

A WORKING PAPER IN REGULATORY STUDIES

THE COST OF MUNICIPAL SOLID  
WASTE REGULATION

by

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## I. Introduction\*

A mountain of economic and legal literature exists that encompasses nearly every aspect of municipal solid waste (MSW) regulation, but few, if any academic studies seriously discuss or attempt to measure the associated costs.<sup>1</sup> This paper attempts to estimate the costs of federal regulation on the MSW industry (since the inception of Subtitle D as amended by the Hazardous and Solid Waste Amendments of 1984) and proceeds as follows. Section I briefly discusses the origin of federal regulation concerning municipal solid waste landfills (MSWLFs).<sup>2</sup> Section II outlines the explicit requirements of Subtitle D regulation as well as some of its implicit effects on the MSW industry. Section III summarizes the benefit and cost estimates developed by EPA and sets forth a new methodology for measuring the costs of Subtitle D. Section IV presents estimates of the costs of waste disposal attributable to Subtitle D requirements.

## II. Legislative History

Federal involvement in the MSW industry began with the Solid Waste Disposal Act of 1965, which sought to improve disposal methods through a national research program, as well as by providing technical and financial assistance to local, State, and inter-State agencies for the provision of planning, development and conduct of solid waste disposal programs.<sup>3</sup> It was later amended by the Resource Recovery Act of 1970, which primarily

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<sup>1</sup> See 40 C.F.R. § 258.2 (2004) (defining *solid waste* as “any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit under 33 U.S.C. 1342, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).”).

<sup>2</sup> See 40 C.F.R. § 258.2 (2004) (defining a *municipal solid waste landfill (MSWLF)* as “a discrete area of land or an excavation that receives household waste, and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under §257.2 of this chapter. A MSWLF unit also may receive other types of RCRA Subtitle D wastes, such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste, nonhazardous sludge, conditionally exempt small quantity generator waste and industrial solid waste. Such a landfill may be publicly or privately owned. A MSWLF unit may be a new MSWLF unit, an existing MSWLF unit or lateral expansion. A construction and demolition landfill that receives residential lead-based paint waste and does not receive any other household waste is not a MSWLF unit.”).

<sup>3</sup> Pub. L. No. 89-72. See DOE, *Resource Conservation and Recovery Act*, in DOE ENVIRONMENTAL POLICY & GUIDANCE 1 (Sept. 2000) (for a concise explanation of the legal history surrounding Subtitle D), available at <http://www.eh.doe.gov/oepa/laws/rcra.html>.

provided funding to local, State, and inter-State agencies for planning and development of resource recovery programs.<sup>4</sup> Both Acts were amended in 1976 by the Resource Conservation and Recovery Act (RCRA), which established criteria for managing hazardous (Subchapter III, or Subtitle C) and non-hazardous solid waste (Subchapter IV or Subtitle D).<sup>5</sup> The present rules governing the disposal of MSW were promulgated by the Hazardous and Solid Waste Amendments of 1984.<sup>6</sup> This last legislative initiative further expanded upon the criteria established in RCRA for MSWLFs by requiring the Environmental Protection Agency (EPA) to issue specific rules from Congress' overall goals:<sup>7</sup>

The criteria shall be those necessary to protect human health and the environment and may take into account the practicable capability of such facilities. At a minimum such revisions for facilities potentially receiving such wastes should require ground water monitoring as necessary to detect contamination, establish criteria for the acceptable location of new or existing facilities, and provide for corrective action as appropriate.<sup>8</sup>

### III. Subtitle D Regulation and the Municipal Solid Waste Industry

#### A. Subtitle D Regulation as Enacted in the Code of Federal Regulations

Under Subtitle D of an amended RCRA, EPA explicitly required MSWLFs to meet specific criteria in six different categories: location, operation, design, ground-water monitoring and corrective action, closure and post closure care, and lastly, financial assurance. As EPA's final criteria were categorically expansive, Subtitle D regulation increased costs in nearly every aspect of the MSW industry, including the way landfills are "permitted, designed, operated, managed and closed."<sup>9</sup> Furthermore, information, research, and transaction costs were increased as owners and operators must demonstrate that they have fulfilled the necessary requirements by documenting completion of said criteria in the

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<sup>4</sup> Pub. L. No. 91-512. See DOE, *Resource Conservation and Recovery Act*, in DOE ENVIRONMENTAL POLICY & GUIDANCE 1 (Sept. 2000) (for a concise explanation of the legal history surrounding Subtitle D), available at <http://www.eh.doe.gov/oepa/laws/rcra.html>.

<sup>5</sup> Pub. L. No. 94-580 (current version at 42 U.S.C. §§ 6901-6992 (Supp. I 2000)). See DOE, *Resource Conservation and Recovery Act*, in DOE ENVIRONMENTAL POLICY & GUIDANCE 1 (Sept. 2000) (for a concise explanation of the legal history surrounding Subtitle D), available at <http://www.eh.doe.gov/oepa/laws/rcra.html>.

<sup>6</sup> Pub. L. No. 98-616. See DOE, *Resource Conservation and Recovery Act*, in DOE ENVIRONMENTAL POLICY & GUIDANCE 1 (Sept. 2000) (for a concise explanation of the legal history surrounding Subtitle D), available at <http://www.eh.doe.gov/oepa/laws/rcra.html>.

<sup>7</sup> See 40 C.F.R. §§ 257-258 (2004).

<sup>8</sup> 42 U.S.C 6949a(c)(1) (Supp. I 2000). See also, John H. Turner, *Off to a Good Start: The RCRA Subtitle D Program for Municipal Solid Waste Landfills* 15 TEMP. ENVTL. L. & TECH. J. 1 (1996).

<sup>9</sup> Jasbinder Singh, *Alternative Estimates of the Cost of the Regulation of Solid Waste 2* (Dec. 15, 2003) (unpublished manuscript, on file with the author).

operating record and notifying the State Director.<sup>10</sup>

## 1. Location Criteria

Subtitle D and its implementing regulations established criteria for where MSWLFs could be located, which applied to both new and existing facilities. Operators or owners of MSWLFs within 10,000 feet of a runway end used by a turbojet aircraft or within 5,000 feet of any airport must demonstrate that the MSWLF does not pose a bird hazard to aircraft.<sup>11</sup> If the MSWLF is within 5 miles of an airport, the owners or operators must notify the airport as well as the Federal Aviation Administration (FAA).

Operators or owners of MSWLFs located in 100-year flood plains must show that “the unit will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment.”<sup>12</sup> MSWLFs are not allowed in wetland areas, seismic impact zones, or within 200 feet of a fault area unless a variety of requirements are met.<sup>13</sup> Lastly, operators or owners of MSWLFs located in unstable areas must demonstrate “that engineering measures have been incorporated into the MSWLF unit’s design to ensure that the integrity of the structural components of the MSWLF unit will not be disrupted.”<sup>14</sup> MSWLFs that were unable to meet the aforementioned requirements were forced to close before October 9, 1996 (unless otherwise approved).<sup>15</sup>

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<sup>10</sup> 40 C.F.R. § 258.2 (2004) (defining a *State Director* as “the chief administrative officer of the lead state agency responsible for implementing the state permit program for 40 [C.F.R.] part 257, subpart B and 40 [C.F.R.] part 258 regulated facilities.”). *See also* 40 C.F.R. § 258.4 (2004) (discussing research, development, and demonstration permits). *See generally* 40 C.F.R. § 258.10(c) (2004); 40 C.F.R. § 258.11(a) (2004); 40 C.F.R. § 258.14(a) (2004); 40 C.F.R. § 258.15(a) (2004); 40 C.F.R. § 258.29 (2004); 40 C.F.R. § 258.50(h) (2004); 40 C.F.R. § 258.53(a) (2004); 40 C.F.R. § 258.53(c)(1); 40 C.F.R. § 258.53(g) (2004); 40 C.F.R. § 258.56(d) (2004); C.F.R. § 258.60-258.61 (2004); 40 C.F.R. § 258.71-258.73 (2004).

<sup>11</sup> 40 C.F.R. § 258.1(d)(2) (2004) (defining a *bird hazard* as “an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.”).

<sup>12</sup> 40 C.F.R. § 258.11(b)(2) (2004) (defining an *100-year flood* as “a flood that has a 1-percent or greater chance of recurring in any given year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period.”).

<sup>13</sup> 40 C.F.R. §§ 258.12-258.14 (2004). *See also* 40 C.F.R. § 258.14(b)(1) (2004) (defining a *seismic impact zone* as “an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth’s gravitational pull (g) will exceed 0.10g in 250 years.”).

<sup>14</sup> 40 C.F.R. § 258.15(b)(1) (2004) (defining an *unstable area* as “a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill.”).

<sup>15</sup> 40 C.F.R. § 258.16 (2004).

## 2. Operating Criteria

Operators or owners of MSWLFs are required to control public access by the use of either natural or artificial barriers.<sup>16</sup> Owners and operators are required to implement programs for detecting and preventing hazardous solid wastes and polychlorinated biphenyls (PCB) wastes from being deposited in their respective landfills.<sup>17</sup> In addition to taking measures to “prevent or control on-site populations of disease vectors,” owners and operators “must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging” (unless otherwise approved).<sup>18</sup>

For protection of the airshed, owners and operators must continually monitor methane gas levels and comply with the appropriate sections of the Clean Air Act, as amended.<sup>19</sup> For protection of the watershed, appropriate run-on and run-off systems must be in place to handle the water volume from a 25-year storm. Bulk or noncontainerized liquids are prohibited.<sup>20</sup> Otherwise, landfills must be in compliance with the water standards set forth in the Clean Water Act, as amended.<sup>21</sup>

## 3. Design Criteria

To protect groundwater, operators or owners of MSWLFs have two options. They can design their landfill such that a variety of substances do not exceed the concentration levels set by EPA in the uppermost aquifer at a point of compliance that is “no more than 150 meters from the waste management unit boundary.”<sup>22</sup> Otherwise, landfills must include a composite liner and a leachate collection system. The leachate system must be designed in such a way as to “maintain less than a 30-cm depth of leachate over the liner.”<sup>23</sup>

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<sup>16</sup> 40 C.F.R. § 258.25.

<sup>17</sup> 40 C.F.R. § 258.20 (2004). *See also*, 40 C.F.R. § 261.30 (2004) (determining a *hazardous waste* to be ignitable waste, corrosive waste, reactive waste, toxicity characteristic waste, acute hazardous waste, and toxic waste).

<sup>18</sup> 40 C.F.R. §§ 258.22, 258.21 (2004). *See also* 40 C.F.R. § 258.22(b) (2004) (defining *disease vectors* as “any rodents, flies, mosquitoes, or other animals, including insect, capable of transmitting disease to humans.”).

<sup>19</sup> 40 C.F.R. §§ 258.23-258.24 (2004). *See* 40 C.F.R. § 258.28(c)(1) (2004) (defining *liquid waste* as “any waste material that is determined to contain ‘free liquids’ as defined by Method 9095 (Paint Filter Liquids Test), as described in ‘Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods’ (EPA Pub. No. SW-846).”).

<sup>20</sup> 40 C.F.R. §§ 258.26, 258.258.28 (2004).

<sup>21</sup> 40 C.F.R. §§ 258.27 (2004). *See* 40 C.F.R. § 258.40 (Table 1) (2004) (for a list of substances and concentration values).

<sup>22</sup> 40 C.F.R. § 258.40(d) (2004), 40 C.F.R. § 258.40(a) (2004).

<sup>23</sup> 40 C.F.R. § 258.40(a)(2) (2004). *See also* 40 C.F.R. § 258.40(b) (2004) (defining a *composite liner* as “a system consisting of two components; the upper component must consist of a minimum 30-mil flexible membrane liner (FML), and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than  $1 \times 10^{-7}$  cm/sec. FML components consisting of high density

#### 4. Ground-Water Monitoring and Corrective Action

Unless otherwise approved, operators and owners of MSWLFs are required to install a ground-water monitoring system that “consists of a sufficient number of wells, installed at appropriate locations and depths, to yield ground-water samples from the uppermost aquifer.”<sup>24</sup> Monitoring wells and all other equipment used for the measurement, sampling, and analysis of groundwater must be “operated and maintained so that they perform to design specifications throughout the life of the monitoring program.”<sup>25</sup> Additional measures must be taken if a statistically significant increase occurs in the concentration of any of a number of listed substances.<sup>26</sup> MSWLF units were to meet ground-water monitoring requirements prior to October 9, 1996 (depending upon the unit’s specific characteristics pertaining to ground water).<sup>27</sup> New MSWLFs must meet the requirements before receiving any waste.<sup>28</sup>

#### 5. Closure and Post-Closure Care

Operators and owners of MSWLFs must install a final cover that will minimize infiltration and erosion.<sup>29</sup> The cover must have “a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than  $1 \times 10^{-5}$  cm/sec.” (whichever is less).<sup>30</sup> The cover must also be designed to “[m]inimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum 18-inches of earthen material,” and “[m]inimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth” (unless otherwise approved).<sup>31</sup> Closure activity must begin within 30 days of the final receipt of waste and must be finished 180 days later (unless otherwise approved).<sup>32</sup>

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polyethylene (HDPE) shall be at least 60-mil thick. The FML component must be installed in direct and uniform contact with the compacted soil component.”); 40 C.F.R. § 258.2 (2004) (defining *leachate* as “a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.”).

<sup>24</sup> 40 C.F.R. § 258.51(a) (2004). *See also* 40 C.F.R. § 258.51(c) (2004) (“Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of ground-water samples. The annular space (i.e. the space between the bore hole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the ground water.”).

<sup>25</sup> 40 C.F.R. § 258.51(c)(2) (2004).

<sup>26</sup> 40 C.F.R. §§ 258.55-258.58 (2004). *See also* 40 C.F.R. § 258 Appendix I (2004) (for a list of substances).

<sup>27</sup> 40 C.F.R. §§ 258.50(c)(1) – 258.50(d) (2004).

<sup>28</sup> 40 C.F.R. § 258.51(c)(4) (2004). *See also* 40 C.F.R. § 258.2 (2004) (defining a *new MSWLF* as “any municipal solid waste landfill unit that has not received waste prior to October 9, 1993, or prior to October 9, 1997 if the MSWLF unit meets the conditions of §258.1(f)(1) [stating the requirements associated with MSWLFs that receive less than 20 tons of MSW daily].”).

<sup>29</sup> 40 C.F.R. § 258.60(a) (2004).

<sup>30</sup> 40 C.F.R. § 258.60(a)(1) (2004).

<sup>31</sup> 40 C.F.R. §§ 258.60(a)(2-3) (2004).

<sup>32</sup> 40 C.F.R. §§ 258.60(f) – 258.60(g) (2004).

Following closure, the operator and owner must continue to monitor the landfill for 30 years (unless otherwise approved).<sup>33</sup> They must maintain the integrity of the cover, leachate collection system, ground-water monitoring system, and gas monitoring system, as well as continue to monitor the ground water and air.<sup>34</sup>

## 6. Financial Assurance Criteria

Lastly, operators and owners of MSWLFs are required to demonstrate financial viability for the duration of post-closure activity. Various mechanisms are available for the completion of said requirement, including, a trust fund, a surety bond guaranteeing payment or performance, a letter of credit, a corporate or local government financial test, a corporate or local government guarantee, state assumption of responsibility, an alternative but viable method approved by the State Director, or any approved combination thereof.<sup>35</sup>

### **B. The Municipal Solid Waste Industry**

Subtitle D regulation affected every aspect of the MSW industry; from landfill operators and owners, to solid waste collection firms, to the consumer. The explicit requirements of the EPA had many implicit effects; some intended (e.g. small MSWLF closures and regionalization), some unintended (e.g. the shift to private suppliers, increased MSWLF capacity and transportation costs).

#### 1. Closure, Regionalization, and the Shift to Private Suppliers

One intended effect of Subtitle D Regulation was the closure of MSWLFs, and subsequently, the regionalization of the MSW industry. Consider:

Congress knew that substandard facilities would likely close—indeed, it desired that result. As one Senator stated, “new statutory requirements for Subtitle D facilities may hasten the closure of many solid waste facilities that have only a few years of remaining capacity. The requirements could also promote the closure of facilities with substantial capacity, but that are either unable or unwilling to accept new regulatory cost.”<sup>36</sup>

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<sup>33</sup> 40 C.F.R. §§ 258.61(a), (b) (2004).

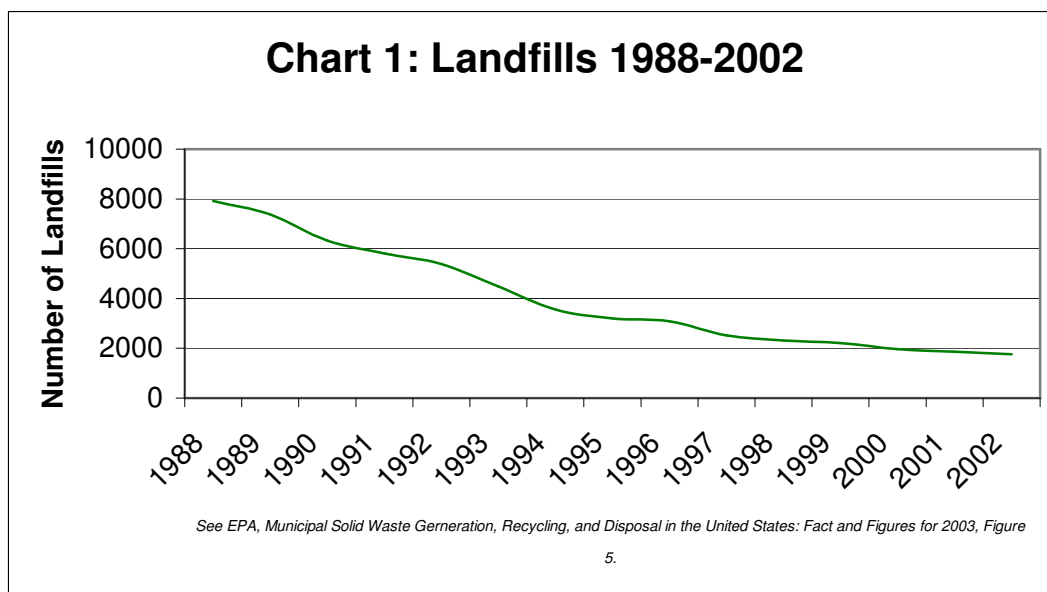
<sup>34</sup> 40 C.F.R. §§ 258.61(a)(1-4) (2004).

<sup>35</sup> See generally, 40 C.F.R. §§ 258.70-258.75 (2004). See also 40 C.F.R. § 258.74 (2004) (for a discussion of the various mechanisms); Financial Assurance Mechanisms for Local Government Owners and Operators of Municipal Solid Waste Landfill Facilities, 61 Fed. Reg. 60,328, 60,335 (1996) (for the economic and regulatory impacts).

<sup>36</sup> John H. Turner, *Off to a Good Start: The RCRA Subtitle D Program for Municipal Solid Waste Landfills* 15 TEMP. ENVTL. L. & TECH. J. 1, 5 (1996) (quoting 130 Cong. Rec. S13,814 9 (daily ed. Oct. 5, 1984) (statement of Sen. Randolph)).

Furthermore:

[T]he Agency stressed that “the final rule, by more fully reflecting the cost of safe waste disposal, will also lead to more responsible waste management practices and promote resource conservation.” The EPA agreed “that regionalization of solid waste management in rural areas, employing larger, better located, designed and operated MSWLFs, is preferable to continued use of small, poorly planned facilities that may pose health and environmental threats to their communities.”<sup>37</sup>



Although yearly data do not exist between 1984 and 1987, it would appear that between 1988 and 2002, Subtitle D regulation decreased the number of landfills by about 77 percent (see Chart 1), from 7,924 to 1,767.<sup>38</sup> Subsequently, landfill closures changed the ownership dynamic in the MSW industry as a whole. Between 1984 and 1998, public ownership of landfills decreased from 83 to 64 percent, with private ownership making up the difference.<sup>39</sup>

<sup>37</sup> John H. Turner, *Off to a Good Start: The RCRA Subtitle D Program for Municipal Solid Waste Landfills* 15 TEMP. ENVTL. L. & TECH. J. 1, 5 (1996) (original citations omitted) (quoting 56 Fed. Reg. 50,978, 50,986, 50,989 (1991)).

<sup>38</sup> See EPA, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2003*, Figure 5 (undated), available at <http://www.epa.gov/msw/pubs/msw05rpt.pdf>. See also, Edward W. Repa, *Solid Waste Disposal Trends* 31 WASTE AGE 262, 262-263 (2000) (The National Solid Waste Management Association (NSWMA) reports that between 1988-1997, Subtitle D regulation caused the number of landfills to decrease by 67 percent, from 7,575 to 2,514. “The dramatic change in the number of landfills in the United States over the past 10 years is primarily attributable to RCRA’s Subtitle D, which became effective in October 1991. The greatest declines in the number of landfills should remain basically the same unless major regulations are adopted nationally.”).

<sup>39</sup> Edward W. Repa, *Solid Waste Disposal Trends* 31 WASTE AGE 262, 264 (2000).



## 2. Increased Landfill Capacity and Disposal Dynamics

Though the number of landfills has declined, landfill capacity has increased dramatically since 1984. According to the National Solid Waste Management Association (NSWMA), national disposal capacity stood at about 11 years in the late 1980's.<sup>40</sup> The NSWMA estimates that we now have roughly twice as much disposal capacity, or about 20 years worth.<sup>41</sup> Although it is difficult to determine the cause of the increase in disposal capacity, it seems likely that operators and owners increased capacity to take advantage of economy of scale effects (so as to remain profitable) as Subtitle D regulation substantially increased fixed costs.<sup>42</sup> Another possible explanation is that national capacity did not rise from 11 to 20 years, but temporarily declined from 20 to 11 years due to regulatory uncertainty (federal, state and local) combined with aggressive recycling mandates—all of which made investments in new capacity too speculative.

The proportion of waste disposed in public vs. private landfills has also changed along with capacity and ownership composition. An equal amount of waste was disposed at public and private facilities in 1984. As of 1998, the amount of waste disposed at public landfills had decreased to 42 percent with the private sector making up the difference.<sup>43</sup> Private landfills receive more waste even though there are roughly half as many private MSWLFs. One analyst suggests that “[t]he scores of public facilities closing redirected that waste to private landfills rather than to new publicly owned facilities, which accounts for the shift to private sites.”<sup>44</sup>

## 3. Long-Distance Transportation of Waste

Regionalization of landfills has increased the distance between garbage collection and garbage disposal. Obviously, having fewer landfills necessarily increases the distance between landfills, and hence the cost of transporting MSW. The standard compactor truck used to collect municipal waste is not cost-effective for long-distance transport. “When it is merely driving, all its expensive compaction mechanism is idle, it is getting poor gasoline mileage, and all but one of its workers (where there are still multiworker crews) are idle.”<sup>45</sup>

The market response to these increased costs has been an increase in the number of transfer stations since the enactment of Subtitle D regulation. At transfer stations, waste is transferred to “large, more fuel-efficient semi-trailers—or trains or barge—for the haul to

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<sup>40</sup> Edward W. Repa, *Solid Waste Disposal Trends* 31 WASTE AGE 262, 263 (2000).

<sup>41</sup> NSWMA, *MSW Landfills* (2004), available at <http://wastec.isproductions.net/webmodules/webarticles/anviewer.asp?a=463&z=44>.

<sup>42</sup> See David N. Beede & David E. Bloom, *Economics of the Generation and Management of Municipal Solid Waste*, NBER Working Paper No. 5116, 21 (May 1995).

<sup>43</sup> Edward W. Repa, *Solid Waste Disposal Trends* 31 WASTE AGE 262, 264 (2000).

<sup>44</sup> Edward W. Repa, *Solid Waste Disposal Trends* 31 WASTE AGE 262, 264 (2000).

<sup>45</sup> Richard C. Porter, *THE ECONOMICS OF WASTE* 50 (2002).

the landfills.”<sup>46</sup> (It becomes cost-effective to do so if the distance from collection to disposal is greater than about 15-20 miles).<sup>47</sup> Unfortunately, there does not seem to be any data on the increased number of transfer stations at this time.

#### IV. Estimating the Costs of Subtitle D Regulation: Some Considerations

##### A. EPA’s Estimates of the Benefits and Costs of Subtitle D Regulation

EPA has conducted several analyses of both the costs and benefits of its regulations. While this paper does not examine the benefits of Subtitle D regulation, it is useful to present EPA’s estimates for comparison. EPA’s Addendum to the original 1990 Regulatory Impact Analysis (RIA) uses two different methods to estimate benefits.<sup>48</sup>

The first method models cancer risks. EPA estimates that in the absence of federal regulations governing MSWLFs, disposal practices would lead to .019 cancer cases per year over a 300-year modeling period. This equals roughly 5.7 cases every 300 years. EPA further estimates that Subtitle D regulation reduces cancer cases by 42.1 percent (to .011 cases per year or 3.3 over the modeling period), which saves roughly 2.4 cases over 300 years (or .008 cases per year).<sup>49</sup>

The second method estimates benefits in terms of reduced resource damage, being the replacement cost of water as well as its option value.<sup>50</sup> EPA estimated resource damage to be equal to about \$560 million (all figures in 1991 dollars) in the absence of federal regulation.<sup>51</sup> Subtitle D regulation is estimated to reduce resource damage by 48 percent (to roughly \$970,000 per year or \$290 million over the modeling period) which saves \$270 million over 300 years (or \$900,000 per year).<sup>52</sup>

EPA notes that these two measures of benefits are not additive. In the first scenario, individuals are drinking the contaminated water, while individuals in the second scenario

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<sup>46</sup> Richard C. Porter, *THE ECONOMICS OF WASTE* 50 (2002).

<sup>47</sup> Richard C. Porter, *THE ECONOMICS OF WASTE* 50 (2002).

<sup>48</sup> Presentation of EPA’s estimates is not intended as an endorsement of its methodology or results.

<sup>49</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, V-2 (September 1991).

<sup>50</sup> EPA, *Final Regulatory Impact Analysis of Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, IX-32 (July 31, 1990) (defining *replacement cost* as “the cost to provide water to users whose supply is contaminated by releases from landfills” and *option value* as “the value of ground water that does not currently serve as a source of drinking water but that may be used in the future.”).

<sup>51</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, V-4 (September 1991) (It seems that this figure is representative of the cost of damage over a 300-year modeling period.).

<sup>52</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, V-4 (September 1991).

are not drinking the contaminated water. EPA further notes that the benefit estimates do not include prevented resource damage to the airshed and surface water.<sup>53</sup>

EPA also states that there are other non-quantifiable benefits of federal MSWLF regulation, such as increased public confidence in landfills,<sup>54</sup> increased protection of property value,<sup>55</sup> existence and bequest valuations,<sup>56</sup> as well as encouragement of responsible waste management practices.<sup>57</sup> EPA does not estimate a value for these benefits in its benefit-cost analysis, but maintains that they should be considered when analyzing various rules.

EPA's estimates of costs are orders of magnitude higher than its estimates of benefits. Its forward looking study estimated that Subtitle D regulation would cost roughly \$5.77 billion over the 300-year modeling period.<sup>58</sup> In total then, EPA estimated that we as a society would spend \$19.23 million per year to save .008 cancer cases (\$2.4 billion per statistical cancer case avoided) or \$900,000 in resource damage per year (in addition to non-quantifiable benefits).<sup>59</sup>

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<sup>53</sup> See EPA, *Final Regulatory Impact Analysis of Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste X-2, X-1 (July 31, 1990).

<sup>54</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, VI-1 (September 1991) (original citation omitted) ("EPA believes that providing federal criteria which prevent ground-water contamination above drinking water standards will increase public confidence in landfills. Furthermore, EPA believes that with an increase in public confidence, local officials will find it somewhat easier to site new landfills... The benefits of expediting siting could translate into a potential savings to local municipalities of up to \$84 million per year.").

<sup>55</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, VI-1-VI-2 (September 1991) (original citation omitted) ("Property value studies of households located near waste sites indicate that property values can be adversely affected when ground-water contamination is discovered... [T]he potential benefits (avoided property value loss) of the final rule could fall within [the] range of \$300 to \$15,000 per household near landfills...").

<sup>56</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, VI-2 (September 1991) ("Literature on natural resource economics also indicates that people place a value on and are willing to pay for protecting resources even if they neither live near the resources nor plan to use them in their lifetime... In addition, the literature also describes a second value people place on knowing they are passing pristine resources onto future generations...").

<sup>57</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, VI-1 (September 1991) ("EPA believes that the final rule, through its recognition of the true cost of safe waste disposal, will reduce financial burdens on future generations and encourage source reduction and recycling.").

<sup>58</sup> Note that this figure is discounted to the present, while the lives-saved figure is not.

<sup>59</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, VII-2 (September 1991) (It should be noted that the benefits reported by the EPA are not discounted).

## B. An Equation for Discovering the Costs of Subtitle D

In this section, we focus only on the cost side of the benefit-cost equation. A complete estimate of the incremental costs incurred as a result of Subtitle D regulation would ideally include (1) increased costs of disposal associated with landfill requirements and (2) increased transportation costs associated with regionalization. These costs will likely be embedded in tipping fees (charged by landfills for disposal) and collection fees, respectively.

An equation that solves for the cost of Subtitle D using tipping fees and collection prices as a proxy should look like this:

$$Y = \{(X^1 - X^2)(L) + (R^1 - R^2)(L)\} - (S + F) \text{ where:}$$

$Y$  is equal to the cost of subtitle D in any given year,  $X^1$  is equal to the real average national tipping fee in any given year,  $X^2$  is equal to the real average national tipping fee in 1984,  $L$  is equal to the number of tons landfilled per year in any given year,  $R^1$  is equal to the real average national cost of collection per ton in any given year,  $R^2$  is equal to the real cost of collection per ton in 1984,  $S$  is equal to the cost of state regulation whose criteria are at least as stringent as those imposed by the federal government, and  $F$  is equal to the cost of flow control regulation.<sup>60</sup>

As discussed in the next section, however, reliable data are not available on collection fees over the years in question, so our estimate relies solely on private tipping fees.

Other issues that must be considered in estimating the costs of Subtitle D are (1) the appropriate baseline from which to measure incremental costs, (2) possible effects of “flow control” regulations, and (3) effects of recycling and source reduction mandates.

### 1. Defining the baseline for analysis

To assess incremental costs (those incurred as a result of Subtitle D) it is important to develop a hypothetical baseline that reflects waste disposal practices in the absence of federal legislation and regulation. State and local communities, as well as private parties, have incentives to protect public health, even without federal standards.

Federal, rather than state or local, environmental regulation is sometimes justified with the argument that environmental interests would be underrepresented relative to business interests at the state level, because states chronically underregulate due to interstate externalities, and because of the so-called “race to the bottom” pathology.<sup>61</sup> Such theories

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<sup>60</sup> This approach to measuring costs necessarily assumes a constant profit margin for firms.

<sup>61</sup> Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. R. 553, 553-557 (2001).

seem implausible when considering the evidence given by Richard L. Revesz. Revesz contends that many states and counties enacted environmental standards prior to 1970 on environmental problems that were understood at the time,<sup>62</sup> and that a number of states develop environmental standards that are more stringent than those established by the federal government.<sup>63</sup> State regulatory efforts in the MSW industry are no exception.

Many states have their own criteria that are equal to, if not more stringent than, the federal requirements imposed by Subtitle D. The EPA's Addendum to the original 1990 RIA documents the extent that new federal and prior state requirements overlapped:

EPA assumed that 33 states (containing 4,626 landfills) require a clay liner, 29 states (containing 3,413 landfills) require a synthetic liner, and 19 states (containing 1,766 landfills) require composite liners... All state landfill liner requirements were assumed to include leachate collection requirements as well. Thus, no additional costs were assigned for leachate collection systems in 36 states (containing 5,017 landfills)... 21 states either require synthetic covers for new landfills or have a performance standard which, when coupled with the [states'] liner requirements, effectively require a synthetic cover... 6 states require synthetic covers [for existing landfills]... 39 (containing 5,149 landfills) states are subject to state ground-water monitoring requirements...<sup>64</sup>

Combined, these programs cost about \$770 million per year (in 1991 dollars).<sup>65</sup> EPA debited this amount from its total cost of federal regulation, and we subtract it from our estimates as well.<sup>66</sup>

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<sup>62</sup> Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. R. 553, 578-583 (2001).

<sup>63</sup> Richard L. Revesz, *Federalism and Environmental Regulation: A Public Choice Analysis*, 115 HARV. L. R. 553, 583-636 (2001) (It should be noted that the author disagrees with some of the claims of Revesz regarding the MSW industry (most due to his non-treatment of Subtitle D regulation), but that the evidence in this paper corroborates with his general thesis.).

<sup>64</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, II-2, II-5 (September 1991).

<sup>65</sup> EPA, *Addendum to the Regulatory Impact Analysis for the Final Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste and Emergency Responses, III-2-III-3 (September 1991) (This figure was arrived at by adding the credit from the original 1990 RIA (\$400 million), with the difference between the best estimate for national annual cost with of the final rule in the original 1990 RIA (\$700 million) and the best estimate for national annual cost of the final rule from the addendum (\$330 million).). *See also*,

<sup>66</sup> EPA, *Final Regulatory Impact Analysis of Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste IV-8 (July 31, 1990). *See also*, EPA, *Final Regulatory Impact Analysis of Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills*, Office of Solid Waste IV-6 (July 31, 1990) (regarding the calculation method, "If EPA promulgates new regulations applicable to the unit, any incremental costs are added to the cost burden for which the owner has already planned.").

## 2. Issues Arising from Flow Control Regulation

Flow control laws are “local government requirements that trash haulers —public and private—deliver the wastes they collect to a specific disposal facility for incineration, landfilling, recycling, or composting.”<sup>67</sup> Such laws effectively restrict solid waste imports from other states and are often used to protect public investments in MSWLFs.<sup>68</sup> MSW is ‘traded’ just like any other commodity; every state but Hawaii exports or imports it.<sup>69</sup> These types of laws have been around since the 1970’s, but were officially declared unconstitutional by the Supreme Court in 1994 as a violation of the commerce clause.<sup>70</sup> Since then Congress has considered several proposals that would legalize flow control legislation, but none have passed as of yet.<sup>71</sup>

Although no Congressional proposals have passed, individual states and communities have intermittently employed flow control laws over the lifetime of Subtitle D (since 1984). Said policies have likely increased local tipping fees. For example:

A number of haulers reported that tipping fees at flow-controlled facilities have been increasing rapidly—a fact that should not be surprising in a government monopoly. One hauler noted that over nine years disposal rates in Lancaster (Pennsylvania) County’s flow-controlled system increased 767 percent, and in nearby York County, flow control-supported rates increased 974 percent over 10 years.<sup>72</sup>

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<sup>67</sup> See Angela Logomasini, *Going against the Flow: the Case for Competition in Solid Waste Management*, Citizens for a Sound Economy Foundation 2 (Sept. 12, 1995), available at <http://www.heartland.org/pdf/23774h.pdf>.

<sup>68</sup> See Thomas C. Kinnaman & Don Fullerton, *The Economics of Residential Solid Waste Management*, NBER Working Paper 7329, 12 (Aug. 1999).

<sup>69</sup> See Edward W. Repa, *Interstate Movement of Municipal Solid Waste*, NSWMA Research Bulletin 05-2, 2 (Jan. 2005), available at <http://www.nswma.org/InterstateWaste2005.pdf>.

<sup>70</sup> *C & A Carbone, Inc v. Town of Clarkstown*, 511 U.S. 383 (1994).

<sup>71</sup> See, e.g., Angela Logomasini, *Trashing the Poor: The Interstate Garbage Dispute*, The Competitive Enterprise Institute 11-15 (Aug. 1, 1999) (for a listing of various Congressional proposals), available at <http://www.cei.org/pdf/1659.pdf>.

National flow control legislation would be quite costly. Ley, Macauley, and Salant (2000) estimate the effects of one proposal where “states are prohibited from making any new shipments to any state with which they were not already trading in 1993, and the maximum tonnage that can be exported by one state to another is limited to specific amounts beginning in 1996.” In their model, the volume traded decreased by roughly 30 percent, but the number of trades increased, as there would be more shipments of small amounts of waste. The overall discounted welfare loss is about \$1.35 billion, with producers bearing the brunt of the cost (about \$1.2 billion). See Eduardo Ley et al., *Restricting the Trash Trade*, 90 THE AMERICAN ECONOMIC REVIEW 243, 244-245 (2000).

<sup>72</sup> Angela Logomasini, *Going Against the Flow: The Case for Competition in Solid Waste Management*, Citizens for a Sound Economy Foundation 5 (Sept. 12, 1995) (original citations omitted), available at <http://www.heartland.org/pdf/23774h.pdf>.

A large amount of the percentage increase reported is likely due to the effects of Subtitle D, not just flow-control policies, but such policies remain an important factor when attempting to determine the legislated affects on local tipping fees levels. It seems probable, however, that such policies have had a negligible affect on the national tipping fee average, as less than 10% of all generated MSW crosses a state border.<sup>73</sup> Therefore, this paper assumes a zero marginal cost increase in tip fees from flow control regulations.

### 3. Issues Arising from Recycling and Source Reduction Mandates

Recycling and source reduction mandates have been implemented at the local, state, and federal level. Such mandates necessarily influence the price of disposal and collection as they divert waste from landfills and add to the cost of collection. In terms of their effect on our model, such mandates are automatically absorbed by the price mechanism that governs the cost of disposal and do not need to be accounted for.<sup>74</sup>

Recycling mandates, however, significantly increase the cost of collection. Such mandates complicate our study as they occur in conjunction with Subtitle D regionalization effects that also increase the cost of collection. Unfortunately, average national pricing data per ton for collection are not readily available at this time and therefore our estimates below do not include the increased costs attributable to the change in collection and transportation activities brought about by Subtitle D. If future analysis were to include those costs, however, it would have to attempt to isolate the increased costs associated with recycling activity from the costs engendered by Subtitle D requirements.

## V. The Cost of Subtitle D Regulation

This section applies the methodology described above to estimate the costs of Subtitle D regulation. Our results are likely to underestimate the actual cost of Subtitle D for at least three reasons. First, as noted above, the regulations likely increased both the cost of waste collection and waste disposal. Reliable data for increased cost of collection due to regionalization effects are not available at this time, and therefore our model cannot compute an estimate for that part of the equation.<sup>75</sup> In the absence of reliable data on collection costs our estimates reflect the change in disposal costs only using tipping fees as a proxy. Second, the tipping fee data that we do have are for private facilities only and therefore do not capture any price differences associated with publicly owned landfills (which are likely to have inefficiently high disposal costs). Third, Subtitle D regulation caused premature abandonment of capital in the form of lost disposal capacity. Only under

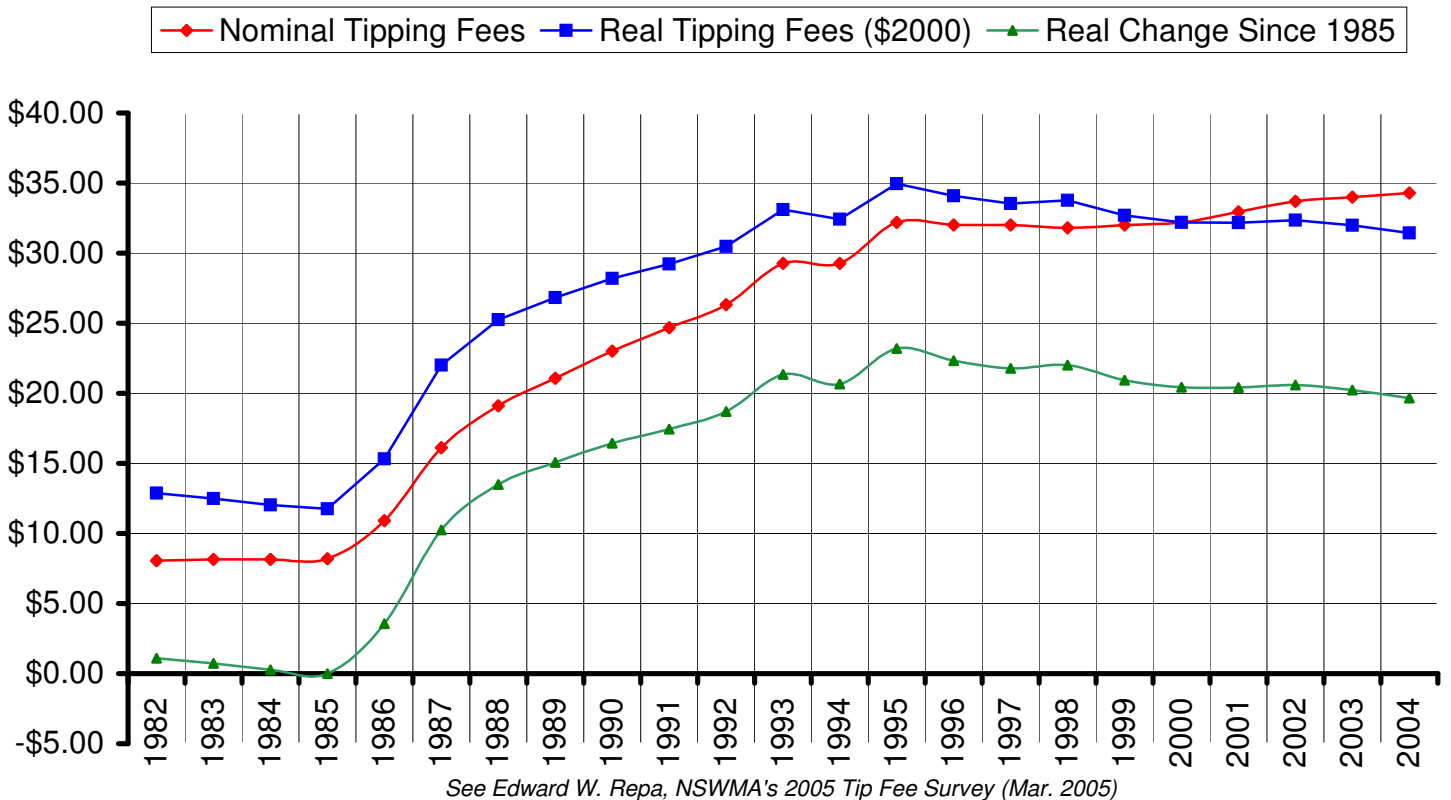
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<sup>73</sup> See Edward W. Repa, *Interstate Movement of Municipal Solid Waste*, NSWMA Research Bulletin 05-2, 2 (Jan. 2005), available at <http://www.nswma.org/InterstateWaste2005.pdf>.

<sup>74</sup> The represented scenario is simplified. Some real world situations will likely be more complicated, i.e., where a municipality has conditioned approval of a new MSWLF on, say, co-location of a money-losing recycling facility. The MSWLF owner will try to recover these excess costs in tipping fees, perhaps using various forms of price discrimination to do so.

<sup>75</sup> See *infra* Parts II.B.1, II.B.3.

**Chart 2: Tipping Fee Data 1982-2004**



unusual conditions would one expect these costs to be captured in collection or tipping fees.

The Amendments to RCRA that authorized Subtitle D were passed in 1984, but as can be seen from Chart 2 (above), real tipping fees did not begin to increase until 1986. In fact, real tipping fees were actually decreasing prior to 1986, then rose sharply as a result of Subtitle D.<sup>76</sup> Real tipping fees peaked at \$34.95 per ton in 1995 but have been trending downward ever since.

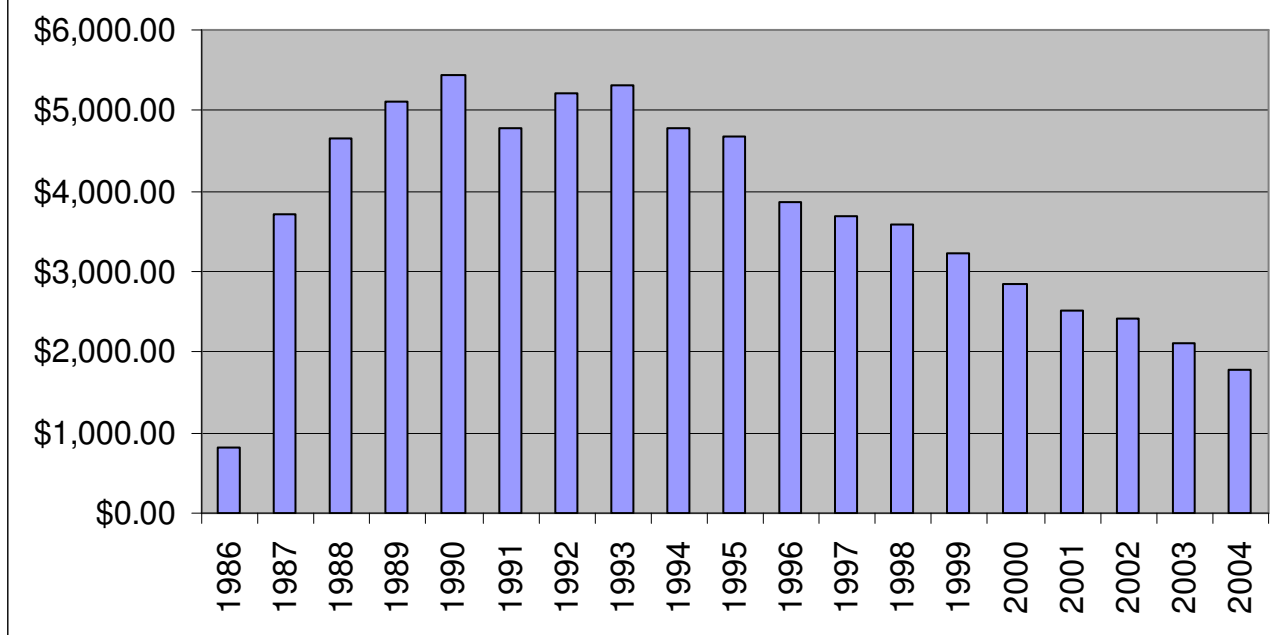
Multiplying the change in real per-ton tipping fees by the actual amount of waste landfilled per year,<sup>77</sup> adding up all of the individual years between 1986 and 2004<sup>78</sup> and

<sup>76</sup> National average tipping fee data do not exist for every year of the modeling period (1982-2004). No data exist prior to 1982. Nominal figures that are non-existent during the modeling period were necessarily averaged from surrounding years' figures.

<sup>77</sup> Official data for the years 1986, 1987, and 1989 are unavailable. Proxy figures were necessarily averaged from surrounding years' figures. See EPA, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2003* (undated), available at <http://www.epa.gov/msw/pubs/msw05rpt.pdf>; EPA, *Municipal Solid Waste in the United States: 1999 Facts and Figures* (July 2001), available at <http://www.epa.gov/epaoswer/non-hw/muncpl/mswfinal.pdf>; EPA, *Characterization of Municipal Solid Waste in the United States: 1997 Update* (May 1998), available at <http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw97rpt.pdf>; EPA, *Characterization of Municipal Solid Waste in the United States: 1995 Update* (Mar. 1996), available at <http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw95.pdf>; EPA, *Characterization of Municipal Solid Waste in the United States: 1994*



**Chart 3: Annual Cost of Subtitle D  
(in millions of \$2000)**



subtracting the costs of state regulation,<sup>79</sup> gives us our net present value of the costs of Subtitle D over its lifetime: over \$71 billion (in 2000 dollars).<sup>80</sup> This translates to an annual cost of more than \$3.7 billion per year since 1986. After the initial costs associated with closure of existing facilities and construction of new, larger regional facilities, the annual costs of disposal appear to be declining, however (see Chart 3 below).

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Update (November 1998); EPA, *Characterization of Municipal Solid Waste in the United States: 1992 Update* (July 1992); EPA, *Characterization of Municipal Solid Waste in the United States: 1990 Update* (June 1992); EPA, *Characterization of Municipal Solid Waste in the United States 1960-2000* (July 25, 1986).

<sup>78</sup> An official estimate of the amount of waste disposed of at landfills in 2004 has not been released yet from the EPA. We estimated a figure by averaging the amount of waste deposited per year for the previous ten years.

<sup>79</sup> The \$770 million figure given by the EPA in 1991 is equal to roughly \$912 million in real dollars. Subtracting this same amount every year from the left side of the equation assumes that the level of State regulation estimated in 1991 was constant through the modeling period.

<sup>80</sup> Net present value calculations were done using an interest rate of 7 percent. See, U.S. Office of Management and Budget, Circular A-4, 33 (Sept. 17, 2003) ("As a default position, OMB Circular A-94 states that a real discount rate of 7 percent should be used as a base-case for regulatory analysis. The 7 percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy.") available at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf>; U.S. Office of Management and Budget, Circular A-94, 8(b)(1) (Oct. 29, 1992) (noting that a 7 percent interest rate is to used) available at <http://www.whitehouse.gov/omb/circulars/a094/a094.pdf>.

## VI. Conclusion

Clearly, Subtitle D requirements radically altered the structure and practice of solid waste disposal in the United States. Subtitle D requirements changed the way landfills are permitted, designed, operated, managed, financed and closed. As noted above, Congress' goal in enacting Subtitle D was to improve protection of health, safety and the environment, and some of the changes brought about by the Act have likely made progress toward this goal. Using EPA's benefit estimates, and assuming benefits began to accrue at the same time costs did (1986), Subtitle D regulations have saved a total of .144 cancer cases<sup>81</sup> or \$16.2 million in resource damage through 2004.

The costs of the changes mandated by Subtitle D regulations, however, are large. Subtitle D has increased disposal costs by over \$71 billion since 1986, or \$3.7 billion per year on average. These estimates do not include any of the costs incurred by the collection sector of the MSW industry. Such costs are likely to be substantial. Further research is needed to determine the historical costs of collection well as any pricing differences between private and public landfills. Such research will help in better estimating what the actual costs of Subtitle D are.

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<sup>81</sup> Note that due to the lag between exposure and the onset of cancer, the health benefits will not begin to accrue for decades, so this likely overstates health benefits.