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Beach Nourishment to the Rescue: Through an Extensive Regulatory Review Process, Beach Nourishment Can Restore and Protect Vital Sea Turtle Nesting Habitat

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BEACH NOURISHMENT TO THE RESCUE: THROUGH AN EXTENSIVE REGULATORY REVIEW PROCESS, BEACH NOURISHMENT CAN RESTORE AND PROTECT VITAL SEA TURTLE NESTING HABITAT

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I. INTRODUCTION

All six sea turtle species that inhabit the waters and beaches of the Atlantic Coast of the United States are listed and protected by Federal

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and State agencies.[1] Despite the protections given to sea turtles, they remain in a precarious situation due to the continual loss of suitable nesting habitat.[2] A majority of the beaches on the eastern coast of the United States are eroding and unless erosion problems are addressed, dry sandy nesting beaches may become a thing of the past.[3]

This note concentrates on potential solutions to stop beach erosion to ensure that sea turtle nesting can continue on U.S. shorelines. Section II provides a description of sea turtles and an introduction to the Endangered Species Act[4] and the National Environmental Policy Act.[5] Section III briefly describes why the beaches of the Atlantic Coast are eroding. Section IV describes three possible solutions to combat erosion: a policy of retreat, hard engineered structures, and beach nourishment. Section IV also concludes that beach nourishment is the preferred alternative because of the compatibility of beach nourishment with the needs of sea turtles. Section V addresses common criticisms of beach nourishment, which can be overcome by extensive regulatory review of proposed beach construction projects as discussed in Section VI. Section VII provides three examples of how an extensive regulatory review of beach nourishment projects can restore and enhance sea turtle nesting success. Finally, Section VIII concludes the note by reaffirming the claim that beach nourishment is the best alternative to restore sea turtle nesting beaches if the projects adhere to a strict regulatory scheme.

II. LEGAL PROTECTION OF THREATENED AND ENDANGERED SPECIES

A. Endangered Species Act

In 1973, Congress drafted the Endangered Species Act ("ESA"), which is "the most comprehensive legislation for the preservation of endangered species ever enacted by any nation."[6] The ESA was created in response to Congress' finding that "various species of fish, wildlife, and plants in the United States have been rendered extinct as a

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[1] *See, e.g.*, 16 U.S.C. §§ 1531-43 (2010); 42 U.S.C.S. §§ 4321-70 (2010); FLA. STAT. § 379.2431 (2009); COMM. ON SEA TURTLE CONSERVATION, NAT'L RESEARCH COUNCIL, DECLINE OF SEA TURTLES: CAUSE AND PREVENTION 16 (Nat'l Acad. Press 1990).

[2] COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at 145.

[3] James G. Titus, *Rising Seas, Coastal Erosion and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, 57 MD. L. REV. 1279 (1998).

[4] 16 U.S.C. §§ 1531-43 (2006).

[5] 42 U.S.C.S. §§ 4321-70 (2006).

[6] Tenn. Valley Auth. v. Hill, 437 U.S. 153, 180 (1978).

consequence of economic growth and development untempered [sic] by adequate concern and conservation."[7] Congress then specified the purpose of the ESA as "a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species. . . ."[8]

At the inception of the ESA, the administration and enforcement of it was delegated to the Secretary of the Interior and the Secretary of Commerce ("Secretaries").[9] As administrators of the ESA, the Secretaries are charged with the duty of listing endangered and threatened species[10] "solely on the basis of the best scientific and commercial data available."[11] The ESA defines endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range . . . ."[12] Additionally, the ESA defines threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."[13] After the Secretaries designate a species as endangered or threatened, the Secretaries then determine the listed species' critical habitat, which is the territory containing "those physical or biological features (I) essential to the conservation of the species, and (II) which may require special management considerations or protection."[14] After a species is listed and the critical habitat is designated, both the species and the habitat are protected from governmental and public actions.[15]

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[7] 16 U.S.C. § 1531(a)(1) (2006).
[8] *Id.* § 1531(b).
[9] 16 U.S.C.. § 1533 (2006).
[10] *Id.* § 1533(a)(1).
[11] *Id.* § 1533(b)(1)(A).
[12] *Id.* § 1532(6).
[13] *Id.* § 1532(20).
[14] 16 U.S.C. § 1532(5)(A) (2006).
[15] *Id.* § 1536(a)(2) ("Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the

Currently, the Secretaries have delegated the administration and enforcement of the ESA to the Fish and Wildlife Service ("FWS") and the National Marine Fisheries Service ("NMFS").[16] The FWS, under the direction of the Secretary of the Interior,[17] is tasked with monitoring "terrestrial species,"[18] while the NMFS, under the direction of the Secretary of Commerce,[19] is generally responsible for saltwater marine species.[20] Threatened or endangered species are also protected from any final actions by, or related to, a federal agency through a "Section 7 consultation."[21] Under Section 7, a final action is defined as when the agency action "mark[s] the 'consummation' of the agency's decision making process" and "the action must be one by which 'rights or obligations have been determined,' or from which 'legal consequences will flow.'"[22] Section 7 of the ESA requires a federal agency "[to] confer with the Secretary on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed under section 4 [16 USCS § 1533] or result in the destruction or adverse modification of critical habitat proposed to be designated for such species."[23] After consultation, the Secretaries are required to respond in ninety days[24] with "a written statement setting forth the Secretary's opinion . . . detailing how the agency action affects the species or its critical habitat."[25] The ninety-day period can be extended when there is mutual agreement between the Secretaries and the agency.[26] If the Secretaries find that the proposed project would result in adverse consequences, known as

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Committee pursuant to subsection (h) of this section."); *see also id.* § 1540(a)-(b) (penalties for any person knowingly violating the ESA).

[16] *See id.* § 1540.

[17] 50 C.F.R. § 1.3 (2009).

[18] Fisher v. Salazar, 656 F. Supp. 2d 1357, 1358 (N.D. Fla. 2009).

[19] 50 C.F.R. § 222.101 (2009).

[20] *See generally id.* §§ 216 (marine mammals), 222 (general endangered and threatened marine species).

[21] Cape Hatteras Access Pres. Alliance v. U.S. Dept. Interior, No. 09-0236 (RCL), 2010 U.S. Dist. LEXIS 84515, at *19 (D.D.C. Aug. 17, 2010).

[22] Nat'l Parks Conservation Ass'n v. U.S. Army Corps of Eng'rs, 446 F. Supp. 2d 1322, 1334 (S.D. Fla. 2006) (citing Bennett v. Spear, 520 U.S. 154, 177-78 (1997)).

[23] 16 U.S.C. § 1536(a)(4) (2006).

[24] *Id.* § 1536(b).

[25] *Id.*

[26] *Id.*

takings,[27] to either the species or the critical habitat, "the Secretary shall suggest those reasonable and prudent alternatives which . . . can be taken by the Federal agency or applicant in implementing the agency action."[28] A taking is defined as an action "mean[ing] to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."[29] After consultation is complete, the federal agency will only be allowed to move forward with the proposed project if the Secretary finds the "agency action"[30] and any "taking of an endangered species or a threatened species incidental to the agency action"[31] will not violate 16 USCS § 1536(a)(2).[32]

B. National Environmental Policy Act

The National Environmental Policy Act (NEPA) was enacted by Congress to achieve four goals: "[1] encourage productive and enjoyable harmony between man and his environment and biosphere and stimulate the health and welfare of man; [2] to promote efforts which will prevent or eliminate damage to the environment; [3] to enrich the understanding of the ecological systems and natural resources important to the Nation; and [4] to establish a Council on Environmental Quality."[33] In order to ensure that the goals of NEPA are met, Congress implemented procedures which require federal agencies to draft an Environmental Assessment before they engage in a proposed activity.[34] An Environmental Assessment requires a determination of whether the proposed activity is a "major" activity with a "significant effect."[35] Major federal actions are defined as "actions includ[ing] new and continuing . . . projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised

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[27] *Id.* § 1532(19) ("The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct [relating to an endangered or threatened species]").
[28] 16 U.S.C. § 1536(b) (2006).
[29] *Id.* § 1532(19).
[30] *Id.* § 1536(b)(3)-(4).
[31] *Id.* § 1536(b)(4).
[32] *See id.*
[33] 42 U.S.C.S. § 4321 (2010).
[34] Little Lagoon Pres. Soc'y, Inc. v. U.S. Army Corps of Eng'rs, No. 06-0587-WS-C, 2008 U.S. Dist. LEXIS 66557, at *52-53 (S.D. Ala. Aug. 29, 2008) (citing Sierra Club v. U.S. Army Corps of Eng'rs, 295 F.3d 1209, 1215 (11th Cir. Fla. 2002)).
[35] *Id.*

agency rules, regulations, plans, policies, or procedures; and legislative proposals."[36] Under NEPA, a significant action is determined through "consideration of both context and intensity" of the action.[37] Under the context portion of the significant action assessment, the agencies must consider the short and long term effects of the project on "society as a whole (human, national), the affected region, the affected interests, and the locality."[38] Intensity of the proposed action encompasses the "severity of impact" the project could have on the environment.[39] When the agencies are determining the severity of impact they consider: beneficial and adverse impacts,[40] uniqueness of the proposed project area,[41] effect on endangered or threatened species,[42] and whether the proposed action could violate environmental protection laws.[43] The Environmental Assessment is a brief statement of the proposed activity and should include enough information for the government agency to determine if the activity has a significant effect on the environment.[44] For beach nourishment projects, the agencies that must be concerned with Environmental Assessments are the FWS[45], the NMFS,[46] and the United States Army Corps of Engineers ("USACE").[47] If the agencies (FWS, NMFS, and USACE) determine that there is no significant effect on the environment from a proposed project, then a "Finding of No Significant Impact" is issued and the proposed activity can move toward construction.[48] However, if the proposed activity would result in a significant impact, then the agencies (FWS, NMFS, and USACE) will

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[36] 40 C.F.R. § 1508.18(a) (2009).
[37] *Id.* § 1508.27.
[38] *Id.* § 1508.27(a).
[39] *Id.* § 1508.27(b).
[40] *Id.* § 1508.27(b)(1).
[41] 40 C.F.R. § 1508.27(b)(3) (2009).
[42] *Id.* § 1508.27(b)(9).
[43] *Id.* § 1508.27(b)(10).
[44] *Id.* § 1508.9.
[45] *See* Fisher v. Salazar, 656 F. Supp. 2d 1357, 1358 (N.D. Fla. 2009).
[46] *See generally* 50 C.F.R. §§ 216 (marine mammals), 222 (general endangered and threatened marine species) (2009).
[47] Devito v. United States, No. 95-CV-2349 (JS), 1997 U.S. Dist. LEXIS 22837, at *4 (E.D.N.Y. Sept. 5, 1997) ("Congress has delegated to the Secretary of the Army the duty to prescribe regulations for the use, administration and navigation of United States navigable waters.").
[48] *See* 42 U.S.C.S. § 4332(2)(C) (2010).

require an Environmental Impact Statement ("EIS"),[49] which includes analysis of the proposed activity and descriptions of any feasible alternative designs.[50] The agencies (FWS, NMFS, and USACE) then review the Environmental Impact Statement and make final determination on whether the proposed activity meets the goals of NEPA and if the project can move forward to construction.[51]

C. Sea Turtles and Their Protection by the ESA and NEPA

Sea turtles are marine reptiles that spend a majority of their time in the world's oceans.[52] The only time sea turtles leave the ocean is when females emerge to lay egg clutches in the sand.[53] A clutch is a sea turtle nest usually comprising of 100 eggs.[54] Upon emergence from the ocean, female sea turtles crawl up the beach, above the high water line,[55] and create deep cavities in the sand to lay their eggs.[56] Once the eggs are laid, the female covers the clutch with sand and returns to the ocean.[57] After an approximately two month incubation period, the hatchlings dig out of the nest and crawl to the sea.[58]

Currently, the ESA lists and protects all six species of sea turtles that live or swim within the Atlantic Coast of the United States: the green, leatherback, loggerhead, hawksbill, olive ridley, and Kemp's ridley sea

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[49] *Id.*

[50] *Id.*

[51] *Id.* § 4332 ("[A]ll agencies of the Federal Government shall--(A) utilize a systematic, interdisciplinary approach . . . in decision-making which may have an impact on man's environment . . . .").

[52] COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at 16.

[53] *See id.*

[54] *See id.* at 4.

[55] U.S. Army Eng'r Research & Dev. Ctr.'s Coastal & Hydraulics Lab., http://chl.erdc.usace.army.mil/ (follow "Glossary" hyperlink; then follow "H" hyperlink; then follow "high water" hyperlink) (last visited Oct. 17, 2010) (The high water line is the "maximum height [on the shoreline] reached by a rising tide.").

[56] *See* THE LOGGERHEAD/GREEN TURTLE RECOVERY TEAM, RECOVERY PLAN FOR U.S. POPULATION OF GREEN TURTLE CHELONIA MYDAS 2 (U.S. Fish & Wildlife Serv. & Nat'l Marine Fisheries, 1991), *available at* http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_green_atlantic.pdf [hereinafter GREEN TURTLE REPORT].

[57] FLA. FISH & WILDLIFE CONSERVATION COMM'N, FISH & WILDLIFE RESEARCH INST., http://research.myfwc.com/ (follow "FAQs" hyperlink; then follow "Sea Turtles" hyperlink) (last visited Oct. 17, 2010).

[58] *Id.*

turtle.[59] The responsibility of conservation and protection of the listed sea turtles is shared by the FWS and the NMFS because the migratory behavior of the sea turtles encompasses both the marine environment (NMFS jurisdiction) and the dry beach (FWS jurisdiction).[60] FWS and NMFS combat the major threats to sea turtles, which are the "destruction and alteration of nesting and foraging habitats."[61]

The decline in sea turtle numbers is directly attributable to mankind.[62] As early as the 1800's, sea turtles were exploited for their meat, shells, skin and eggs.[63] The overhunting of the sea turtle population led to a drastic decline in sea turtle numbers in the early 1900's and those population numbers have yet to recover today.[64] Coastal development and the altering of the native beach characteristics have also had negative impacts on nesting success because these changes cause false crawls and inoperable nests.[65] A false crawl is when a sea turtle "emerge[s] from the ocean but [does] not lay eggs on the beach."[66] The reasons for a false crawl may include: artificial beach lighting, interference while digging the nest, and non-compatible sand.[67] Finally, global climate change and the resulting sea level rise adversely affect sea turtle nesting by altering and destroying nest habitat.[68]

III. COASTAL EROSION AND THE LOSS OF SEA TURTLE NESTING HABITAT

Beach erosion is a combination of natural and man-made processes and defined as "the amount of sand removed from a beach by waves,

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[59] COMM. ON SEA TURTLE CONSERVATION, supra note 1, at 16.

[60] OFFICE OF PROTECTED RES., NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://www.nmfs.noaa.gov/pr/species/turtles/ (last visited Oct. 17, 2010).

[61] *Id.*

[62] COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at 145.

[63] *Id.*

[64] *Id.*

[65] *Id.*

[66] SEA TURTLE NESTING BEHAVIOR, THE VIRGINIA INST. OF MARINE SCI., http://www.fisheries.vims.edu/turtletracking/nestingbehavior.html (last visited Dec. 22, 2010).

[67] SEA TURTLE NESTING BEHAVIOR, THE VIRGINIA INST. OF MARINE SCI., http://www.fisheries.vims.edu/turtletracking/nestingbehavior.html (last visited Dec. 22, 2010).

[68] SEA TURTLE CONSERVANCY, http://www.conserveturtles.org/ (follow "Sea Turtle Information" hyperlink; then follow "Climate Change" hyperlink) (last visited Oct. 17, 2010).

currents, or other processes."[69] The loss of beach property is a major problem and generally "the average coastal shore along the Atlantic and Gulf Coasts is eroding two and four feet per year, respectively."[70] The natural processes that typically result in beach erosion are a combination of longshore sediment transport,[71] storms,[72] and sea level rise.[73] Sea level rise recently garnered more attention because of the dangers that global warming can bring to the environment.[74] Sea level rise "results in a slow, long-term recession of the shoreline, partly due to direct flooding and partly as a result of profile adjustment to the higher water level."[75] Scientists estimate that "average global temperatures rose by more than 1°F and some regions warmed by as much as 4°F."[76] With continual warming, the polar ice caps will melt, causing a global sea level rise resulting in coastal erosion.[77] By 2100, the continual warming of the

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[69] COMM. ON BEACH NOURISHMENT & PROT., NAT'L RESEARCH COUNCIL, BEACH NOURISHMENT AND PROTECTION 24 (Comm. on Beach Nourishment & Prot., Nat'l Acad. Press 1995).

[70] Titus, *supra* note 3, at 1297.

[71] 3 U.S. ARMY CORPS OF ENG'RS, COASTAL ENGINEERING MANUAL, ENGINEER MANUAL 1110-2-1100, III-2-1 (Andrew Morang et al. eds., U.S. Army Corps of Eng'rs 2002), *available at* http://chl.erdc.usace.army.mil/ (follow "Coastal Engineering Manual" hyperlink; then follow "CEM Distribution (Download Chapters)" hyperlink; then follow "CEM Part III - Coastal Sediment Processes" hyperlink) ("Sometimes this transport results only in a local rearrangement of sand into bars and troughs, or into a series of rhythmic embayments cut into the beach. At other times there are extensive longshire displacements of sediments, possibly moving hundreds of thousands cubic meters of sand along the coast each year.").

[72] COMM. ON BEACH NOURISHMENT & PROT., NAT'L RESEARCH COUNCIL, *supra* note 69, at 15 ("Beaches may change drastically in width and elevation during storms.").

[73] *See* ROBERT G. DEAN & ROBERT A. DALRYMPLE, COASTAL PROCESSES WITH ENGINEERING APPLICATIONS 35-42 (Cambridge Univ. Press 2004).

[74] *Climate Change 101: Science and Impacts*, at 1 (2009), http://www.pewclimate.org/docUploads/Climate101-Science-Jan09.pdf ("The impacts of warming can already be observed in many places, from rising sea levels to melting snow and ice to changing weather patterns. Climate change is already affecting ecosystems, freshwater supplies, and human health.").

[75] 1 U.S. ARMY CORPS OF ENG'RS, SHORE PROTECTION MANUAL 15 (Betty Hall et al. eds., 4th ed. 1984).

[76] *Climate Change 101: Science and Impacts*, *supra* note 74, at 1.

[77] S. JEFFRESS WILLIAMS ET AL., COASTS IN CRISIS 17 (U.S. Geological Circular 1075, 1991) ("The increasing release of greenhouse gases, such as carbon dioxide and methane from automobile and industrial exhaust, may promote global warming, the melting of

atmosphere and the melting of glacial formations could result in a sea level rise "between 0.8 and 2.0 m[eters]".[78] In the event of a one meter (three feet) rise in the sea level, the coastline could "erode 50-100 meters from the Northeast to Maryland; 200 meters along the Carolinas; 100-1000 meters along the Florida coast . . . . Because most U.S. recreational beaches are less than 30 meters (100 feet) wide at high tide, even a thirty-centimeter (one foot) rise in sea level would require a response."[79] Such a loss in coastal land would devastate the United States because the United States coastline experiences a "faster growth in population and housing, a larger increase in population density, and a higher percentage of the population . . . [than] the rest of the country."[80]

IV. RESPONSES TO COASTAL EROSION

In response to these natural erosional processes, the public can either engineer a solution or let the shoreline retreat unchecked.[81] The following solutions are the generally accepted theories relating to the different approaches to manage coastal erosion and climate change.[82]

A. Retreat

A retreat policy, which is theoretically simple, is the least probable solution. Retreat policy declares that people who live at the coast should

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massive ice sheets in Greenland and Antarctica, and consequently the raising of sea level worldwide.").

[78] W.T. Pfeffer et al., *Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise*, 321 SCIENCE 1340, 1342 (2008).

[79] James G. Titus et al., *Greenhouse Effect and Sea Level Rise: The Cost of Holding Back the Sea*, 19 COASTAL MGMT. 171 (Issue 2 1991), *available at* http://epa.gov/climate change/effects/downloads/cost_of_holding.pdf.

[80] U.S. CENSUS BUREAU, U.S. DEPT. OF COMMERCE, COASTLINE POPULATION TRENDS IN THE UNITED STATES: 1960 TO 2008, at 22 (2010), *available at* http://www.census.gov/prod /2010pubs/p25-1139.pdf.

[81] Titus et al., *supra* note 79, at 8 ("Possible responses fall broadly into three categories: erecting walls to hold back the sea; allowing the sea to advance and adapting to it; and raising the land." Erecting walls and raising the land both refer to engineering solutions to erosion).

[82] *See generally* Martin M. Randall, Comment, *Coastal Development Run Amuck: A Policy of Retreat May Be the Only Hope*, 18 J. ENVTL. L. & LITIG. 145 (2003); Kelley M. Jancaitis, *Florida on the Coast of Climate Change: Responding to Rising Seas*, 31 ENVIRONS ENVTL. L. & POL'Y J. 157 (2008); James G. Titus, *Does the U.S. Government Realize That the Sea Is Rising? How to Restructure Federal Programs So That Wetlands and Beaches Survive*, 30 GOLDEN GATE U. L. REV. 717 (2000).

abandon their homes and businesses because sea level rise will continue eroding the coastline and thus endanger the people who live at the coast.[83] While the theory is simple, application of the theory of retreat will prove difficult. People continue to migrate to coastal areas in large numbers,[84] and relocation of these people from the coast can be "costly and difficult to implement without causing severe disruptions."[85] Additionally, there are risks that abruptly implementing a policy of retreat will result in rash decisions by politicians leading to great economic costs and unreasonable relocation alternatives.[86]

Retreat is only feasible when there are parcels of land landward of the coastal communities available for relocating the buildings.[87] If there is a hasty decision made by politicians, the most suitable parcels of land may not be utilized.[88] Relocating entire coastal communities may also be economically infeasible when compared with engineering solutions to protect the coastal community, which results in uneconomic funding of the retreat policy.[89] A potential solution to the fear of hasty political decisions is a gradual change in governmental coastal policy by disfavoring coastal development and amending local coastal zone management policies.[90] To ease the effects of an abrupt implementation of retreat, local governments can employ "restrictions, setbacks, and

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[83] Gordon McGranahan et al., *The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones*, 19 ENV'T & URBANIZATION 17, 20 (2007) ("The risks to human settlements could be reduced if people and enterprises could be encouraged to move away from the coast, or at least from the most risk-prone coastal locations (this would also reduce the pressures human settlements place on coastal ecosystems).").

[84] *See* WILLIAMS ET AL., *supra* note 77.

[85] McGranahan et al., *supra* note 83, at 17.

[86] *Id.* at 20 (noting the "[d]anger that ill-considered or politically short-sighted measures to shift population from the coastal areas will impose unnecessary economic costs on key coastal enterprises and fail to provide the basis for viable alternatives inland or in more appropriate coastal locations").

[87] Derek J. McGlashan, *Managed Relocation: An Assessment of Its Feasibility as a Coastal Management Option*, 169 GEOGRAPHICAL J. 6 (2003).

[88] *Id.*

[89] *Id.*

[90] McGranahan et al., *supra* note 83, at 20-21 ("Avoiding policies that favour coastal development (such as the special economic zones in China, whose rapid population growth is described below), and imposing more effective coastal zone management, could make a difference in the longer term.").

rolling easements."[91] One possible restriction that can be utilized is a "reservation of use and occupancy" agreement.[92] A reservation of use and occupancy agreement is an agreement made with the National Park Service which allows the previous owner of land to use and enjoy their land "for either a term of years or for life."[93] The government can enter into these agreements with property owners who live on eroding coastlines and allow the owners to live out their lives on the coast without losing their property.[94] After the term of the agreement expires, the property then becomes a protected National Park.[95] Once the eroding coastline becomes a National Park, the coastline will then be able to evolve naturally within the preserve.[96] While reservation of use and occupancy benefits the government, the individual property owners can suffer.[97] Typically under the reservation of use and occupancy agreements, property owners are not allowed to make improvements to their property.[98] Property owners often end up selling their property for less than the market value because the selling prices for these agreements are based on "the current value of the property less one percent for each year of the term of the reservation."[99]

Governmental agencies can also facilitate the theory of retreat through the use of setbacks which prevent construction seaward of the prescribed surveyed line.[100] Setbacks are generally determined "based on erosion rates, elevation, and estimated changes in the shoreline."[101] The creation of a consistent setback is also difficult because coastal erosion is a dynamic process which can be difficult to quantify.[102] A problem with setbacks is that they only affect new home builders.[103] For example, if a beachfront parcel owner wants to build a house on the beach, the

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[91] Jancaitis, *supra* note 82, at 191.
[92] Lisa A. St. Amand, *Sea Level Rise and Coastal Wetlands: Opportunities for a Peaceful Migration*, 19 B.C. ENVTL. AFF. L. REV. 1, 18-19 (1991).
[93] *Id.* at 19.
[94] *Id.*
[95] *Id.*
[96] *Id.*
[97] *Id.*
[98] Amand, *supra* note 92, at 19
[99] *Id.*
[100] Jancaitis, *supra* note 82, at 191.
[101] *Id.* at 192.
[102] *Id.*
[103] *Id.*

proposed house must be situated landward of the setback line.[104] However, a current homeowner on the beach is unaffected by setback requirements unless the homeowner wants to expand his housing footprint. Permits can be applied for and issued to build a house landward of the setback lines if an applicant meets certain provisions in accordance with the applicable laws.[105]

Rolling easements are another regulatory approach available to ease the effects of retreat by allowing the shorelines to naturally migrate.[106] Rolling easements allow the Government to purchase private property rights either when the sea level raises a specified amount or when private land is overtaken by the high water line.[107] Currently, four states (Maine, Rhode Island, South Carolina, and Texas) have implemented a variation of rolling easements.[108] Buyers may think twice about "investing in inappropriate construction, expansions, or upgrades on their property" because the Government can take private land through the use of rolling easements.[109] Rolling easements have a low social cost because prospective purchasers are aware they could lose their property before deciding to purchase the land.[110] However, rolling easements, like setback lines, suffer from a restricted application to new coastal construction.[111] Rolling easements could be beneficial on undeveloped coasts by restricting where buildings can be constructed.[112] However, the usefulness of rolling easements is limited on developed coasts, which are becoming more prevalent because of the amount of people moving to the coast.[113]

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[104] *Id.*

[105] *See, e.g.*, S.C. CODE ANN. § 48-39-290 (2009) (defining special permits and exceptions; allows for constructing seaward of a setback line); FLA. ADMIN. CODE ANN. 62B-33 (2008) (providing the rules and regulations for building seaward of the Coastal Construction Control Line, which is a type of setback line in Florida).

[106] Jancaitis, *supra* note 82.

[107] Titus et al., *supra* note 79.

[108] *Coastal Zones and Sea Level Rise*, U.S. Envtl. Prot. Agency, http://www.epa.gov/ (follow "Climate Change" hyperlink; then follow "Health and Environmental Effects"; then follow "Coastal Zones and Sea Level Rise") (last visited Oct. 17, 2010).

[109] Jancaitis, *supra* note 82, at 193.

[110] *Id.*

[111] *Id.*

[112] WILLIAMS ET AL., *supra* note 77.

[113] *Id.*

The problems with retreat, relocation, and amending coastal management policies are demonstrated in *Lucas v. South Carolina Coastal Council.*[114] In *Lucas,* the United States Supreme Court held that South Carolina's Beachfront Management Act[115] resulted in an unlawful taking because the act effectively rendered Lucas' land valueless by barring Lucas from building on his land.[116] The Court remanded the case back to the South Carolina Supreme Court in order to determine if damages were owed to Lucas.[117] In deciding to remand the case to calculate damages, the United States Supreme Court chose limited coastal regulation in favor of private property rights.[118] On remand, the South Carolina Supreme Court found that there was a "temporary nonacquisitory taking of his property without just compensation," and damages, in the amount of $1,575,000.00, were owed to Lucas.[119] In awarding damages to Lucas, the South Carolina Supreme Court demonstrated the difficulty in implementing coastal management policies.[120]

The continual migration of the United States public to the coast and the desire to develop beachfront land will likely "defeat or repeal purely regulatory prohibitions on coastal floodplain development and limit or negate the effectiveness of restrictions on government subsidies."[121] The problem of coastal development and relocation was demonstrated in New Orleans after Hurricane Katrina.[122] Hurricane Katrina struck New Orleans as a Category 3 hurricane.[123] In the direct aftermath of Hurricane Katrina, several of the New Orleans levees and flood walls were overtopped, causing massive flooding which devastated the majority of

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[114] Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992).

[115] *S.C. CODE ANN. § 48-39-250 (2010).*

[116] *See Lucas*, 505 U.S. at 1003.

[117] Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992).

[118] Daniel D. Barnhizer, *Givings Recapture: Funding Public Acquisition of Private Property Interests on the Coasts*, 27 HARV. ENVTL. L. REV. 295 (2003).

[119] Lucas v. S.C. Coastal Council, 309 S.C. 424, 427 (S.C. 1992).

[120] *See id.*

[121] Barnhizer, *supra* note 118, at 350.

[122] Jim Snyder, *New Orleans Is 'Back' From Katrina Devastation, Officials Say*, BLOOMBERG BUSINESSWEEK, Aug. 29, 2010, http://www.businessweek.com/news/2010-08-29/new-orleans-is-back-from-katrina-devastation-officials-say.html.

[123] Nicole T. Carter, New Orleans Levees and Floodwalls: Hurricane Damage Protection (Order Code RS22238), U.S. Cong. Research Serv., The Library of Cong., *available at* http://www.fas.org/sgp/crs/misc/RS22238.pdf.

the city.[124] The impact of the flooding was furthered by the topography of the city because much of the city is "below sea-level and lacking natural drainage."[125] Despite the lack of natural drainage, "90 percent of the metropolitan area population" has returned to New Orleans.[126] In addition, the USACE received $5.7 billion from Congress to repair the existing levee system.[127]

The problem of coastal development and relocation has also been demonstrated in the Far East.[128] After the Indian Ocean tsunami struck Thailand in 2004, residents returned to the coast despite the risk of another catastrophic event.[129] The local residents' return to the devastated coast "demonstrated the profound difficulties involved in instituting more restrictive coastal settlement policies without further undermining the lives and livelihoods of the most vulnerable residents."[130] Implementing retreat would require people to either relocate their homes or completely demolish them.[131] Either method would require extensive construction, which has been shown to negatively affect sea turtle nesting.[132] The demolition and removal of coastal structures may also leave "debris on the beach which may further impede access to suitable nesting sites . . . and trap hatchlings and nesting turtles."[133]

B. Hard Structures

There are several different hard structures that are used to protect the beach and upland properties.[134] Upland properties are those properties

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[124] *Id.*

[125] *Id.*

[126] Snyder, *supra* note 122.

[127] Task for Hope, U.S. Army Corps of Eng'rs, Budgets/Money, Sept. 19, 2006, *available at* http://www.mvn.usace.army.mil/hps/pdf/Budgets.pdf.

[128] McGranahan et al., *supra* note 83, at 21.

[129] Phil Cummins & Mark Leonard, *The Boxing Day 2004 Tsunami - A Repeat of 1833?*, 77 AUSGEO NEWS 3 (2005), http://www.ga.gov.au/image_cache/GA5892.pdf.

[130] *Id.*

[131] St. Amand, *supra* note 92, at 13.

[132] GREEN TURTLE REPORT, *supra* note 56, at 4 ("Increased human activity on the project beach at night may cause further disturbance to nesting females. Artificial lights along the project beach and in the nearshore area . . . may deter nesting females and disorient emergent hatchlings.").

[133] *Id.*

[134] *See generally* 2 U.S. ARMY CORPS OF ENG'RS, SHORE PROTECTION MANUAL Ch. 6 (Betty Hall et al. eds., 4th ed. 1984).

located landward of mean high waterline that can be privately owned.[135] Three of the most common structures are seawalls, groins, and breakwaters.[136]

1. Seawalls

Seawalls are used to protect upland structures from wave attack and erosion by separating the land from the sea.[137] However, seawalls do not provide any seaward protection of the beach.[138] As coastal erosion continues, the dry beach will eventually erode until the ocean abuts the seawall.[139] The continual erosion seaward of the seawalls tends to result in sea turtle nest failure because high tides can submerge the nests.[140] Additionally, complete erosion of the dry beach is a significant problem because a dry sandy beach is required for successful sea turtle clutches.[141]

2. Groins

Groins are shore perpendicular structures, usually built as a field,[142] commonly constructed by placing piles of rock on the beach.[143] Groins build beaches by trapping longshore sediment transport on their updrift side.[144] However, the shorelines on the downdrift side of the groins become starved of sand and erode.[145] Therefore, agencies move away

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[135] U.S. Army Eng'r Research & Dev. Ctr.'s Coastal & Hydraulics Lab., http://chl.erdc.usace.army.mil/ (follow "Glossary" hyperlink; then follow "U" hyperlink; then follow "uplands" hyperlink) (last visited Oct. 17, 2010).

[136] *See id.*

[137] DEAN & DALRYMPLE, *supra* note 73, at 404.

[138] *Id.* at 405 ("[T]here are examples of seawalls in which the beach in front of it has disappeared . . . or excessive downdrift erosion has occurred.").

[139] *Id.*

[140] GREEN TURTLE REPORT, *supra* note 56, at 3.

[141] ARCHIE CARR, SO EXCELLENT A FISHE: A NATURAL HISTORY OF SEA TURTLES 84-86 (Natural History Press 1967).

[142] DEAN & DALRYMPLE, *supra* note 73, at 390.

[143] N.C. DEP'T ENVTL. & NATURAL RES., TERMINAL GROIN STUDY FINAL REPORT, VI-3 (2010), http://www.nccoastalmanagement.net/CRC/tgs/Terminal%20Groin%20Study%20Final%20Report.pdf.

[144] 2 U.S. ARMY CORPS OF ENG'RS, SHORE PROTECTION MANUAL 5-35 (Betty Hall et al. eds., 4th ed. 1984).

[145] *Id.* at 5-43.

from implementing groins.[146] Groins are additionally disfavored because of their potential adverse effects on sea turtles.[147] Groins can impede sea turtles from reaching the desired nesting habitat, resulting in false crawls or construction of inadequate nests.[148]

3. Breakwaters

Breakwaters are structures parallel to the shoreline, usually built in a series (called a breakwater field), that provide a stable beach in their lee by blocking wave energy from getting to the coastline.[149] However, wave migration toward the shore is not blocked in the breakwater field gaps, causing an undulating shoreline with greater shore width directly behind the breakwaters and narrower shoreline in the gaps.[150] By lowering the wave energy in the lee of the breakwaters, the breakwaters effectively lower alongshore sediment transport and trapping of sand.[151] Like groins, breakwaters will cause downdrift erosion by impounding additional sand which usually migrates to downdrift beaches.[152] Rip currents can also form in the gaps of the breakwater field moving sand off of the beach.[153] Florida wildlife officials criticize breakwaters because they "have significant impacts on migration to and from the beach by adult and hatchling sea turtles."[154] The Florida Fish and Wildlife Conservation Commission (FFWCC) also commented that breakwaters lead to increased predation of hatchlings because the breakwater can disorient

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[146] NOAA Coastal Serv. Ctr., *Effects of Shoreline Structures on Performance*, http://www.csc.noaa.gov/beachnourishment/html/geo/shorelin.htm (last visited Oct. 17, 2010) ("However, since groins function by trapping sand within the littoral system, they may have an associated adverse effect on the downdrift shoreline. The recognition of this effect was the impetus for the gradual evolution of beach erosion control toward nourishment.").

[147] *See generally* COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at Ch. 6.

[148] *Id.* at 77.

[149] 2 U.S. ARMY CORPS OF ENG'RS, *supra* note 134, at 5-61 ("An offshore breakwater is a structure that is designed to provide protection from wave action to an area or shoreline located on the leeward side of the structure.").

[150] *See, e.g., id.* at Figures 5-27, 5-32, and 5-33.

[151] 2 U.S. ARMY CORPS OF ENG'RS, *supra* note 134, at figs. 5-27, 5-32, 5-33.

[152] DEAN & DALRYMPLE, *supra* note 73, at 397.

[153] 2 U.S. ARMY CORPS OF ENG'RS, *supra* note 134, at 5-73.

[154] Craig Pittman, *A Proposed $30-Million Project to Slow Singer Island Beach Erosion Could Affect Nesting by Endangered Sea Turtles*, ST. PETERSBURG TIMES, June 29, 2009, http://www.tampabay.com/news/environment/wildlife/article1014073.ece.

them as they venture out to sea.[155] The negative impacts to downdrift beaches and the potential interference with sea turtle nesting success make this alternative undesirable.

C. Beach Nourishment

Beach nourishment is a soft solution to coastal erosion because nourishment "directly remedies the basic cause of most erosion problems—a deficiency in natural sand supply—and benefits rather than damages the adjacent shore."[156] In comparison to previously discussed erosion protection techniques, beach nourishment is different because nourishment protects the upland structures and extends the width of the beach.[157] On the most basic level, beach nourishment is the process of placing dredged sand onto an eroded beach.[158] Typically, the dredged material comes from offshore borrow areas and is pumped in a slurry[159] to the beach through a series of pipes connected to a dredge.[160] As the mixture of sand and water is pumped onto the beach, heavy machinery is used to move the sand into the designed beach template.[161] Beach nourishment generally widens the beach an additional one hundred to

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[155] FLA. FISH & WILDLIFE CONSERVATION COMM'N, BIOLOGICAL OPINION FOR USACE APPLICATION NO. SAJ-2006-5344 (IP-JWH), at 31 (Apr. 7, 2010), http://www.surfrider pbc.org/docs/pdf/breakwaters/FWCtoUSACE-BiologicalOpinioinBreakwaters04072010.pdf ("The segmented breakwater may adversely affect sea turtle hatchlings by serving as a physical or visual barrier, delaying offshore migration, causing disorientation, depleting or increasing expenditure of the 'swim frenzy' energy critical to reach the relative safety of offshore areas, and possibly entrapping hatchlings within the crevices of the structures or within eddies or other associated currents.").

[156] U.S. ARMY CORPS OF ENG'RS, *supra* note 71, at 19.

[157] *Id.* at 19-20 ("Such protection often fails at flanks of these reaches as the adjacent unprotected shores continue to recede. Partial or inadequate protective measures may even accelerate erosion of adjacent shores.").

[158] D.P. ROBINSON, L. ZEPP & H.M. SHOUDLY, *THE DISTRIBUTION OF SHORE PROTECTION BENEFITS: A PRELIMINARY EXAMINATION* 67 (U.S. Army Eng'r Inst. for Water Res. 2001).

[159] NOAA Coastal Serv. Ctr., *Glossary*, http://chl.erdc.usace.army.mil/chl.aspx?p=GlossaryItems&a=Glossary;3011 (last visited Nov. 17) ("Slurry" is defined as "a term describing the mixture of soil or sediment and water hydraulically dredged and pumped to a disposal site.").

[160] Larry R. McCormick et al., Living with Long Island's South Shore 41 (Duke Univ. Press 1984).

[161] COMM. ON SEA TURTLE CONSERVATION, *supra* note 1.

two hundred feet,[162] but quickly reverts to its natural beach shape by shifting the newly placed sands around the beach profile.[163]

Once a beach undergoes a nourishment project, periodic renourishment is usually required.[164] The frequency of the renourishment cycle is typically determined before the start of the initial beach nourishment.[165] When determining the frequency of the renourishment cycle, several factors are considered.[166] The engineer must consider the erosion rate of the beach, the amount of the sand needed to replenish the beach, and the funding available for the beach construction project.[167] After weighing the factors and needs of a particular beach, the renourishment interval is set, usually ranging from two to ten years.[168] For example, if there is substantial funding and a large borrow site[169] of beach compatible sand, the construction plans could include a very wide beach, which would result in an extended renourishment cycle because the more sand placed on an eroded beach, the less frequent nourishment is required.[170]

Beach nourishment projects should be the preferred solution to solve coastal erosion because they "remain the most efficient and effective means available to enhance the dune and beach system to resist storm damage and protect our oceanfront public infrastructure and private properties while ensuring the recreational use of our national shoreline treasures for future generations."[171] Additionally, the National Oceanic and Atmospheric Administration endorsed beach nourishment for eroded

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[162] Donna R. Christie, *Of Beaches, Boundaries, and SOBS*, 25 J. LAND USE & ENVTL. L. 19, 39 (2009).

[163] DEPT. BOATING & WATERWAYS & STATE COASTAL CONSERVANCY, CALIFORNIA BEACH RESTORATION STUDY, at 4-4 (Jan. 2002), http://www.dbw.ca.gov/PDF/Reports/Beach Report/FUll.pdf.

[164] *Id.* at 4-6.

[165] *Id.*

[166] *Id.*

[167] *Id.*

[168] *Id.*

[169] NOAA Coastal Serv. Ctr., *Glossary*, http://www.csc.noaa.gov/beachnourishment/html/geo/glossary.htm#b (last visited Oct. 17) ("Borrow site" is defined as the area where the beach compatible sand is taken from before being placed on the beach.).

[170] *See* DEPT. BOATING & WATERWAYS & STATE COASTAL CONSERVANCY, *supra* note 163, at Ch. 4.

[171] *See* DEPT. BOATING & WATERWAYS & STATE COASTAL CONSERVANCY, *supra* note 163, at Ch. 4.

beaches because nourishment "can be beneficial to nesting turtles if conducted properly."[172]

V. CRITICISM OF BEACH NOURISHMENT

A misguided criticism of beach nourishment is that the newly nourished beach quickly narrows after placement of the sand.[173] The quick reshaping of the newly placed beach and the subsequent narrowing of the dry beach is a source of criticism.[174] However, beach nourishment projects are "designed so that the desired beach width is provided after the sand has been re-worked by waves and currents, and this narrower design width should be the public expectation."[175]

A more relevant criticism of beach nourishment is that the newly placed sand rarely matches characteristics of the native beach sand.[176] For nesting sea turtles, several problems arise if the nourished beach sand does not match the native grain size and color.[177] If the sand grain size is too large, the nest can collapse on the hatchings as they try and emerge from the nest.[178] Additionally, larger sand grain size can also result in difficult digging conditions for the female turtles.[179] Newly placed sand that is a smaller grain size than the native beach can also cause problems to nesting sea turtles.[180] When the sand grain size is smaller than the native, "the gas diffusion rate required to support embryonic

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[172] GREEN TURTLE REPORT, *supra* note 56, at 4.

[173] *See, e.g., id.*; Jessica VanTine & Tiffany B. Zezula, Comment, *The Beach Zone: Using Local Land Use Authority to Preserve Barrier Islands*, 20 PACE ENVTL. L. REV. 299, 309 (2002) ("The erosion rate of a replenished beach is typically at least ten times that of natural beaches.").

[174] VanTine & Zezula, *supra* note 173.

[175] DEPT. BOATING & WATERWAYS & STATE COASTAL CONSERVANCY, *supra* note 163, at 4-4.

[176] U.S. ARMY CORPS OF ENG'RS, ENGINEERING AND DESIGN - ENVIRONMENTAL ENGINEERING FOR COASTAL PROTECTION, EM 1110-2-1204 (1989), http://140.194.76.129/publications/eng-manuals/em1110-2-1204/entire.pdf.

[177] *Id.*

[178] *Id.* at 4-10.

[179] BRYANT C. COONEY ET AL., BEACH NOURISHMENT: GLOBAL PERSPECTIVES AND LOCAL APPLICATIONS TO THE NORTH CAROLINA COASTLINE 39 (2003) ("[T]oo great a composition of silt, shell, or rock fragments that harden and make digging difficult").

[180] *See, e.g.*, COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at 78; U.S. ARMY CORPS OF ENG'RS, *supra* note 176, at 4-10; Katherine R. Butler, Comment, *Coastal Protection of Sea Turtles in Florida*, 13 J. LAND USE & ENVTL. L. 399, 412 (1998).

development may become inadequate."[181] A variation in grain size from the native sand can also affect the moisture content of the sand.[182] The moisture content of the sand on the nesting beach sand can affect hatchling success.[183] If there is too much moisture in the sand, gas diffusion can be lowered.[184] On the other hand, if there is too little moisture, the nest might have "higher temperatures and egg desiccation."[185] Sand color also plays a pivotal role in nesting sea turtles and hatchling development.[186] Sand color can influence the temperature of the sand which plays a role in "[n]est site selection, incubation duration, sex ratio, and hatchling emergence."[187] Temperature is also important because the temperature of the clutch determines the sex ratio of the hatchings.[188] Warmer temperatures result in more female hatchlings, while lower temperatures result in longer incubation periods and more male hatchlings.[189]

Another criticism of beach nourishment is that newly nourished beaches often suffer from compaction of beach sediments.[190] Compaction of the beach is a direct result of the nourishment process because pumping the sand slurry results in high compaction of the placed beach sediments.[191] This high compaction of the beach can negatively affect sea

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[181] U.S. ARMY CORPS OF ENG'RS, *supra* note 176, at 4-10.
[182] *Id.*
[183] *Id.*
[184] *Id.* at 4-11.
[185] *Id.*
[186] *Id.*
[187] U.S. ARMY CORPS OF ENG'RS, *supra* note 176, at 4-10.
[188] *Id.*
[189] *Id.*
[190] Butler, *supra* note 180, at 412 ("[R]enourishment itself often results in severe compaction of the beach, significantly reducing nesting success."); Tara Zuardo, Comment, *Habitat-Based Conservation Legislation: A New Direction for Sea Turtles Conservation*, 16 ANIMAL L. 317, 326 (2010) ("[S]and may be too compacted for turtles to nest, affecting the entire incubation process and sometimes destroying nests entirely."); COONEY ET AL., *supra* note 179, at 39 ("Studies have shown that the number of turtle nests decrease on a nourished beach, which can be caused by inability to crawl up the beach because of steep cliffs formed from pumped sand, too great a composition of silt, shell, or rock fragments that harden and make digging difficult.").
[191] NOAA Coastal Serv. Ctr., *Erosion Hot Spots and Causes* (last visited Oct. 17, 2010), http://www.csc.noaa.gov/beachnourishment/html/geo/erosion.htm.

turtle nesting.[192] High compaction can affect nest excavation,[193] incubation time,[194] and the success of hatchling emergence from the nest.[195] Pumping sand onto the beach can also result in a steep beach slope,[196] or beach scarps, which can prevent sea turtles from climbing up the beach and getting to nesting habitat.[197] Beach scarps are near-vertical steps located on the beach face that can reach a maximum of three feet due to erosion.[198] The height variations in beach scarps "depend[] on wave action and the nature and composition of the beach."[199]

Beach nourishment projects conducted during sea turtle nesting season, from May 1 through November 15,[200] can negatively affect sea turtle nesting. The placement of sand during nesting season could result in burial of existing sea turtle nests.[201] The presence of construction equipment, people, and lights may deter females from crawling up to the beach.[202] Lighting on the beach can also disorient emergent hatchlings because they naturally crawl to bright light, which is usually the surf on natural beaches.[203]

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[192] Butler, *supra* note 180, at 412 ("Transporting the sand onto the beach and the renourishment itself often result in severe compaction of the beach, significantly reducing nesting success.").

[193] U.S. ARMY CORPS OF ENG'RS, *supra* note 176, at 4-10 ("Smaller grain size, flatter shaped grains, and greater density may cause compaction of the beach.").

[194] Zuardo, *supra* note 190, at 326.

[195] *See* U.S. ARMY CORPS OF ENG'RS, *supra* note 176.

[196] COONEY ET AL., *supra* note 179, at 39.

[197] COMM. ON SEA TURTLE CONSERVATION, *supra* note 1, at 76.

[198] U.S. Army Eng'r Research & Dev. Ctr.'s Coastal & Hydraulics Lab., http://chl.erdc.usace.army.mil/ (follow "Glossary" hyperlink; then follow "B" hyperlink; then follow "beach scarp" hyperlink) (last visited Oct. 17, 2010).

[199] *Id.*

[200] *Id.*

[201] U.S. ARMY CORPS OF ENG'RS, *supra* note 176, at 4-9.

[202] *See* GREEN TURTLE REPORT, *supra* note 56.

[203] *See* BLAIR E. WITHERINGTON & R. ERIK MARTIN, UNDERSTANDING, ASSESSING, AND RESOLVING LIGHT-POLLUTION PROBLEMS ON SEA TURTLE NESTING BEACHES, FL. MARINE RESEARCH INST. TECHNICAL REPORTS (Fla. Dept. Envtl. Prot. 1996), *available at* http://research.myfwc.com/engine/download_redirection_process.asp?file=tr-2_3101.pdf&objid=2156&dltype=article.

VI. EXTENSIVE REGULATORY REVIEW OVERCOMES THE CRITICISMS OF BEACH NOURISHMENT

Utilizing an extensive permitting process for beach nourishment projects can alleviate some, if not all, of the problems discussed above.[204] By enforcing a strict permitting process for beach nourishment, permitting agencies can "ensure [that project] timing, methodology, and sand sources are compatible with nesting and hatching activities."[205]

Currently, only five states on the eastern coast of the United States have specific beach nourishment sand compatibility requirements.[206] Of those states, Florida's beach nourishment sand compatibility standards for sea turtle nesting can serve as a representative model because "[m]ost of the sea turtle nesting in the continental U.S. occurs in Florida."[207] The Florida Legislature tasked the Florida Department of Environmental Protection (FDEP) with protecting sea turtles.[208] Protecting sea turtles includes the authority to accept or decline coastal construction permits based on how the proposed project affects sea turtle nesting habitat.[209] In order to obtain a beach nourishment permit in Florida, a professionally certified engineer must sign and seal a Joint Application for Joint Coastal Permit (JCP).[210] Within the JCP permit, there are two specific

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[204] GREEN TURTLE REPORT, *supra* note 56, at 4 ("Careful consideration and advance planning and coordination must be carried out to ensure timing, methodology, and sand sources are compatible with nesting and hatching activities.").

[205] *Id.*

[206] KAREN GREENE, ATL. STATES MARINE FISHERIES COMM'N, BEACH NOURISHMENT: A REVIEW OF THE BIOLOGICAL AND PHYSICAL IMPACTS 8 (2002), www.vliz.be/imisdocs/publications/41411.pdf (The following five states have sand compatibility requirements: Connecticut, Florida, New Jersey, North Carolina, Rhode Island.).

[207] VICTORIA BROOK VAN METER, FLORIDA'S SEA TURTLES (Fla. Power & Light (FPL) 2002), http://www.fpl.com/environment/endangered/pdf/turtles.pdf ("Leatherback and green turtles rarely nest north of Florida and about 90 percent of the loggerhead nests found in the United States are in Florida. Florida's east coast from New Smyrna Beach south to Boca Raton accounts for more than 80 percent of the nesting crawls or tracks observed on the east coast of the U.S.").

[208] FLA. STAT. § 379.2431 (2009).

[209] *Id.* § 379.2431(f)-(i).

[210] *See id.* § 161.055.

requirements, numbers 20 and 33(b), that relate to beach compatibility of proposed beach fill.[211]

Permit requirement number 20, as enumerated in the JCP application form, requires that the JCP applicant include detailed information about any proposed excavation or fill activities.[212] The information required by the permit includes: (1) core boring logs,[213] (2) sand grain size and color analysis of both the existing and proposed sediment through the use of gradation curves[214] and Munsell color analysis,[215] (3) carbonate content of the existing and proposed sediment,[216] and (4) a sediment Quality Assurance/Quality Control plan.[217] The purpose of the Quality Assurance/Quality Control plan is "[to] ensure that the sediment to be used for beach restoration or nourishment will meet the standards set forth in paragraph 62B-41.007(2)(j), F.A.C."[218] Furthermore, 62B-41.007(2)(j) mandates that only "beach compatible fill shall be placed on the beach or in any associated dune system"[219] and defines beach compatible fill as "material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system."[220] Paragraph 62B-41.007 further restricts the proposed beach fill by limiting the amount of fine and coarse sediments allowable in proposed sediment.[221]

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[211] Fla. Dept. Envtl. Prot., *Joint Application for Joint Coastal Permit* (Mar. 2007), http://www.dep.state.fl.us/beaches/data/pdf/jntpmtap.pdf [hereinafter Fla. Dept. Envtl. Prot., *Joint Application*].

[212] Fla. Dept. Envtl. Prot., *Joint Application for Joint Coastal Permit* (Mar. 2007), http://www.dep.state.fl.us/beaches/data/pdf/jntpmtap.pdf [hereinafter Fla. Dept. Envtl. Prot., *Joint Application*].

[213] TEX. DEPT. TRANSP., GEOTECHNICAL MANUAL (Aug. 2006), http://onlinemanuals.txdot.gov/txdotmanuals/geo/geo.pdf.

[214] *See generally id.* (Core boring logs are used to describe local soil conditions such as material type, density, color, and moisture content.).

[215] MACBETH DIV. OF KOLLMORGEN CORP., MUNSELL SOIL COLOR CHARTS (1975 ed.) (Munsell color is a measurement used to relate different soils by color.).

[216] E.H. Kennair & L.B. Railsback, *Beach and Shoreline Sands from Around the World*, (Dept. of Geology, Univ. Ga. 2004), *available at* http://www.gly.uga.edu/railsback/sands/sandstitle.html (Carbonate content, which is the amount of calcium carbonate in sand, varies from beach to beach.).

[217] *See* Fla. Dept. Envtl. Prot., *Joint Application*, *supra* note 211.

[218] *Id.* at 6 of 9.

[219] FLA. ADMIN. CODE. ANN. r. 62B-41.007(2)(j) (2010).

[220] *Id.*

[221] *Id.*

Permit requirement number 36 requires that the applicant include an analysis of potential effects of the proposed activity to the coastal system.[222] As part of that analysis, permit requirement number 36(b) requires the applicant to quantify the compatibility of the proposed fill with the native beach sediment.[223] The analysis should include "superimposed graphs of the cumulative grain-size distribution . . . of the fill material over the data for the existing or native sediment."[224] By providing the gradation curves of the proposed and native sediment, the applicant provides FDEP with a "widely accepted standard of reference" to determine grain size compatibility of the proposed and native sediments.[225]

Through the permitting process and application of JCP permit requirement numbers 20 and 36, FDEP can review a JCP permit and ensure that the proposed beach fill will be compatible with the native beach.[226] In the event that FDEP finds that the sand is not compatible, FDEP can send a Request for Additional Information to the applicant "identifying errors, omissions or clarifications in the application information that must be provided by the applicant."[227] If the applicant does not remedy the problems listed in the Request for Additional Information, FDEP can issue a notice of denial.[228] Otherwise, FDEP can file a "notice to proceed" and allow the proposed activity to commence.[229] With the issuance of a permit, FDEP can also mandate "additional permit conditions based on site specific circumstances to insure compliance with the provisions."[230]

Included in the additional permit conditions could be a requirement to till the beach after beach construction.[231] If there is a concern with the compaction of the nourished beach, the applicant can use beach tilling to

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[222] Fla. Dept. Envtl. Prot., *Joint Application*, *supra* note 211, at 6 of 9.
[223] *See id.*
[224] *Id.* at 7 of 9.
[225] *See* U.S. ARMY CORPS OF ENG'RS, *supra* note 71, at 4-28.
[226] *See* FLA. ADMIN. CODE. ANN. r. 62B-49.005 (2010).
[227] *Id.* r. 62B-49.002(14)..
[228] *See id.* r. 62B-49.005.
[229] *Id.* r. 62B-49.002(11).
[230] *Id.* r. 62B-49.013(2).
[231] Fla. Dept. Envtl. Prot., Emergency Permit for Construction or Other Activities Pursuant to Section 161.053, Florida Statutes, Permit No. PB-875 M1 E, (May 2007), http://www.dep.state.fl.us/beaches/publications/pdf/emergency/WaterGladeDunesTowers SeagrapePB-875M1_EFO.pdf [hereinafter Fla. Dept. Envtl. Prot., Emergency Permit].

fluff and soften the newly placed sand.[232] Beach tilling should be conducted so that the sand is softened to a depth of approximately three feet, ensuring the sand is softened for an adequate nesting depth.[233]The permit may require interaction with the USACE in order to determine both effectives and frequency required for the beach tilling.[234] A recent permit condition for an emergency permit, number PB-875 M1 E, given by FDEP for a beach nourishment project, mandated a beach compaction monitoring plan.[235] The applicant was required to conduct sand compaction testing after the initial nourishment and continue the testing plan for an additional three years prior to each turtle nesting season.[236] If the compaction is above a prescribed threshold, consultation with Florida Fish and Wildlife Conservation Commission (FFWCC) is required to determine if beach tilling is necessary.[237] The applicant was additionally required to provide an annual report on the beach compaction monitoring program which would be reviewed annually by FFWCC and subsequently amended by FFWCC if necessary.[238]

Another permit condition in PB-875 M1 E required the monitoring for and removal of beach scarps.[239] The permit required the applicant to conduct surveys for beach scarps and document the results after the completion of the project and for an additional three years prior to each turtle nesting season.[240] If beach scarps were found exceeding 18 inches in height over a continual distance of 100 feet, the escarpment location was documented and leveled utilizing a method authorized by FFWCC.[241] Additionally, the applicant must conduct weekly surveys during turtle nesting season and contact FFWCC if beach scarps have formed during the season.[242]

The JCP permit application specifically refers to construction and construction methods in three different permit requirements.[243] Permit

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[232] *See* GREEN TURTLE REPORT, *supra* note 56.
[233] *Id.*
[234] *Id.*
[235] *See* Fla. Dept. Envtl. Prot., Emergency Permit, *supra* note 231.
[236] *See* Fla. Dept. Envtl. Prot., Emergency Permit, *supra* note 231.
[237] *Id.*
[238] *Id.*
[239] *Id.*
[240] *Id.*
[241] *See id.*
[242] *See* Fla. Dept. Envtl. Prot., Emergency Permit, *supra* note 231.
[243] *See* Fla. Dept. Envtl. Prot., *Joint Application*, *supra* note 211.

requirement number 35 requires that the applicant report proposed methods to protect endangered species during construction.[244] These proposed methods will then be reviewed by FDEP and are forwarded to the FWS.[245] The FWS reviews the proposed methods for protecting endangered species before drafting a biological opinion about the proposed project, which is required before issuance of a JCP.[246] Permit requirement numbers 23(c) and 26 require that the applicant enclose proposed construction techniques and the anticipated construction schedule.[247] Included under permit requirements 23(c) and 26, FDEP, through the recommendation of FWS, required "hourly nighttime beach patrols during the entire nesting season."[248] Additionally, in an issued beach nourishment permit, Permit No. 0192068-001-JCC, FDEP listed numerous requirements associated with the construction of the beach nourishment project during turtle nesting season.[249] FDEP required the applicant to conduct daily sea turtle nesting surveys of the project area and adjacent beaches prior to the start of each construction day.[250] In the event the applicant found a sea turtle nest located within the active construction area, the turtle nest was required to be relocated in a suitable location that enhances hatchling success.[251] Sea turtle nest relocation must be completed by a FWS permitted agent responsible for nest relocation.[252] The relocated nests, along with any new sea turtle nests located on the finished sections of the constructed beach, are marked with survey tape to prevent interference with the nests until hatchling emergence.[253] In addition to the relocated nest requirements, nighttime

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[244] *See id.* at 8 of 9.
[245] *See id.*
[246] *See id.* at 7 of 9.
[247] *See id.* at 5-6 of 9.
[248] Am. Littoral Soc'y v. Herndon, 720 F. Supp. 942, 945 (S.D. Fla. 1988).
[249] Fla. Dept. Envtl. Prot., Consolidated Joint Coastal Permit and Intent to Grant Sovereign Submerged Lands Authorization, Permit No. 0192068-00 I-JC, (Nov. 2008), http://bcs.dep.state.fl.us/envprmt/palm_bch/issued/0192068_Central_Boca_Raton_Beach_Nourishment_Project/001-JC/Final%20Order%20%2811-0303%29/Final%20Order%20%2811-03-03%29.pdf [hereinafter Fla. Dept. Envtl. Prot., Permit No. 0192068-00].
[250] *Id.*
[251] *Id.*
[252] *Id.*
[253] *Id.*

storage of equipment on the beach is forbidden during the nesting season so that nesting turtles will not be impacted.[254]

FWS also mandated turtle monitoring plan documentation procedures when beach nourishment projects are conducted on sea turtle nesting beaches.[255] In Permit No. 0164713-001-JC, FWS required the applicant to provide sea turtle monitoring reports documenting sea turtle nesting activity on the constructed and adjacent beaches.[256] The applicant was required to conduct the turtle nest monitoring plan that was approved by FWS for a minimum of three seasons after the beach nourishment project was complete.[257] The monitoring reports were required to include the amount of false crawls, lost nests, and the nesting success including emergence and hatchling survival.[258]

VII. REEMERGENCE OF SEA TURTLES NESTING NUMBERS AT RESTORED BEACHES IN FLORIDA

The permit conditions that FDEP has utilized over the years have demonstrated that beach nourishment projects can be beneficial to sea turtle nesting.[259] The City of Boca Raton, Florida submitted a permit for a beach nourishment project in response to beach erosion which destroyed "the City's former self-releasing [turtle] hatchery."[260] The permit was contested by several groups and ultimately ended up in court when plaintiff environmental groups sought a preliminary and permanent injunction to stop the issuance of the permit.[261] The United States District Court for the Southern District of Florida held that the proposed "beach nourishment restoration project has been reviewed thoroughly—not just by federal agencies, but by state agencies . . . [and any issues] have been fully addressed and dispelled."[262] Hence, the project was allowed to move forward to construction.[263] When the court rendered its opinion, the

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[254] *Id.*

[255] Fla. Dept. Envtl. Prot., Permit No. 0192068-00, *supra* note 249.

[256] *Id.*

[257] *Id.*

[258] *Id.* at 13 of 19 (Table 1).

[259] *See generally supra* note 248; Pinellas County, *Environmental Management |Coastal Management | Impacts*, (last visited Oct. 17, 2010), http://www.pinellascounty.org/Environment/pageshtml/coastalMngmt/sandKeyRnourish/cm150.html.

[260] *Am. Littoral Soc'y*, 720 F. Supp. at 945.

[261] *Id.*

[262] *Id.* at 954-55.

[263] *Id.*

bench noted that the City of Boca Raton ran a sea turtle preservation program that "has received both state and national recognition," and that Florida "has used the City's program as a model for other Florida cities."[264] The court also cited to a previous beach nourishment project that the City of Boca Raton conducted in 1986.[265] A year after the project, it was found that the "overall nesting success rate . . . increased from 37% in 1985 to 54.2% in 1987."[266] In support of Boca Raton's proposed beach nourishment project, the court noted that, considering the observed success of restoring sea turtle nesting from the 1986 beach nourishment project, "the pattern of beach erosion as well as the resulting higher percentage of relocated turtle nests annually indicates any delay would disserve the public interest."[267]

Pinellas County, Florida conducted five beach nourishment projects between 1988 and 2005, covering approximately 25 miles of beach and involving 6.25 million cubic yards of sand.[268] Each project was permitted by FDEP and thus went through an extensive review before the permit was approved.[269] Additionally, for the 2005 beach nourishment project, Pinellas County teamed with the Clearwater Marine Aquarium to ensure sea turtle nesting success.[270] Beach nourishment projects have increased the number of nesting turtles throughout Pinellas County by creating a dry nesting beach.[271] In fact, the sea turtle nesting numbers along the beaches of Pinellas County have "steadily increased from 77 in 1993 to 195 in 2003."[272] Pinellas County has additionally observed that as a result of the longshore sediment transport, the nourishment projects

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[264] *Id.* at 946.
[265] *Id.*
[266] *Am. Littoral Soc'y*, 720 F. Supp. at 948.
[267] *Id.* at 955.
[268] *See* Pinellas County, *Environmental Management |Coastal Management | History*, (last visited Oct. 17, 2010), http://www.pinellascounty.org/Environment/pageshtml/coastalMngmt/sandKeyRnourish/cm140 [hereinafter *Pinellas Nourishment History*]; *see also* Pinellas County, *Environmental Management |Coastal Management | FAQ's*, (last visited Oct. 17, 2010), http://www.pinellascounty.org/Environment/pageshtml/coastalMngmt/sandKeyRnourish/cm160.
[269] *Pinellas Nourishment History*, *supra* note 268.
[270] *Id.*
[271] *Id.*
[272] *Id.*

benefit down drift beaches with an influx of sand, which leads to an increase in turtle nesting on those downdrift beaches.[273]

Brevard County Shore Protection Project is another beach nourishment project that demonstrated sea turtle nesting recovery after beach nourishment.[274] The project was conducted in two phases and restored approximately 13.2 miles of beach along Brevard County, Florida.[275] As part of the state-required, post-construction monitoring plan, Brevard County contracted with the University of Central Florida's Marine Turtle Research Group (MTRG) to monitor sea turtle nesting success.[276] To submit a complete opinion on the effects of the beach nourishment project on sea turtles, MTRG "monitored three key indicators of sea turtle nesting beach success: overall nest production; nesting success (ratio of nests laid to number of false crawls); and reproductive or hatching success (percentage of eggs hatching and producing hatchlings that emerge)."[277] After collecting all of the data, MTRG found that turtle nesting success rates were below normal during the beach construction, but returned to normal in 2003.[278] The monitoring report concluded "that the relatively high hatching success rates demonstrate that good quality sand and beach construction has resulted in normal to high success rates for marine turtle egg incubation."[279]

VIII. CONCLUSION

Beach erosion cannot continue unchecked unless the United States is willing to lose its sea turtle population to extinction. While there are several methods discussed above that can potentially address coastal erosion, beach nourishment is the most reasonable alternative because it creates new nesting habitats by building beaches. Additionally, if beach

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[273] *Id.*

[274] *See generally* Gary Appelson, *Beach Nourishment and Turtles - Can They Get Along?*, (Sea Turtle Conservancy, 2004), (last visited Oct. 17, 2010), http://www.conserveturtles.org/velador.php?page=velart50.

[275] *Id.*

[276] *Id.*

[277] *Id.*

[278] *See generally* Gary Appelson, *Beach Nourishment and Turtles - Can They Get Along?*, (Sea Turtle Conservancy, 2004), (last visited Oct. 17, 2010), http://www.conserveturtles.org/velador.php?page=velart50.

[279] *See generally* Gary Appelson, *Beach Nourishment and Turtles - Can They Get Along?*, (Sea Turtle Conservancy, 2004), (last visited Oct. 17, 2010), http://www.conserveturtles.org/velador.php?page=velart50.

nourishment projects are conducted using a strict regulatory permitting process, the projects can be constructed properly, ensuring that the newly constructed beaches meet specifications that can enhance sea turtle nesting success. To ensure sea turtle nesting success throughout the United States, all coastal states should look to Florida's JCP regulatory program as a guideline.