Plugs to Pull: Proposals for Facing High Great Lakes Water Levels

The Great Lakes are living up to their name. The media,[1] congressional subcommittees,[2] and scores of Great Lakes property owners are clamoring for relief from Lake levels exceeding all records kept since 1860.[3] With water levels ranging from one to three feet higher than normal,[4] damages caused by high water flooding and erosion of the Great Lakes shoreline are estimated at over one billion dollars.[5] And more is yet to come. The United States Geological Survey has determined that Lake levels were once much higher than present,[6] leading others to predict that Lake levels may eventually be three to ten feet higher than current levels.[7]

A long-term solution must be found to help Great Lakes residents cope with high water levels. This comment will discuss the cyclical water levels of the Great Lakes, the recent high water levels, and the current governmental regulatory efforts to: 1) de-

1. *See* Lyon, *High Time*, The Chicago Tribune, Oct. 4, 1987 (Magazine), at 12; Cobb, *The Great Lakes' Troubled Waters*, NAT'L GEOGRAPHIC, July 1987, at 2; Hitt & Miller, *Great Lakes Set Record High Water Levels*, 1985 NAT'L WATER SUMMARY 35; *One Year Later: Flood Victims Rebuilding*, NAT. RESOURCES REG., Oct. 1987, at 5; *National Treasure Being Destroyed*, 2 INT'L GREAT LAKES COALITION NEWS, Fall-Winter 1986, at 1; Green, *Coping With Lake Michigan's Rising Water Level*, ILLINOIS ISSUES, Nov. 1986, at 14; Aron, *The South Shore Coalition: Making Much Ado About High Water Levels*, Evening Observer, Mar. 13, 1987, at 20; *Rising Lake Erie Alarms Beachfront Residents*, N.Y. Times, Nov. 30, 1986, at 48; Linstedt, *Storms, Strife Can't Drown Spirit of Lakeside Community*, Buffalo News, Nov. 30, 1986, § D, at 1; Saari, *When Lake Superior Knocks on the Door*, LAKE SUPERIOR MAG., Mar.-Apr. 1987, at 22.

2. *Great Lakes Coastal Issues: Hearings Before the Subcomm. on Oceanography of the House Comm. on Merchant Marine and Fisheries*, 100th Cong., 1st Sess. (in press); *High Water Levels of the Great Lakes: Hearings Before the Subcomm. on Water Resources of the House Comm. on Public Works and Transportation*, 100th Cong., 1st Sess. (1987) [hereinafter *Great Lakes Hearings*].

3. Cobb, *supra* note 1, at 4.

4. *Great Lakes: Too Much of a Good Thing*, 1987 NAT. WILDLIFE FED'N CONSERVATION 3.

5. *Public Property Damage Exceeds $1.5 Billion*, INT'L GREAT LAKES COALITION NEWS, Summer 1987, at 7.

6. Larsen, *Long-Term Trends in Lake Michigan Levels: A View From the Geological Record*, PROC. 1ST IND. DUNES RES. CONF. (in press).

7. Rowe, *Man vs. Nature: What Can Be Done About Record Great Lakes Levels*, MICH. OUT-OF-DOORS, Apr. 1987, at 36.

crease Lake levels; 2) provide relief to those property owners who have suffered damage caused by high Lake levels; and 3) help prevent future damage to the Great Lakes shoreline. It concludes by describing proposals, including new federal legislation, which could further resolve these issues.

I.
AN INTRODUCTION TO THE GREAT LAKES

The five Great Lakes—Superior, Michigan, Huron, Erie and Ontario—form the largest freshwater chain of lakes in the world.[8] They contain over eighteen percent of the world's fresh surface water[9] and over ninety-five percent of that of the United States.[10] Over 30 million Americans and eight million Canadians living along 11,200 miles of shoreline call the Great Lakes area home.[11]

Once described as a series of "dog bowls" draining down one into another,[12] the Great Lakes flow south and east from Lake Superior, the largest, deepest and highest in elevation of the Lakes, through the narrow St. Mary's River into Lake Huron.[13] Water from Lake Michigan joins Lake Huron at its northern tip via the Straits of Mackinac; these two Lakes are hydrologically considered to be a single lake.[14] Water then flows south and east from Lake Huron through the St. Clair River, Lake St. Clair, and the Detroit River

8. INSTITUTE OF WATER RESEARCH, MICH. STATE UNIV., AN INTRODUCTION TO MICHIGAN'S WATER RESOURCES 29 (1987).

9. U.S. ENVIRONMENTAL PROTECTION AGENCY & ENVIRONMENT CANADA, THE GREAT LAKES: AN ENVIRONMENTAL ATLAS AND RESOURCE BOOK 3 (1987) [hereinafter ENVIRONMENTAL ATLAS].

10. INSTITUTE OF WATER RESEARCH, *supra* note 8, at 29. The Lakes contain six quadrillion gallons of water that could flood the continental United States at a depth of 8 to 10 feet. GREAT LAKES COMM'N, WATER LEVEL CHANGES: FACTORS INFLUENCING THE GREAT LAKES 1 (1986).

11. ENVIRONMENTAL ATLAS, *supra* note 9, at 3; INTERNATIONAL JOINT COMM'N, FURTHER REGULATION OF THE GREAT LAKES 9 (1976). Of the 11,200 total shoreline miles, 1,700 miles are used for recreation, 700 for industrial and commercial purposes, 1600 for agriculture, 2,000 for residential use, and the remainder are forest land or otherwise undeveloped. *Id.*

12. *Great Lakes Hearings*, *supra* note 2, at 144 (testimony of William Romer, Special Assistant to the Commissioner on Great Lakes, New York State Department of State).

13. U.S. ARMY CORPS OF ENG'RS, GREAT LAKES WATER LEVELS, BRIEFING OF SENATORS AND REPRESENTATIVES FROM THE GREAT LAKES BASIN CONDUCTED BY THE INTERNATIONAL JOINT COMM'N 2 (July 19, 1985) [hereinafter BRIEFING]. The elevation above sea level of each of the Great Lakes is: Lake Superior, 600 feet; Lake Michigan, 577 feet; Lake Huron, 577 feet; Lake Erie, 569 feet; and Lake Ontario, 243 feet. ENVIRONMENTAL ATLAS, *supra* note 9, at 4.

14. T.E. CROLEY, UNDERSTANDING RECENT HIGH GREAT LAKES WATER LEVELS 3 (Great Lakes Environmental Research Laboratory Contribution No. 499, 1986).

into the relatively shallow Lake Erie.[15] From Lake Erie, water discharges through the Niagara River, cascading 240 feet over Niagara Falls into Lake Ontario.[16] Finally, water drains from Lake Ontario through the St. Lawrence River, to the Gulf of St. Lawrence, and into the Northern Atlantic.[17]

A. *Great Lakes Water Levels*

As might be expected, water levels in each of the Great Lakes rise or fall according to the amount of water entering into the Lake and the amount leaving it. Water may enter a Lake via precipitation, runoff (including snow melting from the surrounding land area), inflow from connecting channels, and groundwater inflow.[18] Water may leave a Lake through evaporation, consumption, outflow at the Lake outlet, and ground water outflow.[19]

Water level fluctuations are a normal part of the Great Lakes hydrological cycle. Modern records of Lake levels kept from 1860 show that levels plummeted in 1935,[20] climbed to record heights in 1952, fell again in 1964, and peaked again in 1973 and once more in 1985-86.[21] Older geological records indicate that past levels were much higher and more variable than they have been during the twentieth century, and only 300 years ago were significantly higher than they measure today.[22]

The primary reason that Great Lakes water levels vary is that the amount of precipitation falling on the Lakes and their drainage basin also increases or decreases. A single inch of rain falling on the area that drains into Lake Superior will add 114 billion cubic feet of additional water to the Lake.[23] High water levels generally manifest themselves one year after greater-than-average rainfall takes

15. ENVIRONMENTAL ATLAS, *supra* note 9, at 4. The average depths of the Great Lakes are: Lake Superior, 483 feet; Lake Michigan, 279 feet; Lake Huron, 195 feet; Lake Erie, 62 feet; and Lake Ontario, 283 feet. The greatest depth for each Lake is: Lake Superior, 1330 feet; Lake Michigan, 923 feet; Lake Huron, 750 feet; Lake Erie, 210 feet; and Lake Ontario, 802 feet.

16. INSTITUTE FOR WATER RESEARCH, *supra* note 8, at 30.

17. BRIEFING, *supra* note 13, at 2.

18. GREAT LAKES COMM'N, *supra* note 10, at 2. This last factor is thought to be negligible. BRIEFING, *supra* note 13, at 5.

19. BRIEFING, *supra* note 13, at 5.

20. ENVIRONMENTAL ATLAS, *supra* note 9, at 12.

21. BRIEFING, *supra* note 13, at 1, 8.

22. ENVIRONMENT CANADA, LIVING WITH THE GREAT LAKES 7 (quoting Dr. Frank Quinn, Great Lakes Environmental Research Laboratory).

23. *Great Lakes Hearings*, *supra* note 2, at 423 (testimony of Rep. James L. Oberstar).

place in the Great Lakes Basin.[24] Highest water levels occur during periods of abundant precipitation and lower temperatures (which decrease evaporation from the land surrounding the Lakes).[25]

Modern meteorological records show distinct trends in Great Lakes weather patterns. Since 1940, annual rainfall in the Great Lakes Basin increased steadily, with especially heavy precipitation after 1970. Precipitation peaked at an all-time high in 1985.[26] The Great Lakes have also experienced cooler temperatures over the past twenty-five years,[27] which translate into less evaporation of water from land surfaces.[28] The combined effect of increased rainfall and cooler temperatures has been a twelve percent increase in the amount of water pouring into the Lakes.[29]

Human activities also influence the water levels of the Great Lakes. By directing water into or out of the Lakes, water levels can be altered. Fill placed along the banks of the Great Lakes can also displace water or create flow blockages. Conversely, dredging to deepen or maintain channels for shipping can lower Lake levels.

B. *Crisis Water Levels*

In 1973 to 1974, Lakes Michigan and Huron reached record heights, and all the Lakes have been above their long-term averages continuously since.[30] A period of unusually wet and warm weather from December 1984 through March 1985[31] brought rain rather than snow to the Great Lakes Basin. Rain has a faster rate of runoff into the Lakes and thus slows the normal seasonal decline of water levels.[32] By the end of February 1985, most of the melting snow cover in the Great Lakes Basin had saturated the land and emptied

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24. GREAT LAKES COMM'N, *supra* note 10, at 3.

25. BRIEFING, *supra* note 13, at 6, 17. Higher precipitation leads to higher water levels within one year. T.E. CROLEY, *supra* note 14, at 6.

26. *See* ENVIRONMENTAL ATLAS, *supra* note 9, at 12; T.E. CROLEY, *supra* note 14, at 4. One exception to the upward trend was a major drought in the early 1960s, which caused Lake levels to dip to precarious lows.

27. Cobb, *supra* note 1, at 17; BRIEFING, *supra* note 13, at 8; GREAT LAKES COMM'N, *supra* note 10, at 3.

28. GREAT LAKES COMM'N, *supra* note 10, at 4. During a cool, dry month, almost seven inches can evaporate from a Lake's surface. The average annual evaporation lowers Lake levels by as much as 30 inches on Lake Erie and 21 inches on Lake Huron. ENVIRONMENT CANADA, *supra* note 22, at 3 (quoting Dr. Marie Sanderson, the Great Lakes Institute, University of Windsor).

29. GREAT LAKES COMM'N, *supra* note 10, at 4.

30. BRIEFING, *supra* note 13, at 40.

31. *Id.* at 18-21.

32. *Id.* at 18.

into the Lakes.[33]

This weather pattern caused extremely high Lake levels in four of the five Great Lakes. Lake Superior's water level rose to 602.02 feet in November of 1985,[34] nearly two feet above its average of 600.59 feet.[35] Lakes Michigan and Huron had the greatest rise in levels, reaching 581.62 feet in October of 1985.[36] This represents more than a three-foot gain over these Lakes' normal water level of 578.27 feet.[37] Lake Erie, the shallowest of the Lakes, rose to 573.70 feet in June of 1986,[38] greatly above its 570.44 average water depth.[39] Only Lake Ontario failed to reach record levels, peaking at 246.66 feet in June, 1986, 1.26 feet less than its record 247.92 feet limit measured in 1973.[40] However, Lake Ontario's twentieth-century average is 244.71 feet,[41] so its 1986 height still represents a remarkable rise in levels.

C. *Future Great Lakes Water Levels*

The future of Great Lakes water levels is uncertain. Geological records indicate that during the past two centuries, Lake levels have fluctuated to markedly higher (and lower) levels than those calculated during the relatively brief period modern measurements have been taken.[42] One researcher ominously observes that the "historically recorded levels, considered high by modern standards, probably represent a relatively low episode on a naturally fluctuating trend."[43]

Currently, levels are approximately a foot lower than the record-breaking heights reached during the summer of 1987, due mainly to a warm, dry summer.[44] The Lake levels during the summer of 1988 were at average, or decreasing to average levels.[45] However, Lake

33. *Id.* at 21.
34. GREAT LAKES COMM'N, GREAT LAKES MONTHLY AND ANNUAL AVERAGE WATER LEVELS: 1971 TO MID-1987 (1988).
35. Hitt & Miller, *supra* note 1, at 37.
36. GREAT LAKES COMM'N, *supra* note 34.
37. Hitt & Miller, *supra* note 1, at 37.
38. GREAT LAKES COMM'N, *supra* note 34.
39. Hitt & Miller, *supra* note 1, at 37.
40. GREAT LAKES COMM'N, *supra* note 34.
41. Hitt & Miller, *supra* note 1, at 37.
42. Larsen, *supra* note 6.
43. *Id.*
44. Schmidt, *Great Lakes Unpredictable as Weather*, N.Y. Times, Sept. 27, 1987, at 10; *Managing Water and Shorelines: How the Region is Coping*, GREAT LAKES REP., May 1987, at 1.
45. SEA GRANT INSTITUTE, UNIV. OF WISCONSIN—MADISON, LAKE LEVEL UPDATE NO. 26 (Mar. 17, 1989).

levels are still exceeding the twentieth-century average by over a foot, and the threats of flooding and erosion are almost certain to arise again. Based on the recent precipitation and temperature trends, the Army Corps of Engineers believes it likely that high water levels will continue for the next several years.[46] The snowmelt report issued by the National Weather Service for the spring of 1987 documents above average snowfall for the Great Lakes during the fall and winter of 1986-87. Given temperature patterns, 1987 spring runoff was predicted to be above normal, increasing flooding possibilities.[47] The National Weather Service stated that in the spring of 1989 there was potential for heavy runoff in the Northern Great Lakes Basin, minor to moderate runoff in the Central Western Basin, and little potential for runoff in the Lower Basin.[48]

Even if precipitation decreased, resulting in drought conditions, the great size of the Lakes and their limited natural outflows cause extremes in water levels to persist for a long time after the factors causing these extremes have changed.[49] Studies at the Great Lakes Environmental Research Laboratory indicate that it will still take about six years for Lakes Michigan and Huron to return from their January, 1986, height to their normal level. About nine years will be required for Lake Erie to return within two inches of normal.[50] Therefore, it appears that higher Lake levels and the resulting damage will be a feature of the Great Lakes for some time.

D. *Damage Caused by High Water Levels*

Higher water reduces beach area and affects local property tax bases. High water can cover industrial or municipal outfall pipes, flushing wastes back into treatment systems. High water can also submerge fishing piers or docking facilities, expose coastal-sited waste dumps, reduce clearance under bridges, affect fish habitat and spawning grounds, and alter the mix of upland and wetland vegetation. The most damaging aspect of high water is the flooding of shoreline structures and erosion of coastlines. Of the 5000 miles of U.S. Great Lakes shoreline, over 1000 miles are subject to flooding

46. Rowe, *supra* note 7, at 36, 40; T.E. CROLEY, *supra* note 14, at 10.

47. Letter from Dean T. Braatz, Hydrologist, National Weather Service (Feb. 12, 1988) (enclosing General Snowmelt Outlook for the Upper Midwest).

48. Letter from Dean T. Braatz, Hydrologist, National Weather Service (Mar. 24, 1989) (enclosing Spring Flood Outlook).

49. GREAT LAKES COMM'N, *supra* note 10, at 2; BRIEFING, *supra* note 13, at 4.

50. T.E. CROLEY, *supra* note 14, at 9.

and over 500 miles to erosion forces.[51]

Shoreline flooding and erosion is especially acute when wind produces large waves. A few extra inches of wind-whipped water can erode a sloping beach area by several feet.[52] Even where the Great Lakes shoreline is steep, wind-driven waves can undercut stable clay bluffs and sweep fifteen to twenty feet of shore away in a single day.[53]

The 1985-86 water levels caused over $1.5 billion in damage, including damage to sewage treatment and other public service facilities, destruction of roads, loss of wetlands, harm to recreational interests, and erosion of beaches and shoreline.[54] While property owners all along the Great Lakes suffered damage, those along Lake Erie and Lake St. Clair were hardest hit.[55]

Much of the damage to shoreline property can be attributed to intensive shore development that alters protective dunes and wetlands, removes stabilizing vegetation, and generally reduces the ability of the shoreline to withstand the damaging effects of wind and waves. Construction of permanent structures too close to the waterline or on unstable bluffs exacerbates the problem. Summer homes and other structures built at a safe distance during the relatively low-water periods of the 1930s and 1960s are now resting on the very edge of the Lakes.

II.
EXISTING PROGRAMS TO COUNTER HIGH WATER LEVELS

Although some believe that private landowners should be primarily responsible for protecting their property from damage caused by flooding or erosion, most communities recognize that they must frequently act to shield fragile coastlines from harm. This occurs when private landowners do not have the resources to protect their property, when public works or land are threatened, or when it is more effective to manage an area without regard to property lines. When flooding or erosion are too widespread, or when repeated

51. *Great Lakes Hearings*, *supra* note 2, at 101 (statement of Robert Dawson, Assistant Secretary of the Army, Civil Works).

52. Hitt & Miller, *supra* note 1, at 40.

53. *Id.*

54. *Property Damage Exceeds $1.5 Billion*, INT'L GREAT LAKES COALITION NEWS, Summer 1987, at 7.

55. ENVIRONMENT CANADA, *supra* note 22, at 1 (quoting Dr. Frank Quinn, Great Lakes Environmental Research Laboratory).

storms ravage an area, local communities turn to state governments for assistance. If the state lacks the resources to provide sufficient aid to all damaged communities, the state can request aid from the federal government.

Given the devastating effects of the cyclical periods of high water, it is not surprising that the eight Great Lakes States all provide some type of shore protection and flooding assistance. This aid includes geological surveys for use by local governments in developing structural shore protection devices,[56] emergency home moving programs,[57] reduced cost sandbags,[58] and shore erosion or bluff recession site analyses.[59]

Current federal programs provide some aid to the Great Lakes States through the construction of shore protection devices, nonstructural shore protection, personal loans, or relocation assistance. These programs, however, generally concentrate on damage caused by flooding, rather than the severe erosion threatening the Great Lakes shore, and often require the declaration of an official disaster before aid can be administered.[60]

A. *Federal Shore Erosion and Flood Control Projects*

The United States Army Corps of Engineers provides most of the technical erosion and flood control assistance in the Great Lakes area. Though the Corps' authority extends to all areas of the United States, some legislation specifically focuses the expertise and funds of the Corps on alleviation of Great Lakes high water levels.

1. Planning

Congress has enacted at least two specific shoreline erosion planning provisions for the Great Lakes Basin. The most significant of these is found in the Water Resources Development Act of 1986

56. *See* GREAT LAKES COMM'N, GREAT LAKES SHORE EROSION AND FLOODING ASSISTANCE PROGRAMS 7 (1987).

57. *Id.* at 8. Michigan created a temporary program which provided a loan interest subsidy for homeowners not participating in the U.S. Army Corps of Engineers Advanced Measures program. The state provided funds to reduce interest rates three percent for loans to move homes away from eroding bluffs or to elevate homes in flood threatened areas. Under limited circumstances, structural shore protection may be funded. Only loans of $25,000 or less are eligible for the interest buy-down. *Id.*

58. *Id.* (Michigan).

59. *Id.* at 9 (Pennsylvania).

60. Although no specific figures are available, the U.S. allocated more than $45 million for Corps flood-control projects in fiscal year 1988 and only $15 million for erosion control. In addition, the National Flood Insurance Program covers mainly flood damages. *See infra* notes 66-69.

where Congress directed the Corps to examine its current policies in light of the rising water levels of the Great Lakes.[61] The Act requires an assessment of current and predicted shoreline erosion along the Great Lakes, an evaluation of the relationship between erosion and the regulation of outflows from Lakes Superior and Erie, an economic and hydrological analysis of all flows into and out of the Lakes, a summary of the legal and institutional impacts of rising water levels on riparian land owners, and recommendations for new or additional federal involvement in shoreline protection. This study is underway, with a final report due to Congress in November, 1989.[62]

The second provision is the Lake Ontario Protection Act of 1976.[63] Congress directed the Secretary of the Army to develop a plan for shoreline protection along Lake Ontario. All federal agencies with programs affecting Lake Ontario's water level must comport their activities with the plan to minimize Lake Ontario shoreline damage. A draft report focusing on a small portion of the Lake Ontario shore at Clayton, New York, has been prepared, though not officially released.[64] According to the Corps, it is unlikely that other studies will be completed under the Lake Ontario Protection Act of 1976, due to funding problems.[65]

2. Construction

Under the Flood Control Act of 1965,[66] the Secretary of the Army may construct, operate and maintain any water resource development project which may provide flood control or shoreline protection. Individual project cost may not exceed $15 million, and Congress must approve proposals submitted by the Corps. Under related authority,[67] the Corps is also directed to conduct a five-year national shoreline erosion control demonstration program, in which low-cost shoreline protection devices are to be constructed in erosion prone areas. These devices could be demonstrated on public or private lands. For demonstration projects erected on non-federal

61. Pub. L. No. 99-662, Title VII, § 706, 100 Stat. 4158 (1986), *reprinted in* 33 U.S.C. § 426 (Supp. V 1987).

62. *Id.*

63. 33 U.S.C. § 426l (West Supp. 1989).

64. Telephone interview with Tim Daly, U.S. Army Corps of Engineers, Buffalo District (May 15, 1989).

65. *Id.*

66. 42 U.S.C. § 1962d-5 (1982 & Supp. V 1987).

67. Shoreline Erosion Control Demonstration Act of 1974, Pub. L. No. 93-251, Title I, § 54, 88 Stat. 26, *reprinted in* 42 U.S.C. § 1962d-5 (1982).

lands, the beneficiaries will bear twenty-five percent of the construction costs, as well as all operation and maintenance costs.[68]

Under its authority to control flooding and flood damage, the Corps may spend up to $5 million without congressional approval to construct small projects on a cost-shared basis.[69] Under section 14 of the Flood Control Act of 1946,[70] the Corps implements its Emergency Shoreline Erosion Protection Program, providing assistance for the protection from erosion damage of highways, bridge approaches, public works, churches, hospitals, schools and other nonprofit public services.[71] The federal government pays seventy-five percent of the program's cost. A federal limit of $500,000 per project applies, and like all projects under the Flood Control Act, the Corps conducts a stringent cost-benefit analysis before determining the feasibility of the project.[72]

The Corps also began a Self Help Program in 1986, in which both technical advice and materials such as sandbags and plastic sheeting are provided to communities free of charge for temporary flood protection.[73] By mid-1987, the Corps had distributed over five million

68. The Corps completed two demonstration projects on the shores of the Great Lakes under this authority: a $550,000 revetment/bluff stabilization proposal at Port Wing, Wisconsin; and a $78,000 breakwater/revegetation project at Geneva State Park, near Ashtabula, Ohio. U.S. ARMY CORPS OF ENGINEERS, LOW-COST SHORE PROTECTION: FINAL REPORT 457-502 (1981). Of the total $630,000 spent on these two projects, only 3000 feet of shore was protected. *Id.* at 457, 480. The Corps may also erect structures or provide sand to replenish beaches to protect publicly-owned land from erosion or flooding. 33 U.S.C. § 426e-426h (1982 & Supp. V 1987). Because only 20 percent of the Great Lakes shoreline is publicly owned, this program has limited application to the Great Lakes States. In fiscal year 1988, Congress approved two erosion or flood control projects in the Great Lakes, both in Pennsylvania. Pub. L. No. 100-202, 101 Stat. 1329 (1987); H.R. REP. No. 498, 100th Cong., 1st Sess. 716 (1987). Federal funds may not be used to maintain these structures, and Congress must specifically approve any projects. Costs must be shared by the benefiting state or municipality, at percentages ranging from zero (for federally-owned property) to 50 percent (for privately owned property whose protection will result in public benefits). *Water Resource Policies and Authorities: Federal Participation*, in Shore, *Hurricane, Tidal and Lake Flood Protection*, 33 C.F.R. § 282, Table 1 (1988). Privately owned land that is threatened by erosion can benefit from this program if the land is used for public purposes or if the protection of nearby lands requires extending assistance to the private area. 33 U.S.C. § 426e(d) (1982).

69. 33 U.S.C. § 701s (1982 & Supp. V 1987). This is also called the section 205 program. It received $33.535 million in fiscal year 1988. Pub. L. No. 100-202, 101 Stat. 1329 (1987); H.R. REP. No. 498, 100th Cong., 1st Sess. 718 (1987).

70. 33 U.S.C. § 701r (Supp. V 1987).

71. The section 14 program was allocated $9 million for fiscal year 1988. Pub. L. No. 100-202, 101 Stat. 1329 (1987); H.R. REP. No. 498, 100th Cong., 1st Sess. 718 (1987).

72. 33 U.S.C. § 701r (Supp. V 1987).

73. 33 U.S.C. § 701n(a) (Supp. V 1987).

sandbags, 30,000 cubic yards of sand, and over 200,000 feet of plastic to 113 Great Lakes local governments.[74]

In 1985, at the request of the governors of Michigan and Ohio, the Corps instituted its Advanced Measures Program, providing federal funds to repair any flood control work threatened or destroyed by flood waters.[75] Using monies from the Flood Control and Coastal Emergencies Fund, the Corps may also provide federally authorized shore protection devices if necessary to guard against imminent loss of life and property. The Corps may repair any federally-authorized shoreline protection structure damaged or destroyed by extraordinary wave, wind or water action.

Under the Advanced Measures Program, the Corps received over 185 proposals from Michigan, Ohio, New York, Minnesota, Illinois, and Wisconsin. Only sixteen projects were approved, mainly due to lack of support by local communities, unfavorable cost-benefit ratios, and claims for erosion damage rather than flood damage. As of August 1987, eight projects have been completed at a total cost of $5.81 million; it is estimated that this investment prevented over $28.83 million in additional flood damage along the Great Lakes coast.[76]

The cost-benefit analysis conducted for all flood control works has been the bane of many local communities, who find they cannot qualify for project assistance. The Corps' policy, as outlined in its regulations,[77] is to undertake erosion and flood prevention projects only when those projects "best serve the public interest."[78] In maximizing the "public interest," a cost-benefit analysis balances environmental concerns and national economic development, taking into account whether the property to be protected is private or public. The "public use" factor is relevant only to the "benefits" side of the equation for shore erosion control proposals. The Corps has concluded that projects which would enhance the recreational aspects of property not open for public use are not public benefits, and therefore not eligible for federal funds. In addition, when evaluating the economic benefits to a community, the Corps does not consider benefits to agricultural uses, transportation routes or public

74. The federal bill for this program was $4.3 million in fiscal year 1987. U.S. ARMY CORPS OF ENG'RS, FACT SHEET, GREAT LAKES ADVANCED MEASURES 2 (Aug. 4, 1987).

75. Pub. L. No. 99-662, Title IV, § 917, 100 Stat. 4192 (1986).

76. U.S. ARMY CORPS OF ENG'RS, *supra* note 74, at 1.

77. 33 C.F.R. § 282 (1988).

78. *Id.* § 282.6.

infrastructure.[79]

State and local government officials petitioned Congress to curb or eliminate these limitations, which remove much of the property along the Great Lakes shore from the scope of federal programs.[80] Recently, Senator Howard M. Metzenbaum of Ohio succeeded in passing legislation which expands the scope of projects eligible for protection under the Advanced Measures Program. Under the Senator's legislation, the Corps must balance the estimated costs of a proposed flood control project against not only a project's economic contributions to the environment and national development, but also the more narrow benefits to homes, commercial establishments, and agricultural interests.[81] Therefore, flood control structures which protect farmland or small businesses may now influence a cost-benefit ratio favorably and receive the Corps' approval for construction.

Environmental laws must also be satisfied before seawalls, groins or jetties can be constructed along the shores in local communities. The Corps must obtain a water quality certification from the appropriate state under section 401 of the Clean Water Act before building any shoreline protective structure.[82] For those states with coastal zone management programs,[83] the Corps must also make a determination that the protective structure is consistent to the maximum extent practical with the state coastal program.[84]

In addition, if the Corps or another federal agency does not construct the protective device itself but disburses federal funds to a private contractor, the contractor must obtain from the Corps permits under section 10 of the Rivers and Harbors Act[85] and section 404 of the Clean Water Act.[86] For those states with federally approved coastal zone management programs, the applicant must certify that the project to be constructed is consistent with the coastal management program under section 307(c)(3) of the Coastal Zone Management Act of 1972.[87] The state may object to this certifica-

79. *Great Lakes Hearings*, *supra* note 2, at 181 (testimony of Thomas D. Martin, Director, Michigan Office of the Great Lakes).

80. *Id.*

81. Farm Disaster Assistance Act of 1987, Pub. L. No. 100-45, § 9, 101 Stat. 323 (1987) (codified at 33 U.S.C. § 701n(2) (Supp. V 1987)).

82. 33 U.S.C. § 1341 (1982).

83. Wisconsin, 43 Fed. Reg. 25,169 (1978); Michigan, 43 Fed. Reg. 51,829 (1978); Pennsylvania, 45 Fed. Reg. 71,640 (1980); New York, 47 Fed. Reg. 47,056 (1982).

84. Coastal Zone Management Act of 1972, 16 U.S.C. §§ 1451, 1455(c)(2) (1982).

85. 33 U.S.C. § 403 (1982).

86. *Id.* § 1344.

87. 16 U.S.C. § 1456(c)(3) (1982).

tion, and no permits may be issued for the project until either the state retracts its objection, or the Secretary of Commerce or a court reverses the state decision.[88] Various other state permits are also required by Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin.[89]

B. *National Flood Insurance Program*

One of the largest federal investments in the Great Lakes shoreline is managed under the National Flood Insurance Program (NFIP), which is administered by the Federal Emergency Management Agency (FEMA). The impetus behind the NFIP was a desire to decrease federal payments for flood relief, provide property owners reasonable protection against the worst floods, and create an incentive for restricting inappropriate development in flood hazard areas.

Created in 1968 by the National Flood Insurance Act,[90] the program provides subsidized insurance for certain properties[91] located within a participating community.[92] A community is "participating" when it agrees to adopt and enforce floodplain management restrictions which guide construction practices in flood-prone areas.[93] Flood-prone areas are identified on flood hazard boundary maps prepared by FEMA, which delineate the Special Flood Hazard Areas.[94] The flood insurance program imposes various monetary limits on the amount of insurance it will provide for a single structure, depending on the type of structure.[95] In the Great Lakes,

88. Eichenberg & Archer, *The Federal Consistency Doctrine: Coastal Zone Management and "New Federalism,"* 14 ECOLOGY L.Q. 9, 33, 46 (1987).

89. GREAT LAKES COMM'N, *supra* note 56, at 3-4.

90. 42 U.S.C. §§ 4001-4128 (1982).

91. These include residences housing less than five families, church property, small businesses and other properties determined eligible by the Director of the National Flood Insurance Program. 42 U.S.C. § 4012(a)-(b).

92. 42 U.S.C. § 4012(c).

93. *Great Lakes Hearings*, *supra* note 2, at 115 (testimony of Donald L. Collins, Assistant Administrator, Federal Insurance Agency); *see also* 42 U.S.C. § 4012(c).

94. An area defined as having a one percent chance of flooding above a certain base level in any given year. J. McShane, Coastal Development and the National Flood Insurance Program: An Update 2 (1988) (unpublished paper, available from FEMA).

95. Single-family houses may be insured for up to $35,000; multi-family dwellings can be insured for up to $100,000. 42 U.S.C. § 4013(b)(1)(A)(i) (1982). This limit may be increased up to $150,000 in certain circumstances. *Id.* § 4013(b)(2). Ten thousand dollars is the insurance limit for personal property. *Id.* § 4013(b)(1)(A)(ii). Small businesses are limited to no more than $100,000 per structure, plus $100,000 for each occupant; this limit includes building contents. *Id.* § 4013(b)(1)(B). These limits can be increased up to $250,000 per structure plus $200,000 per occupant. *Id.* § 4013(b)(4) (1982).

more than 340 communities participate in the NFIP, with property insured for more than $10 billion. Since 1978, more than $107 million has been paid in claims in the Great Lakes area.[96]

1. Erosion and Flood Insurance

As originally passed, the National Flood Insurance Act did not provide insurance coverage for erosion losses.[97] This was changed in 1973, when Congress decreed that payment should be made under the NFIP for losses caused by "erosion or undermining caused by waves or current of water exceeding anticipated cyclical levels."[98]

FEMA has interpreted this provision to exclude "ordinary erosion," based on the Act's legislative history[99] and a colloquy between a sponsor of the 1973 amendment and another Member of the House.[100] FEMA also found in the legislative history a curious benchmark for determining erosion losses along the Great Lakes. FEMA reasoned that because the sponsor of the amendment referred to the record high water levels which occurred in 1973, these levels would be the basis for determining if the Lakes exceeded their

96. Telephone interview with Jim Taylor, National Flood Insurance Program, Federal Emergency Management Agency (Mar. 31, 1988).

97. *See* 24 C.F.R. § 1911.4(c) (1970). The rule was:

> When a sudden surge or force of nature, such as a severe storm, deluge, or hurricane, accelerates the normal wave action or otherwise causes an abnormally rapid and severe inundation and/or sudden washing away of normally dry land areas by water, any structural property damage proximately caused thereby would be covered under the flood insurance policy. However, where normal, continuous wave action, accompanied by ordinary erosion or the gradual and anticipated wearing away of land, is the proximate cause of structural property damage, there is no coverage.

98. *See* 42 U.S.C. § 4121(c) (1982).

99. H.R. REP. No. 359, 93rd Cong., 1st Sess. (1973).

100.[M]r. Young of Illinois. Mr. Chairman would the wording the gentlemen has added to this legislation, particularly the words 'exceeding anticipated cyclical levels', [sic] will that standard be sufficient so that damages which have been caused by the current levels of Lake Michigan be a flood type of situation where loans could be extended under damage caused by that type of flooding?

[M]r. Yates. It is my intention and the intention of this amendment to take care of such situations because the levels of Lake Michigan and the other Great Lakes are much higher than the expected cycles the Army Corps of Engineers had anticipated. The cycles of the levels of the lakes vary from year to year. At the present time they are the highest in the history of the country and have resulted in tremendous damage to the owners of apartments and condominiums and homes in my district along the shore of Lake Michigan. I am told the same situation prevails with respect to homeowners who have their homes on the shores of the other Lakes. It would be the intention to take care of the situation the gentleman just described[.]

119 CONG. REC. H7543 (1973), *reprinted in Great Lakes Hearings, supra* note 2, at 124-25.

"anticipated cyclical levels" for purposes of claim adjustments.[101] FEMA will therefore pay claims for damages to homes on steep bluffs untouched by water, but whose foundations are damaged when the bluffs suffer abnormal, flood-related erosion.[102]

Though this program appears to solve many of the problems for Great Lakes property owners, it does not seem to provide the protection needed against high-water-level erosion. In *Hidenfelter v. Federal Emergency Management Agency*,[103] the plaintiffs unsuccessfully argued that they were entitled to payment under their NFIP policy for damages to their house foundations caused by high-water-level erosion on Lake Michigan between 1968-78.

Despite the court's findings that 1) the water levels during 1968-78 were continuously above the 1900-83 average for the Lake, and 2) the dramatic increase in the rate of erosion of the plaintiffs' property was due in part to high water levels on the Lake between 1969-76, it held that plaintiffs were not entitled to recover under the NFIP. The court reasoned that payment under the National Flood Insurance Act could be made only for erosion caused by flooding. Using evidence presented at trial concerning the normal fluctuations in Lake Michigan's levels, the court concluded that the high water levels from 1969 through 1976 did not constitute a flood, but rather contributed to the type of gradual erosion not intended to be covered by flood insurance. This holding suggests that, despite the intention of the drafters of the 1973 amendment to the National Flood Insurance Act, claimants cannot recover under their NFIP policies unless they can establish that the damage occurred during a short period of time when water levels exceeded the 1973 record heights.

Another insurance program important to the Great Lakes is that outlined in section 1362 of the Flood Insurance Act.[104] Under this program, FEMA will purchase insured property which is damaged substantially beyond repair by a flood.[105] Purchased property is then transferred to the state or local community for use consistent with the risk of future flood or erosion damage. Section 1362 also

101. *Great Lakes Hearings, supra* note 2, at 125.

102. *Id.* at 127.

103. 603 F. Supp. 434 (W.D. Mich. 1985).

104. 42 U.S.C. § 4103 (1982 & Supp. V 1987).

105. *Id.* Property is eligible if it has been significantly damaged three times during the past five years, with repairs equaling or exceeding at least 25 percent of the value of the structure. In addition, if laws or regulations prevent or greatly increase the cost of repair, severely damaged property may be purchased by the National Flood Insurance Program.

authorizes the NFIP to provide loans at a two percent interest rate to property owners for the costs of elevating structures above the flood plain.

In practice, FEMA has not exercised these purchase or loan-making powers very often, mainly due to inadequate funding. FEMA estimated in 1981 that it would need at least $50 million for an effective acquisition program.[106] The most recent appropriation for this program is one-tenth this amount.[107] In the Great Lakes area, FEMA has purchased only a single property in Hamburg, New York, located along Lake Erie, in 1987.[108]

2. The Jones-Upton Amendment

Congress recently amended the Flood Insurance Act to reduce the amount and number of claims made under the program, and to give property owners a choice when their homes or businesses are threatened by imminent collapse or destruction. Previously, property owners had to wait until their insured property was actually destroyed by flooding or erosion before a claim could be filed under their flood insurance policy. Under an amendment authored by Congressmen Walter Jones of North Carolina and Frederick Upton of Michigan, a state may certify that a structure is subject to imminent collapse or subsidence as a result of erosion.[109] At that point, the NFIP may pay up to forty percent of the value of the structure for demolition and removal of its foundation and septic system. Following demolition, the property owner may collect up to an additional seventy percent of the value of the property to cover the expenses of demolition. If a property owner waits until after a structure collapses into the water, only the initial forty percent is available to the property owner. This should encourage property

106. Coast Alliance, Nat'l Wildlife Fed'n & Great Lakes United, National Flood Insurance Program 1 (undated and unpublished position paper).

107. In fiscal year 1988, Congress appropriated $4.531 million for this program. Pub. L. No. 100-202, 100 Stat. 1329 (1987). The House and Senate Appropriations Committees had proposed $4.720 million. H. R. REP. No. 498, 100th Cong., 1st Sess. 854 (1987).

108. *Great Lakes Hearings*, *supra* note 2, at 63-64. In 1986, $286,753 was allocated to acquire 18 parcels of property in Hamburg. Telephone interview with Jim Taylor, National Flood Insurance Program, Federal Emergency Management Agency (Mar. 31, 1988).

109. Housing and Community Development Act of 1987, Pub. L. No. 100-242, § 544, 101 Stat. 1815, 1940 (to be codified at 42 U.S.C. 4013(c)). This amendment originated in a bill introduced by Rep. Upton in early 1987. H.R. 1823, 133 CONG. REC. H1588 (1987).

owners to dispose of their property quickly, before it becomes a coastal hazard or pollution source.

In addition, the Jones-Upton amendment authorizes payment of up to forty percent of the value of the structure in lieu of demolition if the property owner can relocate the structure to a safer area. This option is one which may be readily accepted by homeowners who have emotional ties to their houses. It should also reduce payments under the NFIP, as a lower percentage of the value of the structure will be paid by the Program, and damages to personal property and business inventory are avoided.[110]

The amendment also restricts the reissuance of flood insurance on structures located (or relocated) on any parcels of land certified by a state. To be eligible for future flood insurance, residences accommodating no more than four families must be located behind a setback line determined by calculating the rate of erosion for thirty years.[111] Larger structures must be placed behind a sixty-year erosion setback line. This restriction should prevent future insurance claims by locating development away from areas prone to erosion and flood, at least until December 1989, when the Jones-Upton amendment "sunsets."[112] Only three states bordering the Great Lakes now impose setbacks in erosion or flood hazard areas;[113] perhaps this legislation will encourage similar land use controls in other Great Lakes States.

C. *Federal Disaster Assistance*

Disaster relief programs provide another source of federal assistance with potential application to the Great Lakes high water levels. Generally, before federal aid can be provided, the governor of an affected state must request that the president declare an area or areas of the state major disaster areas under Public Law 93-288.[114] This is done through the Federal Emergency Management

110. D. Ashe, Shoring Up the American Dream: Amendments to the National Flood Insurance Program 3 (1988) (unpublished paper) (available from L. Pittman).

111. Housing and Community Development Act of 1987, Pub. L. No. 100-242, § 544(5), 101 Stat. 1815, 1941.

112. *Id.* § 544(7). Although FEMA is developing regulations to implement the new program, an interim program is being devised. Payment may be made for structures subject to "imminent danger of collapse," a term interpreted loosely to include buildings that are likely to be inundated with water or sufficiently undermined to fall into the water within three years. J. McShane, *supra* note 94, at 6-7.

113. Telephone interview with John Houlahan, Coastal Program Specialist, National Oceanic and Atmospheric Administration (Feb. 29, 1988).

114. *See* 42 U.S.C. § 5141(b) (1982).

Agency.[115] FEMA reviews the governor's request and conducts a site visit. Damage assessments are made based primarily on costs for temporary housing, repairing public facilities, and restoring the area. FEMA examines the financial resources of the damaged local communities and state government to see if federal funds are needed. If FEMA judges the damage to be severe and the local needs unmet, it will forward a recommendation to the president to sign a Disaster Declaration.[116] As a condition of receiving federal disaster aid, the state must develop a hazard mitigation plan within six months of the Disaster Declaration.[117]

Before the president signs the declaration, the U.S. Army Corps of Engineers is authorized to provide interim flood and coastal storm emergency relief within ten days of the governor's request for disaster relief.[118] The actions taken by the Corps must be essential to the preservation of life and/or property, and may include channel clearance, emergency shore protection, removal of debris endangering public health and safety, and temporary restoration of essential public facilities and services.

1. The Federal Emergency Management Agency

After the president issues a Disaster Declaration, areas identified in the document are eligible for federal assistance for both flooding and erosion damages. The primary provider of aid is FEMA, acting through its Disaster Assistance Program. States, local governments and non-profit organizations may use federal dollars to clear debris, erect emergency shoreline protection devices, and repair public facilities.[119] Cost sharing is required at a seventy-five percent federal to twenty-five percent nonfederal ratio.[120] Local governments may also receive loans if they have lost their tax base because of the disaster.[121] Individuals may receive temporary housing,[122] unemployment compensation,[123] grants of up to $5,000 to meet disaster-

115. Exec. Order No. 12,148, 44 Fed. Reg. 43,239 (1979), *reprinted in* 50 U.S.C. app. at 467 (1982).

116. GREAT LAKES COMM'N, *supra* note 56, at 5.

117. *Id.* at 6.

118. 33 U.S.C. § 701n (1982 & Supp. V 1987).

119. 42 U.S.C. §§ 5172-5173 (1982).

120. FEDERAL EMERGENCY MANAGEMENT AGENCY, A GUIDE TO FEDERAL AID IN DISASTERS 10 (Mar. 17, 1987).

121. 42 U.S.C. § 5184 (1982).

122. *Id.* § 5174.

123. *Id.* § 5177.

related expenses,[124] relocation assistance,[125] legal services for low-income families,[126] food stamps,[127] crisis counseling,[128] and loans to businesses (including farmers) for repair or replacement of uninsured property and some production losses.[129] FEMA also uses representatives from appropriate federal and state agencies to make field investigations and identify methods to prevent future damages. These recommendations often form the basis for the state hazard mitigation plan required by the Disaster Declaration.[130]

2. Miscellaneous Relief

The Small Business Administration provides loans to individuals or small businesses in declared disaster areas.[131] Farmers whose land has been damaged by flooding or erosion connected with a natural disaster can obtain assistance through the Emergency Conservation Program,[132] the Soil Conservation Service,[133] or the Farmers' Home Administration.[134] The Department of Education may offer funds to repair and operate damaged elementary and secondary public schools.[135] The American National Red Cross also provides grants and other types of emergency assistance, including shelter, first aid, food, minor home repairs, and occupational supplies under a Federal Charter.[136]

Despite the $1.5 billion in damages suffered by the Great Lakes during 1985-86, no governor requested the declaration of a major disaster. The Governor of Wisconsin requested an emergency declaration because of coastal erosion in fifteen counties, but was denied assistance by FEMA on cost-benefit grounds.[137] FEMA also argued that the type of relief needed—massive shoreline protection structures—was beyond the scope of the Disaster Relief Program and would require special legislation.

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124. 42 U.S.C.A. § 5178 (West Supp. 1989).
125. 42 U.S.C. § 5181 (1982).
126. *Id.* § 5182.
127. *Id.* § 5179.
128. *Id.* § 5183.
129. FEDERAL EMERGENCY MANAGEMENT AGENCY, *supra* note 120, at 7-8.
130. GREAT LAKES COMM'N, *supra* note 56, at 6.
131. 15 U.S.C. § 636 (1982 & Supp. V 1987).
132. 16 U.S.C. §§ 2201-2205 (1982).
133. *Id.* §§ 1001-1008 (1982 & Supp. V 1987).
134. *Great Lakes Hearings*, *supra* note 2, at 97.
135. FEDERAL EMERGENCY MANAGEMENT AGENCY, *supra* note 120, at 10.
136. Pub. L. No. 58-4, 33 Stat. 599-600 (1905).
137. *Great Lakes Hearings*, *supra* note 2, at 130; telephone interview with Kevin Clark, Federal Emergency Management Agency (Mar. 31, 1988).

D. *Federally Protected Areas*

Another method of avoiding damage from erosion or flooding is by acquiring shoreline property for open space or recreational use. This limits the number of permanent structures which could later be washed away by encroaching Lake waters. In the Great Lakes area, the federal government, through the National Park Service, has established five reserves where extensive shoreline development is prohibited.[138]

In addition, the Fish and Wildlife Service of the Department of the Interior manages nine wildlife refuges along the banks of the Great Lakes, providing wildlife habitat and recreational opportunities for area residents, while shielding these areas from development and additional damages.[139]

III.

PROPOSALS FOR FACING HIGH WATER LEVELS

After watching beaches wash away and shore structures become submerged, coastal property owners and other groups naturally find higher water levels in the Great Lakes an anathema. Environmentalists are concerned about the loss of wetlands which could affect the Great Lakes fishery. In addition, they are concerned that hazardous waste sites may poison the water if placed too close to flooding or erosion areas. Municipalities and industries are finding that they must create new outfalls for effluent discharges. Fishing piers

138. The largest of these is the Pictured Rocks National Lakeshore, stretching 40 miles along the upper peninsula of Michigan on the shore of Lake Superior. NATIONAL PARK SERVICE, NATIONAL PARKS IN THE MIDWEST (undated pamphlet). This park is located in an area of moderate erosion, near Grand Isle, Michigan. ENVIRONMENTAL ATLAS, *supra* note 9, at 19. Also in Michigan is Isle Royale National Park, an island wilderness in Lake Superior. NATIONAL PARK SERVICE, *supra*. Sleeping Bear Dunes National Lakeshore is located in Benzie and Leelanau counties in Michigan, 16 U.S.C. § 460x (1982 & Supp. V 1987), in a severely eroding area. ENVIRONMENTAL ATLAS, *supra* note 9, at 19. Ashland and Bayfield counties in Wisconsin feature the Apostle Islands National Lakeshore. 16 U.S.C. § 460w (1982 & Supp. V 1987). The 21 islands and 11 miles of Lake Superior beachfront are also subject to a moderate amount of erosion. ENVIRONMENTAL ATLAS, *supra* note 9, at 19. The Indiana Dunes National Lakeshore occupies 15 miles along the Lake Michigan shore near Porter, Indiana. 16 U.S.C. § 460(u) (1982 & Supp. V 1987). This dune area suffers from severe erosion. ENVIRONMENTAL ATLAS, *supra* note 9, at 19.

139. Telephone interview with Kathi McClosky, U.S. Fish and Wildlife Service, U.S. Department of the Interior (Mar. 3, 1988). These areas are: Green Bay, Wisconsin; Gravel Island, Wisconsin; Huron, Michigan; Michigan Islands, Michigan; Harbor Island, Michigan; Wyandotte, Michigan; Ottawa, Ohio; Cedar Point, Ohio; and West Sister Island, Ohio.

and boating facilities must now be elevated above the lapping waves.

However, there are other interests which welcome high water levels. Commercial navigators benefit, as higher water provides a deeper draft for large vessels, which can in turn carry more cargo.[140] Less dredging is necessary to clear channels and harbors. Hydropower production is improved, as more water is available to flow through generating turbines.[141] This means fewer communities along the Great Lakes must rely on pollution-prone fossil fuel power plants to supply needed electricity. Finally, even environmentalists suggest that with high water levels there would be greater dilution capacity in the event of a pollutant spill or other accidental concentrated discharge into the Great Lakes.[142]

Despite the tension between shoreline residents, environmentalists, and commercial interests, there has been a call for assistance and action from the federal government. Parties at state and local levels are expecting federal intervention in the following areas: immediate reduction of Lake levels, compensation for existing harm, and prevention of future damage.

A. *Reducing Lake Levels*

There are at least four possible federal responses to the request to reduce water levels in the Lakes: 1) let nature run its course, 2) manipulate the water through locks, dams and other man-made controls, 3) decrease the total amount of water in the Lakes by increasing diversions, or 4) increasing consumptive uses.

1. Option One: Let Nature Run Its Course

The first option has the obvious but attractive feature of immediate implementation with no cost. We know from experience that

140. "[F]or every inch reduction in lake levels, ships must reduce their cargo by a range of 125 tons for smaller vessels to 225 tons for larger ones. Most Great Lakes carriers are of the larger variety, so losses tend to be at the higher end of the range." Interview with George Ryan, President, Lake Carriers Association, Cleveland, Ohio, in an interview with the staff of The Center for the Great Lakes (Apr. 1986), *quoted in* A. BIXBY, THE LAW AND THE LAKES 16 (1986).

141. For example, an increased diversion of 10,000 cubic feet per second of water from Lake Superior would result in a $130 million loss to U.S. and Canadian hydropower interests. A. BIXBY, *supra* note 140, at 16, (citing analysis by Dr. Al LeFeuvre, Canada Centre for Inland Waters, Environment Canada, presented by E.T. Wagner, Canada Centre for Inland Waters, Environment Canada, in remarks at Great Lakes Legal Seminar: Diversion and Consumptive Use, Cleveland, Ohio, Dec. 12, 1985).

142. *See* A. BIXBY, THE LAW AND THE LAKES 16 (1986); INSTITUTE OF WATER RESEARCH, *supra* note 8, at 44.

Lake levels drop eventually. Lake levels are primarily driven by precipitation and temperature, factors largely beyond artificial control.[143] Moreover, global warming trends (the "greenhouse effect") may bring warmer climates to the Great Lakes, increasing evaporation, and resulting in a natural lowering of average Lake levels.[144]

2. Option Two: Artificial Manipulation of the Lakes

In 1964, in response to *low* water levels in the Lakes, the United States and Canada requested the International Joint Commission (IJC) to investigate whether additional regulation of water levels was in the public interest.[145] The resulting report,[146] which was released over a decade later in 1976, examined all feasible methods of controlling water levels in the Lakes. Prefacing its conclusions to the 1976 Report with a cautionary note, the IJC stated:[147]

> Since the Great Lakes already possess a high degree of natural regulation, only a limited reduction in the range of water levels is practical. Major reduction in water level fluctuation in any one lake would result in much wider variations in outflows and would necessitate extremely costly regulatory works and remedial measures and could cause serious effects upstream and downstream.

In its final analysis, the IJC rejected most of the six proposals studied, which included adding additional dams and dredging new channels. The IJC concluded that most of the water regulation schemes were not cost effective, once downstream effects and environmental consequences were considered. However, the final recommendations issued by the Commission to the United States and Canadian governments included a study to determine the effects of the regulation of Lake Erie, and a new reference on the effects of diversions into and out of the Great Lakes Basin.[148]

Although they chose not to pursue immediately any of the engineering proposals studied by the IJC, the United States and Canadian governments in 1977 did request the IJC to determine whether limited regulation of Lake Erie would be in the public interest of

143. The International Joint Commission reports that a large-scale weather modification proposal sufficient to alter Great Lakes water levels is unlikely. INTERNATIONAL JOINT COMM'N, *supra* note 11, at 23.

144. Lemonick, *The Heat Is On*, TIME, Oct. 19, 1987, at 58, 63; *Drop in Great Lakes Levels Predicted*, Houghton Daily Mining Gazette, Oct. 30, 1987, at 7.

145. Reference to the International Joint Commission (Oct. 7, 1964), *reprinted in* INTERNATIONAL JOINT COMM'N, *supra* note 11, app. A.

146. INTERNATIONAL JOINT COMM'N, *supra* note 11, *passim*.

147. *Id.* at 58.

148. *Id.* at 60, 62.

both countries.[149] As in the 1976 IJC Report, the IJC evaluated the effects of these proposals on shore property, hydroelectric power, the environment, recreational interests, and navigation.[150]

In each of the three cases studied by the IJC under the 1977 reference, costs exceeded benefits by at least $13.8 million. While incidents of coastal erosion and flooding would occur less frequently, and recreational beach area would grow,[151] a preliminary environmental analysis showed that the lowering of water levels in Lake Erie and Lake St. Clair would decrease wetland area.[152] Moreover, the construction and operation of the new proposed regulatory works in the Niagara River, and the dredging of the St. Lawrence River, could harm fish and their habitat.[153] Commercial navigation and recreational boating would suffer under all three plans, as would hydropower production.[154]

Therefore, the IJC concluded once again that manipulation of water levels through control structures was not a viable alternative. It recommended that no further studies concerning the regulation of Lake Erie for the purposes of reducing high water levels be undertaken.[155]

Despite these recommendations against artificial manipulation of water levels, on April 25, 1985 the IJC reduced the outflow from Lake Superior by approximately one-third of the amount prescribed in current regulatory practice, in order to ease high water levels on Lakes Michigan, Huron and St. Clair. Such an action had been deemed necessary only once before, in 1921, when control structures were completed on the St. Mary's River.[156] Water levels were expected to be lowered 3.5 inches on Lakes Michigan and Huron, 2.5 inches on Lake St. Clair and 1.75 inches on Lake Erie. As a result of the outflow reduction, Lake Superior rose 4.75 inches, close to the 602-foot limit on its level established by Plan 1977.[157] In August, 1985, the IJC rescinded its order to reduce Lake Superior's outflow because the resulting high water began to ravage Lake

149. Reference to the International Joint Commission (Feb. 21, 1977), *reprinted in* INTERNATIONAL JOINT COMM'N, LIMITED REGULATION OF LAKE ERIE, app. A (1983).

150. INTERNATIONAL JOINT COMM'N, *supra* note 149, at iii.

151. *Id.* at 29, 31.

152. *Id.* at 25-26. Niagara Plan 25N would be the most damaging to wetlands.

153. *Id.* at 27.

154. *Id.* at 30-32.

155. *Id.* at 44.

156. Hitt & Miller, *supra* note 1, at 35.

157. BRIEFING, *supra* note 13, at 30-31.

Superior's shores.[158]

Although it can be argued that any reduction of high water levels would be beneficial, the expense of the regulation needed to achieve such a reduction is not sound economic policy.[159] From the IJC's 1985 action, one can conclude that although the economics of particular regulation schemes are unattractive, concrete effects on shoreline property may sway authorities to use them. Both the Canadian and United States governments are subject to tremendous political pressure, which can be brought to bear when water levels reach devastating heights. In the face of severe political pressure, analyses performed by detached economists mean little. The "bottom line" is that Lake levels can be adjusted through engineering techniques, albeit at great cost, and shore property interests can be protected.

3. Option Three: Diverting Great Lakes Water

Another way to lower water levels is to reduce the amount of water in the Lakes by either cutting off inflows or increasing outflows. Hence the idea of Great Lakes diversions.

In response to the recommendations by the IJC in its 1976 Report on Further Regulation of the Great Lakes, the United States and Canadian governments delivered a reference to the IJC on Great Lakes diversions and consumptive uses on February 21, 1977.[160] The two countries requested the IJC to examine the effects of existing and proposed diversions, the potential to reduce high water levels in the Great Lakes by altering diversion rates, and existing and future consumptive uses in the Great Lakes Basin. This reference required a comprehensive study to be completed by March 1, 1979.[161]

158. International Joint Comm'n, Great Lakes Levels—A Commission Overview 11 (Sept. 1, 1987) (unpublished paper).

159. Of course, the problem with diverting water out of the Great Lakes Basin is that Lake levels would be even lower during periods of low precipitation. Stopping or reducing diversions out of the Basin may be difficult. When Lake levels drop, freighters carry less cargo, less hydropower is generated, spawning areas for fish are reduced, boating facilities and piers must be extended, industries must pump water higher. The U.S. Army Corps of Engineers estimates that each time water flow through the Great Lakes is reduced 5000 cubic feet per second, the region suffers a $69 million a year loss. This breaks down into $1.8 million recreational boating; $10 million commercial shipping; $44 million hydropower. Cole-Misch, *Great Lakes Diversions: A Conflict Assessment*, 8 ENVTL. PROF. 112, 113, 115, 119.

160. Reference to the International Joint Commission (Feb. 21, 1977), *reprinted in* INTERNATIONAL JOINT COMM'N, GREAT LAKES DIVERSION AND CONSUMPTIVE USES, app. A (1985).

161. *Id.*

To perform the analysis required by the reference, the IJC examined the five existing diversions into and out of the Great Lakes Basin. These include: two diversions into Lake Superior at Long Lac and Ogoki, the diversion of water from Lake Michigan at Chicago, the diversion of water from Lake Erie into Lake Ontario through the Welland Canal, and the diversion of water from the Niagara River to Lake Ontario at the New York Barge Canal.[162]

(a) Stopping Inflows From Long Lac and Ogoki

Created in the 1940s, the Long Lac and Ogoki diversions increase the water present in the Great Lakes by redirecting water south from Canada into Lake Superior.[163] The amount of water diverted into the Great Lakes has varied over the years between 2,530 and 8,020 cubic feet per second.[164]

The Long Lac and Ogoki diversions do not greatly affect the Lakes' water levels. The levels of all five Lakes rose only slightly: .21 feet in Lake Superior, .37 feet on Lakes Michigan and Huron, .25 feet on Lake Erie, and .22 feet on Lake Ontario.[165] The IJC has calculated that these increased water levels contribute $57.8 million annually to the Basin, while economic losses (mostly increased shoreline erosion) amount to $4.8 million.[166]

Despite these figures, the United States negotiated with a cooperative Canada to reduce inflows from these diversions during periods of high water in 1952 and 1973.[167] More recently, at the request of

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162. INTERNATIONAL JOINT COMM'N, *supra* note 160 at 9.

163. The Long Lac diversion rechannels waters from the northward-flowing Kenogami River to the Aguasabon River, which discharges into Lake Superior at Terrace Bay, Ontario. The Ogoki diversion connects the Ogoki River to Lake Nipigon, which drains into Lake Superior through the Nipigon River. The diversions were originally created in the 1940s to aid hydroelectric power generation and to transport forestry products. *Id.* at 10. The flow of these waters into Lake Superior is governed by an exchange of notes between the U.S. and Canadian governments, and Article III of the Niagara River Water Treaty. *See* Exchange of Notes (Oct. 14, 1940) between the Government of the United States of America and the Government of Canada, including Supplementary Notes (Oct. 31, 1940, and Nov. 7, 1940), *reprinted in* INTERNATIONAL JOINT COMM'N, *supra* note 160; Niagara River Water Diversion Treaty, Feb. 27, 1950, United States-Canada, art. III, 1 U.S.T. 694, 696, T.I.A.S. No. 2130. These agreements grant the Canadian government the increased flows 1000 miles downstream at either Niagara Falls or the Welland Canal for hydropower purposes. No diversion limits were set, although the countries calculated the amount of water available to the Canadians at Niagara Falls at 5000 cubic feet per second. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 10.

164. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 13.

165. *Id.*

166. *Id.* at 15.

167. *Id.* at 13.

the State Department, Canada convinced Ontario Hydro to reduce the Ogoki flows into Lake Superior by 4,000 cubic feet per second beginning on June 28, 1985, by diverting water into Lake Nipigon.[168] The actual effect of this action on Lake Superior was very small: a lowering of 0.1 inch per month.[169] In August, 1985 when Lake Nipigon's water levels rose to destructive heights, Ontario Hydro redirected its flows back into Lake Superior.[170]

(b) Increasing the Chicago Diversion

The only major diversion of outflow from the Great Lakes takes water out of Lake Michigan at the Chicago River. The diversion was originally implemented to create 1) water supplies for inland communities, 2) sanitation, and 3) a navigation link to the Mississippi River.[171]

The diversion of water out of Lake Michigan has been a source of controversy during the twentieth century, prompting angry protests from the Canadian government and the Great Lake states bordering Illinois. This dispute reached a climax in 1930, when the U.S. Supreme Court established a maximum diversion rate.[172]

The Chicago Diversion has already lowered the levels of Lake Superior by .08 inches, Michigan and Huron by 2.5 inches, Erie by 1.7 inches, and Ontario by 1.2 inches.[173] The IJC was unable to estimate the specific dollar benefits or costs attributable to this diversion. In general, it concluded that if water were not diverted at Chicago, downstream navigation and hydropower interests would benefit, but the shoreline would suffer increased erosion and flooding. Ultimately, benefits greatly exceeded costs.[174]

Although the flow rate through the Chicago Diversion has been maintained since 1938,[175] the United States has considered increasing the outflow on several occasions. President Eisenhower refused to sign two bills increasing the diversion in the 1950s, much to Can-

168. Hitt & Miller, *supra* note 1, at 39..

169. BRIEFING, *supra* note 13, at 46-47.

170. International Joint Comm'n, *supra* note 158, at 7.

171. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 15.

172. Wisconsin v. Illinois, 281 U.S. 179 (1930), *modified*, 388 U.S. 426, 427 (1967). This case has been labeled as one which rivals Dickens' Jarndyce v. Jarndyce in its complexity and length. *Great Lakes Hearings*, *supra* note 2, at 409. The maximum diversion rate is currently 3,200 cubic feet per second. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 15.

173. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 15.

174. *Id.* at 15-16.

175. *Id.* at 15.

ada's relief.[176] In 1976, the Water Resources Development Act authorized the U.S. Army Corps of Engineers to conduct a study and a demonstration program where the rate of diversion from Lake Michigan through Chicago would be increased from its present rate of 3,200 to an average of 10,000 cubic feet per second.[177] The additional water channeled through the Illinois River would dilute wastes, as well as reduce Lake Michigan shoreline flooding and erosion.[178] The legislation limited flows when the Illinois River approached or reached flood conditions, when Lake Michigan dropped below its average water level, or when navigation was harmed on the St. Lawrence Seaway.[179]

The Canadian government protested this unilateral increase in diversion rates and noted that it had not been consulted prior to passage of the legislation.[180] Consequently, Congress funded only the study authorized by the bill through 1981. This study determined that the large increase in diversion rates was not economically justified, although smaller increments might be.[181]

Even in the face of this negative finding, the issue of increased diversion through the Chicago River resurfaced in 1987. On the first day of the 100th Congress, the first of three similar bills was introduced. Each of them proposed increasing the diversion of water from Lake Michigan to a level between 8,700 and 10,000 cubic feet per second.[182] The bills met heavy opposition, even with provisions protecting downstream property and navigation interests on the St. Lawrence Seaway.[183] The bills were not enacted, probably because political pressure to act subsided as Lake levels fell.[184]

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176. *Id.*

177. Pub. L. No. 94-587, § 166, 90 Stat. 2917, 2934 (1976) (codified at 33 U.S.C. 426k (1982)).

178. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 22-23.

179. *Id.* at 23.

180. *Id.*

181. *Id.*

182. H.R. 247, 100th Cong., 1st Sess., 133 CONG. REC. H149 (1987). The other bills were H.R. 2284, 100th Cong., 1st Sess., 133 CONG. REC. H3191 (1987), and H.R. 2758, 100th Cong., 1st Sess., 133 CONG. REC. H5443 (1987).

183. Letter to David Miller, Executive Director, Great Lakes United, from David Peterson, Premier of Ontario (Feb. 26, 1987); *see also* Flaherty, *Vander Jagt is Criticized for Plan to Lower Lakes*, Traverse City Record Eagle, Feb. 1, 1987, at 10. In partial response to public resistance to increased outflows from the Chicago Diversion, Congressman Toby Roth of Wisconsin introduced H.R. 1573. 133 CONG. REC. H1274 (1987). This bill authorized the Army Corps of Engineers to recommend indicators that could be used to signal the need for changes in the diversion rate to maintain Lake Michigan at its 1900-1986 average.

184. Telephone interview with Dan Bloom, Legislative Director to Congressman F.

(c) Increasing Diversion Through The Welland Canal

At Port Colborne, New York, water is channeled from Lake Erie, across the Niagara Peninsula, to Lake Ontario by the Welland Canal.[185] The Canal allows boat traffic to avoid the rapids and falls of the Niagara River, and supplies water for municipal and industrial uses. Flow from the Welland Canal varied between 2,400 cubic feet per second and 3,000 cubic feet per second between 1913 and 1940.[186] However, flows have been steadily increased since then to 9,200 cubic feet per second, in order to drive additional hydropower stations.

The Welland Canal has lowered the level of Lake Erie by approximately .44 feet, Lakes Michigan and Huron by .18 feet, and Lake Superior by .06 feet. It has not affected Lake Ontario's average levels, but has influenced the range of its levels slightly.[187] The IJC concluded in general terms that the Welland Canal's navigation benefits, and the greater efficiency in producing power achieved at the DeCew Falls power station greatly offset any losses attributable to lower water levels.[188]

(d) Increasing New York Barge Canal Flows

The New York Barge Canal is actually a series of interconnected watercourses which channel water from Lake Erie at Tonawanda, New York, to Lake Ontario.[189] The diversion was created in 1918 to enhance navigation, although the water is also used for irrigation and power production.[190] Water diverted from Lake Erie flows at an average of 700 cubic feet per second, with maximum flows during the April-November navigation season reaching 1,100 cubic feet of water per second.[191]

Because all water diverted into the Canal system is returned completely to Lake Ontario, and the withdrawal point is downstream from the natural hydraulic control of Lake Erie, the IJC concluded

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James Sensenbrenner (Mar. 10, 1988); telephone interview with Bill Cadigan, Staff Assistant to Congressman John E. Porter (Mar. 9, 1988).

185. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 16. Opened in 1929, the Welland Canal is the first diversion channel built in the Great Lakes. Cole-Misch, *supra* note 159, at 112-113.

186. INTERNATIONAL JOINT COMM'N, *supra* note 156, at 16.

187. *Id.* at 18.

188. *Id.* at 18, 20. However, the creation of this channel allowed sea lampreys access to the upper Lakes, decimating valuable lake trout populations. *Id.* at 20.

189. *Id.*

190. *Id.*

191. *Id.*

that this diversion has no effect on any of the five Lake levels.[192]

(e) Conclusions About Diversions

The collective effect of all the existing diversions on the Great Lakes levels is to increase Lake Superior's average level by .07 feet, lower Lake Michigan and Lake Huron by .02 feet, lower Lake Erie by .33 feet, and raise Lake Ontario's level by .08 feet.[193]

The IJC issued a final report on Great Lakes diversion in January, 1985. It found that the diversions at Long Lac, Ogoki, Chicago and the Welland Canal have altered Great Lakes levels.[194] The IJC concluded that it was physically possible to adjust the flow rates of the existing diversions without structural changes so that extremes in water levels would be vitiated.[195] However, such changes create greater financial losses to hydropower and navigation projects than benefits to the Great Lakes shoreline. One exception to this rule was increased flows through the Welland Canal, a change that had been made before the study was issued.[196]

4. Option Four: Increasing Consumption of Lake Water

Water which is "consumed" in the Great Lakes is not returned to the Lakes after withdrawal. Consumption losses include water which evaporates during withdrawal or use, is absorbed by plants via irrigation, is incorporated into the manufacturing of products, and which is lost during thermal energy generation.

As part of its 1977 Reference, the International Joint Commission also examined the existing consumption of Great Lakes water and foreseeable changes in consumption patterns.[197] Based on 1975 figures, the IJC concluded that approximately 4,950 cubic feet of water per second was consumed annually in the Great Lakes Basin.[198] Three-quarters of the water was consumed by manufacturing, municipal and power uses, with most of the water lost through power plant cooling system evaporation.[199] The United States ac-

192. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 20.
193. *Id.*
194. *Id.* at 22.
195. *Id.* at 25.
196. *Id.*
197. INTERNATIONAL JOINT COMM'N, *supra* note 160, at 27.
198. Other figures show this number to be 4,260 cubic feet of water per second (cfs), including losses of 780 cfs from municipal use, 2,780 cfs from manufacturing, and 700 cfs from power production. ENVIRONMENTAL ATLAS, *supra* note 9, at 27.
199. *Id.* at 27.

counted for eighty-seven percent of the total lost water.[200]

The IJC has predicted that consumption of water in the Great Lakes Basin will double by the end of the century,[201] mainly due to projected population growth, additional demands for energy production (including more water-intensive nuclear power), and continued growth in iron and steel manufacturing, and the paper industry.[202]

Congress authorized a study of the consumption of Great Lakes water in 1986.[203] This study was meant to determine the environmental and economic impact of water consumption, and to examine the control measures needed to *reduce* the quantity of water consumed in the Basin. The legislation specified no completion date, and although $750,000 was authorized for the study, it has not yet begun.

Increasing consumption of Great Lakes water appears to be an event which will occur naturally. As population increases in the area, so does the demand for drinking water, irrigation, thermal and nuclear power, mining, and livestock uses—all uses which reduce the amount of water flowing back into the Lakes. By encouraging activities which consume greater amounts of water, such as iron or steel manufacturing, paper mills, chemical manufacturing, and nuclear power plants, more water can be withdrawn permanently from the Basin. However, the total amount of water consumed is relatively small compared to the vast reserves of the Lakes; Lake levels are not likely to be affected even by a doubling or tripling of consumptive uses.

5. New Lake Level Reference

Prompted by the record water levels of 1985-86, the governments of the United States and Canada requested the International Joint Commission in 1986 to complete a study of all possible methods of alleviating damage from fluctuating water levels on the Great Lakes.[204] The request made by the 1986 Reference was extremely broad. It required the following: reassessments of all earlier studies; investigations into current Great Lakes shoreline land use practices

200. *Id.* at 27, 28. Of total U.S. water use, Michigan consumed one-third and Ohio one-fifth. *Id.* at 29.

201. International Joint Comm'n, *supra* note 158, at 33, 37. This amounts to between 5,700 to 8,400 cubic feet of water per second.

202. *Id.* at 31-34.

203. Pub. L. No. 99-662, § 1147, 100 Stat. 4253 (1986).

204. Telephone interview with Dave Brower, U.S. Army Corps of Engineers (Mar. 11, 1988).

with a calculation of socioeconomic costs and benefits of these varying land uses; a determination of methods to increase outflows; and a recommendation for a public information program on Lake level changes. The deadline given for this report was May 1, 1989.

The United States and Canada also asked the IJC for an interim report on quick-fix measures, which could be used to buffer the damage caused by the record water levels. In a November, 1986 letter sent to the United States and Canadian secretaries of state,[205] the IJC made several suggestions to ameliorate shoreline damage caused by high water levels. The suggestions included advocating advanced storm tracking and warning systems, ensuring the sufficiency and availability of pre- and post-storm emergency relief programs, formally designating a federal lead agency in each country to coordinate Great Lakes levels information-sharing and program development, and improving coastal area management practices. In addition, the IJC identified engineering actions which were technically feasible, could be implemented immediately, and which would reduce Lake levels.

Of course, the IJC had cautioned in its earlier reports that the costs of many of its suggestions exceeded the benefits derived from them. It is therefore not surprising that of these suggestions, only a few have been accomplished, including the improvement of the Canadian storm forecasting system and the removal of a barge from the Niagara River.[206] The falling water levels have apparently decreased pressure to instigate additional measures, or move toward swift completion of the final report.[207]

B. *The Legal Regime Affecting Regulation of the Great Lakes*

The six quadrillion gallons of water within the Lakes is subject to the riparian rights of residents, two Canadian provinces, eight U.S.

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205. INTERNATIONAL JOINT COMM'N, ACTIVITIES REPORT 1986, app. 3, at 31-35 (1987).

206. *See* Letter to David G. Chance, Secretary, Canada Section, International Joint Comm'n, from Joe Clark, Secretary of State for Internal Affairs (Jan. 21, 1987); INTERNATIONAL JOINT COMM'N, *supra* note 205, at 7 (depicting removal of barge).

207. Letter to George P. Schultz, Secretary of State, from David LaRoche, Secretary, U.S. Section, International Joint Comm'n (Dec. 10, 1987), *reprinted in* INTERNATIONAL JOINT COMM'N, *supra* note 205, at 35. Also under the terms of this reference, the IJC is preparing a survey of all emergency measures and shoreline management activities covering several areas: storm warning/forecasting; flood and erosion area mapping; estimated damages; environmentally sensitive areas; public and private facilities; and land use management policies and programs. Such a document should prove to be a valuable resource for regional planners and provide a sound platform for additional work by the IJC, and the U.S. and Canadian governments.

states, and the federal governments of Canada and the United States. The differing schemes allocating water and water uses in the Great Lakes Basin thus sometimes conflict, sometimes overlap, and are often insufficient to address the legal issues arising from actions to alter water rights.[208]

1. International Law

Because the Great Lakes are mainly international waters, the Boundary Waters Treaty affects any diversions of Great Lakes water. The Treaty was signed by the United States and Great Britain, on behalf of Canada, on January 11, 1909.[209] The Treaty established rules regulating the use of Great Lakes water, and created the International Joint Commission (IJC).[210] The Treaty grants the IJC authority to approve any use, obstruction or diversion of boundary waters, or waters flowing from boundary waters, if their use would affect the natural level or flow of boundary waters. Boundary waters are defined as those "from main shore to main shore of the lakes and rivers and connecting waterways, or the portions thereof, along which the international boundary between the United States and the Dominion of Canada passes, including all bays, arms, and inlets thereof."[211] Under Article VIII, the IJC may condition its approval orders to compensate for the diversion, use or obstruction of boundary waters, and may require indemnification of injured persons.

Although the IJC will be involved in almost any proposal to reduce Lake levels or their flows, the parties to the Treaty may also enter into special agreements for Great Lakes water use, thereby bypassing the IJC.[212] In addition, because the definition of boundary waters excludes tributary waters which flow into or out of boundary waters and rivers which cross the U.S.-Canadian border, diversions from these areas are arguably beyond the IJC's reach. Also apparently excluded is Lake Michigan, which lies wholly

208. One scholar has stated that the United States could drain the Great Lakes dry or dedicate their water for use by the Far West, notwithstanding the interests of Canada. Tarlock, *Inter and Intrastate Usage of Great Lakes Waters: A Legal Overview*, 18 CASE W. RES. J. INT'L L. 67, 85 (1986). Such a scenario is unlikely, of course, but does highlight the problems inherent in the legal regime governing water quantity of the Great Lakes.

209. Treaty Relating to Boundary Waters and Boundary Questions, Jan. 11, 1909, United States-Great Britain, 36 Stat. 2448, T.S. No. 548 (hereinafter Boundary Waters Treaty).

210. *Id.* at art. VII.

211. *Id.* at preliminary art.

212. *Id.* at art. IV.

within the United States. Because these waters remain in the exclusive control of the country of origin,[213] a country may take diversions of water from these sources unilaterally.[214] Other loopholes in the IJC's authority include water withdrawn for domestic or sanitary purposes, navigation or commerce projects erected wholly inside one party's international boundary if the project will not "materially affect" flows of boundary waters within the other party's jurisdiction,[215] and diversions which existed before the Treaty was signed.

These provisions limit the IJC's veto power over the present Chicago Diversion. This is because the diversion 1) is sited at a non-boundary water source, 2) is used by the City of Chicago for sanitation and drinking water, 3) is used downstream for navigation to the Mississippi River, 4) was initiated before the signing of the Treaty in 1909,[216] and 5) has only a minor effect on Lake levels. The Welland Canal may also be exempt from IJC authority due to its pre-1909 construction date.[217]

Some have also questioned whether small diversions or consumptive uses[218] which do not individually affect boundary water flows or levels are subject to IJC powers.[219] This lack of authority further dulls the teeth of the IJC in controlling water quantity in the Great Lakes, as numerous small diversions could have a cumulative effect on water levels.

Both the United States and Canadian governments are to have "equal and similar rights" in Great Lakes boundary waters.[220] However, Article VIII of the Treaty directs the IJC to consider a hierarchy of uses when resolving Great Lakes water issues. Domestic and sanitary uses have precedence over navigation, and navigation is favored over hydropower production and agricultural uses. Considerations of shoreline property interests are conspicuously absent, and these priorities may stymie diversions proposed solely to

213. *Id.* at art. II.

214. Some may question whether this authority may be exercised if a diversion would "materially affect" boundary water.

215. Boundary Waters Treaty, *supra* note 209, at art. III.

216. *History of Man Made Projects and Events in the Great Lakes*, 3 INT'L GREAT LAKES COALITION NEWS, Fall 1987-Winter 1988, at 8.

217. *Id.*

218. Although not specifically mentioned in the Treaty text, consumptive uses appear to be subject to the IJC's jurisdiction. Sugarman, *Binding Ties, Tying Bonds: International Options for Constraints on Great Lakes Diversions*, 18 CASE W. RES. J. INT'L L. 239, 243 (1986).

219. A. BIXBY, *supra* note 142, at 21.

220. Boundary Waters Treaty, *supra* note 209, at art. VIII.

reduce shoreline erosion and flooding. This hierarchy has been roundly criticized as antiquated and too restrictive of IJC powers.[221]

Should either the United States or Canada divert water from tributary waters on its respective side of the Great Lakes, or otherwise affect the flow rates through the connecting channels, the Boundary Waters Treaty provides few remedies. Under Article II, injured parties may seek legal relief, but the courts have construed this provision as enabling relief only to private interests.[222] Therefore, a Canadian shoreline property owner in Port Dalhousie could object to a U.S. proposal to increase outflows through the Welland Canal if the property owner could show material injury proximately caused by the increased diversion. However, such an objection carries no obligation on the part of the U.S. government to abate the increased currents or recompense the property owner, under the terms of the Treaty.[223]

The Treaty is more explicit for disputes between the United States and Canada over the use of boundary waters. Article X authorizes referrals to the IJC, which then acts as an arbitrator, issuing a decision which is binding on both parties. Unfortunately, the composition of the IJC—three commissioners from Canada,[224] three from the United States—makes it probable that the IJC would be deadlocked along national lines. In that case, the Treaty provides for an umpire selected under the Hague Convention for the Pacific Settlement of International Disputes. While this dispute resolution mechanism sounds promising, in the nearly seventy years the Treaty has been operative, neither country has invoked Article X or the Hague convention.[225] Less formal diplomatic channels have proven successful, as witnessed by the proposed increases in the Chicago Diversion in the 1950s.

Finally, should either party to the Treaty wish to take an action asserting rights under its provisions or any order of the IJC, it may terminate the Treaty relationship by giving notice. Notice must be provided a year in advance of the termination,[226] and in the absence

221. Williams, *Public International Law and Water Quantity Management in a Common Drainage Basin: The Great Lakes*, 18 CASE W. RES. J. INT'L L. 155, 185 (1986).

222. A. BIXBY, *supra* note 142, at 28.

223. Williams, *supra* note 221, at 186.

224. Boundary Waters Treaty, *supra* note 209, at art. VII.

225. A. BIXBY, *supra* note 142, at 29.

226. Boundary Waters Treaty, *supra* note 209, at art. XIV.

of the Treaty customary rules of international law would apply.[227]

2. U.S. Water Law

Water rights are primarily an issue for states to regulate, although the federal government regulates to protect national interests in interstate or international waters. As each of the Great Lakes is interstate and four of the five are international, federal law requirements are combined inextricably with state jurisprudence in the matter of water law.

The states' primary source of authority for regulation derives from their general police powers under the tenth amendment to the Constitution.[228] Less important to the legal question is state ownership of the beds beneath the U.S. portion of the Great Lakes.[229]

All Great Lakes States based their water allocation schemes on the common law of riparian rights.[230] A riparian[231] is a person who owns land abutting a stream or other water body.[232] Each riparian has a right to reasonable use of the water passing by his or her property.[233] Under riparian law, domestic uses (drinking water, subsistence agriculture) have priority over other uses when water is limited.[234] Finally, riparian law limits the use of water to riparian lands within the watershed of use, subject to many exceptions.[235] This right to use water may be transferred by a riparian, but such an action may be challenged by other riparians.[236] Each Great Lakes State has modified the common law system of riparian rights in some fashion, affecting water allocation and rights of private citizens to protest outside uses of Great Lakes water.

Minnesota was the first state to establish a permit system for water diversions from the Great Lakes.[237] Withdrawals of more

227. Williams, *supra* note 221, at 193.

228. U.S. CONST. amend. X; F. TRELEASE & G. GOULD, WATER LAW 346 (4th ed. 1986).

229. Submerged Lands Act, 33 U.S.C. §§ 1301-1315 (1982).

230. Tarlock, *supra* note 208, at 68.

231. "Riparian" is used to describe interests arising from proximity to streams and rivers; "littoral" is the term for interests abutting tidal waters or lakes. BLACK'S LAW DICTIONARY 1192, 842 (5th ed. 1979).

232. A. BIXBY, *supra* note 142, at 17.

233. RESTATEMENT (SECOND) OF TORTS, § 41, introduction, *reprinted in* F. TRELEASE & G. GOULD, *supra* note 228, at 259.

234. Tarlock, *supra* note 208, at 74.

235. *Id.* at 75. However, Professor Tarlock states that "[a]ll that is clear is that the Supreme Court would not apply a per se rule requiring that all water be used in the watershed of origin."

236. *Id.*

237. A. BIXBY, *supra* note 142, at 18.

than 10,000 gallons per day average or one million gallons per year require permission from the state.[238] Like the Boundary Waters Treaty, Minnesota law also establishes a hierarchy of water uses, and requires notification to the other Great Lakes States any diversion of water from Lake Superior for points beyond the Great Lakes region.[239]

Illinois also regulates the use of water from Lake Michigan. The Level of Lake Michigan Act authorizes the Illinois State Department of Transportation to allocate any consumption or diversion of water from Lake Michigan among public water supply systems, sanitary districts and other users.[240] A permit is required for a consumptive use of more than two million gallons a day.[241] Illinois also prohibits the export of water outside the state absent consent of all the Great Lakes States and the IJC.[242]

Illinois' Level of Lake Michigan Act is similar to Indiana's water diversion law which provides that diversions of Great Lakes water for consumption outside the Basin must be approved by the governor of each Great Lakes State.[243] In addition, facilities withdrawing more than 100,000 gallons per day must register with the state, and submit an annual summary of water use.[244]

Ohio has a permit scheme that is triggered by diversions of over 100,000 gallons per day (sixteen cubic feet per second) from Lake Erie or the Ohio River. Criteria for granting a permit for an out-of-Basin use include whether the water proposed for diversion is needed in the Basin, and whether it would endanger public health or welfare.[245]

Michigan, the most water-conscious of the Great Lakes States,[246] created the Great Lakes Preservation Act in 1985.[247] The state embargoed new diversions in its jurisdiction of water from the Great Lakes pending the development of a comprehensive water manage-

238. *Great Lakes Hearings*, *supra* note 2, at 33 (testimony of Governor Richard Celeste of Ohio, with attached summary of water management practices in the Great Lakes).

239. A. BIXBY, *supra* note 142, at 25.

240. *Great Lakes Hearings*, *supra* note 2, at 273.

241. *Id.*

242. A. BIXBY, *supra* note 142, at 24.

243. *See* IND. CODE ANN. § 13-2-1-9 (Burns 1988); A. BIXBY, *supra* note 142, at 23.

244. *Great Lakes Hearings*, *supra* note 2, at 33. As of July 1985, more than 2,300 facilities had registered. *Id.* at 275.

245. *See id.* at 33; A. BIXBY, *supra* note 142, at 23.

246. Michigan touches four of the five Great Lakes.

247. *Great Lakes Hearings*, *supra* note 2, at 33.

ment plan. This plan was submitted to the governor in September 1987, but no permit system was recommended.[248]

New York and Pennsylvania do not have comprehensive state schemes for regulating Great Lakes water use, but rather rely on common law.[249] Pennsylvania, for example, only regulates the withdrawal of surface water by public agencies.[250]

Wisconsin administers a water use permit system through its Department of Natural Resources. Withdrawals of 100,000 gallons per month of Great Lake water require registration with the state.[251] New or expanded withdrawals of one million gallons per day must be registered with the state, and withdrawals of two million gallons per day must meet special standards.[252] The state considers whether the proposed withdrawal is consistent with 1) the protection of the environment, 2) the protection of the public health, safety and welfare, 3) state plans for future water use, and 4) reasonable conservation practices.[253] If proposals are made for water use beyond the Great Lakes Basin, the Wisconsin Department of Natural Resources must give prior notice to, and consult with, the other Great Lakes States and the two Canadian provinces that have Great Lakes interests.[254]

While the Great Lakes States are primarily responsible for controlling Great Lakes water, the federal government may exert its authority if state regulation affects superior federal interests such as: navigation, commerce, or foreign affairs. In addition, the Supreme Court may exercise its original jurisdiction over suits between states disputing the allocation of an interstate water resource. Congress is also involved in the approval of interstate agreements.[255]

The constitutional grant of power to the federal government over foreign affairs, commerce, and navigation plays an important role in

248. GREAT LAKES AND WATER RESOURCES PLANNING COMM'N, WATER RESOURCES FOR THE FUTURE (1987). The Commission recommended that significant withdrawals of water be reported annually to the State. *Id.* at 54; *see also Great Lakes Hearings*, *supra* note 2, at 276.

249. *Great Lakes Hearings*, *supra* note 2, at 33.

250. However, the largest consumers of water are industrial and hydropower interests. *Id.* at 33, 277.

251. *Id.*

252. *Id.* at 272.

253. *Id.*

254. A. BIXBY, *supra* note 142, at 25.

255. U.S. CONST. art. I, § 10, cl. 3. The approval of such compacts by the Congress may shield them from constitutional attack under the Commerce Clause, an important protection when water embargoes are involved. Intake Water Co. v. Yellowstone River Compact Comm'n, 590 F. Supp. 292 (D. Mont. 1983).

regulating Great Lakes water use. Using its authority to oversee activities that affect navigation, the federal government has granted the U.S. Army Corps of Engineers control over the construction of structures that could impair navigation,[256] and over dredge and fill activities.[257] The Corps also operates navigation works in the Great Lakes. Because many increased or new diversions from the Great Lakes will likely require the construction of new water control devices, the Corps of Engineers will have an important role in determining how or whether water use will be regulated.

The Supreme Court has exercised original jurisdiction in disputes brought by states over the apportionment of interstate water.[258] In distributing water between two or more disputing states, the Supreme Court applies the rule of equitable apportionment. The Court has held that states all have an equal right to share in interstate waters, but to invoke this doctrine a state must show that a threat to its share of water is imminent. Local water use law is a guiding principle.[259] Existing uses of water are usually preserved, and parties from outside the drainage basin who wish to use water must meet a higher burden of need.[260]

The Commerce Clause of the U.S. Constitution[261] gives the federal government preemptory and plenary power over activities which can affect interstate commerce. This broad power has been used to limit state laws which have interfered with the interstate transfer of water, as well as the protection of wetlands, coastal zone management, and some water pollution regulation.

In a decision that construed water law and the Constitution, the Supreme Court in *Sporhase v. Nebraska*[262] held that water is an article of commerce. Therefore, state water regulations involving interstate use are subject to federal constraints. In *Sporhase*, the Court invalidated a Nebraska statute that inhibited the export of groundwater to neighboring states unless reciprocity was granted. The Court found that unless Nebraska had a legitimate public purpose in restricting the use of its groundwater, it could not treat non-

256. 33 U.S.C. § 403 (1982).

257. *Id.*; *see also* 33 U.S.C. § 1344 (1982 & Supp. V 1987).

258. A state would sue in *parens patriae* on behalf of its citizens for an agreement settling the amount of water to which it is entitled. Tarlock, *supra* note 208, at 96-102. Interestingly enough, one of the earliest equitable apportionment cases involved the infamous Chicago Diversion. Missouri v. Illinois, 200 U.S. 496 (1906).

259. Tarlock, *supra* note 208, at 99.

260. *Id.* at 102.

261. U.S. CONST. art I, § 8, cl. 3.

262. 458 U.S. 941 (1982).

residents differently than Nebraskans. Economic gain was not considered a legitimate public purpose, but conservation of the resource for public health and welfare was legitimate. Nebraska also failed to demonstrate that its regulation was justified because of a state water shortage.

Given the abundance of water in the Great Lakes, it is unlikely that any Great Lakes State could justify restricting the exporting of water outside its jurisdiction based on a shortage. A state could make arguments grounded on public health and welfare purposes, based on the Lakes' cyclical swings in water levels. However, the vast quantities of water available in the Lakes for drinking water and sewage treatment, even during low water cycles, means that public health would not likely be endangered. Because low water levels negatively affect hydropower and navigation interests, local economies might suffer; but this appears to be just the type of contention the Supreme Court has found unpersuasive.

In the only water rights case involving the Great Lakes, *Wisconsin v. Illinois*,[263] the plaintiffs did successfully use economic arguments. In *Wisconsin v. Illinois*, the Supreme Court limited the diversion of additional water by Illinois through the Chicago Sanitary and Ship Canal. Plaintiffs, the other Great Lakes States, argued that the withdrawal of so much additional water would have detrimental economic effects downstream, because of reduced hydropower production and navigation problems. The Supreme Court accepted this argument.

After *Sporhase,* it is unclear whether the Supreme Court would decide *Wisconsin* the same way today.[264] In a flurry of legislation passed in the wake of *Sporhase*, most of the Great Lakes States have established new water appropriation schemes that were carefully based on citizen health and welfare justifications rather than on any

263. Wisconsin v. Illinois, 281 U.S. 179 (1930), *modified*, 388 U.S. 426 (1967) (modification of decree enjoining Illinois to incrementally decrease the amount of water the state was diverting to carry off Chicago sewage).

264. Economic arguments were insufficient to defend a water rationing scheme in El Paso v. Reynolds, 563 F. Supp. 379 (D.N.M. 1983). In that case, the district court found unconstitutional a New Mexico law prohibiting the transport of scarce groundwater across state boundaries. The state had argued that it was facing an impending shortage of water for reasonable public welfare needs, including municipal, agriculture, industry, energy production, fish and wildlife, and recreation. In light of the absolute prohibition of all water exports, the court concluded that aside from the amount needed for human survival, these restraints were crafted to allow El Paso to "blossom in unrestrained economic prosperity." *Id.* at 390. One year later, the newly redrafted water usage statute was again overturned based in part on a two-year ban on new groundwater appropriations. El Paso v. Reynolds, 597 F. Supp. 694 (D.N.M. 1984).

economic rationale. Although using different justifications, most of the Great Lakes States still place restrictions on the use of water taken out of the Great Lakes either beyond the confines of the Great Lakes drainage basin or state boundaries. However, Congress has the power under the Commerce Clause to approve state laws which might otherwise impermissibly restrict interstate commerce.[265] Such permission must be exercised expressly, such as through approval of an interstate compact.[266] For example, in 1968, Congress approved the Great Lakes Basin Compact,[267] thirteen years after it was negotiated. The Compact created the Great Lakes Commission, which it authorized to collect information and develop Great Lakes Basin management plans, and to recommend water resources policies. In addition, the Compact required that each of the signatories "consider" the recommendation of the Commission on any water diversion.[268] No enforcement mechanisms were provided, so at best, this agreement is hortatory.[269]

More recently, the governors of the eight Great Lakes States and the premiers of Ontario and Quebec entered into the Great Lakes Charter of February 1985.[270] The first purpose of the Charter is to "conserve the levels and flows of the Great Lakes."[271] The Charter prohibits any diversions of water out of the Great Lakes Basin without approval of all the signatories, if individually or cumulatively, the diversions would have significant harmful effects on Lake levels, in-Basin uses, or the Great Lakes environment.[272] In addition, the Charter requires the parties to establish programs to manage and regulate the diversion and consumption of Great Lakes waters.[273]

The Charter has successfully encouraged state legislative movements to improve water management practices in the states and

265. *See supra* text accompanying note 261.

266. Prudential Ins. Co. v. Benjamin, 328 U.S. 408 (1946).

267. Great Lakes Basin Compact, Pub. L. No. 90-419, 82 Stat. 414 (1968).

268. Tarlock, *supra* note 208, at 103.

269. This absence of enforcement mechanisms contrasts with the power of the International Joint Commission under the Boundary Waters Treaty.

270. Morandi, *Not for Sale*, STATE LEGISLATURES, Jan. 1987, at 18.

271. The Great Lakes Charter, Purposes, *reprinted in* Cole-Misch, *supra* note 159, at 117. Other purposes include protection of the ecosystem, cooperation in managing water resources, protection of present developments within the system, and provision of a foundation for future investment and development. *Id.*

272. *Id.* at Principle III.

273. Many Great Lakes States have followed the mandate of the Charter and have implemented legislation that places controls on the use of Great Lakes water. For example, Illinois now requires a permit from its Department of Transportation for consumptive uses of more than two million gallons of water per day. Morandi, *supra* note 270, at 19.

provinces surrounding the Basin.[274] There has also been some movement toward a uniform system for withdrawing Great Lakes water. Without the power of enforcement, however, the Charter must necessarily rely on the good faith of its signatories for compliance.

In seeming support for the Great Lakes Charter, Congress passed a law in 1986 prohibiting the diversion of any water by any state, federal agency, or private entity for use outside the Great Lakes Basin without the consent of all the Great Lakes States governors.[275] This law also prohibits any federal agency from conducting studies involving the diversion of Great Lakes water to areas outside the Great Lakes Basin without such approval.

This law appears to codify certain provisions of the Great Lakes Charter. However, a grandfather clause excepts any diversion authorized as of November 17, 1986.[276] This clause may effectively hamstring any further regulatory efforts to control diversions from or inflows to the Lakes. Indeed, Congress continued to authorize the Corps of Engineers to work on increasing the Chicago Diversion, as well as other Great Lakes diversion-related proposals after 1986, without the required gubernatorial approval.[277]

3. Conclusions

If the United States government wanted to pursue one of the recommendations of the IJC for adjusting water levels in the Great Lakes, it would need the cooperation of the IJC, the Canadian government, at least one Great Lakes State, and one of the Canadian provinces. While the United States and Canada might enter into a special agreement and bypass the approval of the IJC, state and provincial laws must still be respected. The resulting labyrinth of laws presents a daunting prospect.

For example, if Lake Erie were to be regulated by increasing outflows of the Niagara River, the IJC would have to approve the construction of new control works, the dredging of the river and the blasting of bedrock at the headwaters of the river, under Article III of the Boundary Water Treaty. Because much of this work would take place on the United States' side of the river, the Army Corps of Engineers would have to issue permits under the Rivers and

274. *See* A. BIXBY, *supra* note 142, at 24-25.

275. 42 U.S.C. § 1962d-20 (Supp. V 1987).

276. "This section shall not apply to any diversion of water from any of the Great Lakes which is authorized on November 17, 1986." *Id.*

277. *See Great Lakes Hearings*, *supra* note 2, at 135.

Harbors Act of 1899 and under the Clean Water Act for the construction works and the dredging of the river. Congress would also have to appropriate money for such activity. The province of Ontario would probably require a diversion permit, and New York State would need to review the proposal under its coastal zone management program, and provide a water quality certification under the Clean Water Act.

At each stage of approval, the proposal could be halted or conditions attached to mitigate adverse conditions. In addition, unhappy shoreline residents along either side of Lake Erie, Lake Ontario or even one of the upstream Lakes who would suffer increased shore erosion and flooding as a result of the proposal, could pursue lawsuits in state, provincial or federal courts to halt the project under various environmental statutes[278] or riparian common law. If either the United States or Canada did not accept the idea of increased flows from the Niagara River, it could pursue avenues of appeal within the terms of the Boundary Waters Treaty, or take drastic measures by giving notice and terminating the Treaty relationship. Though these numerous stages of review limit the ability of either government to respond quickly to the needs of its citizens, they act as safeguards ensuring that unilateral action will not unfairly appropriate the waters of the Great Lakes, a national and international resource.

C. *Preventing Future Harm from Rising Water Levels*

Perhaps the most difficult of the challenges facing the federal government is to shield the Great Lakes shoreline from additional erosion and flooding caused by rising water levels. Federal regulators have three courses of action open to them: 1) allow the Army Corps of Engineers and others to "armor" the coast with new protective structures;[279] 2) impose sound land use practices along the

278. *See, e.g.*, National Environmental Policy Act, 42 U.S.C. §§ 4321-4370(a) (1982 & Supp. V 1987); Federal Water Pollution Control Act, 33 U.S.C. §§ 1251-1376 (1982 & Supp. V 1987).

279. There are many structural devices that can protect the shoreline from erosion or flooding damage. These include breakwaters, groins, revetments, and bulkheads (or seawalls). *See generally* U.S. ARMY CORPS OF ENG'RS, LOW COST SHORE PROTECTION (1981). Breakwaters are erected offshore to break or absorb the energy of incoming waves. *Id.* at 14. Groins or jetties extend perpendicular from the shore, capturing sand as it drifts along the coast and trapping it on the updrift side of the structure. *Id.* at 18. Revetments are usually made of stones or other large, heavy materials blanketing the natural contours of the shore to protect it from wave action. *Id.* at 22. Bulkheads are also constructed on the shoreline but are usually built out from the shore edge to

shoreline to deter construction of new flood and erosion prone structures; and 3) public education.

1. Shoreline Protection Devices

The Corps of Engineers and some Great Lakes communities support the idea of "armoring" the coast with structural devices, and have sought to have appropriations increased for the Corps under section 14 of the Flood Control Act of 1949 and section 103 of the Rivers and Harbors Act of 1962.[280] In addition, Senator Metzenbaum's proposal, discussed earlier,[281] will expand the number of projects that survive Corps' cost-benefit scrutiny.

However, the Corps' authority is primarily directed at protecting public, not private property; this is a great limitation when one notes that private hands hold eighty percent of the U.S. Great Lakes shoreline.[282] Even if approved by the Corps, many of the larger structural devices need specific congressional approval, and all need congressional funding authorizations. Neither the Corps nor the Great Lakes States were effective in obtaining much additional funding during the disastrous 1985-86 water level crisis, and given the current bleak budget situation,[283] it is unlikely that much additional money will be available in the near future.

Many commentators who have examined coastal erosion and related flood control techniques are extremely critical of shoreline protection devices. Most shoreline structures are erected on an individual basis, and lack of coordination among landowners often results in incompatible and poorly operating devices. Problems associated with structural or "armoring" solutions include interruption of the coastal transport of sand and other sediments needed to nourish beaches,[284] exacerbation of existing erosion elsewhere,[285]

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take the pounding of the waves. *Id.* at 26. This type of structure usually helps retain land that is sliding into the water.

280. *Great Lakes Hearings*, *supra* note 2, at 9 (testimony of Governor Richard Celeste of Ohio), 459 (testimony of Lee Bott, Chicago Shoreline Protection Commission), 467 (testimony of Rep. David E. Bonior).

281. *See supra* text accompanying note 81.

282. ENVIRONMENTAL ATLAS, *supra* note 9, at 22.

283. *See, e.g.*, Cranford, *Economic Forecasts: Why the Numbers Matter*, 46 CONG. Q. WEEKLY REP. 337 (1988).

284. *Great Lakes Hearings*, *supra* note 2, at 257.

285. *Id.* at 252. The U.S. Army Corps of Engineers accepted responsibility for shore damage attributed to navigation structures at Grand Haven Harbor, Michigan. J.F. CASSILY, RESTORATION OR ABANDONMENT: OUR LAST CHANCE TO SAVE OUR COASTAL SHORELINE BEACHES AND PROPERTIES 46-48 (in press).

decreased public access,[286] short life span,[287] and aesthetic degradation.[288] Shore protection devices can also be very expensive to build at $100-$600 per linear foot.[289] Furthermore, maintenance of these structures is costly, sometimes amounting to many times the original cost of the structure.[290]

Given these strong opposing arguments, it is not surprising that coastal planners and environmentalists resist the use of structures to protect existing buildings and land on the shoreline of the Great Lakes. In some instances, where less environmentally harmful or inexpensive alternatives (such as relocation or elevation) are not available, engineering solutions may be the only answer.[291] Structural devices may work best for large public facilities, such as power generation plants, where the contribution to the community may justify the costs or outweigh the detrimental effects on other surrounding property.

The use of "soft" engineering techniques is another approach to protecting existing shoreline development. These techniques include planting grasses and shrubs to hold unstable soil, and placing sand on balding beaches.[292] Though some contend that "soft" techniques are the most ecologically sound method of combatting erosion,[293] they have their limitations. Vegetation may not be effective to stem erosion from high or heavy waves, since the stabilizing root system is not very deep.[294] Beach nourishment is also seldom permanent, and costs for placing sand can total $1 million per mile.[295]

New structures are being developed that will potentially neutralize the damaging effects of wave and wind on shorelines. Termed "pro-wave" devices, these structures are placed in the water close to

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286. *Great Lakes Hearings*, *supra* note 2, at 16.

287. *Id.* at 258, 470, 492.

288. J.F. CASSILY, *supra* note 285, at 15. This could affect coastal tourism.

289. *Great Lakes Hearings*, *supra* note 2, at 306 (discussion from SAVING THE AMERICAN BEACH: A POSITION PAPER BY CONCERNED COASTAL GEOLOGISTS).

290. *Id.* at 472.

291. *Id.* at 252. The National Wildlife Federation concedes that structural stabilization projects could be used to protect military installations, urban industrial complexes, harbor entrances and docking facilities.

292. U.S. ARMY CORPS OF ENG'RS, *supra* note 279, at 11, 12.

293. *Great Lakes Hearings*, *supra* note 2, at 252.

294. *See, e.g.*, U.S. ARMY CORPS OF ENG'RS, *supra* note 279, at 479, 501, 502.

295. *Great Lakes Hearings*, *supra* note 2, at 306. This cost can be decreased if fill is available nearby, for example from a Corps dredging project. U.S. ARMY CORPS OF ENG'RS, *supra* note 279, at 12. A dramatic example of a futile beach renourishment investment is found at Oceanside, California, which spent $3 million to place sand on its beach, only to have it wash away in a single storm in 1983. *See* J.F. CASSILY, *supra* note 285, at 39.

shore to slow advancing waves and to filter sand from littoral currents. This sand eventually accumulates in the area between the device and shore, creating a new beach. Costs involved in installing a pro-wave device range from $150,000 to $650,000 per shoreline mile, much less than beach renourishment or structural devices.[296] However, the technology is new, and the effects of installing these devices have not been studied adequately.[297]

Michigan has successfully used a nonstructural technique to prevent coastal erosion; the state created a small but successful loan interest subsidy program to relocate erosion-threatened houses.[298] Houses, including their accompanying septic systems, water lines and electrical cables, were relocated from eroding or flood-threatened sites to areas set back from the shoreline beyond danger. One estimate for the cost to relocate a home is approximately $36,000,[299] much less than the cost to purchase a new one. Michigan allocated $2 million to its relocation program in 1986; the program was renewed in 1987 for an additional $1 million.[300] One disadvantage of offering relocation funds to alleviate erosion dangers is that such a program assumes that the property owner has sufficient land to relocate the structure on the same parcel or is willing to purchase new land for the relocated building. In addition, many buildings may be too large or structurally weak to be successfully relocated.

Elevating flood-threatened buildings above flood waters is another nonstructural method of protecting them. The Michigan program mentioned previously provides grants of up to $3,500 to property owners for elevation.[301] Some buildings may be unsuitable for elevation, and if the ground beneath the structure is subject to erosion or is otherwise unstable, it may not support an elevated structure.[302]

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296. J.F. CASSILY, *supra* note 285, at 49-53, 55.

297. Conversation with Chris Shafer, Chief, Great Lakes Shorelands Division, Michigan Department of Natural Resources (Jan. 30, 1988).

298. *Great Lakes Coastal Issues: Hearings Before the Subcomm. on Oceanography of the House Comm. on Merchant Marine and Fisheries, supra* note 2 (testimony of Martin Jannereth, Michigan Department of Natural Resources at 2).

299. *Great Lakes Hearings, supra* note 2, at 317.

300. Telephone interview with Chris Shafer, Chief, Great Lakes Shorelands Division, Michigan Department of Natural Resources (Apr. 6, 1988).

301. *Great Lakes Coastal Issues: Hearings Before the Subcomm. on Oceanography of the House Comm. on Merchant Marine and Fisheries, supra* note 2 (testimony of Martin Jannereth, Michigan Department of Natural Resources at 2).

302. Lemonick, *Shrinking Shores*, TIME, Aug. 10, 1987, at 38, 40.

2. Land Use Management

In all its reports, the IJC noted the importance of sound land use management practices to deter inappropriate development along the shore of the Great Lakes.[303] Legal scholars,[304] environmental groups,[305] state administrators,[306] and coastal geologists[307] also agree that the most productive way to prevent future shoreline damage is to control current shoreline development. The commentators agree that the burden of implementing land use controls in areas subject to risk from high water levels ought to be placed primarily on the eight Great Lakes States and their local governments.

(a) The Coastal Zone Management Act

A variety of bills introduced in Congress following the record 1985-86 water levels reflect a land use approach to high water levels. Building on an existing program that aids coastal states in managing development along their shoreline, H.R. 1004[308] would amend the Coastal Zone Management Act of 1972 (CZMA)[309] by establishing a new grant program for protection from and chronic coastal erosion and flooding. The CZMA encourages coastal states to plan responsible coastal development with federal grant money. It also encourages the use of "coastal consistency"—the ability of states to object to federal projects which affect their coastal areas.

To qualify for federal money and the power of consistency, a coastal program must "minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas."[310] In addition, states must develop a planning process to assess the effects of erosion, and study ways to control erosion and restore eroded areas.[311]

Although only four of the Great Lakes States have developed federally approved coastal zone management programs,[312] three others

303. INTERNATIONAL JOINT COMM'N, *supra* note 11, at 61; INTERNATIONAL JOINT COMM'N, *supra* note 149, at 44; INTERNATIONAL JOINT COMM'N, *supra* note 160, at 39.

304. *Great Lakes Hearings*, *supra* note 2, at 249-250 (quote from Prof. Dan Tarlock, Chicago Kent College of Law).

305. *Id.* at 299 (testimony of Sharon Newsome, National Wildlife Federation).

306. *Id.* at 153 (testimony of Steven G. Thorne, Minnesota Department of Natural Resources).

307. *Id.* at 318 (results of the Skidaway Institute of Oceanography Conference on America's Eroding Shorelines).

308. 101st Cong., 1st Sess., 135 CONG. REC. H273 (1989).

309. 16 U.S.C. §§ 1451-1464 (1982 & Supp. V 1987).

310. 16 U.S.C. § 1452(2)(B) (1982).

311. 16 U.S.C § 1454(b)(9) (1982).

312. Wisconsin, Michigan, Pennsylvania, and New York.

are currently developing programs.[313] These states represent a great majority of the coastline that is threatened by coastal erosion; perhaps the existence of a coastal erosion grant program will prove to be an incentive for the two remaining Great Lakes States to join the national CZMA program.

Under H.R. 1004, each state must develop a coastal erosion and flood control program that includes three elements: 1) a minimum thirty-foot erosion setback for new development in the coastal zone, or the equivalent of such a setback; 2) provisions for awarding direct loans, loan interest subsidies, or grants to homeowners, small businesses, certain charities and state and local government entities which cannot otherwise afford to protect their property; and 3) a project hierarchy for funding. The project funding hierarchy gives first priority to nonstructural erosion and flood control projects, such as relocation and elevation of buildings. This is consistent with the prejudice against structural solutions to coastal erosion and flooding caused by high Lake levels. The hierarchy gives second priority to acquisition of threatened property. Unlike nonstructural protection, this is a permanent solution and one which is likely to be expensive, given its basis in the section 1362 program in the National Flood Insurance Act.[314] As a third priority, H.R. 1004 authorizes structural protections, but only on the conditions that the project is for municipal structures or infrastructure, the project is consistent with all environmental standards, the project will protect the structure for at least thirty years, and the project does not transfer erosion or flooding elsewhere. Given these stringent conditions, it is unlikely that any structural devices will qualify under this bill. Finally, the bill gives fourth priority for funding to matching shares for other consistent federal or state programs, such as the Michigan interest subsidy program and the National Flood Insurance section 1362 program.

One advantage that H.R. 1004 has over many Great Lakes relief measures is that no additional money is needed. Funding for this grant program is taken from the Coastal Erosion and Flood Control Assistance Fund. All unobligated funds under section 308 are deposited in a revolving fund.[315] Section 308 of CZMA authorized

313. Ohio, Illinois, and Minnesota. Telephone interview with Ann Berger, Great Lakes Regional Manager, National Oceanic and Atmospheric Administration (Mar. 1, 1988).

314. Prices for one acre of oceanfront property in East Hampton can total $1 million. Gilbert, *America Washing Away*, 94 SCI. DIG., Aug. 1986, at 28, 32, 35.

315. 16 U.S.C. § 1456a (1982 & Supp. V 1987).

loans to coastal states to offset the impacts of coastal-dependent energy development. While authority for new loans expired on September 30, 1986, repayments continue to be made to a Coastal Energy Impact Fund (CEIF) established under section 308(h).[316] This money is not currently allocated for coastal purposes.[317]

H.R. 1004 received generally favorable reviews. However, witnesses testifying during the hearings on an identical bill held in October 1987[318] suggested a more stringent setback requirement, perhaps based on the expected life of the structure.[319] In addition, by operating through CZMA, funds would not be immediately available to Minnesota, Indiana, Illinois or Ohio, all states which experienced erosion damage during the 1985-86 high water levels. The funding level for this program is also very small, with CEIF revenues expected to amount to only $8.5 million in fiscal year 1990.[320] This is a very small pie to divide among the 29 states with approved coastal zone management programs,[321] each of which could qualify for funds.[322] President Reagan also attacked state assistance programs under CZMA and repeatedly requested their elimination.[323]

(b) A New FEMA Loan Program

In 1987, Congressman Dennis Eckart of Ohio introduced H.R. 1068, a bill that avoids some of the pitfalls mentioned above.[324] H.R. 1068, the Great Lakes Emergency Shoreline Protection Act, allows homeowners to work with their local lending institutions to finance erosion control devices and strategies. The Secretary of Housing and Urban Development, acting through the Federal Emergency Management Agency (FEMA) would guarantee ninety

316. 16 U.S.C. §§ 1456a(d)(1), 1456a(h) (1982 & Supp. V 1987).

317. 135 CONG. REC. E352-53 (1989) (statement of Rep. Robert Davis).

318. *Great Lakes Coastal Issues: Hearings Before the Subcomm. on Oceanography of the House Comm. on Merchant Marine and Fisheries, supra* note 2.

319. *Id.* (testimony of National Wildlife Federation at 10-11).

320. U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION BUDGET ESTIMATES FISCAL YEAR 1990, at 3 (1989).

321. Bondareff and Pittman, *Recent Legal Developments Under the Coastal Zone Management Act*, 1 COASTAL ZONE, 491-92 (1987).

322. Almost all coastal states are experiencing shoreline erosion and flooding difficulties. *See* Lemonick, *supra* note 302; Precious, *Bayside Owners Fight Erosion's Inevitable Tide*, Washington Post, Oct. 3, 1987, at E1; Taylor, *The Case of the Vanishing Beaches*, U.S. NEWS AND WORLD REP., June 22, 1987, at 33; and Strickland, *The Way of the Coasts*, OCEANS, April 1987, at 8.

323. U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BUDGET ESTIMATES FISCAL YEAR 1990, at 76 (1989).

324. H.R. 1067, 100th Cong., 1st Sess., 133 CONG. REC. H667 (1987).

percent of the value of the loans, while states would provide a three to five percent interest subsidy. The term of the loan could not exceed thirty years and the aggregate amount of the loan could not exceed $75,000. A six year authorization of $2 million per year is included.

One of the major drawbacks to Eckart's bill is the negligible amount of money authorized. A single shoreline protection device can cost more than $500 million.[325] States also question the large burden the cost sharing formula in the bill would place on their treasuries.[326] In addition, there is nothing in the bill to discourage a proliferation of uncoordinated, inefficient small structural devices. FEMA also has little experience administering a construction program, and has been resistant to new demands on its small staff.

Senator Glenn of Ohio introduced companion legislation, S. 2784,[327] which is identical to H.R. 1068, and S. 799,[328] which operates the same program through the U.S. Army Corps of Engineers. Congress did not enact either bill.

(c) A New FEMA Grant Program

The only successful new Great Lakes financial assistance program enacted thus far is the Great Lakes Planning Assistance Act of 1988.[329] Under this program, FEMA may make a one-time grant of up to $250,000 to a Great Lakes State for four purposes, all related to damage associated with high water levels on the Great Lakes. The purposes are 1) preparation of plans for mitigation, warning, and emergency assistance, 2) coordination of available state and federal assistance, 3) development of nonstructural measures to reduce or prevent damage, including mapping, and construction setback requirements, and 4) assistance to local governments. The state must provide twenty-five percent in matching funds. The Act also provides a maximum authorization of two million dollars.

The Act also authorizes the Army Corps of Engineers to dispense nonstructural emergency assistance to 1) prevent or reduce damage attributable to high Lake levels, 2) provide technical assistance to

325. *See* Ozanne, Completing the Regulation of the Great Lakes Water Levels 2, *citing* U.S. ARMY CORPS OF ENG'RS, GREAT LAKES WATER LEVEL FACTS 14 (paper presented at a briefing for the Wisconsin Congressional Staff, Jan. 21, 1987).

326. *Great Lakes Hearings*, *supra* note 2, at 174-175.

327. S. 2784, 99th Cong., 2d Sess., 132 CONG. REC. S11,929 (1986).

328. S. 799, 100th Cong., 1st Sess., 133 CONG. REC. S3509 (1987).

329. Great Lakes Planning Assistance Act of 1988, Pub. L. No. 100-707, §§ 201-203, 102 Stat. 4711-15.

local governments and private citizens, 3) compile data on Lake levels, emergency economic relief measures, and measures to prevent or alleviate high Lake level damages. Finally, the Act directs the Corps to consider the erosion or flooding effects of activities submitted for a permit under section 10 of the Rivers and Harbors Act of 1899[330] or section 404 of the Clean Water Act,[331] and to encourage the use of dredged materials for shoreline stabilization.

This version of the Act was shortened from the original, which had language very similar to H.R. 1068, with a $20 million authorization.[332] The Senate viewed the expanded version of the program negatively, primarily because of fiscal concerns and the parochial application of the section. The final version represented a last minute compromise.[333] Although it promises some additional funds, the final version essentially codifies existing Corps relief measures. This assumes that FEMA, an agency reluctant to become involved in erosion problems in the past, will request an appropriation of funds in future years.

(d) Coastal Barrier Resources Act Amendments

Another new Great Lakes law, the Great Lakes Coastal Barrier Act of 1988, amends section 4 of the Coastal Barrier Resources Act (CBRA)[334] by requiring the Secretary of the Interior to recommend appropriate areas along the Great Lakes shore for inclusion in the Coastal Barrier Resources System.[335] The purpose of CBRA is to place the risk of building in high hazard areas on those who choose to build there, not the general taxpayer. The federal government spends billions of dollars each year settling flood insurance claims, building flood and erosion control structures and replacing badly located public facilities.[336] Accordingly, areas included within the System are no longer eligible for certain types of federal financial assistance which promote development, such as flood insurance or funds for the construction of new roads and sewer systems.

Only those areas which are privately owned, undeveloped, unprotected and subject to wave and wind action are eligible for inclusion

330. 33 U.S.C. § 403 (1982).

331. 33 U.S.C. § 1344 (1982 & Supp. V 1987).

332. H.R. 2707, 100th Cong., 2d Sess., Title II, 134 CONG. REC. H957-58 (1988). This version passed the House of Representatives by a 368 to 13 vote. *Id.* at H965.

333. Interview with Chris Miller, Staff of Senator John Glenn (Dec. 7, 1988).

334. 16 U.S.C. §§ 3501-3510 (1982).

335. Great Lakes Planning Assistance Act of 1988, Pub. L. No. 100-707, § 204, 102 Stat. 4711-15.

336. *See* 133 CONG. REC. E2645 (1987) (statement of Rep. Robert Davis).

in the System. These land areas are generally unsuited for development because natural shoreline recession and movement of unstable sediments undermine man-made structures. Therefore, only approximately 150 shoreline miles in Michigan, Minnesota, New York, Ohio and Wisconsin initially have been determined as suitable for inclusion.[337] Funding from state or local governments or the private sector would not be affected, but the risk of future destruction of development placed in these precarious areas would be borne by these parties.

Because only a small number of areas would qualify for inclusion in the existing System,[338] a CBRA approach will protect only a few more miles along the Great Lakes shoreline. There are some who question the degree of protection afforded by the removal of federal subsidies, noting that along the Atlantic coast, development has continued apace in some CBRA areas.[339] The Act also exempts outright many federal subsidies which could encourage development and thus, later destruction. In addition, with approval of the Department of the Interior, certain other federal monies for improvements within a coastal barrier are available.

Finally, designation of new Coastal Barrier areas may encounter strong opposition from state officials and local residents who do not understand the limited nature of the subsidy ban. Real estate developers who fear reduction in property values are also a powerful lobbying force against this conservation program.[340]

3. Public Education

Educating the property owners along the Great Lakes shore about the unstable nature of the Lake levels and the Lakes' potential for destruction is a key factor in preventing future damage. This federal effort has already proven successful, as witnessed by the outreach programs conducted by the Great Lakes Sea Grant Network, authorized by the National Sea Grant College Pro-

337. U.S. Department of the Interior, Inventory of Potential Coastal Barrier Resources System Units in the Great Lakes Basin (Jan. 29, 1988) (available from L. Pittman).

338. This number could increase if the Department of the Interior's recommendations to expand the scope of the Coastal Barrier Resources System are accepted by the Congress. U.S. DEPARTMENT OF THE INTERIOR, REPORT TO CONGRESS: COASTAL BARRIER RESOURCES SYSTEM, EXECUTIVE SUMMARY 7-12 (Mar. 1987).

339. *See, e.g.*, U.S. DEPARTMENT OF THE INTERIOR, DRAFT SUPPLEMENTAL LEGISLATIVE ENVIRONMENTAL IMPACT STATEMENT ON PROPOSED CHANGES TO THE COASTAL BARRIER RESOURCES SYSTEM IV-7 (Jan. 1988).

340. Celis, *Proposal to Expand Protection of Coastal Lands Draws Fire*, Wall St. J., May 6, 1987, at 33, at col. 1.

gram.[341] Colleges and universities in Illinois, Indiana, Michigan, Minnesota, New York, and Wisconsin held workshops on coastal erosion, published pamphlets on engineering techniques to combat shoreline destruction, and kept track of Lake levels throughout the crisis.[342]

Another program enacted during the 100th Congress will provide much needed new information about the Great Lakes shoreline for property owners, state and local governments, and federal agencies dealing with Lake level problems. The Great Lakes Shoreline Mapping Act of 1987[343] authorizes the National Oceanic and Atmospheric Administration, in consultation with the U.S. Geological Survey, to prepare updated, computer-generated Great Lakes shoreline maps. There is a great need for this information. While the federal government has mapped the greater portion of the U.S. Great Lakes shoreline, many of these maps of the nearshore and shore areas are over fifty years old.[344] Current maps use too large a scale and are less detailed than necessary to help determine wave heights, flood elevations, and evacuation routes.[345] The International Joint Commission has also noted the need for improved data on the current configuration of the Great Lakes shoreline.[346]

The maps prepared under this act must contain appropriate technical information to predict and prevent damage caused by erosion and related flooding in the Great Lakes: the information includes offshore bathymetry, topography of the onshore area, geological conditions of the shoreline area and information on the recent geological past. The maps must reflect the need for more detailed information in high-risk erosion areas to plan for natural hazards. Before preparing the maps, the National Oceanic and Atmospheric Administration must consult with and consider the informational needs of the U.S. Army Corps of Engineers, the Federal Emergency

341. This program is authorized under 33 U.S.C. §§ 1121-1131 (1982), *as amended by* Marine Science, Technology, and Policy Development Act of 1987, Pub. L. No. 100-220, 101 Stat. 1469 (Supp. V. 1987). The Act was recently amended to give greater prominence to the Great Lakes.

342. SEA GRANT ASS'N, THE NATIONAL SEA GRANT COLLEGE PROGRAM 1987-1992, at 3.17, 3.30, 3.31, 4.4 (1987).

343. Pub. L. No. 100-220, §§ 3201-3206, 101 Stat. 1469, 1475-77 (1987).

344. Flaherty, *Panel Okays Redrawing of Great Lakes Maps*, Traverse Record Eagle, July 27, 1987, at 11.

345. *Great Lakes Coastal Issues: Hearings Before the Subcomm. on Oceanography of the House Comm. on Merchant Marine and Fisheries, supra* note 2 (testimony of Martin Jannereth, Michigan Department of Natural Resources at 5).

346. Letter to George Schultz, U.S. Secretary of State, from David LaRoche, Secretary, U.S. Section, International Joint Comm'n 1 (Nov. 14, 1986).

Management Agency, other appropriate federal agencies, the Great Lakes States, and appropriate local governments.

The costs involved in implementing this deceptively simple idea are its major drawback. The U.S. Geological Survey estimates that it will cost between $10 and $27 million per year for ten years to complete the entire U.S. shoreline.[347] Budget and time costs can be reduced, however, by first concentrating on those areas identified as facing a high risk of erosion.

IV.
CONCLUSION

The future of Great Lakes water levels is uncertain, though most experts agree that Lake levels will remain high for the next five to ten years. Current state and federal programs have not dealt adequately with the tremendous shoreline destruction precipitated by the higher levels. Legislative solutions do exist that would alleviate high water by manipulating the water levels through engineering projects. In addition, claims for erosion damage could be funded through an erosion insurance program or by expanding existing flood-related relief to cover erosion situations. Ultimately, the most effective answers appear to be 1) encouragement, through incentives, of coastal planning and programs which consider fluctuating water levels, and 2) an erosion insurance program based on the Federal Flood Insurance Program.

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347. Telephone interview with S. Jeffress Williams, Office of Energy and Marine Geology, U.S. Geological Survey (May 6, 1987).

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