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## POLLUTION CONTROL: WASTEWATER IRRIGATION

JOHN R. SHEAFFER\*

AS THESE words are being written, the Congress of the United States is completing another round of effort to guarantee the nation an adequate supply of clean water effectively distributed to meet the people's needs.<sup>1</sup> The Senate and the House first passed somewhat differently phrased amendments to the Federal Water Pollution Control Act, and later approved (Senate, 74-0; House 366-11) a compromise agreed on by a conference committee after months of debate. Although a Presidential veto is being talked of, such conservative Republicans as Congressman William Harsha of Ohio are characterizing "the greatest environmental legislation ever before Congress." The legislative intent behind this superlative is explicitly stated in the Senate Public Works Committee report on the original Senate version of the bill (S. 2770):

Perhaps the principal cause of inefficiency and poor performance in the management of waste in the metropolitan regions is the incoherent and uncoordinated planning and management that prevails in many areas of the nation. Adjacent communities and industries are under no mandate to coordinate land use or water quality planning activities. This results in poor overall performance and the proliferation of many direct and indirect discharge sources into receiving waters. Such diffuse and divergent programs not only intensify pollution problems but they prevent the use of economies of scale, efficiency of treatment methods, and, most importantly, coherent integrated and comprehensive land use management.<sup>2</sup>

The House Public Works Committee report on the House bill (HR 11896) calls Section 208—which authorizes areawide waste treatment management—"the most important aspect of a water pollution control strategy."<sup>3</sup>

Clearly, there has been a dramatic shift away from past depen-

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1. S. 2770, 92d Cong., 1st Sess. (1971) and H.R. 11896, 92d Cong., 2d Sess. (1972).

2. SENATE COMM. ON PUBLIC WORKS, FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1971, S. DOC. No. 414, 92d Cong., 1st Sess. 36 (1971).

3. HOUSE COMM. ON PUBLIC WORKS, FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972, H.R. DOC. No. 911, 92d Cong., 2d Sess. 95 (1972).

dencies on local and state governments for planning and executing regulation of wastewater treatment and discharge of wastewater into streams and lakes. In support of greater federal participation in the pollution control process, Congressman John D. Dingell (Michigan) observed that "the nationwide cleanup program did not gain momentum until the federal government attempted to set water standards in order to prevent states from bidding with each other on standards for industry."<sup>4</sup> A counterforce pushing for continuance of the destructive competitive tradition has been noted by Leonard Woodcock, president of the United Automobile Workers Union. He has attributed a new environmental "game plan" to American industry, and has cited what he believes to be an instance of the way the "game" is played: "When General Motors came under pressure from a federal court action for discharging wastes into the Hudson River from its Tarrytown plant, it shifted its offending operation from Tarrytown to Baltimore."<sup>5</sup>

To maintain a healthy balance in the national water cleanup, planning activities must be accelerated to keep pace with the rapid increase in funding of federal construction grants. No longer will inventories of pollution sources or hearings on violations be considered adequate. Nothing less than the formulation of basic alternative systems for wastewater management and their evaluation in terms of ecological, hygienic, social, esthetic and economic parameters will suffice. The arbitrary constraints of the past will not be accepted, as Thomas C. Jorlings, minority counsel for the Senate Committee on Public Works, warned in his comment on the intent of the bill:

The planning section deals with the problem of what areas should be considered in a given plan. River basin plans lend themselves to providing parameters for basin development. This would require "management units, consisting of industry and others, that would be able to act without regard to artificial boundaries such as state lines."<sup>6</sup>

Historically, every local unit of government in the country held itself responsible for taking care of its own waste problems. With

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4. HOUSE COMM. ON PUBLIC WORKS, FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972, H.R. DOC. No. 911, 92d Cong., 2d Sess. 23 (1972).

5. Woodcock, *Pollution Black Mail*, Washington Star, June 9, 1972, at —, col. —.

6. HOUSE COMM. ON PUBLIC WORKS, *supra* note 4, at 2.

few exceptions, each local unit acted with only itself and its immediate needs in mind, either constructing some type of sewage treatment plant or discharging wastes into a body of water deemed capable of diluting and assimilating them. Because further economic development was a continuing objective of most local governments, efforts frequently were made to accommodate rather than to discipline polluters.

The proliferation of local governments, *e.g.*, 250 municipalities in the Illinois portion of the Chicago metropolitan area, has resulted in proliferation of sewage treatment plants. Even in the urban region encompassed by the world-famous centralized Metropolitan Sanitary District of Greater Chicago, there were 339 treatment plants in 1966.<sup>7</sup>

#### STATE ROLES

Initially, the role of the states in matters relating to waste water was largely regulatory and administrative. This role has been expanded dramatically as federal water quality legislation has broadened. For example, under the Water Quality Act of 1965 (PL89--234) the states were given first option in setting water quality standards for their interstate waters provided only that they would act by June 30, 1967.<sup>8</sup> States that took the option were able to formulate plans to implement and enforce their standards. Notwithstanding the number of states that accepted this opportunity, the water quality program still lagged. On November 16, 1970, the Environmental Protection Agency's Water Quality Office issued an *Evaluation of Implementation Plans, State Program Plans, and FWQA Status Reports on Enforcement of Conference Recommendations*.<sup>9</sup> This document concluded that:

Implementation plans in sufficient detail to enable progress to be measured towards compliance with standards do not exist for most states. Even if the most liberal interpretation is made as to what constitutes interim dates or milestones, ten states are still without such dates, while interim dates for most other states border on minimal checkpoints at best . . . .

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7. J. SHAEFFER, THE WATER RESOURCE IN NORTHEASTERN ILLINOIS: PLANINGG ITS USE 36 (1966).

8. Water Quality Act of 1965, Pub. L. No. 89-234, 79 Stat. 903.

9. U.S. ENVIRONMENTAL PROTECTION AGENCY WATER QUALITY OFFICE, EVALUATION OF IMPLEMENTATION PLANS, STATE PROGRAM PLANS AND FWQA STATUS REPORTS ON ENFORCEMENT CONFERENCE RECOMMENDATIONS (1970).

It is questionable whether all interstate streams have been included in the water quality standards. . . . Thirty-one states have unilaterally extended implementation schedules, established either in implementation plans or by recommendation of enforcement conferences (some for as much as 6 years).<sup>10</sup>

Several states<sup>11</sup> in the last category have excused their dilatory tactics on the grounds that their "reputations" for toughness in regulating pollution make federal "interference" unjustifiable. This is a disheartening record, particularly in the light of environmentalist enthusiasm for clean water in virtually every state.

#### FEDERAL LEGISLATIVE HISTORY

The first specific, comprehensive federal thrust toward water pollution control was embodied in the Act of June 30, 1948.<sup>12</sup> This law authorized the Surgeon General of the United States to assist and encourage states' study plans and supporting research. The law also provided for low interest loans up to \$250,000 each (or one-third the cost of each project) for sewage and waste treatment works. The overall spending limit on the program was \$22.5 million. One million dollars a year was made available to the states in the form of grants for pollution studies, and \$800,000 a year was authorized for aid in drafting construction plans for water pollution control projects. The total funding for all purposes covered by the law amounted to \$24.3 million a year. The terms of this legislation were extended through fiscal 1956 by the Act of July 17, 1952.<sup>13</sup>

Emergence of a permanent National Water Pollution Control program came with the enactment of the Act of July 9, 1956.<sup>14</sup> This legislation permitted federal participation and cooperation in the development of comprehensive programs. The law provided \$3 million a year in grants for Fiscal Years 1957-1961 to assist in the preparation of state plans for pollution control and \$500 million for grants to assist in the construction of sewage treatment plants for Fiscal Years 1957-1966. Federal contribu-

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10. *Id.* at 1.

11. Among others: California, Illinois, Massachusetts, Washington, Colorado and Connecticut.

12. Act of June 30, 1948, ch. 758, 62 Stat. 1155.

13. Act of July 17, 1952, ch. 927, 66 Stat. 755.

14. Act of July 9, 1956, ch. 518, 70 Stat. 498.

tions were raised from a ceiling of \$250,000 to a ceiling of \$600,000 for single projects and \$2.4 million for regional systems.

The current federal program was shaped by the Water Quality Act of 1965<sup>15</sup> and the Clean Water Restoration Act of 1966.<sup>16</sup> The former (P.L. 89-234) gave the states an opportunity to adopt water quality standards and implement plans for regulation of their interstate waters by June 30, 1967. Upon approval of the state standards by the Administrator of the Environmental Protection Agency, those standards would become the federal enforcement standards. If the standards adopted by the state were not adequate, the EPA Administrator was authorized to initiate standards that were adequate. The Water Quality Act of 1965 also provided grants for research into and development of better methods to control pollution from stormwater and combined sewer overflows; and it increased the available construction grants to \$150 million for Fiscal Years 1966 and 1967.<sup>17</sup>

The Clean Water Restoration Act of 1966 (P.L. 89-753) accelerated federal participation in the construction of sewage treatment facilities.<sup>18</sup> For the Fiscal Years 1967 to 1971, federal expenditures totaling \$3,550,000,000 were authorized; actual appropriations in those years were just a little over 50 per cent of the authorized sums.

#### THE POTENTIAL CONFLICT

This legislative history reflects growing federal interest and participation in matters relating to wastewater. In many respects, federal legislation has stimulated expansion of state programs, thus bringing about rapid expansion of both federal and state wastewater control activities and setting the stage for a potential conflict. An incipient confrontation is evident in the reactions of the states to the Senate and House versions of the Federal Water Pollution Control Act Amendments. For example, Michigan supported the House bill because:

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15. Water Quality Control Act of 1965, Pub. L. No. 89-234, 79 Stat. 903.

16. Clean Water Restoration Act of 1966, Pub. L. No. 89-753, 80 Stat. 1246.

17. Water Quality Control Act of 1965, Pub. L. No. 89-234, 79 Stat. at 903.

18. Clean Water Restoration Act of 1966, Pub. L. No. 89-753, 80 Stat. at 1246.

it gives the states a stronger role in pollution control. The Senate bill, the Muskie bill, would take control away from the states and give it to the federal government. We feel we've got a strong pollution control program. We believe that we may want to set higher standards in Michigan than some other states. And with the Environmental Protection Agency delegating the responsibility for water pollution control to the state as it would under the House bill, we can provide a higher degree of treatment and protection of our waters.<sup>19</sup>

Yet Michigan is strongly opposing the EPA's suggested guidelines for thermal discharges into Lake Michigan. In this instance, Michigan wants to set a less restrictive standard than EPA has proposed.

Joe P. Teller, Deputy Director, Texas Water Quality Board, was even more outspoken in opposing federal intervention:

A totally new set of planning requirements is needed. These should not come from nor should the authority for their implementation be given to EPA because EPA caused the present bad situation and should not be allowed to continue it. The situation in Texas is not that bad, and Texas does not need federal authority. . . . The federal-state regulations are impaired by the legislation. It is federal legislation rather than national legislation—it is not in the national interest. The planning sections are too rigid. It is, in fact, a "bureaucratic boondoggle"—the provisions are too inflexible to permit logical interpretation. . . .

The continuity of basin planning would be endangered by the fragmentation of Section 209. It will drive a wedge between the federal government and the states and will mean the end of effective state progress in water pollution control.<sup>20</sup>

This position was articulated even though water quality in the Upper Trinity River Basin in Texas caused a team of consultants to conclude that "the Upper Trinity River now poses a potential health hazard, does not satisfy aesthetic considerations, and is not suitable for many desired uses."<sup>21</sup> One might ask how such a situation could occur if state controls were effective. The fact is that the states, after holding primary jurisdiction over water quality for more than a hundred years, are seriously opposing a federal input into the planning process even though past ineffectiveness of state controls is well documented.

#### A NEW APPROACH

After approximately twenty-five years of ever-increasing spending for cleaner water, it has become apparent that measurable improve-

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19. Press Release, State of Michigan, Office of the Governor.

20. *Supra* note 4.

21. REPORT TO THE NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, UPPER TRINITY RIVER BASIN COMPREHENSIVE SEWERAGE PLAN at 1-4 (1970).

ments in water quality are rare. Eugene T. Jensen, Chief, Water Quality Office, EPA, told an American Society of Civil Engineers National Specialty Conference at Los Angeles:

I am ashamed to admit that . . . the old "pros" in the field of water pollution control appear to be lagging. The people and Congress appear to have swept by us. We seem willing to settle for too little. . . . We build (sewage) treatment facilities—but we fear expenditures that exceed what is absolutely necessary to maintain minimum stream quality. We tolerate poor operation. We are satisfied with less than modern treatment techniques, and confine our new, advanced, waste treatment technology to pilot plants and research laboratories. When the public asks for treatment to permit reuse (of wastewater), we hold back and point out only the weaknesses of the new treatment technology. We take some enforcement actions, but we do not make "unreasonable" requests. Is "reasonableness" an excuse for weakness, and "prudence" another word for timidity? The cases in which a major (polluted) stream or lake has actually been restored can be counted on one hand.

. . . .  
The problem will not be solved merely by enactment of legislation, no matter how well conceived or how expertly drawn. . . . We, the professionals in the field of water pollution control, are going to have to change ourselves, our concepts, and our way of doing things. . . . First and foremost perhaps, we must stop being satisfied with yesterday's technology. New technology is available. Until it is transferred into actual treatment facilities, it is of little value. Just because we have relied on trickling filters and activated sludge plants in the past does not mean that we should continue to do so today.

You will object, perhaps, that these processes have been well tried and have proved reliable. Yes, they have proved reliable if by reliable one means that they are known to break down and are subject to erratic performance. . . .<sup>22</sup>

Mr. Jensen's indictment was verified by a December 1971 survey conducted by the editorial staff of *Public Works*.<sup>23</sup> City and county engineers were asked: "What types of treatment, within financial feasibility, do you consider desirable for present or future (wastewater) installations?" Sixty-five per cent of the respondents favored activated sludge, a system with demonstrated inability to cope with the complex wastes of urban America.<sup>24</sup>

Ralph Nader's water pollution study group concluded that the technology being applied to water treatment today is inadequate to produce clean water. The Nader report stated that "we only begin to outgrow our fixation on the halfway treatment technology handed down to us by the pollution control profession when we stop being

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22. Lear, *Environmental Repair: The U.S. Army Engineers' New Assignment*, SATURDAY REVIEW, May 1, 1971, at 48.

23. 103 PUBLIC WORKS, No. 4, 52-55 (April, 1972).

24. *Id.* at 52-53.



satisfied with the moderately polluted rivers which that technology offers and begin to demand water that is truly clean."<sup>25</sup>

The simple truth is that we are not disposing of sewage. We are simply relocating it. We are either carrying it into the water or burning it into the air. This is sheer extravagance, which we cannot afford indefinitely.

Prudence dictates a return at the earliest feasible moment to the endless cycle of life that governs the natural world of which we are creatures. The cycle begins when the energy of the sun beats down on the sea. The heat thus generated evaporates the uppermost water. The vapor rises into the sky and condenses there to form clouds. Salt particles cast loose by breaking waves are lifted by the wind and deposited in the clouds, there to become the nuclei for ice crystals, which later fall as snowflakes or as raindrops on the land hundreds or even thousands of miles away. The rainwater either percolates into the soil or runs off into the rivers to be carried back to the oceans whence it came.

Human and other animal wastes excreted on the land are dissolved by the rain and decomposed by bacteria resident in the soil. This process is also a part of the natural cycle of life, but it tends to be forgotten in man's eagerness to escape the unsightliness and the smell of organic decomposition. Our practice is to hurry our wastes into the nearest water to get them out of the range of our eyes and noses.

As long as the number of earth's inhabitants held some reasonable proportion to the volume of water that carried the wastes away, the burden dumped into the rivers and lakes remained within the competence of waterborne bacteria to scavenge. However, the steadily accelerating population explosion of recent decades has magnified the malodorous cargo to insupportable dimensions.

Disposal of human wastes on land is too logical an alternative to be seriously arguable. Yet it is being argued, in terms that every lawyer interested in the nation's welfare should be aware of. Let me define the socio-legal context.

The food that our population consumes is, like all other goods of the marketplace, guaranteed free passage across all political

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25. BENSTOCK & ZWICK, *WATER WASTELAND* 389 (1971).

boundaries within the United States. This is guaranteed by the Constitution.<sup>26</sup> The need of cities for a continuous supply of the means of survival is too compelling to allow even the thought of constraint on the flow.

Now there is just as great a need for a city to dispose of its wastes as there is for a population to eat. In fact, the act of digestion makes the act of excretion inevitable. Nevertheless, the legal mechanics of government are being employed to interfere with the outward flow of wastes from the cities—except, ironically, when the wastes flow into the water, which must at one point or another be used for drinking.

The State of Maine offers a specific illustration of this lopsided state of affairs. In a special session of the year 1970, the Maine Legislature adopted An Act Prohibiting Dumping of Out-of-State Waste Matter.<sup>27</sup>

Apparently no one sitting in the legislature was able to see how ludicrous that Act was in the real terms of modern civilization. Apparently no legislator asked himself what would be the reaction of the people and the State of Maine if the legislatures of other states should prohibit the importation into their territories of Maine paper and wood products or of Maine potatoes.

Many environment-conscious citizens are working to restore the popularity of returnable bottles as containers of milk and soft drinks. I applaud the work that these people are doing. But the energy they are expending would bring immeasurably greater return to society if they were to broaden the focus of their campaign and require a "returnable after using" label on the foodstuffs flowing from the farms into the cities.

The concept of returnable nutrients is not original with me. It has been suggested from many quarters. Ecologist Barry Commoner put it formally in testimony before the Illinois Pollution Control Board: "I'm just proposing a very simple thing: Lend the nitrogen to the city folks—but get it back."<sup>28</sup>

Progressive farmers understand the wisdom of this procedure.

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26. U.S. CONST. art. I, § 8.

27. ME. REV. STAT. ANN. tit. 17, § 2253 (Supp. 1972).

28. *Hearings on Proposed Standards for Plant Nutrients—Before the Illinois Pollution Control Board*, Case No. R 71-15, at 162 (1971).

For example, Benjamin J. Reynolds of Avondale, Pennsylvania, has written about the successful operation of the spray irrigation he uses at Green Valley Farms:

By utilizing agricultural ground for the disposal of treated disposable effluents and agricultural waste we can create the green belts that our planners are dreaming of. This will provide areas of lush green crops and verdant woods which will be aesthetically pleasing to the eye. These lush green fields and woods will

provide open space for our evergrowing population

increase food production

provide more nursery trees to beautify our landscape

provide more boardfeet of lumber for our use

As I like to term it—this will be tax-paying open space producing highly salable crops for our economy. I feel the special benefit beside the production of food and fibre will be the cooperation engendered between our urban neighbors and our rural communities.<sup>29</sup>

#### ENVIRONMENTAL PRINCIPLE

A first attempt at giving the returnable nutrient concept explicit legal form has been made in the Congress, where the House accepted Michigan Representative Guy Vander Jagt's proposal to incorporate into the House version of the Federal Water Pollution Control Act Amendments earlier referred to (HR 11896) the following phraseology:

(d) The Administrator shall encourage waste treatment management which results in the construction of revenue producing facilities providing for—

(1) the recycling of potential sewage pollutants through the production of agriculture, silviculture or aquaculture products, or any combination thereof;

(2) the confined and contained disposal of pollutants not recycled;

(3) the reclamation of wastewater; and

(4) the ultimate disposal of sludge in a manner that will not result in environmental hazards.

(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

(f) The Administrator shall encourage waste treatment management which combines "open space" and recreational considerations with such management.<sup>30</sup>

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29. REYNOLDS, AN ECOLOGICAL BLUEPRINT FOR TODAY (1971).

30. HOUSE COMM. ON PUBLIC WORKS, FEDERAL WATER POLLUTION CONTROL AMENDMENTS OF 1972, H.R. DOC. No. 11896, 92d Cong., 2d Sess. 23 (1972).

Vander Jagt's language does three things at once. First, it shifts the strategy from wasteful disposal to beneficial management by treating human wastes as displaced resources. Second, it puts management of these resources on a multipurpose footing, not only contributing valuable fertilizer to agriculture, silviculture and aquaculture, but in the process also providing a constructive use for thermal discharges from electric power generators and at the same time opening new outdoor recreational facilities. By encouraging acceptance of wastewater management as a means of creating revenues, Vander Jagt's third objective becomes possible—that is, the use of these revenues by regional government agencies to finance other environmental restorations. In this context, federal construction grants for wastewater treatment systems can be seen as dynamic federal-state-local revenue sharing.

Once the fundamental unity of the natural life cycle is taken as an appropriate measure of human responsibility for the care of the human environment, and once the interacting air-water-land system is recognized as an indivisible entity, the reason for failure of many so-called "environment-improving" facilities is clear. For example, an "advanced" waste treatment plant is simply a separation facility. It divides some of the solid waste from the liquid waste and may dispose of the solids (the unhappily-named "sludge") by incineration. An analysis of stack gases at the multiple hearth sludge incinerator at the South Lake Tahoe Plant shows 2.2, 2.13, and 3.2 percent sulphur dioxide—a discharge similar to that emitted by a coal burning power plant.<sup>31</sup> In other words, a water pollution problem at Lake Tahoe is translated, in part, to an air pollution problem.<sup>32</sup>

Another illustration of the prevalent tendency to transfer or relocate environmental problems rather than to solve them is found in a survey of mercury vapor in the atmosphere above twelve facilities in Illinois. One of these facilities is a sludge processing facility; several others are refuse incinerators. This dozen of facilities together was discharging more mercury into the environment at the time of the survey than were the fifty largest reported mercury polluters in the U.S.<sup>33</sup> Through disregard of the unity of the en-

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31. Analysis made by B.S.P. Corp. from tests conducted Nov. 10, 1970.

32. Letter from G.L. Culp to the Honorable Guy Vander Jagt, April 26, 1971.

33. STATE OF ILLINOIS, INSTITUTE FOR ENVIRONMENTAL QUALITY, MERCURY

vironment, a water pollution program again is converted into an air pollution problem in Illinois.

Since both air and water are mobile, it is plainly the land that offers the greatest potential for restricting migration of pollutants. The land tends to stay put, particularly if ground water levels and movements and surface water flows are managed.

Because of the almost universal disregard in this country of the principle of the endless life cycle, there is an urgent need to demonstrate the value of the principle in actual practice. Fortunately, the Muskegon County (Michigan) Wastewater Management System will be available late this year for comparative purposes.<sup>34</sup> President Nixon has described this project, which is now nearing completion, as "a new and promising approach to sewage disposal."<sup>35</sup>

In essence, the Muskegon County Wastewater Management System is a closed system that recycles nutrients, reclaims water to meet drinking water quality standards, and confines and contains wastewater constituents not suitable for recycling. The system addresses the question of non-returnable nutrients in a sound engineering and economically feasible manner.

#### THE MUSKEGON COUNTY WASTEWATER MANAGEMENT SYSTEM

The basic objective of the Muskegon County Wastewater Management System is to eliminate discharge of wastes from thirteen municipalities and five industries into the watercourses of the county. These waters currently are called upon to assimilate large amounts of inadequately treated industrial and municipal pollutants (organic materials, solids, nutrients, and toxic substances). The system is designed to meet the 1990 requirements of the county, which has a

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#### VAPOR EMISSIONS, REPORT ON AERIAL SURVEY OF SOURCES POTENTIALLY AFFECTING THE AIR IN ILLINOIS (1971).

34. For articles in which the Muskegon County, Michigan wastewater system is described, *see generally*: Design Basis for Muskegon County Plan for Managing Wastewater, August, 1969 (prepared by Bauer Engineering Inc.); Federal Water Quality Administration of the U.S. Department of the Interior, Engineering Feasibility Demonstration Study for Muskegon County, Michigan, Wastewater Treatment—Irrigation System, serial no. 11010 F 177 Y (September, 1970); *Hearings on Water Pollution Control Legislation Before the House Comm. on Public Works*, 92d Cong., 1st Sess. 437-489 (1972); and Muskegon County Plan for Managing Wastewater, (prepared by the Metropolitan Planning Comm. for Muskegon County, May, 1969).

35. Letter from Richard M. Nixon to John R. Sheaffer, April 8, 1970.

population of 170,000, generating an average flow of 43.4 million gallons per day, including an industry flow of 24 million gallons per day.<sup>36</sup> The system is comprised of two similar but independent subsystems, one servicing the Muskegon-Mona Lake area and the other the Whitehall-Montague area. These two subsystems will replace four existing municipal treatment facilities with a present total flow of eleven million gallons a day, and will eliminate the direct discharge of five industrial plants with a combined flow of 19 million gallons per day.

The Muskegon-Mona Lake subsystem, being the larger (42 vs. 1.4 million gallons per day) will be described here to illustrate the six basic components of the system: (1) a collection and transportation network, (2) biological treatment cells, (3) storage basins, (4) irrigation land and facilities, (5) a living filter (the soil), and (6) a drainage network.

*Collection and Transport Network:* This component of the system consists of the network of sewers, force mains, and pumping stations required to collect wastewater at eleven access points in the existing sewer systems and on the properties of water-using industries. This interceptor net contains 13 miles of reinforced concrete pipeline, ranging from 16 to 42 inches in diameter, and six prefabricated pumping stations. A large central pumping station, with four pumps having a peak capacity of 56,000 gallons per minute, pumps the combined wastewaters eleven miles through a 66-inch diameter reinforced concrete pipe to the waste management site. These collection and transport facilities account for about a third of the cost of the system.

*Biological Treatment Cells:* At the waste management site, the raw wastes are discharged into three aerated biological treatment cells or lagoons. Each cell has eight acres of surface area and a working water depth of 15 feet. Each cell contains twelve mechanical surface aerators and six mixing units, with a total of 1,000 horsepower in each cell. The aerators and mixers hold all solids in suspension. Raw sewage is treated in this manner in the cells to assure the reduction of Biochemical Oxygen Demand (BOD) on the water by 70 to 90 per cent. The treatment cells alone produce an effluent

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36. Design Basis for Muskegon County Plan for Managing Wastewater, August, 1969 (prepared by Bauer Engineering Inc.).

comparable in quality to that released into public watercourses by conventional secondary treatment sewage disposal plants.

*Storage and Disinfection:* Effluent from the biological treatment cells is discharged into two storage basins, where the solids settle out and the liquid portion is stored for irrigation. Each of the two basins has an 850-acre surface and a nine foot working depth. Together they hold 5100 million gallons. The total storage capability eliminates the necessity for irrigating during periods of heavy rainfall or during times when the ground is frozen. It also allows for storage, assimilation, and biodegradation of toxic industrial spills. When such spills occur in conventional secondary treatment plants, the plants are overloaded and shut down, automatically shunting raw sewage into rivers and lakes until the load on the plant returns to normal levels.

When the weather encourages continuous irrigation, the treated effluent from the biotreatment cells can be passed around the storage basins and moved directly into a settling basin where the solids settle out. The liquid remaining in the settling basin is then moved, as is the liquid from the storage basins, into an outlet basin and thence to disinfection and irrigation facilities. The solids collected in the settling basins are pumped back into the main storage basin.

A 400-foot-wide clay blanket around the periphery of the basins, in combination with an impervious clay layer located approximately 60 feet below the surface, will restrict percolation through the basin bottoms and require movement in a horizontal direction. To prevent the seepage from joining the groundwater outside the waste management site, a drainage ditch encircles the basins, and seven drainage wells are placed at the western edge of the basin area. Water collected in the ditch or withdrawn from the wells is returned to the storage basins.

After withdrawal from the outlet basin, the treated wastewaters are disinfected by chlorination prior to irrigation. Chlorine dosage will be established at the initiation of system operations and will be set at the level required to reduce total coliforms to less than 1,000 per milliliter in the irrigation water—a suitable quality for full body contact. The wastewater will enter two lined channels after disinfection is complete, and will flow to the two irrigation pumping stations. The pumps will deliver it to the irrigating rigs through a

network of asbestos cement underground pipelines ranging from 6 inches to 42 inches in diameter. The total length of the network is more than 27 miles.

*The Irrigation Land and Facilities:* The irrigation land consists of 6,000 acres surrounding the treatment cells and storage basins. Lack of nutrients and moisture-holding capability had caused much of this land to be retired from agricultural use. Approximately 3,000 acres are wooded, primarily with scrub oak, and must be cleared.

A battery of 55 rotating irrigation machines will be fed by the underground pipelines. These machines will apply the treated wastewater, with its load of nutrients, to the land. The radii of the sprayers range from 75 to 1300 feet. The period of rotation can be varied from one to seven days. Spray from the machines is directed downward under low pressure to minimize aerosol effects.

The design of the system allows an annual irrigation water application of 2.5 million gallons per acre per year over a seven month application period. The amount was arrived at through combined consideration of crop nutrient requirements and permissible means of water application. The desired maximum rate of water application is 4 inches per week (wastewater and rainfall). In the early years, the average rate of wastewater application will be approximately 2.1 inches per week and will build up to a designed year average of 3 inches per week.

*The Living Filter:* The living filter, or aerobic soil zone, through which the irrigation water passes, provides wastewater treatment that could be described as equivalent to that of a conventional tertiary treatment plant.<sup>37</sup> Phosphates, nitrates, potassium, organics and trace minerals in the water are returned to the soil and either banked there, taken up into growing vegetation, or discharged into the air. The BOD, suspended solvents, and color are removed as the water percolates through the soil. Heavy metals are removed by fixation and ion exchange.

Sandy soil has been found to be a very effective filter for removal of viruses from wastewater. Because of the positive electric charge

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37. OFFICE OF WATER PROGRAMS, FEDERAL ENVIRONMENTAL PROTECTION AGENCY, ENVIRONMENTAL IMPACT STATEMENT: SEWERAGE PROJECT NUMBER WPC—Mich.—1503 (1971).



when the pH of the wastewater is between 6 and 9, the viruses are scavenged by oppositely charged soil particles and held until decomposed into innocuous protein.

*Drainage and Discharge:* After percolating through the living filter, the water is collected in a drainage system. Seventy miles of perforated drain tile, 19 miles of main drain pipe, 10 miles of drainage ditches, and two pumping stations are connected to 35 wells. The drainage network controls the level of the zone of saturation (water table) and the direction of ground water movement. Thus the possibility of soil saturation and uncontrolled salt buildup associated with prolonged irrigation is eliminated. The underdrainage assures that the Muskegon site will not become waterlogged and therefore unfit for cultivation.

The drainage system will also eliminate adverse effects on the level or suitability of ground water supplies in the vicinity. Ground water will be permitted to leave the wastewater site only after careful monitoring. The monitoring system consists of 203 observation wells around the perimeter of the irrigation site. The wells are clustered in order to provide evaluation of groundwater quality at different depths. Groundwater in the site area moves a maximum of 36 feet per year, and there is a 250 foot wide border around the site in which irrigation is not carried on. Thus, if contamination is detected in the wastewater after passing through the soil, there is sufficient time to correct the problem, 250/36 or seven years.

Stormwater runoff is contained within the waste management site by a series of berms around the lowland edges of the irrigation circles. The waters will pond within the circles until they can be handled by the drainage system.

After collection from the drainage system, the water will be discharged to the area's normal water courses, *i.e.*, the Muskegon River and Black Creek, to augment flow into Muskegon and Mona Lakes and into Lake Michigan. The Whitehall-Montague subsystem discharges into the White River. The design anticipates that after percolation through the soil, the water will meet or exceed all standards of the U.S. Public Health Service for drinking water quality.

Solid footing for these interpretations is provided by two reports recently completed for the U.S. Army Corps of Engineers. One of these, titled *Wastewater Management by Disposal on the Land*,

was prepared by the U.S. Army Cold Regions Research and Engineering Laboratory.<sup>38</sup> The second report, *Assessment of the Effectiveness and Effects of Land Disposal Methodologies of Wastewater Management*, was prepared by an interdisciplinary team of consultants from the University of Washington in Seattle.<sup>39</sup> The latter document gives the following removal efficiencies expectable from a properly designed and operated land treatment system such as the Muskegon system.

<u>Parameter</u> <sup>40</sup>	<u>% Removal Efficiency</u>
Biochemical Oxygen Demand	99
Suspended Solids	99+
Nitrogen	80-90
Phosphorus	99
Heavy Metals	99
Organic Compounds	99
Viruses	99+
Bacteria	99
Total Dissolved Solids: Cations	0-75
Anions	0-50

The quality of reclaimed water collected in the underground drainage system of a land treatment system is tabulated below:

<u>Parameter</u> <sup>41</sup>	<u>Effluent Quality</u>
COD mg/1	6
BOD mg/1 (5 day)	2
Suspended Solids mg/1	c.0
Dissolved Solids mg/1	400
Soluble Phosphorus mg/1	0.01
NH <sub>3</sub> -N mg/1	c.0
NO <sub>3</sub> -N NO <sub>2</sub> mg/1	2
Organic N mg/1	c.0
Oils, Greases mg/1	c.0
Phenols mg/1	c.0
Pathogens, Viruses	c.0
Trace Metals	c.0
Boron	c.0
Arsenic	c.0
Cyanide	c.0

38. COLD REGIONS RESEARCH ENGINEERING LABORATORY, WASTEWATER MANAGEMENT BY DISPOSAL ON THE LAND (1972).

39. UNIV. OF WASHINGTON, ASSESSMENT OF THE EFFECTIVENESS AND EFFECTS OF LAND DISPOSAL METHODOLOGIES OF WASTEWATER MANAGEMENT (1972).

40. HEW Public Health Service Drinking Water Standards, U.S. Dept. HEW § 5.2 (1962).

41. REGIONAL WASTEWATER MANAGEMENT SYSTEM FOR CHICAGO METROPOLI-

These figures exceed U.S. Public Health Service drinking water quality standards<sup>42</sup>—they are compatible with the “no discharge of pollutants” policy enumerated in both the Senate and House versions of the Federal Water Pollution Control Act.

Social economies of considerable scale are achieved by the Muskegon County Wastewater Management System’s use of the land as a substitute for the conventional tertiary stage of wastewater treatment. First of all, most conventional treatment plants and sludge storage lagoons occupy urban waterfront sites that are among the most valuable sites in their respective towns. Pumping the wastewater away from these sites to less well developed sites frees the prime waterfront land for more appropriate purposes.

Other opportunities are opening for making the land a part of the treatment process. The irrigated acreage, after addition of the nutrients in the sewage effluents becomes more productive in agricultural or forestry terms. Non-irrigated areas within the irrigation site provide space for innovative management of garbage and other municipal and industrial solid wastes. The portion of solid wastes not susceptible to recycling can be used to create hills or sculptured landscape.

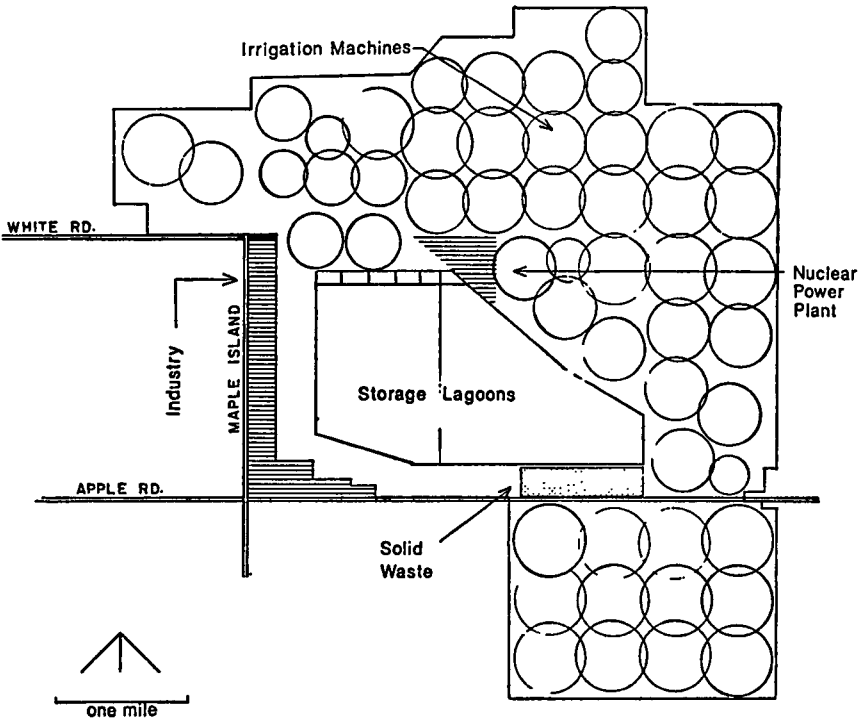
The two 850-acre storage basins are potential cooling ponds for power generators, especially for nuclear furnaces. The heat absorbed by the ponds will speed up biologic activity in the aerated treatment cells and reduce the biochemical oxygen demand on the water. Heat transferred to the storage basins will increase the irrigation water’s competence to stimulate plant growth. A degree of frost protection will also be provided. Ingress of warm water will accelerate circulation within the basins preventing thermal stratification that might produce odors when overturning of the strata occurs in springtime. Evaporation resulting from the heat will concentrate nutrients in the wastewater and raise its value as a fertilizer. Finally, as the cost of this system will be shared by the users of the wastewater and the power companies, the public should pay less for waste disposal and possibly less for electric power.

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TAN AREA, SUMMARY REPORT OF OFFICE OF THE CHIEF OF ENGINEERS, DEPT. OF THE ARMY, PREPARED FOR THE USE OF THE U.S. SENATE COMM. ON PUBLIC WORKS (March, 1972).

42. *Supra* note 40.

Benefits will accrue to the power companies, which will acquire isolated nuclear furnace sites. In Muskegon, for example, a zero population zone extends for two miles in every direction from the proposed power plant location. The nuclear furnace will draw cooling water from the drainage system, and, if necessary, from the drainage system, the groundwater resource, and the Muskegon River. Because of the manner of storage basin construction, emergency quenching water will always be available, even if there are dyke failures.



WASTEWATER IRRIGATION-NUCLEAR POWER ILLUSTRATIVE SITE PLAN

In the rare event of low-level irradiation of the wastewater, hazards will be diminished by the fact that the wastewater will be enormously diluted in the course of being irrigated onto the land. In any case, crops grown on the irrigation site will not be sold for direct human consumption, but for livestock feed or industrial processes. By the time the livestock is converted into food for humans,

shortlived radioisotopes will at least be largely decayed and probably mutated into harmless elements. If long-lived isotopes should for any reason become a problem, they can be excluded from the human food chain altogether. At worst, the possibility of danger will be under far more effective control than in any alternative cooling system.

In terms of anticipated revenue, that from the Muskegon System will be:

- \$360,000 agricultural profits (1 acre inch of treated effluent has the fertilizer equivalent of 25 pounds of 10-19-12 commercial fertilizer).
- \$300,000 solid waste disposal fees (based on a disposal charge of \$2.00 per ton).
- \$2,500,000 cooling charges and location fees from industry.<sup>43</sup>

These three items represent an annual income in excess of \$3 million from the synergistic effects of the system, more than enough to cover the local share of the cost of retiring the debt incurred in building the system (\$16 million bond issue) and the overall operation and maintenance cost, which is estimated at about \$2,650,000 annually. Not included in these figures are the estimated fees the county will collect for the clean water it delivers to its citizens.

Should the system be adopted nationally, what would be the extent of the annual revenue share mentioned earlier in this essay? I offer the estimate below:

<i>Agricultural crops</i> —5,840,000 acres irrigated. (40 billions gallons per day x 365)		
2,500,000 gallons/acre/year		
@ \$60/acre benefit =		\$350,400,000
<i>Solid wastes</i> —145,000,000 urban Americans with 1,000 lbs. of solid wastes/year =		
72,500,000 tons/year @ \$2.00/ton disposal revenue above costs =		145,000,000
<i>Power Plants</i> —300 additional plants projected by 1990 with cooling charges, site rental, and water supply fees totaling an estimated \$2,500,000/year/site =		750,000,000
<b>TOTAL</b> .....		<b>\$1,245,400,000</b>

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43. Sheaffer, *The Ecological Revolution—Is There a Role for County Government?*, AMERICAN COUNTY, May, 1972 at 9.

Assuming a cost of \$90 per million gallons of wastewater treated (the Muskegon cost)<sup>44</sup>, the annual bill for treating a waste flow of forty billion gallons daily would be \$1,314,000,000. That is to say, revenue from ancillary benefits arising from use of a land treatment system approximately equals the cost of the system.

Then why are land treatment systems not springing up throughout the country? One reason is the "local perspective" which has characterized wastewater planning up to now. Each city has sought its own solution for its own problem and since, in general, the jurisdictional limits of a city are coterminus with the city's corporate limits, sufficient land for irrigation has not generally been available for the larger urban complexes. This limitation will not be removed until our planners accept the reality that the modern American metropolis is, by and large, interstate in nature. Of the 100 largest cities in the country, 63 (excluding those that discharge wastes into the Gulf of Mexico) are interstate either in terms of geography or in terms of water quality effects. This interstate character requires a direct federal input into the planning process. Such an input is now being organized by the U.S. Army Corps of Engineers. The Corps has been making studies of land disposal systems as alternatives to conventional sewage disposal systems in the areas centered in Chicago, Cleveland, Detroit, San Francisco and the Merrimac River basin. Feasibility reports have been drawn up for all these areas, and the conclusions have led President Nixon and the Congress to extend the scope of the comparative analysis to include Atlanta, Austin, Baton Rouge, Boise, Denver, Duluth, Kansas City, New Orleans, Omaha, St. Louis, Seattle, Spokane and Superior.

The availability of viable alternatives across a broad spectrum of urban America is, of course, only a beginning. Local and state officials still must exercise the wisdom of choosing and installing the alternative that offers the purest water.

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44. SENATE COMM. ON PUBLIC WORKS, SUMMARY REPORT OF THE OFFICE OF THE CHIEF OF ENGINEERS, DEPT. OF THE ARMY, REGIONAL WASTEWATER MANAGEMENT SYSTEM FOR THE CHICAGO METROPOLITAN AREA, 92d Cong., 2d Sess. 9 (1972).