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# A PRELIMINARY DISCUSSION OF NATURAL GAS PIPELINES UNDER THE GREAT LAKES

Mary Beth Brandoni\*

## I. INTRODUCTION

“The Great Lakes are an extraordinary natural endowment, holding 18 percent of the world's supply of surface fresh water. They are home to 33 million people, 47 percent of whom draw their drinking water from the Lakes. The Great Lakes are also vital to many North American fish and wildlife species. Their wealth of natural resources has long made the region a heartland of economic strength.”<sup>1</sup> Several proposals have been made to construct pipelines and cables beneath the Great Lakes. For example, “[i]n the last year, four lines have been proposed or approved that would transmit electricity or pump natural gas across lakes Superior and Erie.”<sup>2</sup> In addition, “Peoples Energy Corp. and Houston-based El Paso Corp. have formed a partnership to build a 104-mile-long pipeline through Lake Michigan.”<sup>3</sup> Even though it is unlikely that *all* such proposals will be approved and constructed, this recent activity is evidence that the Great Lakes are being looked at for increased development, despite their inherent value.

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\* Mary Beth Brandoni is a graduate of the University at Buffalo School of Law. All of the ideas presented here were drawn from discussions in the Spring 2003 Environmental Law Colloquium at the University at Buffalo School of Law, at Great Lakes United, and with professionals in the field.

<sup>1</sup> The Great Lakes Binational Toxics Strategy: Canada – United States Strategy for Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin, <http://www.epa.gov/glnpo/bns/index.html>.

<sup>2</sup> Sarah Kellog, *Proposed Pipelines for Great Lakes Worry Environmentalists*, BOOTH NEWSPAPERS, Washington Bureau. July 8, 2002, available at [http://www.greatlakesdirectory.org/zarticles/070802\\_great\\_lakes\\_pipeline.htm](http://www.greatlakesdirectory.org/zarticles/070802_great_lakes_pipeline.htm).

<sup>3</sup> Tammy Webber, *Pipeline May Snake Across Great Lakes*, ASSOCIATED PRESS, March 26, 2001, available at <http://seattlepi.nwsource.com/national/pipes26.html>.

This paper seeks to bring together some of the questions and issues surrounding the proposals to construct natural gas pipelines in the Great Lakes. Specifically, it asks why the Great Lakes are being looked at for pipeline development, what the possible effects of such development may be, and how such development can be better regulated. Finally, I question whether the Great Lakes *should* be subject to pipeline development—a question that needs to be freely debated prior to pipeline construction.

## II. WHY THE GREAT LAKES?

### *A. Natural Gas and Energy Consumption in the United States*

“The United States of America is the world's largest energy producer, consumer, and net importer.”<sup>4</sup> Twenty-four percent of the total energy used by Americans is produced with natural gas.<sup>5</sup> One of the primary uses of natural gas is for the generation of electricity. “Natural gas is the third-largest source of U.S. electricity generation, accounting for 16 percent of generation in 2000. Under existing conditions, natural gas generating capacity is expected to constitute about 90 percent of the projected increase in electricity generation between 1999 and 2020.”<sup>6</sup> In addition to its use as fuel, natural gas is also utilized as “a feedstock during the manufacturing process of such products as chemicals, rubber, apparel, furniture, paper, clay, glass, and other petroleum and coal products.”<sup>7</sup> Without natural gas, the structure of American industry and the energy market would be at a loss.

The political leadership of the United States has traditionally favored energy consumption over energy

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<sup>4</sup> Country Analysis Briefs, Energy Information Administration (October 2003) <http://www.eia.doe.gov/emeu/cabs/usa.html>.

<sup>5</sup> National Energy Policy—Report of the National Energy Policy Development Group (May 2001), 21, <http://www.whitehouse.gov/energy/>.

<sup>6</sup> *Id.*

<sup>7</sup> *Id.*

conservation, and the current trend is towards increased resource development, not environmental protection. Although many of the recent proposals for pipelines in the Great Lakes were introduced during previous administrations, similar proposals are unlikely to be discouraged by President Bush, who “wants to open many protected public lands to oil and gas exploration, including federal lands in the Rocky Mountains and the Arctic National Wildlife Refuge, as well as certain offshore areas currently closed to drilling.”<sup>8</sup> In fact, on May 17, 2001, President Bush released his National Energy Policy, a document that acknowledges the importance of developing natural resources for energy. According to Vice President Cheney, chairman of the National Energy Policy Development Group, “We can explore for energy, we can produce energy and use it, and we can do so with a decent regard for the natural environment.”<sup>9</sup>

To keep up with the patterns of consumption encouraged by the Bush administration’s energy policy, the natural gas transportation infrastructure must be increased. According to the National Energy Policy, “Natural gas distribution [ ] is hindered by an aging and inadequate network of pipelines. To match supply and demand will require some 38,000 miles of new gas pipelines, along with 255,000 miles of distribution lines.”<sup>10</sup> Furthermore, “[t]o meet growing demand, national gas pipeline capacity will have to be expanded by an estimated 1.5 percent per year, particularly along the corridors that move Canadian and Gulf of Mexico supplies to eastern and Midwestern states.”<sup>11</sup> Canada is a major source of imported natural gas in the United States,<sup>12</sup> making the Great Lakes region, with the natural resources it holds,

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<sup>8</sup> Mary Cooper, *Energy Policy*, CQ Researcher (May 25, 2001), available at <http://www.cqpress.com>.

<sup>9</sup> National Energy Policy, 8, <http://www.whitehouse.gov/Energy/>.

<sup>10</sup> *Id.*, 2, <http://www.whitehouse.gov/Energy/>.

<sup>11</sup> DOUG DUPLER. *Natural Gas, in ENERGY: SHORTAGE, GLUT, OR ENOUGH? 2001* (Information Plus Reference Series, Gale Group), available at, <http://www.galenet.com/servlet/OVRC>. (last visited Feb. 2004)

<sup>12</sup> *Id.* available at <http://www.galenet.com/servlet/OVRC>.

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one of several prime locations for the expansion of natural gas pipelines.

A second reason the Great Lakes are “ideal” locations for the construction of natural gas pipelines are the high energy consumption of the Northeastern United States, especially in Great Lakes states. For example, “[t]he largest users of natural gas in 1999 were California, Illinois, Michigan, New York, Ohio, and Pennsylvania.”<sup>13</sup> As a result, “pipelines transporting natural gas from the Gulf of Mexico do not have enough additional capacity to fully meet the northeast’s increasing gas demand, so companies are building new pipelines to transport gas from western Canada to the northeastern U.S.”<sup>14</sup> With natural gas market hubs already located in Chicago, Illinois and Leidy, Pennsylvania, the Great Lakes region is well on its way to becoming a significant natural gas transportation center.<sup>15</sup> (See figure 1)

It is not surprising that the Great Lakes themselves have been targeted for natural gas pipeline installation, considering the fact that construction within the Lakes is not unusual. The Millennium Pipeline Company reasoned:

Construction in Lake Erie and the other [G]reat [L]akes regularly occurs. Examples include dredging for navigation, sand and gravel operations, and construction of other utility facilities, such as intakes and outflows for water treatment facilities. The lakes are also crossed at several points by telephone and fiber optic cables. On the Canadian side, Lake Erie also holds an extensive network of gas and oil pipelines.<sup>16</sup>

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<sup>13</sup> *Id.* available at <http://www.galenet.com/servlet/OVRC>.

<sup>14</sup> Northeast-Midwest Congressional Coalition Great Lakes Task Force, Millennium Pipeline Briefing: Meeting Notes (April 13, 2001).

<sup>15</sup> *Investments in Gas Pipeline Capacity to Grow in 2000*, ALEXANDER’S GAS & OIL CONNECTIONS REPORTS. 2, 3 (Feb. 18, 1999), available at <http://www.gasandoil.com/goc/reports/rex90844.htm>

<sup>16</sup> Millennium Pipeline, Questions and Answers, <http://www.millennium>

Thus, it can be argued that additional construction would have little impact on the Lakes.<sup>17</sup> Taken together, energy policy, increased regional consumption and routine lake construction makes siting natural gas pipelines beneath the Great Lakes a seemingly logical conclusion.

### *B. Access and Opposition to Land Use*

The construction of pipelines, especially through communities, inevitably generates public opposition and high costs. “[T]he energy industry views crossing under the Great Lakes as a cheaper alternative to acquiring land rights-of-way for pipelines. Underwater, there are no impediments such as homes, farms, or roads to go around or tunnel beneath.”<sup>18</sup> For instance, “[The Millennium Pipeline] route [across Lake Erie] is shorter than going overland and avoids some of the problems associated with securing jurisdiction from multiple communities.”<sup>19</sup> In fact, the NIMBY (Not In My Back Yard) phenomenon may be pushing the natural gas industry toward uninhabited regions, such as the Great Lakes. A cursory review of the comment letters received by the Federal Energy Regulatory Commission in response to the Millennium Pipeline project reveals that opposition to the proposed route was primarily land-based and site-specific, with little concern

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[pipeline.com/qanda16.htm](http://pipeline.com/qanda16.htm).

<sup>17</sup> However, this is not to say that cumulative environmental impacts should not be considered. For example, “[ ] NEPA [the National Environmental Policy Act] provides the context and carries the mandate to analyze the cumulative effects of federal actions.” Introduction to Cumulative Effects Analysis, Council on Environmental Quality, (Jan. 1997) <http://ceq.eh.doe.gov/nepa/ccenepa/sec1.pdf>.

<sup>18</sup> *Lake Erie Considered for Natural Gas Pipeline*, (February 18, 2001), <http://www.mindfully.org/Energy/Lake-Erie-Gas-Pipeline.htm>.

<sup>19</sup> Great Lakes Task Force, (April 13, 2001) (The Millennium Pipeline will originate at [ ] the international boundary in Lake Erie and primarily follow existing utility corridors across the southern tier of New York to a terminus in Westchester County), *Maps*, <http://www.millenniumpipeline.com/maps.htm>.

154 BUFFALO ENVIRONMENTAL LAW JOURNAL [Vol. 11 expressed for Lake Erie. Most protest letters expressed concern over the proximity of the pipeline to schools and residential areas, risks to New York City's water supply, and the protection of Haverstraw Bay.<sup>20</sup> Lake Erie was rarely mentioned.

It must be noted, however, that public opposition to land-based routes does not necessarily become legal opposition to land-based routes. Concerned parties not directly affected by a proposed pipeline route may lack the legal standing needed to intervene in the regulatory process. Furthermore, most 'directly affected' parties do not take action. According to a study conducted by the Interstate Natural Gas Association of America (INGAA), "only 5% of directly affected land owners even file to become interveners in pipeline construction proposals. Moreover, filing for intervener status does not necessarily indicate a protest."<sup>21</sup> However, public opinion can affect energy companies in other, and some would argue, more important ways, with or without legal backing. As illustrated above, public comment letters have the potential to influence FERC and other governmental regulatory agencies. Thus, public image should not be underestimated.

Land routes may also differ significantly from routes through the Great Lakes in terms of cost. According to Ted Borawski, an oil and gas geologist working in the Department of Conservation and Natural Resources of the Commonwealth of Pennsylvania, land crossings are much more expensive than offshore routes. Mr. Borawski justified this statement with data and examples from the Millennium Pipeline application process in Pennsylvania:

Currently, due to unresolved issues of overlapping administrative jurisdiction,<sup>22</sup> the Pennsylvania

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<sup>20</sup> Comment letters viewed on: <http://trimsweb1.ferc.fed.us>.

<sup>21</sup> Jerald Halvorsen, *Understanding NIMBY: A Study of Protests Against Gas Pipeline Projects*, 137 PUBLIC UTILITIES FORTNIGHTLY 70, ill.6 (1990).

<sup>22</sup> Telephone Interview with Ted Borawski, Pennsylvania Department of Conservation and Natural Resources, (March 14, 2002) (The Pennsylvania Department of Environmental Resources (DER) was recently divided into the

Department of Environmental Protection charges a yearly fee of \$5000 for a natural gas pipeline right-of-way across Lake Erie, regardless of whether the pipeline is 2 feet or 2000 feet long. A memorandum of understanding is being drafted, which will relinquish authority over pipeline licenses from the Department of Environmental Protection. Authority over pipeline right-of-ways will be returned to the Department of Conservation and Natural Resources, where the cost for a pipeline right-of-way across Lake Erie is \$300 per acre per year. Even so, this price is still significantly less than the cost of a land route. To illustrate, the Millennium Pipeline will cost \$350,000 to \$500,000 per year for its Lake Erie right-of-way. A similarly sized land route would incur a one-time cost of \$300,000 to \$600,000 per acre, the net cost of which is significantly higher than the Lake route.<sup>23</sup>

This is an example based on Pennsylvania costs only. However, it illustrates that routes across the Great Lakes may be financially inviting to pipeline companies. Research into the fees charged by other Great Lakes states is needed in order to understand the extent to which cost plays a role in Great Lakes pipeline proposals.

### *C. Lack of Clear Legal Protection*

A third factor that has contributed to proposals for natural gas pipelines in the Great Lakes is the lack of a clear, enforceable

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Department of Conservation and Natural Resources (DCNR) and the Department of Environmental Protection (DEP). The DCNR retained control over oil and gas issues, while the DEP was given the authority to license utility right-of-ways. According to Mr. Borawski, this overlap in administrative jurisdiction permitted the relatively inexpensive cost of a Lake-crossing easement to go unnoticed).

<sup>23</sup>

*Id.*



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policy preventing or opposing such development. Laws protecting the Lakes from this type of development are not in effect. For instance, the Environmental Impact Assessment completed for the Lake Erie portion of the Millennium Pipeline acknowledges over 40 international, federal, and state laws of the United States and Canada that potentially affect the pipeline. (See figure 2) Despite the extent of this list, a cursory reading reveals that specific protection from pipeline construction in the Great Lakes is lacking. In fact, despite the undisputed importance of the Great Lakes as a source of drinking water, a valuable aquatic habitat, and a unique regional attraction, the Great Lakes have failed to achieve legislative protection comparable to that granted to the oceans or our national forests.

Furthermore, here as in other contexts, consistency with many 'environmental' laws does not guarantee Lake-protecting results. For example, the Coastal Zone Management Act<sup>24</sup>, the federal law implementing the states' coastal zone management programs, is largely procedural, providing few substantive protective mandates for the protection of 'coastal zones.'<sup>25</sup> Similarly, the National Environmental Policy Act<sup>26</sup> is also procedural. As explained by the Supreme Court in *Robertson v. Methow Valley Citizens Council*,

The sweeping policy goals announced in §101 of NEPA are thus realized through a set of "action-forcing" procedures that require that agencies take a "hard look" at environmental consequences," and that provide for broad dissemination of relevant environmental information. [ ] NEPA itself does not mandate particular results, but simply prescribes the necessary process. [ ] If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not

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<sup>24</sup> 16 U.S.C 1451 *et seq.* (1986).

<sup>25</sup> The definition of 'coastal zone' includes the Great Lakes.

<sup>26</sup> 42 U.S.C. 4321 *et. seq.* (1986).

constrained by NEPA from deciding that other values outweigh the environmental costs.<sup>27</sup>

Even the public trust doctrine,<sup>28</sup> which incorporates a degree of environmentally protective principles, seems to provide little actionable ground upon which to block the development of pipelines in the Great Lakes.

It is important not to overlook the fact that the Great Lakes are the subject of several international treaties between the United States and Canada, as well. These agreements attempt to protect and conserve Great Lakes resources, under the guidance of the International Joint Commission and its Science Advisory and Water Quality Boards. It appears these agreements have not and never will be utilized to prevent underwater pipelines, as they lack specifically applicable provisions and seem remedial, instead of prohibitory, in scope.

For example, Article III of the Boundary Waters Treaty addresses “uses, obstructions and diversions” as well as “the deepening of channels, the construction of breakwaters, the improvement of harbors, and other governmental works for the benefit of commerce and navigation.”<sup>29</sup> Arguably, natural gas pipelines could theoretically fall into the ‘governmental works for the benefit of commerce’ category. However, Article III only applies to activities that “affect [ ] the natural level or flow of boundary waters,”<sup>30</sup> which would exclude natural gas pipelines

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<sup>27</sup> 490 U.S. 332 at 350.

<sup>28</sup> The public trust doctrine is a common law doctrine, adopted in the United States from our English roots. The basic principle of the doctrine is that the sovereign holds navigable waters and the beds underlying them in trust for the public for designated purposes. Traditionally, these purposes have included the public right of access for navigation and fishing. Recently, American common law has also recognized recreation as one of the designated purposes. Johnson, Scott. “Public Access to Public Waters in Great Lakes States” University of Toledo College of Law, Legal Institute of the Great Lakes. Spring 2000. [www.wtlaw.edu/ligl/spring2002/publicwater.htm](http://www.wtlaw.edu/ligl/spring2002/publicwater.htm).

<sup>29</sup> Boundary Waters Treaty of 1909, Article III.

<sup>30</sup> *Id.*

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buried in lake bottomlands. Furthermore, the private pipeline projects that have been proposed so far do not fall under the category of 'governmental works.'

In contrast, the Great Lakes Water Quality Agreement, which explicitly commits the U.S. and Canada "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem,"<sup>31</sup> addresses pipeline activities. Specifically, the Agreement states,

The Parties, in cooperation with State and Provincial Governments, shall continue to develop and implement programs and other measures to fulfill the purpose of this Agreement and to meet the General and Specific Objectives. [ ] The programs and measures to be adopted shall include the following: (a) Review of the design, construction and location of both existing and new facilities for their adequacy to prevent the discharge of oil or hazardous polluting substances. [ ] Each Party shall submit a report to the International Joint Commission outlining its programs and measures, existing or proposed, for [ ] (ii) pipelines on land and submerged under water.<sup>32</sup>

The term 'hazardous polluting substance' is defined as,

...any element or compound identified by the Parties which, if discharged in any quantity into or upon receiving waters or adjoining shorelines, would present an imminent and substantial danger to public health or welfare; for this purpose, "public health or welfare" encompasses all factors affecting the health and welfare of humans including but not

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<sup>31</sup> Great Lakes Water Quality Agreement of 1978, Article II.

<sup>32</sup> *Id.* Articles VI, VI(h) and Annex 8(3)(a) and 8(4)(b)(ii).

limited to human health, and conservation and protection of flora and fauna, public and private property, shorelines and beaches.<sup>33</sup>

The major components of natural gas—methane, propane, ethane, butane, and pentanes—are not listed as hazardous polluting substances. (see figure 3) I was unable to determine whether the Agreement identifies any natural gas byproducts or other pipeline-related chemicals as hazardous polluting substances. If so, this provision of the Great Lakes Water Quality Agreement seems to indirectly endorse the construction of pipelines under the Great Lakes, as long as specified programs and measures are implemented to prevent lake contamination. As natural gas itself is not deemed a hazardous polluting substance, the Great Lakes Water Quality Agreement seems to provide no protection to the Great Lakes from natural gas whatsoever.

Article IX of the Boundary Waters Treaty may provide default relief. It states, “The [United States and Canada] agree that any other questions or matters of difference arising between them, involving the rights, obligations, or interests of either in relation to the other [ ], along the common frontier between [them], shall be referred [ ] to the International Joint Commission for examination and report...”<sup>34</sup> Based on this language, the International Joint Commission provides a forum in which the United States and Canada could address any disputes or concerns about pipelines in the Great Lakes. Theoretically, the existence of this forum might be a disincentive for companies to propose construction in the Lakes, as it is an additional level of administrative oversight that must be recognized.

Irrespective of the applicability of these provisions to pipelines, activity in the Canadian waters of the Great Lakes renders the point seemingly moot. Currently, Canada maintains over 2000 natural gas wells, 550 of which are actively producing,

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<sup>33</sup> *Id.* Article I(j).

<sup>34</sup> Boundary Waters Treaty, Article IX.

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beneath Lake Erie within Canadian waters.<sup>35</sup> Notably, these wells  
are connected by a series of natural gas pipelines.<sup>36</sup> Therefore, it  
seems logical to conclude that either (a) these agreements provide  
no basis for constraining the construction of pipelines in the Great  
Lakes, or (b) applicable provisions continue to be disregarded by  
both countries. Either way, it seems unlikely that such tenuous  
regulatory authority would be raised now, after forty-eight years of  
Canadian pipeline development.<sup>37</sup>

In conclusion, many factors, including a consumption-  
driven energy policy and public ambivalence, have directed the  
energy industry's attention to the Great Lakes region. The Great  
Lakes appear to be the next frontier for natural gas pipelines.

### III. POSSIBLE CONSEQUENCES OF PIPELINES IN THE GREAT LAKES

The United States has never constructed a pipeline directly  
beneath the waters of any Great Lake<sup>38</sup>, making a discussion of the  
consequences of pipeline construction seem highly speculative.  
However, comparisons to other locations, such as the Gulf of  
Mexico, as well as similar developments in the Canadian region of  
the Great Lakes provide a sufficient basis for discussion. The three  
potential consequences I have identified are environmental  
impacts, precedent, and increased public awareness.

#### *A. Environmental Impacts*

Opposition to pipeline development within the Great Lakes  
has been primarily founded on environmental protection  
arguments. For example, in opposition to the Millennium Pipeline,  
Maria Maybee of Great Lakes United wrote, "[This] project  
jeopardizes a recovering biologically productive freshwater body  
for the quickest route for a limited supply of fuel. This is not wise

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<sup>35</sup> Borawski, *supra* note 23.

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*; discussion in Environmental Colloquium, March 20, 2003.

<sup>38</sup> This statement excludes tributaries and connected waterways.

natural resource management.”<sup>39</sup> And, “[i]t is not known how increased turbidity during installation, potential long-term effects of (sic) benthic organisms along the pipeline trench, possible disruption of fish migrations along the trench, and leaks or breaks might impact lake life.”<sup>40</sup> The U.S. Fish and Wildlife Service echoed this message at an administrative level, in a letter addressed to the Army Corps of Engineers.<sup>41</sup>

However, there are at least two sides to every story, and for every environmental risk raised, a counterargument can be made. Columbia Gas Transmission, a company involved in the Millennium project, maintains, “What we have found is that [the Millennium] pipeline can be built and operated safely in Lake Erie. [ ] We looked very closely at the environmental concerns, we looked at the science and studied the lake bottom. We think there will be negligible interference with the environment.”<sup>42</sup> And, according to Ted Borawski, studies by the Pennsylvania Departments of Conservation and Natural Resources and Environmental Protection concluded that the Millennium Pipeline would cause a “net zero” of environmental disturbances. In fact, the only significant concern he raised involved the remote possibility that a large shipping vessel might sink and inadvertently breach the pipeline.<sup>43</sup>

With such a wide divergence of opinions over the environmental implications of natural gas pipelines in the Great Lakes, comparisons to other locations, such as the Gulf of Mexico,

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<sup>39</sup> Marie Maybee, “Millennium Pipeline on Track to Gouge Lake Erie.” *available at* [http://www.glu.org/english/information/newsletters/15\\_3-fall-2001/Millennium-pipeline.html](http://www.glu.org/english/information/newsletters/15_3-fall-2001/Millennium-pipeline.html) (Feb. 11, 2004).

<sup>40</sup> *Id.*

<sup>41</sup> “This proposed project may increase turbidity and sedimentation, disrupt fish migration in Lake Erie during construction, potentially disrupt benthic fauna, and cause mortality to aquatic species in the event of leaks or pipeline rupture.” Fish and Wildlife Service. *Letter to Colonel John B. O’Dowd, U.S. Army Corps of Engineers*, FERC RIMS DOC # 1006600:0, *available at* <http://ferris.ferc.gov/idmws/nvcommon/NVViewer.asp?> (March 5, 2002).

<sup>42</sup> “Lake Erie Considered for Natural Gas Pipeline.”

<sup>43</sup> Borawski, *supra* note 23.

162 BUFFALO ENVIRONMENTAL LAW JOURNAL [Vol. 11 provide valuable perspective. According to a study by the Commission on Engineering and Technical Systems, "offshore oil and gas industry accidents and incidents [in the Gulf of Mexico] produce surprisingly little pollution, compared with several other causes and sources [such as runoff, natural seeps and tank vessel accidents.]"<sup>44</sup> A comparison to the Great Lakes may imply the conclusion that any pollution added to the Lakes from pipelines would be negligible, as well. However, other comparisons to the Gulf of Mexico indicate that pipelines might adversely affect wildlife in the Great Lakes. Based on a report by the U.S. Fish and Wildlife Service, "the pipeline could disrupt the lake by leaking pollutants like those from offshore operations already crisscrossing the Gulf of Mexico. The agency said damage assessments by its Louisiana field office showed that some submerged natural gas pipelines leaked an oily condensate that accumulates as the line ages [which] can kill waterfowl and shellfish."<sup>45</sup> In addition, "data collected after accidental gas blowouts in the Sea of Asov in 1982 and 1985 indicated that fish suffered abnormalities indicative of acute poisoning such as impaired coordination, pathologies of organs and tissues, and modifications of protein synthesis..."<sup>46</sup> Based on this data, impacts do seem possible.

Perhaps the most valid source of impact data comes from the Great Lakes themselves. As indicated earlier in this paper, a series of natural gas wells and pipelines are located on the Canadian bottomlands of Lake Erie. Between 1955 and the present, no environmental incidents due to the presence of these pipelines have been reported.<sup>47</sup> Unless arguments can be made

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<sup>44</sup> *Improving the Safety of Marine Pipelines*, Committee on the Safety of Marine Pipelines, Marine Board, National research Council (1994) Commission on Engineering and Technical Systems, at 28. <http://books.nap.edu/books/0309050472/html/20.html>. (Feb. 11, 2004) (The study, which analyzed gas and oil activities in the Gulf, also focused on safety risks due to pipeline failures, such as human injury and death, as well as economic costs).

<sup>45</sup> "Lake Erie Considered for Natural Gas Pipeline," referring to a Department of Fish and Wildlife study.

<sup>46</sup> Fish and Wildlife Service, FERC RIMS DOC # 2263302

<sup>47</sup> Borawski, *supra* note 23.

distinguishing current proposals from existing Great Lakes pipelines, such as size, pressure, design or cumulative effects, the risk of adverse environmental impacts caused by pipelines in the Great Lakes seems difficult to substantiate.

### *B. Precedent*

An international natural gas pipeline may be precedent-setting, in ways that could be more cause for alarm than specific instances of environmental degradation. “Environmentalists are concerned that using the Great Lakes for pipelines could encourage more lakefront industrial development. [Cameron] Davis [executive director of the Lake Michigan Federation] said he also fears the pipelines would allow suppliers to begin moving oil and chemicals through the lakes.”<sup>48</sup>

Alarm over the prospect of numerous pipelines and pipeline facilities potentially being constructed throughout the Great Lakes region seems well founded, based on observations of the extensive network of pipelines in the Gulf of Mexico. Construction of shallow water pipelines<sup>49</sup> in the Gulf of Mexico is increasing. In the Gulf “the total miles of [shallow water] pipelines installed in 2001 were 27,100, while the total miles in 2000 were 25,176, an increase of 1924.”<sup>50</sup> Obviously, the Gulf of Mexico varies significantly from the Great Lakes in terms of size and natural gas reserves. However, an annual increase in total pipeline mileage in the Gulf of 173 miles,<sup>51</sup> coupled with a national energy policy that encourages consumption, lends credence to the assumption that current pipeline proposals “could be the tip of the iceberg.”<sup>52</sup>

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<sup>48</sup> Webber, *supra* note 4.

<sup>49</sup> Shallow water pipelines are those less than 1000 feet deep. Veronica Murillo, “Saturated product market slowing pipeline installation in Gulf of Mexico,” *Offshore*, Mar. 2002.

<sup>50</sup> *Id.* It is important to note that this number includes repairs and replacements.

<sup>51</sup> *Id.*

<sup>52</sup> Kellogg (quoting Jennifer Nalbene, Habitat and Biodiversity Coordinator at Great Lakes United).



Several authors have expressed concern that the granting of a pipeline right-of-way will lead to its subsequent use by additional utility lines. However, it seems unlikely that the same right-of-way granted for a natural gas pipeline will be used for additional pipelines or cables, due to safety issues.<sup>53</sup> Construction near a pre-existing natural gas pipeline must maintain a distance from the line of several hundred feet, to avoid breaching or otherwise compromising the pre-existing line.<sup>54</sup> Thus, future pipelines would need to establish independent routes across lake bottomlands. However, it is relatively safe to assume that, once the first pipeline is constructed on U.S. bottomlands without incident, subsequent construction will face more lenient regulatory scrutiny.

One drawback to future independent routes is that such dispersed construction may contribute to heightened environmental impacts; each new transmission line will disrupt previously undisturbed bottomlands and benthic communities. A similar argument was made by the Department of State, in regard to the effect of multiple pipelines on Haverstraw Bay:

The construction of a pipeline in this area would be precedent setting and could lead to similar proposals to construct other pipelines across inappropriate areas in Haverstraw Bay. If constructed in a similar manner, the cumulative effects of such structures in the wetlands, mudflats, shoals, and shallow open estuarine waters in Haverstraw Bay would significantly degrade the quality and integrity of the designated habitat by changing the physical, biological and chemical parameters that the habitat and many species using it are dependent upon.<sup>55</sup>

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<sup>53</sup> Borawski, *supra* note 23.

<sup>54</sup> *Id.*

<sup>55</sup> Department of State Decision—review of the Millennium Pipeline proposal. May 9, 2002. F-2001-0246.

Thus, the development of natural gas pipelines in the Great Lakes could have far reaching environmental and regulatory effects.

### *C. Public Awareness*

A third possible consequence of pipeline development in the Great Lakes is increased public awareness of the Great Lakes. Pipelines often receive significant media attention, and this attention may reflect Great Lakes issues. To a degree, this has already begun on a national level. For example, the Senate approved an amendment to the Energy Policy Act of 2002 “requiring [the Department of Energy] to study the environmental impact of building more pipelines and powerlines under the Great Lakes.”<sup>56</sup> According to Senator Carl Levin, who sponsored the amendment, “It is obvious that energy transmission infrastructure is important, but it is critical that we understand the impacts of placing this infrastructure across the lake beds. [ ] It is also imperative that we develop a long-term strategy for their placement.”<sup>57</sup> In theory, pipeline proposals could spark a constructive policy discussion about the future use of Great Lakes resources.<sup>58</sup> Thus, pipelines in the Great Lakes may have a variety of consequences, all of which bring to bear important considerations for the future of the Great Lakes.

## IV. ARE ADDITIONAL REGULATIONS POSSIBLE?

Throughout this paper, I have referred to a confusing and largely non-protective regulatory system controlling the installation of pipelines in the Great Lakes. This characterization is my own, derived largely from conversations with professors,

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<sup>56</sup> “Senate Approves Energy Bill, Including Tax Credit for Alaska Gas; House-Senate Conference may be Difficult,” *Foster Natural Gas Report*, Apr. 25, 2002. Report number 2384.

<sup>57</sup> Kellogg, *supra* note 3.

<sup>58</sup> In the alternative, public awareness may result in the mainstream acceptance of natural gas pipelines.

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environmentalists, and professionals within the system. And, while the questionable validity of my characterization is freely conceded, it, coupled with possible environmental consequences to the Lakes, has compelled me to undertake a cursory discussion of how additional regulations could provide greater environmental protection. For the moment, a discussion of whether greater regulation *should* be implemented has been postponed.

### *A. Site Specific Regulations*

One way for pipeline construction under the Great Lakes to face increased regulation would be for Great Lakes states and/or the federal government to pass restrictive legislation on point. For example, several Great Lakes states have passed laws banning directional drilling under the Great Lakes. Great Lakes states could theoretically ban the construction of pipelines under the Lakes, too.<sup>59</sup> In addition, Congress has banned directional drilling under the Great Lakes via the fiscal year 2002 annual spending bill. “The [ ] provision would prevent federal agencies from issuing permits for new drilling [in the Great Lakes] through Sept. 30, 2003, while the government produces a study on the environmental affects (sic) such drilling might have.”<sup>60</sup> Similarly, Congress could prevent federal agencies from granting pipeline permits, pending the results of the studies mandated by the Senate’s amendment to the Energy Policy Act of 2002 (mentioned above). This would ensure that all possible environmental impacts have been thoroughly analyzed prior to pipeline construction. I am not necessarily an advocate of additional regulations, as I have found the current system to be sufficiently complex. And yet, it seems that my previous analysis of the causes and consequences of pipeline development in the Great Lakes is without merit if there is no room

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<sup>59</sup> Of course, any action taken at the state level might implicate the Dormant Commerce Clause, which could limit this form of pipeline regulation.

<sup>60</sup> Alan Fram, *Drilling Under the Great Lakes Banned by Congress*, at <http://www.mindfully.org/Water/Drilling-Under-Lakes.htm>.

*B. Enforcement of Current Regulations*

Instead of adding new provisions and additional legislation to the pipeline permitting process, various regulatory provisions currently in effect could be more vigorously enforced. Great Lakes pipeline proposals should be reviewed for thorough and complete compliance with federal and state regulations. Once again, the Millennium Pipeline provides relevant examples of regulatory compliance arguably in need of ‘fine tuning.’

It has been argued that the Lake Erie crossing of the Millennium Pipeline is inconsistent with policies seven and nine of the New York State Coastal Management Program.<sup>61</sup> Policy seven states, “significant coastal fish and wildlife habitats will be protected, preserved and, where practical, restored so as to maintain their viability as habitats.”<sup>62</sup> Policy nine encourages “expand[ing] recreational use of fish and wildlife resources in coastal areas by increasing access to existing resources, supplementing existing stocks, and developing new resources.”<sup>63</sup> The inconsistency stems from the fact that “[i]t took many years of hard work on the part of water quality experts to clean up [Lake Erie] so that it could once again sustain the walleye and the federally endangered lake sturgeon, among other fish species.”<sup>64</sup> The addition of a potentially polluting pipeline does not ‘protect, preserve, and expand coastal fish resources.’ In addition, a natural gas pipeline’s inconsistency with policy eighteen, requiring that

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<sup>61</sup> Debra Brown, *Letter to David P. Boergers, Secretary of the Federal Energy Regulatory Commission*, FERC RIMS DOC # 2300297, available at <http://www.rimsweb1.ferc.fed.us/rims> (July 1, 2002).

<sup>62</sup> 19 NYCRR § 600.5(b)(1) available at <http://www.dos.state.ny.us/cstl/cstlcr.html#policies>.

<sup>63</sup> 19 NYCRR § 600.5(b)(2) available at <http://www.dos.state.ny.us/cstl/cstlcr.html#policies>

<sup>64</sup> Brown, *supra* note 62.

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“proposed major actions in the coastal area must give full consideration to [the vital economic, social and environmental interests of the state and of its citizens] is not an unreasonable argument.”<sup>65</sup> New York State held the Millennium Pipeline proposal to be inconsistent with the Coastal Zone Management Program in 2002.<sup>66</sup> This decision cited inconsistencies which potentially impacted Haverstraw Bay, the Village of Croton-on-Hudson, and the drinking water supply for New York City and Westchester Communities.<sup>67</sup> However, stricter compliance with state policies might be warranted for lake crossings, as well.

A second example of Millennium’s questionable regulatory compliance involves the National Environmental Policy Act. New York State Attorney General Eliot Spitzer questioned the adequacy of the NEPA review conducted by the Federal Energy Regulatory Commission regarding “the possible need for sectionalizing block valves” in the Millennium Pipeline.<sup>68</sup> Mr. Spitzer argued,

[Sectionalizing block] valves, located at regular intervals along the Lake Erie crossing, could close the pipeline in the event of a rupture and thus limit the amount of gas that would escape to that amount in the ruptured section. We believe this issue must be addressed and analyzed, as required by the National Environmental Policy Act [ ] before any final approval by FERC of the Millennium Pipeline.”<sup>69</sup>

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<sup>65</sup> 19 NYCRR § 600.5(i) available at <http://www.dos.state.ny.us/cstl/cstlcr.html#policies>

<sup>66</sup> New York State Dep’t of State, *Department of State Finds Pipeline Proposal Inconsistent with State’s Coastal Management Program*, at [http://www.dos.state.ny.us/pres/pr2002/cstl5\\_9.html](http://www.dos.state.ny.us/pres/pr2002/cstl5_9.html) (May 9, 2002).

<sup>67</sup> *Id.*

<sup>68</sup> Eliot Spitzer, *Letter to David Boergers, Secretary of the Federal Energy Regulatory Commission on FERC RIMS DOC # 2224321*, available at <http://www.rimsweb1.ferc.fed.us/rims> (Nov. 9, 2001).

<sup>69</sup> *Id.*

A gap in the regulatory review process has apparently left this issue unaddressed, which could result in detrimental consequences.

FERC apparently takes the position that because the decision of whether to install sectionalizing block valves will be made by the U.S. Department of Transportation (DOT) and because the EIS prepared by FERC “leaves the possibility open,” FERC has complied with NEPA. [ ] However, [ ] it appears that DOT will not perform its own environmental review and that DOT expects FERC to address and analyze the relevant issues and impacts. For example, in relation to the question of valve spacing under the lake, [the Director of Regulations at DOT’s Office of Pipeline Safety] stated [ ] that “FERC needs to analyze the impacts of having 93 miles of gas available to feed a fire.”<sup>70</sup>

Finally, it has been suggested<sup>71</sup> that the North American Free Trade Agreement (NAFTA) may be implicated in the regulation of prices for utility corridors under the Great Lakes. Because it is significantly cheaper for a utility company to purchase a right-of-way through the Lakes than over land, this may be an illegal subsidy prohibited by NAFTA, if it provides opportunities to some countries at the expense of others. Further investigation of this suggestion is needed.

Based on the aforementioned examples and others that have not been included in this paper, an argument can be made that various regulatory provisions regarding pipelines were not fully complied with in regard to the Millennium Pipeline. If other pipeline proposals are approved under similarly lax enforcement standards, the Great Lakes region will face increased risk.

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<sup>70</sup>*Id.*<sup>71</sup>Errol Meidinger, *Environmental Colloquium Lecture* (March 20, 2003).

*C. Current Regulations, New Applications*

Stricter environmental protection from pipelines under the Great Lakes may be available through the application of additional, preexisting regulatory measures to the pipeline permitting process. The following are several possibilities, all of which seem applicable to pipelines under the Great Lakes, but none of which I have thoroughly verified.<sup>72</sup>

The Toxic Release Inventory, authorized by the Emergency Planning and Community Right-to Know Act of 1986,<sup>73</sup> “requires [the Environmental Protection Agency] and the States [to] annually collect data on releases and transfers of certain toxic chemicals from industrial facilities and make the data available to the public.”<sup>74</sup> Because the construction and maintenance of a natural gas pipeline necessarily involves potentially toxic chemicals—methane being the most obvious—pipeline operators could, and arguably should, have TRI reporting requirements imposed upon them.

Federal legislation may also be a source of additional regulations that affect the construction of pipelines under the Great Lakes. For example, the process of installing a pipeline<sup>75</sup> under the Great Lakes will disturb sediments, resulting in sediment and contaminants in the sediment being suspended in Lake water and redeposited on Lake bottomlands. It could be argued that this activity *should* be considered a ‘discharge,’ resulting in permit requirements and limitations under the Federal Water Pollution Control Act, including the National Pollution Discharge Elimination System. Of course, regardless of the letter of the law,

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<sup>72</sup> These ideas are compiled based on discussions coordinated by Great Lakes United.

<sup>73</sup> 42 U.S.C. 11001 *et seq.* (1986).

<sup>74</sup> EPA, *What if the Toxics Release Inventory (TRI) Program*, at <http://www.epa.gov/tri/whatis.htm>.

<sup>75</sup> The Millennium Pipeline would be installed using a process called ‘jet trenching.’

the Environmental Impact Assessment for the Millennium pipeline states, “[t]he sediments along the proposed pipeline route [across Lake Erie] can be considered as being uncontaminated by toxic chemicals.”<sup>76</sup> Additional research into the sediments, as well as potential changes in federal regulations, is needed.

Even if the disturbance of contaminated sediments is not subject to such regulation, federal water pollution legislation may still be applicable to additional pipeline activities. For example, “[t]he [Millennium] pipeline will be tested hydrostatically in stages, including the directionally drilled shore crossing sections, [ ] and the entire pipeline system upon construction completion. [ ] It is assumed that direct discharge to Lake Erie will be acceptable. TransCanada will seek to obtain permits from [the New York State Department of Environmental Conservation].”<sup>77</sup> Under the Clean Water Act, any chemicals contained in the water discharged into the Great Lakes after hydrostatic testing could possibly trigger permitting requirements. More research into this issue is needed.

Requiring pipeline operators to purchase insurance policies to protect potentially affected communities, in case of damage to homes or property, is another possibility for increased regulation. Alternatively, communities should be able to participate in the development of an emergency response plan, in case of a pipeline accident. Such a plan could include the coordination of community ‘first responders,’ government officials, and possible HAZMAT assistance. According to the EIA for the Millennium Lake Erie Crossing, “TransCanada’s Emergency Procedures Manual (EPM) provides the overall strategy for the Company’s emergency response effort, general responder responsibilities and basic response procedures.”<sup>78</sup> However, if an emergency response plan is developed on a site-specific basis, communities might have greater protection.

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<sup>76</sup> Environmental and Socio-Economic Impact Assessment of the Proposed Millennium Project Lake Erie Crossing—Amended EIA Report. (EIA) Prepared by Beak International, Inc. March 2000. page 4.58.

<sup>77</sup> *Id.* at 5.55.

<sup>78</sup> *Id.* at 6.17.



The addition of these and other regulatory requirements might be a means by which to discourage and/or prevent the construction of pipelines in the Great Lakes; in theory, increased regulation may become cost prohibitive and more burdensome, making land routes more favorable for pipeline construction. Regardless, affected communities and environments would be better served were these or similar requirements imposed. Additional research into the applicability of these provisions is needed before any could be realistically proposed.

#### IV. CONCLUSION

In this paper, I have attempted to address some of the policy issues surrounding the proposed construction of natural gas pipelines in the Great Lakes. However, such policy issues cannot be adequately resolved until or unless a more pressing and fundamental question is addressed: namely, *should* the Great Lakes be used for pipeline development? In order to answer this question, we must look beyond the Lakes themselves.

The construction of pipelines under the Great Lakes is one of many alternatives for the development of North America's energy infrastructure. It is a choice, the environmental consequences of which may be beneficial or detrimental, depending on the scale in which they are analyzed. According to James E. Hickey, Director of International Programs and Professor of Law at Hofstra University, the regional effects of energy choices are often not—but should be—considered. As an illustration, he describes how local opposition to a nuclear power plant in New York City had unexpected regional consequences.

[T]he successful efforts in the 1980s of Long Islanders in New York to cancel a new 800-MW nuclear power plant, in part, encouraged plans for the completion of the James Bay hydroelectric project in Quebec to replace the 800 MW of power lost on Long Island. To complete the James Bay

development, the required reservoirs would change river flows, eliminate ponds, flood forests, adversely affect indigenous plant life, destroy habitat for fish and other migrating species, and displace indigenous peoples. In seeking the cancellation of new nuclear power production in the 1980s, Long Islanders did not take into account the cross-energy sector environmental effects on new hydroelectric production decisions in Canada.<sup>79</sup>

If a pipeline is constructed beneath the Great Lakes, it will result in local, regional and international impacts, both good and bad. This does not answer the question of 'should,' but it adds breadth to the inquiry.

Second, an increase in natural gas pipelines may promote the United States' dependence on "clean" energy. Natural gas has a carbon content that is approximately 40 percent lower than coal.<sup>80</sup> Using natural gas instead of coal may have environmental benefits. For example, if the United States had ratified the Kyoto Protocol, "U.S. natural gas consumption was estimated to increase by 21 percent, due to the initiative to reduce greenhouse gas emissions."<sup>81</sup> As a result, an arguably short-term environmental disturbance in the Great Lakes may result in long-term benefits regarding global warming. Finally, the Great Lakes are not only an important natural resource for the region, but for the nation and the international community as well. The development of potentially despoiling energy infrastructure within a system that contains 18 percent of the world's surface freshwater resources should be preceded by a global consensus on resource use. "The

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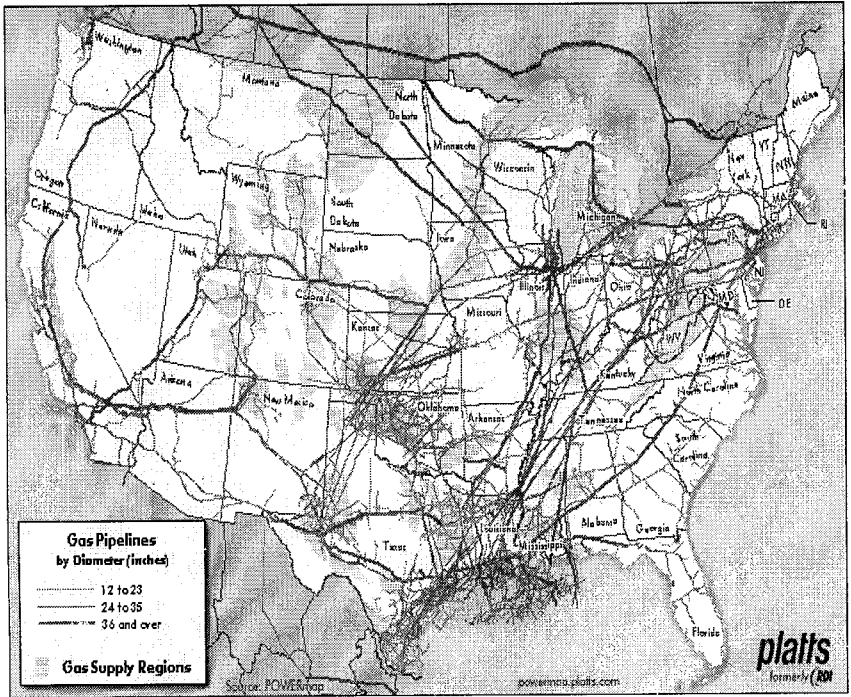
<sup>79</sup> James E. Hickey, *The Environmental Implications of the Discovery and Delivery of New Energy Resources in the Canada/US Context*, 28 CAN.U.S.L.J. 209, 213 (2002).

<sup>80</sup> Robert E. Borgstrom & David A. Foti, *U.S. gas pipelines: the challenge of global warming*, PUBLIC UTILITIES FORT. (1994) Jun. 15, 1999, at 66.

<sup>81</sup> *Id.*

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future reality of new energy production in Canada and the U.S.  
will involve increasing transnational integration of fuel cycles,  
greater appreciation of cross-sector effects of energy production  
decisions, and greater attendant regional and global environmental  
effects.”<sup>82</sup> Despite arguments based on state or federal jurisdiction  
or littoral and riparian rights, no one ‘owns’ the water—it  
circulates among us, and unilateral acts that threaten its existence  
must not be tolerated.

Should the Great Lakes be used for pipeline development?  
I cannot answer this question with certainty, although my gut  
reaction is to oppose such development. This paper acknowledges  
that a natural gas pipeline beneath a Great Lake may be the lesser  
of several evils. However, I firmly believe that acquiescence to  
Great Lakes pipeline development will lead us down the infamous  
‘slippery slope,’ a path that the environment cannot afford to take.  
The governmental agencies, private companies, and public interest  
groups involved in the pipeline debate need to remember that the  
actions they take are likely to have effects that are greater and  
more resilient than the Great Lakes themselves.



Appendix 1: Map of North American Gas Pipelines<sup>83</sup>

<sup>83</sup> EIA, table 1.2 (map of North American gas pipelines) located at <http://www.platts.com/features/usgasguide/pipelinemap.shtml>.

Appendix 2: POTENTIALLY RELEVANT CANADIAN AND U.S. LEGISLATION  
CANADA

- National Energy Board Act
- Navigable Waters Protection Act
- Canada Water Act
- Canadian Environmental Protection Act
- Fisheries Act
- Migratory Birds Convention Act
- Canadian Environmental Assessment Act

ONTARIO

- Public Lands Act
- Endangered Species Act
- Environmental Protection Act
- Lakes and Rivers Improvement Act
- Public Utilities Act
- Drainage Act
- Pesticides Act
- Ontario Water Resources Act
- Aggregate Resources Act
- Ontario Heritage Act
- Game and Fish Act
- Beach Protection Act
- Beds of Navigable Waters Act
- Fill, Construction and Alteration to Waterways Regulation of the Conservation Authorities Act
- Forest Fires Prevention Act

UNITED STATES

- National Environmental Policy Act
- Rivers and Harbors Act
- Clean Water Act
- Marine Protection, Research, and Sanctuaries Act
- Coastal Zone Management Act
- Fish and Wildlife Coordination Act
- Endangered Species Act
- National Historic Preservation Act
- National Fishing Enhancement Act

PENNSYLVANIA

- Dam Safety Act
- Bluff Recession and Setback Act
- Soil Conservation Law

- Pennsylvania Solid Waste Management Act
- Air Pollution Control Act
- Fish Laws of 1959
- Clean Streams Law
- Historic Preservation Act

## NEW YORK

- State Environmental Quality Review Act
- Environmental Conservation Law
- Article 7 of the Public Service Commission Law
- Waterfront Revitalization and Coastal Resources Act
- Freshwater Wetlands Act

## INTERNATIONAL

- Boundary Waters Treaty
- Great Lakes Water Quality Agreement of 1978

## APPENDIX 3 - HAZARDOUS POLLUTING SUBSTANCES

Acetaldehyde	Acetic Acid	Acetic Anhydride
Acetone Cyanohydrin	Acetyl Bromide	Acetyl Chloride
Acrolein	Acrylonitrile	Aldrin
Allyl Alcohol	Allyl Chloride	Aluminum Sulfate
Ammonia	Ammonium Acetate	Ammonium Benzoate
Ammonium Bicarbonate	Ammonium Bichromate	Ammonium Bifluoride
Ammonium Bisulfite	Ammonium Carbamate	Ammonium Carbonate
Ammonium Chloride	Ammonium Chromate	Ammonium Citrate, Dibasic
Ammonium Fluoborate	Ammonium Fluoride	Ammonium Hydroxide
Ammonium Oxalate	Ammonium Silicofluoride	Ammonium Sulfamate
Ammonium Sulfide	Ammonium Sulfite	Ammonium Tartrate
Ammonium Thiocyanate	Ammonium Thiosulfate	Amyl Acetate
Aniline	Antimony Pentachloride	Antimony Potassium Tartrate
Antimony Tribromide	Antimony Trichloride	Antimony Trifluoride
Antimony Trioxide	Arsenic Disulfide	Arsenic Pentoxide
Arsenic Trichloride	Arsenic Trioxide	Arsenic Trisulphide
Barium Cyanide	Benzene	Benzoic Acid
Benzonitrile	Benzoyl Chloride	Benzyl Chloride
Beryllium Chloride	Beryllium Fluoride	Beryllium Nitrate
Butyl Acetate	Butylamine	Butyric Acid
Cadmium Acetate	Cadmium Bromide	Cadmium Chloride
Calcium Arsenate	Calcium Arsenite	Calcium Carbide
Calcium Chromate	Calcium Cyanide	Calcium Dodecylbenzenesulfonate
Calcium Hydroxide	Calcium Hypochlorite	Calcium Oxide
Captan	Carbaryl	Carbon Disulfide
Chlordane	Chlorine	Chlorobenzene
Chloroform	Chlorosulfonic Acid	Chlorpyrifos
Chromic Acetate	Chromic Acid	Chromic Sulfate
Chromous Chloride	Cobaltous Bromide	Cobaltous Foremate
Cobaltous Sulfamate	Coumaphos	Cresol
Cupric Acetate	Cupric Acetoarsenite	Cupric Chloride
Cupric Nitrate	Cupric Oxalate	Cupric Sulfate
Cupric Sulfate, Ammoniated	Cupric Tartrate	Cyanogen Chloride
Cyclohexane	2, 4-D Acid	2, 4-D Esters

Dalapon	DDT	Diazinon
Dicamba	Dichlobenil	Dichlone
Dichlorvos	Dieldrin	Diethylamine
Dimethylamine	Dinitrobenzene (mixed)	Dinitrophenol
Diquat	Disulfoton	Diuron
Dedocylbenzenesulfonic Acid	Endosulfan	Endrin
Ethion	Ethylbenzene	Ethylenediamine
EDTA	Ferric Ammonium Citrate	Ferric Ammonium Oxalate
Ferric Chloride	Ferric Fluoride	Ferric Nitrate
Ferric Sulfate	Ferrous Ammonium Sulfate	Ferrous Chloride
Ferrous Sulfate	Formaldehyde	Formic Acid
Fumaric Acid	Furfural	Guthion
Heptachlor	Hydrochloric Acid	Hydrofluoric Acid
Hydrogen Cyanide	Isoprene	Isopropanolamine Dodecylbenzenesulfonate
Kelthane	Lead Acetate	Lead Arsenate
Lead Chloride	Lead Fluoborate	Lead Fluoride
Lead Iodide	Lead Nitrate	Lead Stearate
Lead Sulfate	Lead Sulfide	Lead Thiocyanate
Lindane	Lithium Chromate	Malathion
Maleic Acid	Maleic Anhydride	Mercuric Cyanide
Mercuric Nitrate	Mercuric Sulfate	Mercuric Thiocyanate
Mercurous Nitrate	Methoxychlor	Methyl Mercaptan
Methyl Methacrylate	Methyl Parathion	Mevinphos
Mexacarbate	Monoethylamine	Monomethylamine
Naled	Naphthalene	Naphtenic Acid
Nickel Ammonium Sulfate	Nickel Chloride	Nickel Hydroxide
Nickel Nitrate	Nickel Sulfate	Nitric Acid
Nitrobenzene	Nitrogen Dioxide	Nitrophenol (mixed)
Paraformaldehyde	Parathion	Pentachlorophenol
Phenol	Phosgene	Phosphoric Acid
Phosphorous	Phosphorus Oxychloride	Phosphorus Pentasulfide
Phosphorus Trichloride	Polychlorinated Biphenyls	Potassium Arsenate
Potassium Arsenite	Potassium Bichromate	Potassium Chromate
Potassium Cyanide	Potassium Hydroxide	Potassium Permanganate
Propionic Acid	Propionic Anhydride	Pyrethrins
Quinoline	Resorcinol	Selenium Oxide



Sodium	Sodium Arsenate	Sodium Arsenite
Sodium Bichromate	Sodium Bifluoride	Sodium Bisulfite
Sodium Chromate	Sodium Cyanide	Sodium Dodecylbenzenesulfonate
Sodium Fluoride	Sodium Hydrosulfide	Sodium Hydroxide
Sodium Hypochlorite	Sodium Methylate	Sodium Nitrite
Sodium Phosphate, Dibasic	Sodium Phosphate, Tribasic	Sodium Selenite
Strontium Chromate	Strychnine	Styrene
Sulfuric Acid	Sulfur Monochloride	2,4,5-T Acid
2,4,5-7 Esters	TDE	Tetraethyl Lead
Tetraethyl Pyrophosphate	Toluene	Toxaphene
Trichlorfon	Trichlorophenol	Triethanolamine Dodecylbenzenesulfonate
Triethylamine	Thrimethylamine	Uranyl Acetate
Uranyl Nitrate	Vanadium Pentoxide	Vanadyl Sulfate
Vinyl Acetate	Xylene (mixed)	Xylenol
Zinc Acetate	Zinc Ammonium Chloride	Zinc Borate
Zinc Bromide	Zinc Carbonate	Zinc Chloride
Zinc Cyanide	Zinc Fluoride	Zinc Formate
Zinc Hydrosulfite	Zinc Nitrate	Zinc Phenolsulfonate
Zinc Phosphide	Zinc Silicofluoride	Zinc Sulfate
Zirconium Nitrate	Zirconium Potassium Fluoride	Zirconium Sulfate
Zirconium Tetrachloride		

## APPENDIX 4 - POTENTIAL HAZARDOUS POLLUTING SUBSTANCES

Acridine	Allethrin	Aluminum Fluoride
Aluminum Nitrate	Ammonium Bromide	Ammonium Hypophosphite
Ammonium Iodide	Ammonium Pentaborate	Ammonium Persulfate
Antimony Pentafluoride	Antimycin A	Arsenic Acid
Barhan	Benfluralin	Bensulide
Benzene Hexachloride	Beryllium Sulfate	Butifos
Cadmium	Cadmium Cyanide	Cadmium Nitrate
Captafol	Carbophenothion	Chlorflurazole
Chlorothion	Chlorpropham	Chromic Chloride
Chromium	Chromyl Chloride	Cobaltous Fluoride
Copper	Crotoxypfos	Cupric Carbonate

Cupric Citrate	Cupric Formate	Cupric Glycinate
Cupric Lactate	Cupric Paraamino Benzoate	Cupric Salicylate
Cupric Subacetate	Cuprous Bromide	Demeton
Dibutyl Phthalate	Dicapthon	2,4-Dinitrochlorobenzene
p-Dinitroresol	Dinocap	Dinoseb
Dioxathion	Dodine	EPN
Gold Trichloride	Hexachlorophene	Hydrogen Sulfide
m-Hydroxybenzoic Acid	p-Hydroxybenzoic Acid	Hydroxylamine
2-Hydroxyphenazine-1-Carboxylic Acid	Lactonitrile	Lead Tetraacetate
Lead Thiosulfate	Lead Tungstate	Lithium Bichromate
Malachite Green	Manganese Chloride, Anhydrous	MCPA
Mercuric Acetate	Mercuric Chloride	Mercury
Metam-Sodium	p-Methylamino-Phenol	2-Methyl-Napthoquinone
Neburon	Nickel Formate	Phenylmercuric Acetate
n-Phenyl Naphthylamine	Phorate	Phosphamidon
Picloram	Potassium Azide	Potassium Cuprocyanide
Potassium Ferricyanide	Propyl Alcohol	Pyridyl Mercuric Acetate
Rotenone	Silver	Silver Nitrate
Silver Sulfate	Sodium Azide	Sodium 2-Chlorotoluene-5-Sulfonate
Sodium Pentachlorophenate	Sodium Phosphate, Monobasic	Sodium Sulfide
Stannous Fluoride	Strontium Nitrate	Sulfoxide
Temephos	Thallium	Thionazin
1,2,4-Trichlorobenzene	Uranium Peroxide	Uranyl Sulfate
Zinc Bichromate	Zinc Potassium Chromate	Zirconium Acetate
Zirconium Oxychloride		

