphoma). Return to text.

[83] *See* San Diego Gas & Elec. Co. v. Superior Ct., 920 P.2d 669, 679-80, 694 (Cal. 1996) (alleging five personal injury causes of action including "medical monitoring," intentional and negligent infliction of emotional distress, strict product liability, and negligent product liability). Return to text.

[84] *See* Florida Power & Light Co. v. Glazer, 671 So. 2d 211, 213 (Fla. 3d DCA 1996) (alleging contraction of chronic myelogenous leukemia (CML) because of continuous exposure to magnetic fields emanating from utility's transformer and distribution lines). Return to text.

[85] *See In re Brewer*, 18 ELECTROMAGNETIC FIELD LITIG. REP. 10 (Apr. 1995). In this workman's compensation case, the Washington Department of labor & Industries first awarded benefits to an aluminum smelters plant worker based on his claim that his terminal non-Hodgkin's lymphoma was caused by exposure to high levels of EMF and then reversed that award of benefits because the condition did not result from a defined industrial injury and was not an occupational disease. Return to text.

[87] A commonly experienced example of this phenomenon is when a sock clings to a shirt after both items have been in a drier rubbing together. The rubbing together causes the clothes to pick up or lose electrons from one another producing the familiar "static electricity." *See id.* Return to text.

[88] *See* OTA BACKGROUND PAPER, *supra* note 56, at 7. Return to text.

[89] *See id.* at 8. Return to text.

[90] *See id.* at 1. Return to text.

[91] *See id.* at 4. Hair dryers, electric razors, electric curlers, bedside radios, blenders, vacuum cleaners, televisions, microwave ovens, and personal computers are routinely used in modern society. These items are now considered necessities of modern life, rather than mere conveniences. Electric and magnetic fields also arise from many natural sources and are present in all living organisms. *See id.* Return to text.

[92] *See* OTA BACKGROUND PAPER, *supra* note 56, at 4. Return to text.

[93] *See id.* at 5 (Fig. 2-1). Return to text.

[94] *See id.* Return to text.

[95] *See id.* at 4. Return to text.

[96] *See id.* Return to text.

[97] *See id.* Return to text.

[98] *See id.* Return to text.

[99] *See id.* (citing D. Minner, *The Top 100 Utilities 1986 Operating Performance*, ELECTRIC LIGHT AND POWER (August 1987); Energy Information Administration, U.S. Department of Energy, Statistics of Privately-Owned Electric Utilities, 1981 Annual Technical Report 130 E/EIA-0044(81) (1983)). Return to text.

[100] *See* NRC REPORT, *supra* note 3, at 11. Return to text.

[101] *See* OTA BACKGROUND PAPER, *supra* note 56, at 1. Return to text.

[102] *See id.* Return to text.

[103] *See* NRC REPORT, *supra* note 3, at 11 n.1. Return to text.

[104] *See id.* Return to text.

[105] *See id.* Return to text.

[106] *See id.* Return to text.

[107] *See id.* at 12 n.4. Return to text.

[108] *See id.* at 24. Waveform, the change in amplitude and phase with time, is another characteristic of AC electric or magnetic fields. *See id.* The waveform of 50-60 Hz AC fields encountered in the environment is the sinusoidal field, those most often used in biological experiments. *See id.* Sinusoidal fields can contain distortions causing "harmonics," which are multiples of the fundamental frequency, such as 120 Hz, 180 Hz, 240 Hz, etc. *See id.* Return to text.

[109] *See id.* at 12. Return to text.

[110] *See id.* Return to text.

[111] *See id.* at 11 n.2. Return to text.

[112] *See* Appendix. Return to text.

[113] *See* NRC REPORT, *supra* note 3. Return to text.

[114] *See id.* at 12 n.3, 24 (noting the frequencies that are generally designated "ELF" are range from 3 Hz to 3000 Hz (3 kHz)). Return to text.

[115] *See id.* at 12. Return to text.

[116] *See id.* Return to text.

[117] *See id.* Return to text.

[118] *See id.* Return to text.

[119] *See id.* Return to text.

[120] *See id.* Return to text.

[121] *See* Tom Watson and Curtis S. Renner, *The Scientific and Legal Bases for Litigating EMF Property Cases*, *in* CURRENT CONDEMNATION LAW: TAKINGS, COMPENSATION & BENEFITS 126, 128 (Alan T. Ackerman ed., 1994). The concern about possible health effects of exposure to EMF originated during World War II when men were exposed to high-frequency radar systems and video screens. Subsequently, claims of adverse health effects arose in connection with police radar guns, cellular phones, microwave ovens and other high-frequency sources. *See* NRC REPORT, *supra* note 3, at 10. Radar guns and cellular telephones are beyond the very high fre quency range on the Electromagnetic Spectrum and thus are not examples of the extra low frequency residential electric and magnetic fields. *See Blesy et al. v. Kustom Signals*, 18 ELECTROMAGNETIC FIELD LITIG. REP. 13 (concerning radar guns); *Ward v. Motorola*, 18 ELECTROMAGNETIC FIELD LITIG. REP. 8 (concerning cellular telephones). Return to text.

[122] *See* NRC REPORT, *supra* note 3, at 12. Return to text.

[123] *See* Watson & Renner, *supra* note 121, at 129. Return to text.

[124] *See id.* Return to text.

[125] NRC REPORT, *supra* note 3, at 12. Return to text.

[126] *Id.* at 13. Return to text.

[127] *See* OTA BACKGROUND PAPER, *supra* note 56, at 6. Electric and magnetic fields are either propagating or non-propagating. *See id.* Propagating fields travel long distances from their source; non-propagating fields are confined to the vicinity of their source. *See id.* "A wavelength is the distance that a propagating field travels during one oscillatory cycle." *Id.* The intensity of a confined field decreases more rapidly with distance from the source of the field than does the intensity of a propagating field, so propagating fields dominate at distances far from the source as compared to the distance traveled by one 60 Hz wavelength, which covers several thousand kilometers. *See id.* The power frequency fields that people are exposed to are the non-propagating type because the 60 Hz wavelength is on the lower end of the electromagnetic spectrum. *See id.* The exposure to people is greatest because of the proximity of power lines and electric appliances. The term "radiation" refers to propagating fields and not to the confined, non-propagating type, but because low frequency EMF or ELF are non-propagating, to use the term "ELF radiation" is technically inappropriate. *See id.* Return to text.

[128] *See* ASHER R. SHEPPARD & MERRILL EISENBUD, BIOLOGICAL EFFECTS OF ELECTRIC AND MAGNETIC FIELDS OF EXTREMELY LOW FREQUENCY 1-1 (1977). Return to text.

[129] *See id.* Return to text.

[130] *Id.* at 2-7, 2-8. Electric or magnetic fields are involved in the following normal biological functions: normal brain rhythms as observed by electroencephalogram and magneto encephalogram patterns; the activity of the nervous system; bone growth, and the regeneration of new bone growth after injury; and natural sensitivity to very weak electric and magnetic fields in fish, birds, and bacteria. *See id.* Return to text.

[131] *See* NRC REPORT, *supra* note 3, at 22. Interestingly, nerve cells have electric activity within them and cause current densities on the surface of the body. A human would have to be exposed to a 60 Hz field of 1 G to produce an equivalent current density within the body. Typical residential fields are about 1 mG, and thus cause induced current densities that are 1,000 times less than those induced by nerve cell activity. Return to text.

[132] *See* OTA BACKGROUND PAPER, *supra* note 56, at 16 (citing Kaune & Phillips, *Dosimetry for Extremely Low-Frequency Electric Fields*, *in* BIOLOGICAL EFFECTS OF AND DOSIMETRY OF STATIC AND ELF ELECTROMAGNETIC FIELDS (M. Grandolfo & S. Michaelson eds., 1985)). When the free electric charges, contained in the ion-rich blood and lymph fluids in the human body, move in response to charges on and currents in nearby power lines and appliances, the currents in the body have been produced by electric or magnetic induction. *See id.* Body shape, posture, orientation, size of charges and currents in the source, distance from source, and presence of shields all affect the surface charge and body currents. *See id.* Return to text.

[133] *See* NRC REPORT, *supra* note 3, at 13. Return to text.

[134] *See id.* Return to text.

[135] *See id.* Return to text.

[136] *See id.* Return to text.

[137] *See id.* at 12. Physicist James Clerk Maxwell described the relationship between magnetic fields and electric fields in the nineteenth century. He showed that changing magnetic fields produce electrical fields and that alternating currents of electricity produce magnetic fields. *See* OTA BACKGROUND PAPER, *supra* note 56, at 16. Return to text.

[138] *See* NRC REPORT, *supra* note 3, at 12. Return to text.

[139] *See id.* at 13. The term "electromagnetic field" or "EMF" is used to generally describe electric and magnetic fields together. Return to text.

[140] *See id.* Return to text.

[141] *See* OTA BACKGROUND PAPER, *supra* note 56, at 7. Return to text.

[142] *See id.* at 7. Return to text.

[143] *See id.* at 8. Return to text.

[144] *See id.* Return to text.

[145] *See id.* Return to text.

[146] *See id.* Return to text.

[147] *See id.* Return to text.

[148] *See id.* Return to text.

[149] *See* NRC REPORT, *supra* note 3, at 16. Return to text.

[150] *See id.* Return to text.

[151] *See id.* at 26-27 (citing ANSI/IEEE, PROCEDURES FOR MEASUREMENT OF POWER FRE QUENCY ELECTRIC AND MAGNETIC FIELDS FROM AC POWER LINES. 644 (1987)). Measurement procedures are described in detail by the cited study. Return to text.

[152] *See id.* at 25-26. Return to text.

[153] *See id.* at 25. Electric and magnetic fields have many complex characteristics such as strength, harmonics (integral multiples of a fundamental frequency), transients (short duration signals containing a range of frequencies and appearing at irregular time intervals), temporal and spatial changes. *See id.* Strength of the 60 Hz magnetic field has been the characteristic tacitly assumed in the majority of studies to be directly related to exposure. *See id.* The strength is measured as the average root-mean-square (rms, a time averaged measurement). Return to text.

[154] *See id.* Return to text.

[155] *See id.* at 25 (citing W.T. Kaune and M.L. Gillis, *General Properties of the Interaction Between Animals and ELF Electric Fields*, 2 BIOELECTROMAGNETICS 1-11 (1981)). Return to text.

[156] *See id.* at 25. Return to text.

[157] *See id.* Return to text.

[158] *See id.* at 26-27. The devices can be set to record many samples of a magnetic field over a long period of time, for example, a sample every 10 seconds for 24 hours. *See id.* The electric and magnetic field measuring devices frequently are calibrated against the calculated field because, when properly performed, calculations of the fields are more accurate than measurements. Return to text.

[159] *See* NRC REPORT, *supra* note 3, at 27. Return to text.

[160] *See id.* (citing Electric Power Research Institute, Palo Alto, Cal., PROJECT RP 2966-1, THE EMDEX PROJECT: TECHNOLOGY TRANSFER AND OCCUPATIONAL MEASUREMENTS, EN-7048-V1, - V2, and -V3 (1990)) [hereinafter EMDEX PROJECT]. Return to text.

[161] *See id.* at 27-28. Return to text.

[162] *See id.* at 28. Return to text.

[163] *See id.* Return to text.

[164] *See id.* (citing OFFICE OF RADIATION AND INDOOR AIR, U.S. ENVTL. PROTECTION AGENCY, EPA/402/R-92/008, EMF IN YOUR ENVIRONMENT: MAGNETIC FIELD MEASUREMENTS OF EVERYDAY ELECTRICAL DEVICES (1992)) [hereinafter EMF ENV'T]. For a 115 kV transmission line, an average representative magnetic field 91.4 m away was 0.2 mG; for a 230 kV line, the average field was 0.8 mG; and for 500 kV line, the average field was 1.4 mG. Return to text.

[165] *See* NRC REPORT, *supra* note 3, at 32. At peak usage the average figures given in note 118 could double. Return to text.

[166] *See id.* Of course, magnetic fields are strongly present within the substation itself. Return to text.

[167] *See id.* Return to text.

[168] *See id.* Return to text.

[169] *See id.* at 32-33. Burial in underground pipes decreases the typical field to less than one mG because the close spacing of the wires and the metal pipe decreases the field. However, with direct burial, though the wires are closer, thus decreasing the field, the wires are closer to the surface of the ground than overhead wires, thus increasing the field. *See id.* Return to text.

[170] For example, the NRC Committee cited and included in its report tables from: EMF ENV'T, *supra* note 164; EMDEX PROJECT, *supra* note 160. Return to text.

[171] *See* NRC REPORT, *supra* note 3. Return to text.

[172] *See id.* at 28-29 (citing Geomet Technologies, Inc., PROJECT RP2966-04, ASSESSMENT OF CHILDREN'S LONG-TERM EXPOSURE TO MAGNETIC FIELDS (THE GEOMET STUDY), Rep. TR-101406 (1993) [HEREINAFTER GEOMET STUDY]. At the 95th percentile the kitchens averaged 3.5 mG. Interpretation of the study assumes that a person's activity pattern is uniformly distributed in the living space. Return to text.

[173] *See* NRC REPORT, *supra* note 3, at 29-30 (citing EMF ENV'T, *supra* note 164). Return to text.

[174] *See id.* Return to text.

[175] *See id.* at 31 (citing GEOMET STUDY, *supra* note 172). Return to text.

[176] *See id.* at 30. For positive-temperature-coefficient blankets the fields average about one mG. Return to text.

[177] *See id.* at 31. When measurements are taken at fixed positions in the rooms, they are consistently lower than personal exposure measurements. Return to text.

[178] *See id.* at 33. Return to text.

[179] *See id.* at 118-19. Return to text.

[180] *See id.* at xix. Return to text.

[181] *See id.* Return to text.

[182] *See id.* Return to text.

[183] *See id.* Return to text.

[184] *See id.* at 9-10. The Board on Radiation Effects Research of the NRC's Commission on Life Sciences convened the Committee to perform the review and report its finding. Return to text.

[185] See i*d.* at 10. The Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems consisted of the following people:

CHARLES F. STEVENS (*Chair*), Howard Hughes Medical Institute, Salk Institute, La Jolla, Calif.

DAVID A. SAVITZ (*Vice Chair*), Department of Epidemiology, University of North Carolina, Chapel Hill, N.C.

LARRY A. ANDERSON, Pacific Northwest National Laboratory, Richland, Wash.

DANIEL A. DRISCOLL, Department of Public Service, State of New York, Albany, N.Y.

FRED H. GAGE, Laboratory of Genetics, Salk Institute, San Diego, Calif.

RICHARD L. GARWIN, IBM Research Division, Yorktown Heights, N.Y.

LYNN W. JELINSKI, Center for Advanced Technology-Biotechnology, Cornell University, Ithaca N.Y.

BRUCE J. KELMAN, Golder Associates, Inc., Redmond, Wash.

RICHARD A. LUBEN, Division of Biomedical Sciences, University of California, Riverside, Calif.

RUSSELL J. REITER, Department of Cellular and Structural Biology, University of Texas Health Sciences Center, San Antonio, Tex.

PAUL SLOVIC, Decision Research, Eugene, Oreg.

JAN A. J. STOLWIJK, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Conn.

MARIA A. STUCHLY, Department of Electrical and Computer Engineering, University of Victoria, B.C., Canada.

DANIEL WARTENBERG, UMDNJ-Robert Wood Johnson, Medical School, Piscataway, N.J.

JOHN S. WAUGH, Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

JERRY R. WILLIAMS, The Johns Hopkins Oncology Center, Baltimore, Md. Return to text.

[186] *See id.* Return to text.

[187] *See* NRC REPORT, *supra* note 3, at 17. Cancer is an especially dreaded disease. One can easily understand why a potential risk of cancer caused by exposure to electric and magnetic fields is of particular concern, and the fact that childhood leukemia has been associated with ELF only increases that concern. Return to text.

[188] *See id.* Return to text.

[189] *See id.* at 53-54. The NRC Committee cautioned that a problem exists in interpreting the responses of cells in culture in terms of the manner in which cells in a living body (in vivo) would respond. Similar exposures and appropriate surrogates are required. Confidence in results from power frequency field exposure is gained by experiments that produce responses similar to those responses produced by known carcinogens, neurotoxins, or developmental toxins. Return to text.

[190] *See id.* at 52-53. The NRC Committee was impressed by the number and quality of studies reporting negative results. The few studies reporting positive results used no superior methods or cell systems as would warrant the NRC Committee concluding other than that residential magnetic field strengths (0.1 to 10 G) have no significant effects on cultured cell systems. Return to text.

[191] *See id.* at 53. Return to text.

[192] *See id.* at 56. Other indicated heritable changes include non-heritable chromosomal aberrations and sister chromatid exchanges (SCE). Return to text.

[193] Twenty-two of the 24 sinusoidal field exposure studies reported negative results. *See id*. (citing J.E. McCann, et al., *A Critical Review of the Genotoxic Potential of Electric and Magnetic Fields*, 297 MUTAT. RES. 61 (1993) (reviewing many of the studies in Table A3-1 in Appendix A of the NRC Report and concluding that no convincing evidence exists that power frequency fields induce direct genotoxic effects)); J.C. Murphy et al., *Power Frequency Electric and Magnetic Fields: A Review of Genetic Toxicology*, 296 MUTAT. RES. 221 (1993) (studying under the auspices of the International Commission for Protection Against Environmental Mutagens and Carcinogens and concluding no genotoxic effect by the preponderance of the data, but noting need for further study)). Two studies from the same laboratory reported positive genotoxicity results. *See id.* (citing G. D'Ambrosio et al., *Chromosomal Aberrations Induced by Extremely Low Frequency Electric Fields*, 4 J. BIOELECTROMAGNETICS 279 (1985); D'Ambrosio et al., *Chromosomal Aberrations in Bovine Lymphocytes Exposed to 50-Hz Electric Currents*, 7 J. BIOELECTROMAGNETICS 239 (1988-1989)). Studies using fields other than sinusoidal 50-60 Hz fields, such as high-frequency EMF, static fields, or pulsed (intermittently applied) fields, were also included in Table A3-1. *See id.* Genotoxic effects were reported where fields were pulsed or intermittent and the exposure levels were much higher than those commonly experienced in residences and workplaces. *See id.* at 56-57 (citing I. Nordenson et al., *Chromosomal Aberrations in Human Amniotic Cells After Intermittent Exposure to Fifty Hertz Magnetic Fields*, 15 BIOELECTROMAGNETICS 293 (1994); A.M. Khalil & W. Qassem, *Cytogenic Effects of Pulsing Electromagnetic Field on Human Lymphocytes In Vitro: Chromosome Aberrations, Sister-Chromatid Exchanges and Cell Kinetics*, 247 MUTAT. RES. 141 (1991)). Positive genotoxic effects in the form of excess SCE in human lymphocytes when exposed to 50-Hz sinusoidal magnetic fields and an agent used in the treatment of ovarian cancer were reported, though the authors of the study questioned the results. *See id.* at 57 (citing M. Rosenthal & G. Obe, *Effects of 50-Hertz Electromagnetic Fields on Proliferation and on Chromosomal Alterations in Human Peripheral Lymphocytes Untreated or Pretreated with Chemical Mutagens*, 210 MUTAT. RES. 329 (1989)). A study using pulse-modulated microwaves alone and following or preceding X-rays reported transformed foci in certain cells. *See id.* (citing E.K. Balcer-Kubiczek & G.H. Harrison, *Neoplastic Transformation of C3H/10T1/2 Cells Following Exposure to 120-Hz Modulated 2.45-GHz Microwaves and Phorbal Tumor Promoter*, 126 RADIAT. RES. 65 (1991)). These studies

and others involving high-frequency EMF and tumor promoters prompted the NRC Committee to mention the possibility of the need for further study in this area, but, because of the great majority of negative effects for 50-60 Hz field exposure, the NRC Committee concluded that power frequency fields are not a direct genotoxic agent. Return to text.

[194] *See* NRC REPORT, *supra* note 3, at 58. Heritable changes and transient changes are the two categories of changes observed in cultured cells exposed to electric and magnetic fields and are relevant to carcinogenic, neurobehavioral, and reproductive effects of concern in attempts to evaluate potential hazards associated with fields. Because developmental toxins need act only a short time during gestation, developmental effects are most susceptible to transient changes caused by electric and magnetic field exposure. Return to text.

[195] *See id.* at 58. Return to text.

[196] *See id.* at 6. Return to text.

[197] *See id.* Return to text.

[198] *See id.* at 58 (citing W.R. Adey, *ELF Magnetic Fields and Promotion of Cancer Experimental Studies & Collective Properties of Cell Membranes, in* INTERACTION MECHANISMS OF LOW- LEVEL ELECTROMAGNETIC FIELDS IN LIVING SYSTEMS at 23-46, 47-77 (B. Norden & C. Ramel eds., 1992); R. Cardossi et al., *Lymphocytes and Low-Frequency Electromagnetic Fields*, 6 FASEB J. 2667 (1992); S.F. Cleary, *A Review of In Vitro Studies: Low-Frequency Electromagnetic Fields*, 54 J. AM. IND. HYG. ASSOC. 178 (1993); R.P. Liburdy, *ELF Fields and the Immune System: Signal Transduction, Calcium metabolism, and Mitogenesis in Lymphocytes with Relevance to Carcinogenesis, in* INTERACTION MECHANISMS OF LOW- LEVEL ELECTROMAGNETIC FIELDS IN LIVING SYSTEMS AT 217 (B. Norden & C. Ramel eds., 1992); R.A. Luben, *Effects of Low-Energy Electromagnetic Fields (Pulsed and DC) on Membrane Signal Transduction Processes in Biological Systems*, 61 HEALTH PHYS. 15 (1991); R.A. Luben, *Effects of Low-Energy Electromagnetic Fields (EMF) on Signal Transduction by G Protein-Linked Receptors, in* ELECTRICITY AND MAGNETISM IN BIOLOGY AND MEDICINE at 57 (M. Blank ed., 1993); T.S. Tenforde, *Biological Interactions of Extremely-Low-Frequency Electric and Magnetic Fields*, 25 BIOELECTROCHEMISTRY AND BIOENERGETICS 1 (1991); T.S. Tenforde, *Biological Interactions and Potential Health Effects of Extremely-Low-Frequency Magnetic Fields from Power Lines and Other Common Sources*, 13 ANNU. REV. PUBLIC HEALTH 173 (1992); J. Walleczek, *Electromagnetic Field Effects on Cells of the Immune System: The Role of Calcium Signaling*, 6 FASEB J. 3177 (1992)). Return to text.

[199] *See* NRC REPORT, *supra* note 3, at 16. The NRC Committee explains:

At the end of the risk-assessment process, the body of evidence is weighed together to reach an overall assessment of a possible hazard. If the results from several areas of research (e.g., epidemiologic [sic] studies, tests in cell systems, or whole animal studies) are consistent and have been replicated and if a biologically plausible mechanism of action for the effect is evident, the evidence for the effect is given great weight. In contrast, a body of evidence that includes inconsistent and conflicting results, no replication of results, and effects that are often at the threshold of detection might be given little weight in reaching a conclusion.

Id. Return to text.

[200] *See id.* at 62. Return to text.

[201] *See id.* at 53, 61-62 (citing C.V. Byus et al., *The Effects of Low-Energy 60-Hz Environmental Electromagnetic Fields Upon the Growth-Related Enzyme Ornithine Decarboxylase*, 8 CARCINOGENESIS 1385 (1987) (reporting that human lymphoma cells, mouse myeloma cells, and rat hepatoma cells showed increase in ODC activity when exposed to 60 Hz electric field)). Return to text.

[202] *See id.* at 61-62. The hypothesis is discussed further *infra* at notes 205-11 and accompanying text. Return to text.

[203] *See id.* at 62-63 (citing R.P. Liburdy et al., *ELF Magnetic Fields, Breast Cancer, and Melatonin: 60-Hz Fields Block Melatonin's Oncostatic Action on ER-Positive Breast Cancer Cell Proliferation*, 14 J. PINEAL RES. 89 (1993)). Return to text.

[204] *See id.* Return to text.

[205] *See id.* Return to text.

[206] *See id.* at 63. Return to text.

[207] *See id.* Return to text.

[208] *See id.* Magnetic fields at one G and above and electric fields at 10 kV/m and above likely have some effect. Return to text.

[209] *See id.* Return to text.

[210] DNA is the molecular basis of heredity. When genetic information is transferred to a messenger RNA molecule from the DNA molecule, the process is called "transcription." *See* 18 THE OXFORD ENGLISH DICTIONARY 393 (2d ed. 1989). Return to text.

[211] *See* NRC REPORT, *supra* note 3, at 63 (citing R. Goodman & A. Shirley-Henderson, *Transcription and Translation in Cells Exposed to Extremely Low Frequency Electromagnetic Fields*, 25 BIOELECTROCHEMISTRY AND BIOENERGETICS 335 (1991) (reporting an increase in transcription in selected chromosome loci of salivary gland cells)). Return to text.

[212] *See id.* Return to text.

[213] *See id.* at 64-65 (citing J.L. Phillips et al., *Magnetic Field Induced Changes in Specific Gene Transcription*, 1132 BIOCHEMISTRY AND BIOPHYSICS ACTA 140 (1992) (showing transient changes in transcription rates)). Return to text.

[214] *See id.* at 65. Return to text.

[215] *See id.* at 65-66 (citing J.D. Saffer & S.J. Thurston, *Short Exposures to 60 Hz Magnetic Fields Do Not Alter MYC Expression in HL60 or Daudi Cells*, 144 RADIAT. RES. 18 (1995); A. Lacy-Hulbert et al., *No Effect of 60-Hz Electromagnetic Fields on MYC or Beta-actin in Human Leukemic Cells*, 144 RADIAT. RES. 9 (1995)). Return to text.

[216] *See id.* Return to text.

[217] *Id.* at 65. Return to text.

[218] *See id.* at 66. Return to text.

[219] *See id.* Return to text.

[220] *See id.* at 66-67. Return to text.

[221] *See id.* at 67. The NRC Report did not discuss earlier studies except for those on the effects of electric and magnetic fields on calcium efflux from chick brains. Return to text.

[222] *See id.* at 72. Many studies from the past twenty years show some positive association between changes in calcium concentrations and field exposure, but often depend on concepts designated as "frequency windows," "temperature windows," or "power-density windows" to explain the association. Return to text.

[223] *See id.* Often statistical significance is achieved only after data is pooled. Return to text.

[224] *See id.* In some of the experiments, the exact experimental protocols were not followed. In others, the investigators were not able to replicate the experiments. Return to text.

[225] *See id. at* 72 (citing R.P. Liburdy, *Calcium Signaling in Lymphocytes and ELF Field: Evidence for an Electric Field Metric and a Site of Interaction Involving the Calcium Ion Channel*, 301 FEBS LETT. 53 (1992); J. Walleczek & T.F. Budinger, *Pulsed Magnetic Field Effects on Calcium Signaling in Lymphocytes: Dependence on Cell Status and Field Intensity*, 314 FEBS LETT. 351 (1992); M.G. Yost & R.P. Liburdy, *Time-Varying and Static Magnetic Fields Act in Combination to Alter Calcium Signal Transduction in the Lymphocyte*, 296 FEBS LETT. 117 (1992)). Return to text.

[226] *See id.* Return to text.

[227] *See id.* at 53. Return to text.

[228] *See id.* Return to text.

[229] *See id.* at 73. Return to text.

[230] *See id.* at 156. A study is conducted blindly when the researchers are without knowledge at to whether the subject is a case or a control. The knowledge that a home was occupied by a case child or a control child could have introduced bias in the study. Return to text.

[231] *See id.* at 74. Return to text.

[232] *See id.* at 73-74. Though evidence does exist that neuroendocrine changes result from exposure to residential strength fields, these changes have not been shown to produce adverse health effects. Return to text.

[233] *See id.* at 74. Return to text.

[234] *See id.* at 75-76 (citing C.D. Klaasen & D.L.Eaton, *Principles of Toxicology*, *in* CASARATT AND DOUL'S TOXICOLOGY: THE BASIC SCIENCE OF POISONS 12 (M.O. Amdur et al. eds., 4th ed. 1991)). Return to text.

[235] *See* NRC REPORT, *supra* note 3, at 74-75. There are two types of dose-response relationships: individual dose-response relationship, describing the responses of an individual to different doses of an agent; and population dose-response reationship, describing the distribution of responses of a population of individuals to different doses. Return to text.

[236] *See id.* at 75. The NRC Committee urged caution in using the term "dose-response" relationship where an epidemiological study finds an association between a disease and one or more variables because such use is always "suspect until the variable is shown to be a representative factor of the putative causative agent." *Id.* Return to text.

[237] *See id.* Actually measuring the dose that reached the site where an effect is detected is the most accurate way to determine dose-response data. This is usually not done because of the cost, but rather, measurement of exposure is substituted for true dose measurement. In considering adverse health effects in individual dose-response relationships, the usual characteristic is the greater the dose of a toxin, the greater the response. Return to text.

[238] *See id.* Return to text.

[239] *See id.* Return to text.

[240] *See id.* at 73. Return to text.

[241] *See id.* at 79. The epidemiological studies reporting an association between estimated exposures to fields and cancer generated research interest in a possible connection between magnetic fields and cancer. The epidemiological studies are discussed at *infra* notes 298-346 and accompanying text. Return to text.

[242] *See id.* at 79-80. Return to text.

[243] *See id.* at 79.

244. See id. at 80. Return to text.

[245] *See id.* at 122-23. Confounding agents are agents "causing a mixing of effects between the exposure of interest and extraneous risk factors" and "is not a product of the design or conduct of the study, but results from a natural association among risk factors." *Id.* Return to text.

[246] *See id.* at 79-81 (citing D.Sh. Beniashvili & M.Z. Menabde, *Low-Frequency Electromagnetic Radiation Enhances the Induction of Rat Mammary Tumors by Nitrosomethyl Urea*, 61 CANCER LETT.75 (1991) (reporting a mammary tumor-promotion study in rats finding an increase in mammary gland tumors in rats exposed to magnetic fields at 200 mG for 3 hours a day); B.M. Svedenstal & B. Holmberg, *Lymphoma Development Among Mice Exposed to X-rays and Pulsed Magnetic Fields*, 64 INT. J. RADIAT. BIOL. 119 (1993) (reporting a lymphoma study in mice finding no increase in tumors with long-term exposure to magnetic fields); A. Rannug et al., *A Study on Skin Tumor Formation in Mice with 50-Hz Magnetic Field Exposure*, 14 CARCINOGENESIS 573 (1993) (reporting a mouse skin-tumor promotion study finding no increase in tumors with long-term exposure)). Return to text.

[247] *See id.* at 80. Return to text.

[248] *See id.* Return to text.

[249] *See id.* If one were examining an electric or magnetic field to see if it were an initiator, one high-dose exposure would be followed by repeated doses of a known promoter. To examine to see if a field were a promoter, animals would be exposed to a known initiator and then exposed to electric or magnetic fields for a long period of time. Return to text.

[250] *See id.* Return to text.

[251] *See id.* at 81. Return to text.

[252] *See id.* at 81-82 (citing M. Mevissen et al., *Effects of Magnetic Fields on Mammary Tumor Development Induced by 7,12-dimethylbenz[a]anthracene in Rats*, 14 BIOELECTROMAGNETICS 131 (1993) (reporting that the number of tumors per animal increased in the animals exposed to the magnetic field, but a repeat of the experiment found no difference in the number of tumors); D.Sh. Beniashvili & M.Z. Menabde, *Low-Frequency Electromagnetic Radiation Enhances the Induction of Rat Mammary Tumors by Nitrosomethyl Urea*, 61 CANCER LETT. 75 (1991) (reporting a mammary tumor-promotion study in rats finding an increase in mammary gland tumors in rats exposed to magnetic fields at 200 mG for 3 hours a day); W. L`scher et al., *Tumor Promotion in a Breast Cancer Model by Exposure to a Weak Alternating Magnetic Field*, 71 CANCER LETT. 75 (1993) (reporting a significant increase in mammary tumor induction)). Return to text.

[253] *See id.* Return to text.

[254] *See* NRC REPORT, *supra* note 3, at 116. Although biological responses have been shown, the question of whether exposure to electric and magnetic fields causes cancer remains unanswered given the inconsistent results and unreplicated studies. Return to text.

[255] *See id.* at 73. Return to text.

[256] *See id.* at 82 (citing I.L. Cameron, K.E. Hunter, & W.D. Winters, *Retardation of Embryogenesis by Extremely-Low-Frequency 60-Hz Electromagnetic Fields*, 17 PHYSIOL. CHEM. PHYS. MED. NMR 135 (1985) (reporting developmental delays that did not result in abnormal develop ment or decrease in survival)). Return to text.

[257] *See id.* at 83 (citing C.F. Blackman et al., *Influence of Electromagnetic Fields on the Efflux of Calcium Ions from Brain Tissue In Vitro: A Three-Model Analysis Consistent with the Frequency Response up to 510 Hz*, 9 BIOELECTROMAGNETICS 215 (1988) (finding that calcium efflux from brain tissue of chicks exposed to 60-Hz fields affected); C.F. Blackman et al., *Effect of Ambient Levels of Power-Line-Frequency Electric Fields on a Developing Vertebrate*, 9 BIOELECTROMAGNETICS 129 (1988) (finding calcium efflux affected in exposed brain tissue)). Return to text.

[258] *See id.* (citing C.I. Kowalczuk & R.D. Saunders, *Dominant Lethal Studies in Male Mice after Exposure to a 50-Hz Electric Field*, 11 BIOELECTROMAGNETICS 129 (1990) (reporting inability to detect exposure-related mutations in male mice exposed to 60-Hz electric fields)). Return to text.

[259] *See id.* at 84 (citing D.N. Rommereim et al., *Reproduction, Growth, and Development of Rats During Chronic Exposure to Multiple Field Strength of 60-Hz Electric Fields*, 14 FUNDAM. APPL. TOXICOL. 608 (1990) (finding no exposure-related reproductive effects at any of three field strengths: 10, 65, or 130 kV/m)). Return to text.

[260] *See id.* at 86 (citing M.R. Sikov et al., *Developmental Studies of Hanford Miniature Swine Exposed to 60-Hz Electric Fields*, 8 BIOELECTROMAGNETICS 229 (1987) (finding inconsistent results in that the first generation showed no differences, the second generation showed malformations, and the third generation showed no significant adverse effects; however, disease outbreak complicated interpretation of the results)). Note that in three follow-up studies on rats, no exposure-related effects were detected. *See supra* note 217. Return to text.

[261] *See* NRC REPORT, *supra* note 3, at 87 (citing G. Algers & J. Hultgren, *Effects of Long-Term Exposure to a 400-kV 50-Hz Transmission Line on Etrousand Fertility in Cows*, 5 PREV. VET. MED. 21 (1987) (detecting no changes)). Return to text.

[262] *See id.* at 87 (citing A. Martin, *Development of Chicken Embryos Following Exposure to 60-Hz Magnetic Fields with Differing Waveforms*, 13 BIOELECTROMAGNETICS 223 (1992) (detecting no effects)). Return to text.

[263] *See id.* at 88 (citing M.J. Wiley et al., *The Effects of Continuous Exposure to 20 k-Hz Sawtooth Magnetic Fields on the Litters of CD-1 Mice*, 46 TERATOLOGY 391 (1992) (detecting no effects in mice; study was designed to be relevant to video-display terminals)). Return to text.

[264] *See id.* at 89 (citing H. Huuskonen et al., *Effects of Low-Frequency Magnetic Fields on Fetal Development in Rats*, 14 BIOELECTROMAGNETCS 205 (1993) (finding no increase in malformation or resorption rates with increases in minor skeletal anomalies and in mean number of implants and living fetuses in 50 Hz)). Return to text.

[265] *See id.* at 73. Return to text.

[266] *See* NRC REPORT, *supra* note 3. Return to text.

[267] *See id.* at 90. Return to text.

[268] *See id.* at 90-91 (citing R. J. Weigel et al., *Stimulation of Cutaneous Mechanoreceptors by 60-Hz Electric Fields*, 8 BIOELECTROMAGNETICS 337 (1987) (finding that cat detected electric field; hair removal caused decrease in response; and oil application on skin caused a further decrease)). Return to text.

[269] *See id.* at 91-93 (finding no evidence of detection of magnetic fields except at very high field strengths). Return to text.

[270] *See id.* at 90 (citing S. Stern & V.G. Laties, *Comparison of 60-Hz Electric Fields and Incandescent Light as Aversive Stimuli Controlling the Behavior of Rats*, 10 BIOELECTROMAGNETICS 99 (1989) (finding that electric field produced no aversive effect); R.H. Lovely et al., *Rats Are Not Aversive When Exposed to 60-Hz Magnetic Fields at 3.03 mT*, 13 BIOELECTROMAGNETICS 351 (1992) (finding that magnetic field produced no aversive effect)). Return to text.

[271] *See id.* at 93. The NRC Committee noted that behavioral, chemical, and electrophysiological effects of long-term and short-term exposure to 60-Hz magnetic fields have been shown in the area of decrease in stable performance in dealing with reinforced behavior and decrease in induced-seizure duration. The NRC Committee speculated that these effects hypothetically could be associated with a decrease in opiate activity since some reports show that 60-Hz magnetic fields inhibit endogenous opiate activity. *See id.* at 93. Return to text.

[273] *See* NRC REPORT, *supra* note 3, at 95, 103. For example, the pineal gland produces melatonin and stress hormones such as pituitary adrenocorticotropin ("ACTH"), cortico sterone, cortisol, norepinephrine, and epinephrine are released from the adrenal medulla. Return to text.

[274] *See id.* at 95. Return to text.

[275] *See id.* Return to text.

[276] *See id.* at 95 (Fig. 4-1). Return to text.

[277] *See id.* Return to text.

[278] *See id.* Return to text.

[279] *See id.* at 95 (citing R.J. Reiter, *Action Spectra, Dose-Response Relationships, and Temporal Aspects of Light's Effects on the Pineal Gland*, 453 ANN. N.Y. ACAD. SCI. 215 (1985) (reporting that synthesis of melatonin controlled by exposure to electromagnetic wavelengths in visible light region); G.C. Brainard et al., *Mechanisms in the Eye that Mediate the Biological and Therapeutic Effects of Light* 29 & R.J. Reiter, *The Mammalian Pineal Glands as an End Organ of the Visual System* 145, *in* LIGHT AND BIOLOGICAL RHYTHMS IN MAN (L. Wetterberg ed., 1993) (reporting ultraviolet and infrared wavelengths alter pineal melatonin production)). Return to text.

[280] *See id.* at 96. Return to text.

[281] *See id.* at 96-99 (citing B.W. Wilson et al., *Chronic Exposure to 60-Hz Electric Fields: Effects on Pineal Function in the Rat*, 2 BIOELECTROMAGNETICS 371 (1981) (reporting a reduction in nighttime pineal melatonin in rats)). The NRC Committee noted that though early studies of the effect of electric fields were "somewhat convincing," the current evidence that electric fields significantly impair pineal gland melatonin production is not convincing. Return to text.

[282] *See id.* at 99-101 (citing S.M. Yellon, *Acute 60 Hz Magnetic Field Exposure Effects on the Melatonin Rhythm in the Pineal Gland and Circulation of the Adult Djungarian Hamster*, 16(3) J PINEAL. RES. 136 (1994) (reporting two out of three experiments on hamsters showed reduced and delayed pineal and blood melatonin; in one, no effect was shown)). Return to text.

[283] *See id.* at 101-02 (citing W. Rogers et al., *Rapid Onset/Offset, Variably Scheduled 60-Hz Electric and Magnetic Field Exposure Reduces Nocturnal Serum Melatonin Concentration in Non-human Primates*, 3 BIOELECTROMAGNETICS SUPPL. 119 (1995) (reporting baboons showed nighttime depressed melatonin)). Return to text.

[284] *See id.* at 102. Return to text.

[285] *See id.* (citing F.S. Prato et al., *Effects of Exposure to Magnetic Resonance Imaging on Nocturnal Serum Melatonin and Other Hormone Levels in Adult Males: Preliminary Findings*, 7 J. BIOELECTROMAGNETICS 169 (1988-89); J.S. Schiffman et al., *Effect of MR Imaging on the Normal Human Pineal Body: Measurement of Plasma Melatonin Levels*, 4 J. MAGN. RESON. IMAGING 7 (1994)). Return to text.

[286] *Id.* at 107. Return to text.

[287] *See id.* at 74. Return to text.

[288] *See id.* at 110 (citing C.T. Brighton et al., *Evaluation of the Use of Constant Direct Current in the Treatment of Non-union* 213, *in* ELECTRICAL PROPERTIES OF BONE AND CARTILAGE: EXPERIMENTAL EFFECTS AND CLINICAL APPLICATIONS (C.T. Brighton et al. eds., 1979) (reporting implanted DC electrodes can heal nonunion fractures and congenital bone defects)). Return to text.

[289] *See* NRC REPORT, *supra* note 3, at 110 (citing Z.B. Friedenberg et al., *Healing of Nonunion of the Medial Malleolus by Means of Direct Current*, 11 J. TRAUMA 883 (1971) (reporting a case involving one human)). Return to text.

[290] *See id.* at 108, 113 (citing R.A. Luben et al., *Inhibition of Parathyroid hormone actions on Bone Cells in Culture by Induced Low Energy Electromagnetic Fields*, 79 PROC. NATL. ACAD. SCI. USA 4180 (1982) (demonstrating that the osteoblast was desensitized when bone cells were exposed in vitro to pulsed electric and magnetic fields)). Return to text.

[291] *See id.* at 106. Return to text.

[292] *See id.* at 112. Return to text.

[293] *See id.* at 109. However no magnetic component has been reported. Return to text.

[294] *See id.* at 108. Return to text.

[295] *See id.* at 109 (citing C.T. Brighton & W.P. McCluskey, *Cellular Response and Mechanisms of Action of Electrically Induced Osteogenesis*, 4 BONE AND MINERAL RESEARCH 213 (W.A. Peck ed., 1986)). Return to text.

[296] *See id.* at 74. For magnetic fields below one gauss and electric fields lower than one mA/cm2, evidence of effects on bone is scarce. Return to text.

[297] *See id.* at 108. The effects on bone have been associated with magnetic fields of strengths from one to 150 G and for a current density from one to 100 mA/cm2 (current density is proportional to electric fields). Return to text.

[298] *See* NRC REPORT, *supra* note 3, at 245, 254. Table A4-5: Magnetic-Field Exposure and Neurobehavioral Effects, summarizes one study of humans conducted by Tucker and Schmitt in 1978. Table A4-11: Effects of Different Types of Electric-and Magnetic-Field Exposure on Melatonin Metabolism in Humans, summarizes three studies: Prato et al., 1988-89; Schiffman et al., 1994; and Wilson et al., 1990. Return to text.

[299] *Id.* at 118. Return to text.

[300] *See* Nancy Wertheimer & Edward Leeper, *Electrical Wiring Configurations and Childhood Cancer*, 109 AM. J. EPIDEMIOLOGY 273 (1979). Return to text.

[301] *See* NRC REPORT, *supra* note 3, at 117. Return to text.

[302] *See id.* The NRC Committee also considered the two areas of concern other than cancer: potential health effects of exposure to electric and magnetic fields related to reproduction and development, see *id.* at 181-85, and potential health effects related to neurobehavioral responses, see *id.* at 185-90. The NRC Committee concluded that "[t]here is no convincing evidence of an association between exposure to power-frequency electric and magnetic fields and reproductive or developmental effects" nor "of an adverse neurobehavioral effect in association with exposure to residential electric and magnetic fields." *Id.* at 199. Return to text.

[303] *Id.* at 119 (citing SMOKING AND HEALTH, PUB. NO. 1103, REPORT OF THE ADVISORY COMMITTEE TO THE SURGEON GENERAL OF THE U.S. (1964)). Return to text.

[304] *See* NRC REPORT, *supra* note 3, at 119 (emphasis added). Return to text.

[305] *See id.* at 119-20. Statistical processes produce variable results in a given study. Return to text.

[306] *See id.* at 121. Disease misclassification results from false negatives (disease present but not identified) and false positives (disease not present but identified as being present). Exposure misclassification occurs in many ways, such as when trying to classify exposure based on job titles. Misinformation of any type can distort the association between exposure and disease. Return to text.

[307] *See id.* at 122 (noting error in selecting the groups to be compared as one selection bias). Return to text.

[308] *See id.* at 122-23. An extraneous risk factor mixed with the exposure being studied can produce confounding results. For example, if the use of electric blankets by children is being studied and if children using electric blankets are those more likely to be in ill health and thus more likely to have more X-rays, and if exposure to X-rays caused an increased risk for leukemia and X-ray exposures were not accounted for in the study, then use of electric blankets would be blamed for increased risk of leukemia rather than the X-rays that were actually responsible for the increased risk. When an association between an exposure and a disease is affected by a third variable, effect modification occurs. For example, if parents' tobacco smoking initiates leukemia, but magnetic fields promoted the leukemia in its late stages, the relationship between magnetic fields and

leukemia would be stronger among children whose parents smoked than among children of nonsmoking parents. The parental smoking is said to act as an effect modifier of the magnetic field exposure. Return to text.

[309] *Id.* at 124-25 (citing Bradford A. Hill, *The Environment and Disease: Association or Causation?*, 58 PROC. R. SOC. MED. 295 (1961)). These criteria were accompanied by caveats regarding their interpretation including one against using a checklist approach in relying on the criteria. Return to text.

[310] *See* NRC REPORT, *supra* note 3, at 127. Return to text.

[311] *See id.* at 2. Return to text.

[312] *See id.* Return to text.

[313] *See id.* Return to text.

[314] *See id.* Return to text.

[315] *See id.* at 287-89. Class 1 wiring includes high-voltage transmission lines, six or more wire distribution lines, or a thick wire single three-phase distribution circuit. Class 1 wiring within 50 feet of the home is further classified as Very High Current Configuration (VHCC) and as Ordinary High Current Configuration (OHCC) if the home is from 50 to 130 feet from the line. Class 2 wiring is a thin wire single circuit three phase distribution line and is classified as VHCC if within 25 feet of the home, OHCC if from 25 to 50 feet, and Ordinary Low Current Configuration (OLCC) if from 50 to 130 feet. Class 3 wiring configurations consist of first-span wires (secondary wires that are connected to the transformer on one end), and serve three or more homes. If within 50 feet of the home, it is classed as OHCC; if between 50 and 130 feet, then it is classed as OLCC. Class 4 wiring consists of second-span secondary wires serving 3 or more homes or first-span secondary wires serving one or two homes. If the homes are within 130 feet of the Class 4 wires, they are OLCC. Class 5 wiring are not attached directly to the transformer (end-pole configurations). They are secondary wiring, serve only one or two homes, and are classed as Very Low Current Configuration (VLCC). *See id.* Return to text.

[316] *See* WERTHEIMER & LEEPER, *supra* note 300, at 289. In this first Wertheimer and Leeper study, only two categories of wire codes were used: High Current Configuration (HCC) and Low Current Configuration (LCC). The division into the further classes described *supra* at note 315 occurred later in the 1982 Wertheimer and Leeper study. *See* NRC REPORT, *supra* note 3, at 263. Return to text.

[317] *See* OTA BACKGROUND PAPER, *supra* note 56, at 58. Return to text.

[318] *See id.* at 58; NRC REPORT, *supra* note 3, at 255. Return to text.

[319] *See* OTA BACKGROUND PAPER, *supra* note 56, at 58. Wertheimer and Leeper estimated the home's magnetic field from the wire code classification scheme developed from a series of measurements of magnetic fields. Return to text.

[320] *See id.* Return to text.

[321] *See id.* (citing R.S. Greenberg & J.L. Shuster, *Epidemiology of Cancer in Children*, 7 EPIDEMIOLOGIC REVIEWS 22 (1985)). Return to text.

[322] *See id.* Return to text.

[323] *See id.* (citing P. COLE, FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION, AN EPIDEMIOLOGIC PERSPECTIVE ON ELECTROMAGNETIC FIELDS AND CANCER (1987); D.A. Savitz & E.E. Calle, *Leukemia and Occupational Exposure to Electromagnetic Fields: Review of Epidemiologic Studies*, 29 J. OCCUP. MED. 47 (1987)). Return to text.

[324] Blind studies are defined at *supra* note 230. Return to text.

[325] *See* J.P. Fulton et al., *Electrical Wiring Configurations and Childhood Leukemia in Rhode Island*, 111 AM. J. EPIDEMIOL. 292 (1980) (assessing the exposure by wire codes); A. Myers et al., Cartwright, *Childhood Cancer and Overhead Power Lines: A Case-Control Study*, 62 BR. J. CANCER 1008 (1990) (reporting a study in Yorkshire, England, that assessed exposure by distance from overhead lines and calculated fields); L. Tomenius, *50-Hz Electromagnetic Environment and the Incidence of Childhood Tumors in Stockholm County*, 7 BIOELECTROMAGNETICS 191 (1986) (reporting a study in Stockholm County, Sweden, that assessed exposure using wire codes and spot field measurements); D. A. Savitz et al., *Case-Control Study of Childhood Cancer and Exposure to 60-Hz Magnetic Fields*, 128 AM. J. EPIDEMIOL. 21 (1988) (reporting a study of childhood cancer from 1976-1983 in Denver, Colorado, designed to be similar to the 1979 Wertheimer and Leeper study but without the weaknesses of that study, and which used wire codes and spot field measurements to assess exposure). *See also* OTA BACKGROUND PAPER,

supra note 56, at 59; NRC REPORT, *supra* note 3, at 255-56. Return to text.

[326] *See* NRC REPORT, *supra* note 3, at 126. Return to text.

[327] *See id.* at 127. Return to text.

[328] *Id.* at 128-29. Applying this method, which is usually applied to clinical trial data where the specific populations examined are the major differences among the studies, to epidemiological studies is controversial because the differences to which it is applied are the characteristics of the study designs. Return to text.

[329] *See id.* at Appendix A, Table A5-1. Return to text.

[330] *See id.* at 129 (citing A. Ahlbom et al., *Electromagnetic Fields and Childhood Cancer*, 342(8882) LANCET 1295 (1993)). Return to text.

[331] *See id.* at 129 (citing COMMITTEE IN INTERAGENCY RADIATION RESEARCH AND POLICY COORDINATION, OAK RIDGE ASSOCIATED UNIVERSITIES, PUB. NO. 92/F8, HEALTH EFFECTS OF LOW FREQUENCY ELECTRIC AND MAGNETIC FIELDS (1992); H.G. PEACH ET AL., THE VICTORIAN GOVERNMENT, MELBOURNE AUSTRALIA, REPORT OF THE PANEL ON ELECTROMAGNETIC FIELDS AND HEALTH (1992); NATIONAL RADIOLOGICAL PROTECTION BOARD, 3 ELECTROMAGNETIC FIELDS AND THE RISK OF CANCER 1 (Chilton, Didcot, U.K.) (1992)). Return to text.

[332] *Id.* at 129. Return to text.

[333] *See id.* Return to text.

[334] *See id.* Return to text.

[335] *See id.* at 143. Return to text.

[336] *See id.* at 144. Return to text.

[337] *See id.* Return to text.

[338] *See id.* Return to text.

[339] *See id.* at 145-46. The NRC Committee noted that investigation of several possible risk factors failed to explain the association. Return to text.

[340] *See id.* at 146. For example, the measurements might better represent average strength of the fields, peak strength, variability of the field, or time longer than some specific threshold value. Return to text.

[341] *See id.* Return to text.

[342] *Id.* Return to text.

[343] *Id.* at 158. It is important to remember that epidemiological studies showing an *association* between wiring near residences and childhood leukemia or other cancer is not the same as showing that such wiring *causes* the cancer. Return to text.

[344] *See id.* at 175-76 (citing J.D. Jackson, *Are the Stray 60-Hz Electromagnetic Fields Associated with the Distribution and Use of Electric Power a Significant Cause of Cancer?*, 89 PROC. NATL. ACAD. SCI. USA 3508 (1992); COMMITTEE IN INTERAGENCY RADIATION RESEARCH AND POLICY COORDINATION, OAK RIDGE ASSOCIATED UNIVERSITIES, PUB. NO. 92/F8, HEALTH EFFECTS OF LOW FREQUENCY ELECTRIC AND MAGNETIC FIELDS (1992)). Studies have suggested that the fact that the consumption of residential electricity increased to the extent that per capita consumption is twenty times the rate it was fifty years ago while deaths from cancers, excluding respiratory cancer, did not increase but rather declined during that period, implies that magnetic fields could not cause cancer. The persuasiveness of this argument is affected by the knowledge that improvements in treatment and diagnosis of cancer make it difficult to infer anything about the relationship between electricity consumption and the decrease in deaths. Since the childhood leukemia incidence has remained stable while residential electricity consumption has doubled, increased *consumption* of electricity has not caused an increase in leukemia. However, what we do not know is the how electricity consumption relates to magnetic field exposure. Does an increase in consumption mean an increase in the exposure to magnetic fields? This relationship needs to be tested, but many difficulties are involved, such as how to measure the changes in exposure occurring during the years under consideration. Return to text.

[345] *See* NRC REPORT, *supra* note 3, at 3. Wire code ratings have been shown to correlate with factors such as age of home, housing density, and

traffic density, though none of these have been identified as a likely cause of childhood leukemia. Return to text.

[346] *See id.* Return to text.

[347] *See id.* at 192. Return to text.

[348] *See id.* at 191. If the hazard identified is that of cigarette smoking being related to cancer, a quantitative estimate of the risk might be that one out of every seven "pack-a-day" smokers will contract lung cancer. Return to text.

[349] *See id.* at 192-93 (citing NATIONAL RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS (1983)). The goal of this stage is to predict all possible adverse health effects from an agent. Return to text.

[350] *See id.* at 193. This stage determines the amount of exposure to a hazardous agent that is harmful to public health. This is accomplished by applying a mathematical equation to the data to describe the relationship of increased risk of disease to amount of the agent. Return to text.

[351] *See id.* (estimating the amount of the hazardous agent that a typical person is likely to experience). Return to text.

[352] *See id.* (estimating the overall risk to human health). Return to text.

[353] *See id.* at 15, 193. Return to text.

[354] *See id.* at 15-16. Return to text.

[355] *See id.* Evidence might be given little weight if it includes inconsistent and conflicting results, weak effects, and non-replicated results. Conversely, consistent, replicated studies are given great weight, especially if a "biologically plausible" explanation for the supposed relationship exists. Return to text.

[356] *See id.* at 15. Return to text.

[357] *See id.* Return to text.

[358] *See id.* Return to text.

[359] *See id.* at 194. Some NRC Committee members thought risk assessment should not even be undertaken because they considered the data so inconclusive. Other members were concerned about misinterpretations of the quantitative prediction of risk. Return to text.

[360] *See id.* One of the NRC Committee's purposes was to present observations concerning the risk of exposure that would help people decide on actions that might need to be taken or help the government decide if policies need to be established. Return to text.

[361] *Id.* at 194-95. Return to text.

[362] *Id.* at 195. Return to text.

[363] *Id.* Return to text.

[364] *See id.* at 196. A finding of a dose-response relationship is a strong indicator of a real rather than an artificial result of an experiment. The important finding of no dose-response relationship helps explain the NRC Committee's overall assessment. Return to text.

[365] *See id.* Return to text.

[366] *See id.* Note again that wire codes, the surrogate for magnetic field exposure used in studies showing an association with childhood leukemia, have not been confirmed as an appropriate indirect measurement of magnetic fields. When studies have used fields that are measured directly no association has been established. Return to text.

[367] *Id.* at 197. Return to text.

[368] *See id.* If electric and magnetic fields had been shown to damage DNA, then a biologically plausible explanation would exist because cancer is associated with damaged DNA. Return to text.

[369] *See id.* at 197-99. The major health hazard considered was that of cancer. While the studies do not prove that residential electric and magnetic

fields are carcinogenic, neither have they proved that the fields are not carcinogenic at some dose level, in combination with some other biologic agent, or for some sensitive populations of humans. The NRC Committee also concluded that no convincing evidence of health hazards exists in the areas of reproduction or development and neurobehavior. Return to text.

[370] *See id.* at 199 (providing a relative risk of 1.5 as an example). Return to text.

[371] *See id.* at 197-200. Return to text.

[372] *See id.* Return to text.

[373] *See id.* at 203-04. Return to text.

[374] *See id.* at 207-08. Return to text.

[375] *See id.* Research in the areas of plausible biophysical mechanisms, signal-transduction, and gene expression would also likely be productive. Return to text.

[376] *See id*. at 208. Return to text.

[377] *But see Altoonian v. Atlantic City Electric Co*., ELECTROMAGNETIC FIELD LITIG. REP. 7 (July 1996) (awarding judgment of $946,267 in damages for emotional distress caused by the presence of power cables, but refusing to find that EMF caused homeowner's cancer). After both parties appealed the *Altoonian* judgment, the parties reached an undisclosed settlement on the "non-EMF" issues. *See Altoonian v. Atlantic City Electric Co.*, ELECTROMAGNETIC FIELD LITIG. REP. 3 (Nov. 1996). Return to text.

[378] *See* Walter Appling, Senior Engineer for Alabama Power Co., Address at the Institute of Electrical and Electronic Engineers (IEEE) (Feb. 4, 1994). Return to text.

[379] *See id.* Return to text.

[380] *See* Richard C. Reuben, *Utility Power Plays,* A.B.A. J. 18 (Dec. 1996) (identifying the difficulty in establishing a causal link between EMF and physical harm). Return to text.

BLACK GOLD IN A WHITE WILDERNESS&EMDASH;ANTARCTIC OIL: THE PAST, PRESENT, AND POTENTIAL OF A REGION IN NEED OF SOVEREIGN ENVIRONMENTAL STEWARDSHIP

JOSEPH J. WARD[*]

"[T]he world will derive no benefit [from Antarctica]."

—Captain James Cook 1777[1]

BLOCKQUOTE>

I. INTRODUCTION

Almost four decades ago, a famous geologist declared that he "would not give a nickel for all the resources of Antarctica."[2] Antarctica was seen as a frozen and barren wasteland, devoid of any value to humanity. Times have changed that once common percep tion.[3] The last few decades have generated increasing interest in the Antarctic region due largely to the potential presence of vast quantities of oil and other mineral resources.[4] However, unrecognized sovereignty claims and inadequate implementation of environmental protection measures under current Antarctic agreements threaten pandemonium once significant oil deposits are discovered in the region. This Comment explores contemporary questions surrounding the Antarctic oil issue[5] with an eye towards the Antarctica of tomorrow.

Part II of this Comment provides an overview of the geography of Antarctica, while Part III describes the key treaty agreements governing the region. Part IV addresses the prospects of oil exploitation in Antarctica and the surrounding seas, and Part V explains the necessary conditions for feasible oil exploitation. Part VI predicts the effect a significant Antarctic oil discovery would have on the Antarctic Treaty System. Part VII points out problems with the current Antarctic minerals regime and suggests that the sovereignty issue must be resolved if future conflict is to be avoided in the region. Part VIII examines the alternative land use regimes proposed for resolving the sovereignty dilemma, while Part IX discusses environmental concerns surrounding the Antarctic oil issue as they relate to tourism and scientific research activities in the region. Part X discusses policy considerations impacting the future of Antarctic oil and suggests ways of remedying the Protocol on Environmental Protection to the Antarctic Treaty's (Protocol) current inadequacies. This Comment concludes by calling for recognition of sovereign rights in Antarctica, which in conjunction with environmentally sensitive regulations, will ensure sensible oil development when sizable oil fields are discovered in the region.

II. GEOGRAPHY AND GEOLOGY OF ANTARCTICA

The continent of Antarctica is best described as a vast, white wilderness of ice.[6] With a mean annual temperature in the interior of minus forty to minus sixty degrees Celsius,[7] Antarctica is a frozen desert of primal solitude.[8] By comparison, the mean annual temperature of Mars, a planet devoid of life, is around minus eighty-five degrees Fahrenheit.[9] Antarctica is viewed as "the coldest, windiest, highest, driest, most lifeless place on earth."[10] The nearly 5.5 million-square-mile continent[11] is almost entirely covered by a blanket of ice averaging 6000 feet in thickness, with interior areas reaching ice depths of 14,700 feet.[12] This colossal ice sheet comprises over ninety percent of the world's ice.[13]

The sea surrounding Antarctica is called the Southern Ocean.[14] This forbidding sea spawns a sailor's nightmare of severe storms, relentless winds, and gargantuan waves sometimes measuring three-quarters of a mile long and fifty feet high.[15] Icebergs 300 to 1300 feet long and towering 40-130 feet above the water[16] drift ominously through the Southern Ocean like silent juggernauts. Ice in the Antarctic seas covers approximately four million-square kilometers during the summer and increases to twenty million-square kilometers in winter.[17] In contrast to the barren Antarctic continent,[18] the nutrient-rich Southern

Ocean is teeming with life.[19]

Despite the treacherous and turbulent conditions of the Antarctic region, man has migrated to Antarctica and established numerous research outposts on its icy terrain.[20] The United States maintains the most visible presence on the continent with eight bases housing over 1200 people in the summer and about 250 in the winter.[21] The presence of research stations from at least twelve nations on such a remote and hostile land illustrates the immense global interest in Antarctica's future.[22] The number of agreements governing the Antarctic region, which have arisen by necessity as competing national interests infiltrate the region in increasing numbers, underscore the area's enormous potential, and illustrate increasing international environmental concerns about the world's last great frontier.[23]

III. Antarctic Governing Agreements

Many international agreements govern Antarctica and regulate marine pollution in the Southern Ocean.[24] Three agreements of particular relevance to the Antarctic oil issue are the Antarctic Treaty,[25] the Protocol on Environmental Protection to the Antarctic Treaty (Protocol),[26] and the United Nations Convention on the Law of the Sea (UNCLOS).[27]

A. The Antarctic Treaty

Seven countries have officially claimed parts of Antarctica as their sovereign territory,[28] leaving fifteen percent of the continent classified as open territory.[29] Moreover, several countries have neither recognized nor claimed sovereignty in Antarctica, but have reserved the right to do so in the future.[30] Together with the seven claimant states, these five countries drafted the Antarctic Treaty, which was signed in 1959 and entered into force in 1961.[31] The Antarctic Treaty is the fundamental governing agreement for the Antarctic region,[32] and Article IX of the treaty provides the basic legal framework governing environmental issues in Antarctica.[33] The Antarctic Treaty Consultative Parties,[34] consisting of the twenty-six nations possessing full voting rights on Antarctic issues, are fully bound by the terms of the Antarctic Treaty.[35]

Despite constituting the central Antarctic governing agreement, the scope of the Antarctic Treaty remains somewhat ambiguous because Article IV provides that the treaty applies to the Antarctic continent and its ice shelves, but does not affect rights over the high seas surrounding Antarctica.[36] The Antarctic Treaty was intended to ensure that Antarctica "shall not become the scene or object of international discord,"[37] and it has been relatively successful at doing so, but at a price. The Antarctic Treaty did nothing to resolve territorial claims to the continent, purposefully avoiding this politically dividing issue. Instead of addressing the problem directly, the treaty simply freezes territorial claims on Antarctica as they were in 1961 and prohibits any new claims or the expansion of existing claims.[38] Thus, the claimant nations may actively pursue their territorial claims should the Antarctic Treaty ever be permitted to expire.[39] Today, nearly four decades after the Antarctic Treaty first began governing the Antarctic region, the issue of sovereignty and territorial claims remains unsettled.[40]

B. The Protocol on Environmental Protection to the Antarctic Treaty

In 1991, an agreement to protect the Antarctic environment was signed by the Contracting Parties, which includes Consultative and Non-consultative Parties, to the Antarctic Treaty System.[41] The Protocol imposes a complete ban on all mineral exploration or exploitation in Antarctica for at least a fifty year period.[42] However, a loophole in the agreement creates the potential that parties may walk-out of the Protocol after fifty-five years.[43] Despite the potential controversy surrounding this walk-out clause,[44] ten parties to the Antarctic Treaty had ratified the Protocol by January 1997,[45] and the international community is presently abiding by it.[46] The United States ratified the Protocol when President Clinton signed the Antarctic Environmental Protection Act on October 1, 1996.[47] However, the Protocol will not officially take effect until it is ratified by Japan, the sole remaining signatory to the Antarctic Treaty that has not yet done so.[48]

C. United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea (UNCLOS), which was signed in December 1982 and entered into force on November 16, 1994, greatly impacts the Antarctic region. Although not an Antarctic agreement per se, UNCLOS is widely accepted as the authoritative text on modern international ocean law.[49] UNCLOS establishes boundary limits for territorial seas,[50] the contiguous zone,[51] the continental shelf,[52] and Exclusive Economic Zones (EEZs).[53] The area outside national jurisdiction boundaries is designated the common heritage of mankind.[54] Resources in this area, comprised of the seabed, ocean floor, and subsoil,[55] would be jointly owned by the global community.[56]

Two important issues under UNCLOS relating directly to the sovereignty dilemma are whether coastal states exist in Antarctica and whether claimant states may legitimately assert maritime claims. The underlying problem of UNCLOS is that if no claim of sovereignty is recognized in Antarctica, there can be no basis for establishing territorial seas, EEZs, or continental shelves.[57] In the absence of valid territorial claims to Antarctica, the continental shelf would assume the status of the deep sea-bed, and thus be deemed common property.[58] This has far-reaching consequences because UNCLOS' broad definition of the continental shelf was intended to put most sea-bed resources, including oil, under coastal state jurisdiction.[59]

Both the Antarctic Treaty and UNCLOS lack sufficient attention to the issue of sovereignty and jurisdiction over Antarctica and the Southern Ocean.[60] However, the fundamental failing of the current regime more accurately resides in the Protocol's minerals prohibition, which fails to resolve the sovereignty dilemma and lacks adequate environmental protection measures. These significant shortcomings must be remedied if Antarctic oil exploration is to avoid becoming a blackened "gold rush" with the attendant dangers that conflicting territorial claims could produce amidst such chaos.[61]

IV. THERE'S GOLD IN THEM THERE HILLS&EMDASH ;PROSPECTS OF OIL IN THE ANTARCTIC REGION

Due to severely restricted accessibility caused by Antarctica's harsh climate, arrant isolation, and mammoth ice shield, oil prospects in the region are inherently speculative. For instance, a report from the United States Office of Technology Assessment stated that "there are no known oil, gas, or mineral deposits in Antarctica of commercial value"[62] and predicted that no oil deposits would be developed until well into the next century.[63] However, since Ant arctica may once have been part of a vegetated ancient super-continent,[64] there is a possibility that significant oil deposits do in fact exist beneath its icy surface.[65]

Based on accessibility factors, the Antarctic area widely considered to hold the greatest potential for oil exploitation is the continental shelf.[66] One estimate postulates that fifty billion barrels of oil,[67] an amount roughly equivalent to Alaska's entire estimated reserves, lies under the Weddell and Ross Seas alone.[68] Other estimates by the former Union of Soviet Socialist Republics' hydrometeorological service[69] and the Japanese Plan Antarctic Survey[70] give similar projections. One estimate goes so far as to put potential deposits as high as 203 billion barrels.[71] This is staggering in light of the fact that the total historic domestic United States production to date is under 200 billion barrels.[72] Additional studies have found heavy hydrocarbon[73] residues in the Antarctic areas of McMurdo Sound[74] and Bransfield Strait.[75] The real question thus becomes not whether oil deposits exist, but whether they will be found, and if discovered, whether they can be economically extracted.[76]

A 1978 study by the Rand Corporation found that four to ten supergiant oil fields[77] remain undiscovered in the world.[78] Since Antarctica has been explored with much less sophistication than the rest of the earth's surface area,[79] and because its geologic characteristics suggest a strong possibility of hydrocarbon deposits,[80] there is a good chance that at least one supergiant oil field lies somewhere beneath the vast Antarctic terrain.[81]

Over the past few decades, due largely to the studies suggesting the presence of Antarctic hydrocarbons, several oil companies have expressed interest to the Antarctic Treaty Consultative Parties about obtaining permits for oil exploration.[82] Moreover, several non-United States companies may have already

conducted oil exploration activities in the waters surrounding Antarctica.[83]

V. Necessary Conditions for Economic Oil Exploitation in Antarctica

For oil to be feasibly extracted from Antarctica, certain conditions must exist. Oil prices must increase, technology to locate and exploit oil in harsh environments must improve, and world oil demand must continue to grow.[84] As discussed below, all of these conditions are likely to occur in the not-too-distant future.

A. Increased Price and Improved Technology

Whether Antarctic oil fields can be exploited in an economically feasible manner depends greatly on available technology and the price of oil.[85] While some required technologies for Antarctic development will likely be similar to those now used in other harsh environments, such as the Arctic and North Sea regions,[86] potential Antarctic oil producers face unique challenges.[87] Since proven reserves seem to be sufficient to satisfy world demand through 2020,[88] prices may not be high enough for economically feasible exploration until then.[89] However, some predict that within the next decade, oil production will no longer be able to keep up with demand.[90] Moreover, although Antarctic oil might not be actively pursued until well into the next century, interest in potential oil exploitation in Antarctica remains strong.[91]

The basic stages of oil exploitation consist of geological exploration, exploratory drilling, commercial exploitation, and extraction.[92] Most of the activity in Antarctica to date consists of the first stage, geological exploration, with the possibility that some countries have ventured forward into the second stage of exploratory drilling.[93] Technologies to exploit offshore oil resources have increased rapidly over the last two decades in the North Sea and the Arctic.[94] New structural designs and construction methods for oil rig platforms may soon enable drilling at significantly greater depths, while ad vanced computer technology makes possible the ability to locate oil resources where previously undetectable.[95] These technological advances indicate a strong likelihood that Antarctic drilling challenges may soon be overcome.[96] Indeed, many conservationists worry that these technological advances will soon allow oil companies to explore in areas such as Antarctica, once considered immune from development.[97] Rapidly improving technology, coupled with the knowledge that oil companies have entered increasingly challenging environments over the last decade,[98] leads to the conclusion that economically feasible oil exploitation will soon become a reality in Antarctica.[99]

B. Future Global Demand

A rapidly expanding global population and the surging energy needs of an increasingly industrialized world will undoubtedly lead to a demand for more oil.[100] Since oil is a non-renewable resource and therefore exists in finite quantities at existing wells, the probability of pursuing Antarctic oil has led at least one geologist to state, "There's no question in my mind that Antarctica will be drilled."[101] Worldwide oil consumption is currently growing at a rate of 1.6 percent annually, with growth rates in some countries as high as 4.5 percent.[102] As demand for oil continues to increase, certain countries like Japan, which must import virtually all of its oil needs, may decide that establishing a secured energy supply is necessary to protect their national interests.[103] In economic terms, the security of an energy source such as oil would compensate for whatever expense was incurred by establishing it.[104] Moreover, if oil prices sustained a significant drop for any extended period of time, a shortage could result due to lowered investments and reduced incentives to produce.[105] Therefore, this threat could spur oil importing countries into taking quicker action to secure a reliable oil source.

Estimates indicate that the European Union will import oil in amounts equivalent to that of the United States' enormous consumption levels in coming years.[106] Projections also indicate that while growth in demand for oil may be comparatively low in North America and Europe, increased economic activity in Asia will produce correspondingly increased oil production worldwide.[107] Even if alternative fuel sources continue to be explored, and despite assertions that "oil's share of world energy consumption may

have reached its peak,"[108] demand for oil will undoubtedly continue to grow well into the future.[109]

Industrialization will likely spread to most nations of the world during the first half of the twenty-first century. This worldwide industrialization movement, combined with a projected world population explosion, will likely push the Antarctic Treaty parties to begin Antarctic oil exploration in earnest.[110] If the necessary political, economic, and technological conditions arise,[111] oil exploration and exploitation in Antarctica will occur regardless of any agreements to the contrary.

VI. National Appetites for Oil Will Swallow Antarctic Agreements

The discovery of a significant oil deposit in Antarctica will undoubtedly bait the national appetites of energy hungry nations.[112] When a nation feels its best interests will ultimately be served by doing so, the Protocol's ban on Antarctic minerals activity will be broken.[113] The Antarctic Treaty System includes major naval powers and nations prominent on the world stage, including the United States, the United Kingdom, China, Japan, and Russia.[114] The actions of these states will define the contemporary law of the sea in the Antarctic region.[115] When the well begins to run dry, heavy oil importers such as the United States, which indulges in excessive dependence on nonrenewable resources to meet its energy needs, will barely slow down to cast aside the Protocol in their stampede to claim the oil fields of Antarctica.[116]

The United States' insistence on a walk-out clause in the Protocol[117] is testimony to its true intentions, namely to cultivate Antarctica's oil when the opportunity presents itself.[118] As one United States delegate stated: "[W]e have always been opposed to a permanent prohibition on Antarctic activities. It's a matter of principles. We should not foreclose the right of future generations to make decisions."[119] One need not look too closely at this statement to decipher its underlying message. Americans have always embraced fresh challenges and potential sources of wealth. Antarctic oil production appeals to both.

Americans have a strong attachment to their automobiles and those automobiles are dependent on oil.[120] Oil embargoes and fuel restrictions threaten not only economic hardship, but strike at the very heart of America's love affair with the automobile.[121] If energy needs grow serious enough, an outright minerals ban in Antarctica will be deliberately shoved aside by the United States and other like-minded countries.[122] Since future mining technologies will likely incorporate advanced methods of environmental protection,[123] and since world oil demand shows no sign of declining, while stability in oil-exporting areas like the Middle East remains tenuous at best,[124] a secured Antarctic oil supply becomes ever more attractive.[125]

The reality of the situation surrounding Antarctic energy resources mandates that the territorial claims issue cannot continue to be ignored by the Antarctic Treaty parties.[126] The Consultative Parties can no longer agree to disagree about who owns what part of Antarctica. As it currently stands, any nation undertaking oil exploitation in Antarctica would be exercising an act of sovereignty, an act wholly inconsistent with the Antarctic Treaty.[127]

The sovereignty situation in Antarctica is shrouded in accusations of illegitimate territorial claims due to non-compliance with international standards for the acquisition of territorial rights.[128] Since it is doubtful that declared Consultative Parties like Chile and Argentina will ever abandon their claims, and non-declared parties like the United States, Russia, and Japan, are also unlikely to forfeit their rights to Antarctica's future,[129] the time is nearing when the issue of sovereignty must be resolved to avoid the territorial conflicts that may otherwise erupt.[130] Exploration and conservation of Antarctica and the Southern Ocean depend upon these recognized claims of sovereignty.[131] Without sovereignty and the individual ownership that accompanies it, there will be less incentive to conserve oil resources and maintain sustainable development levels once the Antarctic oil rush begins.[132]

VII. The Current Protocol is a Temporary Solution to a Ripening Problem

For the last three decades Antarctica has been stuck in a "legal 'twilight zone' between an international

commons and state sovereignty."[133] The Protocol does nothing to reconcile the region's sovereignty dilemma.[134] It is comparable to applying a blindfold over the eyes of someone needing glasses in order to remedy blurred vision: the immediate problem has been disguised only to increase the potential for a disaster in the future.[135] Prudent solutions entail discarding the Protocol and replacing it with a more realistic agreement that remedies the sovereignty issue, or modifying the Protocol to achieve the same results.[136] Japan has stated that it is "convinced that the co-operative efforts of all the Consultative Parties are in the interests of the entire international community."[137] Yet, when a supergiant oil field is found off the Antarctic coast, whatever Antarctic solidarity exists will quickly melt away unless an adequate governing regime is implemented.[138]

The walk-out clause incorporated into Article 25 of the Protocol is a prime example of the Protocol's deficiency for governing future Antarctic activity. Under the walk-out clause, if a proposed amendment to the Article 7 minerals ban has not entered into force within three years of its adoption by a majority of the Consultative Parties, any signatory can withdraw from the mining prohibition altogether and begin mining two years later.[139] Since Antarctic Treaty nations have historically been slow in ratifying amendments,[140] the likelihood of a walk-out seems all but certain. Political damage from the inclusion of the clause may have already undermined any chance of the Protocol's survival since "[t]he whole basis of the Antarctic Treaty is consensus,"[141] and the walk-out clause "strike[s] at the heart of the treaty."[142] If an agreement on Antarctic resource activity is to adequately govern the region, it cannot allow any party to the agreement to ignore its requirements whenever that party desires to do so.

Another Protocol deficiency which may lead to the agreement's downfall is that the Protocol does nothing to prevent non-Antarctic Treaty System nations from conducting oil exploration activities.[143] Under the Protocol, third-party nations appear unrestrained from drilling anywhere in Antarctica.[144] The Protocol thus fails to address the very real possibility that third party nations will seek out Antarctic oil for themselves.[145] Although member nations are obligated by Article X of the Antarctic Treaty to resist any efforts of non-party nations to assert new claims over any area of Antarctica,[146] when a sizable oil field is discovered, member states will not have the political will to prevent exploitation, particularly since they will likely be scrambling to set up drilling facilities of their own.[147] For a minerals agreement to effectively govern Antarctica it must explicitly provide who may conduct what activities where, while establishing enforcement mechanisms sufficient to regulate activity throughout the region.

Recent history of the Antarctic Treaty System illustrates the unlikelihood of serious compliance or enforcement of the Protocol by the Consultative Parties.[148] In 1983, France built an airstrip on Antarctica, during the construction of which it dynamited Emperor Penguin colonies and destroyed a group of small islands.[149] France admitted that it violated the Antarctic Treaty System's environmental protection mandate,[150] but no other nation ever made a formal complaint for fear of antagonizing the French.[151] If no action is taken against an admitted wrongdoer, there can be little hope of enforcement under the current agreements. Action is even more unlikely when oil prospects present opportunities for substantial economic gain. The failure of parties to adhere to the terms of other Antarctic agreements increases the likelihood that the requirements of the minerals ban will be similarly ignored.[152]

The Protocol's deficiencies may stem from a lack of foresight caused by the hastened scramble to enact an Antarctic environmental agreement.[153] If the Protocol is to have any real permanence, sovereign claims must be established in Antarctica and effective regulations must be implemented to govern oil and other resource exploitation in the region.[154] Unregulated exploration of Antarctic oil would not only pose a substantial threat to the environment, it would also represent a serious threat to the Antarctic Treaty System itself.[155] Many nations have been hesitant to ratify the Protocol so that they may keep their options open on the minerals issue.[156] Since a very real possibility exists that the Protocol will fail, a replacement governing agreement must be developed to ensure stability in the region.[157] In establishing a new Antarctic agreement, the Consultative Parties could negotiate whatever terms best served their various interests as long as they do not violate the principles of *jus cogens*.[158] A crucial component of any agreement ultimately forged will be its method of addressing the sovereignty dilemma so that peaceful resolution of Antarctic territorial claims can be achieved.

In furtherance of a new Antarctic regime capable of sustaining adherence by member nations, the Antarctic Treaty will have to be amended to accommodate sovereignty claims. Otherwise, any state exercising territorial rights would be in violation of the treaty.[159] Once sovereignty on the continent has been established, jurisdiction over the continental shelf will come automatically under UNCLOS without any necessary formal declaration by the sovereign state.[160] Although Antarctica was deliberately excluded from UNCLOS negotiations, and areas other than the deep sea-bed are inherently excluded from regulation by UNCLOS authority,[161] UNCLOS fully applies to Antarctic waters since it specifically refers to all the world's seas and oceans.[162] Thus, under the new regime, Antarctic sovereigns would have an inherent right to declare 200-mile EEZs under customary international law.[163] However, until sovereignty is established, the Antarctic waters and any oil beneath them may be subject to the legal status of high seas.[164] The high seas status of Antarctica's continental shelf areas weakens the Antarctic Treaty System because claimant states may resent the exercise of traditional freedoms of the high seas, such as laying of pipeline and cables, over areas they consider within their continental shelf jurisdiction.

VIII. Resolving the Sovereignty Issue - Possible Land Use Regimes

A. A Condominium Regime

There are several possible regimes which could be established to end sovereignty uncertainties in the Antarctic region. A condominium regime[165] could be formed on the theory that the Consultative Parties have a collective right to Antarctica which is superior to that of the rest of the world.[166] Under this land use regime, the parties would be permitted to establish regulations governing all phases of oil exploration and exploitation.[167] A condominium regime could be a viable system in the Antarctic region, particularly when the migratory nature of oil is considered. Oil pools often straddle both sides of a territorial boundary, enabling one party to extract oil from outside its delineated area.[168] Joint exploration agreements under a condominium regime would prevent such problems since all parties to the agreement would be funneling efforts toward a common purpose.[169]

An added benefit of a condominium regime would be that it could greatly reduce the incentives normally responsible for causing a tragedy of the commons. If all parties drilling for oil feel no need to pump more than the others in order to get their fair share, oil extraction would likely occur at a more sustainable rate with a view towards maximizing long-term operation. A condominium regime could be particularly beneficial under these circumstances since some Antarctic claims overlap. However, a condominium regime may not be realistic since it was previously rejected by the claimant states.[170] The related regime of consortium[171] might be a valid alternative. However, the ultimate issue of sovereignty would not be laid to rest under such an approach since all territorial claims would merge.[172]

B. A World-Park or Common Heritage Regime

Other potential Antarctic land use regimes call for establishing Antarctica as a world park that should be preserved forever or declaring it the common heritage of humankind.[173] These concepts would doubtless be supported by non-industrialized countries and the Organization of Petroleum Exporting Countries (OPEC).[174] However, the likelihood of either of these approaches becoming the basis for an Antarctic land use regime is minute.[175] In fact, one claimant state, New Zealand, has called the concept of Antarctica as a world park an "unachievable utopia."[176] If there were no resource potential in Antarctica, the world park theory might have a better chance of endorsement by the Consultative Parties. As it now stands, those nations have too much invested in Antarctica to relinquish their interests in the region.[177] Likewise, the Antarctic has too long a history of exploration and attempts to establish legitimate claims of sovereignty[178] for the concept of common heritage of humankind to be a realistic notion.[179] This becomes readily apparent when one considers that the Antarctic Treaty parties include all of the permanent members of the United Nations Security Council and all of the declared nuclear weapons states.[180] Such seasoned actors on the world stage are accustomed to flexing their military and political muscle in order to get their way. Should these nations choose to do so, they certainly have the strength to bully lesser nations into accepting their claims.

C. A Division Regime

Considering the pros and cons of the land use regimes that could potentially govern the Antarctic area in conjunction with political and economic reality, the most appropriate regime for Antarctica is division.[181] Under division, claimant states would be able to utilize whatever oil lay beneath their territory however they saw fit.[182] The principle benefits of division would be that since definite property claims would exist, investment in mineral prospecting would be encouraged[183] and problems of free riders, normally associated with common ownership regimes, would be avoided.[184] Of course, the migratory nature of oil requires special considerations, but these could be remedied by establishing prior agreements for extraction limits on oil fields which straddle territorial boundary lines.

Because the internationally recognized prerequisite for establishing territorial sovereignty is effective occupation,[185] opponents of division may argue that no state has effectively occupied Antarctica since the only occupied structures are scientific research stations. However, this argument does not present a significant obstacle since remote areas with harsh environments like that of Antarctica have been considered effectively occupied with less intensive and less consistent demonstrations of authority than that which is usually required for establishing legitimate sovereignty.[186] Thus, claimant states could point to the fierce Antarctic climate as reason for not occupying the continent sooner or more assertively.[187]

The obvious problem that arises under division is just how Antarctica should be divided. This question could be decided by some mutually agreed-upon, politically neutral arbitrator with a guarantee of some pre-established minimum territory for the seven claimant states. One possibility could be to have all Antarctic Treaty parties nominate who they consider to be the top authorities on international territorial disputes and then form a decision-making body out of the most frequently nominated officials.[188] Enforcement of the body's decisions might derive from a specially-created United Nations Polar Regions "Peacekeeping" Force. Another possibility could be to allow states to present their territorial claims to the International Court of Justice.[189] In any event, division would ultimately produce internationally accepted territorial claims in Antarctica, which would impart jurisdictional authority under UNCLOS to the continental shelf surrounding those territories where Antarctic oil prospects appear best.[190] The bottom line is that, under a territorial division regime, world consumers will benefit from an increase as well as a corresponding stability in world oil supply.[191]

IX. The Environmental Controversy of Antarctic Oil Production

To some, the suggestion of oil exploration in Antarctica is profane and deeply disturbing. Preservationists decry such a proposal as brazenly uncaring of environmental concerns and evincing a foolish devotion to the almighty dollar. This section explores the potential harm oil exploitation could have on Antarctica's environment.

A. The Oil Spill as Environmental Nemesis

The catalyst for the creation of the Protocol was a growing worldwide emphasis on environmental protection.[192] Oil contamination of Antarctic waters currently occurs infrequently.[193] However, once exploitation of Antarctic oil commences, pollution can be expected to increase.[194] Yet it should be noted that although major oil spills are widely publicized, they often cause less overall harm to the environment than other sources of pollution.[195] Moreover, the likelihood of spills can be greatly reduced by improving environmental protective technologies.[196] Implementing stricter transport requirements also minimizes environmental harm by oil exploitation activity in the Antarctic region.[197] One additional step that can be taken to minimize damage when and if an oil spill occurs, is requiring drilling companies to post an environmental clean-up bond.[198] It has also been suggested that since marine fauna are numerous and widely dispersed around Antarctica, small spills are unlikely to permanently impact overall populations.[199] Some argue that since Antarctica's low temperatures slow degradation and evaporation of oil,[200] impacted areas could take up to several decades to recover.[201] However, scientists also

report that cold-water oil spills are not nearly as damaging to the environment as those which occur in warmer waters.[202]

When oil exploration begins in earnest in Antarctica, possible sources of oil spills in Antarctic waters will include discharges of sludge from oil tankers, dumping of waste oil, natural oil seeps, and improper discharge of wastes.[203] However, the single greatest danger posed to the Antarctic environment by oil exploration may be well blowouts.[204] A blowout occurs when oil suddenly escapes from a well site in an uncontrolled, continuous eruption.[205] Due to Antarctica's ice covering, if a blowout were to occur during the winter, it would be extremely difficult to cap or to drill relief wells for as long as six months.[206]

Despite the potential danger,[207] oil production does not monopolize the role of polluter in Antarctica. Tourism and ongoing scientific research activities arguably pose an equivalent risk of environmental harm to the Antarctic region.

B. Hidden Dangers—Tourism and Scientific Pursuits

Antarctic pollution dates back to the early explorers of the heroic age.[208] The trend continues today in the form of shattered glass, broken wires, used swabs and syringes, and raw sewage that is pumped directly into the Southern Ocean or left in piles on the ice to melt into the sea during the spring thaw.[209] The United States' research station at McMurdo Sound, a purely scientific base, had an oil spill in 1990 of more than 10,000 gallons when rubber bladders at the base's airfield ruptured.[210] In 1994, an Argentine gas leak spilled 20,000 gallons of fuel and spread to a 5000 square yard area.[211] An example of how extensive pollution from research activities has become can be gleaned from a stream near a Russian research station, which has been so badly polluted over the years that it still runs rust red into the sea.[212] Despite constituting a supposedly benign presence, science has unquestionably affected the Antarctic environment to some degree.

The more recent institution of Antarctic tourism is also taking its toll on the region. Each year, more than 3000 cruise ships visit the world's "last unspoiled wilderness" with tourists from these voyages disturbing penguin and seal breeding colonies,[213] and leaving behind garbage and graffiti as tokens of their visits.[214] Interestingly, the most infamous Antarctic oil spill was not the result of oil exploration activities.[215] The spill occurred in 1989 when the Bahia Paraiso, an Argentine navy transport ship carrying tourists and supplies, ran aground, sustaining a thirty foot gash in its double-walled hull and spilling much of its 250,000 gallons of diesel fuel into the waters near Palmer Station.[216] Tourists visiting Antarctica number between 10,000 to 12,000 each year and these numbers are expected to dramatically increase in the near future.[217] In light of this prediction, pollution from tourism will only get worse before it gets any better, particularly since self-regulatory "guidelines of conduct" for tour operators have been unsuccessful in ending tourist damage to Antarctica.[218]

X. The Outlook on Antarctic Oil

Abraham Lincoln once began a speech by stating that "[I]f we could first know where we are, and whither we are tending, we could then better judge what to do, and how to do it."[219] These words aptly capture the state of the mineral resources issue in Antarctica. Oil has been one of the most important energy sources in the world in the recent past and continues to occupy that role today.[220] It is almost certain to remain an important source in the foreseeable future and world energy needs cannot be ignored.[221] At the same time, it is important for all the nations of the world to strive to keep Antarctica as environmentally protected as possible.

Some suggest that oil pollution is a necessary price for cultural modernization and state industrialization.[222] The full implications of this assertion are beyond the scope of this Comment, but whether environmentalism and economic growth must always clash remains to be seen.[223] Perhaps the two may be able to co-exist and even compliment one another.[224] In some respects, they are dependent on each other. For example, without the prospect of being able to exploit Antarctic oil, many nations may decide to pull the plug on Antarctic research because it is expensive to maintain.[225] The underlying

reason for the doubling of Antarctic research bases over the past two decades was not one of scientific curiosity, but of economic self-interest. Countries "want[] a seat around the table," carving knives in hand, if profitable resources are found.[226] In this sense, it seems that the American Association of Petroleum Geologists may be correct when they say that prohibiting all mineral resource activity in Antarctica was "one of the most wrongheaded and narrow-vision decisions that could possibly be made."[227] Perhaps by placing an entire continent off limits, we are robbing our children of a more prosperous future. Perhaps black gold is better than no gold at all.[228]

At some point in the not-too-distant future, a decision will have to be made about the Antarctic oil issue, one that will produce far-reaching consequences.[229] Obviously, a cavalier attitude should not shape Antarctic policy, but the goals of Antarctic preservation and conservation do not have to be achieved at the expense of economic restriction and scientific recision. A properly regulated Antarctica may ultimately serve as a laboratory for international environmental law.[230] However, careful consideration must be given to all relevant issues, including preservation of habitat, minerals exploitation, species protection, scientific advancement, and tourism.[231]

The Protocol's provision to preserve Antarctica's environment in its relatively pristine state is admirable, but not realistic.[232] When push comes to shove, environmental concerns rarely prevail over human needs.[233] A day will come when current oil and gas sources are depleted. When the global well runs dry, unless alternate fuel sources have been drastically improved and are widely available, an energy hungry world will turn its ravenous eyes toward Antarctica.[234]

In this vision of the future, nations will aggressively reassert territorial claims, regardless of any prohibitions or agreements to the contrary, and a land rush will occur the likes of which has never been seen before.[235] In the midst of overlapping claims and terri torial disputes, armed conflict could easily erupt in the region.[236] To avoid such a dangerous scenario, international interests must be reconciled with individual state needs,[237] while environmental concerns are likewise balanced against economic demands.

In light of the pollution caused by scientific pursuits and tourism, both permitted under the current Antarctic regime, arguments for the absolute prohibition of any oil-related activities in Antarctica, such as currently exists under the Protocol, lose some of their force. A more logical alternative is to allow limited oil exploitation, with close regulation to ensure the utmost safety precautions, while setting aside certain "critical habitat" areas as off-limits to any oil exploitation.[238] New Zealand proposed this very idea nearly two decades ago when it suggested that certain geographical areas be designated prohibited zones for the purpose of all resource exploration and exploitation.[239]

When a company determines a location where it wants to drill, an additional protective step would be to require Environmental Impact Statements (EIS) analyzing possible environmental harms to the area, including the impact of drilling activities as planned and of alternative drilling plans. The EIS could be prepared by an independent international agency regulating Antarctic resources activity or by a branch of the United Nations. Although the Protocol contains environmental assessment provisions, critics complain the provisions fall short of the strongly protective measures needed for the Antarctic environment.[240] In conjunction with a well planned regulatory scheme and a solid enforcement program,[241] these proposals could serve the interests of both environmental protection and economic expansion.

Environmentally sustainable development of oil resources in Antarctica can be achieved if the Antarctic Treaty System parties implement procedures for minimizing environmental degradation in addition to holding polluters strictly liable for damages caused by their activity.[242] However, any change to the Protocol's minerals ban requires a binding legal regime on Antarctic mineral resources to be in place, "including an agreed means for determining whether, and under what conditions, any such activities would be acceptable."[243] If the existing Protocol constitutes the only agreement governing minerals activity in Antarctica when extractable oil is located, a legal vacuum will be formed when the Protocol's prohibition on minerals activity collapses.[244] In order to remedy the situation and prevent a legal vacuum from

forming, the "binding legal regime on Antarctic mineral resource activities," required by Article 25, must be introduced before Antarctic oil exploitation becomes feasible.[245] If the Consultative Parties wait until extractable oil is found, any negotiations for constructing such a binding minerals agreement will be hurried and shallow, preventing proper consideration of environmentally protective measures.[246] Worse still, nations may not even bother taking part in the negotiations, choosing instead to take matters into their own hands and securing their claims by force.[247]

Any ban or limitation on mineral exploitation must be enforceable against those who violate its provisions if it is to be effective. Thus, individual nations should implement statutory provisions regulating Antarctic resource activity that can and will be enforced against their citizens.[248] Such self-policing would compliment the international agreements already in place by providing an additional enforcement mechanism for environmental protection in the region. At the same time, it is axiomatic that protection of the Antarctic environment depends on consensus among the Antarctic Treaty parties and all nations engaging in mineral activities on the continent subscribing to agreed-upon safeguards if adverse environmental impacts are to be minimized.[249]

This author does not claim that oil companies should be given free reign to pursue exploitation activities in Antarctica, but the suggestion that a minerals ban has somehow put to rest the Antarctic oil controversy is equally misplaced.[250] Ignoring the problem will not make it go away. The Protocol's ban on oil and other mineral activity in the Antarctic region has not addressed the essential issues of sovereignty and territorial claims, nor established parameters for effective enforcement measures to protect the Antarctic environment once oil exploitation becomes economically feasible.[251] To avert an otherwise certain future crisis,[252] the Protocol must be amended or replaced by a governing agreement that squarely addresses the sovereignty and environmental enforcement concerns raised in this Comment.[253]

XI. CONCLUSION

The current Antarctic Treaty System is unsuitable for the Antarctica of tomorrow. The Antarctic Treaty's failure to address the sovereignty issue promises future instability in the region. The Protocol's minerals ban does not adequately protect Antarctica's environment because it provides no enforcement mechanism capable of dissuading member nations from pursuing independent energy agendas once significant oil reserves are discovered in the region. Although every effort should be made to maximize preservation of Antarctica, the demands of a twenty-first century world cannot be ignored.

This author is essentially a conservationist at heart. Regrettably, the decision to drill for oil more often centers on economic demands rather than preservationist concerns. Antarctica will ultimately open for oil exploitation and other minerals development, but such activities must be strictly regulated. A new Antarctic governing agreement implemented well before an energy crisis erupts could satisfy future world oil needs, while providing for effective enforcement of needed environmental protections. Oil prospects abound in the frozen continent. All that is needed is an Antarctic Treaty System suited for the unique problems and opportunities certain to arise once the oil begins to flow and capable of peacefully carrying the Consultative Parties and the rest of the world into the Antarctica of tomorrow.

F. Scott Fitzgerald wrote that the early American explorers must have held their breath when they first viewed the majestic continent stretching endlessly before them. They had "come face-to-face for the last time in history with something commensurate to [humanity's] capacity for wonder."[254] Fitzgerald's words from seven decades ago no doubt describe the thoughts of Antarctic visitors today when they first gaze out across a vast, seemingly infinite continent of ice. With suitable governing agreements in place, the gaze of the world can be fixed in similar fashion on an Antarctic future immense with prospects and potential as big as the sky.

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ON AN EARLY VERSION OF THIS PIECE AND PROFESSOR DONNA CHRISTIE FOR POSITIVE FEEDBACK ABOUT THE COMMENT'S CONTENTS. Return to text.

[1] DEBORAH SHAPLEY, THE SEVENTH CONTINENT: ANTARCTICA IN A RESOURCE AGE 7 (1985). This quote, attributed to early Antarctic explorer Captain James Cook, illustrates the generally pessimistic view of Antarctic's resource potential two centuries ago. Return to text.

[2] *The Antarctic Treaty: Hearings Before the Senate Committee on Foreign Relations*, 86th Cong., 2d Sess. 75 (1960) (statement of Dr. Lawrence M. Gould, Chairman, Committee on Polar Research, National Academy of Sciences). Return to text.

[3] *See, e.g.*, D. Michael Hinkley, *Protecting American Interests in Antarctica: The Territorial Claims Dilemma*, 39 NAVAL L. REV. 43, 43 (1990) ("The exploitation of the natural resources of Antarctica will soon become a reality."). Return to text.

[4] *See* Patrick T. Bergin, A*ntarctica, the Antarctic Treaty Regime, and Legal and Geopolitical Implications of Natural Resource Exploration and Exploitation*, 4 FLA. INT'L L.J. 1, 3 (1988) (noting that many now believe the extraction of Antarctica's mineral resources will soon become economically feasible); Gregory J. Lohmeier, Comment, *Keeping Cool Amidst the Ice: Addressing the Challenge of Antarctic Mineral Resources*, 2 EMORY J. INT'L DISP. RESOL. 141, 141 (1987). Return to text.

[5] Most of the burgeoning Antarctic resource interest centers on oil and natural gas. *See* Lohmeier, *supra* note 4, at 148. Return to text.

[6] *See* Robert M. Andersen, *Leading International Efforts to Improve Environmental Controls in Antarctica While Navigating National Politics*, 6 GEO. INT'L ENVTL. L. REV. 303, 303 (1994) ("An ice sheet dominates all but approximately two percent of Antarctica's majestic, yet forbidding, five and a half million square miles."). Return to text.

[7] *See* STEPHEN J. PYNE, THE ICE: A JOURNEY TO ANTARCTICA 51 (1986).

> In this sort of cold . . . if you drop a steel bar it is likely to shatter like glass, tin disintegrates into loose granules, mercury freezes into a solid metal, and if you haul up a fish through a hole in the ice within five seconds it is frozen so solid it has to be cut with a saw.

Bergin, *supra* note 4, at 6 n.18 (quoting I. CAMERON, ANTARCTICA: THE LAST CONTINENT 14 (1974)). Return to text.

[8] Antarctica is the world's coldest continent and no daylight whatsoever penetrates the icy darkness during the austral winter. *See* Andersen, *supra* note 6, at 303 & n.3. Return to text.

[9] *See* PYNE, *supra* note 7, at 51. Interestingly, even a remote and hostile environment like Mars has seen a considerable increase in exploration efforts of late with NASA's on-going Pathfinder mission. Return to text.

[10] Christopher C. Joyner, *Ice-Covered Regions in International Law*, 31 NAT. RESOURCES J. 213, 222 (1991). Antarctic blizzards sometimes produce winds in excess of 200 miles per hour and temperatures in Antarctica can reach 127 degrees Fahrenheit below zero. *See* Allan Young, Note, *Antarctic Resource Jurisdiction and the Law of the Sea: A Question of Compromise*, 11 BROOK. J. INT'L L. 45 n.1 (1985). Return to text.

[11] *See* Bergin, *supra* note 4, at 6 & n.19. This landmass is comparable in size to that of the U.S. and Europe combined. *See id.* Return to text.

[12] *See* Joyner, *supra* note 10, at 220. Return to text.

[13] *See Ice and Ice Formations*, in 20 THE NEW ENCYCLOPEDIA BRITANNICA MACROPAEDIA 793, 797 (15th ed. 1985) [hereinafter BRITANNICA]. Return to text.

[14] The Southern Ocean makes up about 10% of the world's oceans and denotes the southern portions of the Atlantic, Pacific, and Indian Oceans. *See* Jennifer Angelini & Andrew Mansfield, *A Call For U.S. Ratification of the Protocol on Antarctic Environmental Protection*, 21 ECOLOGY L.Q. 163, 168 n.20 (1994). Return to text.

[15] *See* Christopher C. Joyner & Ethel R. Theis, *The United States and Antarctica: Rethinking the Interplay of Law and Interests*, 20 CORNELL INT'L L.J. 65, 70 n.24 (1987). Return to text.

[16] *See* PYNE, *supra* note 7, at 11. The largest documented iceberg sighting was estimated to rise 460 feet above the water. *See id.* In 1965, an 87-mile-long iceberg was reported off Enderby Land, Antarctica, and in 1926, Norwegian whalers observed an iceberg 100 miles long. *See* Young, *supra* note 10, at 45 n.2. Return to text.

[17] *See* Stuart B. Kaye, *Legal Approaches to Polar Fisheries Regimes: A Comparative Analysis of the Convention for the Conservation of Antarctic Marine Living Resources and the Bering Sea Doughnut Hole Convention*, 26 CAL. W. INT'L L.J. 75, 76 (1995). Return to text.

[18] Antarctica has no native trees, reptiles, land birds, or mammals. *See* Christopher C. Joyner, *The Southern Ocean and Marine Pollution: Problems and Prospects*, 17 CASE W. RES. J. INT'L L. 165, 171 (1985). Antarctica's "largest true land animal is probably a millimetre-long, spider-like mite." Rachel Campbell-Johnston, *Why We Must Keep Antarctica a True Wilderness*, TIMES (London), Aug. 7, 1996, at 13. Plant life consists only of algae, fungi, lichens, and mosses. *See* Bergin, *supra* note 4, at 7. Return to text.

[19] The Antarctic seas are home to krill, penguins, seals, whales, and numerous species of seabirds. *See* Paul Lincoln Stoller, Comment, *Protecting the White Continent: Is the Antarctic Protocol Mere Words or Real Action?*, 12 ARIZ. J. INT'L & COMP. L. 335, 336 n.5 (1995). Return to text.

[20] *See* Angelini & Mansfield, *supra* note 14, at 175. Return to text.

[21] *See id.*; *see also* Ritchenya Shepherd, *The United States' Actions in Antarctica: The Legality, Practicality, and Morality of Applying The National Environmental Policy Act*, 14 GEO. MASON L. REV. 373, 400 (1991). The United States' Antarctica operations are run primarily by the National Science Foundation, which operates three year-round research stations: McMurdo Station on Ross Island, Palmer Station on Anvers Island on the Antarctic Peninsula, and Amundson-Scott Station at the South Pole. See Andersen, supra note 6, at 303-04. Return to text.

[22] Over thirty research stations are present on Antarctica from at least 12 nations. *See* Bergin, *supra* note 4, at 9 & n.42. Return to text.

[23] For a thorough historical discussion of international environmental law, see ALEXANDRE KISS & DINAH SHELTON, INTERNATIONAL ENVIRONMENTAL LAW (1991). Return to text.

[24] These agreements include the 1973 International Convention for the Prevention of Pollution from Ships, Nov. 2, 1973, 12 I.L.M. 1319, and the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, Feb. 17, 1978, 17 I.L.M. 546 [hereinafter MARPOL]. Thirty-six of the Antarctic Treaty parties signed MARPOL. *See* Christopher C. Joyner, *The Antarctic Treaty System and the Law of the Sea—Competing Regimes in the Southern Ocean?*, 10 INT'L J. MARINE & COASTAL L. 301, 312 n.59 (1995). The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), Dec. 29, 1972, 26 U.S.T. 2403, 1046 U.N.T.S. 120. Return to text.

[25] Antarctic Treaty, Dec. 1, 1959, 12 U.S.T. 794, 402 U.N.T.S. 71. Return to text.

[26] Protocol on Environmental Protection to the Antarctic Treaty, Oct. 4, 1991, S. TREATY DOC NO. 102-22, 30 I.L.M. 1455, 1460 (not yet in force) [hereinafter Protocol]. The Protocol was finalized as the final act of the Eleventh Antarctic Treaty Special Consultative Meeting. Return to text.

[27] United Nations Convention on the Law of the Sea, S. TREATY DOC. NO. 103-39, 21 I.L.M. 1261 (1982) [hereinafter UNCLOS]. Return to text.

[28] *See* Barbara Mitchell, *Resources in Antarctica: Potential for Conflict*, 1977 MARINE POL'Y 91, 94 (1977). Claims were made by the U.K. in 1908; New Zealand in 1923; France in 1924; Australia in 1933; Norway in 1939; Chile in 1940; and Argentina in 1942. *See* Elizabeth K. Hook, Comment, *Criminal Jurisdiction in Antarctica*, 33 U. MIAMI L. REV. 489, 489-90 (1978). Return to text.

[29] *See* Mitchell, *supra* note 28, at 94. Return to text.

[30] These countries are: Belgium, Japan, Russia, South Africa, and the United States. *See id.* Return to text.

[31] The original twelve Antarctic Treaty members are: Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the Union of Soviet Socialist Republics (now Russia), the United Kingdom, and the United States. *See id.* As of 1992, there were 40 members of the Antarctic Treaty System, but only the 26 members possessing full voting rights are bound by the Antarctic Treaty. *See* William M. Welch, *The Antarctic Treaty System: Is it Adequate to Regulate or Eliminate the Environmental Exploitation of the Globe's Last Wilderness?*, 14 HOUS. J. INT'L L. 597, 619 n.118 (1992). The 26 Consultative Parties include Argentina, Australia, Belgium, Brazil, Chile, China, Ecuador, Finland, France, Germany, India, Italy, Japan, the Netherlands, New Zealand, Norway, Peru, Poland, Russia, South Africa, South Korea, Spain, Sweden, the United Kingdom, the United States, and Uruguay. *See id.* Return to text.

[32] *See* Lohmeier, *supra* note 4, at 141. Return to text.

[33] See Robert M. Andersen & Lawrence Rudolph, *On Solid International Ground in Antarctica: A U.S. Strategy for Regulating Environmental Impact on the Continent*, 26 STAN. J. INT'L L. 93 (1989), for an extensive discussion of the current legal framework governing environmental issues in Antarctica. Return to text.

[34] The Protocol defines the Consultative Parties as "the Contracting Parties to the Antarctic Treaty entitled to appoint representatives to participate in the meetings referred to in Article IX of that Treaty." Protocol, *supra* note 26, at 1462. Return to text.

[35] *See* Welch, *supra* note 31, at 620. Return to text.

[36] *See* Antarctic Treaty, *supra* note 25, at section IV. Return to text.

[37] *See id.* at Preamble. Return to text.

[38] *See* Bernard H. Oxman, *Antarctica and the New Law of the Sea*, 19 CORNELL INT'L L.J. 211, 224 (1986). The sovereignty issue thus exists in a "political vacuum." Kaye, *supra* note 17, at 76. Return to text.

[39] *See* Andersen, *supra* note 6, at 305. Return to text.

[40] *See* Sudhir Chopra et al., *The Antarctic Minerals Agreement*, 83 AM. SOC'Y INT'L L. PROC. 204, 218 (1989). Return to text.

[41] The Consultative Parties that signed the Protocol on Environmental Protection to the Antarctic Treaty are Argentina, Australia, Belgium, Brazil, Chile, China, Ecuador, Finland, France, Germany, Italy, Netherlands, New Zealand, Norway, Peru, Poland, Russia, South Africa, Spain, Sweden, the United Kingdom, the United States, and Uruguay. *See* Protocol, *supra* note 26, at 1455. The contracting parties that signed are: Austria, Canada, Colombia, Greece, Hungary, South Korea, Romania, and Switzerland. *See id.* A nation that desires to become a Consultative Party must demonstrate "its interest in Antarctica by conducting substantial research activity there" as accepted by other Consultative Parties. *See* Lohmeier, *supra* note 4, at 145. Return to text.

[42] *See* Protocol, *supra* note 26, art. 7 ("Any activity relating to mineral resources, other than scientific research, shall be prohibited."). Fifty years after the Protocol enters into force, the mineral prohibition can be lifted if three-fourths of the current Antarctic Treaty Consulta tive Parties vote to do so at a Review Conference and subsequently ratify it. *See* Protocol, *supra* note 26, art. 25, para. 4; *see also* Christopher C. Joyner, *Fragile Ecosystems: Preclusive Restoration in the Antarctic*, 34 Nat. Resources J. 879, 893-94 (1994). Return to text.

[43] *See* Protocol, *supra* note 26, art. 25, para. 5.b. Return to text.

[44] For a discussion about the potential ill-effects of the walk-out provision, *see infra* notes 123-26 and accompanying text. Return to text.

[45] *See* D'Vora Ben Shaul, *Harsh Treatment of a Frozen and Fragile Land*, THE JERUSALEM POST, Jan. 27, 1997, at Features 7. Return to text.

[46] As of May 1997, 26 countries had signed the Protocol, and all but Japan had ratified it. *See Russian Parliament Ratifies Antarctic Environmental Accord*, THE ASSOCIATED PRESS, April 26, 1997. All 26 nations that are party to the Antarctic Treaty must ratify the Protocol for it to enter into effect. *See Antarctic: Clinton Signs Bill Implementing Enviro Accord*, AM. POL. NETWORK GREENWIRE, October 3, 1996. Article 23 provides that the Protocol will enter into force on the 30th day following the date the instruments of ratification are deposited by all Consultative Parties. *See* Protocol, *supra* note 26, art. 23, at 1469. The Consultative Parties that had ratified the Protocol as of October 1996 are: Argentina, Australia, Brazil, Chile, China, Ecuador, France, Germany, Italy, Republic of Korea, Netherlands, New Zealand, Norway, Peru, Poland, South Africa, Spain, Sweden, the United Kingdom, the United States, and Uruguay. *See Antarctic*, *supra*. Return to text.

[47] *See* Jeff Rubin, *Saving the Ice*, 99 AUDUBON 1 (Jan. 1997). Return to text.

[48] *See id*. Return to text.

[49] *See* Joyner, *supra* note 24, at 302. Return to text.

[50] *See* UNCLOS, *supra* note 27, art. 3. Territorial seas may not exceed twelve nautical miles. *See id.* Return to text.

[51] *See id.*, art. 33, para. 2. The contiguous zone may not extend beyond twenty-four nautical miles. *See id.* Return to text.

[52] *See id.*, art. 76, para. 5. The continental shelf may not exceed 350 nautical miles or 100 miles from the 2500 meter isobath. *See id*. Return to text.

[53] *See id.*, art. 57. EEZs may not exceed 200 nautical miles. *See id*. Return to text.

[54] *See id.*, art. 136. Return to text.

[55] *See id.*, art. 1, para. 1.(1). Return to text.

[56] *See id.*, art. 136. Return to text.

[57] Territorial sea is an extension of the sovereignty of a coastal state. *See id.*, art. 2, at 1272. EEZs and the continental shelf are extensions of the territorial sea. *See id.*, art. 55, at 1280, & art. 76, at 1285. Thus, none of these three can exist without a recognized claim of sovereignty on the continent. Although the continental shelf exists *ab initio*, meaning states have an inherent right to it under international law, that right cannot exist unless there is a recognized coastal state to assert it. *See* DONNA R. CHRISTIE, COASTAL AND OCEAN MANAGEMENT LAW IN A NUTSHELL 318-19 (1994). Return to text.

[58] *See* James E. Carroll, *Of Icebergs, Oil Wells, and Treaties: Hydrocarbon Exploitation Offshore Antarctica*, 19 STANFORD J. INT'L L. 207, 219 (1983). Return to text.

[59] *See* Oxman, *supra* note 38, at 238. Return to text.

[60] See *infra* notes 150-66 and accompanying text for a discussion of possible remedies to the sovereignty problem Return to text.

[61] For a discussion about the potential dangers an all-out land rush could produce, *see infra* notes 213-14 and accompanying text. Return to text.

[62] OFFICE OF TECHNOLOGY ASSESMENT, U.S. CONGRESS, POLAR PROSPECTS: A MINERALS TREATY FOR ANTARCTICA 3 (1989) [hereinafter POLAR PROSPECTS]. Return to text.

[63] *See id.* Return to text.

[64] *See* Joyner, *supra* note 10, at 220. Return to text.

[65] Geologists surmise that because Antarctica was once part of the ancient super-continent, Gondwanaland, oil found on other former areas of Gondwanaland evidences the presence of oil in Antarctica. *See* Lohmeier, *supra* note 4, at 147-48. Return to text.

[66] *See* FRANCISCO ORREGO VICUNA, ANTARCTIC MINERAL EXPLOITATION: THE EMERGING LEGAL FRAMEWORK 128 (1988). "Geologic studies indicate sizable [hydrocarbon] potential in the immediate offshore area [of Antarctica]." Lisa Sostack, *Halbouty Likes Antarctic Oil Potential*, THE OIL DAILY, May 8, 1986, at 8 (quoting Michael T. Halbouty, an independent oilman). In 1973, pockets of natural gas were discovered beneath the Ross Sea, causing the U.S. Geological Survey "to speculate that 115 trillion cubic feet of the resource may be recoverable" from Antarctica's continental shelf. Bergin, *supra* note 4, at 24. Return to text.

[67] In 1974, Russia's Institute for Arctic Geology estimated that Antarctic oil deposits surpass Alaska's. *See* Bergin, *supra* note 4, at 24 n.130. Return to text.

[68] *See* Carroll, *supra* note 58, at 212 n.33; *see also* EMILIO J. SAHURIE, THE INTERNATIONAL LAW OF ANTARCTICA 355-57 (1992). Return to text.

[69] *See* JEAN- YVES LE DéAUT, THE ANTARCTIC ENVIRONMENT AND INTERNATIONAL LAW 160 (Joe Verhoeven et al. eds., 1992). Return to text.

[70] *See id.* Return to text.

[71] *See* David H. Elliot, *Antarctia: Is There Any Oil and Natural Gas?*, Oceanus, Summer 1988, at 37. *See generally* MAARTEN J. DE WIT, MINERALS AND MINING IN ANTARCTICA: SCIENCE AND TECHNOLOGY, ECONOMICS AND POLITICS (1985). Return to text.

[72] *See* Elliott, *supra* note 71, at 37. The enormous size of such oil deposits is underscored by noting that

the Organization of Petroleum Exporting Countries' (OPEC) reserves are estimated to be around 440 billion barrels. *See* David L. Larson, *United States Interests in the Arctic Region*, 20 OCEAN DEV. & INT'L L. 167, 169 (1989). Return to text.

[73] Hydrocarbons are generated from marine and terrestrial organic debris, which is broken down into oil and gas by a combination of temperature and time. *See* Elliot, *supra* note 71, at 33. Return to text.

[74] *See id.* at 32. Return to text.

[75] *See* SAHURIE, *supra* note 68, at 355 n.28. Return to text.

[76] *See* PYNE, *supra* note 7, at 353. Ten of 21 Antarctic oil basins were considered viable exploration targets in 1985. *See* Alan Kovski, *Antarctica: A Continent is Placed Off Limits to Oil Exploration*, THE OIL DAILY, Oct. 8, 1991, at 2. It should be pointed out that two arguments commonly used to dissuade interest in Antarctic oil exploration as a profitable enterprise may not have a strong basis in fact. Higher transportation and labor costs are frequently cited as reasons why extracting Antarctic oil is prohibitively expensive. *See* SAHURIE, *supra* note 68, at 432-33. However, both of these reasons have been criticized. With respect to transportation costs, Antarctica is farther away from Europe than the Middle East, it is closer to Japan than the Middle East and not unreasonably far from the United States. Furthermore, volatile oil producing regions, like the Middle East, impute high insurance rates, which increase transportation costs due to the dangers of shipping oil through such politically unstable areas. *See id.* at 432. In addition, labor costs would likely be lower than in the Arctic or North Sea if workers are taken from the nearby low-income countries of the Southern Hemisphere. *See id.* at 433. Return to text.

[77] Supergiant oil fields contain 30-100 billion tons of oil. *See* PYNE, *supra* note 7, at 354; *see also* POLAR PROSPECTS, *supra* note 62, at 20 (defining a supergiant oil field as one containing in excess of five billion barrels of oil). Return to text.

[78] *See* PYNE, *supra* note 7, at 353-54. Return to text.

[79] *See id*. at 354. Return to text.

[80] *See supra* notes 63-78 and accompanying text. Return to text.

[81] *See* SAHURIE, *supra* note 68, at 355. See *id.* at 486 n.8 for an extensive list of oil prospects in Antarctica Return to text.

[82] *See* Andrew N. Davis, *Protecting Antarctica: Will a Minerals Agreement Guard the Door or Open the Door to Commercial Exploitation?*, 23 GEO. WASH. J. INT'L L. & ECON. 733, 740 (1990). Return to text.

[83] *See id.* at 759-60 n.199. Return to text.

[84] As one oil company geologist stated: "If the weather was our only obstacle, we'd probably all be down there bumping into one another." Sharon Denny, *The Hunt for Offshore Oil Moves into Deeper Waters*, THE OIL DAILY, May 6, 1985, at B2. Return to text.

[85] *See* POLAR PROSPECTS, *supra* note 62, at 19-21. Return to text.

[86] *See id.* at 20. Although similar to Arctic drilling in some respects, Antarctic drilling presents different obstacles to overcome because Antarctica, as a frozen continent surrounded by oceans, is generally subject to more severe weather conditions than the Arctic, which is essentially a frozen ocean surrounded by continents. *See* Kaye, *supra* note 17, at 76. Return to text.

[87] For example, due to the high concentration of icebergs in the Southern Ocean, improved technology is necessary to allow drilling platforms to be moved out of harm's way and for well caps on the sea floor to be

protected from icebergs scouring the surface of the continental shelf. *See id.* Technology is not yet available to penetrate the glacial ice covering onshore areas. *See* Kovski, *supra* note 76, at 2. To extract oil from Antarctica would require combining technologies developed for ice-covered areas and deep water. *See* Nick Snow, *OTA Projects Antarctic Development*, THE OIL DAILY, Sept. 29, 1989, at 4. Drifting icebergs as big as Massachusetts could crush drilling rigs like beer cans and rip up subsea pipelines. *See id.* Temperatures a hundred degrees below zero, coupled with hurricane force winds, would break iron "like glass when you hit it with a hammer," says David Kingston, an Exxon Corporation geologist who has studied the problem. *Id.* These conditions notwithstanding, the oil companies are convinced they can conquer any cold-weather difficulties. *See id.* Return to text.

[88] *See* POLAR PROSPECTS, *supra* note 62, at 21. Current world crude oil production is about 21 billion barrels annually and has remained stable at that amount in recent years. As of January 1995, estimates place proven world reserves at between 999 and 1,111 billion barrels. *See* THE WORLD ALMANAC 1997, 238 (Robert Famighetti, ed.) (1996) [hereinafter ALMANAC]. Return to text.

[89] Profitability and risk, not weather or frigid temperatures, will ultimately determine whether a company has the incentive to develop an Antarctic oil field. *See* Snow, *supra* note 87, at 4. Oil was priced at $2 per barrel in 1970, but jumped to $12 in 1973 due to the 1973 oil embargo by OPEC, before stabilizing at around $30. *See* S.F. Singer, *World Demand for Oil*, *in* THE RESOURCEFUL EARTH 339, 346 (J. Simon & H. Kahn eds., 1984). Because of a worldwide surplus of oil and lower oil demand, prices dropped to such an extent that developed countries were discouraged from pursuing alternative fuel sources to meet their energy needs. Today, the worldwide addiction to oil continues. *See generally* Lee A. Daniels, *OPEC's Pricing Predicament*, N.Y. TIMES, June 10, 1985, at D1. Return to text.

[90] *See* William H. Lang Jr. et al., *Oil Crunch Going to Hurt*, HOUSTON CHRON., Jan. 8, 1997, at A21. Return to text.

[91] *See* Denny, *supra* note 84. Indeed, oil companies continue to venture into ever more remote areas in their quest to locate new oil fields. *See* Robert Corzine, *Oil Exploration*, FIN. TIMES, June 2, 1997, at 15. Return to text.

[92] *See* Christopher C. Joyner, *The Evolving Antarctic Minerals Regime*, 19 OCEAN DEV. & INT'L L. 73, 88 n.1 (1988). The basic exploration phase would take 3-5 years with another 9-15 years required for drilling and development. *See id.* Thus, 15-20 years would be needed from the start of exploration until start of production. *See* Francisco Orrego Vicuna, *Antarctic Resources Policy: Scientific, Legal, and Political Issues* 180 (1983). Research ships and aircraft would conduct geological mapping and analysis; drilling of exploratory holes would follow with commercial quantities of oil found on land in about 1 in 50 holes. *See* Carroll, *supra* note 58, at 210-11. Another challenge will be storage facilities since regular shipping will be difficult due to the harsh Antarctic environment. *See id.* In addition, because of the build-up of ice during the long Antarctic winter, the entire production facility would have to be below the surface and able to function nine months of the year without surface maintenance. *See* Colin Deihl, *Antarctica: An International Laboratory*, 18 B.C. ENVT'L AFF. L. REV. 423, 430 (1991). Return to text.

[93] *See* Joyner, *supra* note 92. Return to text.

[94] *See* Michael Crabbe, *Antarctica: Oil Potential for Next Century*, 52 PETROLEUM ECONOMIST 365, 365 (1985). Return to text.

[95] *See* Leigh Derenne Braslow, Comment, *Coastal Petroleum's Fight to Drill Off Florida's Gulf Coast*, 12 J. LAND USE & ENVTL. L. 343, 346 (1997). Return to text.

[96] Ice-reinforced tankers, submersible drilling rigs, and underwater storage facilities are some examples of recent technologies developed to overcome the inherent problems of offshore oil exploration in ice-covered areas. *See* Joyner, *supra* note 92, at 87. These modern technologies can impact costs. For example, icebreakers needed to keep channels open ten months out of the year cause shipping costs in Antarctica to

rise to as much as ten times the United States level. *See* M.J. Peterson, *Antarctica: The Last Great Land Rush on Earth*, 34 INT'L ORG. 377, 388 (1980). Return to text.

[97] *See* Corzine, *supra* note 91, at 15 (noting that technology has progressed to the point where oil fields in more than 5,000 feet of water are now in production and drilling in depths of 10,000 feet is not far off). Return to text.

[98] *See* Deihl, *supra* note 92, at 429. Oil companies that have expressed interest in Antarctica include British Petroleum, Elf, Hunt Oil, Texas Gulf, and Total. *See* DE WIT, *supra* note 71, at 5. Return to text.

[99] *See* SAHURIE, *supra* note 68, at 74; *see also* Lohmeier, *supra* note 4, at 141-42. Oil companies may even join forces for such an undertaking. For example, in January 1995, Shell Oil, Amoco, and Exxon collaborated to develop the deepest offshore oil rig in the Gulf of Mexico capable of extracting 60,000 barrels of oil every day. *See* Amy deGeneres Berret, *UNCLOS III: Pollution Control in the Exclusive Economic Zone*, 55 LA. L. REV. 1165, 1165 (1995). "Ten years from now production from 1,000 feet will be considered common and shallow . . . . In the past five years, more new [oil technologies] have been introduced than in the previous 50 . . . [and] every three years the technology has become obsolete." Sostack, *supra* note 66, at 8. Return to text.

[100] From the beginning of humanity to 1945, it took 10,000 generations to reach a world population of 2 billion. *See* AL GORE, EARTH IN THE BALANCE 30-33 (1992). In the span of just one generation, it will increase from 2 to 9 billion. From 5.5 billion in 1992, the world will be subjected to a population explosion reaching 9 billion by 2032. *See id.* This "Lemming syndrome" indicates that demands for oil will undergo a corresponding increase. *See* Chopra et al., *supra* note 40, at 216 (remarks by Robert Hayton). Return to text.

[101] Bryan Burrough, *Polar Predicament: If Antarctic Oil Search Is a Success, Pollution, Discord May Follow*, WALL ST. J., Dec. 9, 1985 at 1. The potential for Antarctic oil activity is bolstered by the fact that Arctic oil, produced under similarly harsh environmental conditions, has become a major oil source. *See* SAHURIE, *supra* note 68, at 74. Return to text.

[102] *See* Alexei Yu. Roginko & Matthew J. LaMourie, *Emerging Marine Environmental Protection Strategies for the Arctic*, 16 MARINE POL'Y 259, 264 n.34 (1992). World production of petroleum in 1994 was about 66.7 million barrels per day, or 139 quadrillion Btu, and petroleum remained the world's most heavily used source of energy. *See* ALMANAC, *supra* note 88, at 236. Return to text.

[103] *See* SAHURIE, *supra* note 68, at 74 (suggesting that the importance of Antarctic oil is more political than economic since it could alleviate the dependence of many industrialized nations on the will of a few producers, such as OPEC). Almost 100 percent of Japan's oil needs are imported. *See id.* at 97 n.543. Chile, one of original parties to the Antarctic Treaty, imports 60 percent of its oil. *See* Mitchell, *supra* note 28, at 97. Even some countries rich in resources, such as the United States, traditionally have preferred to bring raw materials from abroad. *See* SAHURIE, *supra* note 68, at 97. Return to text.

[104] *See* SAHURIE, *supra* note 68, at 97. Return to text.

[105] *See id.* The low oil prices of 1994, while benefiting consumer countries in the short term, weakened profitability for producers, which may lead to reduced oil supplies and higher prices in the medium and long term. *See* Gerald Karey, *IAEE Conference Begins in Norway*, PLATT'S OILGRAM NEWS, May 27, 1994, at 4. Return to text.

[106] Due to price drops in the 1980s, domestic U.S. oil production shrank from 4000 working rigs in 1981 to less than 2000 at the end of 1985. *See* SAHURIE, *supra* note 68, at 157-58. This reduction in domestic production raised U.S. importation of oil to 30 percent by the mid-1980s with projections of 50 percent for the 1990s. *See id.* Oil and petroleum products make up one of the largest U.S. imports. *See* CIA OFFICE OF PUBLIC AND AGENCY INFORMATION, WORLD FACT BOOK 1995, 444 (1996). Return to text.

[107] *See* Karey, *supra* note 105, at 4. Return to text.

[108] *Id.* Return to text.

[109] *See id.* Return to text.

[110] *See generally* Bernard P. Herber, *Mining or World Park? A Politico-Economic Analysis of Alternative Land Use Regimes in Antarctica*, 31 NAT. RESOURCES J. 839, 847-48 (1991). Return to text.

[111] As discussed previously, several conditions would need to occur to spur Antarctic oil exploration efforts: (1) technology capable of making Antarctic oil exploitation feasible would have to exist; (2) stability of claims would be a prerequisite before any oil exploration would begin; (3) heavy oil importing countries such as Japan, the United States, Germany, and France would need to have interior calls for securing a steady and dependable supply of oil; and (4) oil prices would have to rise. The occurrence of all of these conditions is not at all unreasonable to project. *See* SAHURIE, *supra* note 68, at 158. Return to text.

[112] *See* R. Tucker Scully & Lee A. Kimball, *Antarctica: Is There Life After Minerals? The Minerals Treaty and Beyond*, 13 MARINE POL'Y 87, 88 (1989). It is not difficult to imagine nations calling for a special diplomatic summit in order to negotiate out of the minerals ban when economic exploitation of the area's oil and mineral resources becomes feasible. Return to text.

[113] The United Kingdom has stated that "[i]f the economic pressures come on and if the demand was there . . . you would have a free-for-all in Antarctica which would destroy the environment for ever." Andrew F. Neuman, *Closing the Frozen Treasure Chest: Antarctica's New Environmental Protocol*, 3 FORDHAM ENVTL. L. REP. 57, 68 (1991). Return to text.

[114] *See* Joyner, *supra* note 24, at 330. Return to text.

[115] *See id.* Return to text.

[116] *See* Hinkley, *supra* note 3, at 43-45 (noting suggestions that the United States should assert a territorial claim in Antarctica). Return to text.

[117] The United States refused to sign the Protocol unless an escape clause (Article 25) was included. *See* Welch, *supra* note 31, at 643-44. Return to text.

[118] *See* Hinkley, *supra* note 3, at 44 n.6 (noting that the United States' interests in the Antarctic region include facilitating an increase in the global supply of mineral resources by defining rights to Antarctic mineral resources and ensuring access for the United States to all areas of Antarctica in which mineral resource activities may be determined acceptable). Return to text.

[119] *U.S. Raises Objections to Antarctica Pact*, N.Y. TIMES, June 18, 1991, at C6 (quoting Curtis Bohlen, Chief United States Delegate). Return to text.

[120] The U.S. uses 40 percent of the world's production of petroleum. *See* David L. Bowler, *Policy to Control Greed*, THE HOUSTON CHRON., Jan. 8, 1997. The U.S. imported 15.74 quadrillion Btus of crude oil in 1995, representing the 5th consecutive year of growth in U.S. oil consumption. *See* ALMANAC, *supra* note 88, at 235. Return to text.

[121] In 1996, 46.2 percent of the oil used in the United States was imported and imports could account for up to 71 percent of U.S. oil supplies by 2015. *See Reliance on Oil Imports Rankles Alaska Senator Richard Powelson Scripps Howard*, THE PLAIN DEALER, Aug. 29, 1997, at 18A. Return to text.

[122] *See* Welch, *supra* note 31, at 647. Significantly, the U.S. refrained from ratifying the minerals ban until October 1996, five years after the Consultative Parties adopted it. *See Antarctic: Clinton*, *supra* note

46. Japan had not ratified it as of June 1997. *See Antarctica: Japan Delays Treaty Ratification*, AM. POL. NETWORK GREENWIRE, May 20, 1997. Return to text.

[123] *See* Welch, *supra* note 31, at 649. If a large oil field is found in Antarctica that could be profitably developed, chances are good that "someone will wish to do so." Snow, *supra* note 87, at 4; *see also* Deihl, *supra* note 92, at 447-48 (noting that while potential political fallout could deter some states from pursuing Antarctic oil exploration, that may be outweighed by a state's oil needs). Return to text.

[124] *See, e.g.*, Jim Rossi, *Lessons from the Procedural Politics of the "Comprehensive" National Energy Policy Act of 1992*, 19 HARV. ENVTL. L. REV. 195 (1995) (noting that the Iraqi invasion of Kuwait in 1990 and the Gulf War that followed ignited fears of rocketing oil prices and fueled the effort for a new national energy policy in the United States); *see also* Deihl, *supra* note 92, at 447; Davis, *supra* note 82, at 740 n.45 (stating that "the political instability of several oil producing countries is contributing to the wide fluctuations in oil supplies," which has raised Antarctica's stock as a potentially stable source of energy). Return to text.

[125] "As the nations of the world increasingly exhaust their available resources, it is inevitable that interest in remote regions of the planet will grow." Frants Dalgaard-Knudsen, *The Greenlandic Offshore Area*, 5 N.Y. INT'L L. REV. 63, 70 (1992). Return to text.

[126] *See* Lohmeier, *supra* note 4, at 161. Return to text.

[127] Article IV of the Antarctic Treaty prohibits claims of sovereignty. *See* Antartic Treaty, *supra* note 25. Return to text.

[128] *See* Chopra et al., *supra* note 40, at 218 (remarks by Christopher C. Joyner). Return to text.

[129] *See* Gerard J. Mangone, *Defining the Indefinable: Antarctic Maritime Boundaries, in* MARITIME BOUNDARIES AND OCEAN RESOURCES 227, 240 (Gerald Blake, ed., 1987). It should also be noted here that the U.S., Russia, and Japan were the last three Consultative Parties to ratify the Protocol, indicative of their interest in future Antarctic oil exploitation. *See Russian Parliament Ratifies Antarctic Environmental Accord*, *supra* note 46. Return to text.

[130] *See* Mangone, *supra* note 129, at 240. Return to text.

[131] "[I]t would be quite unrealistic to entertain the belief that sovereignty will be abandoned either in form or in substance." *See* Bergin, *supra* note 4, at 9 (citing ANTARCTIC RESOURCES POLICY: SCIENTIFIC, LEGAL AND POLITICAL ISSUES 218 (O. Vicuna ed. 1983)). Return to text.

[132] Sovereign ownership encourages individual environmental responsibility. A good example of this involves the situation in a typical neighborhood where everyone living in the neighborhood owns his own yard. Most yard owners will naturally be inclined to keep their individual yards well kept by mowing when necessary and watering the lawn when needed. Of course, there may be a minority of owners who are not concerned about the upkeep of their yards. However, when the appearance of those yards becomes too unsightly, the majority of yard-owners can usually exert enough pressure to prompt the non-mower or non-waterer into remedying the situation. Conversely, if all the yards were simply combined into one giant yard which no one person owned, the attention and concern the collective neighbors would show towards the yard would be drastically reduced since each individual neighbor would tend to blame any problems of the yard's appearance on another neighbor or forego upkeep in the belief that even if they do their share of work, the other neighbors will not. Sovereign ownership of Antarctic "yards" would have a similar affect.

The nations most likely to acquire territory in Antarctica consist primarily of industrialized nations. These nations would be more likely to conserve their individually owned areas so as to maximize future sustainability. Those nations in the minority, uncaring about sustainability of their own accord, could similarly be prompted into proper environmentally protective measures by reliable enforcement of

environmental regulations by all Antarctic Treaty System nations. Individual ownership in Antarctica, tempered by actively enforced environmental protection requirements, equates to a realistic governing regime for the Antarctic region which will effectively balance environmental concerns with economic demands. Return to text.

[133] Deihl, *supra* note 92, at 454-55 Return to text.

[134] *See* Catherine Redgwell, *Current Developments—Public Internaitonal Law: Antarctica*, 40 INT'L & COMP. L.Q. 976, 981 (1991) ("The environmental Protocol does not address the sovereignty issue, merely stating in Article 4 that the Protocol neither modifies nor amends the Antarctic Treaty."). Return to text.

[135] A dramatic analogy to the Antarctic Treaty signatories' avoidance of the problem of sovereignty claims in hopes that they will never have to deal with them is the world's treatment of Germany in the years preceeding World War II. Rather than confronting Hitler's Germany after its intitial territorial aggressions, the Allies fooled themselves into thinking that Hitler would be satisfied with those early acquisitions and the problem would dissipate of its own accord. The Allies' purposeful avoidance of the problem embodied by Hitler's Germany ultimately created a far greater problem culminating in the Second World War. Purposely diverting attention from the sovereignty problem in Antarctica may breed similar dangers to the Antarctic Treaty System nations in the near future, as armed conflict could easily erupt in a scramble to secure oil resources in the region. After all, only a few years ago the U.S. sent hundreds of thousands of military troops to the Persian Gulf to ensure a secure supply of Middle East oil. *See* Douglas S. Sandhaus, *Should Congress Open Up the Alaskan Coastal Plain to Oil Exploration? A Discussion of Options*, 2 U. BALT. J. ENVTL. L. 43, 48 (1992) (discussing the debate about "whether the economics of foreign oil were worth sacrificing the blood of American soldiers"). Return to text.

[136] Article 11 of the Protocol provides for a Committee for Environmental Protection, which could exercise its powers to provide guidance on the need for additional Annexes or amendments to the Protocol. *See* Protocol, *supra* note 26, art. 11, 12. Article 25 provides that the Protocol "may be modified or amended at any time." Protocol, *supra* note 26, art. 25. Return to text.

[137] Chistopher C. Joyner, *Japan and the Antarctic Treaty System*, 16 ECOLOGY L.Q. 155, 169 n.64 (1992) (quoting Mr. Kuroda, Japanese delegate to the U. N. General Assembly). Return to text.

[138] *See generally* D.R. Rothwell, *The Madrid Protocol and Its Relationship with the Antarctic Treaty System*, *in* ANTARCTIC AND SOUTHERN OCEAN LAW AND POLICY OCCASIONAL PAPERS 25 (1992). Return to text.

[139] *See* Welch, *supra* note 31, at 643-44; *see also*, Protocol, *supra* note 26, art. 25, para. 5(b). The walkout clause states

> If any such modification or amendment has not entered into force within 3 years of the date of its adoption, any Party may at any time thereafter notify to the Depository of its withdrawal from this Protocol, and such withdrawal shall take effect 2 years after receipt of the notification by the Depository.

Id. Return to text.

[140] *See* Welch, *supra* note 31, at 647. Return to text.

[141] *Id*. at 651. Return to text.

[142] *Id*. Return to text.

[143] *See* Neuman, *supra* note 113, at 78. Return to text.

[144] *See* Welch, *supra* note 31, at 655. Return to text.

[145] *See id.* A similar loophole allows tour companies to register their vessels in non-Antarctic Treaty nations to avoid compliance with environmental protection requirements im posed under the Antarctic Treaty. *See* Shaul, *supra* note 45, at 7; *see also* Hinkley, *supra* note 3, at 43 (pointing out that "since nonparties are not bound by the 'freeze' provisions of article IV, any nonparty could stake its claim to Antarctica as soon as it could get there"). Return to text.

[146] *See* John J. Borceló III, *The International Legal Regime for Antarctica*, 19 CORNELL INT'L L.J. 155, 158 (1986). Return to text.

[147] *See generally* Deihl, *supra* note 92, at 448-49 (pointing out that some ships allegedly conducting scientific research are actually looking for oil). Return to text.

[148] *See* Stoller, *supra* note 19, at 362. Return to text.

[149] *See id.*; *see also* Christopher C. Joyner, *Protection of the Antarctic Environment: Rethinking the Problems and Prospects*, 19 CORNELL INT'L L.J. 259, 269-70 (1986). Return to text.

[150] *See* Joyner, *supra* note 149, at 268-69; Stoller, *supra* note 19, at 362. Return to text.

[151] *See id*. Return to text.

[152] *See* Paul Brown, *Ship on Mission to Clean Up Polar Waste*, THE GUARDIAN, July 19, 1997, at 4 (noting that the 26 nations operating in Antarctica have failed to honor the Madrid Protocol, a 1991 agreement to remove waste from the continent). Return to text.

[153] *See* Neuman, *supra* note 113, at 68. Return to text.

[154] *See generally* Donald R. Rothwell & Stuart Kaye, *Law of the Sea and the Polar Regions: Reconsidering the Traditional Norms*, 18 MARINE POL'Y 41, 58 (1994). Return to text.

[155] *See* Chopra, *supra* note 40, at 209. Return to text.

[156] *See* S.K.N. Blay, *New Trends in the Protection of the Antarctic Environment: The 1991 Madrid Protocol*, 86 AM. J. INT'L L. 377, 399 (1992). Return to text.

[157] Perhaps CRAMRA could be revived and altered to meet the needs of the Antarctic Treaty System parties. *See* Convention on the Regulation of Antarctic Mineral Resource Activities, June 2, 1988, 27 I.L.M. 868 (not in force) [hereinafter CRAMRA]. As one commentator has noted, "[i]ncorporating the CRAMRA approach, or a similar accomodation, into the Protocol is necessary to achieve a comprehensive and effective regime of Antarctic environmental protection." Francicso Orrego Vicuna, *The Protocol on Environmental Protection to the Antarctic Treaty: Questions of Effectiveness*, 7 GEO. INT'L ENVTL. L. REV. 1, 13 (1994). The U.K. stated that CRAMRA "incorporates some of the strictest environmental protection provisions known in international law." Redgwell, *supra* note 134, at 977 (quoting H.C. Deb., Vol. 171, col. 693 (May 4, 1990), *per* the Parliamentary Under-Secretary of State, Foreign and Commonwealth Affairs). Return to text.

[158] *Jus cogens*, codified in the Vienna Convention on the Law of Treaties, prohibits a treaty from becoming valid if it conflicts with a peremptory norm of international law. *See* Francesco Francioni, *Legal Aspects of Mineral Exploitation in Antarctica*, 19 CORNELL INT'L L.J. 163, 174 n.42 (1986). Return to text.

[159] *See* Mary Lynn Canmann, *Antarctic Oil Spills of 1989: A Review of the Application of the Antarctic Treaty and the New Law of the Sea to the Antarctic Environment*, 1 COLO. J. INT'L ENVTL. L. & POL'Y

211, 219-20 (1990). Return to text.

[160] *See* S.K.N. Blay et al., *Antarctica After 1991: The Legal and Policy Options, in* ANTARCTIC AND SOUTHERN OCEAN LAW AND POLICY 10 (1989). This is partly because the continental shelf doctrine was already established under customary international law when the Antarctic Treaty was signed. *See* VICUNA, *supra* note 66, at 127. Designation of a continental shelf is very important because oil and gas are the principal non-living resources found there. *See* JOSEPH J. KALO ET AL., COASTAL AND OCEAN LAW 301 (2d ed., 1994). Return to text.

[161] *See* SAHURIE, *supra* note 68, at 442. Return to text.

[162] *See* Joyner, *supra* note 24, at 305. Return to text.

[163] *See Developments in the Law—International Environmental Law*, 104 HARV. L. REV. 1484, 1537-38 (1991). Return to text.

[164] *See* Joyner, *supra* note 24, at 311. Return to text.

[165] A condominium consists of the joint exercise of sovereignty over a particular territory by two or more states. *See* Peterson, *supra* note 96, at 395. Return to text.

[166] *See* Oxman, *supra* note 38, at 223. This would keep Antarctica under the control of countries with experience in managing the area. *See* Lohmeier, *supra* note 4, at 166. Return to text.

[167] *See* Oxman, *supra* note 38, at 222. Return to text.

[168] *See* Joyner, *supra* note 15 or 92, at 125. Return to text.

[169] *See id.* Return to text.

[170] *See* Peterson, *supra* note 96, at 396 (noting that the U.S. proposed an Antarctic condominium in 1948, which was rejected). Return to text.

[171] A consortium is similar to a condominium in that states would jointly regulate Antarctica. However, a significant difference would be that all territorial claims would merge. *See id.* Return to text.

[172] *See id*. Return to text.

[173] Common heritage of humankind derives from the law of the sea regime for governing deep sea-bed mining, which calls for all exploitation to be carried out for the benefit of the world as a whole. *See* UNCLOS, *supra* note 27, at Preamble. Return to text.

[174] OPEC's primary objective is to control oil prices and supply. *See* SAHURIE, *supra* note 68, at 74. Thus, it would surely disfavor a pro-production regime in Antarctica. Past efforts of OPEC to use oil supply control for political and economic leverage is what prompted states to seek secure supply sources in the first place. *See id.* OPEC's share of the world oil market will exceed 50 percent by the year 2010. *See U.S. Geological Survey Team Gives Undiscovered Reserves Outlook*, PLATT'S OILGRAM NEWS, Oct. 23, 1991, at 2. Return to text.

[175] *See* Hinkley, *supra* note 3, at 52-53 (noting that the world park theory has never been acceptable to the Consultative Parties). Return to text.

[176] *See* Davis, *supra* note 82, at 735. Return to text.

[177] *See* Hinkley, *supra* note 3, at 53. Return to text.

[178] Argentina has sent families to live year-round on its research bases, including expectant mothers to give birth on the Antarctic continent. *See* Peterson, *supra* note 96, at 392. Other claimant states have stationed postmasters on Antarctica for the sole purpose of establishing sovereignty. *See id.* Return to text.

[179] *See* Joyner, *supra* note 149, at 271. The common heritage of humankind principle would require claimant states to relinquish their claims, a scenario that will not occur. *See* Ellen S. Tenenbaum, *A World Park in Antarctica: The Common Heritage of Mankind*, 10 VA. ENVTL. L.J. 109, 113 (1990). "[T]he Consultative Parties are unified in their conviction that exploitation of Antarctic offshore mineral resources is not subject to regulation by the International Sea-Bed Authority." Note, *Antarctic Resources Jurisdiction and the Law of the Sea: A Question of Compromise?,* 11 BROOK. J. INT'L. L. 45, 71 (1985) [hereinafter *Antarctic Resources Jurisdiction*]. Return to text.

[180] *See Antarctic Resources Jurisdiction*, *supra* note 185, at 53. Return to text.

[181] Under division, Antarctica would be carved up into segments that would come under the sovereign control of states participating in division. *See* Peterson, *supra* note 96, at 391. Return to text.

[182] *See id.* Return to text.

[183] *See* WILLIAM E. WESTERMEYER, THE POLITICS OF MINERAL RESOURCE DEVELOPMENT IN ANTARCTICA: ALTERNATIVE REGIMES FOR THE FUTURE 59 (1984); *see also* Lohmeier, *supra* note 4, at 165. Return to text.

[184] In Antarctic oil exploration, free riders might monitor prospecting activities until a discovery was made. The free rider could then move in and commence exploitation without incurring the expenses of exploration. This would discourage companies from ever prospecting to begin with. Division would eliminate free riders by allowing the sovereign to allocate areas for exclusive exploration activity through licensing or permits. Return to text.

[185] *See* Elaine F. Foreman, *Protecting the Antarctic Environment: Will a Protocol be Enough?*, 7 AM. U. J. INT'L L. & POL'Y 843, 848-49 (1992). Courts have held that discovery alone does not establish territorial sovereignty. *See id.* Discovery merely conveys an inchoate title that requires completion by occupation within a reasonable time. *See id.* Return to text.

[186] *See* Peterson, *supra* note 96, at 392. Greenland is one example of another remote area subjected to less severe effective occupation requirements. *See* Hinkley, *supra* note 3, at 46 (citing the Island of Palmas case, (1932) 2 UNRIAA 1105, the Clipperton Island Award, (1928) 2 UNRIAA 829, and the Legal Status of Eastern Greenland case, 1933 P.C.I.J. (ser. A/B) No. 53, at 22, for the proposition that a relaxation of the traditional rule of effective occupation can be made when the land in question is essentially uninhabited merely by "effective administration"). Return to text.

[187] *See* Foreman, *supra* note 185, at 848. Some Antarctic claims do overlap. Chile's claim is largely overlapped by British and Argentinean claims. *See* Stoller, *supra* note 19, at 342. Return to text.

[188] This might satisfy critics who argue for the creation of a stronger institutional mechanism or a role for the United Nations in order to limit the Consultative Parties' control over the region. *See, e.g.*, VICUNA, *supra* note 66, at 488-90. Return to text.

[189] The International Court of Justice is an organ of the United Nations which functions as an international tribunal hearing cases involving issues of international dispute. Return to text.

[190] *See* Lohmeier, *supra* note 4, at 170. Return to text.

[191] *See* Oxman, *supra* note 38, at 242-43. Laws of supply and demand dictate that if more oil is available on the market, the price of that oil will tend to decrease. Price decreases benefit consumers. Thus, more oil

benefits consumers by making oil both more affordable and widely available. Return to text.

[192] *See* Blay, *supra* note 156, at 387 (asserting that since the Exxon Valdez incident, international awareness of environmental issues has significantly increased). Return to text.

[193] *See State of the Environment in Antarctica and its Impact on the Global System, Report of the Secretary-General* at 9, U.N. Doc. A/46/590 (1991). Return to text.

[194] Offshore oil drilling in Antarctica is almost certain to have accidents. *See* Deihl, *supra* note 92, at 449. A massive oil spill could affect heat absorption of Antarctica's ice sheet, resulting in a rise in ocean levels. *See* Jonathan D. Weiss, Note, *The Balance of Nature and Human Needs in Antarctica: The Legality of Mining*, 9 TEMP. INT'L & COMP. L.J. 387, 391 (1995). Collisions between two vessels or contact with a stationary object were the primary causes of tanker spills between 1974 and 1992. *See Oil Spill Intelligence Report* (Cutter Information Corporation, Arlington, Mass.), Feb. 18, 1994. Improved navigational technologies might prevent or reduce such occurrences. Return to text.

[195] *See* CHRISTIE, *supra* note 57, at 242-43. Oil spills are not the most devastating source of pollution to the seas. Intentional discharges, ocean dumping, and land-based sewage and wastes are much more destructive to the marine environment. *See id.* Interestingly, at least one scientific report has concluded that while some animals suffer when oil spills occur, others benefit. *See* William Booth, *Oil Spills: Some Animals Benefit*, THE WASH. POST, Aug. 21, 1989, at A2. Return to text.

[196] It was estimated that oil production in part of the Arctic would require over 200 miles of roads, 400 miles of pipelines, 51 exploratory wells, 54,275 tons of waste-drilling muds, and 3,375 helicopter flights. *See* D.A. Bolze & M.B. Lee, *Offshore Oil and Gas Development: Implications for Wildlife in Alaska*, 13 MARINE POL'Y 231, 231 (1989). Advances in technology will likely reduce such intrusive activities. Return to text.

[197] For example, the 1996 Antarctic Science, Tourism, and Conservation Act required vessels under U.S. jurisdiction that transport oil in the Antarctic to amend their shipboard oil pollution emergency plans by September 30, 1997. *See Vessel Operators in Antarctica Must Amend Emergency Plans*, HAZMAT TRANSPORT NEWS, Apr. 15, 1997, at 52. Return to text.

[198] *See* Braslow, *supra* note 95, at 354 (discussing Section 377.2425, Florida Statutes (1995), which requires oil companies to post a bond or pay into a trust fund providing for clean-up costs in case of spills before drilling is permitted). Return to text.

[199] *See* POLAR PROSPECTS, *supra* note 62, at 139. Return to text.

[200] *See* JOHN WARREN KINDT, MARINE POLLUTION AND THE LAW OF THE SEA 1178 (1986). Return to text.

[201] *See* POLAR PROSPECTS, *supra* note 62, at 139. Estimates of future oil spills in the Bering Sea suggest that for every billion barrels of oil produced, four spills of 1,000 to 10,000 barrels in size, and two spills of more than 10,000 barrels can be expected. These figures would likely be higher for Antarctica due to its deeper waters and harsher climate. *See id*. at 137. Return to text.

[202] *See* Braslow, *supra* note 95, at 346-47. Return to text.

[203] *See* Ambrose O. O. Ekpu, *Environmental Impact of Oil on Water: A Comparative Overview of the Law and Policy in the United States and Nigeria*, 24 DENVER J. INT'L L. & POL'Y 55, 59 (1995). Return to text.

[204] *See* POLAR PROSPECTS, *supra* note 62, at 137. Return to text.

[205] *See id.* Return to text.

[206] *See* Tenenbaum, *supra* note 179, at 128. Return to text.

[207] The largest oil spill in history occurred on March 24, 1989, when the tanker Exxon Valdez grounded on Bligh Reef and spilled 250,000 barrels (11 million gallons) of crude oil into Prince Edward Sound. *See* Douglas S. Sandhaus, *Should Congress Open Up the Alaskan Coastal Plain to Oil Exploration? A Discussion of Options*, 2 U. BALT. J. ENVTL. L. 43, 47 (1992). The Exxon Valdez spill resulted in the bodies of 155 bald eagles, 36,471 other birds, and 166 sea otters recovered with estimates of actual deaths ranging from 3 to 100 times the known body count. *See id*. Return to text.

[208] From the moment man first set foot on Antarctica, he began to pollute it. Tin cans still sit on shelves in the hut of Captain Robert F. Scott more than 85 years after his trip to the South Pole. *See* Stoller, *supra* note 19, at 335. Wooden crates and tins still litter Ross Island; evidence of Scott and Ernest Shackleton's visits nearly a century ago. *See id*. at 351 n.133. Return to text.

[209] *See id.* at 351-52. Return to text.

[210] *See id.* at 352. Return to text.

[211] *See* Richard Roura, *Greenpeace Reports Fuel Leak in Antarctic*, N.Y. TIMES, Nov. 6, 1994, at A5. Return to text.

[212] *See* Stoller, *supra* note 19, at 352. Return to text.

[213] *See* Mary Ann Cunningham, *Antarctica*, *in* ENVIRONMENTAL ENCYCLOPEDIA 44 (William P. Cunningham et al. eds., 1994). Return to text.

[214] *See* Stoller, *supra* note 19, at 359. Return to text.

[215] *See* Boyce Rensberger, *Grounded Ship's Fuel Imperils Antarctic Coast*, THE WASH. POST, Jan. 31, 1989, at A3. The wreck was not officially cleaned up until 1993. *See International Argentina*, PLATT'S OILGRAM NEWS, Jan. 18, 1993, at 6. Return to text.

[216] *See* Rensberger, *supra* note 215, at A3. Return to text.

[217] *See* Shaul, *supra* note 45, at 7; *see also* Angelini & Mansfield, *supra* note 14, at 178. Return to text.

[218] *See* Shaul, *supra* note 45, at 7 (noting that individual tourists bear no burden of responsibility for obeying environmental laws in Antarctica); Angelini & Mansfield, *supra* note 14, at 180. Return to text.

[219] Abraham Lincoln, Speech to the House of Representatives (June 16, 1858) *in* THE LIVING LINCOLN 211-12 (Paul M. Angle & Earl Schenck Miers, eds., 1955). Return to text.

[220] *See* Ekpu, *supra* note 203, at 55. Return to text.

[221] *See id.* Current estimates predict that worldwide oil production will begin terminal decline around 2010. *See* Will Harvie, *Go Abroad, Young Company*, OILWEEK, June 3, 1996, at 18. Return to text.

[222] *See* Epku, *supra* note 203, at 55. Return to text.

[223] Interestingly, this clash of interests infected the formation of the Protocol because the participants in the Protocol negotiation were divided between pro-mining and pro-environment states. This polarization at the negotiations is credited with producing a flawed Protocol. *See* Vicuna, *supra* note 158, at 11. Return to text.

[224] *See* Edith Brown Weiss, *International Environmental Law: Contemporary Issues and the Emergence of a New World Order*, 81 GEO. L.J. 675, 707 (1993) (predicting that environmental protection and economic development will work in increasing cooperation over the next several decades). Return to text.

[225] *See* Bob Davis, *As the Cold War Ends, Many Nations are Cutting Their Antarctic Research*, THE WALL ST. J., Dec. 27, 1991, at B4. Return to text.

[226] *See id.* (*quoting* Alfred Fowler, head of Council of Managers of National Antarctic Program). Return to text.

[227] Alan Kovski, *Antarctica: A Continent is Placed Off Limits to Oil Exploration*, THE OIL DAILY, Oct. 8, 1991, at 2. Return to text.

[228] Of course, this suggestion assumes that keeping Antarctica in its relatively pristine form is not more valuable than exploiting its oil resources. Few would argue that a virgin Antarctica, untouched by human hands, would be wonderful. However, as this Comment points out, humanity has already left its mark on Antarctica in the form of scientific research, tourism, and the pollutants that accompany such enterprises. What is therefore both desirable and realistic is an Antarctica minimally impacted by human activity, which benefits humanity by supplying an important global resource should the need arise, without diminishing or despoiling the continent's inherent spiritual value and intrinsic wildness. *See* Campell-Johnson, *supra* note 18 (noting that "the Romantics invested the wilderness with a power that . . . reflected man's deepest spiritual and emotional needs for something greater than himself"). Return to text.

[229] *See* Redgwell, *supra* note 134, at 981 (stating that "the problem of Antarctic mineral resource activities has merely been postponed rather than resolved"). Return to text.

[230] *See* Deihl, *supra* note 92, at 424. Return to text.

[231] *See* Redgwell, *supra* note 134, at 979 ("The question remains whether the Protocol has indeed achieved the goal of settling the minerals issue without creating a legal vacuum when the prohibition is lifted."). Return to text.

[232] *See* Vicuna, *supra* note 157, at 13 (noting that "the Protocol falls far short of its proclaimed virtues"). Return to text.

[233] Any claim that the primary motivating force behind the Protocol's minerals ban provision was the desire to preserve Antarctica's virgin landscape ignores the reality of the situation. If pools of oil had been bubbling-up as the Protocol negotiations proceeded, can a serious argument be made that the Consultative Parties would not have discarded the minerals ban proposal in favor of a declaration allowing oil extraction? The fundamental rule of inter national politics that nations inherently act in their own interests, and the history of the Consultative Parties in world affairs, combine to answer with a resounding no. Acquiescence by the Consultative Parties to an Antarctic minerals ban, despite the presence of known oil fields in the area, would run counter to their own best interests. Reality dictates that such self-defeating behavior would not have occurred.

The true motivations for adopting a minerals ban derived primarily from the widespread belief that existing oil reserves would provide adequate energy sources well into the next century, the knowledge that technology was not yet available which would make oil development in the region feasible, and the fact that no confirmed oil deposits had yet been located in Antarctica. If a sizable Antarctic oil field was found today, those nations would scramble to find a way to invalidate, overturn, or amend the minerals ban, notwithstanding the Protocol's "mandate" prohibiting minerals activity for at least fifty years. In consideration of this reality, it is certainly noteworthy that during the Protocol negotiations, only 8 countries supported a total ban on future Antarctic minerals activities, while 18 preferred to refrain from burning the bridge to potential Antarctic resource enrichment. *See* Redgwell, *supra* note 134, at 978. Return to text.

[234] Oil exploration around the globe has been increasing of late. For example, Phillips Petroleum's drilling plans for the next five years calls for "a tremendous amount of international activity." *See Overseas Privatization Drives Global Business Trends, Phillips Exec Says*, PETROLEUM FIN. WEEK, Aug. 11, 1997. It is only a matter of time before oil companies direct a similar "tremendous amount" of exploration activities at the Antarctic region. Return to text.

[235] This is the scenario that the Protocol was intended to protect against, as the Consultative Parties adopted it in recognition of "the need to strengthen the Antarctic Treaty system so as to ensure that Antarctic [sic] shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord." *See* Protocol, *supra* note 26, at Preamble. Return to text.

[236] *See* Hinkley, *supra* note 3, at 43 ("The efforts of nations with a real or expected stake in Antarctica to protect their individual interests has increased the potential for international conflict."). The "will to power" and instincts of self-preservation could push nations to the brink of war. According to Nietzsche, the will to power is the fundamental driving force of humanity, consisting of a "will to appropriate, dominate, increase, grow stronger." FRIEDRICH NIETZSCHE, THE WILL TO POWER 367 (Walter Kauffmann, ed., 1967). Return to text.

[237] *See* Hinkley, *supra* note 3, at 43 (addressing the various interests likely to be asserted when a minerals rush begins in Antarctica). Return to text.

[238] Such critical habitat areas could be designated in similar fashion to National Parks and Wildlife Refuges in the United States. Return to text.

[239] *See* Mitchell, *supra* note 28, at 101. Return to text.

[240] *See* Vicuna, *supra* note 157, at 3. Return to text.

[241] Enforcement could be accomplished in a variety of ways. Claimant states could enforce the regulations internally through adherence to a commonly agreed upon administrative scheme, or a special enforcement agency could be created consisting of representatives of all claimant states or all treaty members. The vital element to whatever enforcement mechanism is agreed upon is unity. All interested parties must unilaterally support and actively promote the terms of any agreement if the regime is to succeed. Return to text.

[242] *See* Weiss, *supra* note 224, at 708. Return to text.

[243] *See* Redgwell, *supra* note 134, at 980 (quoting art. 25(5) of the Protocol). Return to text.

[244] *See id*. Return to text.

[245] *See id.* at 981. Return to text.

[246] This would fail to provide for "the development of a comprehensive regime for the protection of the Antarctic environment and dependent and associated ecosystems . . . in the interest of mankind as a whole." Protocol, *supra* note 26, at Preamble. Return to text.

[247] As one commentator remarked before the adoption of the Protocol, "[u]nless an internationally acceptable Antarctic resource regime is soon developed, conflict will inevitably arise in the Southern Ocean." Allan Young, Note, *Antarctic Resource Jurisdiction and the Law of the Sea: A Question of Compromise*, 11 BROOK. J. INT'L L. 45, 71 (1985). Due to the Protocol's shortcomings, Young's warning resonates with equal force today. Return to text.

[248] The U.S. has enacted several statutes to protect the Antarctic environment, including the Antarctic

Conservation Act of 1978, which implements the Antarctic Treaty and prohibits the discharge of pollutants in Antarctica by U.S. citizens. *See* Andersen, *supra* note 6, at 305. Return to text.

[249] *See id.* at 342-43. Return to text.

[250] As the United Kingdom has stated, "there [can] be no comprehensive system for the protection of the Antarctic environment that does not deal with the long term issue of minerals . . . before the need for it arises." Redgwell, *supra* note 134, at 978 (*citing* H.C. Deb., Vol. 182, col. 61 (Dec. 4, 1990)). Waiting until extractable oil is discovered in Antarctica to address the inevitable need for sensible environmental regulations is foolhardy. Prophylactic measures must be taken before the need for them arises if the Antarctic environment is to be adequately protected. Return to text.

[251] Vicuna had the foresight to point out that "[t]here can be little doubt that minerals are available in Antarctica, and it is therefore an artifice to attempt to ignore the issue. When minerals are eventually discovered, the Protocol will prove to be fundamentally unrealistic, and its chances of survival will be virtually nil." Vicuna, *supra* note 158, at 11. Return to text.

[252] *See* Bergin, *supra* note 4, at 40 (warning that Antarctica "could become the setting for an international politico-legal nightmare"). Return to text.

[253] As previously mentioned in this Comment, CRAMRA could serve as an excellent framework for establishing substantive enforcement mechanisms for environmental protection of Antarctica. *See* CRAMRA, *supra* note 158, at art.3 (prohibiting Antarctic mineral resource activities outside the Convention), art. 8(2) (holding operators strictly liable for damage caused by mineral activities), art. 13 (prohibiting mineral activities in protected areas designated by the Consultative Parties), art. 37(7)(d) (requiring compilation of an environmental impact assessment prior to beginning any exploration activity), art. 53-54 (requiring environmental impact assessment and permit before any exploitation activity). These measures, conspicuously absent from the Protocol, provide an excellent framework to flesh-out a comprehensive Antarctic minerals governing agreement. Return to text.

[254] F. SCOTT FITZGERALD, THE GREAT GATSBY 189 (Collier Books 1992) (1925). Return to text.

COASTAL PROTECTION OF SEA TURTLES IN FLORIDA

KATHERINE R. BUTLER*

I. INTRODUCTION

Although sea turtles have survived for some 175 million years,[1] like many animals, these seagoing reptiles compete with an ever-increasing human population for habitat. Many areas once inhabited by sea turtles are now lost or have been permanently altered by humans.[2] This is especially true in Florida, which hosts the highest number of nesting sea turtles in the continental United States.[3] Florida's permanent and vacationing human population is attracted to the sandy beaches in the summer, the season in which sea turtles must come ashore to nest. In addition, most coastal construction and erosion control projects take place during the summer months be cause of winter weather conditions and associated wind and tide impacts.

As a result of animal, bird, and fish predation[4] in their early years of life, sea turtles' reproductive strategy involves producing numerous offspring to compensate for high natural mortality during that time.[5] Today, the most successful predators of sea turtles are humans. Sea turtle populations have been decimated by humans who harvest them for meat and commercial products, as incidental catch in commercial fisheries, and as victims of pollution and non-degradable debris.[6] Along the coast, habitat degradation caused by development impedes sea turtle nesting and results in high hatchling mortality.[7] Because sea turtles are dangerously close to extinction,[8] they are protected in Florida under federal and state laws, administrative regulations, and local ordinances.[9]

This Comment concentrates on the coastal threats to sea turtle survival in Florida and the laws the state has enacted to protect sea turtles against the detrimental effects of human coastal activities, including operating vehicles on the beaches, artificial beachfront lighting, and interference in nesting behavior associated with coastal construction and erosion control projects. After providing background information on sea turtle behavior in Part II and describing the dangers sea turtles face in Florida in Part III, this Comment examines federal and state laws designed to protect sea turtles in Part IV through Part VI. Part VII analyzes the success of these laws and additional efforts to protect Florida's sea turtles. Part VIII con cludes that even though laws now exist to protect sea turtles, the full effect of the laws remains unknown until long-term studies are completed. For the present, the increased public awareness has resulted in at least a higher hatchling survival rate.

II. BACKGROUND ON SEA TURTLES

A. Behavior of Sea Turtles

Sea turtles are air-breathing reptiles that spend most of their lives in the ocean. After hatching, male sea turtles spend their entire lives at sea.[10] Female sea turtles must periodically return to sandy beaches to lay eggs.[11] With a streamlined shell and large, paddle-like flippers, sea turtles are well-adapted to life at sea. However, these characteristics hinder the heavy females on land during the laborious nesting process.[12] When the females awkwardly lumber ashore to nest, they are near-sighted and virtually defenseless.[13] Depending upon the species, adult sea turtles can weigh between seventy-five and 2000 pounds, and the largest can reach a length of over eight feet.[14] Sea turtles grow slowly and are believed to have a long life span.[15]

Reproductive behavior is similar among the different species of sea turtles.[16] With slight variations, the nesting season of each species begins in late spring and ends in late summer.[17] After male and female sea turtles gather near the nesting beaches early in the season to mate, the females travel to the beach to deposit up to ten clutches of eggs during one season.[18] During the nesting process, which can last up to three hours, the female drags herself ashore[19] and crawls to a point above the high-tide line.[20] With her front flippers, she pushes sand away to form a "body pit," digs an "egg cavity" inside the pit with her rear flippers, lays approximately one hundred eggs in the cavity, and then pushes sand back into the cavity with her rear flippers.[21] Before returning to the surf, she throws sand around the area with her front flippers to conceal the nest site.[22] Leaving the eggs to incubate in the warm sand, the female never returns to the nest.[23] Sea turtles nest only every two to three years, although some may nest more frequently.[24]

Most sea turtle nesting in the United States takes place in the southeastern states, especially the Atlantic coast of Florida.[25]

After an incubation period of about two months, the sea turtles hatch.[26] One to seven days later the hatchlings burst from the nest during the night and, naturally attracted to the brighter sky over the water, make a mad dash to the sea.[27] Where the hatchlings go once they reach the sea is a mystery, until they appear again in coastal feeding grounds.[28] Once they reach maturity, the hatchlings move to permanent feeding grounds.[29] Many sea turtles migrate long distances from their feeding grounds to mate and nest.[30]

B. Species of Sea Turtles in Florida

The five species of sea turtles in Florida are the green (*Chelonia mydas*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempi*).[31]

Adult female green turtles weigh about 300 pounds and average a little over three feet in length.[32] These herbivores feed on seagrasses and algae in shallow waters and are known for their navigational abilities.[33] It is believed that they return to nest on the beach where they were born.[34] Between sixty and 800 green turtle nests are found yearly on Florida's east coast, and infrequently on the Panhandle coast.[35] The green turtle population in the Caribbean and south Florida was severely decimated by intense hunting during the last 300 years.[36]

Loggerhead turtles, at 200 to 350 pounds and three feet long, are the most common sea turtles in Florida.[37] They eat mollusks and crustaceans.[38] This species has been found as far north as Newfoundland and as far south as Argentina, but nests primarily in the southeastern United States.[39] Eighty percent of the loggerhead turtles in the western Atlantic nest along 200 miles of Florida's east coast.[40] It has been estimated that approximately 50,000 to 70,000 loggerhead turtle nests are deposited every year in the southeastern U.S.[41]

Leatherback turtles are so called because their carapace is covered with a rubbery, oily material instead of a hard shell like other sea turtles.[42] The largest of the sea turtles, they weigh 700 to 2000 pounds and reach four to eight feet in length.[43] Their size, texture, and barrel-like shape enable them to dive deeper (3000 feet), travel farther (3000 miles), and swim in colder water than any other sea turtle.[44] These unique creatures are also the only sea turtles that subsist on a diet of jellyfish.[45] Between 1981 and 1990, the annual number of leatherback turtle nests on the east coast of Florida increased from thirty-eight to 125.[46]

Hawksbill turtles are one of the smallest sea turtles[47] and the only ones that predominantly eat sponges.[48] They have a beak-like mouth and a beautiful, richly patterned shell[49] highly prized for use in tortoiseshell products.[50] Because of their small body and agility, hawksbill turtles can nest on isolated, reefed, and rocky beaches, and they usually locate their nests under vegetation.[51] In Florida, hawksbill turtles nest on the southeastern coast between Volusia and Dade Counties and into the Keys.[52] Between 1979 and 1990, the annual number of reported nests ranged between zero and two.[53]

The Kemp's ridley turtle is the smallest and rarest sea turtle.[54] The crab-eating adults weigh eighty-five to 100 pounds and measure twenty-four to thirty inches long.[55] Not only do these sea turtles nest during the daytime, but they do so almost exclusively in one area on the east coast of Mexico.[56] Before nesting, the turtles mass offshore to mate, and the females then emerge together to nest within a few hours of each other in a process called an *arribada*.[57] This behavior has rendered Kemp's ridley turtles vulnerable to exploitation by humans.[58] Adult Kemp's ridley turtles swim in the waters surrounding Florida, and although the literature claims Kemp's ridley turtles do not nest in Florida,[59] at least two Kemp's ridley turtle nests were deposited on Florida's east coast in 1996[60] and four were verified in Florida during the 1997 nesting season.[61]

III. DANGERS TO SEA TURTLES ON FLORIDA'S COAST

A. Dangers in the Marine Environment

Sea turtles face threats both in the ocean and on shore. During sea turtles' adult lives in the sea, their large size makes them immune to almost all natural predators except sharks.[62] However, hatchlings in the sea often fall prey to fish

and birds.[63] Humans still pose the largest oceanic threat to sea turtles. In some parts of the world, sea turtles are harvested for their meat and eggs and for products such as tortoiseshell, leather, oil, and cartilage for soup.[64] Sea turtles are endangered at sea by incidental capture or entanglement in commercial and recreational fishing equipment,[65] especially as a result of shrimp trawling,[66] dredging of harbors and shipping channels,[67] collisions with boats,[68] underwater explosives used in oil rig removal, illegal fishing,[69] entrapment in intake pipes of coastal power plants,[70] and the ingestion of non-degradable debris.[71]

B. Natural Dangers in the Coastal Environment

Nesting female sea turtles, eggs, and hatchlings face a myriad of natural dangers on the beach. Eggs and hatchlings fall victim to predators such as raccoons, ants, ghost crabs, foxes, feral hogs, fish crows, herons, coyotes, buzzards, dogs, and armadillos.[72] Nest destruction can be caused by flooding from heavy rains,[73] tidal inundation as a result of nesting below the high-tide line,[74] and flooding and accretion[75] of sand above incubating nests.[76] Storms may also cause trees to fall on the beach, which can become obstacles to nesting females and hatchlings.[77] Additionally, nesting females can become fatally caught in driftwood, vegetation, and rocks on the beach because they are unable to crawl backwards to escape.[78] Hatchlings can be prevented from exiting the nest by beach vine roots that grow into or over the nest after the nest is laid.[79] A relatively recent disease threat noted in Florida's green sea turtles is "fibropapilloma," tumorous growths thought to be viral in origin.[80] Scientists at the University of Florida's Archie Carr Center for Sea Turtle Research suggest the tumors are caused by chemical runoff that affects sea turtles' habitat and damages their immune systems.[81]

C. Human Presence on the Coast

In addition to posing the greatest oceanic threat, humans also pose the most serious coastal threat to sea turtles. Although poaching of nesting females and eggs by humans is substantially lower in the continental United States,[82] these activities continue to severely deplete sea turtle populations in other parts of the world.[83] Human presence on beaches during the nesting season can negatively impact sea turtles.[84] Human activity, noise, and use of flashlights on the beach at night can cause nesting females to halt nesting attempts, resulting in what is called a "false crawl."[85] The nesting female may then shift to other nesting beaches, delay nesting, or choose poor nesting sites.[86] Beach construction can significantly deter nesting females from coming ashore.[87] Additionally, ordinary pedestrian traffic can cause compaction of sand above nests, crushing the hatchlings within, and may create tracks that interfere with the hatchlings' ability to reach the ocean.[88]

Evidence of human presence may also harm sea turtle nesting habitats. Beach campfires can deter nesting females and disorient hatchlings, and if placed over a nest, can kill the embryos below.[89] Litter left by humans can obstruct both nesting females and hatchlings and food may attract predators to the nest area.[90] Recreational beach equipment left on the beach at night, including beach furniture, cabanas, umbrellas, small boats, and beach cycles, can cause false crawls in nesting females, damage nests by crushing or protruding into the nest, and hamper hatchlings' progress towards the sea.[91]

In areas where motor vehicles are allowed on the beach or where illegal beach driving occurs, the use of headlights during night driving can disrupt the nesting process and disorient hatchlings.[92] Tire ruts can interfere with the hatchlings' ability to reach the sea,[93] and vehicles can damage nests and run over hatchlings.[94] Beach cleaning equipment causes similar problems.[95] In addition to the creation of ruts and compaction of nests by heavy machinery, beach cleaning rakes can penetrate or uncover nests.[96]

The invasion or intentional planting of non-native vegetation on the beach also poses a threat to sea turtle nests.[97] These species often displace native plants and can lead to dune destabilization and increased beach erosion.[98] Some non-native plants can form impenetrable root mats which interfere with the nesting process, invade nests, or trap hatchlings.[99]

Florida's extensive coastal development progressively threatens sea turtle nesting habitat and populations. Tall buildings cast shade on the beach and human removal of vegetation from the beach reduces shade, affecting crucial nest temperatures.[100] Increased artificial light from development may discourage females from nesting and cause hatchling disorientation.[101] Coastal development also interferes with natural coastal processes, accelerating erosion

and necessitating erosion control measures, both of which negatively affect the nesting process.[102]

D. Erosion Control Measures

Sandy coastlines and barrier islands in their natural state are constantly moving.[103] During storms, beaches erode and are later rebuilt, while islands disappear and reform throughout various coastal regions.[104] When coastlines and islands became developed for human use, artificial inlets and buildings along the beach interfered with this natural coastal migration, causing a need for coastal armoring to fortify the beach against erosion.[105] However, these structures actually accelerate erosion by intensifying wave action and currents along the shore, and prevent the natural return, or accretion, of sand to the shore.[106] To preserve beachfront development, erosion control measures must continue, along with repeated beach renourishment projects to replace the lost sand.[107] Both of these practices adversely affect nesting sea turtles and their eggs.[108]

Besides causing permanent degradation of nesting habitat through erosion,[109] coastal armoring physically prevents females from reaching suitable nesting sites.[110] When females deposit nests seaward of armoring structures, the nests may be flooded at high tide or washed out by waves.[111] When inadequate amounts of sand cover the armoring structures, females nesting over them may abandon nesting attempts or may construct improperly sized nests.[112] Coastal armoring structures tend to break apart after time, and the resulting debris left on the beach can cause false crawls and trap nesting turtles and hatchlings.[113]

When beach renourishment is conducted during the nesting season, it can bury nests and adversely affect nesting turtles and hatchlings with its increased human activity and artificial lighting at night.[114] Heavy machinery and pipelines associated with beach renourishment projects can also cause false crawls and entrapment of nesting females and hatchlings.[115] An element of beach renourishment is the depositing of new sand on the affected area. However, the sand deposited on the nesting beach may be different from native beach sediments, which could affect females' nest site selection and digging behavior, the nests' incubation temperature,[116] gas-exchange characteristics of the nest,[117] and the nest's moisture content.[118] This difference in sand could also affect the success of hatchling emergence from both egg and nest.[119] Transporting the sand onto the beach and the renourishment itself often result in severe compaction of the beach, significantly reducing nesting success.[120]

Although the necessary repetitive maintenance of beach renourishment projects heightens the threat to sea turtle nesting habitat,[121] beach renourishment is preferable to coastal armoring for nesting habitat protection.[122] Renourishment of extremely eroded beaches, especially where the entire dry beach has been lost, can improve nesting habitat.[123] However, the renourishment process must be conducted carefully to ensure proper timing and sand quality,[124] and where compaction occurs during renourishment, tilling can be used to soften the sand.[125]

E. Artificial Beachfront Lighting

Florida's extensive coastal development brings with it a high level of artificial beachfront lighting, which can make beaches unsuitable for sea turtle nesting.[126] Artificial beachfront lighting, including lights located on or near beaches[127] and the "urban skyglow" from intensive inland light,[128] affects both nesting females and hatchlings.[129] Lighting can deter female sea turtles from emerging from the sea to nest[130] and can interfere with their sea-finding ability[131] after nesting is completed.[132] Because emergent hatchlings rely on visual brightness cues to find the sea, artificial beachfront lighting causes hatchlings to become misdirected during their crucial and dangerous trip from the nest to the sea.[133] Hatchlings in this situa tion often die from exhaustion, dehydration, predation,[134] entrap ment in vegetation or debris, or wandering onto roadways and parking lots where they are struck by cars.[135] Artificial lighting can also cause hatchling disorientation while in the surf and even draw them back out of the water.[136]

The artificial beachfront lighting problem may be the most manageable of the human-caused sea turtle disturbances.[137] Although some beachfront lighting is necessary for safety and security, light management measures can help prevent interference with sea turtle nesting habitat while still addressing human safety concerns.[138] These measures include turning off unnecessary lights during the nesting season; using a smaller number or lower wattage of lights; repositioning, shielding, redirecting, lowering, or recessing fixtures so light does not reach the beach; using

timers and motion detector switches; planting native dune vegetation to screen light; and reduc ing interior lighting by moving lights from windows, drawing curtains or blinds after dark, and tinting windows.[139] In addition, sea turtles are less affected by red, yellow, and low-pressure sodium-vapor lights, which can be substituted for ordinary lights.[140]

Marking, caging, and relocation of nests are defenses against some of the coastal problems described above, but are not always desirable alternatives. Sea turtle nests can be marked or caged to prevent damage by pedestrian and vehicular traffic and beach cleaning equipment.[141] Though no longer in favor as a remedy for all such problems, nest relocation to protected hatcheries or more suitable nest sites is another option to remove nests from the threats of predators,[142] erosion,[143] pedestrian and vehicular traffic,[144] beach cleaning activities,[145] beach renourishment projects,[146] artificial beachfront lighting,[147] and areas of heavy vegetation.[148] However, nest relocation may have negative consequences[149] and does not address the threatened habitat problem.[150] The current emphasis of nesting habitat management is to avoid manipulation of nests and hatchlings as much as possible.[151]

IV. Statutory Protection of Sea Turtles in Florida

A. Federal Endangered Species Act

Six species of sea turtles are federally protected under the Endangered Species Act of 1973 (ESA).[152] They are the green, hawksbill, Kemp's ridley, leatherback, loggerhead, and olive ridley sea turtles. Section 7 of the ESA requires federal agencies to ensure that their actions are "not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of" such species' critical habitat.[153] Section 9 prohibits the sale, import, export, or transport of any endangered species and most threatened species, and makes it unlawful to "take" them.[154] The term "take" is broadly defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."[155] The United States Supreme Court has affirmed the Secretary of the Interior's interpretation that take includes "significant habitat modification or degradation where it actually kills or injures wildlife."[156] Section 10 of the ESA authorizes the Fish and Wildlife Service and National Marine Fisheries Service to permit "incidental"[157] takings by non-federal, private actions if the action "will not appreciably reduce the likeli hood of the survival and recovery of the species in the wild."[158]

B. Florida Endangered and Threatened Species Act

The Florida Endangered and Threatened Species Act of 1977 (FETSA) established Florida's policy to conserve and wisely manage its resources, especially endangered and threatened species.[159] The intent of the FETSA is to "provide for research and management to conserve and protect [endangered and threatened] species,"[160] and the act appoints the Florida Department of Environmental Protection (DEP) as the agency responsible for research and management of marine species.[161] With this authority, DEP listed the green, leatherback, hawksbill, and Kemp's ridley sea turtles as endangered.[162] The loggerhead sea turtle was listed as threatened.[163]

C. Marine Turtle Protection Act

In 1995, the Florida Legislature passed the Marine Turtle Protection Act (MTPA), giving DEP the authority to enforce regulations protecting the green, leatherback, hawksbill, Kemp's ridley, and loggerhead sea turtles.[164] DEP was instructed to implement its re sponsibilities under the United States Fish and Wildlife Service (USFWS) recovery plans for the five species of sea turtles.[165] The MTPA states that "no person may take, possess, disturb, mutilate, destroy, cause to be destroyed, sell, offer for sale, transfer, molest, or harass any marine turtle or its nest or eggs at any time."[166] "Take" is defined as an act which kills or injures sea turtles, including "significant habitat modification or degradation that kills or injures marine turtles by significantly impairing essential behavioral patterns, such as breeding, feeding, or sheltering."[167]

Under the MTPA, a permit application to DEP for any activity that affects sea turtles, their nests, or habitat is subject to conditions and requirements for sea turtle protection.[168] When considering a permit application for such an activity, DEP may condition the nature, timing and sequence of construction to protect nesting sea turtles, hatchlings, and their habitat.[169] DEP must recommend denial of a permit if an activity would result in a "take," unless the taking is incidental under the federal ESA.[170]

However, on the Atlantic coast, DEP cannot restrict the timing of a beach restoration, beach renourishment, or inlet sand transfer project when the applicant already has a sea turtle nest relocation program or has agreed to administer such a program.[171] In this situation, DEP can only require the applicant to successfully relocate and monitor all turtle nests that would be affected by the permitted activity.[172] The MTPA instructs DEP to give special consideration to beach preservation and renourishment projects that restore sea turtle habitat and requires the consideration of nest relocation for all such projects in urbanized areas.[173]

D. Coastal Zone Protection Act

The Coastal Zone Protection Act of 1985 (CZPA), designed to manage sensitive coastal areas by minimizing damage to the environment, private property, and life,[174] specifically addresses protection of sea turtles by allowing DEP to place conditions on construction that provide sea turtle protection pursuant to the MTPA.[175] Further, the CZPA indirectly assists sea turtle conservation efforts by prohibiting vehicular traffic on coastal beaches, with some exceptions.[176] Beach driving authorized by a local government prior to July 1, 1989,[177] is permitted to continue as long as less than fifty percent of the peak demand for off-beach parking is available.[178] Driving is not allowed on any additional beaches.[179]

E. Beach and Shore Preservation Act

The Beach and Shore Preservation Act (BSPA) regulates coastal construction and beach and shore preservation projects such as beach restoration and renourishment, navigation inlet improvement, and erosion control projects.[180] Section 161.041 requires that a permit must be obtained from DEP before commencement of any of these activities on sovereignty lands of Florida, below the mean high water line of any tidal water.[181] Section 161.053 requires permits with special siting and design considerations to construct seaward of the coastal construction control line (CCCL).[182]

DEP can condition a permit to alter, excavate, or construct on property seaward of the CCCL to protect nesting sea turtles, hatchlings, and their habitat.[183] Protection of sea turtles and their nesting sites must also be addressed under this section when DEP grants general permits[184] or areawide permits to local governments and utility companies for special activities,[185] in development agreements between DEP and property owners,[186] and in certain permit-exempt projects to maintain navigation inlets or renourish nearby downdrift beaches.[187]

Pursuant to permit requirements for construction on sovereignty lands or seaward of the CCCL, DEP can issue a permit for installation of rigid coastal armoring structures or other emergency response measures.[188] However, the BSPA delegates to local counties and municipalities the authority to approve construction of temporary coastal armoring in certain emergency situations.[189] In installing these structures, the local government must consider the protection of nesting sea turtles and hatchlings.[190]

The BSPA requires consideration of sea turtle protection[191] in conjunction with state funding for beach restoration and renourishment projects and navigation inlet improvement.[192] When prioritizing projects which can receive up to seventy-five percent state funding, the state considers, among other criteria, the impact of the project on sea turtle nesting and the extent of local government legislation which protects sea turtles from the adverse effects of beachfront lighting and preserves their habitat.[193] In order to receive any state funds, such a project must provide for protection of sea turtles and their nesting habitat.[194]

The 1986 amendments required DEP to designate "coastal areas which are utilized, or likely to be utilized, by sea turtles for nesting," and to adopt guidelines for regulations of local governments to control beachfront lighting to protect sea turtles.[195] DEP carried out these instructions in chapter 62B-55 of the *Florida Administrative Code*, where it designated twenty-six coastal counties as nesting habitat[196] and published the Model Lighting Ordinance for Marine Turtle Protection (MLO).[197]

V. RULES AND PROCEDURES FOR SEA TURTLE PROTECTION

A. Permitting Activities on Sovereignty Lands

Chapter 62B-41 of the *Florida Administrative Code*, Rules and Procedure for Application for Coastal Construction Permits, implements section 161.041 of the Florida Statutes, which regulates coastal construction on sovereignty lands below the mean high water line of the tidal waters of Florida.[198] Coastal construction upon sovereignty lands may not cause the "take" of sea turtles pursuant to the MTPA.[199] Any coastal construction permitted under this chapter and determined to have an adverse impact[200] is monitored to deter mine its impacts upon, among other things, sea turtles.[201]

Applications for permits for coastal construction on sovereignty lands that affects sea turtles are subject to the conditions and requirements for sea turtle protection set forth in Rule 62B-41.0055.[202] Before granting a permit under this rule, DEP must determine that the coastal construction is consistent with the federal ESA and Florida's MTPA and would not result in a "take" under the MTPA.[203] In making this determination, DEP evaluates the number of sea turtles and nests that would be affected, the potential impacts of disturbance on the turtles and nests, and the quality and suitability of the existing beach for nesting in the area of the construction.[204]

Except in certain emergency situations,[205] construction of coastal armoring structures on sovereignty lands is prohibited in federally-designated critical habitat for sea turtles or on the shore of the Archie Carr National Wildlife Refuge.[206] When any coastal construction is permitted, even in the excepted emergency situations, DEP requires "nest surveys, nest relocation, nest marking, modification of coastal construction, measures to reduce sand compaction, and short and long term monitoring to assess the impacts of the permitted coastal construction on marine turtles and their habitat."[207]

Beach restoration and renourishment projects and mechanical sand bypassing projects on sovereignty lands must be designed to provide suitable habitat for sea turtle nesting activity.[208] These beach preservation activities cannot take place during the nesting season unless sea turtle protection measures are employed, including "nest surveys, nest relocation, nest marking, modification of coastal construction and measures to reduce sand compaction."[209] Also, the applicant must provide DEP with justification to conduct the construction during that time period.[210] Coastal construction on sovereignty lands other than beach restoration and renourishment and mechanical sand bypassing is prohibited from taking place during the sea turtle nesting season if DEP determines the construction will result in a significant adverse impact or an inconsistency with the provisions of the MTPA.[211]

Additional sea turtle protections provided by this chapter include the requirement that construction on sovereignty lands must be sited and designed to minimize any adverse impact on sea turtles.[212] Permit applicants must provide evidence that deviation from specified DEP design guidelines does not increase potential adverse impacts to sea turtles.[213] Permit applications for construction, excavation, or maintenance of a coastal inlet must include an analysis of the expected effect on sea turtles in the inlet area, includ ing the effect of alternative construction and no construction.[214] Applications for all coastal construction on sovereignty lands must include "[i]nformation required to assess potential impacts to marine turtles, nests and their habitat."[215] Once the permit is granted, "extreme care" must be exercised during the construction to prevent adverse impacts to sea turtles, nests, and their habitat.[216]

B. Permitting Activities Seaward of the CCCL

Chapter 62B-33 of the *Florida Administrative Code*, Rules and Procedure for Coastal Construction and Excavation, implements section 161.053 of the Florida Statutes, which regulates coastal construction seaward of the CCCL.[217] When DEP considers a permit application under this rule, the agency must assess the effects of the proposed activity on sea turtles, among other things.[218] With the exception of some emergency protection structures, DEP cannot issue a permit if the agency determines that the activity will result in "a significant adverse impact to marine turtles."[219]

When necessary to protect sea turtles and their habitat, DEP may place conditions on the nature, timing, and sequence of permitted construction seaward of the CCCL.[220] In nesting areas, lighting must be shielded or designed so that it will not disturb sea turtles, and windows and doors visible from nesting areas must use tinted glass or other light control measures.[221] If these and other sea turtle protection measures are not taken, DEP will suspend the permitted construction.[222]

Coastal armoring[223] structures seaward of the CCCL must be sited and designed to minimize adverse impacts on sea turtles.[224] Construction of armoring during the sea turtle nesting season is prohibited if DEP determines that a take

will occur pursuant to the MTPA, except in the case of some emergency permitting.[225] Additional coastal armoring is banned on public lands in the Archie Carr National Wildlife Refuge, a refuge established for the protection of sea turtle nesting grounds.[226] However, coastal armoring is permitted on these lands where there is no reasonable alternative and the armoring is "necessary to protect public infrastructure."[227]

Ordinarily, only DEP can issue emergency permits for certain types of coastal construction when there is a "shoreline emergency" resulting from storm impact.[228] However, when a storm causes erosion "such that existing eligible structures have either become damaged or vulnerable to damage from a subsequent frequent coastal storm," local governments are authorized to construct coastal armoring to protect public infrastructure and private structures.[229] Alternatively, the local government may declare an emergency and issue permits to private property owners to construct armoring to "protect their private structures."[230]

These emergency permits must be issued pursuant to the appropriate rules and statutes, and before issuing such a permit, the local government must notify DEP.[231] The emergency armoring must be removed within sixty days unless the local government applies for a DEP permit.[232] Also, the armoring must be sited and designed to minimize impacts to sea turtles.[233] If the installation of the armoring occurs during the sea turtle nesting season, the local government must obtain information on the location of any sea turtle nests in the area and the armoring "shall be sited and constructed in a manner that protects marine turtles."[234] DEP must require removal of armoring that causes a take pursuant to the MTPA.[235]

C. Model Lighting Ordinance for Marine Turtle Protection and Local Ordinances

When implementing section 161.163 of the Florida Statutes in 1993, DEP promulgated the MLO.[236] As instructed by the legislature, the agency designated twenty-six coastal counties which are used, or likely to be used, by nesting sea turtles,[237] and developed guidelines for local governments to control beachfront lighting.[238] Rule 62B-55.004 encourages local governments to adopt and enforce these minimum guidelines.[239] The guidelines prohibit driving on the beach at night during the nesting season and campfires or bonfires on the beach,[240] and suggest model standards for new and existing beachfront lighting.[241]

These model standards include positioning light fixtures so that they are not directly visible from the beach and do not illuminate areas seaward of the frontal dune; mounting fixtures as low as possible and positioning them so that light is cast downward; using recessed or shielded light sources without reflective interior surfaces; using low wattage yellow "bug" type bulbs or low pressure sodium vapor lighting; and using motion detector switches that switch light on for a minimum duration.[242] The guidelines also suggest shielding light sources from the beach with ground level barriers or vegetation buffers.[243] Tinted glass, window treatments, and moving lamps away from windows are recommended to shield interior lighting.[244]

Many counties and cities along Florida's coast have adopted sea turtle lighting ordinances patterned on DEP's MLO. DEP's 1993 survey of Florida sea turtle lighting ordinances showed that twenty-seven cities in fourteen coastal counties have adopted such ordinances.[245] Some of the ordinances include protections beyond those recommended in the MLO. Palm Beach County, for example, established a Sea Turtle Protection Zone and requires an approved Sea Turtle Lighting Plan for all new construction and artificial lighting proposed within the zone.[246] St. Lucie County's ordinance requires an approved Sea Turtle Protection Plan for all coastal development involving the installation of lighting and all coastal development conducted during the nesting season seaward of the primary dune or at night.[247] During the nesting season, St. Lucie County also prohibits turning on exterior light sources directly visible from the beach or illuminating areas seaward of the primary dune.[248] Palm Beach, St. Lucie, and Sarasota Counties require a nighttime site inspection prior to granting a certificate of occupancy to ascertain that all beachfront lighting is in compliance.[249]

In an innovative step, Lee County is in the process of revising its lighting regulations to avoid the difficulty of quantifying possible lighting violations.[250] The county's proposed revision includes the following:

> 2) A rebuttable presumption that there is a violation . . . exists when:
>
> (1) a shadow is created or cast by artificial lighting directly or indirectly illuminating an opaque object in

> sea turtle nesting habitat during the nesting season; or
>
> (2) the disorientation or mortality of a nesting sea turtle or . . . hatchling is caused by artificial lighting directly or indirectly illuminating sea turtle nesting habitat during the nesting season.[251]

Some local ordinances protect sea turtles from dangers other than beachfront lighting. For instance, Collier County requires a county permit for construction within 100 feet of a nesting beach during the nesting season,[252] and Sarasota County requires written approval from DEP for such construction, as well as coordination of activities with sea turtle monitoring personnel.[253] St. Lucie County's mandatory Sea Turtle Protection Plan must incorporate standards that minimize impacts on sea turtles for placement of structures and timing of development.[254]

VI. Research and Protected Areas: Archie Carr Center for Sea Turtle Research and Archie Carr National Wildlife Refuge

In 1986, the Florida Legislature and the University Board of Regents established the Archie Carr Center for Sea Turtle Research at the University of Florida.[255] The Center is named for the pioneer of sea turtle research, Archie Carr, who died in 1987.[256] The Center conducts research on the biology of sea turtles, and its findings are used to further the international conservation of sea turtles.[257] To facilitate sea turtle research around the world, the Center established CTURTLE, a listserv conference network, and the Sea Turtle On-Line Bibliography.[258]

In 1989, the Archie Carr National Wildlife Refuge was designated to protect sea turtle habitat.[259] The refuge consists of over twenty miles of shoreline on Florida's east central coast between Melbourne and Wabasso and attracts more nesting loggerhead turtles than virtually anywhere else on earth, more nesting green turtles than anywhere else in the continental United States, and some nesting leatherback turtles.[260] The refuge is being pieced together as funds for land acquisition become available.[261] The State of Florida purchased the first parcel in 1990 and federal acquisition began in 1991.[262] The U.S. Fish and Wildlife Service (USFWS) is in the process of acquiring the remaining undeveloped land in the refuge with the financial assistance of the State of Florida, Brevard and Indian River Counties, and the Mellon Foundation.[263]

VII. Success of Sea Turtle Protections

The federal government can prosecute for a sea turtle take under the ESA and state agencies can prosecute for a take under Florida's MTPA. DEP can protect sea turtles by imposing conditions on permits or denying permits for coastal construction and erosion control projects. Local governments can enforce local ordinances. Nonetheless, whether these laws are being successfully enforced in Florida is questionable.

A. Federal Laws

1. Violations of the ESA

The federal government holds primary responsibility for enforcing violations of the ESA. USFWS has jurisdiction over sea turtles while they are on land,[264] and the ESA authorizes the agency to seek civil penalties[265] for violations of the statute. Additionally, USFWS may seek criminal penalties such as fines, imprisonment, revocation of federal licenses and permits, and forfeiture of all equipment used in the taking.[266] The ESA also authorizes citizen suits against any person alleged to be in violation of the ESA and against the Secretary of the Interior and USFWS for failure to perform any nondiscretionary duty.[267]

USFWS does not get involved in violations of state or local statutes unless there is evidence of a take under the ESA. In most situations, after notification of a possible take by USFWS, the problem is corrected and there is no need for a civil or criminal proceed ing.[268] However, this is not always the case. In 1994, as part of an enforcement initiative to protect sea turtle hatchlings from beach lighting,[269] USFWS initiated a civil penalty proceeding against a Florida condominium association in Melbourne, Florida.[270] USFWS alleged three violations of the ESA and proposed a penalty of $15,000 per violation. The violations resulted from high loggerhead hatchling mortality on three separate nights caused by the condominium association's lighting near a turtle nesting beach.[271] The case ended with a settlement agreement in which the condominium association agreed to pay a $15,000 fine and correct the lighting

situation.[272]

2. Incidental Take Permits

Under the ESA, USFWS can authorize permits for the incidental taking of sea turtles.[273] The permittee is not liable for any taking that falls within the scope of the permit. As a condition for issuance of such a permit, the applicant must develop a habitat conservation plan specifying actions to minimize negative impacts to the sea turtles.[274] The plan must also identify funds for mitigation efforts, show that there will be no appreciable reduction in the survival of the species or hindrance of its recovery, and contain assurances that the plan will be fully implemented.[275] USFWS recently granted an incidental take permit to Volusia County so that the county could continue to allow driving on its beaches.

Volusia County's fifty miles of beaches[276] have served as a road way for vehicles for over one hundred years[277] and have served for much longer as nesting grounds for loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles.[278] In 1994, USFWS warned Volusia County that permitting driving on its beaches was a potential taking of sea turtles.[279] The county agreed to develop a conservation plan and pursue an incidental take permit from USFWS.[280]

In 1995, two local citizens, on behalf of the loggerhead and green sea turtle species, filed suit against the county in United States District Court under the ESA citizen suit provision.[281] The plaintiffs alleged that Volusia County's allowance of beach driving and the county's ineffective beach lighting ordinance violated the ESA.[282] The plaintiffs sought a preliminary injunction to prevent driving on the beach during the sea turtle nesting season and to compel the county to enforce Florida's Model Lighting Ordinance for Marine Sea Turtle Protection.[283] The court did not compel the county to enforce a stricter lighting ordinance, but temporarily enjoined the county from permitting driving on the beach at night and from allowing driving and parking in the county-designated "Conservation Zone."[284]

During the following year, the county worked with USFWS to develop a Habitat Conservation Plan (HCP) in an attempt to procure an incidental take permit.[285] After a public notice and comment period, USFWS granted the permit to the county in November of 1996.[286] A month later, the judge dismissed the lawsuit. The HCP established three beach areas, each with differing levels of intensity of use.[287] The Natural Beach Areas (18.92 miles) are generally undeveloped and have the highest concentration of sea turtle nests; public driving is not allowed in these areas.[288] The Transitional Areas (11.65 miles) are a mixture of dunes and development and nesting is moderate; driving and parking are permitted except in the thirty-foot wide Conservation Zones.[289] The Urban Areas are heavily developed and minimally used by sea turtles; driving and parking are permitted except in the fifteen-foot wide Conservation Zones.[290]

The HCP also banned driving on the beach at night, and required the county to establish a sea turtle monitoring and management program, hire a professional Protected Species Specialist, establish a cooperative effort with USFWS and DEP to develop an ongoing protected species monitoring program, continue a beach management program, including a vehicle rut removal and maintenance program tailored for protection of sea turtles, and develop a county-wide Beach Lighting Management Plan.[291] The summer of 1997 was the first time the HCP was in force during a sea turtle nesting season, and the county is currently compiling data from its sea turtle monitoring during the season.[292] However, one year of data will not necessarily prove whether the plan worked because sea turtle nesting seasons naturally fluctuate from year to year.[293]

In July of 1997, the plaintiffs appealed the court's dismissal of the lawsuit and two of the judge's earlier rulings: her refusal to allow the addition of leatherback turtles as complainants and her dismissal of the portion of the suit dealing with lighting impacts on sea turtles.[294] The 11th Circuit Court of Appeals in Atlanta heard oral arguments in the case in December of 1997.[295] In August of 1998, the Court of Appeals entirely reversed the federal district court ruling, remanding the case for further proceedings, including a trial on the artificial beachfront lighting issue.[296]

B. Florida Laws

1. Penalties for Violation

Several Florida laws provide penalties for harming sea turtles. Section 327.0725, *Florida Statutes*, states that any person who violates the Florida Endangered and Threatened Species Act of 1977 (FETSA) by intentionally killing or wounding an endangered or threatened species or intentionally destroying the eggs or nest of such a species is guilty of a third degree felony.[297] The legislature also established the Endangered and Threatened Species Reward Program to reward persons who provide information leading to the arrest and conviction of violators of FETSA.[298]

A person who violates the Marine Turtle Protection Act (MTPA)[299] is minimally punished for a first conviction with imprisonment of not more than sixty days or a fine between $100 and $500, or both. A second conviction within one year is punished with imprisonment of not more than six months or a fine between $250 and $1,000, or both.[300] In addition to these penalties for taking, harvesting, or possessing sea turtles or eggs, the court must assess a fine of $100 per "unit of marine life or part thereof."[301] This additional fine appears to dramatically increase the penalty for destruction of a nest, which may contain over 100 turtle eggs. However, in 1991, the Fourth District Court of Appeal held that "unit of marine life" within the meaning of the statute did not include a sea turtle egg and that fining a defendant $100 per egg violated procedural due process.[302] Additional possible penalties include the revocation of licenses and permits and the forfeiture of equipment used in the violation.[303]

Florida's Environmental Protection Act of 1971[304] enables citizens and local governments to sue a governmental agency to compel it to enforce laws protecting sea turtles, or to sue to enjoin an individual or governmental agency from violating laws protecting sea turtles.[305] A citizen or local government can also intervene as a party in certain administrative, licensing, or other proceedings to assert that the activity to be licensed or permitted will harm sea turtles.[306] However, what seems to be a desirable citizen suit provision may not be so desirable; the statute also provides that the prevailing party in any such action is entitled to attorney's fees and costs.[307] The fear of being required to pay the other side's fees likely is a deterrent to taking advantage of the citizen suit provision.

2. Permitting

The coastal construction permitting process protects sea turtles through prevention of harm. DEP reviews the proposed activity and may withhold a permit until the agency is reasonably certain the activity will not harm sea turtles.[308] Under the Marine Turtle Protection Act and the Beach and Shore Preservation Act, all applications for DEP permits for activities that affect nesting sea turtles, hatchlings, or their habitat are subject to conditions for sea turtle protection.[309] DEP may condition the nature, timing, and sequence of most permitted construction to protect nesting sea turtles and hatchlings.[310] If, after the permit is granted, the permittee does not comply with the requirements of the permit, the agency may halt the activity, order compliance with the permit, and in some cases revoke the permit or order removal of the structure.[311] In addition to these restrictions, any person who violates the restrictions on construction seaward of the CCCL or on sovereignty lands, or those on erosion control projects, is guilty of a first degree misdemeanor.[312] Florida Statutes also authorize DEP to impose a fine of up to $10,000 per day for refusal to comply with or willful violation of these restrictions on coastal construction, or any DEP rule or order regarding such coastal construction.[313]

3. Enforcement

Florida has extensive laws and regulations protecting sea turtles and their nesting habitat on the state's coastline, and these laws and regulations contain provisions for enforcement and penalties. However laudatory Florida's sea turtle protection policies may be, they are ineffective if the laws are not enforced. Because of the potential of coastal development to destroy sea turtle nesting habitat in Florida, USFWS has stressed the importance of strict enforcement of lighting ordinances and laws regulating coastal construction, beach armoring, and beach nourishment.[314]

Whether Florida is able to provide successful enforcement is another issue. DEP is working to ensure that the sea turtle protection laws are enforced,[315] but lack of funding and the resulting understaffing substantially impact enforcement efforts.[316] Funding of environmental protection measures may fluctuate according to the political party currently in power,[317] or may be a result of Florida's plethora of legal and societal problems, often viewed as more important than environmental issues.[318] Whatever the cause, one DEP employee suggests that because effective statewide enforcement seems to be economically and logistically impossible, enforcement by local governments and dedicated volunteers is much more feasible.[319] Local enforcement facilitates the day-to-day monitoring of sea turtle nesting

habitat that is necessary for successful manage ment of the sea turtle population.

Political pressures brought to bear on DEP by local communities can create significant problems with coastal construction permitting. Many people wishing to construct or modify structures in well-developed coastal areas, particularly Dade County, where most development occurred prior to the existence of regulation, have a difficult time understanding why they must comply with permit regulations while their neighbors are virtually unregulated.[320] In Dade County, the beach is so well-lit that all sea turtle nests are immediately moved to a protected hatchery.[321] In this area, lighting regulations may seem unfair where the lights do not endanger the relocated hatchlings, although there is still a risk of impacting nesting female sea turtles.[322] Areas like the Panhandle, which has only recently started to increase development, offer a chance for better protection of sea turtles because most coastal construction has oc curred since the imposition of CCCL regulations.[323]

Difficulties inherent in enforcement of coastal construction permits include discovery of and follow-up on violations. After receiving a permit, the permittee may either neglect to follow the permit during construction or construct according to the permit and then illegally change the structure afterwards.[324] A building can be built to permit specifications, but later minor modifications may not require a permit and could bring the building out of permit com pliance.[325] Unless these violations are reported, DEP cannot always follow up on these matters.[326] Permits are only enforceable for the life of the permit. Permits also expire when the permittee moves.[327] Another problem is that dangers to sea turtles, like artificial lighting or shading of the beach, can be caused by structures such as buildings and parking lots landward of the CCCL, which do not require permits involving turtle protection,[328] or by structures constructed prior to regulation.[329] These structures are not within the enforcement jurisdiction of DEP.

Although beach driving is deleterious to sea turtle nesting habitat and unattractive to some beachgoers, prohibition of the practice in areas where it has been permitted for many years is a difficult and controversial issue. Off-beach parking in these areas usually is in adequate to accommodate beach users, as in Volusia County, where a study concluded that 10,000 additional off-beach parking spaces would be necessary to satisfy peak demand if beach parking were prohibited.[330] Besides the financial difficulty for communities in creating off-beach parking, land use restrictions and residents concerned about property values near parking lots add to the problem.[331] Because of the lack of off-beach parking, public beach access would be significantly reduced if beach driving were prohibited, adversely affecting local businesses.[332] Prohibition of beach driving would also have a direct economic effect on beach communities by discontinuing the income from beach access fees, citations and franchise and concession licenses.[333]

Eliminating or minimizing the degradation of nesting habitat caused by erosion control measures is an important goal of sea turtle protection.[334] However, the use of these measures seems likely to continue in the fight against erosion resulting from coastal develop ment.[335] In addition to state protection, federal protection of sea turtles under the ESA is relevant when erosion control projects involve federal land, federal funding, or a federal permit.[336] In these instances, the ESA requires that such actions of federal agencies do not adversely affect endangered or threatened species or their habitat.[337] Nearly all beach renourishment projects receive federal aid,[338] so USFWS can require the proper timing and quality of renourishment projects that replenish nesting habitats. Unfortunately, the majority of coastal armoring does not involve the federal government.[339]

Coastal armoring, especially combined with Florida's new provision allowing local governments to permit so-called "emergency" armoring, is one of the greatest threats to sea turtle nesting habitats.[340] In a 1996 biological opinion, USFWS stated that although the emergency armoring provisions are likely to adversely impact sea turtles, it is still too early to ascertain the regulation's cumulative effects.[341] Detrimental effects may have already occurred. Under the new statute, 2000 feet of armoring was erected with a county permit within the Archie Carr National Wildlife Refuge in 1996.[342] Within the proper amount of time, a DEP permit was applied for and DEP granted the permit because the sea wall was landward of a previously existing, though illegally constructed, sea wall and the agency determined the new sea wall was far enough landward that it would not interfere with sea turtle nesting.[343] However, the armored beach in this refuge specifically designated to protect sea turtle habitat will most likely erode faster than it would have without the armoring, causing the nesting area to rapidly decrease.[344] The emergency armoring statute can easily be abused by local governments and may end up seriously damaging sea turtle habitat. Already, Indian River County has permitted armoring structures without declaring an emergency, and although the structures come under the statutory definition of temporary, they are steel, concrete-capped, and appear to be permanent structures.[345]

Another recent coastal armoring threat to nesting habitat is experimental armoring on Casey Key.[346] DEP is authorized to issue permits to property owners or local governments for the installation of certain experimental armoring.[347] Ostensibly, DEP will not grant the permit if the project is expected to result in a significant adverse impact, including a take of sea turtles under the MTPA,[348] and DEP periodically reviews the project and can order removal or modification of the structure if a take occurs.[349] After DEP granted such a permit, in 1995 a forty-foot wide cement "stepped revetment" was installed on a six to seven hundred foot section of beach on Casey Key.[350] The structure is essentially a series of large cement steps, some buried under the sand.[351] Casey Key does not have a large population of nesting sea turtles,[352] but DEP has received data that the structure is impacting the sea turtles that do nest there.[353] False crawls occur when the turtles attempt to dig in the shallow sand above the steps, and when nests are laid over the steps, water can pool within them.[354] DEP is currently in the process of deciding whether to issue a permit for the installation of a similar structure on Siesta Kay, a very high nesting density beach.[355]

Because local lighting ordinances provide for local enforcement, they are more successfully enforced than statewide regulations.[356] Even with many of these ordinances in force, beachfront lighting continues to be a threat to hatchlings and nesting female sea turtles. Although many citizens voluntarily comply with lighting ordinances once they become aware of the regulations,[357] tensions remain between sea turtles' need for darkness and the human need for security and traffic safety. Enforcement of these ordinances requires nightly attention during the nesting season, which is not always possible on the part of law enforcement agencies.[358] Fortunately, local volunteers often take up this responsibility,[359] but even when lighting ordinances are obeyed, hatchling disorientation sometimes results from inland light in highly developed areas.[360]

Many beachfront lighting problems can be solved through education of the public, especially in areas containing a large number of non-residents who may not be aware of sea turtles' needs. Palm Beach County devised an innovative solution to the beachfront lighting problem by converting violation fines into public education materials.[361] The county recently imposed fines on two condominium associations for violating the county's lighting ordinance.[362] In lieu of taking the money, the county's Department of Environmental Resources Management asked the associations to fund projects related to sea turtle protection or public education.[363] As a result, Sea Turtle Survival League prepared door hangers explaining the dangers of beachfront lighting to nesting sea turtles and hatchlings, and Marine Life Center created dune walkover signs which display sea turtle information and contact phone numbers for additional information.[364]

Determining whether Florida's laws and law enforcement are helping to save the sea turtle and its nesting habitat is difficult to judge because the laws are relatively new in sea turtle time. Sea turtle longevity (possibly up to 100 years) and length of time before reaching sexual maturity (twenty-five to thirty years) require long-term study to acquire meaningful data.[365] Sea turtle breeding habits fluctuate naturally from year to year, so a one, two or even five year study may not yield reliable information as to the status of the popu lation.[366] The current sea turtle population is a reflection of their condition twenty to thirty years ago, a time delay that complicates sea turtle conservation.[367] Also, there are so many threats to sea turtle survival, with new ones often being discovered, that pinpointing exactly what is causing a general decline and predicting the future are limited.[368] To determine if Florida's laws are having a positive effect on sea turtles will require long-term, systematic research projects, which have only recently been initiated.[369]

The success of sea turtle conservation efforts depends on the involvement and education of the public.[370] Florida's citizens and visitors must be informed of human effects on sea turtles and their habitat as a result of coastal development and public use of nesting beaches.[371] Especially with artificial beachfront lighting, increasing public awareness of the problem and the means to alleviate the problem is a positive step towards improving Florida's sea turtle nesting habitat.[372] Often, people are unaware of the detrimental effects their actions may have on sea turtles and are willing to change their behavior once they become aware.[373] However, education does not result in compliance by everyone, hence the need for legislation and successful enforcement.[374]

Additional sea turtle conservation efforts include DEP's sale of $5 sea turtle decals, primarily associated with boat registrations.[375] Revenue from the sale of these decals goes to the Marine Resources Conservation Trust Fund, which is used for sea turtle protection, research, and recovery efforts, among other things.[376] Governor Lawton Chiles recently signed a law establishing a Florida sea turtle license plate, which will provide a secure source of funding for DEP's Marine Turtle Protection Program.[377] Organizations such as Caribbean Conservation Corporation, the

Working Group, Mote Marine Laboratory, Center for Marine Conservation, Audubon Society, and countless local sea turtle conservation organizations in Florida's coastal communities continue to work towards protection of sea turtles and their habitat. Ecotourism "turtle watch" outings are becoming popular and help educate the public about sea turtle conservation.[378] DEP and Florida Marine Research Institute published a Technical Report, *Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches*, geared toward biologists, conservationists, and managers, which contains instructions on how to institute local light management legislation.[379] Florida Power and Light published a booklet on Florida's sea turtles, funds research and educational projects, and works hard to bring its coastal lights into compliance with local sea turtle lighting ordinances.[380]

VIII. CONCLUSION

The beautiful coast of Florida so loved by humans is also a sea turtle nesting habitat critical to the survival of the species. With more people moving to Florida every day, the inexorable develop ment of Florida's sandy beaches will continue to put adverse pressure on sea turtle populations. Coastal development negatively impacts sea turtle nesting habitat with beach cleaning, driving, artificial lighting, and other manifestations of increased human presence in the beach area. Also, this increased development requires repeated use of erosion control measures that intensify the threat to nesting habitat.

Federal and state laws, administrative regulations, and local ordinances protect sea turtles and their nesting habitat in Florida. Whether these laws are successfully being enforced is questionable. Lack of funding results in lack of personnel to discover and follow up on violations, and Florida law does not provide an incentive to file citizen suits. Although we cannot know the true effects of these laws and their enforcement on the protection of sea turtles until long-term studies are completed, there is evidence that increased public awareness has resulted in at least a higher hatchling survival rate. The survival of sea turtles and protection of their nesting habitat will require the concerted effort of dedicated federal, state, and local government employees, conservation groups, and Florida's citizens. We can only hope that with human cooperation and conscientious management of coastal development, sea turtles will continue to successfully nest on Florida's beautiful shores.

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[1] *See* JACK RUDLOE, TIME OF THE TURTLE 17 (1979). *But see* VICTORIA B. VAN METER, FLORIDA'S SEA TURTLES 3 (1992) (stating 150 million years); ROBERT BUSTARD, SEA TURTLES: NATURAL HISTORY AND CONSERVATION 9 (1973) (estimating 90 million years). Return to text.

[2] *See* LINDA COSTON- CLEMENTS & DONALD E. HOSS, SYNOPSIS OF DATA ON THE IMPACT OF HABITAT ALTERATION ON SEA TURTLES AROUND THE SOUTHEASTERN UNITED STATES 1 (NOAA Technical Memorandum NMFS-SEFC-117, 1983) [hereinafter NOAA]. Return to text.

[3] *See* VAN METER, *supra* note 1, at 5. 79,969 sea turtle nests were reported in Florida in 1996. *See Florida Marine Research Institute 1996 Florida Nesting Summary* (visited Nov. 1997) . Return to text.

[4] *See infra* notes 62-63, 72 and accompanying text. Return to text.

[5] U.S. Fish and Wildlife Service, *Biological Opinion: Volusia County, Florida, Incidental Take Permit* (PRT-811813), at 8, Nov. 21, 1996 [hereinafter Biological Opinion]. Return to text.

[6] *See infra* notes 64-71 and accompanying text. Return to text.

[7] *See infra* notes 82-135 and accompanying text. Return to text.

[8] *See* BLAIR E. WITHERINGTON & R. ERIK MARTIN, UNDERSTANDING, ASSESSING, AND RESOLVING LIGHT-

POLLUTION PROBLEMS ON SEA TURTLE NESTING BEACHES 1 (Florida Marine Research Institute Technical Report TR-2, 1996). Return to text.

[9] *See infra* notes 152-263 and accompanying text. Return to text.

[10] *See* ARCHIE CARR, SO EXCELLENT A FISHE: A NATURAL HISTORY OF SEA TURTLES 13 (1984). Return to text.

[11] *See id.* Return to text.

[12] *See* BUSTARD, *supra* note 1, at 16-17. Unlike land tortoises, sea turtles do not normally lift their bodies clear of the ground when walking and must drag their shells through the sand. *See id*. at 17. Return to text.

[13] *See* CARR, *supra* note 10, at 13. By contrast, in the ocean, sea turtles' great size makes them "almost immune to predation." *Id*. Return to text.

[14] *See* VAN METER, *supra* note 1, at 2. Return to text.

[15] *See id*. Sea turtles may live up to 100 years. *See* Telephone Interview with Anne Meylan, Research Scientist in charge of the Marine Turtle Research Program, Florida Marine Research Institute (Nov. 12, 1997). One reason for the lack of exact knowledge on this subject is that not much is known about sea turtles' lives in the ocean. *See* NOAA, *supra* note 2, at 4. Return to text.

[16] *See* NATIONAL RESEARCH COUNCIL, DECLINE OF THE SEA TURTLES: CAUSES AND PREVENTION 21 (1990) [hereinafter NRC]. Return to text.

[17] *See* WITHERINGTON & MARTIN, *supra* note 8, at 2. Return to text.

[18] *See* NRC, *supra* note 16, at 2. Females may mate only once and then lay several clutches of fertile eggs during the nesting season. *See* NATIONAL MARINE FISHERIES SERVICE AND U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLAN FOR U.S. POPULATION OF LOGGERHEAD TURTLE 4 (1991) [hereinafter LOGGERHEAD RECOVERY PLAN]. Return to text.

[19] *See* VAN METER, *supra* note 1, at 2. Return to text.

[20] *See* WITHERINGTON & MARTIN, *supra* note 8, at 2. The nest site is carefully chosen by the female, many of whom stop several times on the way up the beach to check with their snouts the temperature, smell, texture, or water content of the sand. *See* VAN METER, *supra* note 1, at 28.

The temperature of the nest affects egg development and influences the sex of the embryos. *See id*. at 33. Higher incubation temperatures produce mostly females and lower temperatures produce mostly males. *See id*. at 33-34. Change in incubation temperature as a result of rain or shading can affect the length of the incubation period. *See id*. "[E]ven small changes [in nest temperature] could cause increased mortality, delays in hatching, or sex ratio imbalance." NOAA, *supra* note 2, at 11.

Sand particle size is also crucial: "[i]f the sand is too fine, gas diffusion necessary for the eggs to hatch is inhibited and respiratory gas exchange and embryonic development is affected," and if the sand is too coarse, the nest can collapse. *Id*. at 5. Return to text.

[21] *See* WITHERINGTON & MARTIN, *supra* note 8, at 2. Return to text.

[22] *See* CARR, *supra* note 10, at 22. Return to text.

[23] *See* VAN METER, *supra* note 1, at 2. Return to text.

[24] *See id*. Return to text.

[25] *See id.* at 4. Return to text.

[26] *See id*. at 3. Return to text.

[27] *See* WITHERINGTON & MARTIN, *supra* note 8, at 5. When the hatchlings begin to emerge, if those on the top sense sunlight, they will stop and remain in place until the evening comes. *See* RUDLOE, *supra* note 1, at 24. Return to text.

[28] *See* VAN METER, *supra* note 1, at 4. Scientists call this gap the "lost year." *See* RUDLOE, *supra* note 1, at 241. Some believe the young turtles live in floating rafts of sargasso weed. *See* CARR, *supra* note 10, at 99. Return to text.

[29] *See* VAN METER, *supra* note 1, at 5. Feeding grounds in the continental United States include the Gulf of Mexico and the east coast from Florida to Canada. *See id*. at 4. Worldwide feeding grounds are located in the Atlantic, Pacific, and Indian Oceans and the Caribbean Sea, in tropical, subtropical, and temperate waters. *See id*. at 6-8, 14-15, 18-19. Return to text.

[30] *See id.* at 12. One population of green turtles feeds along the coast of Brazil and nests on Ascension Island, 1400 miles away. *Id.* Return to text.

[31] *See id*. at 3. Return to text.

[32] *See id*. at 11. Return to text.

[33] *See* NATIONAL MARINE FISHERIES SERVICE AND U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLAN FOR U.S. POPULATION OF ATLANTIC GREEN TURTLE 2-3 (1991) [hereinafter GREEN TURTLE RECOVERY PLAN]. For an example of these navigational abilities, *see supra* note 30. Return to text.

[34] *See id*. at 3. Return to text.

[35] *See* VAN METER, *supra* note 1, at 8. However, the Green Turtle Recovery Plan lists a range of 350 to 2288 green turtle nests found each year in Florida from 1986 to 1990. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 1. Return to text.

[36] *See* Van Meter, *supra* note 1, at 9-10. Until recently, these turtles were considered a delicacy and are the main ingredient in turtle soup. *See id*. at 9. Green turtles are named for the color of their body fat. *See id*. at 8. Return to text.

[37] *See id.* at 7. Return to text.

[38] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 3. Return to text.

[39] *See id.* at 1-2. Return to text.

[40] *See* Anne Rudloe & Jack Rudloe, *Sea Turtles: In a Race for Survival*, NAT'L GEOGRAPHIC, Feb. 1994, at 94, 108-12 [hereinafter NAT'L GEOGRAPHIC]. Return to text.

[41] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 2. Return to text.

[42] *See* NATIONAL MARINE FISHERIES SERVICE AND U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLAN FOR LEATHERBACK TURTLES IN THE U.S. CARIBBEAN, ATLANTIC, AND GULF OF MEXICO 1, (1992) [hereinafter LEATHERBACK RECOVERY PLAN]. Return to text.

[43] *See* VAN METER, *supra* note 1, at 16. Return to text.

[44] *See id*. at 13-16. A heat exchanging mechanism that permits leatherbacks to maintain a body temperature up to seventeen degrees centigrade above the water temperature enables them to swim in frigid water. *See* RUDLOE, *supra* note 1, at 171. Return to text.

[45] *See* VAN METER, *supra* note 1, at 14. Leatherbacks have back-pointing spines in their throats to hold jellyfish prey

in when water is expelled. *See* RUDLOE, *supra* note 1, at 172. Return to text.

[46] LEATHERBACK RECOVERY PLAN, *supra* note 42, at 3. Return to text.

[47] *See* NRC, *supra* note 16, at 35. Return to text.

[48] *See* VAN METER, *supra* note 1, at 17. Return to text.

[49] *See* NATIONAL MARINE FISHERIES SERVICE AND U.S. FISH AND WILDLIFE SERVICE, RECOVERY PLAN FOR THE HAWKSBILL TURTLE IN THE U.S. CARIBBEAN, ATLANTIC, AND GULF OF MEXICO 1 (1993) [hereinafter HAWKSBILL RECOVERY PLAN]. Return to text.

[50] *See* NRC, *supra* note 16, at 39 ("Additional killing of juvenile[s] . . . for trade in stuffed specimens raises mortality to catastrophic levels.") *Id.* Return to text.

[51] *See* VAN METER, *supra* note 1, at 18; *see also* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 4. Return to text.

[52] *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 2. Return to text.

[53] *See id*. at 3. Return to text.

[54] *See* VAN METER, *supra* note 1, at 18. Return to text.

[55] *See id.* at 20. Return to text.

[56] *See* NRC, *supra* note 16, at 26. Return to text.

[57] *See* VAN METER, *supra* note 1, at 20-21. *Arribada* means "arrival" in Spanish. *See* CASSELL'S SPANISH- ENGLISH ENGLISH- SPANISH DICTIONARY 69 (1997). Return to text.

[58] A film taken in 1947 shows approximately 40,000 females nesting in one day at Rancho Nuevo, the main Kemp's ridley nesting beach in Mexico. *See* U.S. FISH AND WILDLIFE SERVICE AND NATIONAL MARINE FISHERIES SERVICE, RECOVERY PLAN FOR THE KEMP'S RIDLEY SEA TURTLE 5 (1992) [hereinafter KEMP'S RIDLEY RECOVERY PLAN]. In 1968, 5000 females nested there in a single *arribada*, while between 1978 and 1990, "a single *arribada* rarely reached 200 females." *Id.* The Kemp's ridley sea turtles fell prey to egg traders in the early years, but now shrimp trawlers are their main danger. *See* VAN METER, *supra* note 1, at 21-22. Return to text.

[59] *See* KEMP'S RIDLEY RECOVERY PLAN, *supra* note 58, at 3; NRC, *supra* note 16, at 25; VAN METER, *supra* note 1, at 19-21. Return to text.

[60] *See* Carol B. Cole, *Excavation of Kemp's Ridley Nest Hatches Disappointment* (visited Nov. 1997) . The two nests in Volusia County were the first recorded Kemp's ridley turtle nestings on Florida's east coast. *See id*. Return to text.

[61] *See* letter from Robbin Trindell, Ph.D., Biological Administrator, Marine Turtle Program, Bureau of Protected Species Management, Department of Environmental Protection, to author (May 14, 1998) (on file with author). Return to text.

[62] *See* VAN METER, *supra* note 1, at 37. "[M]any turtles bear the wounds of sharks." RUDLOE, *supra* note 1, at 29. Return to text.

[63] *See* BUSTARD, *supra* note 1, at 111-12. Return to text.

[64] *See* VAN METER, *supra* note 1, at 38. The international tortoise shell trade "may be the most significant factor endangering hawksbill populations worldwide." HAWKSBILL RECOVERY PLAN, *supra* note 49, at 15. Return to text.

[65] *See* NRC *supra* note 16, at 74. Turtles drown in trawls, drift nets, seines, gill nets, long lines, and other types of

fishing equipment, including lost or discarded fishing gear. *See id.* at 101; s*ee also* VAN METER, *supra* note 1, at 39. Sea turtles can also become entangled in fish and crab trap ropes, buoy anchor lines, and other ropes and cables. *See* LEATHERBACK RECOVERY PLAN, *supra* note 42, at 14. Return to text.

[66] *See* NRC *supra* note 16, at 75. Incidental capture in shrimp trawls is the most significant cause of mortality for loggerhead and Kemp's ridley turtles in the ocean. *See id.* Return to text.

[67] *See* NRC, *supra* note 16, at 107-09; *see also* NAT'L GEOGRAPHIC, *supra* note 40, at 108. Sea turtles can be crushed by dredges. *See id.* The National Marine Fisheries Service issued a biological opinion in 1991 under Section 7 of the Endangered Species Act, 16 U.S.C. §§ 1531 et seq. (1998), finding that the unrestricted operation of hopper dredges off the southeast coast of the United States jeopardized the existence of sea turtles. *See* KEMP'S RIDLEY RECOVERY PLAN, *supra* note 58, at 10. Return to text.

[68] *See* VAN METER, *supra* note 1, at 42. Many injured and dead turtles are found with propeller wounds, and jet skis may stress turtles near shore during the nesting season. *See id*. Nesting females are especially vulnerable to accidents involving boats and shrimp trawlers because they remain close to shore between nesting intervals. *See* NOAA, *supra* note 2, at 11, "The potential impact from these . . . disasters . . . on the survival of a colony is greatly increased since it is the reproductive contingent that is affected." *Id.* Return to text.

[69] *See* NRC, *supra* note 16, at 110-12; HAWKSBILL RECOVERY PLAN, *supra* note 49, at 17. Sea turtles are also endangered by oil and gas exploration, development, and transportation. Oil spills harm turtles at sea or nesting grounds, exploration may disrupt feeding grounds, and turtles can ingest tar balls released from bilge pumping. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 7. Return to text.

[70] *See* NRC, *supra* note 16, at 112-13; GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 9. Return to text.

[71] *See* NRC, *supra* note 16, at 114; GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 12. Ingestion of plastics, cellophane, balloons, styrofoam, rubber, wax, charcoal, aluminum cans, cigarette filters, rope and string, monofilament fishing line, and hooks can have fatal impacts on sea turtles. *See* NRC, *supra* note 16, at 114; KEMP'S RIDLEY RECOVERY PLAN, *supra* note 58, at 10. Sea turtles are near-sighted and can mistake plastic bags and balloons for jellyfish, a common food of leatherbacks. *See* RUDLOE, *supra* note 1, at 49; VAN METER, *supra* note 1, at 43. Return to text.

[72] *See* VAN METER, *supra* note 1, at 36 ("Today, active nest protection and raccoon control programs on many beaches have greatly increased hatchling production."); NRC, *supra* note 16, at 62-63 (stating that raccoons destroyed nearly all sea turtle nests at Canaveral National Seashore, Florida, before protective measures were taken); LEATHERBACK RECOVERY PLAN, *supra* note 42, at 14; s*ee also* RUDLOE, *supra* note 1, at 19-20 (describing raccoons patiently waiting nearby for a mother turtle to lay her eggs and snatching the eggs from the nest chamber as the mother laid them). These natural predators are sometimes indirectly assisted by humans. For example, large raccoon populations are augmented by habitat alteration, human garbage as a food supplement, and removal of natural predators such as panthers and wolves from the coastal zone. *See* NRC, *supra* note 16, at 63; RUDLOE, *supra* note 1, at 19. Return to text.

[73] *See* VAN METER, *supra* note 1, at 36; NRC, *supra* note 16, at 66. Return to text.

[74] *See* NRC, *supra* note 16, at 66. Return to text.

[75] Accretion is the deposition of beach sediments. *See id*. at 77. Return to text.

[76] *See id.* at 66; LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 9. Severe storms in the southeastern United States usually occur after the height of the nesting season. *See id.* at 9. However, storms can cause problems long after the bad weather has ended. When Hurricane Opal struck Florida's panhandle in 1995, the storm flattened dunes and narrowed and lowered beaches. *See* AP Wire Service, *Sea Turtles Still Haunted by Hurricane Opal* (visited Nov. 1997) . A year later, a United States Fish and Wildlife Service biologist estimated that eighty to ninety percent of the turtle nests in the area may have failed due to erosion-caused tidal inundation and water table seepage into nests. *See id*. Also, the

flattened dunes exposed street and building lights to hatchlings, misorienting them away from the ocean. *See id*.

Leatherback nests are particularly vulnerable to erosion because the turtles' great size and tender skin force them to choose high energy, accessible beaches with a steep slope, which prevents them from traveling far inland to lay their eggs. *See* LEATHERBACK RECOVERY PLAN, *supra* note 42, at 10; NRC, *supra* note 16, at 41.

Nests can also be destroyed when dug into by another nesting female, but this is not a serious cause of mortality because most nesting populations have relatively low densities. *See* NOAA, *supra* note 2, at 65. Return to text.

[77] *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 7. Return to text.

[78] *See* VAN METER, *supra* note 1, at 37. Return to text.

[79] *See* LEATHERBACK RECOVERY PLAN, *supra* note 42, at 14. Return to text.

[80] *See* VAN METER, *supra* note 1, at 37. The tumors were first described in 1938 and are now commonly observed on green turtles in the Indian River area, Florida Bay, and the Florida Keys. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 11. Loggerhead and hawksbill turtles have also been reported to have the tumors. *See* Robert H. George, *Health Problems and Diseases of Sea Turtles*, *in* THE BIOLOGY OF SEA TURTLES 363, 371 (Peter L. Lutz & John A. Musick eds., 1997). The tumors can cause disorientation, blindness, and physical obstruction adversely affecting normal swimming and feeding. *See id.* Return to text.

[81] *See* AP Wire Service, *Tumor Biggest Threat for Endangered Green Turtles* (visited Nov. 1997) . The tumors are more common in sea turtles in near-shore waters, areas near large human populations, and areas with low water turnover, as opposed to turtles in deeper, more remote areas. *See* George, *supra* note 79, at 372. Current treatment includes surgical removal of tumors. *See id* at 374. Return to text.

[82] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 16; NRC, *supra* note 16, at 113. *But see* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 7 (stating that Florida Marine Patrol made twenty-nine arrests for illegal possession of eggs from 1983 to 1989). Return to text.

[83] *See* VAN METER, *supra* note 1, at 37-39. Sea turtle eggs are prized in Latin America as an aphrodisiac and the eggs are sold for raw consumption in bars. *See* NAT'L GEOGRAPHIC, *supra* note 40, at 101. In the past, human exploitation of green turtles caused the extinction of entire populations which once nested in Bermuda and the Cayman Islands. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 2. Prior to the institution of protection efforts in 1966, Kemp's ridley "eggs were taken out in mule trains, by truck and by horseback" from nesting beaches in Rancho Nuevo, Mexico. *See* KEMP'S RIDLEY RECOVERY PLAN, *supra* note 58, at 7. Mexican and United States conservationist and agency collaboration has resulted in a significant decrease in poaching in that area. *See id*. at 11. Return to text.

[84] *See* NRC, *supra* note 16, at 80; WITHERINGTON & MARTIN, *supra* note 8, at 4. Return to text.

[85] A "false crawl" occurs when a female ascends the beach but returns to the sea without nesting. *See* VAN METER, *supra* note 1, at 29. Once the egg-laying process has begun, nesting females are not easily disturbed, but they may turn back if bothered by beach activity or lights when exiting the water, ascending the beach, or digging the nest, or if they encounter an obstacle on the beach. *See id*. Disturbances may also result in the abbreviation of the post-egg-laying behavior of covering eggs and camouflaging the site. *See* WITHERINGTON & MARTIN, *supra* note 8, at 4. False crawls are exhausting exercises for nesting sea turtles because the turtles are so heavy, slow and awkward on land. *See* VAN METER, *supra* note 1, at 27. Turtles prevented from nesting may shed their eggs at sea. *See* WITHERINGTON & MARTIN, *supra* note 8, at 4. Return to text.

[86] *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 10. Flashlights can also misorient hatchlings away from the ocean. *See id*. at 11. Return to text.

[87] *See* NOAA, *supra* note 2, at 11. Return to text.

[88] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 5. Horse traffic can also cause these problems. *See* VAN METER, *supra* note 1, at 42. Return to text.

[89] *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 11. Return to text.

[90] *See* NOAA, *supra* note 2, at 14. Return to text.

[91] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 8. Nesting females can become trapped under heavy furniture. *See id.* If a sea turtle purposefully places a nest in the shade cast by beach furniture, the nest may become too hot if the furniture is removed and the nest site is exposed to direct sunlight. *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 11. Return to text.

[92] *See* LEATHERBACK RECOVERY PLAN, *supra* note 42, at 14. Return to text.

[93] *See* NRC, *supra* note 16, at 81. "The extended period of travel required to negotiate tire tracks . . . may increase the susceptibility of hatchlings to stress and depredation during transit to the ocean." *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 6. Return to text.

[94] *See* NRC, *supra* note 16, at 81. Driving directly over a nest can kill the incubating sea turtles within the nest, or it may compact the sand above the nest to the extent that it interferes with hatchling emergence. *See id*. Driving on beaches during high tides or on narrow beaches also contributes to erosion of nesting habitats. *See id*. Return to text.

[95] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 7. Return to text.

[96] *See* NRC, *supra* note 16, at 79-80. Disposal or burial of debris on the beach can harm nests and impede hatchlings. *See id*. at 80. Beach cleaning also exacerbates erosion because the removal of leaf litter and vegetation allows wind to move sand out of the nesting area. *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 10. Return to text.

[97] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 8. Return to text.

[98] *See id*. Return to text.

[99] *See id*. The Australian Pine has engulfed many coastal areas in Florida and can shade the beach, significantly affecting nest temperatures and nest-site selection. *See* NRC, *supra* note 16, at 81-82. *But see* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 6 (reporting that dense stands of the trees can create a barrier to beach lighting which may result in concentrated nesting). Similarly, nesting sea turtles are often attracted to beaches in front of unoccupied or darkened buildings, which can look like a row of trees. *See* NAT'L GEOGRAPHIC, *supra* note 40, at 112. Return to text.

[100] *See* NOAA, *supra* note 2, at 11, 14. Return to text.

[101] *See id*. at 11; s*ee also infra* notes 126-36 and accompanying text (describing the effects of artificial beachfront lighting on sea turtles). Return to text.

[102] *See* NRC, *supra* note 16, at 77-78. Return to text.

[103] *See* FLORIDA DEPARTMENT OF COMMUNITY AFFAIRS, SAND IN MY SHOES: A GUIDE TO LIVING WITH FLORIDA'S COAST at 17 (1995) [hereinafter DCA]. Return to text.

[104] *See id*. Return to text.

[105] *See id*. Coastal armoring includes sea walls, rock revetments, riprap, sandbag installations, groins, jetties, and bulkheads. *See* NRC, *supra* note 16, at 77; DCA, *supra* note 103, at 17. Return to text.

[106] *See* DCA, *supra* note 103, at 17-19. "More than 350 of Florida's 825 miles of sandy beach . . . are eroding. Of these, 233 miles have critical erosion problems." *See id*. at 18. Approximately 21% of Florida's beaches are armored.

See HAWKSBILL RECOVERY PLAN, *supra* note 49, at 7. Return to text.

[107] *See* DCA, *supra* note 103, at 19; NRC, *supra* note 16, at 77-78. Return to text.

[108] *See* NRC, *supra* note 16, at 77-78; Molly E. Lutcavage et al., *Human Impacts on Sea Turtle Survival*, *in* THE BIOLOGY OF SEA TURTLES 387, 390 (Peter L. Lutz & John A. Musick eds., 1997) (explaining that renourishment usually takes place during the summer nesting season because costs are lower due to calmer seas). Return to text.

[109] During the 1997 nesting season at Egmont Key State Park on Florida's west coast, erosion narrowed the beach so much that females were forced to nest below the high tide line, and hundreds of sea turtle eggs were flooded. *See* N-J Wire Services, *Sea Turtle Nests Swamped By Tides* (visited Nov. 1997) . Return to text.

[110] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 3; NRC, *supra* note 16, at 77. Because the majority of coastal armoring structures are vertical seawalls, the most common problem caused by coastal armoring occurs when females intercept seawalls and abandon nesting. *See* Letter from Dr. Robbin Trindell, *supra* note 61; s*ee also* WITHERINGTON & MARTIN, *supra* note 8, at 4 (reporting 1994 loggerhead nesting success at undeveloped beaches of Canaveral National Seashore as 61%, while nesting success at the residential, heavily armored beaches of Jupiter Island was 45%). Return to text.

[111] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 3. Return to text.

[112] *See* HAWKSBILL RECOVERY PLAN, *supra* note 49, at 7-8. Digging impediments can cause false crawls. *See* WITHERINGTON & MARTIN, *supra* note 8, at 4. Return to text.

[113] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 3; NRC, *supra* note 16, at 77. "Sandbags are particularly susceptible to rapid failure and result in extensive debris on nesting beaches." *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 5. Sand or drift fences used to stabilize dunes can also impede nesting and trap hatchlings and nesting females if they are improperly located. *See id*. at 5-6. Return to text.

[114] *See* NRC, *supra* note 16, at 78. These projects are often conducted twenty-four hours a day. *See id.* The artificial lights and activity may also affect nesting females and hatchlings on adjacent beaches. *See id.* The "mechanical earth moving" of renourishment projects may damage nests by compression or excavation, and may increase the chance of storm washover. *See* NOAA, *supra* note 2, at 13. Return to text.

[115] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 4. Access to nesting sites is affected by steep escarpments, which form in the mid-beach zone as a result of wave action caused by the renourishment. *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 6; Lutcavage et al., *supra* note 108, at 389. During the 1997 nesting season, beach renourishment created a steep beach in Sebastian Inlet State Park which discouraged sea turtles from nesting, causing a high number of false crawls. *See* David Kearns, *Some Turtles Won't Nest in Renourished Beach Area*, FLORIDA TODAY, Aug. 29, 1997, *available in* 1997 WL 12790356. Return to text.

[116] Sand color affects nest temperature, and thus hatchling sex ratios. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 17. *See generally supra* note 20 (explaining effects of temperature on nests). Return to text.

[117] Sand grain shape, size, and compaction can affect gas diffusion within the nest. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 17. *See* NOAA, *supra* note 2, at 5. Return to text.

[118] *See* NRC, *supra* note 16, at 78. The process could also expose buried sediments unsuitable for nesting. *See* NOAA, *supra* note 2, at 13. "Differences in temperature, hydric en vironment, and gas exchange affect hatching rates and possibly the vigor and survivorship of hatchlings." Lutcavage et al., *supra* note 108, at 388. Return to text.

[119] *See* NRC, *supra* note 16, at 78. Return to text.

[120] *See id.* Return to text.

[121] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 6. Return to text.

[122] *See id*. at 16. Return to text.

[123] *See id*. at 6. Return to text.

[124] *See id*. Return to text.

[125] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 17. Return to text.

[126] *See* VAN METER, *supra* note 1, at 42. Return to text.

[127] *See* NRC, *supra* note 16, at 79. This type of lighting includes light from buildings, streetlights, dune crossovers, vehicles, and parking lots. *See id*. Return to text.

[128] *See id*.; WITHERINGTON & MARTIN, *supra* note 8, at 16. Return to text.

[129] *See* WITHERINGTON & MARTIN, *supra* note 8, at 2, 4-5. Return to text.

[130] *See id*. at 2-3. The reason for this deterrence may be that sea turtles perceive artificial lighting as daylight. *See id*. at 2. Nesting sea turtles deterred from one beach by lighting may choose a less appropriate nest site or may shed their eggs at sea. *See id*. at 4. One study found that loggerhead turtles nesting on beaches where background glow is visible prefer darker areas where buildings are silhouetted against the glow. *See id*. at 2. Return to text.

[131] Sea turtles "rel[y] on brightness for correct seaward orientation." *See id*. at 5. Return to text.

[132] *See id*. at 4-5. This situation occurs rarely, but when it does occur it is often fatal: the turtles may be prevented from returning to the sea by topography or obstacles, or may wander onto a road and be struck by a car. *See id*. at 5. Return to text.

[133] *See id*. at 5-15. Return to text.

[134] *See id*. at 5. Return to text.

[135] *See* NRC, *supra* note 16, at 79. From 1989 to 1990, 37,159 misoriented hatchlings were reported to the Florida Department of Natural Resources (precursor of the Florida Department of Environmental Protection), but this does not include the many unreported misorientations. *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 7. Return to text.

[136] *See* NRC, *supra* note 16, at 79. In addition to artificial lights on shore, hatchlings can be attracted to lights on boats, platforms, and piers. *See* WITHERINGTON & MARTIN, *supra* note 8, at 15, 68. These hatchlings may become prey to fish in the near-shore waters. *See id*. at 15. Return to text.

[137] *See* WITHERINGTON & MARTIN, *supra* note 8, at v. Return to text.

[138] *See id*. at 20. Although it is difficult to quantify the amount of beach lighting that negatively affects sea turtles, Blair Witherington and R. Erik Martin offer the following rule: "An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach." *Id*. at 16. Return to text.

[139] *See id*. at 20-22. Return to text.

[140] *See id*. at 23. Return to text.

[141] *See* NRC, *supra* note 16, at 122. Return to text.

[142] *See* RUDLOE, *supra* note 1, at 17; VAN METER, *supra* note 1, at 41. Return to text.

[143] *See* NRC, *supra* note 16, at 121; LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 24. Return to text.

[144] *See* NRC, *supra* note 16, at 122; LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 8. Return to text.

[145] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 5. Return to text.

[146] *See* NRC, *supra* note 16, at 121; Stephen H. Higgins & Louis E. Fisher, *The Impacts of Sea Turtle Nest Relocation in Broward County, Florida*, *in* THE STATE OF THE ART OF BEACH NOURISHMENT: PROCEEDINGS OF THE 1993 NATIONAL CONFERENCE ON BEACH PRESERVATION TECHNOLOGY 309 (Lawrence S. Tait ed., 1993) [hereinafter Higgins]. Return to text.

[147] *See* WITHERINGTON & MARTIN, *supra* note 8, at 69; Higgins, *supra* note 146, at 309. Return to text.

[148] *See* Higgins, *supra* note 146, at 316. However, such nest and hatchery protection measures should always enable hatchling release the same night of hatching. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 21. Return to text.

[149] *See* WITHERINGTON & MARTIN, *supra* note 8, at 69 (listing possible dangers of nest relocation as loss of missed and unrelocated nests and damage to eggs during transit, and stating, "Putting eggs in places other than those chosen by the nesting turtle can be detrimental."); VAN METER, *supra* note 1, at 47 (observing that temperature differences in new location may affect sex ratios); s*ee also* U.S. Fish and Wildlife Service, *Final Environmental Assessment for the Incidental Take Permit and Volusia County Beach Habitat Conservation Plan*, at 3-42 (1996) [hereinafter *Environmental Assessment*] (stating that relocation could affect gas exchange parameters and moisture conditions in nests, and could disrupt the hatchling imprint process, which research has shown may cause some female sea turtles to return to their natal beach to nest). However, a study of the effects of nest relocation in Broward County, Florida, found that the hatching success of relocated nests is equivalent to that of unrelocated nests. *See* Higgins, *supra* note 146, at 309. The study also found that the short-term impact of the relocation program was a decrease in nest destruction and hatchling disorientation. *See id. But see* Telephone Interview with Dan Evans, Coordinator, Sea Turtle Survival League (Nov. 13, 1997) (stating that, in general, hatchling success after relocation is lower because all the natural conditions of the nest cannot be duplicated; the nest location is part of the decision-making process of the nesting female). Return to text.

[150] *See* VAN METER, *supra* note 1, at 41 ("The goal of sea turtle conservation programs is self-sustaining populations that do not require human intervention such as [nest relocation.]"); s*ee also* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 24 ("Nest relocation programs at best should be considered as a short-term measure to protect nests in these situations with primary efforts directed towards habitat restoration."). Return to text.

[151] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 11. In 1995, the Florida Depart ment of Environmental Protection ("DEP") recommended nest caging rather than relocation to protect nests from human impacts. *See Environmental Assessment*, *supra* note 149, at 3-44. DEP considers relocation undesirable as a management tool. *See* Letter from Dr. Robbin Trindell, *supra* note 61. Currently, DEP authorizes nest relocation only for conservation reasons, and not for human-related impacts other than erosion and beach renourishment projects. *See id*. An exception to this policy is the Dade and Broward County area, where intense urban development and associated lighting impacts necessitate moving nests to hatcheries. *See id*. DEP is working with these counties to avoid relocation whenever possible and to develop a lighting plan to reduce the current amount of artificial beachfront lighting. *See id*. Return to text.

[152] 16 U.S.C. §§ 1531-43 (1998). Return to text.

[153] *Id.* § 1536(a)(2). Return to text.

[154] *See id.* §§ 1538(a)(1)(B)- (C). Return to text.

[155] *Id.* § 1532(19). Return to text.

[156] Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 515 U.S. 687, 691 (1995). Return to text.

[157] An incidental take is one otherwise prohibited by the ESA but which is "incidental to, and not for the purpose of, the carrying out of an otherwise lawful activity." § 1539(a)(1)(B). Return to text.

[158] *Id.* § 1539(a)(2)(B)(iv). Return to text.

[159] *See* FLA. STAT. § 372.072(2) (1997). Return to text.

[160] *Id.* Return to text.

[161] *See id.* § 372.072(4)(a)2. The Marine Turtle Protection Program in DEP's Bureau of Protected Species Management is responsible for management efforts toward sea turtle recovery, including recovery program planning, management and administration, coordination of research and management activities, habitat protection, and education. *See Bureau of Protected Species Management, Sea Turtle Protection Efforts* (visited Nov. 1997) . Florida Marine Research Institute, the marine research arm of DEP, monitors statewide nesting activity, documents mortalities, conducts research on the biology of sea turtles, and provides data for managing and evaluating coastal-development effects. *See Florida Marine Research Institute, Marine Turtles* (visited Nov. 1997) . Return to text.

[162] *See* FLA. ADMIN. CODE R. 39-27.003(6)-(9) (1998). "Endangered" means a species "whose prospects of survival are in jeopardy due to modification or loss of habitat; over utilization for commercial, sporting, scientific, or educational purposes; disease; predation; inadequacy of regulatory mechanisms; or other natural or manmade [*sic*.] factors affecting its continued existence." FLA. STAT. § 372.072 (3)(b) (1997). Return to text.

[163] *See* FLA. ADMIN. CODE. R. 39-27.004(3) (1998). "Threatened" means a species "which may not be in immediate danger of extinction, but which exists in such small populations as to become endangered if it is subjected to increased stress as a result of further modification of its environment." FLA. STAT. § 372.072(3)(c) (1997). Return to text.

[164] FLA. STAT. § 370.12(1)(b) (1997). Return to text.

[165] *See id*. Each of these recovery plans prepared by USFWS "delineates and schedules those actions believed necessary to restore [the species] as a viable self-sustaining element of its ecosystem." LEATHERBACK RECOVERY PLAN, *supra* note 42, at i; s*ee also* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at i; HAWKSBILL RECOVERY PLAN, *supra* note 49, at i; KEMP'S RIDLEY RECOVERY PLAN, *supra* note 58, at i; LOGGERHEAD RECOVERY PLAN, *supra* note 18, at i. Return to text.

[166] FLA. STAT. § 370.12(1)(c) (1997). Return to text.

[167] *Id*. Return to text.

[168] *See id.* § 370.12(1)(d). Return to text.

[169] *See id.* § 370.12(1)(e). Return to text.

[170] *See id.* § 370.12(1)(f). Return to text.

[171] *See id*. § 370.12(1)(e). Return to text.

[172] *See id*. Return to text.

[173] *See id.* § 370.12(1)(g). Return to text.

[174] *See* FLA. STAT. § 161.53(5) (1997). Return to text.

[175] *See id.* § 161.53(5)(a). Return to text.

[176] *See id.* § 161.58(2). The exceptions are traffic "necessary for cleanup, repair, or public safety, or for the purpose

of maintaining existing licensed and permitted traditional commercial fishing activities or existing, authorized public accessways . . . ." *See id.* Return to text.

[177] *See* Act effective July 1, 1989, ch. 89-249, 1989 Fla. Laws 1036. Return to text.

[178] *See* FLA. STAT. § 161.58(2)(b) (1997). Return to text.

[179] *See id.* § 161.58(2). Return to text.

[180] FLA. STAT. §§ 161.011-.45 (1997). Coastal construction is defined as including "any work or activity which is likely to have a material physical effect on existing coastal conditions or natural shore and inlet processes." *Id.* § 161.011(6). Return to text.

[181] *See id.* § 161.041(1) (1997). Return to text.

[182] *See id.* § 161.053(1)(a). With the aim of protecting Florida's beach-dune system, the Beach and Shore Preservation Act ordered DEP to establish coastal construction control lines (CCCLs) in counties on Florida's coast where necessary to protect uplands and control erosion. *See id.* § 161.053(1)(a). The CCCLs were established to define the "portion of the beach-dune system which is subject to severe fluctuations based on . . . predictable weather conditions." *Id.*

If a proposed structure is seaward of the CCCL but is sited and designed to protect sea turtles, the construction is exempted from regulation under this section as long as it is located landward of existing armoring that meets certain requirements. *See id.* § 161.053(2)(b). Return to text.

[183] *See id.* § 161.053(5)(c). Return to text.

[184] *See id.* § 161.053(19). This section addresses general permits for projects including dune walkovers, decks, fences, landscaping, sidewalks, driveways, pool resurfacing, minor pool repairs, and certain single-family homes. *See id*. Return to text.

[185] *See id.* § 161.053(18). Such activities can include road repairs, utility repairs and replacements, beach cleaning, and emergency response. *See id.* Return to text.

[186] *See id.* § 161.0531(1). Return to text.

[187] *See id.* § 161.142(3). Return to text.

[188] *See id.* § 161.085(2). Return to text.

[189] *See id.* § 161.085(3). The county or municipality may authorize installation of these structures to protect private structures or public infrastructure from erosion caused by a major storm event. *See id.* Within 60 days of installation, the local government must submit a permit application to DEP for a permanent structure, or the temporary structure must be removed. *See id.* § 161.085(6). Return to text.

[190] *See id.* § 161.085(3)(e). Return to text.

[191] *See id.* § 161.161(1)(i), (2)(j) - (k). Return to text.

[192] *See id.* § 161.111. Return to text.

[193] *See id.* § 161.161(2)(j)- (k). Return to text.

[194] *See id.* § 161.161(2). Return to text.

[195] *Id.* § 161.163 (1997). Return to text.

[196] *See* FLA. ADMIN. CODE R. 62B-55.003 (1995). For a list of the counties, see *infra* note 237. Return to text.

[197] *See* FLA. ADMIN. CODE CH. 62B-55 (1995); s*ee also infra* notes 236-44 and accompanying text (describing chapter 62B-55 in detail). Return to text.

[198] *See* FLA. ADMIN. CODE CH. 62B-41 (1996). Return to text.

[199] *See* FLA. ADMIN. CODE R. 62B-41.003(4) (1995); FLA. STAT. § 370.12(1)(c)(1) (1997). Return to text.

[200] Adverse impact is defined as an impact "to the active portion of the coastal system . . . caused by coastal construction which has a reasonable potential of causing a measurable interference with the natural functioning of the coastal system." FLA. ADMIN. CODE R. 62B-41.002(28)(a) (1996). Return to text.

[201] *See id.* at R. 62B-41.005(17) (1995). Return to text.

[202] *See id.* at R. 62B-41.0055(1). This rule is used as a guideline for local government ordinances for the protection of sea turtles. *See* Paden E. Woodruff, III, Address at Florida State University College of Law, Ocean and Coastal Law Class (Oct., 1997). Return to text.

[203] *See* FLA. ADMIN. CODE R. 62B-41.0055(2) (1995). Return to text.

[204] *See id*. Return to text.

[205] *See infra* note 227 and accompanying text. Return to text.

[206] *See* FLA. ADMIN. CODE. R. 62B-41.0055(4) (1995). For information on the Archie Carr National Wildlife Refuge, see *infra* notes 259-63 and accompanying text. Return to text.

[207] FLA. ADMIN. CODE R. 62B-41.0055(5) (1995). Return to text.

[208] *See id*. at R. 62B-41.0055(3). Nesting activity includes "nesting beach selection, emergence of adult marine turtles from marine waters onto the beach, nest site selection, transit to and from the nest site, nest excavation, egg deposition, nest covering, incubation of eggs, hatching, hatchling emergence, orientation and the transit of hatchlings into marine waters." *Id.* at R. 62B-41.002(39). Return to text.

[209] *Id*. at R. 62B-41.0055(6)(a). Return to text.

[210] *See id.* at R. 62B-41.0055(6)(b). Such justification includes:

> 1. Economic, technological, environmental, and public health, safety and welfare factors; or,
>
> 2. A determination that the habitat within the area of the coastal construction does not support successful marine turtle nesting activity due to beach profile and substrate characteristics; or,
>
> 3. A nest relocation program exists within the area of the coastal construction permitted by [DEP] for marine turtle protection reasons unrelated to the proposed coastal construction . . . .

Id. Return to text.

[211] *See id.* at R. 62B-41.0055(7). A significant adverse impact includes a "take" as defined in the MTPA. *See id.* at R. 62B-33.002(23)(b); FLA. STAT. § 370.12(1) (1997). Return to text.

[212] *See* FLA. ADMIN. CODE R. 62B-41.007(1)(a) (1995). Return to text.

[213] *See id.* at R. 62B-41.007(3). Return to text.

[214] *See id.* at R. 62B-41.008(1)(m)8-9 (1996). Return to text.

[215] *Id.* at R. 62B-41.008(1)(o). Return to text.

[216] *Id.* at R. 62B-41.015(1)(b). Return to text.

[217] FLA. ADMIN. CODE CH. 62B-33 (1996). Return to text.

[218] *See* FLA. ADMIN. CODE R. 62B-33.005(3)(a) (1996). Return to text.

[219] *Id.* at R. 62B-33.005(4)(g). Return to text.

[220] *See id.* at R. 62B-33.005(11). Return to text.

[221] *See id*. Return to text.

[222] *See id*. Return to text.

[223] Armoring includes rigid coastal structures such as seawalls, revetments, and bulkheads. *See id.* at R. 62B-33.0051(1)(b). Return to text.

[224] *See id.* at R. 62B-33.0051(3). Return to text.

[225] *See id.* at R. 62B-33.0051(4). The nesting season is March 1 through October 31 for Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties, and May 1 through October 31 for all other counties. *See id.* at R. 62B-33.002(32). Return to text.

[226] *See id.* at R. 62B-41.0055(4) (1995). Return to text.

[227] *Id.* at R. 62B-33.0051(4) (1996). Public infrastructure includes public evacuation routes, emergency facilities, bridges, utilities, hospitals, and structures of governmental significance. *See* FLA. STAT. § 161.085(7) (1997). Return to text.

[228] FLA. ADMIN. CODE R. 62B-33.014(1) (1997). Return to text.

[229] *Id.* at R. 62B-33.0051(6). In addition to armoring, other measures, including sand bags, reinforcement of foundations, and protective sand berms, can be used. *See id.* at R. 62B-33.0051(6)(d). Return to text.

[230] *Id*. at R. 62B-33.0051(6). Return to text.

[231] *Id*. Return to text.

[232] *See id.* at R. 62B-33.0051(6)(g). Return to text.

[233] *See id.* at R. 62B-33.0051(6)(c). Return to text.

[234] *Id.* at R. 62B-33.0051(6)(k)(2). Return to text.

[235] *See id.* at R. 62B-33.0051(6)(j). Return to text.

[236] FLA. ADMIN. CODE CH. 62B-55 (1995). Return to text.

[237] *See* FLA. ADMIN. CODE R. 62B-55.003 (1995). The designated counties are Bay, Brevard, Broward, Charlotte, Collier, Dade, Duval, Escambia, Flagler, Franklin, Gulf, Indian River, Lee, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pinellas, St. Johns, St. Lucie, Santa Rosa, Sarasota, Volusia, and Walton. *See id*. Return to text.

[238] *See id.* at R. 62B-55.004 - .009. Return to text.

[239] *See id.* at R. 62B-55.004. Return to text.

[240] *See id.* at R. 62B-55.005. Return to text.

[241] *See id.* at R. 62B-55.006 - .007. Return to text.

[242] *See id.* Return to text.

[243] *See id.* at R. 62B-55.007(2)(h). Return to text.

[244] *See id.* at R. 62B-55.007(3). Return to text.

[245] *See* "Florida Sea Turtle Lighting Ordinances," provided by Dr. Robbin Trindell (on file with author). DEP is currently in the process of compiling an updated list. Telephone Interview with Robbin Trindell, Ph.D., Biological Administrator, Marine Turtle Protection Program, Bureau of Protected Species Management, DEP (Oct. 24, 1997). Return to text.

[246] *See* PALM BEACH COUNTY, FLA., LAND DEVELOPMENT CODE art. 9, § 9.1.G.1 (1996). The county also requires that existing lighting in the zone be brought into compliance with listed standards. *See id.* at § 9.1.H.3. Return to text.

[247] *See* ST. LUCIE COUNTY, FLA., LAND DEVELOPMENT CODE § 6.04.02.E.1 (1996). Return to text.

[248] *See id.* § 6.04.02.K. Return to text.

[249] *See* PALM BEACH COUNTY, FLA., LAND DEVELOPMENT CODE art. 9, § 9.1.H.5.a (1996); ST. LUCIE COUNTY, FLA., LAND DEVELOPMENT CODE, § 6.04.02.I.9.a (1996); SARASOTA COUNTY, FLA., ORDINANCE 97-082, § 5(K) (1997). Return to text.

[250] The county's current ordinance requires the use of a light meter to measure whether an artificial beachfront light is in compliance, but DEP advised the county not to require measurement with a light meter. Telephone Interview with Carol A. Lis, Senior Environmental Planner, Lee County Department of Community Development Division of Planning (Nov. 12, 1997); *see also* WITHERINGTON & MARTIN, *supra* note 8, at 8 (explaining that light meters cannot accurately gauge brightness from a sea turtle's perspective). Return to text.

[251] LEE COUNTY, FLA., ORDINANCE § 14-73(a)(2) (proposed Nov. 7, 1997). Assistant County Attorney Patrick G. White, who is working on the revision, cited difficulty in enforcing the previous ordinance as the main reason for the revision. Telephone Interview with Patrick G. White, Assistant County Attorney, Lee County, Florida, (Nov. 13, 1997). The county wants to establish a quantifiable standard that does not require the hiring of experts to prove a violation. *See id.* By including the rebuttable presumption in the proposed regulations, the burden of proof is shifted to the alleged violator, who must present evidence sufficient to prove there was no violation. *See id.* Return to text.

[252] *See* COLLIER COUNTY, FLA., LAND DEVELOPMENT CODE, § 3.10.7 (1994). Return to text.

[253] *See* SARASOTA COUNTY, FLA., ORDINANCE no. 97-082, § 9 (1997). Return to text.

[254] *See* ST. LUCIE COUNTY, FLA., LAND DEVELOPMENT CODE, § 6.04.02.G-I (1990, rev. 1996). Return to text.

[255] *See Archie Carr Center for Sea Turtle Research* (visited Nov. 1997) .< R> *See* NAT'L GEOGRAPHIC, *supra* note 40, at 94, 112. Return to text.

[257] *See Archie Carr Center for Sea Turtle Research* (visited Nov. 1997) .< R> *See id.* Return to text.

[259] *See The Archie Carr National Wildlife Refuge: America's First Sea Turtle Refuge* (visited Nov. 1997) <http://www.cccturtle.org/carrref .htm>. Return to text.

[260] *See id*. In 1994, 16,000 loggerhead nests were counted in the refuge, followed by a record 20,000 nests in 1995. In 1994, 1169 green turtles nests were counted, but fewer than 200 were found in 1995. *See id*. Return to text.

[261] *See* NAT'L GEOGRAPHIC, *supra* note 40, at 94, 112. Return to text.

[262] *See* LOGGERHEAD RECOVERY PLAN, *supra* note 18, at 14. Return to text.

[263] *See The Archie Carr National Wildlife Refuge: America's First Sea Turtle Refuge* (visited Nov. 1997) <http://www.cccturtle.org/carrref .htm>. "By mid-1996, over $60 million had been spent to purchase 4.7 miles of beachfront out of 9.3 miles targeted for acquisition (61% of available targeted land.)" *Id*. Amendments to H.R. 2107, which include a $2 million appropria tion for acquisition of land in the refuge, have passed through committee and may reach the House floor this session. *See* H.R. CONF. REP. NO. 105-337, at 123 (1997), 1997 WL 664422 (Leg. Hist.) Return to text.

[264] *See* 50 C.F.R. § 17.11 (1997); *id.* § 402.01. Return to text.

[265] *See* 16 U.S.C. § 1540(a) (1994). Return to text.

[266] *See id.* § 1540(b), (e). Return to text.

[267] *See id.* § 1540(g). Return to text.

[268] Telephone Interview with Sandy MacPherson, Southeast Sea Turtle Recovery Coordinator, USFWS (Nov. 12, 1997). Ms. MacPherson described two recent cases in which USFWS investigated parties for violation of the ESA for beachfront lighting problems. *See id.* In one case, the party fixed the lighting situation immediately. *See id*. In the other case, correction of the lighting problem took several years of negotiation. *See id*. Return to text.

[269] *See* News Release, U.S. Fish and Wildlife Service, *Deaths of Sea Turtle Hatchlings Due to Beach Lighting Brings Civil Penalty Proceeding Against Florida Condominium Association*, at 1, Sept. 20, 1994 [hereinafter News Release]. Return to text.

[270] *See* Notice of Violation, U.S. v. The Breakers Condominiums, Civil Penalty Proceeding, No. INV 0091 AO, U.S. Department of the Interior, April 18, 1994. Return to text.

[271] *See id*. Prior to the initiation of the proceeding, USFWS warned the association several times that it was violating the Brevard County lighting ordinance and the lighting was likely to result in a take, but the association ignored the warnings. *See* News Release, *supra* note 269, at 1. Return to text.

[272] *See* Settlement Agreement, U.S. v. The Breakers Condominiums, Civil Penalty Proceeding, No. INV 0091 AO, U.S. Department of the Interior, June 8, 1995. One reason for the settlement may have been the existence of substantial evidence suggesting that when USFWS warned the condominium property manager of the hatchling disorientation, the manager did not inform the Condominium Association Board. However, when the Board received the Notice of Violation, it took immediate corrective action. *See id*. at 1-2.

The penalty money was paid into the Lacey Act Reward Account, used to reward people who provide information about wildlife violations that end in arrest and conviction, forfeiture notices in newspapers, and for payment of records custodians who maintain property seized by law enforcement officers that is being used in the prosecution of cases. *See* Letter from Sandy MacPherson, USFWS Southeast Sea Turtle Recovery Coordinator, to Karen Moody, Environmental Specialist, DEP (June 30, 1995) (on file with author). Return to text.

[273] *See* 16 U.S.C. § 1539(a)(1)(B) (1994). Return to text.

[274] *See id*. § 1539(a)(2)(A). Return to text.

[275] *See id*. Return to text.

[276] Of Volusia County's 50.61 miles of coastline, only about 35.61 miles are under the regulatory authority of the county. *See Environmental Assessment*, *supra* note 149, at 1-3. Return to text.

[277] Interview with Rob Walsh, Project Coordinator, Volusia County Department of Environmental Management (Nov. 12, 1997). Return to text.

[278] *See Biological Opinion*, *supra* note 4, at 15-18. However, only about 20% of the turtle nesting on the county's beaches occurs on beaches over which the county has jurisdiction; most of the remainder occurs in Canaveral National Seashore and North Peninsula State Recreation Area. *See* Orientation and Training Certification Program Master Curriculum at 4-5, in Volusia County Habitat Conservation Plan, Nov., 1996. Return to text.

[279] *See* Loggerhead Turtle v. County Council, 896 F. Supp. 1170, 1175-76 (M.D. Fla. 1995). Return to text.

[280] *See Biological Opinion*, *supra* note 4, at 2. Return to text.

[281] *See id.* at 3. Return to text.

[282] *See id.* at 1176. Return to text.

[283] *See* Loggerhead, 896 F. Supp. at 1172. Return to text.

[284] *See id*. at 1182. The "conservation zone" extended thirty feet seaward from the dunes. *See id*. at 1174. Return to text.

[285] *See Biological Opinion*, *supra* note 4, at 4. The county hired two environmental consul tants to complete the plan. *See id*. The county also partially prepared an Environmental Assessment which USFWS was required to complete pursuant to the National Environmental Policy Act, 42 U.S.C. § 4332(C) (1998). *See id*. Return to text.

[286] *See* Federal Fish and Wildlife Permit PRT-811813, Nov. 21, 1996. One of the plaintiffs, Shirley Reynolds, stated she felt USFWS's granting of the permit was "an abandonment of an ecosytsem for political reasons," and questioned the short time frame of the permitting process. Krys Fluker, *Fish and Wildlife Gives County Turtle Permit* (visited Nov. 1997) . The judge postponed the trial twice to allow the county time to negotiate the permit. *See id*. Reynolds described as "cronyism" the county's hiring of an influential Democratic fund-raiser to lobby Washington officials for expedition of the permit process; the lobbyist himself claimed Secretary of the Interior Bruce Babbitt as "a personal friend for 20 years." Carol B. Cole, *Feds to Issue Turtle Permit* (visited Nov. 1997) . Return to text.

[287] *See* Volusia County Beach Habitat Conservation Plan at 7-3, Nov. 1996 [hereinafter HCP]. Return to text.

[288] *See id*. at 7-3 to 7-4. Return to text.

[289] *See id.* at 7-3. The Conservation Zone widths are based on sea turtle nesting records and protect the soft sand area in front of the dunes. *See id.* at E-7, 7-4. Return to text.

[290] *See id.* at 7-3. Nests laid outside the Conservation Zone will usually be barricaded and left in place. *See id*. at E-9. Return to text.

[291] *See* HCP, *supra* note 287, at E-6. The HCP also protects the Southeastern Beach Mouse, Least Tern, and Piping Plover. *See id*. at 4-19 - 4-21. The permit protects the county from liability for sea turtle injuries and deaths caused by beach driving, but not by beachfront lighting. Return to text.

[292] Interview with Rob Walsh, *supra* note 276. Return to text.

[293] Telephone Interview with Dawn Zattau, biologist, U.S. Fish and Wildlife Service (Nov. 12, 1997). Zattau, who worked very closely with the county on the HCP, suggests the HCP made an improvement. *Id.* Nevertheless, DEP received over 45 disorientation reports during the 1997 nesting season (with 341 nests in Volusia County), compared to

28 in 1996 (500 nests). *See* Staff Report, *Hatchlings Still Emerging and Getting Disoriented* (visited Nov. 1997) . The USFWS Southeast Sea Turtle Recovery Coordinator stated that, as expected, in the plan's first year of implementation there have been some problems, but Volusia County has "done pretty well." Interview with Sandy MacPherson, *supra* note 268. USFWS will annually review the HCP and can revoke the permit if the county does not remain in compliance with the HCP. *See* HCP, *supra* note 287, at 11-2. Return to text.

[294] *See* Carol B. Cole, *Women File Appeal of Decision on Turtles* (visited Nov. 1997) . Return to text.

[295] *See* Carol B. Cole, *Oral Arguments Set for Dec. 11 in Volusia County Turtle Lawsuit Appeal* (visited Nov. 1997) . Return to text.

[296] *See* Loggerhead Turtle v. County Council, No. 97-2083, 1998 WL 436547, at *26 (11th Cir. Aug. 3, 1998). The court also found that the district court "abused its discretion" in denying plaintiffs' request to add leatherback turtles as complainants. *See id.* Volusia County requested a rehearing by the appellate court, but the court has not yet ruled on the request. *See* Staff Report, *County Council Looks to Stave Turtle Costs Through Consultant* (visited Sept. 9, 1998) The county plans to pursue a new federal incidental take permit to protect the county against liability for turtle deaths caused by artificial beachfront lighting. *See id*. Return to text.

[297] FLA. STAT. § 372.0725 (1997). A third degree felony can be punished with up to five years of imprisonment and a fine of up to $5,000. *See id*. §§ 775.082 & 775.083 (1997). Return to text.

[298] *See id.* § 372.073 (1997). Return to text.

[299] *Id.* § 370.12(1) (1997). Return to text.

[300] *See id.* § 370.021(2)(a) & (b). Return to text.

[301] *See id.* § 370.021(2)(c)(5)(d)-(h). "Marine life" is defined as "any saltwater fish, saltwater products, or shellfish collected for . . . live specimens." *See* FLA. ADMIN. CODE R. 62R-5.001(2)(a) (1997). Return to text.

[302] *See* Bivens v. Florida, 586 So. 2d 442, 444-45 (Fla. 4th DCA 1991). When arrested, the defendant was found holding a bag full of 1088 turtle eggs. *See id*. at 443. The lower court fined the defendant $500, sentenced him to 60 days in jail, and fined him an additional $108,800 ($100 per egg). *See id.* Return to text.

[303] *See* FLA. STAT. § 370.021(2)(c) & (e) (1997). Return to text.

[304] *Id.* §403.412 (1997). Return to text.

[305] *Id.* § 403.412(2)(a) (1997). The complaining party may be able to obtain a temporary restraining order to prevent "immediate and irreparable harm," but cannot obtain an injunction until the person or entity charged with the violation is given 30 days to "take appropriate action." *Id*. at (2)(c). The Supreme Court of Florida has ruled that a plaintiff need not show a special injury to institute suit under this statute, as required by the traditional rule of standing. *See* Florida Wildlife Fed'n v. State Dep't of Envtl. Regulation, 390 So. 2d 64, 67 (Fla. 1980). However, mere allegation of irreparable injury not sustained by facts is not sufficient to warrant the granting of injunctive relief. *See id*. Return to text.

[306] *See* FLA. STAT § 403.412(5) (1997). Return to text.

[307] *See id*. § 403.412(2)(f). Return to text.

[308] *See id.* § 161.053(5)(c). Return to text.

[309] *See id.* § 370.12(1)(e). Return to text.

[310] *See id.* Return to text.

[311] *See* FLA. ADMIN. CODE R. 62B-41.0151(a) (1996). Return to text.

[312] *See id.* §§ 161.052(8), 161.053(8), & 161.121 (1997). A first degree misdemeanor is punishable with up to one year of imprisonment and a fine of up to $1,000. *See id.* §§ 775.082 & 775.083 (1997). Return to text.

[313] *See id.* § 161.054(1). Violators are also liable for any damage the violation causes to sovereignty lands or beaches, including animal life thereon. *See id.* § 161.054(2). Return to text.

[314] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 16, 18, 22. "[DEP] must frequently monitor beaches and maintain strict enforcement when violations are observed." *Id*. at 18. Return to text.

[315] *See* Letter from Dr. Robbin Trindell, *supra* note 61. DEP recently fined a beach cleaner in Palm Beach County for violating the marine turtle protection conditions in his beach cleaning permit. *See id*. DEP's Bureau of Protected Species Management has formed a compliance/enforcement working group in West Palm Beach, an area with a high density of sea turtle nesting beaches, to discuss marine turtle protection requirements. *See id*. The Bureau will also receive funding from USFWS to assess remediation of lighting problems, including assessing compliance with DEP-approved lighting plans. *See id*. Return to text.

[316] *See* Telephone Interview with Bill Wilkinson, Environmental Specialist, Coastal Protection and Engineering, Bureau of Beaches and Coastal Systems, DEP (Nov. 14, 1997); Telephone Interview with Karen Moody, Environmental Specialist, Marine Turtle Protection Program, Bureau of Protected Species Management, DEP (Nov. 17, 1997) (stating that there are not enough enforcement personnel because there is not enough funding). Return to text.

[317] Progress of enforcement can suffer when parties who advocate "less government" are in power. *See* Telephone Interview with Paden E. Woodruff, III, Environmental Program Ad ministrator, Beach and Coastal Systems Management, Bureau of Beaches and Coastal Systems, DEP (Nov. 12, 1997). Return to text.

[318] *See* Interview with Dan Evans, *supra* note 149. Return to text.

[319] *See* Interview with Bill Wilkinson, *supra* note 316. Return to text.

[320] *See id.* Wilkinson described an additional problem with compliance in Dade County: a large number of coastal properties are owned by wealthy European investors who are not accustomed to such regulations governing their investments. *See id.* Return to text.

[321] *See id.* Return to text.

[322] *See id*. Return to text.

[323] *See id.* Return to text.

[324] *See id.* Return to text.

[325] *See id.* Return to text.

[326] *See id*. (stating that, realistically, DEP officials cannot check all permitted structures at all times and are only able to do spot checks for compliance). Return to text.

[327] *See id.* Return to text.

[328] *See* Interview with Dr. Robbin Trindell, *supra* note 245. Return to text.

[329] *See* Interview with Bill Wilkinson, *supra* note 316. Return to text.

[330] *See Environmental Assessment*, *supra* note 149, § 4.3.3.1, at 4-10. Return to text.

[331] *See* USFWS, *Set of Findings: The County of Volusia Incidental Take Permit* (PRT-811813, USFWS Log. No. 96-535D), Nov. 21, 1996, at 32. Return to text.

[332] *See Environmental Assessment*, *supra* note 149, §§ 4.3.3.1, 4.3.3.4, at 4-10, -11. Return to text.

[333] *See id*. § 3.2.5.4.3, at 3-22. Return to text.

[334] *See* NRC, *supra* note 16, at 14. Return to text.

[335] *See id*. at 121. Return to text.

[336] *See Biological Opinion*, *supra* note 4, at 31. Return to text.

[337] *See* 16 U.S.C. § 1536(a)(2) (1994). Return to text.

[338] *See* NRC, *supra* note 16, at 121. Return to text.

[339] *See id.* Return to text.

[340] *See* Interview with Karen Moody, *supra* note 316. However, in most situations, structures that would qualify for an emergency permit would likely not be located in suitable nesting habitat, because areas where such structures are necessary are subject to high rates of shoreline migration and inundation. *See* Letter from Dr. Robbin Trindell, *supra* note 61. Return to text.

[341] *See Biological Opinion*, *supra* note 4, at 31. Return to text.

[342] *See* Interview with Dan Evans, *supra* note 149; Interview with Karen Moody, *supra* note 316. Return to text.

[343] *See* Interview with Bill Wilkinson, *supra* note 316; Telephone Interview with Robbin Trindell, Ph.D., Biological Administrator, Marine Turtle Protection Program, Bureau of Pro tected Species Management, DEP (April 1, 1998). Dan Evans of Sea Turtle Survival League agrees with this assessment. *See* Interview with Dan Evans, *supra* note 149. This area of Florida's coast continues to be the subject of a struggle between DEP and local governments and property owners over the installation of emergency armoring. *See* Interview with Dr. Robbin Trindell, *supra*. Return to text.

[344] *See* Interview with Dan Evans, *supra* note 149. Even without the armoring structures, this is a "hot spot" coastal area, with six-foot regression rates per year. *See* Interview with Dr. Robbin Trindell, *supra* note 343. Return to text.

[345] *See* Interview with Karen Moody, *supra* note 316; Interview with Dr. Robbin Trindell, *supra* note 343. Return to text.

[346] *See* Interview with Karen Moody, *supra* note 316. Return to text.

[347] *See* FLA. ADMIN. CODE R. 62B-41.0075 (1995). Return to text.

[348] *See id*. R. 62B-41.0075(1)(d). Return to text.

[349] *See id*. R. 62B-41.0075(5)-(7). Return to text.

[350] *See* Interview with Karen Moody, *supra* note 316. Moody asserts that by the time the property owners pushed the permit request through after a two-year fight, the erosion was already severe. *See id.* Return to text.

[351] *See id.* Return to text.

[352] *See* Interview with Dan Evans, *supra* note 149. Return to text.

[353] *See* Interview with Karen Moody, *supra* note 316. Return to text.

[354] *See id.* Return to text.

[355] *See id.* Return to text.

[356] *See* Interview with Dan Evans, *supra* note 149. Return to text.

[357] *See* WITHERINGTON & MARTIN, *supra* note 8, at vi. Return to text.

[358] *See* Interview with Dan Evans, *supra* note 149. Return to text.

[359] *See id.* Return to text.

[360] *See* WITHERINGTON & MARTIN, *supra* note 8, at 16. Return to text.

[361] *See* Telephone Interview with Allison King, Environmental Analyst, Palm Beach County Department of Environmental Resources Management (Nov. 19, 1997). Return to text.

[362] *See id.* King admitted that the county only recently began enforcing the lighting ordinance because funds for the purpose just became available. *See id.* Return to text.

[363] *See id.* Return to text.

[364] *See id.* Return to text.

[365] *See* Interview with Anne Meylan, *supra* note 15; GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 13 ("Because of slow growth rates and subsequent delayed sexual maturity, all monitoring will need to be conducted over a long period of time to establish population trends.") Return to text.

[366] *See* Interview with Anne Meylan, *supra* note 15. Return to text.

[367] *See id.* Return to text.

[368] *See id.* Return to text.

[369] *See id.* Past research efforts were inconsistent: volunteers at different levels of experience and training documented nests in a variety of methods. *See* Telephone Interview with Andrea Mosier, Environmental Specialist/GIS Coordinator, Florida Marine Research Institute (Nov. 12, 1997). Standardized monitoring procedures and data collection are necessary to recognize trends in the nesting population. *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 27. Return to text.

[370] *See* GREEN TURTLE RECOVERY PLAN, *supra* note 33, at 32. Return to text.

[371] *See id; see also Biological Opinion*, *supra* note 4, at 48 (stating that voluntary compliance with ordinances by beachfront property owners is essential to decreasing artificial beachfront lighting). Return to text.

[372] *See* WITHERINGTON & MARTIN, *supra* note 8, at vi. Return to text.

[373] *See id; see also* Telephone Interview with Carol Pratt, USFWS Refuge Ranger at Ding Darling Refuge (Nov. 12, 1997) (stating that most people do not need a law to change their lighting for sea turtles); Interview with Allison King, *supra* note 361 (stating that when a condominium association is informed of its noncompliance with the county lighting ordinance, the association usually will voluntarily come into compliance). Return to text.

[374] *See* WITHERINGTON & MARTIN, *supra* note 8, at vi; Interview with Karen Moody, *supra* note 316. Return to text.

[375] *See Bureau of Protected Species Management, Sea Turtle Protection Efforts* (visited Nov. 1997) <http://www.dep.state.fl.us/psm/w ebpages/turtle2.htm>. Return to text.

[376] *See* FLA. STAT. § 327.25 (1997). Return to text.

[377] *See Velador, Caribbean Conservation Corporation Newsletter* (visited Nov. 1997) . Return to text.

[378] *See* Lutcavage et al., *supra* note 108, at 390-91. *But see* WITHERINGTON & MARTIN, *supra* note 8, at 4 (stating that "watched" turtle nests may result in abbreviated nest covering and camouflaging on the part of the nesting female). Return to text.

[379] WITHERINGTON & MARTIN, *supra* note 8. Return to text.

[380] *See* VAN METER, *supra* note 1, at 45-46; Carol B. Cole, *Turtles Face the Light for Life* (visited Nov. 1997) . Return to text.

DEATH ON THE HIGH SEAS: THE DEMISE OF TOVALOP AND CRISTAL

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I. INTRODUCTION

There had been earlier reports of haze—haze that caused several other collisions.[1] However, around 9 p.m. on October 15, 1997, under a clear night sky in one of the world's most congested shipping lanes, two tankers traveled toward each other on a collision course, one inexplicably travelling in the wrong lane.[2] Port authorities gave no less than three warnings, some thirteen minutes in advance; ample time for either captain to correct his course.[3] The Singapore Strait, which connects the Strait of Malacca with the South China Sea, had been described as an accident waiting to happen.[4] The wait was over. The Cyprus-flagged *Evoikos* collided with the Thai-registered *Orapin Global*, spilling an estimated 25,000 tons of fuel oil into the Singapore Strait.[5] Despite the swift containment actions of the Singaporeans, current damage estimates place the total costs at around $100 million.[6] In this modern era of supertankers and international oil spill compensation schemes, one would assume the assignment of liability and the payment of damages sufficient to compensate those injured would just naturally follow. While the determination of liability is most assuredly underway,[7] the payment of sufficient compensation is unlikely.

In February 1997, two private industry agreements that had served to compensate victims of oil pollution for the past twenty-five years lapsed.[8] The Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution (TOVALOP) and the Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution (CRISTAL) were both voluntary agreements developed by the oil industry to address gaps in the existing framework of maritime pollution law.[9] The introduction of the newest International Convention on Civil Liability for Oil Pollution Damage (CLC) and accompanying International Oil Pollution Compensation Fund (Fund Convention) in 1992 resulted in their demise.[10] By January 1996, the 1992 CLC and Fund Convention had received enough ratifications to ensure the protocols would enter into force in mid-1996.[11] As of October 1997, twenty-six countries had ratified the 1992 protocols.[12] Viewed as Sredundant" and considered to have outlived their usefulness,[13] on February 20, 1997, their most recently assigned expiration date, TOVALOP and CRISTAL were simply not renewed.[14]

This article suggests that the passage of time will reveal the demise of TOVALOP and CRISTAL was premature and that the quiet passing of these agreements may, in fact, signify a "calm before the storm," the outer bands of which became clearly visible in Singapore. Part II of this article provides an overview of TOVALOP and CRISTAL. Other U.S. and international remedies for oil spill damages are discussed in Part III. Part IV discusses the ramifications which are being realized because TOVALOP and CRISTAL are no longer enforced, and Part V concludes that any future oil pollution compensation scheme must include TOVALOP and CRISTAL because these agreements provided the greatest likelihood of compensation to those damaged by maritime oil pollution.

II. THE PRIVATE AGREEMENTS

A. Tanker Owners Voluntary Agreement Concerning Liability for Oil Pollution

The International Tanker Owners Pollution Federation Limited (ITOPF or the Federation) developed TOVALOP (also called the "Standing Agreement").[15] Although the impetus for its creation has been described in both negative and positive terms,[16] the ultimate effect was to provide mitigation and compensation for damage by oil pollution from tankers.[17] Seven tanker owners, its original sponsors, signed the Standing Agreement into existence in 1969.[18] As of 1987, over ninety-eight percent of the free world's tanker owners, including many government-owned fleets, had become signatories to TOVALOP.[19] The Federation, an association comprised of parties to TOVALOP, was charged with administering the Standing Agreement.[20]

Membership in the Federation required participating tanker owners to establish and maintain the financial capability to withstand limited liability claims.[21] Typically, this would be reflected by the vessel's acquiring insurance with a Protection and Indemnity (P&I).[22] Under TOVALOP, the tanker owner was expected to "take such [p]reventive

[m]easures and/or [t]hreat [r]emoval [m]easures as are practicable and appropriate under the circumstances."[23] TOVALOP basically defines "Preventive Measures" as any reasonable measures taken after an incident had occurred to prevent or minimize pollution damage, while it defines "Threat Removal Measures" as any reasonable measures taken after an incident had occurred for the purposes of removing the threat of an escape or discharge of oil.[24]

Tanker owners also were expected to voluntarily, and as promptly as possible, dispose of all valid claims arising against the owner under the Standing Agreement.[25] In the event of a dispute regarding claims, the Standing Agreement provided for the commencement of arbitration proceedings under the rules of the International Chamber of Commerce.[26]

TOVALOP's compensation scheme was keyed to the tonnage of the vessel: $160.00 per ton, with a maximum amount of compensation available of $16.8 million for a vessel of 105,000 gross tons.[27] TOVALOP was a no-fault compensation scheme, with only limited coverage exceptions to the tanker owner's liability: (1) where the damage occurs in a geographic area covered by the CLC; (2) the damage is the result of an act of war, hostilities, civil war, insurrection or a natural phenomenon of an exceptional, inevitable and irresistible character; (3) wholly caused by an act or omission of a third party done with intent to cause damage; and (4) wholly caused by the negligence or other wrongful act of any Government or other authority responsible for the maintenance of lights or other navigational aids in the exercise of that function.[28]

B. Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution

CRISTAL (also referred to as the "Supplemental Agreement") was also a voluntary industry agreement designed to address oil pollution damage by supplementing TOVALOP.[29] Unlike TOVALOP, the parties to CRISTAL were not the tanker owners, but the various oil companies "engaged in the production, refining, marketing, storing, trading or terminaling of [o]il, or any one or more of whose affiliates are so engaged or . . . receives [o]il in bulk for its own consumption or use."[30] CRISTAL first took effect in 1971.[31] Similar to TOVALOP, a separate entity, Cristal Limited (the Institute),[32] administered CRISTAL.[33] CRISTAL required the establishment of a fund, contributed to by all signatories to the Supplemental Agreement.[34] The total amount of oil received, based on crude/fuel oil receipts, directly affected each signatory's contribution amount.[35] The Institute made the determination of how much money was necessary to assure the fund's ability to make the payments under CRISTAL.[36] The amount was prorated, by dividing the total amount needed by the total of crude/fuel oil receipts for all signatories, and then multiplying that figure by each individual signatory oil company's receipts.[37]

Once a determination was made that compensation from the tanker owner under TOVALOP proved insufficient to meet all claims, CRISTAL came into play.[38] Earlier versions of CRISTAL required that three basic conditions exist before paying compensation: the oil carried by the vessel must have been owned by a party to CRISTAL; the tanker from which the oil was spilled must have been a party to TOVALOP; and the spill must have occurred under cir cumstances which would have resulted in liability had the CLC been in force at the time of the incident.[39] However, the 1993 version of CRISTAL removed both the TOVALOP signatory requirement, as well as the exclusion for CLC covered liability.[40]

The same defenses to liability stated in TOVALOP applied to the 1993 version of CRISTAL. However, CRISTAL still would reimburse the oil company signatories for their clean-up efforts, even if the damage was the result of "negligence or other wrongful act of any Government or other authority responsible for the maintenance of lights or other navigational aids in the exercise of that function."[41]

Special Drawing Rights (SDR's)[42], as defined by the International Monetary Fund, expressed CRISTAL's compensation scheme.[43] Like TOVALOP, payments were linked to the size of the tanker. Funds were not paid, however, until the Institute determined the oil company's costs had exceeded specific amounts.[44] For example, a tanker weighing 5,000 tons or less, the oil company must have paid out costs of three million SDR's (or $3.78 million); for a tanker weighing in excess of 5,000 tons, the calculation was based on 420 SDR's (or $529.20) for each ton over 5,000, up to a maximum of 59,700,000 SDR's (or $75 million).[45] The aggregate compensation available under CRISTAL, after the minimum payouts were met, was 32 million SDR's (or $40.32 million) for a tanker of 5,000 tons or less, and for a tanker in excess of 5,000 tons, 652 SDR's (or $819.00) for each ton in excess of 5,000, up to a maximum

of 120 million SDR's (or $151.2 million).[46] Designed as a last resort after all other avenues of compensation were exhausted, the minimum payouts, as well as amounts due under any other available remedy, were deducted from the above amounts prior to a CRISTAL payout.[47]

III. Other Remedies for Oil Spill Damage

A. U.S. Admiralty and Maritime Tort Law

Claimants can, in many situations, still pursue damages outside the private agreements. For claimants able to pursue remedies under U.S. laws, the Extension of Admiralty and Maritime Jurisdiction Act, originally passed in 1948, expanded admiralty jurisdiction to include "all cases of damage or injury, to person or property, caused by a vessel on navigable water, notwithstanding that such damage or injury be done or consummated on land."[48] A party seeking to invoke U.S. admiralty jurisdiction is required to satisfy two conditions, location and connection with maritime activity.[49] A court applying the "location test" must determine whether the tort occurred on navigable water, or whether injury suffered on land was caused by a vessel on navigable water.[50] In applying the "connection test," the court must assess the general features of the type of incident involved to determine whether the incident has a "potentially disruptive impact on maritime commerce."[51] The court must then determine whether the general character of the activity giving rise to the incident shows a "substantial relationship to 'a traditional maritime activity.'"[52] Courts have consistently agreed that oil pollution damage cases fall within that definition.[53] Admiralty courts draw on general admiralty law, combined with common law tort concepts of trespass, negligence, and nuisance in constructing a "maritime tort."[54] Attendant costs and delays are only a part of the difficulty faced when choosing this remedy.

To prevail on a trespass claim, the damaged party must prove the damage was either intentional or negligent.[55] Additionally, proof of actual entry or intrusion onto the damaged property is required, making this a particularly difficult burden for claimants to overcome.[56]

A successful negligence claim requires the existence of a legal duty to conform to a certain standard, a breach of that duty, and proof that the breach proximately caused the claimant's damage.[57] Claimants have enjoyed some success under this theory of recovery, and it remains a viable option.[58]

A claim under nuisance theory, to be successful, requires a claimant to show: (1) they have suffered "special damage," that is, damages distinct from those suffered by the public at large; (2) that the spill is appropriately termed a "nuisance;" and (3) the existence of intent or negligence sufficient to interfere with the damaged party's use and enjoyment of the damaged property.[59]

B. Federal Limitation of Liability Act

Claimants seeking relief under United States Admiralty law may also be faced with an additional burden, the potential for the application of the Limitation of Shipowner's Liability Act of 1851 (LSLA).[60] LSLA allows the owner of a vessel responsible for damages caused by maritime oil pollution to limit liability to the value of the vessel and her freight following a spill not within "the privity or knowledge" of the owner.[61] Some courts have readily allowed ship owners to limit their liability.[62] This is especially true when the post-accident actions taken were viewed as reasonable.[63]

Other courts have, however, sometimes refused to allow ship owners to escape full liability. When the Liberian tanker, *Torrey Canyon*, ran aground in 1967, spilling 119,000 tons of oil just outside the English Channel, the Second Circuit restricted the scope of the LSLA, and held Union Oil Company responsible for the full amount of damages.[64] As discussed below, the *Torrey Canyon* spill had even farther reaching implications for both U.S. and international compensation schemes.

C. International Conventions

The *Torrey Canyon* spill set off a firestorm of activity in the international realm. The United Nations' International Maritime Organization spearheaded the effort to design an international compensation scheme that would, regardless of

fault, result in the guaranteed payment of damages, up to a certain limit.[65] The International Convention on Civil Liability for Oil Pollution Damage (CLC), adopted in Brussels in 1969, resulted from these efforts.[66]

1. International Convention on Civil Liability for Oil Pollution Damage (CLC)

The CLC provides uniform rules and procedures for determining questions of liability and adequate compensation for oil pollution damage caused by vessels.[67] The CLC imposes strict liability on shipowners for damages from an oil spill and for the costs of any action taken to minimize that damage.[68] Compensation is keyed to the weight of the vessel.[69] Originally, liability of an owner for a single incident was limited to approximately $160 for each ton, up to a maximum of $16.8 million.[70] To qualify for the limitation, the owner is required to keep on deposit a sum representing the limits of his liability.[71] Additionally, any ship carrying in excess of 2,000 tons of oil in bulk as cargo is required to obtain a certificate attesting to its financial security.[72]

The CLC also provides the vessel owner with certain defenses to liability. A vessel owner shall not be liable for pollution damage when such damage is caused by "an act of war, hostilities, civil war, insurrection or a natural phenomenon of an exceptional, inevitable and irresistible character," or acts or omissions of third parties "done with intent to cause damage," or negligent or wrongful acts committed by governmental entities in the maintenance of lights or other navigational aids.[73]

The 1984 Protocol to the International Convention on Civil Liability for Oil Pollution Damage (1984 Protocol) increased liability limits for ships not exceeding 5,000 tons to 3 million SDR's (or $3.78 million); for ships in excess of 5,000 tons, liability is calculated on an additional 420 SDR's (or $529.20) per ton above 5,000, up to a maximum of 59.7 million SDR's (or $75.2 million).[74] Additionally, the 1984 Protocols created an unlimited liability provision.[75] Under the unlimited liability provisions, a vessel owner is not entitled to limit liability if it proves that the pollution damage resulted from the vessel owner's "personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result."[76]

The ratification of the 1992 protocol signaled the demise of TOVALOP and CRISTAL. The 1992 Protocol increases liability limits for ships not exceeding 5,000 tons to $4.5 million, increasing on a linear scale up to a maximum of $89 million.[77] Additionally, the 1992 protocol provides a simplified procedure for future increases in liability amounts, an expanded geographic zone, and coverage for preventative measures even where no spill occurs; however, only in the presence of grave and imminent danger of pollution damage.[78]

2. International Convention on the Establishment of an International Fund for Oil Pollution Damage

The CLC recommended the establishment of an international fund "to ensure that adequate compensation will be available for victims of large scale oil pollution incidents."[79] Two years after the international conference that produced the CLC, a second conference was held to establish provisions for such an international fund to supplement the CLC.[80] The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund Convention) resulted.[81]

Contributions to the fund are made by all persons receiving more than 150,000 tons of oil during the calendar year within a contracting state.[82] The Fund Convention specifically provides for relief to claimants where vessel owners are not liable, are financially incapable of meeting their obligations, or where damages suffered exceed the owner's liability allowed under the CLC.[83] The Fund Convention also provides compensation to vessel owners for the costs of their efforts to minimize damage and indemnifies them for part of their liability under the CLC if the owner has complied with the provisions of the CLC and has not engaged in willful mis conduct.[84] Originally, the maximum compensation for innocent claimants was $60.9 million per incident for those who could demonstrate their damages were caused by one or more ships, but who might otherwise be unable to collect.[85] The 1984 Fund Conven tion Protocol increased the compensation available under the Fund Convention to $568 per ton, with a maximum liability of approximately 135 million SDR's (or $170.1 million) per incident.[86] Simi larly, as with the CLC, the 1992 protocol to the Fund Convention signaled the end of CRISTAL. The Fund Convention's 1992 protocol increased the maximum liability to $203 million, including the compensation payable by the shipowner under the 1992 CLC protocol.[87]

D. United States Oil Pollution Act of 1990 (OPA 90)

Although the United States signed the 1969 International Convention and actively participated in the development of its 1984 Protocol, it later refused to adhere to this same protocol,[88] citing liability limits that would result in inadequate coverage.[89] Instead, and largely in reaction to the massive oil spill from the *Exxon Valdez* in Prince William Sound, Alaska, in March 1989, Congress passed the Oil Pollution Act of 1990 (OPA 90).[90] The United States also has given no indication of an intent to ratify the CLC and Fund Convention 1992 protocols.[91]

OPA 90 establishes that the owner or operator of a vessel, or a shore-side or offshore facility (the "Responsible Party") shall be strictly responsible for the removal costs and damages caused by an incident involving the spill, or substantial threat of a spill, of oil.[92] Compensable injuries include injury to personal property or real estate, loss of subsistence use of natural resources, loss of taxes or revenues due to destruction or injury to property, lost profits or impairment of earning capacity, and increased costs of providing public services to an area affected by an oil spill.[93] OPA 90 also allows recovery for damages to natural resources.[94]

Under OPA 90, liability limits are also based on the tonnage of the vessel. Liability for vessels weighing less than 3000 gross tons is set at $2 million, and for vessels weighing over 3,000 tons, the liability limit is set at $1,200.00 per gross ton, or $10 million.[95] Claimant compensation is paid from the $1 billion Oil Spill Liability Trust Fund.[96]

One important feature of OPA 90 is its direct contravention of the Limitation of Liability Act. OPA 90 specifically provides:

> Nothing in this Act . . . shall in any way affect, or be construed to affect, the authority of the United States or any State or political subdivision thereof—
>
> (1) to impose additional liability or additional requirements; or
>
> (2) to impose, or to determine the amount of, any fine or penalty (whether criminal or civil in nature) for any violation of law;
>
> relating to the discharge, or substantial threat of a discharge, of oil.[97]

Available defenses are also delineated. If the discharge was caused solely by an act of God, an act of war, or an act or omission of a third party, a responsible party may assert any one or combination of these defenses.[98] However, if the Responsible Party has failed to report a spill, fails to cooperate with officials in connection with removal activities, or fails to comply with applicable orders, these defenses may not be asserted.[99] Additionally, if gross negligence or willful misconduct of a claimant causes the spill, the responsible party will not be liable to that errant claimant.[100]

As important as what OPA 90 is designed to do, is what OPA 90 does not do. It does not limit the ability of states to create their own oil pollution laws.[101] OPA 90 carries a clear congressional message that states may provide for liability in excess of OPA 90's limits, and that these state schemes will not be subject to the Limitation of Liability Act.[102]

E. U.S. State Legislation

Many coastal states have formulated their own legislation. Many of these statutes track OPA 90 in both structure and substance, with a few notable exceptions.[103] For example, Texas passed the Oil Spill Prevention & Response Act of 1991, which covers any vessel with the capacity to carry 10,000 gallons or more of oil, either as cargo or fuel.[104] The result is that virtually every large vessel visiting Texas is covered by the more stringent restriction.[105]

Florida's oil pollution law, the Oil Spill Prevention and Control Act,[106] was challenged prior to the passage of OPA 90 in *Askew v. American Waterways Operators, Inc.*[107] OPA 90's predecessor, the Water Quality Improvement Act, contained a non-preemption clause similar to the one in OPA 90.[108] The Supreme Court upheld the Florida Act because it covered only liability concerns, and no conflict existed.[109]

Washington's oil pollution law went further than the Texas and Florida laws by developing an "elaborate set of

reporting guidelines, alcohol and drug testing programs, pollution prevention regulations, navigation requirements, planning requirements, and penalty provi sions."[110] These regulations were so comprehensive, they faced an almost immediate court challenge by the International Association of Independent Tanker Owners (Intertanko) as a violation of the Constitution's Supremacy Clause.[111] Intertanko argued that the structure of OPA 90 and the placement of the savings and non-preemption clauses within particular provisions of the act necessarily limited their applications to liability, compensation, and removal, but not to prevention.[112] However, the district court found this argument un persuasive and upheld the constitutionality of the Washington act, determining there was no general preemptive intent that could be inferred from OPA 90.[113]

IV. DISCUSSION

The patchwork of state, federal, and international legal regimes that may come into play upon the occurrence of a maritime oil spill within U.S. territorial boundaries suggests injured parties will likely receive sufficient compensation. For spills that occur outside those boundaries, however, this is not the case.

There are several permutations available for countries operating in the international oil shipping realm. For example, countries may elect not to become a signatory to the CLC. They may forego the CLC for any number of reasons. For example, they may possess the same concerns as the U.S. Senate regarding the CLC's ability to fully compensate oil spill damages; they may be in the process of designing their own legal regime (similar to OPA 90); or they may have re lied successfully on the private industry agreements in the past and simply not had time to garner whatever support their governments require to ratify the 1969/71 conventions or the 1992 protocols.

Of approximately 160 maritime countries, only 75 were a party to the 1969/71 conventions.[114] A country may be a signatory to the 1969/71 conventions and have ratified the 1984 protocols, but not the 1992 protocols. A country also may be a signatory to the 1969 CLC, yet not be a member of the 1971 Fund Convention. This is the situation in which Singapore found itself. A signatory to the 1969 convention, Singapore has not ratified either the 1984 or 1992 protocols.[115] Neither has it ever been a member of the 1971 Fund Convention.[116] This means that for Singapore claimants, the *Evoikos* owner's liability will be restricted to around $13 million of the estimated $100 million in damages.[117] Had TOVALOP and CRISTAL not lapsed, the impact of the 1969 convention's shortfall would have been negligible. Even where countries are parties to both the 1969 CLC and 1971 Fund Convention, liability limits may be inadequate. As of mid-1996, there were four separate pollution incidents in which countries who were parties to the 1969/71 conventions were faced with claims that exceeded the amounts available.[118]

Rather than recognize the demise of TOVALOP and CRISTAL as premature, ITOPF has chosen to present the Singaporean's dilemma as a strong argument for more countries to leave behind the 1969/71 conventions and choose ratification of the 1992 protocols.[119] It emphasizes that those who take advantage of the resulting two-tiered system, which received its official sanction May 15, 1998, and elect to remain under the 1969/71 conventions will face larger fund ing requirements.[120] ITOPF points out that the amounts retained in each fund to be used for compensation is a direct function of the number and size of signatories to each convention.[121] As more countries ratify the higher liability limits of the 1992 protocols, there is necessarily less money contributed to the 1971 Fund Convention. Without TOVALOP and CRISTAL to fall back on, countries who may not be proponents of the 1992 protocols are left with very little choice.

When Philippines President Fidel V. Ramos signed his country's accession to the 1992 protocols, it was described in the press as saving the government millions of dollars.[122] However, Ramos indicated the accession was due to the termination of TOVALOP and CRISTAL and concerns regarding the increased density of large oil supertankers passing through Philippine territorial waters.[123] What choice did Ramos, or any other signatory country, really have? If countries elect to remain under the 1969/71 conventions, they will find themselves carrying the lion's share of the funding load. Their only other alternative is to create their own oil pollution regimes, like the United States did by creating OPA 90, and create them now,[124] or run the risk of a catastrophic spill without adequate relief mechanisms for its victims.

V. CONCLUSION

In 1995 and 1996, fewer claims for damages caused by maritime oil pollution were filed, with only "intermediate"

spills reported.[125] In 1995, there were only two spills that exceeded 700 tons each, both of which occurred in South Korean waters.[12]*6 The Sea Prince* was grounded on July 23, 1995, losing approximately 700 tons, and the *Honam Sapphire* on November 17, losing approximately 1,000 tons.[127] In fact, 1995 was a stellar year for oil spills, with the ITOPF, which has been collecting data since 1970, reporting a total of 5,000 tons of oil lost from a total of only twenty-one oil spills.[128] This was the lowest total ever recorded.[129] Although 1996 recorded only twenty spills, one of them, the *Sea Empress* incident in Milford Haven, lost over 70,000 tons of oil.[130] Despite ITOPF's optimism that CLC and Fund Convention liability levels are adequate, we should not make the mistake of believing 1995 stands for anything other than an anomaly. As technology advances and world oil consumption increases, the potential increases for the occurrence of oil spills of major proportions become more likely. In late-1996, prior to the demise of TOVALOP and CRISTAL, ITOPF reported a 142 percent increase in the 140,000 gross tonnage weight tanker.[131] Rather than the "one-size fits all" CLC brand compensation scheme being pushed by ITOPF, a reinstatement of TOVALOP and CRISTAL would ensure that in no instance would victims of maritime oil pollution go un compensated, regardless of what legal regime is or is not in place. Compensation for damages should not depend on the geographic location of a spill, but on those whose business it is to ship and purchase the oil, regardless of where they travel.

For "interim" agreements, a lifetime of twenty-five years and a membership of ninety-eight percent of the world's tanker tonnage, speak volumes about TOVALOP's and CRISTAL's proven place in the international oil pollution regime. Despite the laudable efforts of the international conventions to meet the demands of ever-changing oil pollution concerns, the short-sightedness of ITOPF's "clean-up" efforts in terminating the private agreements is, much like the waters in the Singapore Straits, becoming clearer. The ITOPF focus should not be a tidy oil pollution compensation scheme, but one that actually provides the greatest likelihood of compensation to those damaged by maritime oil pollution. Such a compensation scheme necessarily would include the reinstatement of TOVALOP and CRISTAL.

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[*] B.S., UNIVERSITY OF WEST FLORIDA (1994); J.D., FLORIDA STATE UNIVERSITY (1998). Return to text.

[1] *See* Santha Oorjitham, *Damage Control: A Quick Oil Clean-up and Speedy Charges*, NATIONS, Oct. 31, 1997. Return to text.

[2] *See id.* Return to text.

[3] *See id.* Return to text.

[4] *See id.* Return to text.

[5] *See id.* Return to text.

[6] *See* Raj Rajendran, *Singapore Charges 2 Captains in Oil Spill*, SEATTLE TIMES, Oct. 22, 1997, at A12. Return to text.

[7] *See id.* Return to text.

[8] *See* David Knott, *Hole Appears in Tanker Spill Cover*, OIL & GAS J., Mar. 17, 1997, at 30. Return to text.

[9] *See id.* Return to text.

[10] *See* Mayer, *Collective Action Call on Oil Pollution Compensation*, LLOYD'S LIST INT'L, May 30, 1996, at 5. Return to text.

[11] *See Estonia Tragedy Casts a Long Shadow*, LLOYD'S LIST INT'L. Jan. 2, 1996, *available in* 1996 WL 6268873. Return to text.

[12] *See* Allison Giles, *Countries Urged to Sign Shipping Rules New Spill Protocols Are Preferred by Group*, PLATT'S

OILGRAM NEWS, Aug. 29, 1997, *available in* 1997 WL 8880440. The United States is not a signatory to the 1992 protocols. *See id.* Return to text.

[13] *See* Knott, *supra* note 8. Return to text.

[14] *See* Mayer, *supra* note 10. Return to text.

[15] *See* David A. Barrett & Christine M. Warren, *History of Florida Oil Spill Legislation*, 5 FLA. ST. U. L. REV. 309, 340 (1977). Return to text.

[16] *Compare id.* at 339 (claiming the industry was only interested in warding off more stringent legislative action) *with* Gordon L. Becker, *A Short Cruise on the Good Ships TOVALOP AND CRISTAL*, 5 J. MAR. L. & COM. 609, 610-11 (arguing it was more a responsible industry action to fill in existing gaps in the existing regime). Return to text.

[17] *See* Barrett & Warren, *supra* note 15, at 340. Return to text.

[18] *See* Becker, *supra* note 16, at 610. Return to text.

[19] *See* Lawrence G. Cohen, *Revisions of TOVALOP and CRISTAL: Strong Ships for Stormy Seas*, 18 J. MAR. L. & COM. 525, 526 (1987). Return to text.

[20] *See* Barrett & Warren, *supra* note 15, at 340. Return to text.

[21] *See* Tanker Owners Voluntary Agreement Concerning Liability for Oil Pollution (TOVALOP), Jan. 7, 1969, *as amended* Oct. 13, 1993, II(B)(3), *reprinted in* 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-136 (7th ed. 1993) [hereinafter TOVALOP Agreement]. Return to text.

[22] *See* Cohen, *supra* note 19, at 526. "Claims arising under the TOVALOP Agreement are met by [a] vessel's P&I insurers." *Id.* at 537. Return to text.

[23] TOVALOP Agreement VI. Return to text.

[24] *See id.* Return to text.

[25] *See id.* II(B)(4). Return to text.

[26] *See id.* VIII(E) and (F). Return to text.

[27] *See id.* VII(A); Cohen, *supra* note 19, at 526. Return to text.

[28] *See* TOVALOP Agreement IV(B)(a)-(d). Return to text.

[29] *See* Cohen, *supra* note 19, at 524. Return to text.

[30] A Supplemental to Tanker Liability for Oil Pollution (CRISTAL), *as amended* Oct. 11, 1993, I(H) *reprinted* in 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-148.7 (7th ed. 1993) [hereinafter CRISTAL Agreement]. Return to text.

[31] *See* Becker, *supra* note 16, at 614. Return to text.

[32] *See id.* (noting original name as the "Oil Companies Institute for Marine Pollution Compensation Limited"). Return to text.

[33] *See* CRISTAL Agreement II(A). Cristal Limited organized and existed under the laws of Bermuda, and was comprised of members who were also parties to the Supplemental Agreement. *See id.* Return to text.

[34] *See id.* VII(A)(1). Return to text.

[35] *See id.* VII(2)(i). Return to text.

[36] *See* Becker, *supra* note 16, at 614-17. Return to text.

[37] *See* CRISTAL Agreement VII(B)(2). Return to text.

[38] *See* Becker, *supra* note 16, at 615. Return to text.

[39] *See id.* Return to text.

[40] *See* CRISTAL Agreement IV(A) & (B). Return to text.

[41] *Id.* IV(D)(2). Return to text.

[42] "[C]ompensation levels are denominated in Special Drawing Rights . . . based upon a weighted 'basket' of currencies selected by the International Monetary Fund." Cohen, *supra* note 19, at 528 n. 14. Return to text.

[43] *See id*. The exchange rate varies on a daily basis; $1.26 was used to represent a value of 1 SDR. *See id.* Return to text.

[44] *See* CRISTAL Agreement IV(D)(4). Return to text.

[45] *See id.* Return to text.

[46] *See id.* IV(D)(5). Return to text.

[47] *See* Barrett & Warren, *supra* note 15, at 345. Return to text.

[48] 46 U.S.C. app. § 740 (1997). Return to text.

[49] *See* Jerome B. Grubart, Inc. v. Great Lakes Dredge & Dock Co., 513 U.S. 527 (1995); *see also,* In re Exxon Valdez, 767 F. Supp. 1509 (D. Alaska 1991). Return to text.

[50] *See* Sisson v. Ruby, 497 U.S. 358, 363 (1990). Return to text.

[51] *Id.* at 362. Return to text.

[52] *Id.* at 365; *see also* Lynch v. McFarland, 808 F. Supp. 559 (W.D. Ky. 1992). Return to text.

[53] *See* California v. S.S. Bournemouth, 307 F. Supp. 922 (C.D. Cal. 1969); Burgess v. M/V Tamano, 373 F. Supp. 839 (S.D. Me. 1974); Johnson v. Colonial Pipeline Co., 830 F. Supp. 309 (E.D. Va. 1993). Return to text.

[54] *See* Stephen E. Roady, *Remedies in Admiralty for Oil Pollution*, 5 FLA. ST. U. L. REV. 361, 367 (1977). Return to text.

[55] *See* Cereghino v. Boeing Co., 826 F.Supp. 1243, 1250 (D. Oregon 1993). Return to text.

[56] *See* Burgess v. M/V Tamano, 370 F. Supp. 247, 250 (S.D. Me. 1973). Return to text.

[57] *See* Sekco Energy, Inc. v. M/V Chouest, 1993 WL 322942, at *3 (E.D. La. 1993). Return to text.

[58] *See* Roady, *supra* note 53, at 375. Return to text.

[59] *See In re* Oswego Barge Corp., 439 F. Supp. 312 (N.D.N.Y. 1977). Return to text.

[60] *See* 46 U.S.C. app. § 181 (1997). Return to text.

[61] *See id.* § 183(a). Return to text.

[62] *See* Tug Ocean Prince, Inc. v. United States, 584 F.2d 1151 (2d Cir. 1978). Return to text.

[63] *See In re* New Jersey Barging Corp., 144 F. Supp. 340 (S.D.N.Y. 1956). Return to text.

[64] *See In re* Barracuda Tanker Corp., 409 F.2d 1013 (2d Cir. 1969). Return to text.

[65] *See* Cohen, *supra* note 19, at 528. Return to text.

[66] *See* Becker, *supra* note 16, at 618. Return to text.

[67] *See* International Convention on Civil Liability for Oil Pollution Damage (CLC), Nov. 29, 1969 (entered into force June 19, 1975), *reprinted in* 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-62.133 (7th ed. 1993) [hereinafter CLC]. Return to text.

[68] *See id.* Return to text.

[69] *See id.* Return to text.

[70] *See* Becker, *supra* note 16, at 619 (discussing CLC art. V and the conversion from francs to U.S. dollars). Return to text.

[71] *See* CLC, *supra* note 66, art. V, ¶ 3. Return to text.

[72] *See id.* art. VII. Return to text.

[73] *Id*. art. III, ¶ 2. Return to text.

[74] *See* Protocol to the International Convention on Civil Liability for Oil Pollution Damage, May 25, 1994, art 6, ¶ 1, *reprinted in* 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-77 (7th ed. 1993) [hereinafter CLC 1984 Protocol]. (Dollar conversions for the Special Drawing Rights units were calculated using the same rate applied in the private agreements above.) Return to text.

[75] *See* CLC 1984 Protocol, *supra* note 73, art. 6, ¶ 2. Return to text.

[76] *Id.* Return to text.

[77] *See* Mayer, *supra* note 10, at 5. Return to text.

[78] *See id.* Return to text.

[79] Daniel Kopec & H. Philip Peterson, Note, *Crude Legislation: Liability and Compensation Under the Oil Pollution Act of 1990*, 23 RUTGERS L.J. 597, 610 (1992) (quoting Resolution on Establishment of an International Compensation Fund for Oil Pollution Damage). Return to text.

[80] *See id*. Return to text.

[81] *See id.* Return to text.

[82] *See* International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Dec. 18, 1971 (entered into force Oct. 16, 1978), art. 10, *reprinted in* 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-100.2 (7th ed. 1993) [hereinafter Fund Convention]. Return to text.

[83] *See* Fund Convention, *supra* note 81, art. 4. Return to text.

[84] *See id.* arts. 4-5. Return to text.

[85] *See* Kopec & Peterson, *supra* note 78, at 610. Return to text.

[86] *See* Protocol to the International Convention on the Establishment of an International Fund for compensation for Oil Pollution Damage, May 25, 1984, art. 6, ¶ 3, *reprinted in* 6 MICHAEL F. STURLEY, BENEDICT ON ADMIRALTY 6-116.2(3) (7th ed. 1993). Return to text.

[87] *See* Mayer, s*upra* note 10, at 5. Return to text.

[88] *See* Paul S. Edelman, *International Convention for Oil Spills*, 216 N.Y.L.J. 3, 3 (1996). Return to text.

[89] *See* 33 U.S.C. § 2701 (1997); Michael P. Donaldson, *The Oil Pollution Act of 1990: Reaction and Response*, 3 VILL. ENVTL. L.J. 283, 302 & n.124 (1992). Another author has suggested that the Senate's reluctance to ratify the 1984 convention was more of a preemption issue affecting states' rights. *See* Stephen T. Smith, Comment, *An Analysis of the Oil Pollution Act of 1990 and the 1984 Protocols on Civil Liability for Oil Pollution Damage*, 14 HOUS. J. INT'L L. 115, 135 (1991). Return to text.

[90] *See* Francis J. Gonynor, *Six Years Before the Mast: The Evolution of the Oil Pollution Act of 1990*, 9 U.S.F. MAR. L.J. 105, 105-06 (1996). Return to text.

[91] *See* Giles, *supra* note 12. Return to text.

[92] *See* 33 U.S.C. § 2702(a) (1997). Return to text.

[93] *See id.* § 2702 (b)(2)(B-F). Return to text.

[94] *See id.* § 2702 (b)(2)(A). Return to text.

[95] *See id.* § 2704(a). Return to text.

[96] *See id.* §§ 2701(11) & 2712. Return to text.

[97] *Id.* § 2718(c). Other authors suggest the Limitation of Liability Act is still viable after the passage of OPA 90. *See* Patricia Simmons Schminke, *The Oil Pollution Act of 1990: Has It Muddied the Waters of Liability Limitation?*, 5 U. BALT. J. ENVTL. L. 173 (1995); William M. Ducan, Esq., *The Oil Pollution Act of 1990's Effect on the Shipowner's Limitation of Liability Act*, 5 U.S.F. MAR. L.J. 303 (1993). Return to text.

[98] *See* 33 U.S.C. § 2703(a)(1-3). Return to text.

[99] *See id.* § 2703 (c)(1-3). Return to text.

[100] *See id.* § 2704 (c)(1). Return to text.

[101] *See id.* § 2718(a)(1). Return to text.

[102] *See id.* Return to text.

[103] *See* Gonynor, *supra* note 89, at 124. Return to text.

[104] *See id.* at 124-25. Return to text.

[105] *See id.* at 125. Return to text.

[106] *See* Fla. Stat. § 376.011 (1997). Return to text.

[107] 411 U.S. 325 (1973). Return to text.

[108] *See* 33 U.S.C. § 1251 (1997), *superceding* 33 U.S.C. § 1161. Return to text.

[109] *See Askew*, 411 U.S. at 343. Return to text.

[110] *See* Goynor, *supra* note 89, at 125 (footnote omitted). Return to text.

[111] *See* International Ass'n of Indep. Tanker Owners (Intertanko) v. Lowry, 947 F. Supp. 1484 (W.D. Wash. 1996). Intertanko is an international association comprised of more than 300 shipping companies that account for 80% of the world's independently owned oil tankers. *See id.* at 1488. Return to text.

[112] *See id.* at 1491. Return to text.

[113] *See id.* Return to text.

[114] *See* Giles, *supra* note 12. Return to text.

[115] *See* Janet Porter, *Tanker Compensation May Not Be Paid Because of Failure to Adopt Protocol Agreements*, LLOYD'S LIST INT'L, Oct. 18, 1997, *available in* 1997 WL 4465756. Return to text.

[116] *See id*. Return to text.

[117] *See id*. Return to text.

[118] *See* Liz Shuker, *Oil Spill Victims to get Increase in Payments*, LLOYD'S LIST INT'L, May 30, 1996, *available in* 1996 WL 6275887. Return to text.

[119] *See* Knott, *supra* note 8, at 30. Return to text.

[120] *See* Giles, *supra* note 12, at 2. Return to text.

[121] *See id.* Return to text.

[122] *See Philippines Signs Conventions on Oil Spill Compensation*, ASIA PULSE, Feb. 12, 1997, *available in* 1997 WL 10593279. Return to text.

[123] *See id.* Return to text.

[124] This is an unlikely event considering OPA 90 was some 15 years in the making. *See generally* Donaldson, *supra* note 88, at 288. Return to text.

[125] *See Making the Polluter Pay*, BUS. LINE, Feb. 17, 1997, *available in* 1997 WL 8205523. Return to text.

[126] *See* Anthony Poole, *Quiet Year for Major Oil Tanker Spills*, LLOYD'S LIST INT'L, Sept. 26, 1996, *available in* 1996 WL 11840846. Return to text.

[127] *See id.* Return to text.

[128] *See* Fauziah Ismail, Note, '*Ratify '92 Protocols' Call to States*, BUS. TIMES, Aug. 6, 1996, *available in* 1996 WL 10510117. Return to text.

[129] *See id.* Return to text.

[130] *See id*. Return to text.

[131] *See* Fauziah Ismail, *Tovalop Registers Slight Increase in Tanker Tonnage*, BUS. TIMES, Oct. 9, 1996, *available in* 1996 WL 11792865. Return to text.

BOOK REVIEW

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<BLOCKQUOTE>WETLAND< /SFONT> MITIGATION: MITIGATION BANKING AND OTHER STRATEGIES FOR DEVELOPMENT AND COMPLIANCE. By Mark S. Dennison with contributions from James A. Schmid. Government Institutes, Inc., Rockville: 1997, Pp. 305.

BLOCKQUOTE> Having practiced environmental law in Florida for many years and after being involved in land use development activities in wetland areas, I was interested in reading *Wetland Mitigation: Mitigation Banking and Other Strategies for Development and Compliance*. The book's preface states that it is written as a guide to understanding, evaluating, and implementing various mitigation measures needed to avoid, minimize or compensate for land use development impacts to wetlands. Further, this book explains the regulatory framework, permit process, and mitigation prerequisites to obtaining permit approvals to carry out land use development activities in wetland areas.[1]

As a practitioner in this field, I concur that a "how to" book with real life examples of successfully permitted cases is worthwhile. From this standpoint, I critique the book's chapters, address inaccurate statements, and suggest means by which this book could be improved.

The book's format is reader-friendly as it is written in easy to understand language and contains many helpful tables and useful appendices. However, some omissions and faulty premises appear throughout the discussion that need addressing. For instance, in Chapter One Mr. Dennison writes that "[w]etland studies were the driving force behind enactment of federal and state environmental laws and regulations aimed specifically at protection of the nation's wetlands."[2] Assuming that wetland science is the tail wagging the dog of wetland regulation is a faulty premise. In reality, wetland protection was an afterthought of the Clean Water Act. Wetlands are not mentioned or defined in the Clean Water Act, and not until July 25, 1975 did the word wetland appear in the Corps of Engineers (COE) regulations.[3]

However, Mr. Dennison correctly identifies the policy of "no net loss" of wetlands as a political response to the popular sentiment, rather than a well thought out public policy. He writes:

> As the public became more environmentally conscious and mindful of the vital role wetland ecosystems played for the environment, the federal government saw it crucial to declare a policy of "no net loss" of wetlands.[4]

Chapter One goes on to describe the scientific and biological functions served by wetlands. He states that wetlands are vital to the survival of various plants and animals, including threatened and endangered species like the wood stork, Florida panther, and whooping crane.[5] However, stating that wetlands are vital to the survival of the Florida panther is a misconception. Wetlands are not a preferred habitat of this species. Rather, the Florida panther was relegated to the wetlands. This is according to the Florida Department of Environmental Protection and Water Management District biologists who testified in the state's Environmental Resource Permit administrative rulemaking that the panther has been forced from its preferred upland habitat by man.[6]

Mr. Dennison lists several "valuable" functions performed by wetlands. I take issue with Mr. Dennison's value judgments regarding wetland functions. Many of the same functions performed by wetlands are also performed by uplands. Functions are objective, but the assessment of value is subjective. While listing functions performed by wetlands is all right, placing the value of these functions or the value of the species they support in a superior posture to those functions performed or species supported by uplands is improper. Are terrestrial animals less important or valuable than aquatic species? Essentially, the elevation of the importance of wetlands over other land forms is a common practice. This hypo thesis needs testing. The author accepts the premise that wetlands are somehow superior and proceeds from that premise.

Chapter Two describes how wetlands are defined and identified. Mr. Dennison recognizes that how a particular wetland is identified depends on many factors. He states:

> Obviously, wetlands must be identified to be regulated and/or protected; however, wetland delineation-despite ongoing scientific refinements-is yet to be an exact science. Even if a complete and precise scientific methodology existed for wetland identification, true application of any methodology would surely be hampered by human factors, including resources and time available for determination, the relative expertise of the delineator, and the influence of competing political interests (i.e., environmental protectionists, government regulators, private property owners).[7]

However, the discussion on how to define wetlands begs the real question, which is defining what you want to regulate. The scientific and regulatory determination need not be synonymous. Congress has not decided if it wants to regulate all land areas fitting a scientific definition of wetlands. Therefore, the book and the federal regulations treat as an article of faith that all wetlands should be regulated.

This chapter spends little time on the three subgroups of soil (muck, peat, and mucky peat), hydrology, and vegetative criteria. Soils can in fact be misleading as an artifact of a previous wet condition that no longer exists. Soils will persist to appear hydric long after surface water has been removed from the equation.

The vegetation section is lacking a clear discussion of obligate and facultative wetland species. This distinction is very important as is the principle of dominance versus mere presence. Tree counting, quadrates, and transects all skew vegetative analysis as do varying levels of photo interpretation. These points are critical to a basic understanding of wetland delineations and permit processing.

Furthermore, the chapter omits the critical fact that wetland expanse and size is essential because of acreage thresholds associated with general permits, and because mitigation demands are generally correlated to the amount of wetlands impacted. The latter principle is neglected throughout the book. This is a major omission in a book entitled *Wetland Mitigation*. The author may have felt this basic principle was self-evident and thus the omission. I would suggest that the readership needs to know why challenging jurisdictional assertions are important.

Chapter Three provides an overview of various federal regulatory programs aimed at development activities in wetland areas. Readers must be alerted to the fact that recent case law has overruled the discussion regarding the incidental discharge rule. In *American Mining Congress v. United States Army Corps of Engineers*,[8] the United States District Court for the District of Columbia found that the so-called *Tulloch* rule promulgated by the Environmental Protection Agency and the Army Corps of Engineers was invalid.[9] Under the *Tulloch* rule, the agencies considered the "incidental fallback" that accompanies dredging and land clearing activities to be a "discharge" necessitating a permit under section 404 of the Clean Water Act. In *American Mining Congress*, the court concluded that this rule exceeded the scope of the agencies' statutory authority.[10]

This chapter needs additional improving by adding some discussion regarding the relationship between the National Environ mental Policy Act of 1969 (NEPA) and Section 404 of the Clean Water Act. Case law has found that in the absence of additional federal entanglement through funding or regulations, section 404 alone is not a major federal action for NEPA purposes.[11]

As a whole, the book is over inclusive of regulatory programs tangential to wetland mitigation and under inclusive of discussion regarding traditional mitigation. For example, the book goes into some detail regarding the Water Resource Development Act of 1986, Advance Identification of Wetlands, and Special Area Management Plans, yet the book only devotes forty pages to traditional mitigation.

Chapter Four walks the reader through the wetland permitting process. However, the complexity of ascertaining whether a Section 404 permit is needed receives no attention. Chapter Two contains fifteen pages of discussion on wetland identification but the critical nexus of where the "lines" are drawn and the scope and size of the permit is never made. The size of the parcel subject to jurisdiction is critical. The author notes that less than one percent of the applications submitted are denied,[12] but the book fails to emphasize that the debate regarding jurisdiction sets the entire stage for the ultimate discussion of mitigation. The "calculus" of mitigation ratios whereby X acres of impacted

wetland acres requires Y acres of restored, enhanced, or preserved acres should be noted as a fundamental "how to" issue.

The author's objective of producing a guide to evaluate and implement mitigation measures is missed without the critical connection being made between wetland acres impacted. Frequently, regulators will argue that the jurisdictional area is inconsequential so long as you receive a permit. That philosophy belies the important cost consideration of providing mitigation. The real number of permit denials should be measured by the number of projects withdrawn or abandoned because the price to comply with the process and the proposed mitigation conditions is simply too high.

Even though it provides a basic outline of the federal regulatory process, Chapter Four gives woeful short shrift to the overlapping and duplications of state, regional, and local wetland programs that operate concurrently. In one short sentence, the author innocently notes that "the applicant may need to secure additional state and local wetland permit approvals."[13] In practice, the difficulty in serving many governmental masters has rendered the Section 404 pro gram one of the most unpopular regulatory programs in the nation. One improvement that might add to Chapter Four is a simple flow chart of the federal process similar to the one provided in the *Developer's Guide to Federal Wetlands Regulation*.[14]

The best part of the book is the presentation of illustrative examples, in Chapter Five, of how the mitigation process works. The preface promises "numerous real life mitigation case studies."[15] Unfortunately, Chapter Five contains only two such illustrative cases.

A great service would be provided if the public were enlightened on the meaning of "practicable alternatives." Cases deciding the issue of practicability are critically important to provide a blue print to applicants. The most significant missing component of the practicable alternatives discussion is the concept of "water dependency." The first case illustration mentions its importance, but no part of the chapter discusses water dependency. Water dependency is a thresh old and fundamental element of the Section 404(b)(1) guidelines. If you have a water dependent activity, your alternative analysis is much less severe.[16] This topic is essential to an understanding of federal sequencing. The greatest unknown which is given no real guidance in the federal regulations is what constitutes a "water dependent" activity.

Chapter Five is mislabeled. This chapter is actually a discussion of the "sequencing" of wetland avoidance, minimization and compensatory mitigation as oppose discussing mitigation compliance. The two paragraphs on pages 107-108 do not remotely approach the level of information needed to understand the difficulty of achieving mitigation compliance. A number of standard conditions regarding mitigation success could be put forth regarding areal extent, vegetative density, financial assurance, future land use restrictions, reporting and monitoring that would alert the reader to the pitfalls that lurk in achieving mitigation compliance.

The mitigation option overview in Chapter Six is generally very good, except for the brief reference to mitigation satisfying the Section 404(b)(1) guidelines.[17] The discussion of available types of mitigation indicates that increased public access and pure acquisition and preservation are no longer favored. However, the author does not provide an explanation of the rationale for the elimination of enhanced public access as mitigation.

One major overlooked factor in the discussion of mitigation types is that, in practice, the deciding factor is usually costs. Chapter Eight provides a recitation of costs in the case examples, but do note that land costs and preservation of mitigation areas are almost always a requirement regardless of the type of mitigation selected. Therefore, enhancement and/or restoration will be more expensive than simple preservation because there are costs incurred in addition to, not in lieu of, acquisition and preservation.

The overview of the mitigation banking concept is clearly stated in Chapter Seven. However, the benefits of "upfront mitigation" are under emphasized. Many regulators have complained of the temporal loss of wetland functions which occurs from the time construction starts and until the mitigation site is successful.[18] In most mitigation banks, the credits are realized and the environmental benefits created long before the adverse construction impacts occur. This phenomenon is a great plus for mitigation banks, and it also explains why functional replacement can be approved on a one-to-one basis instead of using a large multiplier. In order for banks to be economical and competitive in the market, a critical consideration is that the credits needed to offset wetland losses are as small as possible.

The functional value assessment discussion, in Chapter Seven, is somewhat dated. Virtually no agency operating in Florida uses Habitat Evaluation Procedures (HEP) or Wetland Evaluation Technique (WET) to perform wetland functional assessments. The Mitigation Bank Review Team (MBRT), which oversees mitigation banks in Florida, has developed its own review manual with functional criteria referred to as modified wetland rapid assessment procedures (MWRAP). This evaluation technique is a modified version of an assessment methodology developed and used by the South Florida Water Management District.

This protocol for review was only endorsed in mid-1997, but nationwide the Corps of Engineers (COE) has expressed an intention to perform impact analysis using an assessment technique known as an hydrogeomorphic (HGM) analysis. The chapter is lacking in any reference to this new direction by the COE since credit and impact functional analysis must be compatible or else no means is available to assess the credits needed to offset a given impact. On page 132 the author provides a very brief statement that the same methodology must be used to determine debts and credits.[19] This is a fundamental ingredient for having a ledger that compares apples to apples. The ease of administering a mitigation bank is directly dependent on a functional assessment methodology being easily ap plied to the impact site and the bank site.

Another mitigation issue largely overlooked, in this chapter and the book as a whole, is geographic proximity. The COE's preference for on-site versus off-site mitigation is a disincentive for mitigation banks. A critical issue for mitigation banks is the mitigation service area which defines the geographic limits where mitigation credits can be sold. In many cases, a large service area is critical if a broad enough market is going to be created to sell the credits in a timely fashion.

There is no further explanation of the federal agencies policies on cash payment and no citation as to the federal agencies authority to accept cash payments. The practice of allowing a state, regional, or local government to perform mitigation with monies paid by a private permittee is relatively widespread. The author misses a golden opportunity to discuss how this practice is directly at odds with private mitigation banks.

In Florida, the "pay and go" option is very attractive to permittees, but when the recipient of the payment is a government entity that also regulates the same activity being approved through cash payment, significant ethical issues surface. Mitigation banks are at distinct disadvantages if government regulators are undercutting their price. Who would a permittee rather pay $30,000 an acre for mitigation, a private mitigation banker, the state, or the local permitting agency approving the project?

Legislation has been pursued in Florida to put limits on government pay and go arrangements.[20] The mitigation bankers have insisted on "full cost" accounting and review by independent agen cies on the permitting of projects by cash payments.[21] The problem is that public lands can be used to subsidize mitigation efforts, thus taking the land cost out of the price of the mitigation which in effect ensures that private bank options will always be competitively disadvantaged.

Chapter Eight delivers precisely as advertised, providing a grand overview of the November 1995 federal guidance on mitigation banking. Each of the important elements of the guidance document are examined.

However, the free form non-rule nature of the guidance is presented without comment or criticism. The soft under belly of mitigation banking is the lack of federal statutory or rule authority. Since the Clean Water Act makes no mention of the concept, the federal agencies have created a permitting process without the benefits of regulations. This anomaly deserves considerable discussion. Applicants are at risk with no support from the Federal Administrative Procedures Act. Mitigation banks are approved by multi-agency contracts called mitigation bank instruments (MBI) which are not permits issued under Section 404 and the accompanying Corp of Engineer/Environmental Protection Agency rules. This informal review process has created innumerable delays and frustrations for mitigation bank applicants.

Florida has a relatively elaborate statute and rule outlining its mitigation bank process, but the federal agencies operate wholly independent and outside of those state established protocols. The federal guidance, the MBRT, and the procedure attending the MBI are all subject to attack because of the absence of enabling legislation or formal federal rulemaking.

In Florida, the issue of mitigation bank credits being unavailable if an environmental improvement project is planned and approved has been a major stumbling block, especially in South Florida. On page 146, this limitation is noted, but there is no elaboration on what it means to "supplement" a publicly planned and approved project.[22] This limitation in the federal guidance document has been used by the COE in Florida to deny or delay three mitigation banks: Florida Power and Light's (FPL) Everglades Mitigation Bank, Florida Mitigation Trust Corporation's (FMTC) Lake Okeechobee Mitigation Bank, and the South Florida Water Management District's (SFWMD) Loxahatchee Mitigation Bank.

Under the Jacksonville COE's expansive review of the federal effort to restate the Everglades, virtually no private measure can be reviewed as anything but supplanting federal plans. This short sighted policy precludes private augmentation of federal effort. Clearly, eradication of noxious vegetation-like melaleuca is critical to environmental restoration of the Everglades. However, mitigation banks are excluded from receiving credits for this activity if eradication is the sole province of the federal government. Similarly, FPL has been denied hydrologic credit for manipulation of water levels and canal improvements for fear that the federal plan to reengineer the Everglades plumbing might undo FPL's good work.

The section on the processing of a MBI is the another one of the best parts in the book. The reader is able to gain a full comprehension of the MBRT process culminating in the execution of the MBI.

The four case studies presented in Chapter Nine are informative, but to a certain extent highlight some of the missing information from previous chapters. The jurisdictional wetland discussion of vegetative composition speaks of obligate and facultative plants without any previous background on these distinctions. Case study number one fails to differentiate the public interest nature of the wastewater plant construction. Since the overall objective of the construction in wetlands is to improve water quality in the Delaware River, one is left asking why is mitigation needed at all?

Curiously, case study number two highlights the difficulty of "gardening" created wetlands and ensuring against failure. In that case, vandalism is blamed for vegetative failure but no explanation is given about the reaction of the regulator. The required mitigation was part of an after the fact permit matter, yet the reader is left guessing whether the permittee was excused from his obligation or required to provide alternative compensation.

The third case study introduced the concept of payment in lieu of mitigation. This was an alternative never discussed in the preceding chapters. In the seven pages providing a discussion of the cash payment illustration, the federal agencies' position on the proposal is missing except a notation on page 177 that the COE was satisfied because they didn't require any other need to effectively offset impacts at a given site.[23]

SUMMARY

Overall the book is a fair primer on the topic of mitigation, but it covers too many tangential issues. The author wrestles with the conflicting objectives of providing in-depth analysis of the many subplots impacting mitigation decisions and the desire to cover the water front in a readable yet cursory fashion. The use of New Jersey and Pennsylvania case studies which were decided generally at the state level demonstrates the problem with presenting the book as a guide to federal wetland mitigation. In practice, the federal review of wetland mitigation is greatly driven by state wetland programs. The book's greatest shortcoming may be the lack of a caveat that federal mitigation is to a great degree the imposition of basic federal principles to a wide variety of state programs.

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1992; J.D., Florida State University College of Law, May 1997. Return to text.

[1] *See* MARK S. DENNISON & JAMES A. SCHMID (contributing), WETLAND MITIGATION: MITIGATION BANKING AND OTHER STRATEGIES FOR DEVELOPMENT AND COMPLIANCE xiii (1997). [*hereinafter* WETLAND MITIGATION] Return to text.

[2] *Id*. at 1. Return to text.

[3] As a result of the decision in *National Resources Defense Council, Inc. v. Callaway*, 392 F. Supp 685 (D.D.C. 1975), the COE adopted regulations defining navigable waters to include wetlands. Return to text.

[4] WETLAND MITIGATION, *supra* note 1, at 1. Return to text.

[5] *See id*. at 3. Return to text.

[6] *See generally* Florida transcripts of depositions in *Sun City Center Corp. v. Southwest Florida Water Management District*, DOAH Case No. 94-2179RP (1994). Return to text.

[7] WETLAND MITIGATION, *supra* note 1, at 16 (1997). Return to text.

[8] 951 F. Supp. 267 (D.D.C. 1997) , *motion to amend judgment denied*, 962 F. Supp. 2 (D.D.C. 1997). Return to text.

[9] *See id*. at 271. Return to text.

[10] *See id.* Return to text.

[11] *See* Village of Los Ranchos De Albuquerque v. Barnhart, 906 F.2d 1477 (10th Cir. 1990). Return to text.

[12] *See* WETLAND MITIGATION, *supra* note 1, at 74. Return to text.

[13] *Id*. Return to text.

[14] *See* LAWRENCE R. LIEBESMAN, DEVELOPER'S GUIDE TO FEDERAL WETLANDS REGULATION 58-61 (2d ed. 1993). Return to text.

[15] WETLAND MITIGATION, *supra* note 1, at xiii (1997). Return to text.

[16] *See* Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 40 C.F.R. § 230 (1996). Return to text.

[17] *See* WETLAND MITIGATION, *supra* note 1, at 114. Return to text.

[18] Joint State/Federal Mitigation Bank Review Team Guidance Document for Florida (July, 1997). Return to text.

[19] *See* WETLAND MITIGATION, *supra* note 1, at 132. Return to text.

[20] *See* FLA. STAT. § 373.4315 (1996); Act effective Oct. 1, 1997, ch. 97-222, 1997 Fla. Laws. Return to text.

[21] *See id*. Return to text.

[22] *See* WETLAND MITIGATION, *supra* note 1, at 146. Return to text.

[23] *See id*. at 177. Return to text.

BOOK REVIEW

BROWNFIELDS: A COMPREHENSIVE GUIDE TO REDEVELOPING CONTAMINATED PROPERTY. BY TODD S. DAVIS AND KEVIN D. MARGOLIS with a preface by Vice President Al Gore. Section of Natural Resources, Energy, and Environmental Law American Bar Association: 1997, Pp. 703. $139.95

I. INTRODUCTION

As the New Millennium approaches, we are faced with evidence of a new era of environmental programs meant to revitalize urban areas by returning idled and contaminated properties to productive land uses, with the vision of sparking, like a flame, economic growth, new jobs, and hope in once economically depressed communities. Currently underway is the United States Environmental Protection Agency's (EPA) brownfields initiative. Meanwhile, many states are following the federal government's lead in adopting legislation and rules to implement a state level brownfields initiative. For example, earlier this year, the Florida Environmental Regulation Commission adopted the Florida Department of Environmental Protection's proposed rule implementing the 1997 Florida Brownfields Redevelopment Act.[1] Throughout America, the recycling of contaminated property is turning what were once environmental liabilities into opportunities for property owners, developers, companies, and bankers to help create a cleaner environment, more jobs, and a larger tax base. For American cities and counties, this era of new environmental programs brings promise and hope for more sustainable inner-city districts. The complex nature of brownfields issues stems from the potential for environmental, health, and financial disaster inherent in recycling contaminated property. Due to the complexity of this subject, the proposed book is divided into four parts, which provides a focused analysis of this subject.

II. PART I-BACKGROUND INFORMATION

In Part I of the book, the term *brownfields* is defined as "abandoned, idled or underused industrial and commercial sites where expansion or redevelopment is complicated by real or perceived environmental contamination that can add cost, time, or uncertainty to a redevelopment project." This language is also the EPA's working definition of a brownfields. Also in Part I, the point of view of those persons or groups with an interest in brownfields redevelopment are identified, as well as their potential risks, and benefits if a project is successful. Environmental groups, bankers, developers, neighboring homeowners, site owners, and regulators each play an important role in brownfields redevelopment. The success of a potential brownfields project depends on the ability of interested parties to not only understand their individual risks and benefits, but they must also understand the risks and benefits to other players so that a concerted and collaborated effort may materialize to the benefit of everyone. After identifying the issue and players, the book presents an overview of federal and state laws governing brownfields cleanups, including the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and parallel state statutes. However, since states' brownfields laws are currently evolving, this book does not include an analysis of Florida's new brownfields act[2] and implementing rule[3]. Next, the Clinton Administration's Brownfields Initiative is presented along with the EPA Administrator's, Carol Browner's, demonstrated commitment to a plan of action with respect to brownfields redevelopment.

III. PART II-LEGAL, BUSINESS, FINANCIAL, AND POLITICAL ISSUES ASSOCIATED WITH REDEVELOPING CONTAMINATED PROPERTY

Part II of the book provides a step-by-step "how-to-do" a brownfields deal, beginning with identifying a potential brownfields site and prospective use; establishing its property value and making an offer to purchase; negotiating terms, conditions, and a purchase price; closing the deal and taking title; and finally proceeding with development. Next is a zeroed-in analysis of two investor-focused issues: whether anticipated remediation costs associated with particular

chemical(s) at a site make acquisition of that site financially feasible for a prudent investor, and whether the site will be marketable for the investor's anticipated reuse after a economically feasible remediation has been accomplished. Valuation of contaminated property is analyzed by the book's authors, first considering the estimated value of the property with and without contamination, and then the difference between the two values which would indicate the loss in total value due to contamination. From a continued investment perspective, a close look at creative financing strategies for redeveloping brownfields is provided in Part II. Lender concerns regarding liability and EPA's creative efforts to address this concern in order to facilitate financing of brownfields redevelopment is succinctly summarized, along with state initiative in this regard. EPA has taken several steps to demonstrate its commitment to brownfields projects. In December 1996, EPA began accepting applications from cities, counties, towns, and Indian Tribes for brownfields assistance grants up to $200,000 each. These funds may be used to assist in Phase 1 and Phase 2 site assessments, or to help creatively resolve problems at selected brownfields sites.

Historically, banks have avoided lending money to brownfields redevelopment projects on the premise that, in the event of foreclosure, a lender can be held liable whenever an owner can be held liable. To encourage private sector financing for brownfields redevelopment, EPA has taken the following measures to reduce commercial lending risks: issued a guidance document on Prospective Purchaser Agreements, expanding the circumstances when EPA will not sue purchasers of contaminated property for contamination that occurred before the purchase; issued a policy statement to reassure property owners that EPA will not file suit against them for groundwater contamination on their property caused by acts on a nearby property; issued a Superfund and Underground Storage Tank Lender Liability Guidance document to explain its policy of not pursing banks for cleanup costs; adopted a policy to allow for the issuance *of comfort letters* useful to facilitate lending transactions relating to brownfields properties.

The different comfort letters that EPA allows to be issued include No Previous Interest Letters, No Current Superfund Letters, Federal Superfund Interest Letters, and State Action Letters. A No Previous Superfund Interest Letter indicates that there is no historical evidence of Superfund program involvement with the property in question. A No Current Superfund Interest Letter indicates that the property has had, but no longer has, federal Superfund interest or that it is near, but not within, property where there is current interest. A Federal Superfund Interest Letter indicates that EPA has (or plans) to respond at the site and the status of any such response. A State Action Letter indicates that the state has taken the lead role for a response action at the property. EPA's efforts, reducing environmental liability for banks and providing federal dollars for local governments, presents new opportunities for brownfields redevelopment in cities and counties throughout America.

Part II then turns to federal income-tax issues. The federal income-tax implications presented by brownfields redevelopment are an important tool for investors. The often-astronomical costs associated with remediation of a contaminated site may be deductible. Part II of the book analyses those instances when these costs should be capitalized and added to the property's tax basis, and other federal income-tax implications. Part II also contains three chapters which analyze political issues surrounding brownfields redevelopment, including the importance in building community support for a project; managing the media; and environmental equity.[4] Two additional chapters focus on environmental insurance coverage as a vehicle to transfer or contain the risk of redeveloping a brownfields. This analysis considers coverage issues relative to both new and old insurance policies. Finally, in Part II, the importance in hiring a reputable laboratory to complete a site investigation is highlighted along with the investor's role in properly delegating scientific issues to laboratories and legal issues to environmental lawyers. Improperly managing such issues could prove to be an expensive mistake for the novice investor.

IV. Part III-Scientific Concepts Used to Address Contaminated Property

A discussion of geologic and hydrogeologic principles is contained in Part III. The discussion is sufficient enough to orient readers about chemical transport and the varying phases of soil, bedrock, and groundwater contamination that are commonly found at former industrial and commercial sites. The concept of risk assessment is applied to environmental health issues, beginning with identifying the hazard, conducting a dose-response and exposure assessment, and concluding with a risk characterization. The final result is a calculated and quantitative estimate of risks under various conditions of exposure. The concept of risk-based corrective action (RBCA) is a clean-up standard that is based on the anticipated future use of the property. For example, the soil or sand clean-up level for a site to be used for a child

daycare center where children are expected to play outdoors would be much higher than the clean-up level for a parking lot under RBCA. By a consensus, the RBCA process makes practical and common sense from a financial perspective, but it is controversial in regard to human exposure assumptions. There is a critical analysis of RBCA in Part III of this book, followed by a physician's perspective about the human health exposure assumptions in the RBCA process. Finally, the remainder of Part III provides a series of risk-based remediation strategies which include washing, stabilization/fixation, vapor extraction for contaminated soil and in-well stripping, in-situ biodegradation, and liquid removal for contaminated groundwater.

V. Part IV-State Voluntary Cleanup Programs

The final part of this book offers a discussion of state voluntary cleanup programs implemented in Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin. As previously mentioned, after this book was published, the Florida Legislature took significant initiative in regard to brownfields legislation that of course is not included in this book.

VI. Conclusion

This book is an excellent tool for lawyers who wish to become acquainted with the complexities of brownfields redevelopment. The authors do an excellent job at not limiting their analysis to any one point of view. On the contrary, these authors begin their discussion by clearly defining the term, and then proceed with analyzing the subject of brownfields redevelopment from multiple perspectives, including developers, regulators, environmental groups, health professionals, bankers, and property owners. No matter which one of these interested parties is the client, this book contains valuable information so that a lawyer may successfully assist any client involved in a brownfields redevelopment project.

Foot Notes

1. Fla. Stat. Ch. 376.77-84 (1997).

2. Fla. Stat. Ch. 376.77-.84 (1997).

3. Fla Admin. Code Ch. 62-785 (1998).

4. *See* Maribel Nicholson & Ralph DeMeo, *Air of Equality*: *An Analysis of Florida's Environmental Equity and Justice Act*, FLA. B. J, Oct. 1994, at 112.

1998 RECOMMENDED WEB SITES FOR LAND USE AND ENVIRONMENTAL LAW

MARTHA MANN[*]

I. INTRODUCTION

The Internet is a global, gigantic network of smaller networks which allows anyone with a computer, modem, and an Internet Service Provider (ISP) to retrieve and view information stored on host computers located throughout the world.[1] The success and popularity of the Internet, also referred to as the "information superhighway" is undeniable. Today, there are approximately 320 million Web pages accessible on the World Wide Web.[2] For those conducting legal research on the Internet, legal Web sites have become a tremendous resource for free legal information.[3] Statutes, case law, law journals, and many other resources are easily accessible over the Internet. There are also discussion groups, mailing lists, and other forms of communication for those interested in particular areas of the law.

But as the popularity of the Internet grows, so do the number of Internet sites and the amount of information placed on the Web. With the number of Internet sites expected to grow 1000 percent in the next few years, it is not surprising that no more than about forty percent of the Web pages are indexed by search engines.[4] To alleviate this problem, there are guides to the Internet which offer listings of Web sites, online discussion groups and mailing lists, and other information.[5] Recommended Web sites may also be found in journals.[6]

In this Web sites review, the addresses are subdivided under various topic areas, which are listed alphabetically. The topic areas are Brownfields Information, Compliance Information, Courts, Environmental News, Journal, and Newsletters, Environmental Programs, Environmental Statistics and Databases, Governmental Agencies and Regulatory Web Sites, Industry Web Sites, Land Use, Laws, Legal Research and Law Libraries, Legislative Information, Miscellaneous Environmental Sites, Products, Recent Developments and Current Case Law, Risk Management under the Clean Air Act, and State/Regional Web Sites.

II. BROWNFIELDS INFORMATION

BANK OF AMERICA BROWNFIELDS REDEVELOPMENT PAGE

URL: *http://www.bankamerica.com/community/envp9.html*

Description: This site contains an introduction of what brownfields are, and comments from Bank of America and other bank officers on the issue of brownfields redevelopment. The site also includes a bibliography with a presentation of the available research on brownfields.

THE BROWNFIELDS CENTER

URL: *http://www.ce.cmu.edu/Brownfields/inde x.html*

Description: The Brownfields Center brings together researchers from Carnegie Mellon University and the University of Pittsburgh to study the relationships between brownfields redevelopment and urban infrastructure renewal, economic development, and quality of life. The site includes information about various projects, participants, and periodicals.

EPA BROWNFIELDS PAGE

URL: *http://www.epa.gov/brownfields*

Description: As a very comprehensive site for information about brownfields, this web site includes projects and initiatives, news, laws and regulations, contacts, publications, and other resources. The site also provides links to the brownfields home pages of each region, and other home pages within the Office of Solid Waste and Emergency Response.

FINK ZAUSMER'S BROWNFIELDS PAGE

URL: *http://www.lawsite.com/BROWNFIELDS/*

Description: As a page devoted to the collection and posting of information and ideas for redeveloping brownfields, it contains information about state and federal law and policy regarding brownfields, including tax incentives and EPA memoranda.

III. COMPLIANCE INFORMATION

AUDIT POLICY INTERPRETIVE GUIDANCE

URL: *http://es.epa.gov/oeca/apolguid.html*

Description: This site contains information issued by the EPA Office of Enforcement and Compliance Assurance including audit policy updates from 1996 to the present.

ENVIRO$ EN$E

URL: *http://es.epa.gov/index.html*

Description: This government web site is considered the best repository for pollution prevention, compliance assurance, and enforcement information. The site also includes several databases, handbooks, case studies, statutes, executive orders, and compliance policies and guidelines.

HAZARDOUS MATERIAL ADVISORY COUNCIL (HMAC)

URL: *http://www.hmac.org/*

Description: The HMAC is an international, non-profit organization devoted to promoting regulatory compliance and safety in transportation of hazardous materials, substances, and wastes. The site contains a menu of activities and services available to assist the public and members in achieving compliance with regulations. The web site also contains information about related publications, conferences, and meetings.

IV. COURTS

FEDERAL COURT LOCATOR

URL: *http://www.law.vill.edu/Fed-Ct/fedct.html*

Description: This web site provides access to federal court opinions and rules, as well as Court of Appeals and District Court home pages, and related federal agencies.

JOSHUA (JUDICIAL ONLINE SUPERHIGHWAY USER ACCESS SYSTEM)

URL: *http://www.flcourts.org/*

Description: A guide to the Florida court system, with court opinions and rules, and links to the state courts' home pages.

V. ENVIRONMENTAL NEWS, JOURNALS, AND NEWSLETTERS

ALLIANCE FOR ENVIRONMENTAL TECHNOLOGY NEWS SPLASH

URL: *http://aet.org/news/index.html*

Description: This Web site contains archived press releases and newsletters and recent articles relating to the paper industry.

AMBIENT MONITORING NEWSLETTER

URL: *http://www.dep.state.fl.us/water/division/ monitoring/pubs.htm*

Description: A Web based newsletter focusing on surface and groundwater issues written by the state of Florida's Department of Environmental Protection (DEP).

CAPITOL REPORTS® ENVIRONMENTAL "NEWS LINK"

URL: *http://www.caprep.com/*

Description: Primarily a news digest for environmental news, the news is broken down by topics: Air Quality, Brownfields, Climate Changes, Enforcement, Hazardous Materials, etc. The site also contains informational links to agencies, state and federal courts, legislation, and regulations.

CHEMICALS IN THE ENVIRONMENT PUBLIC ACCESS INFORMATION

URL: *http://www.epa.gov/cie*

Description: Published by the EPA's Office of Pollution Prevention and Toxics, the site contains articles and a quarterly bulletin of chemical program issues.

CNN EARTH PAGE

URL: *http://cnn.com/EARTH/index.html<R >*

Description: This site contains news stories of environmental interest, which are updated daily.

COMMON SENSE INITIATIVE UPDATE

URL: *http://www.epa.gov/commonsense/update.htm*

Description: This Web site includes updates on the activities of the EPA's Common Sense Initiative Council and Subcommittees.

DEP HOT TOPICS (News Releases and Topics of Interest)

URL: *http://www.dep.state.fl.us/news.html*

Description: This Florida DEP site contains news releases, information on workshops, hearings, recent reports, and employee newsletters.

EDF LETTER (Newsletter of Environmental Defense Fund)

URL: *http://www.edf.org/pubs/edf-letter*

Description: This site contains the full text of issues in newsletters since 1970 addressing endangered species legislation, pesticide legislation, superfund information, and a history of various environmental actions.

ENVIRO-NEWSBRIEF

URL: *http://www.epa.gov/natlibr/hqirc/end.htm*

Description: A daily update providing summaries of news articles pertaining to the EPA and general governmental issues. The site also includes environmental related articles from newspapers, newsletters, and other publications.

ENVIRONMENTAL NEWS NETWORK DAILY NEWS

URL: *http://www.enn.com/subscriptions/enews wire-registration.asp*

Description: Updated daily, this site contains news stories by journalists and scientists.

ENVIRONMENTAL RESOURCES MANAGEMENT

URL: *http://www.erm.com*

Description: This site contains publications, newsletters, and alerts on regulations, conferences, and other events. It also contains a weekly update on state-by-state regulatory information.

EPA JOURNAL

URL: *http://www.epa.gov/epajrnal/*

Description: This site is a magazine on national and global environmental perspectives. Each issue is on a different topic (Clean Water, Environmental Technology and the Economy, etc), and issues dating from 1993 are accessible. (They are behind, though, and no issues in 1996, 1997 or 1998 have been placed on the site.)

FLORIDA POLLUTION PREVENTION PROGRAM NEWSLETTER

URL: *http://www.dep.state.fl.us/waste/progr ams/p2/10.htm*

Description: This Florida DEP produced newsletter focuses on state and local pollution prevention activities.

GREEN LIGHTS® AND ENERGY STAR® BUILDINGS ONLINE PUBLICATIONS

URL: *http://www.epa.gov/appdstar/news<R>*

Description: This site publishes bulletins and updates with information on the EPA's

Green Lights® and ENERGY STAR® Buildings participant accomplishments and program developments. Past issues are also retrievable.

LAW JOURNAL EXTRA! ENVIRONMENTAL LAW

URL: *http://www.ljx.com/practice/environmen t/index.html*

Description: This popular site contains recent stories and regular columns, as well as current case and statute information.

NEWSLEAKS NEWSLETTER ONLINE

URL: *http://www.dep.state.fl.us/waste/progr ams/tanks/newslett.htm*

Description: This is the quarterly newsletter for the Florida DEP Storage Tank and Petroleum Cleanup Programs. Issues date back to 1995.

OFFICE OF ENFORCEMENT AND COMPLIANCE ECHO NEWSLETTER

URL: *http://es.epa.gov/oeca/echo/echotble.html*

Description: This site contains a bi-monthly newsletter published by the EPA's Office of Enforcement and Compliance. The most recent issue on the Internet is July 1997.

POLLUTION PREVENTION NEWS

URL: *http://www.epa.gov/opptintr/ChemLibPPN /*

Description: Included in this governmental web site are the most recent and past bi-monthly publications of the EPA's Office of Pollution Prevention and Toxics.

PRETREATMENT COMMUNICATOR

URL: *http://www.dep.state.fl.us/water/wf/do m/ppr_news.htm*

Description: The Communicator is a quarterly newsletter of the Florida DEP providing information about industrial pretreatment.

RCRA, SUPERFUND & EPCRA MONTHLY HOTLINE REPORTS

URL: *http://www.epa.gov/epaoswer/hotline/mr qs.htm*

Description: Frequently asked regulatory questions and answers are compiled and published monthly by the EPA. Reports can be downloaded by month or year.

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT NEWS RELEASE INDEX

URL: *http://sjr.state.fl.us/news/PIO_med4.htm*

Description: Specific to Florida's St. Johns River Water Management District, a complete index of news releases issued by the St. Johns River Water Management District dating back to 1996 are available at this site.

STREAMLINES

URL: *http://sjr.state.fl.us/info/streamln/s lns_idx.htm*

Description: This site contains a quarterly publication by Florida's St. Johns River Water Management District addressing water conservation.

TECH TRENDS

URL: *http://clu-in.com/ttrends/trends1.htm*

Description: This Web site contains a newsletter that provides descriptions and performance data for innovative source control technologies that have been applied in the field.

THE WATER MONITOR

URL: *http://www.epa.gov/OWOW/watermonitor/*

Description: A bi-monthly newsletter that summarizes water monitoring and related activities occurring in the ten EPA regions, the states, and at EPA Headquarters. Topics typically include re cent and ongoing water monitoring projects, as well as non-point source monitoring and watershed assessment and management activities.

WATER ONLINE TIMES

URL: *http://www.wateronline.com/*

Description: Created for professionals and vendors in the water and wastewater industries, this site provides news, product information, and discussion groups.

YALE WORKING PAPERS ON SOLID WASTE POLICY

URL: *http://www.yale.edu/pswp*

Description: This site contains abstracts of papers written by experts in the field of solid waste which are commissioned by Yale's School of Forestry and Environmental Studies. Full articles can be ordered from the site.

VI. ENVIRONMENTAL PROGRAMS

ACID RAIN PROGRAM

URL: *http://www.epa.gov/docs/acidrain/ardho me.html*

Description: This site provides information on the program, the environmental effects of acid rain, emissions trading NOx reduction, emissions monitoring and reporting, emissions data, and conservation and renewable energy incentives.

BROWNFIELDS (see separate listing)

COMMON SENSE INITIATIVE (CSI)

URL: *http://www.epa.gov/commonsense/<R >*

Description: Provided in this site is an overview of all CSI projects, including news items, upcoming activities, updates, and accomplishments. The site also contains a listing of participating indus tries and partners.

HAZWRAP

URL: *http://www.ornl.gov/HAZWRAP/*

Description: Under the guidance of the DOE, the Hazardous Waste Remedial Actions Program, HAXWRAP, works with federal, state, and local U.S. agencies to provide solutions to environmental problems presented by environmental remediation, pollution prevention and waste minimization. The site contains information on partnerships, services, capabilities, and articles on a variety of environmental and land use topics.

ISO-14000 INFORMATION CENTER

URL: *http://www.iso14000.com/*

Description: ISO 14000 provides industry with a way to track, manage, and improve environmental performance without conflicting with the business priorities of an operation. By design, ISO 14000 is a simplified environmental management standard which takes into account business and economic considerations while improving on already established environmental protection programs. This site contains an ISO overview and a list of articles and other publications pertaining to the ISO 14000 environmental management standards.

PROJECT XL

URL: *http://www.epa.gov/ProjectXL/*

Description: Project XL, which stands for "eXcellence and Leadership," is a national pilot program that tests innovative ways of achieving better and more cost-effective public health and environmental protection. Use this site to obtain information and the names of contacts for the EPA's Project XL. Information on specific projects is available, as are legal and policy documents of the EPA.

RECYCLER'S WORLD

URL: *http://www.recycle.net/*

Description: This site was established as a World Wide Web trading site for information related to secondary recyclable commodities, by-products, used and surplus items or materials. It covers a wide variety of recyclable commodities.

VII. ENVIRONMENTAL STATISTICS/DATABASES

CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

URL: *http://www.cger.uiowa.edu/servers/serv ers_environment.html*

Description: Created and updated by the Center at the University of Iowa, this site contains one of the most extensive directories of environmental information and topics. Unique links included are those to research programs and projects, along with digital and graphic environmental data.

CHEMFINDER

URL: *http://chemfinder.camsoft.com/*

Decription: A good resource for information on nearly any known chemical.

ENVIROFACTS WAREHOUSE

URL: *http://www.epa.gov/enviro/index_java.html*

Description: This site includes a fantastic compilation of data covering a wide variety of environmental areas (Superfund, water discharge, hazardous waste, etc), as well as a system for generating reports from available data. Other information such as maps and recent news are also accessible.

HAZDAT (Hazardous Substance Release/Health Effects Database)

URL: *http://www.info-xpress.com/hawkwatch/*

Description: Information on the effects of hazardous substances on humans, on emergency events which include the contaminants found, concentration levels, and other related information are provided at this site.

THE NATIONAL ENVIRONMENTAL DATA INDEX

URL: *http://www.nedi.gov/*

Description: This site provides direct access to environmental data and information descriptions drawn from the data of the Departments of Agriculture, Commerce, Defense, Energy, Interior, and the EPA, NASA, and the National Science Foundation.

TECHNOLOGY TRANSFER NETWORK

URL: *http://www.epa.gov.ttn/*

Description: This site contains access to the EPA's Support Center for Regulatory Air Models, a warehouse for air quality models.

THE WWW VIRTUAL LIBRARY: THE ENVIRONMENT

URL: *http://ecosys.drdr.virginia.edu/Environment.shtml*

Description: Created at the University of Virginia, this truly amazing web site contains a page of general environmental links and pages of specific information and data on topics such as the atmosphere, biosphere, hydrosphere, and lithosphere. This site also includes the notable "List o' lists of Environmental Resources."

VIII . GOVERNMENTAL AGENCIES & REGULATORY WEB SITES

ADMINISTRATIVE PROCEDURE DATABASE

URL: *http://www.law.fsu.edu/library/admin*

Developed and maintained by the American Bar Association's Section of Administrative Law and Regulatory Practice and the Florida State University College of Law, this Web site includes recent federal APA reform developments, recommendations of the

Administrative Conference of the United States, and links to federal and state legal materials. Also included are links to state APAs and reform proposals, as well as model state acts and inter-state organization.

THE ENVIRONMENTAL PROTECTION AGENCY

URL: *http://www.epa.gov*

Description: The EPA Web site is one of the largest and most established of the governmental agency sites. You can search the EPA server by phrase or by listed topics ranging from endocrine disrupters to environmental justice. There is also an "Envirofacts" database, a federal regulation environmental subset, and a link to an Environmental Indicators Home Page, which further provides links to data collected nationally, or by state, county or zip code.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

URL: *http://www.dep.state.fl.us/*

Description: This site provides links to news, guides and manuals, permitting information, legislative events, rules and statutes, and related links.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

URL: *http://www.noaa.gov/*

Description: This site contains links to environmental data, legislative affairs, and other environmental information.

PARKNET: THE NATIONAL PARK SERVICE PLACE ON THE WEB

URL: *http://www.nps.gov*

Description: This site contains a search engine and a library with environmental news, legislative information, and references related to the National Park Service and its preservation of America's cultural and national heritage.

U.S. DEPARTMENT OF ENERGY (DOE)

URL: *http://www.doe.gov/*

Description: Notable for its DOE Information Bridge, this site contains searchable citations of worldwide energy research as well as bibliographic citations with links to DOE sponsored or acquired full-text reports. It also contains EnergyFiles, the DOE's virtual library, and the DOE's bibliographic database.

U.S. DEPARTMENT OF INTERIOR (DOI)

URL: *http://www.doi.gov/index.html*

Description: This comprehensive Web site contains news, links to bureaus within the DOI, and an information index.

U.S. DEPARTMENT OF LABOR OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION (OSHA)

URL: *http://www.osha.gov/*

Description: The OSHA Web page includes links to health and safety-related news releases, regulations, and an information index.

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

URL: *http://www.dot.gov/*

Description: The Department of Transportation's home page includes information on the United States DOT and links to individual states' Department of Transportation and related legal Web sites.

U.S. FISH AND WILDLIFE SERVICE

URL: *http://www.fws.gov/*

Description: Access to information about coastal conservation, environmental contaminants, wetlands, and other topics are found at the Web site. It also includes frequently asked questions and news releases.

WATER MANAGEMENT DISTRICTS (FLORIDA)

URL: *http://www.state.fl.us/nwfwmd/* (Northwest Florida)

http://sjr.state.fl.us/ (St. Johns River)

http://www.dep.state.fl.us/swfwmd/ (Southwest Florida)

http://www.sfwmd.gov/ (South Florida)

Description: The amount of information varies by site, but most sites have newsletters and links to related sites.

IX. INDUSTRY WEB SITES

AIR & WASTE MANAGEMENT ASSOCIATION HOME PAGE

URL: *http://www.awma.org/*

Description: This Web site is a source of information regarding meetings and online publications of environmental professionals in air and waste management.

THE ALLIANCE FOR ENVIRONMENTAL TECHNOLOGY

URL: *http://aet.org/*

Description: The Alliance is an international association of chemical manufacturers and forest products companies dedicated to improving the environmental performance of the pulp and paper industry. The site provides information on the use of Elemental Chlorine-Free technology, news, and technical and market reports.

AMERICAN FORESTRY AND PAPER ASSOCIATION

URL: *http://www.afandpa.org/index.html*

Description: Information on forestry, paper, and wood products, as well as congressional news, recycling information, and state government relations are provided at this site. The Web site also includes a weekly highlight page of information such as recycling surveys, and stories on sustainable development.

ELECTRIC POWER RESEARCH INSTITUTE

URL: *http://www.epri.com/*

Description: The Electric Power Research Institute, whose members collectively generate over seventy percent of the electricity generated in the United States, founded the Institute for collaborative research and development. The site lists business groups, special projects, and energy links.

PULP AND PAPER NET

URL: *http://www.pulpandpaper.net/*

Description: A site devoted to the pulp and paper industry includes industry news and job opportunities, and a listing of suppliers and products. Fully searchable archives of industry news and press re leases for subscribers are also available.

THE SUSTAINABLE FORESTS DIRECTORY

URL: *http://homepages.together.net/~wow/ind ex2.htm#anchor818681*

Description: This site contains articles, industry trade organizations, and information on certification, meetings, and research.

X. LAND USE

CYBURBIA

URL: *http://www.cyburbia.org*

Description: A very comprehensive directory of Internet resources relevant to planning, architecture, "urbanism," and other topics related to development is located at this site. It also contains information about architecture and planning-related usenet groups, and hosts several interactive message areas. The site links to over 6000 sites.

PLANNING COMMISSIONERS' JOURNAL - PLANNERS WEB CITY AND REGIONAL PLANNING RESOURCES

URL: *http://www.plannersweb.com*

Description: This site includes a list of links to a number of state planning and citizen organizations on the Web, as well as a list of several regional planning organizations on the Web. The site is notable for its special online resource pages, including the Sprawl Resource Guide, Takings and Property Rights, and top ten lists of most threatened

rivers, most endangered historic sites, most en lightened communities, etc.

XI. LAWS (STATUTES, REGULATIONS AND RULES)

CODE OF FEDERAL REGULATIONS

URL: *http://law.house.gov/cfr.htm*

Description: This site contains the Code of Federal Regulation (CFR).

DEP ENVIRONMENTAL RULES

URL: *http://www.dep.state.fl.us/rules.ftp.html*

Description: This site contains the Florida DEP rules.

FEDERAL REGISTER

URL: *http://www.access.gpo.gov/su_docs/aces 140.html*

Description: This site allows searches of CFR, Federal Register, Public Laws, U.S. Government Manual, weekly compilation of Presidential documents, and U.S. Congress information.

STATE AND FEDERAL REGULATIONS

URL: *http://www.law.cornell.edu/regs.html*

Description: This well-organized site contains sources or links to state and federal regulations.

UNIFORM COMMERCIAL CODE (ARTICLES 1 - 9)

URL: *http://www.law.cornell.edu/ucc.table.html*

Description: This well-organized site contains the Uniform Commercial Code.

U.S. CODE

URL: *http://law.house.gov/usc.htm*

Description: This government site contains the U.S. Code.

XII. LEGAL RESEARCH AND LAW LIBRARIES

THE AMERICAN ASSOCIATION OF LAW LIBRARIES / WASHBURN

URL: *http://lawlib.wuacc.edu/*

Description: This site contains links to a broad spectrum of legal resources. For example, a listing of law schools, law firms and even course outlines is available, as is access to many law library catalogs is included. There is also information about discussion groups

for specific areas of law.

CATALAW

URL: *http://www.catalaw.com/*

Description: This Web page calls itself the "catalog of catalogs" of law on the Internet. All legal and government indexes on the Internet are arranged into one uniform "metaindex." Searches can be executed based on a topic or region. The site also contains lawyer directories and professional resources.

THE FINDLAW INDEX

URL: *http://www.findlaw.com*

Description: A very useful starting point for a search, this site contains its own search engine and legal subject index. Topical legal stories and case records are regularly featured, as are recent U.S. Supreme Court decisions. The site also contains links to U.S. Federal Government resources, state law resources, foreign and international resources, as well as links to a directory of law schools, law firms and lawyers, and consultants and experts.

HEIROS GAMOS

URL: *http://www.hg.org/hg.html*

Description: This is a very large and comprehensive general legal Web site containing over 20,000 original pages and 70,000 links. Included are directories of law-related organizations, over 200 practice areas, discussion groups, a library, journals, and government listings.

The Institute of Continuing Legal Education

URL: *http://www.icle.org/index.htm*

Description: Sponsored by the state bar and law schools of Michigan, this site includes a number of Web links in the areas of real property law and environmental law. It includes laws and cases, government agencies and law firms, as well as practice resources and guides.

THE INTERNET LEGAL RESOURCE GUIDE

URL: *http://www.ilrg.com/*

Description: This site contains a categorized index of 3,100 Web sites covering resources such as academic journals, professional associations, a form index, and federal and state research tools. The sidebar index is quite helpful in narrowing the possible links to resources.

INTERNET SLEUTH LEGAL AND GOVERNMENT INFORMATION

URL: *http://www.charm.net/~ibc/sleuth/lega.html (legal)*

http://www.charm.net/~ibc/sleuth/gove.html (government)

Description: This legal Web page offers a search engine for the courts, links to a variety

of sources as diverse as the American Civil Liberties Union and Court TV. The site also includes access to federal law, the Federal Rules of Evidence, and a Web journal of current legal issues. The government page includes links to a plethora of government Web sites.

LAWCRAWLER

URL: *http://www.lawcrawler.com/index.html*

Description: One of the most comprehensive and helpful search engines devoted purely to legal and governmental Internet resources. It is useful for federal and state searches.

LAWYERS' LEGAL RESEARCH INDEX

URL: *http://www.llr.com*

Description: This site is especially useful for those still learning how to negotiate the Internet. The site takes the online user through Internet basics and instructions on beginning an online research project as part of its legal research instruction. Of interest to the environmental researcher are lists and links to Internet resources in administrative law. The site also enables full-text searches of recent case law. Said to have one of the better search engines, this is also the only site on the Internet where one can find all United States Supreme Court decisions since 1990, all federal court of appeals decisions since 1992, and recent state court decisions.

THE LEGAL INFORMATION INSTITUTE AT CORNELL LAW SCHOOL (LLI)

URL: *http://www.law.cornell.edu*

Description: One of the more established Web sites, LII was founded in 1992 to distribute legal information electronically, including disseminating it over the Internet. This site contains a wealth of well-organized primary sources and links to other sites and sources. The site includes sections on "environmental law," "pollution," and "natural resources." Accessible environmental law materials include U.S. Code, Code of Federal Regulations, state statutes and environmental regulations, recent environmental decisions of the U.S. Supreme Court, and federal agency information.

NATIONAL LIBRARY FOR THE ENVIRONMENT

URL: *http://www.cnie.org/nle/*

Description: This site allows access to congressional research service reports, population and environment linkages, and the Virtual Library of Biodiversity, Ecology and the Environment.

PACE VIRTUAL ENVIRONMENTAL LAW LIBRARY

URL: *http://www.law.pace.edu/env/vell6.html*

Description: This site is an organized "library," providing links to primary legal sources and its own search engine. This site is purely geared toward environmental legal research on the Internet, with links to research topics, the reliability of Internet data, standards, current issues, and secondary sources.

U.S. HOUSE OF REPRESENTATIVES INTERNET LAW LIBRARY

URL: *http://law.house.gov*

Description: The site provides full text offerings of the United States Code and the Code of Federal Regulations in addition to historical documents such as the Declaration of Independence, the Constitution, and international treaties. It also includes links to state and international laws and treaties.

THE WWW VIRTUAL LIBRARY: THE ENVIRONMENT

URL: *http://ecosys.drdr.virginia.edu/Environment.html*

Description: This truly amazing Web site contains a page of general environmental links and pages of specific information and data on a diversity of topics. Also included is the notable "List o' lists of Environmental Resources."

XIII. LEGISLATIVE INFORMATION

THOMAS (LEGISLATIVE INFORMATION ON THE INTERNET)

URL: *http://thomas.loc.gov*

Description: Created by the U.S. Congress "in the spirit of Thomas Jefferson," this site tracks the week's Congressional floor activities, major legislation, the Congressional Record (back to 1993), committee reports and transcripts, and historical documents.

U.S. HOUSE OF REPRESENTATIVES

URL: *http://www.house.gov*

Description: This site provides links to members of the House of Representatives, recent legislative reports, committee reports, and bills current being considered.

U.S. SENATE

URL: *http://www.senate.gov*

Description: This site provides links to members of the Senate, recent legislative reports, committee reports, and bills current being considered.

XIV. MISCELLANEOUS ENVIRONMENTAL SITES

THE GLOBAL ENERGY MARKETPLACE

URL: *http://gem.crest.org/*

Description: Sponsored by the EPA, and created by the Center for Renewable Energy and Sustainable Technology, this site includes new summaries, case studies, publications, economic analyses, mitigation assessments and other resources related to sustainable energy. This site also contains a state-specific section of the Global Energy Marketplace.

THE GREEN PAGE

URL: *http://www.echonyc.com/kamml/enviro.html/*

Description: Although this Web page prefaces itself with a disclaimer as to the dated information contained within, the site contains an eclectic list of links and environmental resources on the Net.

GREEN UNIVERSITY INITIATIVE

URL: *http://www.gwu.edu/greenu*

Description: Created through a partnership between the EPA and George Washington University, the site allows users to access federal environmental information resources by subject, name, or via Web search engines. Environmental career opportunities are also listed.

XV. PRODUCTS

CITATION PUBLISHING, INC.

URL: *http://www.citation.com/*

Description: Citation Publishing is an electronic publisher of regulatory environmental, health and safety compliance literature. The site gives information on their CD-ROM publications and restricted Internet access.

ENVIRONMENTAL SIMULATIONS, INC. GROUNDWATER MODELING

URL: *http://www.groundwatermodels.com/index.html*

Description: As a provider of groundwater modeling software, this site includes demonstrations and detailed information regarding its software.

XVI. RECENT DEVELOPMENTS/CURRENT CASE LAW

ENVIRONMENTAL LAW INFORMATION CENTER

URL: *http://www.webcom.com/~staber/welcome.html*

Description: The Web site contains current cases, acts, and bills in the field of environmental law.

XVII . RISK MANAGEMENT UNDER THE CLEAN AIR ACT (SECTION 112(R))

AIR & WASTE MANAGEMENT ASSOCIATION

URL: *http://www.awma.org/*

Description: The site provides information on implementation of section 112(r),

including access to technical papers, guidance documents, and workshop schedules.

THE CHEMICAL EMERGENCY PREPAREDNESS AND PREVENTION OFFICE (CEPPO)

URL: *http://www.epa.gov/swercepp*

Description: CEPPO is the EPA's 112(r) clearinghouse, and is said to be the most comprehensive 112(r) site on the Internet. The site provides access to 112(r) Federal Register notices, fact sheets, guidance documents, model risk management plans for specific processes, summary reports, and meeting notices of various 112(r) work groups, links to state and local emergency planning commissions, and other 112(r) information.

LEPC/SERC NET (LOCAL EMERGENCY PLANNING COMMISSIONS AND STATE EMERGENCY RESPONSE COMMISSIONS)

URL: *http://www.rtk.net/www/lepc/webpage/*

Description: This site was developed to assist emergency planners and the public in implementing the Emergency Planning and Community Right to Know Act (EPCRA). The site also includes links to LEPC and SERC Web sites and other information.

SAFETY ONLINE

URL: *http://safetyonline.net/*

Description: This site is a commercial information source for the safety professional, covering topics such as process safety management and 112(r) hazard analyses.

XVIII. STATE/REGIONAL WEB SITES

EnviroWorld

URL: *http://www.enviroworld.com/*

Description: Mainly geared toward Florida environmental matters, this site provides a great deal of Florida news, legislative information, and recent case law. The site also lists consultants and businesses.

FICUS (FLORIDA INTERNET CENTER FOR UNDERSTANDING SUSTAINABILITY)

URL: *http://www.ficus.usf.edu*

Description: A useful source for information on Florida planning which includes a library, tools and calculators, discussion groups, and legislative updates. The site also provides news pertaining to sustainable development in Florida.

THE LIBRARY OF CONGRESS FLORIDA STATE AND LOCAL GOVERNMENT PAGE

URL: *http://www.lcweb.loc.gov/global/state/ fl-gov.html*

Description: The site contains a listing of state government, regional and local government, and some city government Web sites.

THE NATIONAL ASSOCIATION OF STATE INFORMATION RESOURCE EXECUTIVE STATESEARCH

URL: *http://www.nasire.org/ss/index.html*

Description: The Statesearch service provides links by state to Web pages aimed at energy, environment, and natural resources.

THE STATE PUBLIC INTEREST RESEARCH GROUPS (PIRG): PROTECTING OUR ENVIRONMENT

URL: *http://pirg.org/enviro/index.htm<R>*

Description: PIRG's Web page includes information on state PIRG environmental programs, campaigns, and other environmental resources.

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*[*] J.D., Florida State University College of Law (1998); M.A., University of North Florida (1994); B.A., University of North Florida (1991).**Return to text.*

*[1] For a complete overview of the Internet and the World Wide Web, see American Civil Liberties Union v. Reno, 929 F. Supp 824, 830-49 (E.D.Pa. Dist. Ct. 1996).**Return to text.*

*[2] See Paul Recer, Search Engines Run Out of Gas Navigating Terribly Tangled Web, TALLAHASSEE DEMOCRAT, March 28, 1998 at A1.**Return to text.*

[3] Notwithstanding the fee for Internet access.

[4] See Recer, supra note 2.

[5] See, e.g., JAMES EVANS, LAW ON THE NET (2d ed. 1997) (listing over 2000 law-related sites by topic); CAROL BRIGGS ERICKSON & TONI MURPHY, ENVIRONMENTAL GUIDE TO THE INTERNET (1997) (providing an introduction to the World Wide Web, and listing environmental Web sites, discussion groups and mailing lists, newsletters, and journals).

[6] See, e.g., Albert Robbins, A Top Librarian Shares the Sites, LAW & TECH. PRODUCT NEWS, Dec. 1997 at 118; Martha Mann, Recommended Legal Web Sites for Land Use and Environmental Law, 12 J. LAND USE & ENVTL. L 425 (1997); Eugene Volokh, Computer Media for the Legal Profession, 94 MICH. L. REV. 2058 (1996). The J. Land Use & Envt'l L. plans to continue providing an update to its web site review article at least once a volume. *Return to text.*

<CN>RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW<A HREF="Rece.htm#FNT*">[*]</A><A NAME=FNR*></A>

RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW[*]

I. UNITED STATES SUPREME COURT CASES

A. Ohio Forestry Ass'n v. Sierra Club, *118 S.Ct. 1665 (1998)*

In this unanimous opinion written by Justice Breyer, the United States Supreme Court concluded that the Sierra Club's claim, was not ripe for judicial review.[1] The Sierra Club charged that the Forest Service's plan to allow logging and clearcutting in a national forest was too excessive.[2]

Under the National Forest Management Act of 1976 (NFMA), the Secretary of Agriculture is required to "develop, maintain, and revise land and resource management plans for units of the National Forest System."[3] The Forest Service developed a plan for the Wayne National Forest located in southern Ohio.[4] Collectively, the Sierra Club and the Citizens Council on Conservation and Environmental Control objected to the plan.[5] After pursuing various administrative remedies, the Sierra Club sued in federal court.[6] The Sierra Club claimed that Forest Service violated various laws by approving a plan which allowed below-cost timber sales of timber removed by clearcutting; the defendants action of accepting this plan violated their duties as public trustees; and the regulations the defendants used to select the amount of forest suitable for timber production failed to identify economically unsuitable lands.[7]

The district court reviewed the Plan and granted summary judgement for the Forest Service by concluding that the Forest Service had acted properly in making its determinations.[8] The Court of Appeals reversed the district court's decision when it concluded that the Plan improperly favored clearcutting, thus violating NFMA.[9] The Supreme Court granted certiorari to determine if the Plan's dispute was yet a justiciable controversy.

In concluding that the case was not ripe, the Court considered whether a delayed review would cause hardship to the plaintiffs; whether judicial intervention would inappropriately interfere with further administrative action; and whether the courts would benefit from further factual development of the issues presented.[10] Applying these analytical steps, the Court concluded that the Sierra Club claims were not based on adverse effects of a kind that would traditionally qualify as harm.[11] Further, the Court did not find a harm against the interest that the Sierra club advanced.[12] The Court also found that immediate judicial review would be time-consuming and potentially unnecessary since many different parcels of land were involved.[13] A review at this point would threatened the kind of "'abstract disagreements over administrative policies,' . . . that the ripeness doctrine seeks to avoid."[14]

B. Steel Co. v. Citizens for a Better Env't, *118 S.Ct. 1003 (1998)*

In an opinion written by Justice Scalia, the United States Supreme Court determined that a citizen environmental group did not have standing to sue under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA or the Act) for past violations of the Act.[15]

EPCRA establishes a framework of state, regional, and local agencies designed to inform citizens about the presence of hazardous and toxic chemicals in their communities.[16] EPCRA also mandates that users of specific toxic and hazardous chemicals have to file annual "emergency and hazardous chemical inventory forms" and "toxic chemical release forms" which disclose specific information about facilities operating with hazardous and toxic chemicals.[17] EPCRA has several enforcement mechanisms, including a citizen suit provision.[18] According to the citizen suit provision, citizens may not proceed with their suits unless they file a notice of intent to sue with the Administrator of the Environmental Protection Agency (EPA), various state officials in the state where the alleged violation occurred, and the alleged violator.[19] Furthermore, citizens may not proceed with their suit if the EPA commences administrative or civil proceedings based on the alleged violation.[20]

Since 1988, the Steel Company had failed to file the appropriate forms required by EPCRA.[21] In 1995, a citizen environmental group sent the requisite notices of its intent to enforce EPCRA pursuant to EPCRA's citizen suit provision.[22] Upon receiving its notice, the Steel Company filed all the correct overdue forms with the appropriate

administrative agencies.[23] As a result, the EPA chose not to take any action against the Steel Company.[24] However, the citizen group filed suit in federal district court, seeking declaratory and injunctive relief and requesting orders requiring the Steel Company to pay civil penalties and litigation expenses.[25]

The Supreme Court held that the citizens lacked standing to sue because none of the relief sought would reimburse the citizens for the losses caused by the Steel Company's failure to timely file its reports.[26] In other words, the Court stated that even if an injury-in-fact did exist, the citizens' suit failed to meet the redressibility requirement established in *Lujan v. Defenders of Wildlife*.[27]

Furthermore, Scalia reaffirmed the well-established notion that courts may not decide the merits of any case before determining whether Article III jurisdiction exists.[28] In doing so, Scalia explicitly rejected the argument promoted by Justice Stevens' concurrence that a cause of action brought pursuant to EPCRA constitutes a jurisdictional issue that must be decided before resolving the standing issue.[29] Additionally, the Court rejected the "doctrine of hypothetical jurisdiction" which several appellate circuits had applied to avoid unanswered jurisdictional questions where (1) the merits of the case were more readily resolved than the jurisdictional issues and (2) the prevailing party on the merits would have been the prevailing party if jurisdiction had been denied.[30]

C. U.S. v. Bestfoods, Inc., *118 S.Ct. 1876 (1998)*

In a unanimous opinion written by Justice Souter, the Court overruled the Sixth Circuit in deciding that under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA),[31] a parent corporation can be held liable for cleaning up a subsidiary's toxic waste site, especially when the parent corporation is directly responsible for the operation of the waste site.

The U.S. brought suit against CPC International Inc. (CPC), the parent corporation of Ott Chemical Co. (Ott), and others, for cleaning up Ott's industrial chemical waste.[32] The district court ruled that operator liability attached to a parent corporation when the corporate veil can be pierced under state law, and when the parent corporation has exerted influence over its subsidiary during a period of hazardous waste disposal. [33] Under this test, the court held CPC liable because CPC had selected Ott's board of directors and another CPC official was significantly involved in developing Ott's environmental compliance policy.[34] Sitting en banc, the Sixth Circuit reversed in part by acknowledging that the a parent company may be held directly liable as an operator of a facility owned by its subsidiary, but refusing to find liability for a parent company if it does not actually operate its subsidiary's facility in the place of the subsidiary, or alongside of it as a joint venturer.[35]

The Supreme Court noted that under corporate law, a general principle exists that a parent corporation is not liable for the acts of its subsidiaries and that CERCLA does not infringe upon this principle.[36] But, the corporate veil may be pierced and a parent corporation held liable for the parent's conduct when the corporate form is misused to accomplish certain improper acts.[37] As legislated, a parent corporation actively participating in, and exercising control over, the operations of a subsidiary's facility may be held directly liable as an owner/operator.[38]

The Court went on to acknowledge that the Sixth Circuit correctly rejected the district court's analysis of basing CPC's liability on CPC's majority control over Ott's board of directors.[39] This type of analysis focused on the relationship between the parent corporation and its subsidiary rather than the parent corporation and facility.[40] However, the Court found that the Sixth Circuit was wrong in its limiting of liability under CERCLA since there was evidence that an agent of CPC was involved with developing Ott's environmental compliance policy. [41] The case was remanded to the lower court to reevaluate and resolve if the agent of CPC's activities constituted direct control by CPC over Ott.[42]

D. Other Recent Land Use Cases

1. Alaska v. Native Village of Venetie Tribal Gov't, *118 S.Ct. 948 (1998)*

The Supreme Court held that the Native Village of Venetie Tribal Government (the Tribe) lacked the power to impose a tax upon non-members of the Tribe where the lands being used by the non-members were not "Indian country" within the meaning of the Alaska Native Claims Settlement Act (ANCSA).[43]

In 1971, Congress enacted ANCSA to settle all land claims by Alaska Natives.[44] In doing so, Congress revoked various Indian reservations and authorized the transfer of money and reservation land to state-chartered private business corporations owned and operated by Alaska Natives.[45] Pursuant to this scheme, the United States conveyed fee simple title to the former Venetie Reservation to two Native-owned corporations which, in turn, transferred title to the Tribe.[46]

In 1986, Alaska entered into a joint venture with a private contractor to construct a public school in Venetie.[47] After the contractor and the State refused to pay the Tribe for approximately $161,000 in taxes imposed for doing business on tribal land, the Tribe sought to collect the money in tribal court.[48] As a result, the State sued the Tribe in federal court to enjoin the collection of the tax.[49]

The Supreme Court held that the Tribe's land does not constitute "Indian country."[50] According to the Court, "Indian country" refers to a limited category of Indian lands that (1) have been set aside by the federal government for the use of the Indians as Indian land and (2) are under federal superintendence.[51] The Court held that the land at issue in this case failed to satisfy either of these requirements because Congress, in enacting ANCSA, clearly intended that non-members of the Tribe could own the Venetie Reservation and that the Tribe is free to use it for non-Indian purposes.[52] Furthermore, the Court held that ANCSA clearly ended federal superintendence over the Tribe's lands by revoking all existing Alaska reservations except the Annette Island Reserve and by conveying the lands to private business corporations.[53]

Because the Tribe's land does not constitute "Indian country," the Tribe implicitly lacks the power to impose a tax on the State and private contractor.[54]

2. South Dakota v. Yankton Sioux Tribe, *118 S.Ct. 789 (1998)*

The Supreme Court held that South Dakota acquired primary jurisdiction over land once belonging to the Yankton Sioux Tribe (Tribe).[55] As a result, a solid waste disposal facility now located on the land is subject to the State's environmental regulations.[56]

In 1858, the United States and the Tribe signed a treaty establishing the Yankton Sioux Reservation.[57] However, in 1887, Congress enacted legislation permitting the federal government to allot tracts of tribal land to individual Indians and, with tribal consent, to open remaining holdings to non-Indian settlements.[58] In 1892, the federal government and the Tribe reached an agreement whereby the Tribe gave the federal government all of its unallotted lands for $600,000.[59] Congress ratified this agreement in 1894.[60]

A solid waste disposal facility now sits on the unallotted, non-Indian land; however, this facility falls within the Tribe's original 1858 boundaries.[61] As a result, the Court had to determine whether state or federal regulations now have primary jurisdiction over the land.[62]

In an opinion written by Justice O'Connor, the Court held that courts must examine congressional intent to determine whether a federal statute diminishes or retains an Indian reservation's boundaries.[63] The Court stated that when a statute contains both explicit cession language and a provision for a fixed sum payment, a "nearly conclusive" presumption of diminishment arises.[64] The Court also noted that even in the absence of a clear expression of congressional intent, evidence of the surrounding circumstances may support the conclusion that a reservation has been diminished.[65]

Applying this analysis to this case, the Court held that the plain language of the 1894 ratification by Congress evinces the "clear and plain" intent to diminish the Yankton Sioux Reservation, thereby extinguishing the reservation status of the unallotted lands.[66] As a result, the State acquired primary jurisdiction over the unallotted lands, and the waste disposal facility on these lands is now subject to the State's environmental laws.[67]

The Court noted, however, that it was not determining whether Congress disestablished the reservation altogether.[68]

E. Cases in Which the Supreme Court has Granted Certiorari

<CN>RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW<A HREF="Rece.htm#FNT*">[*]</A><A NAME=FNR*></A>

1. Del Monte Dunes at Monterey v. City of Monterey, *95 F.3d 1422 (9th Cir. 1996)*

The Supreme Court granted *certiorari*[69] in this case in which the Ninth Circuit held that a property owner's inverse condemnation claim against a city could be submitted to a jury for resolution because an inverse condemnation claim constitutes an action at law.[70]

2. U. S. v. Cordova Chem. Co, *113 F.3d 572 (6th Cir. 1995)*

The Supreme Court granted *certiorari*[71] in this case in which the Sixth Circuit held that a parent corporation could incur operator liability under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) for the conduct of its subsidiaries only if the elements necessary to pierce the corporate veil are present.[72] Furthermore, the court held that a parent corporation does not incur former owner liability under CERCLA if the parent corporation owned the contaminated site for a brief period and no evidence exists that additional releases of hazardous substances occurred during that time.[73] Finally, the Sixth Circuit also held that CERCLA precludes a finding of arranger liability against the State's Department of Natural Resources (Department) when the Department engaged in good faith negotiations to acquire the site and to create a plan to clean up the groundwater contamination.[74]

3. Sierra Club v. Thomas, *105 F.3d 248 (6th Cir. 1997)*

The Supreme Court granted *certiorari*[75] in this case in which the Sixth Circuit held that environmental groups have standing to chal lenge the Forest Service's land resource management plan allowing clearcutting in the Wayne National Forest.[76] Furthermore, the court held that the plaintiffs' claim presents a sufficiently ripe contro versy.[77] The court concluded that the land resource management plan was arbitrary, capricious, and not in compliance with the intent of the National Forest Management Act because the Forest Service's planning process was improperly predisposed to clearcutting.[78]

II. ELEVENTH CIRCUIT CASES

A. GJR Inv., Inc. v. County of Escambia, *132 F.3d 1359 (11th Cir. 1998)*

GJR Investments, Inc. (GJR) wanted to construct an RV campground on its property in Escambia County, Florida.[79] Before receiving approval from the county, GJR had to file four separate applications and two separate state court actions.[80] As a result, GJR sued the county and county officials for damages allegedly caused by the delays in approving the project.[81] More specifically, GJR claimed that the county's action violated its rights to due process and equal protection and constituted a compensable taking.[82] The county claimed qualified immunity as a defense.[83]

The doctrine of qualified immunity states that government officials performing discretionary functions are immune from suit unless the conduct which is the basis of the suit violates "clearly established [federal] statutory or constitutional rights of which a reasonable person would have known."[84] For a right to be "clearly established," previous case law must have developed it in a concrete factual context so as to make it obvious to a reasonable government actor that his actions violate federal law.[85]

Applying this analysis, the court had to determine whether GJR pled any federal claims that would abrogate the county's qualified immunity.[86] The court held that GJR failed to sufficiently plead a violation of a "clearly established" right, and, as a result, dismissed GJR's complaint with prejudice.[87]

B. Andrews v. U.S., *122 F.3d 1367 (11th Cir. 1997)*

Pursuant to the Equal Access to Justice Act (EAJA), the plaintiffs in this case requested attorneys' fees incurred in pursuing claims against the federal government under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).[88] EAJA allows plaintiffs to recover fees and costs incurred in litigating their CERCLA claims.[89] The district court granted the plaintiffs attorneys' fees.[90]

However, the Eleventh Circuit held that the district court abused its discretion by not giving greater weight to the plaintiffs' limited success on their CERCLA claims when determining attorneys' fees.[91] Specifically, the Eleventh

Circuit noted that the CERCLA damages awarded at trial equaled less than one percent of the amount the plaintiffs originally sought and were slight in comparison to the overall damages award.[92] Furthermore, the court stated that the CERCLA claims did not vindicate an important non-monetary principle.[93] Considering that the district court did not weigh these factors, the Eleventh Circuit held that the district court abused its discretion when calculating attorneys' fees for the plaintiffs' CERCLA claims.[94]

C. Andrews v. U.S.*, 121 F.3d 1430 (11th Cir. 1997)*

Current and former residents of a semi-rural neighborhood sued the United States, seeking damages for injuries resulting from the contamination of groundwater caused by hazardous waste disposal by two Navy bases.[95] The Navy had contracted with an independent contractor for the safe disposal of its hazardous waste.[96]

The plaintiffs sought damages under the Federal Tort Claims Act (FTCA) which constitutes a limited waiver of the federal government's sovereign immunity.[97] FTCA allows suits against the federal government for damages caused by tortious conduct of federal employees when such conduct would render a private actor liable under the law of the place where the conduct occurred.[98] However, FTCA does not allow claims based on the exercise or the failure to exercise a discretionary function.[99] The Eleventh Circuit discussed a two-part test to determine the applicability of this "discretionary function" exception; the court must determine (1) whether the challenged conduct involves an element of judgment or choice and (2) if the challenged conduct does involve discretion, whether that discretion was used to make a policy decision.[100]

The Eleventh Circuit held that in this case, this discretionary function exception shields the government from strict tort liability for the consequences flowing from the Navy's decision to delegate its waste disposal.[101] Furthermore, the court held that the government is not liable for negligent failure to supervise its independent contractor.[102] However, the court held that the exception does not shield the Navy for breach of its duty to not place flammable liquid waste in the dumpsters on base.[103] However, the court determined that the Navy's breach of this duty did not cause the contamination of the plaintiffs' wells.[104]

The court noted that Congress has since enacted federal environmental legislation mandating nondelegable responsibility for hazardous waste disposal on the part of those who generate it, thereby making this decision something of an anachronism.[105]

D. Villas of Lake Jackson, Ltd. v. Leon County*, 121 F.3d 610 (11th Cir. 1997)*

Leon County, Florida rezoned the property owner's tract of land from an intense development category to a single family housing category.[106] Due to this rezoning, the landowners were deprived of the right to complete a high density apartment development that they had already started.[107] The landowners claimed that the right to complete the high density apartment project was vested under Florida law because of their reliance on the county's prior regulatory activity on this issue.[108]

When they filed suit in federal court, the landowners framed their claim as a substantive "due process taking" as opposed to a compensable taking under the Takings Clause of the Fifth Amendment.[109] However, the Eleventh Circuit held that a substantive due process taking does not exist as a separate and independent cause of action from the Takings Clause.[110] Furthermore, the court noted that substantive due process only applies when the claim is for arbitrary and capricious conduct, and the court held that the rezoning in this case was not arbitrary and capricious because the rezoning had a rational relation to the county's interest in protecting the water quality at a nearby lake.[111]

The court stated that a right to the specific use of property is protected only by the following constitutional constraints: (1) procedural due process claims challenging procedures used by the government entity to adopt the regulation; (2) substantive due pro cess claims based on the arbitrary and capricious action of the government in adopting the regulation; (3) a takings claim which seeks just compensation and/or invalidation of the regulation; and (4) claims under some other constitutional provision that gives the landowners a protectable right that is not specifically involved with the real property right itself.[112]

Additionally, the Eleventh Circuit held that the district court correctly entered summary judgment for the county on the

landowners' equal protection claim.[113]

E. Digital Properties, Inc. v. City of Plantation, *121 F.3d 586 (11th Cir. 1997)*

Digital Properties (Digital) sought to establish an adult book and video store in Plantation, Florida.[114] Digital's representatives spoke to several city employees, none of whom offered a conclusive, authoritative denial of Digital's ability to use the property as an adult entertainment store.[115] Nevertheless, in anticipation of being denied the appropriate permits to use its property as an adult book and video store, Digital filed suit against the city in federal court, claiming that the city's zoning scheme violated its First Amendment rights.[116]

The Eleventh Circuit held that Digital failed to present a case or controversy ripe for judicial review.[117] The court noted that Digital did not even have confirmation that the city failed to provide at least one zone where adult enterprises were explicitly permitted.[118] Furthermore, Digital failed to exhaust its administrative remedies.[119] As a result, the court held that no concrete deprivation of Digital's First Amendment rights had occurred and found that no justiciable case or controversy existed.[120]

F. LaFarge Corp. v. Travelers Indemnity Co., *118 F.3d 1511 (11th Cir. 1997)*

The Environmental Protection Agency (EPA) was investigating and preparing a clean-up of toxic wastes at a Tampa, Florida borrow pit owned and operated by LaFarge Corporation (LaFarge).[121] Travelers Indemnity Company (Travelers) had issued a series of comprehensive general liability insurance policies to LaFarge.[122] When LaFarge notified Travelers of the EPA's potential charges against it, Travelers told LaFarge that the pollution exclusion clauses in the insurance contracts relieved Travelers of any duty to defend LaFarge against EPA's potential charges.[123] As a result, LaFarge sued Travelers, seeking declaratory relief and damages for breach of contract.[124]

In this diversity suit, the Eleventh Circuit applied the "substantial relationship test" to determine that Florida law applied because Florida has the most significant relationship with the transaction and the parties at issue.[125]

The court also noted that the insurance contracts between the parties do have a pollution exclusion clause but that an exception to this exclusion exists when the actual discharge of pollutants is sudden and accidental.[126] Furthermore, the policies preclude relief if the pollution arises from a discharge of waste that is expected or intended or non-sudden and gradual.[127] In other words, if the actual discharge of the pollutants was sudden and accidental, Travelers would provide coverage for LaFarge, but if the actual discharge was expected or intended or non-sudden and gradual, Travelers did not have to provide coverage for LaFarge.[128] The court found that the discharge of the pollutants was not sudden and accidental; therefore, the exception to the pollution exclusion clause does not apply, and Travelers does not have to defend LaFarge against EPA's claims.[129]

G. LEAF, Inc. v. EPA, *118 F.3d 1467 (11th Cir. 1997)*

The Safe Water Drinking Act (SWDA) establishes a regulatory program for the protection of underground resources of drinking water.[130] Pursuant to SWDA, the Environmental Protection Agency (EPA) has to promulgate regulations establishing the minimum requirements for state underground injection control (UIC) programs.[131] Furthermore, the EPA has to approve a State's proposed UIC program.[132]

After EPA granted approval to Alabama's UIC program, LEAF, an environmental activist group, petitioned EPA to withdraw its approval of the program, claiming that Alabama's program failed to comply with the requirements established by SWDA.[133] Specifically, LEAF argued that SWDA mandates the regulation of hydraulic fracturing activities as part of the UIC program and that Alabama's UIC program fails to regulate such activities.[134] However, EPA denied LEAF's petition, claiming that SWDA does not mandate the regulation of hydraulic fracturing activities.[135] LEAF subsequently filed a petition for review of EPA's denial of LEAF's petition.[136]

The court held that Congress, in adopting SWDA, clearly dictated that the UIC programs are to regulate all underground injection, including hydraulic fracturing activities.[137] Because the words used by Congress are unambiguous, the court held that it does not have to give deference to EPA's interpretation of the statute.[138] As a result, the court concluded that EPA's interpretation of the regulations is inconsistent with the SWDA and granted

LEAF's petition for review.[139]

H. U.S. v. Banks, *115 F.3d 916 (11th Cir. 1997)*

Banks, an owner of three lots in Big Pine Key, Florida, was bulldozing two of his lots and covering them with fill.[140] The Army Corps of Engineers warned Banks that part of his land constituted wetlands and that discharges onto those areas were illegal without a permit.[141] Nevertheless, Banks never acquired the appropriate permits and continued to discharge fill without a permit.[142] The federal government sued Banks under the Clean Water Act (CWA) and asked the court to enjoin Banks from discharging fill materials into the wetlands, to require him to restore the wetlands, and to require him to pay an appropriate civil penalty.[143]

The first issue resolved by the Eleventh Circuit was whether the statute of limitations in 28 U.S.C. ? 2462(1991) applied to the government's claims.[144] The court held that the statute of limitations applied only to civil penalties; however, the statute did not bar the government's claims for equitable relief.[145]

Furthermore, the court concluded that the district court's finding that Banks land constituted jurisdictional, adjacent wetlands was not clearly erroneous because sufficient evidence existed to prove that Banks' property met the statutory and regulatory definitions of jurisdictional and adjacent wetlands.[146]

Finally, the Eleventh Circuit held that Banks failed to carry his burden of persuasion on the issue of whether Nationwide Permit 26 (NWP 26) issued by the government authorized some of his discharges.[147] In fact, the court held that the government consistently construed Banks' activities to be outside the scope of NWP 26 which authorizes the discharge of material into specific navigable waters.[148]

III. Florida Supreme Court Cases

A. Deni Assoc. v. State Farm Fire & Casualty Ins. Co., *Nos. 89115, 89300, 1998 WL 29822 (Fla. Jan. 29, 1998)*

In this case, the Supreme Court consolidated two unrelated cases which addressed the same issue: the applicability of a pollution exclusion clause in a comprehensive general liability insurance policy.[149] In one case, the insurer wanted to apply it to indoor air contamination from an ammonia spill, and in the other case, the insurer wanted to apply it to an incident in which insecticide was accidentally sprayed on bystanders.[150]

Both pollution exclusion clauses excluded coverage for any injury or damage caused by the "discharge, dispersal, release, or escape of pollutants."[151] The court held that the pollution exclusion clause is clear and unambiguous on its face, and, as such, is applicable to both cases.[152] Furthermore, the court explicitly rejected the argument that a pollution exclusion clause is limited to environmental or industrial pollution.[153]

The court also explicitly rejected the doctrine of reasonable expectations under which the court upholds an insured's expectation as to the scope of coverage as long as such expectations are reason able.[154] The court held that the reasonable expectations doctrine is unnecessary in Florida because if a policy is ambiguous in Florida, the ambiguities are construed against the insurer.[155]

B. Advisory Opinion regarding the Fish and Wildlife Conservation Comm'n, No. 91193, 1998 WL 25443 (Fla. Jan. 8, 1998)

In this Advisory Opinion to the Attorney General, the Supreme Court held that the initiative petition to unify the Marine Fisheries Commission and the Game and Freshwater Fish Commission complied with the single-subject rule but failed to comply with ballot title and summary requirements.[156] The court held that the summary failed to explain the transfer of power from the Legislature that would result if this initiative passed.[157] As a result, the title, summary, and proposed text of the initiative cannot appear on the 1998 ballot.[158]

C. Advisory Opinion regarding Amendment 5 (Everglades), No. 90042, 1997 WL 731823 (Fla. Nov. 26, 1997)

In this Advisory Opinion to the Governor, the court held that Amendment 5 (Amendment), which requires polluters to

<CN>RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW<A HREF="Rece.htm#FNT*">[*]</A><A NAME=FNR*></A>

pay for the abatement of pollution in the Everglades, is not self-executing.[159] As a result, the Amendment requires implementing legislation, notwithstanding the existence of the Everglades Forever Act.[160] Furthermore, the court construed the Amendment to require those in the Everglades Agricultural Area (EAA) who cause water pollution in the Everglades Protection Area (EPA) or in the EAA to bear the costs of abating that pollution.[161]

D. State v. Inland Protection Fin. Corp.*, 699 So. 2d 1352 (Fla. 1997)*

In 1996, the Legislature created the Inland Protection Financing Corporation (Corporation) to assist the Department of Environmental Protection (DEP) in financing the rehabilitation of petroleum contamination sites by providing a mechanism for bond issuances to pay for the rehabilitation.[162] The Corporation intends to issue bonds from amounts paid by DEP under a service contract.[163] The State Attorney challenged the Corporation's authority to issue bonds.[164]

The court held that the Corporation's purpose to finance the rehabilitation of petroleum contamination sites serves a legitimate public purpose.[165] Furthermore, the court held that because the bonds do not pledge public credit or taxing power, the issuance of the bonds does not violate the constitutional prohibition against lending the State's credit to private entities.[166] Finally, the court held that since the bonds are not supported by a pledge of tax revenue, the issuance of the bonds does not violate the constitutional prohibition against the State's issuance of revenue bonds.[167] Accordingly, the court affirmed the trial court's judgment of bond validation.[168]

E. Lane v. Chiles*, 698 So. 2d 260 (Fla. 1997)*

Commercial net fishermen challenged the constitutionality of Article X, section 16 of the Florida Constitution, known as the "Net Ban Amendment."[169] The voters adopted the Net Ban Amendment as an initiative in 1994.[170]

The court held that the rational basis standard, as opposed to the strict scrutiny standard, applies when reviewing the validity of an initiative.[171] Furthermore, the court held that the Net Ban Amendment does not violate the plaintiffs' right to due process because the Amendment is rationally related to the State's goal of protecting its natural resources and does not prohibit the plaintiffs from engaging in their chosen occupation.[172] As a result, the court held that the Amendment does not constitute a compensable taking.[173] Additionally, the court held that the Amendment does not violate the plaintiffs' right to equal protection because the Amendment does not seek to punish any particular type of fishermen.[174] Finally, the court held that the Net Ban Amendment is not subject to a challenge on the grounds that it constitutes improper subject matter for the constitu tion.[175] The court also concluded that the plaintiffs' challenge to the ballot summary was untimely.[176]

IV. PROPOSALS FROM FLORIDA'S 1997-98 CONSTITUTION REVISION COMMISSION[177]

Florida's 1997-98 Constitution Revision Commission (CRC) has proposed the following amendment to Florida's constitution: Con servation of Natural Resources and Creation of Fish and Wildlife Conservation Commission. This amendment, which will be on the November 1998 ballot, amends Articles II, VII, and X of the Florida Constitution. If adopted, this amendment will require that the Legislature make adequate provision for the conservation of natural resources. Furthermore, it will unify the Game and Fresh Water Fish Commission and the Marine Fisheries Commission, thereby removing exclusive legislative authority to regulate marine life. Additionally, this amendment will authorize revenue bonds to finance the acquisition and improvements of lands for conservation, outdoor recreation, and related purposes. Finally, this amendment will restrict the disposition of state lands designated for conservation purposes.

V. NEW LAWS FROM FLORIDA'S 1998 LEGISLATIVE SESSION[178]

During its 1998 session, the Florida Legislature passed eleven bills related to environmental and land use issues for the Governor's signature. The Governor vetoed two of the bills.[179] A brief overview of the bills enacted into law is provided below.

CS/SB 812 Air/Accidental Release

Chapter 98-193, Florida Statutes

This bill was passed to satisfy a requirement of the federal Clean Air Act Amendments of 1990. With the Department

<CN>RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW<A HREF="Rece.htm#FNT*">[*]</A><A NAME=FNR*></A>

of Community Affairs having implementing authority, this law allows Florida to obtain delegation of the federal Accidental Release Prevention Program. The Program is aimed at dealing with accidental releases of certain toxic, flammable, and explosive substances by preventing such releases and minimizing the consequences of the releases if they do occur. A fee system is included in this law to ensure that the program is self-sustaining.

CS/SB 1202 Brownfields

Chapter 98-75, Florida Statutes

In 1997 the Brownfields Redevelopment Act became law. This new law clarifies several glitches identified since its adoption. This new law also included several additional economic incentives. For example, the Brownfields Property Ownership clearance Assistance Program will assist in removing prior liens from certain Brownfields properties.

The Brownfields Areas Loan Guarantee Program limits loan guarantees backed by up to five million dollars in funds from the Non-mandatory Land Reclamation Trust Fund. This law also creates the Center for Brownfields Rehabilitation Assistance at the University of South Florida. The Center will research and assist in Brownfields site rehabilitation.

CS/SB 244 Drycleaning/Solvent Cleanup

Chapter 98-189, Florida Statutes

This new law updates Florida's drycleaning-solvent, contaminated-site cleanup program. For example, a contaminated-site rehabilitation tax credit against the intangible personal property tax and against corporate income tax is included. Another change is that the period for applying for eligibility in this program is shortened from December 31, 2005 to December 31, 1998.

CS/HB 945 Environmental Equity and Justice

Chapter 98-304, Florida Statutes

This new law creates the Center for Environmental Equity and Justice at Florida A&M University and the Community Environmental Health Program. The Center is created to conduct and facilitate research; develop policies, and engage in education, training, and community outreach with respect to environmental equity and justice issues. The Program is created to ensure the availability of public health services to residents of low-income communities who may adversely be affected by contaminated sites located in or near their community.

CS/HB 3701 Hazardous Waste Facilities

Chapter 98-334, Florida Statutes

This new law prohibits the Department of Environmental Protection from issuing permits for hazardous waste facilities within certain described distances of any residence, hospital, prison, school, nursing home facility, day care facility, stadium, place of worship, or the like.

CS/SB 1176 Phosphogypsum Stack System Management

Chapter 98-117, Florida Statutes

In response to a spill in Polk County last year, the Department of Environmental Protection is given the authority to adopt rules that relate to the safety, operational requirements, and management of phosphate gypsum stacks.

CS/SB 2474 Public Schools/Growth Management

Chapter 98-176, Florida Statutes

This law extends the concurrency requirements to public schools and codifies the recommendations of the Public

Schools Construction Study Commission on planning and siting of public schools. This law also makes several other changes to Florida's growth management laws, such as an optional sector plan for local governments to address Development of Regional Impact issues within certain designated geographic areas.

CS/CS/HB 3229 Tax Exemption for Pollution Control Equipment

Chapter 98-317, Florida Statutes

With an effective date of January 1, 1999, this law exempts pollution control equipment used in connection with manufacturing from the Florida sales tax. Also exempted from the Florida sales tax by this law are certain items used to control pollution at specified solid waste management facilities.

CS/SB 312 Water/"Local Sources First"

Chapter 98-88, Florida Statutes

In 1997, the legislature passed a comprehensive water supply bill. One issue left unresolved was the issue of looking at local sources prior to transporting water across a water management district's boundary lines. This law establishes new state water policy whereas the use of local water source should be encouraged, although not mandated. When evaluating whether a permit for transporting and using water across county boundaries is in the public interest, the districts must evaluate a number of considerations aimed at ensuring that local courses of water are investigated and used when possible. Two of the few exceptions allowed by this law include water trans portation for Everglades restoration and electricity production.

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[*] THE RECENT DEVELOOPMENTS SECTION WAS RESEARCHED AND WRITTEN BY CHANTA G. HUNDLEY, J.D. , FLORIDA STATE UNIVERSITY COLLEGE OF LAW (1998). Return to text.

[1] *See Ohio Forestry Ass'n*, 118 S.Ct. at 1673.

2> *See id. at* 1678. Return to text.

[3] *See* 16 U.S.C. §1604(a). Return to text.

[4] *See Ohio Forestry Ass'n*, 118 S.Ct. at 1668. Return to text.

[5] *See id.* at 1669. Return to text.

[6] *See id.* Return to text.

[7] *See id*. Return to text.

[8] *See id.* Return to text.

[9] *See id.* at 1670. Return to text.

[10] *See id.* Return to text.

[11] *See id.* Return to text.

[12] *See id.* Return to text.

[13] *See id.* at 1671. Return to text.

[14] *See id.* at 1671-72. Return to text.

[15] *See Steel Co.*, 118 S.Ct. at 1020. Return to text.

[16] *See id*. at 1008. Return to text.

[17] *See id.* at 1008-09. Return to text.

[18] *See id*. at 1009. Return to text.

[19] *See id*. Return to text.

[20] *See id*. Return to text.

[21] *See id*. Return to text.

[22] *See id.* Return to text.

[23] *See id.* Return to text.

[24] *See id.* Return to text.

[25] *See id.* Return to text.

[26] *See id*. at 1016-20. Return to text.

[27] Lujan v. Defenders of Wildlife, 504 U.S. 555 (1992). *See Steel Co.*, 118 S.Ct. at 1020. Return to text.

[28] *See Steel Co.*, 118 S.Ct. at 1012, 1014. Return to text.

[29] *See id*. at 1009-12. Return to text.

[30] *See id*. at 1012-16. Return to text.

[31] 42 U.S.C. ? 9601-9675. Return to text.

[32] *See Bestfoods*, 118 S.Ct. at 1883. Return to text.

[33] *See id*. Return to text.

[34] *See id.* Return to text.

[35] *See id.* Return to text.

[36] *See id.* at 1884. Return to text.

[37] *See id.* at 1885. Return to text.

[38] *See id.* Return to text.

[39] *See id.* at 1887. Return to text.

[40] *See id.* Return to text.

[41] *See id.* at 1887-90. Return to text.

[42] *See id*. at 1890. Return to text.

[43] *See Native Village*, 118 S.Ct. at 951. Return to text.

[44] *See id*. Return to text.

[45] *See id*. Return to text.

[46] *See id*. Return to text.

[47] *See id*. Return to text.

[48] *See id*. Return to text.

[49] *See id*. at 952. Return to text.

[50] *See id*. at 955-56. Return to text.

[51] *See id*. at 953. Return to text.

[52] *See id*. at 955-56. Return to text.

[53] *See id*. Return to text.

[54] *See id*. at 951-52. Return to text.

[55] *See* Yankton *Sioux Tribe*, 118 S.Ct. at 793. Return to text.

[56] *See id*. Return to text.

[57] *See id*. at 793-96. Return to text.

[58] *See id*. Return to text.

[59] *See id*. Return to text.

[60] *See id*. Return to text.

[61] *See id*. at 796. Return to text.

[62] *See id*. at 793. Return to text.

[63] *See id*. at 797-98. Return to text.

[64] *See id*. at 798. Return to text.

[65] *See id*. at 802-04. Return to text.

[66] *See id*. at 798-802. Return to text.

[67] *See id*. at 805. Return to text.

[68] *See id*. Return to text.

[69] *See* City of Monterey v. Del Monte Dunes at Monterey, No. 97-1235, 1998 WL 37996 (U.S. March 30, 1998). Return to text.

[70] *See Del Monte Dunes*, 95 F.3d at 1426-27. Return to text.

[71] *See* United States v. Bestfoods, 118 S.Ct. 621 (1997). Return to text.

[72] *See Cordova Chem.*, 113 F.3d at 578-81. Return to text.

[73] *See id*. at 582-83. Return to text.

[74] *See id*. at 581-82. Return to text.

[75] *See* Ohio Forestry Ass'n Inc. v. Sierra Club, 118 S.Ct. 334 (1997). Return to text.

[76] *See Sierra Club*, 105 F.3d at 250. Return to text.

[77] *See id*. Return to text.

[78] *See id.* at 250-52. Return to text.

[79] *See GJR*, 132 F.3d at 1362. Return to text.

[80] *See id*. Return to text.

[81] *See id*. at 1361-64. Return to text.

[82] *See id*. at 1362. Return to text.

[83] *See id*. at 1364. Return to text.

[84] *Id*. at 1366(citations omitted). Return to text.

[85] *See id.* Return to text.

[86] *See id*. at 1367-70. Return to text.

[87] *See id*. at 1370. Return to text.

[88] *See Andrews*, 122 F.3d at 1374. Return to text.

[89] *See id.* Return to text.

[90] *See id.* Return to text.

[91] *See id*. at 1375-76. Return to text.

[92] *See id.* Return to text.

[93] *See id.* Return to text.

[94] *See id.* Return to text.

[95] *See Andrews*, 121 F.3d at 1436. Return to text.

[96] *See id.* Return to text.

[97] *See id*. at 1437-38. Return to text.

[98] *See id*. at 1438. Return to text.

[99] *See id*. Return to text.

[100] *See id.* Return to text.

[101] *See id*. at 1440-41. Return to text.

[102] *See id.* Return to text.

[103] *See id*. at 1441. Return to text.

[104] *See id.* Return to text.

[105] *See id.* at 1442. Return to text.

[106] *See Lake Jackson*, 121 F.3d at 611-12. Return to text.

[107] *See id*. at 612. Return to text.

[108] *See id.* Return to text.

[109] *See id*. Return to text.

[110] *See id*. at 612-614. Return to text.

[111] *See id*. at 614. Return to text.

[112] *See id.* at 615. Return to text.

[113] *See id.* Return to text.

[114] *See Digital Properties*, 121 F.3d at 587-88. Return to text.

[115] *See id*. at 588-89. Return to text.

[116] *See id.* at 589. Return to text.

[117] *See id.* Return to text.

[118] *See id.* Return to text.

[119] *See id.* Return to text.

[120] *See id.* Return to text.

[121] *See LaFarge*, 118 F.3d at 1513. Return to text.

[122] *See id*. at 1513-14. Return to text.

[123] *See id*. at 1514. Return to text.

[124] *See id.* Return to text.

[125] *See id*. at 1515-16. Return to text.

[126] *See id*. at 1516. Return to text.

[127] *See id*. at 1517. Return to text.

[128] *See id*. at 1516-17. Return to text.

[129] *See id*. at 1516-18. Return to text.

[130] *See LEAF*, 118 F.3d at 1469. Return to text.

[131] *See id*. Return to text.

[132] *See id*. Return to text.

[133] *See id*. at 1471. Return to text.

[134] *See id*. Return to text.

[135] *See id*. Return to text.

[136] *See id*. at 1472. Return to text.

[137] *See id*. at 1474-75. Return to text.

[138] *See id*. at 1477. Return to text.

[139] *See id*. at 1478. Return to text.

[140] *See Banks*, 115 F.3d at 918. Return to text.

[141] *See id*. Return to text.

[142] *See id*. Return to text.

[143] *See id*. Return to text.

[144] *See id*. at 918-19. Return to text.

[145] *See id*. at 919. Return to text.

[146] *See id*. at 919-21. Return to text.

[147] *See id*. at 921-22. Return to text.

[148] *See id*. Return to text.

[149] *See Deni*, Nos. 89115, 89300, 1998 WL 29822, at *1. Return to text.

[150] *See id*. Return to text.

[151] *See id*. Return to text.

[152] *See id*. at *2-*4. Return to text.

[153] *See id*. at *2. Return to text.

[154] *See id*. at *4-*5. Return to text.

[155] *See id*. at *5. Return to text.

[156] *See Fish and Wildlife Conservation Comm'n*, No. 91193, 1998 WL 25443, at *2-*5. Return to text.

[157] *See id*. at *4. Return to text.

[158] *See id*. at *5. Return to text.

[159] *See Amendment 5*, No. 90042, 1997 WL 731823, at *3. Return to text.

[160] *See id*. at *4. Return to text.

[161] *See id*. Return to text.

[162] *See Inland Protection*, 699 So. 2d at 1353. Return to text.

[163] *See id*. Return to text.

[164] *See id*. at 1355-57. Return to text.

[165] *See id*. at 1356. Return to text.

[166] *See id*. Return to text.

[167] *See id*. at 1357. Return to text.

[168] *See id*. Return to text.

[169] *See Lane*, 698 So. 2d at 262. Return to text.

[170] *See id*. Return to text.

[171] *See id*. at 262-63. Return to text.

[172] *See id*. at 263-64. Return to text.

[173] *See id*. Return to text.

[174] *See id*. at 264. Return to text.

[175] *See id*. at 263. Return to text.

[176] *See id*. at 264-65. Return to text.

[179] The Governor Vetoed the Everglades Restoration Restudy Bill, CS/HB 4141, and the Lake Belt Mining Bill, CS/CS/HB 4071. Return to text.

CS/SB 312 Water/"Local Sources First"
CS/CS/HB 3229 Tax Exemption for Pollution Control Equipment
CS/SB 2474 Public Schools/Growth Management
CS/SB 1176 Phosphogypsum Stack System Management
CS/HB 3701 Hazardous Waste Facilities
CS/HB 945 Environmental Equity and Justice
CS/SB 1202 Brownfields

C. Advisory Opinion regarding Amendment 5 (Everglades), No. 90042, 1997 WL 731823 (Fla. Nov. 26, 1997)
D. State v. Inland Protection Fin. Corp., *699 So. 2d 1352 (Fla. 1997)*
E. Lane v. Chiles, *698 So. 2d 260 (Fla. 1997)*

<CN>RECENT DEVELOPMENTS IN LAND USE AND ENVIRONMENTAL LAW<A HREF="Rece.htm#FNT*">[*]</A><A NAME=FNR*></A>

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CS/SB 244 Drycleaning/Solvent Cleanup V. NEW LAWS FROM FLORIDA'S 1998 LEGISLATIVE SESSION[178]

CS/SB 812 Air/Accidental Release

D. Villas of Lake Jackson, Ltd. v. Leon County, *121 F.3d 610 (11th Cir. 1997)*

E. Digital Properties, Inc. v. City of Plantation, *121 F.3d 586 (11th Cir. 1997)*

F. LaFarge Corp. v. Travelers Indemnity Co., *118 F.3d 1511 (11th Cir. 1997)*

G. LEAF, Inc. v. EPA, *118 F.3d 1467 (11th Cir. 1997)*

H. U.S. v. Banks, *115 F.3d 916 (11th Cir. 1997)*

III. FLORIDA SUPREME COURT CASES

A. Deni Assoc. v. State Farm Fire & Casualty Ins. Co., *Nos. 89115, 89300, 1998 WL 29822 (Fla. Jan. 29, 1998)*

B. Advisory Opinion regarding the Fish and Wildlife Conservation Comm'n, No. 91193, 1998 WL 25443 (Fla. Jan. 8, 1998)